Environmental Resource Inventory

Update ~ 2013

for

Township of East Hanover

County of Morris

Compiled by

The Land Conservancy of New Jersey
An accredited land trust

with

Township of East Hanover Environmental Commission

June 2013

ENVIRONMENTAL RESOURCE INVENTORY UPDATE - 2013

for

Township of East Hanover
County of Morris

Prepared for:

Township of East Hanover Environmental Commission

Prepared June 17, 2013 by:

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

Adopted by the Township of East Hanover Land Use Planning Board on June 25, 2013

ENVIRONMENTAL RESOURCE INVENTORY UPDATE - 2013

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Township of East Hanover
County of Morris

Produced by:

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Cover Photographs:

Top: Whippany River, Center: Hatfield Swamp, Bottom: Lurker Park

Photobar Photographs:

From Left to Right:

Royal Fern, Yellow Iris, Box Turtle, Red Cardinal Flower

Photographs taken by The Land Conservancy of New Jersey in East Hanover Township

EXECUTIVE SUMMARY

East Hanover Township, lying in a former glacial lake bottom, bracketed by the remnant marshes and glacial runoff streams (now known as the Whippany, Rockaway, and Passaic Rivers) has long worked to maintain a balance between preserving its natural and historic places while redeveloping its landscape as it moves along from its past as a collection of farming communities to its present configuration as a series of residential, commercial, and industrial communities. The presence of the landscape is still strongly felt long after immigrant farmers from New England settled into the "neck" of Hanover, stretching between wetlands and waterways that continue even today to provide essential environmental services like the filtration of water for drinking.

Reaffirming its commitment to stay at the forefront of environmental awareness and contributing to its goal of providing the benefits of preserving and protecting its natural resources for the broadest number of its residents, the Township of East Hanover, in accordance with its municipal motto "Pro Bono Publico" ("For the Public Good"), has prepared this update to and expansion of its *2004 Environmental Resources Inventory: Protecting our Water Resources (ERI).* Since publication of the *2004 ERI*, the Township has experienced directly the effects of a changed climate that has brought flooding and elevated temperatures unprecedented in the historical record. These natural intrusions have provided confirmation of the necessity of the Township's policy of land preservation directed at its surrounding and buffering wetlands including Hatfield Swamp, Troy Meadows, and the riparian areas along the Passaic River. Stormwater management ordinances such as requirements for drywells to reduce runoff and coverage of waste receptacles to prevent degradation of water quality have been enacted in recognition of the ways in which human development is tied to the landscape and how the landscape responds to human activities.

Planning for the future of the "green infrastructure" widens our vision to include all the relevant stakeholders and potential allies. East Hanover has sought to combine its efforts with similar work being done in adjacent communities and by county agencies in both Morris and Essex Counties. Participatory and regional clean-up days help not only to remove debris, but also to alert residents to the status of those strips of landscape that provide vital environmental services, but suffer from degradation for doing so.

By partnering with neighbors on all sides and with dedicated environmental organizations such as the Whippany River Watershed Action Committee, the Association of New Jersey Environmental Commissions, and The Land Conservancy of New Jersey, East Hanover renews its commitment to environmental stewardship of its natural and historic areas. Updating the snapshot of its current environmental conditions is another such step.

Knowledge of the natural resources of East Hanover will allow its officials and its citizens to make informed decisions as they strive to preserve and promote the character of the Township and to create a sustainable community within its landscape. The *2013 Environmental Resource Inventory (ERI) Update* is based on available data from federal and state resources, as well as municipal resources, including the *2004 Environmental Resource Inventory for East Hanover Township*. Extensive mapping and tables detailing the Township's environmental resource base are included within the *2013 ERI Update*. With an eye to East Hanover's environmental health and historic well-being, the Township is preparing this *2013 Environmental Resource Inventory Update* to provide its residents and its neighbors with documentation of the state of the environment and to provide a clear basis on which to move forward into the future.

GEOLOGY

Physiographic Provinces

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

The Piedmont Province covers 1,600 square miles, which is roughly 20% of the state. This province is mostly underlain with "slightly folded and faulted sedimentary rocks of Triassic and Jurassic age (240 to 140 million years old) and igneous rocks of Jurassic age." (*New Jersey Geological Survey, Information Circular – Geologic Mapping in New Jersey)* The Piedmont Province's surface is generally low rolling hills marked with sudden, steep ridges, which extend across the state and includes the palisades area in the east.

One of the most unique geologic features of East Hanover lies underground and is the Buried Valley Aquifer system. The Buried Valley Aquifer covers about 80 square miles in New Jersey, with parts of it in Essex, Morris, Union, and Somerset Counties. The Buried Valley Aquifer is a contiguous system of valley fill aquifers created by glacial action. The system was formed when pre-glacial geologic processes formed a system of valleys which were filled in with glacial sediment during and after glacial presence in the area. These sediments are able to contain a significant amount of water, making it a highly productive aquifer.

Bedrock Geology

The geology of East Hanover can be classified into two layers: bedrock geology, which is the consolidated, underlying rock that extends deep into the earth's crust, and surficial geology, which is the unconsolidated sedimentary materials overlaying bedrock formations, and which is the parent material for soils. The properties of these layers "determine the physical extent of aquifers and the chemical quality of the water they yield. They also control how groundwater recharges and moves through the aquifers, how contaminants seep into and move through soil and groundwater, and where natural hazards like radon, sinkholes, and seismic instability may occur. Finally, these properties

establish where geologic resources such as sand, gravel, peat, clay, quarry rock, and mineral ores are located. Geologic properties also determine the suitability of an area for the use of septic systems, the management of stormwater and surface runoff, and the stability of foundations for buildings, bridges, tunnels, and other structures" *(New Jersey Geological Survey, Information Circular – Geologic Mapping in New Jersey).* It is the combination of the valleys in the bedrock formation and the permeability of the surficial geology which create the Buried Valley Aquifer lying beneath the Township.

The underlying bedrock geology of East Hanover is not very complex, being made up of only three different geologic formations. Of the three, the Boonton Formation (Jb) dominates the Township, covers 83% (4,313 acres) of East Hanover, and is a solid formation located in the south and west of the Township, continuing up to the entrance of Interstate 280. The Hook Mt. Basalt Formation (Jh), which covers 12% (627 acres) of the Township, and the Towaco Formation (Jt), covering 5% (242 acres), are located in the northwestern corner of the Township. The *Bedrock Geology Map* (*Map 1 in the Maps section*) depicts the distribution of bedrock types within East Hanover and *Table 1* shows the frequency of occurrence of each formation.[1]

Table 1. Bedrock Geology in East Hanover

Abbreviation	Geologic Name	Lithology	Acres	Percent
Jb	Boonton Formation	sandstone, siltstone, and mudstone, fine-grained; minor dolomitic siltstone and shale	4,313.37	83.2%
Jh	Hook Mt. Basalt	basalt, fine- to coarse-grained	627.44	12.1%
Jt	Towaco Formation	sandstone, siltstone, silty mudstone, fine- to medium-grained; less abundant calcareous siltstone and mudstone	241.99	4.7%
		Total:	**5,182.80**	**100.0%**

Source: NJDEP

Surficial Geology

Surficial geology is the unconsolidated materials overlaying bedrock formations. East Hanover's surficial geology is more varied than its bedrock geology, with eight different geologic types spread throughout the Township. The largest type present is the Late Wisconsinan Glacial Lacustrine-Fan Deposits (Qwlf), which cover 28% (1,467 acres) of the Township. This is followed closely by Rahway Till (Qwtr) (25%, 1,296 acres) and the Late Wisconsinan Glacial Lake Bottom Deposits (Qwlb) (22%, 1,146 acres). *Table 2*

[1] *The ArcGIS mapping software calculates the acreages for the municipality based upon the specific dataset being utilized and this can vary slightly for each individual analysis.*

details the surficial geology of East Hanover, and the *Surface Geology Map (Map 2 in the Maps section)* depicts the surficial geology features in the Township.

Table 2. Surficial Geology in East Hanover Township

Abbreviation	*Geologic Name*	*Lithology*	*Age*	*Acres*	*Percent*
Qwlf	LATE WISCONSINAN GLACIAL LACUSTRINE-FAN DEPOSITS	Sand, pebble-to-cobble gravel, minor silt; yellowish brown, reddish brown, light gray. As much as 200 feet thick.	late Pleistocene, late Wisconsinan	1,466.53	28.3%
Qwtr	RAHWAY TILL	Clayey silt to sandy silt with some to many pebbles and cobbles and few boulders; reddish brown, reddish yellow, yellowish brown, brown. As much as 100 feet thick, generally less than 40 feet thick.	late Pleistocene, late Wisconsinan	1,295.89	25.0%
Qwlb	LATE WISCONSINAN GLACIAL LAKE-BOTTOM DEPOSITS	Silt, clay, fine sand; gray, brown, yellowish brown, reddish brown. As much as 200 feet thick.	late Pleistocene, late Wisconsinan	1,145.90	22.1%
Qal	ALLUVIUM	Sand, gravel, silt, minor clay and peat; reddish brown, yellowish brown, brown, gray. As much as 20 feet thick.	Holocene and late Pleistocene	1,006.02	19.4%
Qst	POSTGLACIAL STREAM TERRACE DEPOSITS	Sand, silt, pebble-to-cobble gravel; yellowish brown to reddish brown. As much as 20 feet thick.	Holocene and late Pleistocene	142.15	2.7%
Qs	SWAMP AND MARSH DEPOSITS	Peat and organic clay, silt, and minor sand; gray, brown, black. As much as 40 feet thick.	late Pleistocene and Holocene	119.86	2.3%
Qst2	UPPER POSTGLACIAL STREAM TERRACE DEPOSITS	Deposits as in unit Qst forming stream terraces with surfaces 15 to 30 feet above the modern floodplain.	Holocene and latest Pleistocene	3.53	0.1%
Qwde	LATE WISCONSINAN GLACIAL DELTA DEPOSITS	Sand, pebble-to-cobble gravel, minor silt; yellowish brown, reddish brown, light gray. As much as 150 feet thick.	late Pleistocene, late Wisconsinan	2.93	0.1%
			Total:	**5,182.80**	**100.0%**

Source: NJDEP

TOPOGRAPHY

East Hanover has a relatively smooth topography; there is less than a 100 foot difference in elevation throughout the Township. There are a few outlying hills, but only at a few points are the slopes created from the terrain considered steep, with much of the Township consisting of a gentle incline. *(See Topography Map, Map 3 in the Maps Section)*

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

CLIMATE

Prevailing Air Currents in New Jersey

According to the Office of the New Jersey State Climatologist (ONJSC) at Rutgers University, a "broad, undulating flow from west to east" dominates atmospheric circulation in the middle latitudes of North America, including New Jersey. "These 'prevailing westerlies' shift north and south and vary in strength during the course of the year, exerting a major influence on the weather throughout the State."

The climate of the state of New Jersey varies widely over its relatively short length (166 miles north to south) due to its geology, its position between the Atlantic Ocean and Delaware Bay, and the prevailing westerly flow of air across its numerous ridgelines and valleys. Overall, the state has a fairly wet climate, with approximately 120 days of measurable precipitation per year. Fall months are the driest, with an average of 8 days per month of measurable precipitation, while the other seasons average 9-12 days. Most of the precipitation falls during thunderstorms, which occur 25-30 times per year in most areas. Snowfall in the northern part of the state is expected between October 15 and April 30. Total precipitation usually amounts to 43-47 inches, though the most recent years have varied greatly from the average. Temperatures vary from annual low day averages of 30.7^{o}F in January to 74.1^{o}F high averages in July, though the averages from the last 30 years do show increases in average temperature. Temperature differences between northern and southern locations are greatest in winter months and least in summer months, but all of the state's weather stations have recorded highs over 100°F and lows below 0°F.

Climate Zone

New Jersey is divided into five climate zones (Northern, Central, Southwest, Pine Barrens, and Coastal). East Hanover lies on the northern edge of the Central zone, adjacent to its border with the Northern zone. (ONJSC) The Township's climate partakes of the characteristics of both these larger climatological divisions. The Northern and Central zones generally have "continental" climates, with minimal influence from the Atlantic Ocean. A storm track from the mid-continent Mississippi Valley, running across the Great Lakes and along the St. Lawrence Valley is the major weather conduit for these regions of New Jersey, following the prevailing air currents that blow westerly, from the northwest in winter and the southwest in summer. Moving moist air across the Northern and Central regions runs into New Jersey's highlands and ridgelines, forcing it upwards into cooler parts of the atmosphere and triggering rainfalls. Thunderstorms spawned in Pennsylvania and New York often move into northern New Jersey where they reach

maximum development in late afternoon-evening. The Northern and Central zones see twice as many thunderstorms as the Coastal region does, where the nearby Atlantic Ocean helps maintain a stable atmosphere. This weather pattern holds for most months, but it is occasionally disrupted in fall and winter months (October through April) when large oceanic systems and coastal storms (nor'easters) move through the area, bringing severe weather on an easterly track.

The Central zone is also prone to slightly warmer temperatures due to its concentration of developed urban areas, which tend to absorb and re-radiate solar heat, a phenomenon referred to as the "heat island" effect. The northern edge of the Central zone is generally the boundary between wintertime freezing and non-freezing precipitation and is also the summertime limit between comfortable and uncomfortable nighttime temperatures. This region typically experiences 15-20 days above 90°F.

Temperature and Precipitation

The ONJSC maintains temperature and precipitation data from monitoring stations around the state. Some of these records go back to the 1890s. The ONJSC has compiled a northern New Jersey regional report, with values calculated from an average of monthly temperatures.

The variability of New Jersey's weather is displayed well by the latest two years (2011 and 2012), which brought on extremes of precipitation and temperature, both low and high. Copious amounts of precipitation fell on New Jersey in 2011, making it the wettest year on record, with a statewide average of 64.9" of rainfall, almost 5" above the previous record. The northern sections of the state, typically its wettest part, were particularly drenched, with West Milford (Passaic County) reaching a weather-station record of 90.7". Areas close to East Hanover, such as Mount Olive (88.2") and Jefferson Township (87.9") also recorded abnormally high precipitation, due to not only a pattern of severe summer storms (Tropical Storms Irene and Lee) but including a wet spring that featured major flooding from consecutive heavy rainstorms in March (6-7, 10-11). An early-season snowstorm in October (29-30) brought an unexpected amount of canopy damage to trees that were still with considerable foliage thanks to overall warmer temperatures that led 2011 to be the fourth warmest year in the state's records, dating back to 1895.

East Hanover, along with northern New Jersey, is faced with changes to its climate stemming from increases in temperature and more frequent alternations of dry-weather drought and wet-weather heavy precipitation and flooding. Since 1970, the average annual temperature in the Northeastern United States has increased by 2°F, or 0.5^{o}F per decade. Average winter temperatures have increased twice as much, being especially pronounced from November through March. The average number of very hot days (days over 90°F) has increased by 2 days per year over the past 45 years. New Jersey has experienced this warming to an even greater extent than the Northeast as a whole, with 23 very hot days per year, a gain of 6 from its average of 17 per year in 1949. Looking at the records for northern New Jersey (Division 1, consisting of the Counties of Bergen, Essex, Hudson, Hunterdon, Morris, Passaic, Somerset, Sussex, Union, and Warren), the mean temperature over the entire period of meteorological records (1895-2011) is 50.8^{o}F.

With the focus on the 30-year period of 1971-2000 ("old normal"), the average rises to 50.9^{o}F. Concentrating on the most recent 30-year period of 1981-2010 ("new normal"), the average peaks at 51.6^{o}F. While there is likely to be little difference in the average increase across the state in the coming decades, most predictive models indicate that northern and inland New Jersey will see slightly higher temperature increases, anywhere from 2 to 6°F by 2050.

The record for warmest year would be broken in 2012, with the state's average annual temperature coming in at 56°F, almost a half degree above the previous warmest year (1998). Until a dip in temperatures in November, the state experienced 21 months of above-average temperatures (February 2011-October 2012). Snowfall was low across the state until a November 7 storm dropped up to 13" across the eastern half of the state. The advent of Hurricane/Post-Tropical Cyclone Sandy in October (28-30) was the culmination of a season of high-wind events across the state that also suffered a fast-moving band of thunderstorms (derecho) in June and a September tornado (EF0). Despite the additional rainfall these events brought, the year was below-average in precipitation, with the state 3.7" below its average. The precipitation shortfall was particularly felt in the Northern and Central zones, where Sandy did not deposit much rainfall.

Precipitation in East Hanover, also following the general trends for northern New Jersey, is harder to predict, given the greater variability in the meteorological records for rainfall and snowfall. However, the annual precipitation for the state as a whole over the past 4 decades has shown increases of approximately 10% over the 1895-1970 averages (44" versus 48.6" for the most recent decade, 2001-2010). Focusing again on northern New Jersey (Division 1), the overall mean annual precipitation is 46.5" (1895-2011), the "old normal" (1971-2000) is 49.8" and the "new normal" (1981-2010, which does not include the record year of 2011) is 49.4". Increased occurrences of heavy precipitation events (defined as exceeding daily thresholds of 1, 2, or 4 inches) have been observed, with the heaviest storms also now delivering 54% more precipitation per event. Looking ahead, northern New Jersey is likely to see greater precipitation increases than southern New Jersey, with a 10-12% increase by mid-century (2050). That increase is also more likely to fall as winter precipitation, predicted to increase by 11-16%. The "hundred year" storms (storms with a large precipitation amount that occur only 1% of the time) are predicted to grow from their current 9 to 10 inches delivered to 12 to 14 inches and will occur, on average, every 35 to 55 years.

Climate Change

As the meteorological extremes of 2011-2012 indicate, the climate of New Jersey is changing. Global responses to the rise in atmospheric "greenhouse" gases like carbon dioxide include increases in temperature, rises in sea levels, and alteration in annual precipitation patterns and amounts. For New Jersey, the coming decades are likely to bring continuing increases in average temperature and steady or increasing amounts of precipitation, especially in winter months. More frequent severe weather events such as heat waves, droughts, and extreme precipitation events and consequent flooding are

likely to occur. Coastal New Jersey is exceptionally vulnerable as the sea level rise it experiences is complicated by land subsidence due to groundwater withdrawal.

In 2007, the International Panel on Climate Change (IPCC) reported that increasing carbon dioxide (CO_2) emissions into the atmosphere, as a result of human activity, has warmed the Earth's surface by more than 1.3^{o}F during the past century. The Union of Concerned Scientists has indicated that temperatures in the Northeast are likely to rise in winter and summer over the next several decades. Without a reduction in CO_2 and other greenhouse gas emissions (GHGs), average temperatures may rise by up to 14°F. Studies have predicted that by the end of this century the New York City region and cities such as Trenton could experience more than 20 days per summer with temperatures above 100°F.

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

A greenhouse gas (GHG) is defined by the NJDEP as:

> "an atmospheric gas that slows the rate at which heat radiates into space, thus having a warming effect on the atmosphere. GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide, chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and some other halogenated gases."

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

- stabilization of statewide GHGs to 1990 levels by 2020, and
- a further reduction to 80% below 2006 levels by 2050.

According to the NJDEP, New Jersey must meet these limits in order to avoid the most damaging impacts of climate change. In 2009, the latest year for which major sector estimates are available, total estimated emissions were 112.1 million metric tons of CO_2 equivalent (MMTCOe), below the 1990 baseline and 2020 target of 125.6 MMTCOe. The 2050 goal is much more ambitious: to be 80% below the 2006 level, or approximately 25.5 MMTCOe.

In December 2011, the state revised its Energy Master Plan, which is the strategic vision for the use, management, and development of energy in New Jersey over the next decade. Because fossil fuels like coal, oil and natural gas are the largest sources of GHGs in the state, the Energy Master Plan serves as the platform for discussions about how New Jersey can meet the Global Warming Response Act's 2050 greenhouse gas limit. *(NJDEP)*

The transportation sector continues to be the major contributor to GHGs (47.3% in 2009) and vehicle miles traveled continue to increase while fuel efficiencies have leveled off. In 2009, electricity generation was the second largest contributor, at 23.5%, followed by residential at 15.2, industrial at 10.6, commercial at 10.8. Highly warming gases, waste management and land clearing contributed another approximately 23%, while terrestrial carbon sequestration (forests absorbing carbon) provided an offset of -7.6%.

NJDEP predicts that major new initiatives and technologies will be required. Of most import for East Hanover, which is largely residential in nature and which has additional intrusion from high traffic roadways, a 2008 report states:

> "For the residential sector, emissions from direct fossil fuel use in 1990 were about 15.7 MMtCO2eq, and are estimated to decrease to about 11.5 MMtCO2e by 2020. Emissions associated with natural gas consumption accounted for about 60% of total residential emissions in 1990, and are estimated to increase to 98% of total residential emissions by 2020" while petroleum (39.5 to 2%), coal and wood decrease. *(NJDEP)*

On a county level, Morris County is using an Energy Efficiency and Conservation Block Grant (EECBG) to audit and retrofit existing county buildings with energy efficient components, promote greenhouse gas emissions inventories for public buildings and develop a smart vehicle routing system for its recycling vehicles to reduce transportation demands. One effect of these initiatives will be to avoid 75,290 metric tons of CO_2e emissions. *(EECBG)*

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

AIR

Air Quality: National Clean Air Standards

First adopted in 1970, the federal Clean Air Act requires the United States Environmental Protection Agency (EPA) to establish health and environmental standards for a set of six widely spread air pollutants. The pollutants targeted by the Clean Air Act include particulate matter (PM), ground-level ozone ("smog"), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead. These six pollutants, known as the "criteria" pollutants, are regulated based upon the National Ambient Air Quality Standards (NAAQS) set by the EPA to limit the hazards they pose to human health (primary standards) and to the natural and human environment (secondary standards). When a standard is set or revised, the EPA formally designates the area as being in attainment (meeting the primary standard) or in non-attainment (exceeding the standard). It is the responsibility of each state to develop State Implementation Plans (SIPs) to attain and maintain these standards. In New Jersey, that role is assigned to the New Jersey Department of Environmental Protection (NJDEP) Division of Air Quality (DAQ) and its Bureau of Air Monitoring (BAM), which monitors the State's ambient air monitoring network.

The Clean Air Act was amended in 1990, with focus on four areas of pollution: acid rain, urban air pollution, toxic air emissions, and stratospheric ozone depletion. The amendment also introduced a permits program and strengthened enforcement.

New Jersey's geographical location in the heavily developed northeastern United States, coupled with the prevailing westerly wind currents that carry pollutants from Midwestern and Appalachian industrial areas, elevates its air quality issues to regional levels. High ozone and particulate matter concentrations within New Jersey are demonstrably produced through the combination of in-state and out-of-state sources, via a mechanism called "regional transport". Given the complexity of modeling air pollution on a regional level, New Jersey actively partners with other states, regional planning groups, and academic researchers. Through these cooperative arrangements, the contributions of upwind and downwind states are determined and regional air pollution control strategies are proposed and developed.

Regional / Local Statistics

The State uses the air quality data from its air monitoring network to determine which areas are in compliance with NAAQS as well as overall trends in air pollution levels. The NJDEP produces yearly reports but also provides real-time reporting through its Air

Quality Index website (*www.njaqinow.net*). Although there are monitoring sites throughout the state, each site measures a limited set of pollutants; no one site tracks them all.

The six pollutants for which standards have been set by the EPA – ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead – are known as *criteria pollutants*. Over the period 1990-2010, total emissions of these air pollutants have decreased by more than 41 percent nationally. *(USEPA)*

In New Jersey, according to the NJDEP DAQ website, air quality has improved significantly over the last 40 years since the first Earth Day, in 1970, but exceeds the current NAAQS standards for ozone throughout the state and for fine particulates in urban areas (13 counties). New Jersey has attained sulfur dioxide (except for a portion of Warren County), lead, carbon monoxide and nitrogen dioxide standards.

Additional air pollutants that may cause adverse health effects but are not criteria pollutants are referred to as Hazardous Air Pollutants (HAPs) or air toxics. The NJDEP DAQ also regulates the emissions of these HAPs. For many toxins the State has set its own standards, with stricter requirements than the EPA.

Criteria Pollutants

Each of the six criteria pollutants is discussed below. Information on national and state standards and localized air monitoring results are provided based on 2010 NJDEP reports, the latest available data at time of publication. In the discussions of the individual criteria pollutants, primary standards are those associated with health effects and secondary standards are based on "welfare" effects (e.g., damage to trees, crops and materials).

Ozone

Ozone (O_3) is defined by the NJDEP *2010 Ozone Summary* as a gas that consists of three oxygen atoms. In the upper atmosphere, where it occurs naturally, it offers protection from harmful ultraviolet rays. But at ground level it can have adverse health effects. Ground-level ozone is monitored from April through October because its formation, from nitrous oxide (NO_x) and volatile organic compounds (VOCs), requires the presence of sunlight and heat. Hot, dry summers result in more ozone than cool, wet ones.

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

New Jersey standards are based on 1-hour averaging, with primary standards set at 0.12 ppm and secondary standards set at 0.08 ppm. They are not as stringent as the revised NAAQS.

To date, the effort to lower ozone concentrations has focused on reducing emissions of VOCs. However, improvements have leveled off in recent years, especially with respect to maximum 8-hour average concentrations. According to the NJDEP report, significant further improvements will require reductions in both VOCs and NO_x. Levels of NO_x in New Jersey are affected by emissions from upwind sources outside New Jersey.

Statewide, New Jersey is classified as a "moderate" ozone non-attainment area for NAAQS for the 2008-2010 period, with an overall score of 0.092 ppm. This score falls at the lowest end of the moderate category.

Morris County is designated non-attainment for ground-level ozone. Morris County is included within a multi-state non-attainment area that also comprises southern New York, Long Island, and western Connecticut (NY-NJ-CT), in recognition of the regional nature of ozone formation and movement. Ground-level ozone forms as a result of a photochemical reaction among a number of precursor sources such as nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. The precursor chemicals are primarily emitted by motor vehicles, power plants, chemical factories, and even natural sources. Ozone and its precursors can travel hundreds of miles downwind. With sunlight as a catalyst, ground-level ozone is principally a daytime problem, especially in summer months. Meteorological conditions can also affect ozone formation, with hot, drier conditions being more productive. In New Jersey, the ozone "season" runs from April 1 to October 31.

Ground-level ozone can damage the human respiratory system as well as exacerbate existing conditions such as bronchitis, heart disease, emphysema, and asthma. People with pre-existing respiratory ailments, people who work outdoors primarily, and children are all considered at-risk for ozone-related health problems. Additionally, ground-level ozone damages plants, including food crops and trees, making it responsible for losses of up to $500 million a year in the United States.

In 2011, there were 21 days in which New Jersey exceeded the latest (2008) 8-hour ozone standard. Under the previous (1997) standard, 9 days would have shown exceedance values. Since 1990, the ozone trend under either standard has been declining, primarily as a result of reduction in VOC emissions. Even with the increase in hot summer days over the period, peak ozone concentrations are lower than previously recorded. Ozone is monitored by New Jersey's Department of Environmental Protection (NJDEP) at 16 sites throughout the state (10 annually, 6 only "in season"). Within Morris County, ozone is monitored in Chester Borough. Over the past 3 years (2009-2011), the Chester monitoring site showed 6 days with ozone levels above the primary standard. As an average over that same time, the Chester station has reported ozone concentrations at the primary standard (0.075 parts per million). By comparison, ten stations report ozone averages above the standard during 2009-2011, while three register below average readings. (One station began reporting in 2011 and has not compiled a 3-year average yet.) As part of the NY-NJ-CT non-attainment area, Morris County is rated "Marginal" in non-attainment for the 2008 ozone standard, the lowest rating for non-attainment.

The ozone monitoring in Chester and Leonia reported 5 days above 0.075 ppm and Ramapo reported 4, as shown in *Table 3*.

Table 3. Ozone - 2010						
8-Hour Averages in Parts Per Million (ppm) Standard: .075 ppm						
Station	*Highest*	*2nd*	*3rd*	*4th*	*Avg. of 4th Highest 8-Hr Avgs 2008-2010*	*# Days with 8-Hr Avg Above 0.075ppm*
Chester	0.094	0.086	0.078	0.078	0.075	5
Ramapo	0.094	0.083	0.077	0.077	0.074	4
Leonia	0.085	0.083	0.077	0.076	0.076	5
State	0.111	0.083	0.080	0.080	0.092	35
Source: NJDEP 2010 Ozone Summary						

Sulfur Dioxide

NJDEP's *2010 Sulfur Dioxide Summary* defines SO_2 as "a heavy, colorless gas with a suffocating odor that easily dissolves in water to form sulfuric acid. SO_2 gases can be formed when fuels containing sulfur are burned, or when gasoline is extracted from oil." Most of the sulfur dioxide released into the air comes from electric utilities, followed by fossil fuel combustion, industrial processes, non-road equipment and on-road vehicles.

Sulfur dioxide reacts with other gases and particles in the air to form sulfates that can be harmful to people (particularly children, the elderly and asthmatics) and the environment. Sulfur dioxide reacting with other substances in the atmosphere forms acid rain, which damages forest, crops and aquatic environments and decays building materials.

There are several standards for monitoring SO_2, ranging from 1-hour to annual averaging. New Jersey's standards differ slightly from national standards, as shown in *Table 4*.

Table 4. National and New Jersey Ambient Air Quality Standards for Sulfur Dioxide ppm = parts per million; ppb = parts per billion; ug/m3 = micrograms per cubic meter			
Averaging Period	*Type*	*New Jersey*	*National*[a]
12 – month average	Primary	80 µg/m^3 (0.03 ppm)	0.03 ppm
12 – month average	Secondary	60 µg/m^3 (0.02 ppm)	---
24 – hour average	Primary	365 µg/m^3 (0.14 ppm)	0.14 ppm
24 – hour average	Secondary	260 µg/m^3 (0.10 ppm)	---
3 – hour average	Secondary	1300 µg/m^3 (0.5 ppm)	0.5 ppm
1 – hour average[b]	Primary	---	75 ppb

a – National standards are block averages rather than moving averages.
b – Final rule signed June 2, 2010 and effective on August 23, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hr average at each monitor within an area must not exceed 75 ppb.
Source: NJDEP 2010 Sulfur Dioxide Summary

Regulations requiring the use of low sulfur fuels in New Jersey have been effective in lowering SO_2 concentrations. No monitoring sites recorded exceedances of the primary or secondary SO_2 NAAQS during 2010. The last year an exceedance of the national SO_2 standards was recorded in the state was 1980. *Table 5* shows data for the three monitoring

sites closest to East Hanover that capture SO_2 data. Data from all three sites show levels well below the NAAQS.

Table 5. Sulfur Dioxide - 2010				
National Standards in Parts per Billion (ppb) and Parts per Million (ppm)				
	75 ppb	0.50 ppm	0.14 ppm	0.03 ppm
Monitoring Site Data				
Monitoring Site	*3-Year Avg. 99th %-ile of Daily Max 1-Hour Avg (ppb)*	*3-Hour Avg Max (ppm)*	*24-Hour Avg Max (ppm)*	*12-Month Avg Max (ppm)*
Chester	27	0.032	0.013	0.001
Newark Firehouse	---*	0.018	0.0108	0.0018
Hackensack	14	0.009	0.002	0.000
** Three-year data unavailable.* *Source: NJDEP 2010 Sulfur Dioxide Summary*				

In 2011, New Jersey requested an expansion of the non-attainment area for sulfur dioxide (SO_2) to include a greater portion of the northwestern portion of the state, including the western border of Morris County (covering the municipalities of Jefferson Township, Mount Arlington Borough, Roxbury Township, Mount Olive Township, Chester Township and Borough, and Washington Township). The emissions from a Pennsylvania coal-fired power generating station located on the Delaware River are the target of New Jersey's petition.

Carbon Monoxide

According to the NJDEP *2010 Carbon Monoxide Summary*, vehicles, construction equipment, boats and other engines are the predominant contributors of carbon monoxide (CO) emissions nationwide. Boilers, incinerators and forest fires also contribute. This colorless, odorless and poisonous gas is formed when carbon in fuels is not burned completely. Exposure most often causes headaches and nausea; the threat to health is most serious in people with cardiovascular disease.

Although there are no national secondary standards, New Jersey has set its secondary standards at the same level as primary standards and uses a different measuring metric than national standards (see *Table 6*). In addition, New Jersey standards are not to be exceeded more than once in any 12-month period.

Table 6. National and New Jersey Ambient Air Quality Standards for Carbon Monoxide mg/m^3 = milligrams per cubic meter; ppm = parts per million			
Averaging Period	*Type*	*New Jersey*	*National*
1-Hour	Primary	40 mg/m^3 (35 ppm)	35 ppm
1-Hour	Secondary	40 mg/m^3 (35 ppm)	----

Table 6. National and New Jersey Ambient Air Quality Standards for Carbon Monoxide mg/m^3 = milligrams per cubic meter; ppm = parts per million			
Averaging Period	*Type*	*New Jersey*	*National*
8-Hour	Primary	10 mg/m^3 (9 ppm)	9 ppm
8-Hour	Secondary	10 mg/m^3 (9 ppm)	----
Source: NJDEP 2010 Carbon Monoxide Summary			

According to the NJDEP report, "carbon monoxide levels have improved dramatically over the past 20 years. The last time the CO standard was exceeded in New Jersey was in January of 1995, and the entire state was officially declared as having attained the CO standard on August 23, 2002." Because on-road vehicle emissions form the major contributor to CO levels, there is a variation throughout the day, with the highest peaks around 7 to 8 am, and another, lower but more extended, rise between 4 and 8 pm.

In 2010, of the CO monitoring stations closest to East Hanover, the highest concentrations were reported in East Orange (see *Table 7*). The East Orange station also had the highest 8-hour average concentration of any reporting station in the state. Most CO monitoring stations are located in high traffic areas in northeastern New Jersey. All statistics are well below the national and state standards.

Table 7. Carbon Monoxide - 2010 1-Hour and 8-Hour Averages in Parts Per Million (ppm) 1-hour standard = 35 ppm; 8-hour standard = 9 ppm				
Monitoring Sites	*Maximum 1-Hr Avg*	*2nd Highest 1-Hr Avg*	*Maximum 8-Hr Avg*	*2nd Highest 8-Hr Avg*
Morristown	1.7	1.4	1.0	1.0
East Orange	3.7	3.4	3.1	2.1
Hackensack	2.7	2.3	1.9	1.6
Source: NJDEP Carbon Monoxide Summary 2010				

Nitrogen Dioxide

According to the NJDEP *2010 Nitrogen Dioxide Summary*, nitrogen dioxide (NO_2) is a reddish-brown, highly reactive gas that is formed in the air through the oxidation of nitric oxide (NO). When it reacts with other chemicals, it can form ozone, particulate matter and other contributors to acid rain and haze. Oxides of nitrogen (NO_x) are combinations of gases comprising mostly NO_2 and NO. They are emitted from fuel-related sources, which include vehicle exhaust, the burning of coal, natural gas and oil, industrial processes such as welding, and household gas stoves and heaters. NO is released into the atmosphere as NO_x but easily converts to NO_2.

NO_2 can aggravate or cause respiratory illness and prolonged exposure can permanently damage the lungs. Along with NO, it can irritate the eyes, nose, throat and lungs and cause nausea and tiredness. Both are found in tobacco smoke. The environmental effects of nitrogen oxides can include potential changes in the composition of some plants in

wetland and terrestrial ecosystems, acidification of freshwater bodies, eutrophication of estuarine and coastal waters, increases in levels of toxins harmful to fish and other aquatic life, and visibility impairment.

The levels for the national and state standards are the same; however, national standards are based on calendar year averages, while state standards apply to any 12-month period. Because the bulk of NO_x emissions comes from vehicle exhaust, levels are highest during morning and afternoon rush hours. Levels are also higher in winter than in summer. (see *Table 8*)

Table 8. National and New Jersey Ambient Air Quality Standards for Nitrogen Dioxide (NO_2)
Parts Per Million (ppm) and Micrograms Per Cubic Meter (µg/m^3)

Averaging Period	*Type*	*New Jersey*	*National*
12-month average	Primary	100 µg/m^3 (0.053 ppm)	
Annual average	Primary		0.053 ppm (100 µg/m^3)
12-month average	Secondary	100 µg/m^3 (0.053 ppm)	
Annual average	Secondary		0.053 ppm (100 µg/m^3)
1-hour average	Primary		0.100 ppm (190 µg/m^3)
Source: NJDEP 2010 Nitrogen Dioxide Summary			

NO_2 concentrations in New Jersey have fallen steadily from an average of 0.040 ppm in 1975 to 0.012 ppm in 2010. Neither the statewide nor the individual station averages have exceeded the health standard of 0.053 ppm, although the highest reporting stations in 1975 came close. Of the eight reporting stations for 2010, East Orange and Chester are two of the closest to East Hanover. Chester reported the lowest levels of all reporting stations, while East Orange's results were toward the higher end. Elizabeth Lab, which reported the highest levels, is included for comparison in *Table 9*.

Table 9. Nitrogen Dioxide (NO_2) and Nitric Oxide (NO) - 2010
Parts Per Million (ppm)
National Standards: 1-Hour - 0.100 ppm; 12-Month - 0.053 ppm

	Nitrogen Dioxide			*Nitric Oxide*
Monitoring Sites	*1-Hr Avg 2010 98th %-ile*	*1-Hr Avg 2008-2010 98th %-ile*	*12-Mo Avg*	*12-Mo Avg*
East Orange	0.064	0.062	0.018	0.012
Chester	0.035	0.038	0.004	0.000
Elizabeth Lab	0.071	0.073	0.022	0.021
Source: NJDEP 2010 Nitrogen Dioxide Summary				

Although NO_2 concentrations score well within the NAAQS, oxides of nitrogen continue to be of concern because of their role in the formation of other pollutants – particularly ozone and fine particles.

Particulate Matter

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

Environmentally, particulate matter causes reduced visibility, absorbing and scattering sunlight, obscuring natural landscape color and clarity over wide expanses ("regional haze"). Additionally, the deposition of particulate matter on plants or on human structures can cause unwanted chemical reactions that damage surfaces and protective coatings.

NAAQS for both Inhalable Particulates (PM_{10}) and Fine Particulates ($PM_{2.5}$) are set at the same level for both primary (health) and secondary (environmental welfare) standards. Although the EPA abandoned standards for TSPs in favor of the smaller PM_{10} and $PM_{2.5}$ particulates, New Jersey still maintains TSP standards, as shown in *Table 10*.

Table 10. Particulate Matter – 2010 National and New Jersey AAQs
Micrograms Per Cubic Meter ($\mu g/m^3$)

	Averaging Period	*National*	*New Jersey*
Total Suspended Particulates (TSP)	12-Month Primary 12-Month Secondary 24-Month Primary 24-Month Secondary	--	75 $\mu g/m^3$ 60 $\mu g/m^3$ 260 $\mu g/m^3$ 150 $\mu g/m^3$
Inhalable Particulates (PM_{10})	Annual	50 $\mu g/m^3$	---
	24-Hr Avg	150 $\mu g/m^3$	---
Fine Particulates ($PM_{2.5}$)	Annual	15.0 $\mu g/m^3$	---
	24-Hr Avg	35 $\mu g/m^3$	---

Source: NJDEP 2010 Particulate Summary

In 2010, four New Jersey air monitoring stations measured PM_{10}, 24 measured $PM_{2.5}$ and seven monitored what is known as smoke shade or the coefficient of haze (COH), for which no standard is set. Several stations use the EPA sanctioned Federal Reference Method (FRM) sampling, based on a 24-hour period, but New Jersey also has additional monitors that continuously measure particulate concentrations (TEOMs), providing the real-time data that the FRM cannot. TEOM data is made available to the public via the Air Quality Index (*www.njaqinow.net*).

In 2010, all areas of the state were in attainment for Inhalable Particulates, PM_{10}. The closest of the four PM_{10} monitoring stations to East Hanover was in Jersey City, where

the highest daily concentration was 109 μg/m^3, versus the national standard of 150, and the annual mean was 29, versus the national standard of 50.

All sites met the annual standard for Fine Particulates, $PM_{2.5}$., but 10 sites, mostly in northern New Jersey, including Morristown, Paterson and Elizabeth Lab, exceeded the 24-hour standard of 35 μg/m^3. In addition, 10 northern New Jersey counties, including Morris County, were designated as non-attainment not for their local results but "due to their potential $PM_{2.5}$ contribution to the Elizabeth Lab monitor and additional sites in New York City that recorded violations."

Further breaking down the fine particulate contribution to air pollution, four stations, including Chester and Elizabeth Lab, measure 39 components. The five highest contributors are organic carbon, sulfate, nitrate, elemental carbon and sulfur. Elizabeth Lab reported the highest concentrations of each of these five particulates. Both organic and elemental carbon are sourced primarily from motor vehicles, and Elizabeth Lab is located in a high traffic area. Chester scored lowest for elemental carbon and nitrate but was close to Elizabeth Lab for both sulfate and sulfur levels.

In 2011, only one of New Jersey's 20 $PM_{2.5}$ 24-hour monitoring sites (Elizabeth, Union County) showed particulate concentrations above the EPA primary limit. The lowest concentration average for the year was recorded at Chester Borough. Analysis of the Chester station's samples showed that the largest components of collected particulate matter came from sulfate compounds (a product of coal burning) and organic carbon particles (primarily vehicle exhaust). NJDEP also maintains 11 real-time particulate monitoring sites; in 2011, they recorded a total of 5 days of unhealthy particulate concentrations from the Elizabeth site, which also had the highest recorded annual concentration. Because of the long-distance movement of particulate matter, the exceedance of the Elizabeth monitoring site is cause for the other northern New Jersey counties to remain in non-attainment. In December 2012, the State submitted a request to the US EPA for redesignation of all of its counties for attainment of the older (1997) annual $PM_{2.5}$ standard (15 μg/m^3) as well as the current (2006) daily $PM_{2.5}$ standard. Such redesignation would require New Jersey to implement a maintenance plan for particulate matter to continue to track and evaluate air concentrations as well as contingency steps to assess and correct any observed violations of the NAAQS standards.

"Smoke shade" is an indirect measurement of particles in the atmosphere and is used for daily reporting in the Air Quality Index. Smoke shade is measured as a Coefficient of Haze (COH), with a benchmark set at 2.0. Readings above this level are deemed "Unhealthy for Sensitive Groups." The two closest stations, Morristown and Hackensack stations, reported levels below the benchmark. The highest reporting stations were Jersey City and Elizabeth Lab, also below the benchmark (see *Table 11*).

Table 11. Smoke Shade – 2010

Benchmark 2.0			
Station	*Max Daily Avg.*	*2nd Highest Daily Avg.*	*Annual Mean*
Morristown*	0.58	0.54	0.17
Hackensack	0.56	0.50	0.15

Table 11. Smoke Shade – 2010			
Benchmark 2.0			
Station	*Max Daily Avg.*	*2nd Highest Daily Avg.*	*Annual Mean*
Jersey City	1.15	1.10	0.35
Elizabeth Lab	1.12	0.99	0.32
**Morristown shut down at the end of 2010.* *Source: NJDEP*			

Lead

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

According to the EPA, taking lead out of on-road motor vehicle gasoline has been the primary reason for a decline in lead in the air. Between 1980 and 2010 the EPA reported an 89% decrease in national average. Contributors to lead in the air today include ore and metals processing and leaded aviation fuel. As of 2012, only two non-attainment areas are listed for lead in the country: one in Montana and one in Missouri. *(EPA)*

The NJDEP has data for New Jersey stations monitoring lead in the air from 1990 to 1995-96. Although some stations exceeded NAAQS levels in the early 1990s, all were below the standards by 1996. Although no stations reporting to the NJDEP BAM were monitoring lead in recent years, a monitoring site is proposed for Paterson. (NJDEP) Data available from the EPA includes information for a monitoring site in New Brunswick (see *Figure 1*) that includes statistics through 2008, indicating that levels were close to or above the national standards in several years during the 1999-2006 period. The primary and secondary NAAQS for lead are presently set at 0.15 micrograms per cubic meter of air ($\mu g/m^3$) measured on a rolling three month average. *(EPA)*

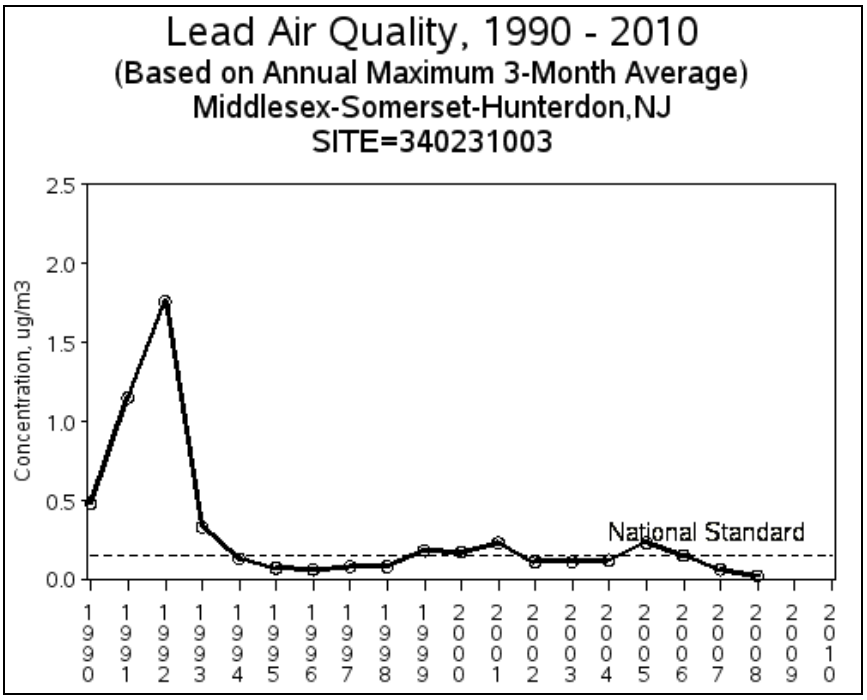

Figure 1. Lead Air Quality (1990-2010); Source: USEPA

Air Toxics

The Clean Air Act was amended in 1990 to establish another class of air pollutants, the Hazardous Air Pollutants (HAPs). A list of 187 airborne toxic substances was created, along with a number of toxin reduction programs to address the specific sources of each listed substance. Health effects from HAPs include increases to cancer risk, respiratory, neurological, reproductive, and immune system damage, and irritation or damage to specific organs. The EPA is required to conduct assessments of the risk associated with the various HAPs as well as identifying the leading health threats. Every three years, starting in 1996, the EPA compiles these assessments in its National-Scale Air Toxics Assessment (NATA) report. NJDEP compares the estimated NATA air concentrations to their chemical-specific health benchmarks and divides the modeled air concentration by the health benchmark to get a risk ratio. If the risk ratio for a specific chemical is greater than one, it may be of concern, increasing the risk for cancer or other negative health effects.

In its latest release, the 2005 NATA report listed 22 air toxins to New Jersey residents, 21 of which are carcinogens and one of which, acrolein, is not. For Morris County, the leading toxins are formaldehyde (a carcinogen) with a risk ratio of 24 (indicating its presence at concentrations 24 times above the safe exposure benchmark, roughly the number of additional deaths per million annually) and carbon tetrachloride (9.1 risk ratio). NJDEP also monitors the chemicals of concern identified in the 2005 NATA with three sites statewide, including one in Morris County in Chester Borough. In 2011, the Chester station had the lowest average concentrations for the majority of the NATA air toxins. Its readings confirmed formaldehyde as the leading air toxin with a risk ratio of 31, while carbon tetrachloride declined to 4 (mainly from a re-evaluation of its toxicity).

Replacing it as the second highest health threat was the toxic metal cadmium, with a risk ratio of 10. The list for Morris County, comparing air concentrations to health benchmarks, is shown in see *Table 12*.

Table 12. Morris County Average 2005 NATA Modeled Air Concentrations Compared to Health Benchmarks

Pollutant	*Modeled Air Concentration ($\mu g/m^3$)*	*Health Benchmark ($\mu g/m^3$)*	*Risk Ratio*	*% Contribution from*				
				Point Sources	*Nonpoint Sources*	*On-road Mobile Sources*	*Nonroad Mobile Sources*	*Background & Secondary*
Acetaldehyde*	1.7	0.45	3.7	0%	3%	5%	2%	90%*
Acrolein*	0.041	0.020	2	<1%	16%	13%	11%	60%*
Arsenic Compounds	0.00049	0.00023	2.1	3%	7%	4%	3%	83%
Benzene	0.91	0.13	**7**	<1%	8%	29%	14%	49%
1,3-Butadiene	0.073	0.033	**2.2**	0%	0%	30%	15%	55%
Cadmium Compounds	0.000087	0.00024	0.4	6%	32%	0%	<1%	62%
Carbon Tetrachloride	0.61	0.067	**9.1**	0%	<1%	0%	0%	100%
Chloroform	0.096	0.043	**2.2**	<1%	38%	0%	0%	62%
Chromium (hexavalent form)	0.00025	0.000083	**3**	10%	4%	3%	<1%	83%
Cobalt Compounds	0.00014	0.00011	**1.3**	99%	1%	0%	0%	0%
1,4-Dichlorobenzene	0.082	0.091	0.9	<1%	44%	0%	0%	56%
1,3-Dichloropropene	0.069	0.25	0.3	0%	100%	0%	0%	0%
Diesel Particulate Matter	0.53	0.0033	**161**	0%	0%	56%	44%	0%
Ethylbenzene	0.19	0.4	0.5	<1%	15%	51%	34%	0%
Ethylene Oxide	0.0088	0.011	0.8	1%	11%	0%	0%	88%
Formaldehyde*	1.8	0.077	**24**	<1%	3%	7%	4%	86%*
Methyl Chloride	1.2	0.56	**2.1**	<1%	<1%	0%	0%	100%
Naphthalene	0.086	0.029	**3**	<1%	33%	27%	5%	35%
Nickel Compounds	0.0010	0.0021	0.5	39%	13%	2%	1%	45%
PAH/POM**	0.0078	0.0072**	**1.1**	<1%	79%	8%	13%	0%
Perchloroethylene	0.16	0.17	0.9	<1%	39%	0%	0%	61%
1,1,2-Trichloroethane	9.3E-7	0.063	2.0E-5	53%	47%	0%	0%	0%

- Chemicals with risk ratios greater than or equal to 1 are in **bold**. The four highest risks for Morris County

Table 12. Morris County Average 2005 NATA Modeled Air Concentrations Compared to Health Benchmarks

Pollutant	Modeled Air Concentration ($\mu g/m^3$)	Health Benchmark ($\mu g/m^3$)	Risk Ratio	% Contribution from				
				Point Sources	Nonpoint Sources	On-road Mobile Sources	Nonroad Mobile Sources	Background & Secondary

are highlighted in gray.

- Risk Ratios based on noncarcinogenic effects are in *italics*.
- The symbol ug/m3 is micrograms per cubic meter, the amount (in micrograms) of a chemical in a cubic meter of air. This is also known as a concentration.
- For diesel particulate matter, on-road and non-road concentrations include a model-estimated background concentration.
- *Acetaldehyde, acrolein and formaldehyde concentration estimates include secondary formation, which is the process by which chemicals in the air are transformed into other chemicals.
- **PAH/POM is "polycyclic aromatic hydrocarbons/polycyclic organic matter." These define a broad class of compounds. The chemicals making up this class were broken up into 8 groups based on toxicity, and each group was assigned a cancer-weighted toxicity estimate. 0.0072 ug/m3 is the health benchmark average across the 8 groups.

Source: NJDEP

The four chemicals with the highest risk ratios in Morris County are diesel particulate matter (161), formaldehyde (24), carbon tetrachloride (9.1) and benzene (7).

Diesel particulate matter, according to table above, poses the highest risk factor for Morris County, with an overall ratio of 161 times the benchmark. The risk ratio is higher in the eastern and central part of the County and along the I-80 corridor. Sussex County has the lowest cancer risk ratio (40) from diesel particulate matter and Hudson County the highest (925). In Morris County, 56% of diesel particular matter comes from on-road mobile sources and 44% from non-road sources.

Formaldehyde. Formaldehyde is mostly formed in the atmosphere from chemicals released from mobile and other sources and does not degrade quickly. In Morris County, background and secondary formations account for 86% of sources. The Countywide score is 24.

Carbon tetrachloride (CT). The entire state is at a risk ratio of 5-10 times benchmark, with Morris County assessed at 9.1. While no longer used in New Jersey, CT has a long half-life and thus residual levels remain in the air. CT contributes significantly to ozone depletion and thus is being phased out nationally under the Clean Air Act Amendments.

Benzene. Benzene is a component of gasoline and oil and is used industrially to make other chemicals, plastics and synthetic fibers. It is ranked in the top 20 chemicals for production volume in the United States. Eastern Morris County has a benzene risk ratio of 5-10 times benchmark, with Morris County as a whole scoring 7. Primary sources are on-road mobile (29%) and background concentrations (49%).

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

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

Morris County's emissions come mostly from on-road and non-point sources, followed by non-road mobile sources, with a very low contribution by point sources

The final category of contributions to emissions is background and secondary sources. Background concentrations generally cannot be sourced to current, local emissions. The six air toxics that are of concern in this category for New Jersey are:

- Arsenic compounds
- Benzene
- 1,3-Butadiene
- Carbon tetrachloride
- Chloroform
- Methyl chloride

Secondary formation, or atmospheric transformation, refers to chemicals that have been transformed in the air from an air pollutant into another chemical, which may have a different level of toxicity. Four air toxics of concern in this category are the primary toxics acetaldehyde, formaldehyde, and acrolein and the decay of 1,3-butadiene to acrolein.

Radon

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

The Reading Prong, which stretches from Pennsylvania to southern New York State, is particularly uranium rich. The New Jersey section of the Reading Prong is known as the New Jersey Highlands and encompasses much of Morris County. Because of this uranium rich belt, Morris County is considered a high risk county for radon presence. Municipalities in the County rank as either Tier 1 (high radon potential) or Tier 2 (moderate radon potential). According to the NJDEP Bureau of Environmental Radiation, East Hanover is a Tier 2 municipality for radon risk.

For more information on radon, visit *http://www.nj.gov/dep/rpp/radon/index.htm* and for a full list of municipal radon ratings, visit *http://www.njradon.org/ctytiera.htm#14*

Measuring Air Quality - the Air Quality Index

To provide a common rating standard for air quality against each of the six NAAQs standards, the EPA established the Air Quality Index (AQI), a score from 0 to 500 that compares the measured concentration of a given criteria pollutant against its primary standard, with a score of 100 indicating that the pollutant was measured at the value of the standard. Values of 0-50 indicate Good air quality, 51-100 are Moderate. Values up to 150 indicate air quality of concern for sensitive groups (people with existing respiratory/cardiac conditions, children, older adults), while values above 150 are unhealthy for all persons within the area of measurement. NJDEP prepares daily forecasts of AQI readings for each of 9 reporting regions that cover the state. Morris County is included in AQI Region 3 ("Suburban"), along with Somerset and Middlesex Counties. The highest rating for any pollutant at each of the monitoring sites within a region is used to assign a rating to the region as a whole. Actual pollutant measurements are converted in real-time to provide current AQI ratings as well.

In 2011, New Jersey reported 166 days of Good air quality, 153 Moderate days, 44 Unhealthy for Sensitive Groups, and only 2 Unhealthy days. The highest recorded AQI was 170 at the Clarksboro (Gloucester County) station, with ground-level ozone as the principal pollutant. For Region 3 (Morris, Somerset, Middlesex), there were 305 Good days, 48 Moderate days, and 12 Unhealthy for Sensitive Group days. The highest recorded AQI for the region was 143, observed twice at the Rutgers station, both times with ozone the principal pollutant.

Noise and Odors

Noise

The NJDEP, authorized by the Noise Control Act of 1971, N.J.A.C. 7:29, oversees noise control and abatement in New Jersey. The Office of Local Environmental Management (OLEM) works with County Health Departments and municipalities to monitor noise complaints and compliance. The NJDEP does not have a Noise Control Program, but the Noise Information website provides a list of contacts depending on the type of noise: aircraft, highway, commercial or industrial, or residential noise and nuisances. (*NJDEP http://www.state.nj.us/dep/enforcement/contact-noise.html*).

While noise can be a factor in many areas of New Jersey, it does not appear to be a major issue for Morris County or East Hanover Township. Only one noise investigation was reported in Morris County for 2008. The NJDEP encourages municipalities to follow the Model Noise Ordinance available on the NJDEP website and maintains a list of municipal ordinances submitted to the NJDEP for review and approval.

Odors

According to the NJDEP, "odor is an air contaminant and therefore may be considered air pollution if it is present in a way that unreasonably interferes with the enjoyment of life or property." Guidelines for odor control are set forth in The Air Pollution Control Act: N.J.S.A. 26:2C-1 et seq. and N.J.A.C. 7:27-1.1 et seq.

Odor complaints can be reported to the Northeast regional field office at 973 656-4444 or the DEP 24 hour toll-free environmental hotline at 877-927-6337.

Meteorology and Pollution

Meteorology plays an important role in the distribution of pollution throughout the troposphere, the layer of the atmosphere closest to the earth's surface. Atmospheric processes such as wind speed and wind direction affect the transport and dispersion of air pollution. Weather phenomena, such as precipitation and solar radiation, influence chemical reactions and transformations in the atmosphere that affect air pollutants. By studying meteorological and air pollution data together, scientists and mathematicians have developed reasonably accurate models for predicting the fate of pollutants as they go through the stages of transport, dispersion, transformation and removal. The Elizabeth Lab meteorological station monitors wind speed and wind direction. The East Orange meteorological station monitors temperature and relative humidity. The Chester meteorological station and Newark firehouse monitor solar radiation. *(NJDEP DAQ)*

HYDROLOGY

East Hanover Township is bounded by the meeting of three rivers: the Whippany River on the west, the Passaic River on the east, and the Rockaway River on the north. Additionally, the Black Brook drains the Black Meadows, a portion of which is located in southwestern East Hanover Township. Hassock Brook and Pinch Brook flow into the Black Brook, and the Black Brook is a tributary of the Whippany River which itself flows into the Passaic River. The Whippany River has its origins in Mendham Borough and traverses through the County to its confluence with the Passaic River. The Passaic River rises in southern Mendham Township, runs south along the border with Somerset County before flowing north through the Watchung valley, and turns eastward at Montville towards the Great Notch, Little Falls and Paterson. (*A Natural Resource Management Guide for the County of Morris*) Black Brook forms the basis of Black Meadows which stretches between East Hanover and Hanover Township and Florham Park near the Morristown Airport. The municipality is located across three different watersheds (the Rockaway River, Passaic River and Whippany River) as well as five sub-watersheds. Hatfield Swamp is located within the "Hanover Neck" portion of the Township, bounded by the three rivers and located north of Interstate Route 280. Troy Meadows forms the boundary of the municipality with Parsippany-Troy Hills.

Watersheds

"A watershed is a topographic area within which apparent surface water runoff drains into a specific point on a stream or to a waterbody such as a lake." *(EPA, Ecoregions and Watersheds, 1997)* The NJDEP has divided the state into Watershed Management Areas (WMAs). A watershed-based approach to natural resource management is considered by state and national agencies to be the most appropriate unit for managing complex environmental problems.

East Hanover Township falls within WMA 6, which comprises the basins of the Upper Passaic River, Rockaway River, and Whippany River. The Passaic River forms the entire eastern border with Livingston Township, Roseland Borough, West Caldwell Township, and Fairfield Township. The Rockaway River forms the northern tip of the Township and the Whippany River flows along the western section of the Township with Parsippany-Troy Hills and Hanover Townships. The riparian lands surrounding these rivers form the basis for much of the wetlands in East Hanover, making them some of the more fragile environments in the Township.

Every WMA is composed of multiple watersheds and subwatersheds. The United States Geological Survey (USGS) has mapped and identified watersheds using a hierarchal

numbering system. This system identifies watersheds using a hydrological unit code (HUC) consisting of up to 14 digits for the smallest watersheds. The HUC14 watersheds for East Hanover Township are identified on *Watershed Map (Map 4 in the Maps section)* and listed in *Table 13.* HUC 14 Watersheds in East Hanover Township.

Table 13. HUC 14 Watersheds in East Hanover Township

Watershed	Acres	Percent
Rockaway River (Passaic River to Boonton dam)	216.09	4.17%
Troy Brook (below Reynolds Avenue)	120.83	2.33%
Whippany River (Rockaway River to Malapardis Brook)	1,904.93	36.75%
Passaic River Upper (Pine Brook bridge to Rockaway)	0.19	-
Passaic River Upper (Rockaway to Hanover RR)	818.70	15.80%
Passaic River Upper (Hanover RR to Columbia Road)	844.21	16.29%
Black Brook (Hanover)	1,277.85	24.66%
Total:	**5,182.80**	**100%**

Source: NJDEP

Surface Water and Its Quality

Surface water is water that collects on the ground or in a stream, river, lake, wetland, or ocean. Major water bodies in East Hanover include the Passaic, Rockaway and Whippany Rivers.

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

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

The general classification for the other fresh waters in the State is Fresh Water 2 (FW2). Further classifying these water bodies, the presence of trout in a stream means that the waters are relatively free of chemical or biological contaminants. A stream can be classified as Trout Production (TP), Trout Maintenance (TM) or Non-Trout (NT). Trout production waters are waters designated "for use by trout for spawning or nursery purposes during their first summer." Trout maintenance waters support trout throughout the year. Waters classified as Non-Trout (NT) do not support trout, either because of their physical nature or due to biological or chemical characteristics.

For FW2 waters, Category One (C1) is the higher water protection designation given by the NJDEP. These high importance waterways are protected from measurable changes in water quality characteristics as determined by their clarity, color, scenic setting, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s). The C1 classification signifies the highest level of protection for a stream in New Jersey; among other regulations, no new development can occur within 300 feet of Category One waterways.

The quality of surface waters can be affected by point sources and non-point sources of pollution as well as from erosion and sedimentation. Point source means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged (*Clean Water Act, 1972*). This includes discharges from sewage treatment plants and factories, stormwater runoff, illegal dumping, and malfunctioning underground storage tanks and septic systems. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

As opposed to point source pollution, non-point source pollution comes from many different sources. As rainfall or snowmelt moves over and through the ground, it picks up and carries natural and human-made pollutants (such as fertilizers, herbicides and motor oil) and deposits them into surface and groundwater.

The effects of pollutants on specific waterways can vary, but are manifested in drinking water supplies, recreation, fisheries, and wildlife. One of these effects is eutrophication. Eutrophication in freshwater systems is the addition of substances, either human-made or natural, to a waterbody, affecting the primary productivity of that waterbody. Substances such as nitrates and phosphates promote excessive algae and phytoplankton growth. These “blooms” can have negative effects on the ecosystem. These negative impacts include a clouding of the water, which limits sunlight, stopping the growth of plants deeper in the water. Additionally, eutrophication can lead to anoxia, a condition where a waterbody has depleted levels of oxygen, which is the result of the decomposition of dead phytoplankton.

Water quality can also be negatively impacted by sedimentation. Sedimentation is the transportation and deposition of eroded materials. Development near streams and on steep slopes reduces vegetation cover in these areas. This ground cover can typically absorb the impact of raindrops, and when it is removed, the soil becomes more susceptible to erosion. The eroded soil is then transported and deposited by runoff into surface waters, where it can contaminate water and increase its turbidity, effectively blocking sunlight to plant species and negatively affecting the ecosystem.

The density of land uses in East Hanover and surrounding municipalities has affected the surface water quality of those water bodies located within the Township. There are no Category One waters located within East Hanover Township. All waterways in East Hanover Township are categorized as Non-Trout (FW2-NT) waters.

Groundwater Recharge Areas

Groundwater is the primary drinking and agricultural water source for the residents of New Jersey, and is a major source of drinking water for residents of East Hanover Township. Groundwater recharge is the process in which surface water, from lakes, streams, or rainwater runoff, flows or seeps downwards beneath ground surface, saturating soil or rock. Groundwater is contained in porous rocks and sediments. Where such water-holding rocks or unconsolidated materials yield a usable quantity of water, it is called an aquifer, the source from which drinking water is drawn through wells. Protecting the land's capacity to recharge its aquifers, and limiting development to stay within the capacity of local water resources, is critical to maintaining our underground water supply.

Aquifer-recharge potential is calculated through the combination of a standardized statewide aquifer ranking system and the particular groundwater recharge coverage in the area of interest. Aquifer recharge or recharge to water-bearing geologic units is defined as the groundwater that reaches the water table in the uppermost geologic unit with a thickness of 50 feet or greater. Groundwater recharge potential is ranked by average annual infiltration. The composite aquifer/groundwater recharge potential rank highlights the multiple relationships between the groundwater-recharge area ranks (indicative of the infiltration rate) and the underlying water-table aquifer ranks (indicative of the aquifer's capacity to absorb, transmit and supply water) and provides a guide to how well the system in any given area allows groundwater to reach and recharge the aquifer. *Table 14* depicts the ranking system.

Table 14. Statewide Aquifer and Morris County Groundwater Rankings

Aquifer Rank	*Median Well Yield (Gallons/Minute)*	*Groundwater Rank*	*Avg. Annual Infiltration (In/Yr)*
A	>500	A	20-23
B	>250-500	B	15-19
C	>100-250	C	10-14
D	25-100	D	1-9
E	<25	0	0

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

Source: NJDEP NJGS

The *Aquifer Recharge Potential Map* (*Map 5 in the Maps section*) shows the distribution of rankings for East Hanover Township. This map shows the potential for an aquifer to recharge in a given area, ranked by well yields in gallons per minute (gpm), combined with capacity for groundwater recharge, which is ranked by average annual infiltration in inches per year. The combined ranking provides a guide to how well the system in any given area allows groundwater to reach and recharge the aquifer. The areas with the highest recharge potential are those with the lowest ranking number; thus, a ranking of 12 indicates a higher rate of potential recharge than a ranking of 98.

The highest statewide aquifer ranks are “A” (more than 500 gpm), and in Morris County, the areas of greatest groundwater recharge have a ranking of “A” (20-23 inches per year). 3% of the Township ranks at level A/B (20-23 in/yr and 250-500 gpm), where the first letter is the groundwater recharge rate and the second letter is the aquifer rank. Another 22% of the Township ranks at A/C (20-23 in/yr and 100-250 gpm) which is the highest ranking achieved in the Township, covering 22% of the community. Aquifer recharge rankings are shown in *Table 15*.

Table 15. Aquifer/Groundwater Recharge Rankings in East Hanover Township

Rank	Number	Acres	Percent
A/B	12	180.87	3%
A/C	13	1,116.03	22%
A/D	14	227.89	4%
A/E	15	14.43	0%
D/B	42	62.46	1%
D/C	43	341.22	7%
D/D	44	172.72	3%
D/E	45	22.64	0%
E/B	52	46.27	1%
E/C	53	505.06	10%
E/D	54	250.51	5%
E/E	55	33.43	1%
L/L	97	544.16	11%
W/W	98	1,663.61	32%
	Total:	**5,181.30**	100%

Source: NJDEP

Aquifer Identification

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

Aquifers are typically equated to the type of geologic formation in which they exist. Aquifers in New Jersey are classified as either bedrock or surficial. Bedrock aquifers consist of rock formations while surficial aquifers are formed from unconsolidated materials such as sand or gravel or glacial sediment.

East Hanover Township is serviced by both bedrock and surficial aquifers. The Township’s bedrock aquifer is made up of the Brunswick Aquifer (4,554 acres) and Basalt aquifer (629 acres). The surficial aquifers in the Township are made up of Lake

Bottom Sediment (2,394 acres), Sand and Gravel (1,712 acres), Till (834 acres), and some unidentified material (242 acres). Bedrock and surficial aquifers in East Hanover Township are shown on the *Bedrock and Surficial Aquifers Map (Map 6 in the Maps section)* and detailed in *Tables Table* 16 *and Table* 17.

Table 16. Surficial Aquifers in East Hanover Township

Name	*Rank*	*Acres*	*Percent*
Lake Bottom Sediment	E	2,394.23	46.2%
Sand and Gravel	B	1,712.46	33.0%
Till	D	833.72	16.1%
Unidentified	-	242.39	4.7%
	Total:	**5,182.80**	**100.0%**

Source: NJDEP

Table 17. Bedrock Aquifers in East Hanover Township

Name	**Rank**	**Acres**	**Percent**
Brunswick Aquifer	C	4,554.24	87.9%
Basalt	D	628.57	12.1%
	Total:	**5,182.80**	**100.0%**

Source: NJDEP

Public Water Supply and Wellhead Protection

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

Well Head Protection Areas (WPAs) are delineated for both public community and non-community wells. The delineations for these wells are the two, five, and twelve-year tiers. Each tier represents the horizontal extent of groundwater captured by a well pumping at a specific rate over those periods of time (NJDEP).

There are four public community wells in East Hanover Township, which are all owned by the East Hanover Water Department. The WPA for these wells is shown on the *Public Wellhead Protection Map* (*Map 7 in the Maps section*). This map also illustrates the wellheads which are located close to the border of East Hanover Township, as well as the protection zones for those wellheads, indicating the sensitivity of neighboring water supplies to activity within the Township.

Riparian Zones

In order to better protect the public from the hazards of flooding, preserve the quality of surface waters, and protect wildlife and vegetation, the NJDEP has adopted Flood Hazard Area Control Act rules (N.J.A.C. 7:13) in order to incorporate more stringent standards for development in flood hazard areas and riparian zones. A riparian zone is land and vegetation within and adjacent to surface waters.

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

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

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

SOILS

Soils Overview

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

Soil Classifications

The official Soil Survey for Morris County was updated in 2008 by the Natural Resources Conservation Service (NRCS), an agency of the United Sates Department of Agriculture (USDA). The soils maps and tables in this *Environmental Resource Inventory Update* are based on the data from that official survey.

The NRCS Soil Survey plots soils by map units. The Soil Survey names each map unit based on the characteristics of the dominant soils within that unit. These *map unit names* identify the soils by both their *soil series* classification(s), and by characteristics that differentiate them from other soil groupings in the same series.

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

- Capital letters at the end of the abbreviation indicate the slope phase, with "A" being less steep and "E" being steeper.
- The small letters "a," "b" or "c" following these capital letters indicate the degree of stoniness: stony, very stony, and extremely stony, respectively.
- The small letter "t" at the end of an abbreviation indicates "frequently flooded."

  The Soil Survey also categorizes each map unit as one of four *map unit types*: Consociations, complexes, associations and undifferentiated groups.

Consociations (Cn) are named for the *dominant soil*. In a consociation, delineated areas use a single name from the dominant component in the map unit. Dissimilar components are minor in extent.

Complexes (Cx) and ***associations (An)*** consist of two or more *dissimilar* components that occur in a regularly repeating pattern. The total amount of other dissimilar components is minor in extent. The major components of an association can be separated at the scale of mapping, while the major components of a complex cannot. Complexes often make up one of the major components of an association.

The *Soils Types Map* (*Map 8 in the Maps section*) depicts the distribution of soils within East Hanover by *map unit name*; these soils are briefly described in the *Soils* table below. *Table 18* identifies the major soil series table and provides descriptions to give further information about these soils.

Table 18. Soils of East Hanover Township

Abbrv.	***Map Unit (MU) Name***	***MU Type***	***Acres***	***%***
AdrAt	Adrian muck, 0 to 3 percent slopes, frequently flooded	Cn	160.82	3.11%
BhdAt	Biddeford silt loam, 0 to 2 percent slopes, frequently flooded	Cn	413.51	7.99%
BohB	Boonton moderately well drained gravelly loam, 3 to 8 percent slopes	Cn	174.93	3.38%
BohC	Boonton moderately well drained gravelly loam, 8 to 15 percent slopes	Cn	216.56	4.18%
CarAt	Carlisle muck, 0 to 2 percent slopes, frequently flooded	Cn	444.56	8.59%
FmhAt	Fluvaquents, loamy, 0 to 3 percent slopes, frequently flooded	Cn	19.73	0.38%
HanB	Haledon silt loam, 3 to 8 percent slopes	Cn	1,147.10	22.16%
HanC	Haledon silt loam, 8 to 15 percent slopes	Cn	116.60	2.25%
PbpAt	Parsippany silt loam, 0 to 3 percent slopes, frequently flooded	Cn	252.96	4.89%
PbphAt	Parsippany silt loam, sandy loam substratum, 0 to 3 percent slopes, frequently flooded	Cn	694.68	13.42%
PohA	Pompton sandy loam, 0 to 3 percent slopes	Cn	11.40	0.22%
PohB	Pompton sandy loam, 3 to 8 percent slopes	Cn	76.99	1.49%
PrkAt	Preakness sandy loam, 0 to 3 percent slopes, frequently flooded	Cn	5.43	0.10%
RksB	Riverhead gravelly sandy loam, 3 to 8 percent slopes	Cn	185.61	3.59%
RksC	Riverhead gravelly sandy loam, 8 to 15 percent slopes	Cn	176.62	3.41%
UdrB	Udorthents, refuse substratum, 0 to 8 percent slopes	Cn	50.74	0.98%
UR	Urban land	Cn	60.74	1.17%
USRHVB	Urban land-Riverhead complex, 3 to 8 percent slopes	Cx	242.73	4.69%
USROCC	Urban land-Rockaway complex, 3 to 15 percent slopes	Cx	277.38	5.36%
USWHHB	Urban land-Whippany, occasionally flooded complex, 0 to 8 percent slopes	Cx	97.38	1.88%
WATER	Water	Cn	28.13	0.54%
WhpA	Whippany silt loam, 0 to 3 percent slopes	Cn	12.59	0.24%
WhpB	Whippany silt loam, 3 to 8 percent slopes	Cn	125.45	2.42%

Table 18. Soils of East Hanover Township				
Abbrv.	***Map Unit (MU) Name***	***MU Type***	***Acres***	***%***
WhphA	Whippany silt loam, sandy loam substratum, 0 to 3 percent slopes	Cn	8.51	0.16%
WhphB	Whippany silt loam, sandy loam substratum, 3 to 8 percent slopes	Cn	98.58	1.90%
WkkAt	Willette muck, 0 to 2 percent slopes, frequently flooded	Cn	75.85	1.47%
	Total:		**5,175.57**	100.00%
Source: NRCS Soil Survey 2008				

The soil series of East Hanover cover a range of types, including hydric soils that are representative of wetland complexes. As a part of the glacial-era Lake Passaic, much of the soil of the Township derives from sediments laid down as an ancient lakebed. Only a comparatively small fraction is classified as Urban (meaning it shows greater disturbance from human activities than from natural processes). The following are descriptions of the major soil series in East Hanover Township, abstracted from the *NRCS Soil Survey*:

Haledon - The Haledon series consists of very deep, somewhat poorly drained soils in low positions on upland plateaus and at the base of slopes. They form in glacial tills. Surface runoff is medium to very high, and permeability is moderate/moderately rapid above the fragipan (packed layer). This soil series is often used for landscaping purposes and hosts housing developments. Haledon soils cover 2.4.4% of East Hanover.

Parsippany - The Parsippany series consists of deep, poorly drained soils in extinct lake basins and near streams. These soils form in silty and clayey sediments containing a high proportion of fine particles derived from weathered basalt (lava), shale, and granite. Frequent flooding occurs in areas of Parsippany soils, particularly when adjacent to major streams. The water table is at or near the surface throughout the winter and early spring and following periods of heavy rainfall. A small portion of Parsippany soils are agricultural; most are woodland. Parsippany soils represent 18.3% of the surface of East Hanover.

Urban land - Urban land is soil that has been re-worked to such an extent that more than 50% of the original soil has been disturbed. Urban soils generally occur in areas that have already been developed and are not suitable for other purposes. East Hanover has 13.1% of its soils classified as Urban.

Carlisle - The Carlisle series consists of very deep, very poorly drained soils formed in woody and herbaceous organic materials in depressions within lake plains, outwash plains, ground moraines, flood plains, and moraines. Potential for surface runoff is low or negligible, and permeability is moderately slow to moderately rapid. When drained, these soils are highly productive for agricultural uses. Carlisle soils make up 8.6% of the total area of East Hanover.

Biddeford - The Biddeford series consists of very deep, very poorly drained soils formed in glacial lake or stream deposits on lowlands and river valleys. The soils are moderately permeable near the surface, slow or very slow below, which results in intermittent

ponding or very slow runoff. Most Biddeford soils are idle brushlands or woodlands. 8.0% of the soils in East Hanover are Biddeford soils.

Boonton - The Boonton series consists of deep to very deep, moderately well to well drained soils formed in till on uplands. They form loose surfaces to moderate depths above the fragipan (packed layer). Runoff varies from slow to rapid, depending on slope. Most Boonton soils are in areas that have become highly urbanized. Boonton soils cover 7.6% of East Hanover.

Riverhead - The Riverhead series consists of very deep, well-drained soils formed in glacial outwash deposits, primarily of granite. Runoff potential is low to medium, and permeability is moderately rapid at or near the surface, very rapid underneath. Most Riverhead soils have been cleared and are used for agriculture or are in suburban developments. Riverhead soils are 7.0% of the landscape of East Hanover.

Whippany - The Whippany series consists of very deep, somewhat poorly drained soils formed in silty and clayey sediments derived principally from shale, basalt, and granite, on elevated terraces or on gently sloping areas within a larger topographic basin. Runoff is negligible to very high, depending on slope. Permeability is slow. When cleared, Whippany areas are typically used for pasture and hayfields, though higher value crops can be grown if the drainage is improved. Whippany soils represent 4.7% of the lands within East Hanover.

Adrian - The Adrian series consists of very deep, very poorly drained soils formed in herbaceous organic materials over sandy deposits on outwash plains, lake plains, lake terraces, flood plains, moraines, and till plains. Potential for runoff is negligible, and permeability is moderate in the organic layer, rapid in the sandy deposit. When saturated, these soils flood, typically for long periods between October and June. Adrian soils are generally in native vegetation, typically marsh grasses and shrubs. Adrian soils cover 3.1% of the area of East Hanover.

Pompton - The Pompton series consists of very deep, moderately well-drained to somewhat poorly drained soils formed in water-sorted sediments. They are typically found in outwash plains and terraces in waterways. Permeability is moderately rapid at or near the surface, rapid or very rapid beneath. The water table is often within 12 inches of the surface in late winter and early spring and following periods of extended rainfall. Pompton soils are woodland or fields if left undisturbed, but they are often used for residential or industrial development sites. Pompton soils compose 1.7% of the land surface of East Hanover.

Willette - The Willette series consists of very deep, very poorly drained soils formed in organic materials overlying clay deposits. Typically, they form in depressions on lake plains, ground moraines, and end moraines. They are in former lakes or ponds that range in size from a few acres to several hundred acres. Vernal pools are frequently formed in Willette soils, which are infrequently drained for agricultural purposes. Willette soils are found in 1.5% of the total area of East Hanover.

Udorthents (refuse substratum) - Udorthents are a family of soil series that feature extremely shallow depth (often referred to as "skeletal" soils) with a high moisture content. They lack any layer development and are often the result of removal processes, either natural (erosion) or human (mining, excavating). They are generally classified by the layer beneath. "Refuse substratum" refers to areas used for refuse disposal or landfills. 1.0% of the surface area of East Hanover is classified as Udorthents.

Fluvaquents - Fluvaquents are a family of soil series that feature poorly to very poorly drained soils formed in human-transported materials or on excavated landscapes, deposited on riverbanks, tidal mudflats, or other areas of waterborne soil transport. Repeated deposition of material limits development on fluvaquent soils. Only 0.4% of East Hanover is designated as Fluvaquents.

Preakness - The Preakness series consists of very deep, poorly to very poorly drained soils on outwash plains and terraces, generally found in low positions and swales. Runoff is negligible or low, and permeability is moderate or moderately rapid at or near the surface, rapid or very rapid underneath. The water table is at or near the surface from late autumn to spring, and the areas are often ponded in winter and during periods of high rainfall. Preakness soils flood frequently for brief periods in late winter and early spring; they flood more extensively following severe storms in late summer and early autumn. When drained, Preakness soils were farmed earlier but now are used for housing developments. Preakness soils make up only 0.1% of the East Hanover landscape.

Complete soil series descriptions can be found on the NRCS site at: *http://soils.usda.gov/technical/classification/osd/index.html*.

Soil Characteristics

Soils can be identified by their suitability for agricultural use (prime farmland, farmland of statewide importance, and farmland of unique importance). The *NRCS Soil Survey* does not deem any soils in East Hanover Township suitable for agricultural use. Soils can also be categorized by their susceptibility to erosion, the natural process by which wind, moving water, ice and gravitational forces cause soil and particulate materials to be displaced. There are no soils categorized as highly erodible or potentially erodible in East Hanover Township.

Hydric Soils

According to the NRCS, "A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part." *(NRCS, Hydric Soils - Introduction).* Hydric soils are an important element of wetland areas and naturally support wetland vegetation. If a soil is classified as "hydric," Federal/State Wetlands Law may restrict land use due to the relationship of hydric soils to wetlands and wetland preservation.

The *NRCS Soil Survey* for Morris County reveals within East Hanover, hydric soils are represented by the Adrian, Biddeford, Carlisle, Fluvaquents, Parsippany, Preakness and Willette series. These series cover 2,067.5 acres, or 39.9% of the total area within the Township.

WETLANDS

Wetlands are important natural resources that contribute significantly to an area's social, economic, and environmental health. Among the services they provide are filtration of chemicals, pollutants, and sediments from water; flood control; critical habitat for wildlife; recreation and tourism. The NJDEP defines a freshwater wetland as "an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation; provided, however, that the Department, in designating a wetland, shall use the three-parameter approach (that is, hydrology, soils and vegetation) enumerated in the 1989 Federal Manual." (*N.J.A.C. 7:7A)* NJDEP has adopted this manual as the technical basis for identifying and delineating wetlands.

The NJDEP regulates virtually all activities in a wetland, including removing vegetation, filling, and placing obstructions. Depending on the environmental value of a particular wetland, there may also be a transition area, or buffer, around the wetland that will require a waiver issued by the NJDEP for any activity within that zone. For example, a wetland containing endangered species habitat would require a 150-foot wide transition area, whereas a small wetland in a ditch might not require any transition area at all. Most freshwater wetlands require a 50-foot transition area.

Wetlands in New Jersey are classified into three different values; exceptional resource value, ordinary resource value, or intermediate resource value. The criteria for these classifications are described below.

Exceptional Resource Value Wetland

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

Ordinary Resource Value Wetland

- A freshwater wetland which does not exhibit any of the characteristics of a Exceptional Resource Value Wetland which is:
- An isolated wetland, as defined at *N.J.A.C. 7:7A-1.4*, which:
- Is smaller than 5,000 square feet; and

- Has the uses listed below covering more than 50% of the area within 50 feet of the wetland boundary. In calculating the area covered by a use, the Department will only consider a use that was legally existing in that location prior to July 1, 1988, or was permitted under this chapter since that date:

    - Lawns
    - Maintained landscaping
    - Impervious surfaces
    - Active railroad rights-of-way
    - Graveled or stoned parking/storage areas and roads
    - A drainage ditch
    - A swale or
    - A detention facility created by humans in an area that was upland at the time the facility was created regardless of the wetland resource classification of the wetland under these rules, or the classification of the body of water, as FW-1 or FW-2 trout production, to which it discharges.

Intermediate Resource Value Wetland

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

According to the NJDEP 2007 Land Use/Land Cover data, there are 1,445 acres of wetlands within East Hanover, occupying 28% of the Township. The *Wetlands Map (Map 9 in the Maps section)* shows the locations of wetlands in the Township. *Table 19* presents a summary of wetlands by type. The dominant type of wetland in East Hanover is deciduous wooded wetlands, composing 59% of the Township's wetlands. Though this information is based on NJDEP mapped wetlands, the presence of unmapped wetlands in East Hanover, which are still subject to NJDEP regulation, is not excluded. These unmapped wetlands would require a professional delineation before a regulated activity could occur in or around them.

Table 19. Wetlands in East Hanover Township

Type	*Acres*	*Percent*
Deciduous Wooded Wetlands	852.45	59.0%
Herbaceous Wetlands	432.00	29.9%
Deciduous Scrub/Shrub Wetlands	69.35	4.8%
Wetlands Rights-of Way	41.79	2.9%
Phragmites Dominate Interior Wetlands	20.60	1.4%
Disturbed Wetlands (Modified)	14.45	1.0%
Managed Wetlands in Maintained Lawn Greenspace	11.96	0.8%
Cemetery on Wetland	1.98	0.1%
Total:	**1,444.59**	**100.0%**

Source: NJDEP 2007 Land Use/Land Cover

VEGETATION

Since 1986, the NJDEP has mapped land use within the state through their Land Use/Land Cover (LU/LC) data sets. Areas are delineated using color infrared images. The latest update of this data occurred in 2007. The NJDEP also maps critical habitat for imperiled and priority species through the Landscape Project, which is a pro-active, ecosystem-level approach to the long-term protection of these habitats, and rare plant species and ecological communities through the Natural Heritage Database.

Land Cover

The NJDEP identifies six LU/LC categories: agriculture, barren land, forest, urban, water, and wetlands. The Urban cover type represents 62% of East Hanover's land cover, representing the residential and commercial sections of the Township. Agricultural and barren lands are virtually nonexistent. Wetlands account for 28%, and forest covers 6%. Water, including the Whippany and Passaic Rivers, is about 2% of the land cover. Together, wetlands and rivers provide riparian corridors providing a different type of habitat for wildlife species.

Table 20 shows the percentage of East Hanover covered by each land cover type and the *Land Use/Land Cover Map* shows their distribution throughout the Township. *(Map 10 in the Maps Section)*

Table 20. Land Cover Type in East Hanover Township

Type	*Acres*	*Percent*
Agriculture	1.94	0.0%
Barren Land	31.02	0.6%
Forest	398.51	7.7%
Urban	3,209.63	61.9%
Water	97.12	1.9%
Wetlands	1,444.59	27.9%
Total:	**5,182.80**	**100.0%**

Source: NJDEP 2007 Land Use/Land Cover

Forest Types

According to the 2007 LU/LC data, 399 acres, or 8% of East Hanover Township, is classified as forested, with 69% classified as deciduous forest with greater than 50% crown closure. The second most prevalent category is deciduous forest with 10-50% crown closure, followed by old field at 7.1%, brush/shrubland (7.0%), and plantation (0.4%). See *Table 21* for the complete breakdown.

Table 21. Forest Types in East Hanover Township

Type	*Acres*	*Percent*
Deciduous Forest (>50% Crown Closure)	275.63	69.2%
Deciduous Forest (10-50% Crown Closure)	65.40	16.4%
Old Field (< 25% Brush Covered)	28.18	7.1%
Deciduous Brush/Shrubland	17.64	4.4%
Mixed Deciduous /Coniferous Brush/Shrubland	10.17	2.6%
Plantation	1.49	0.4%
Total:	**398.51**	**100.0%**

Source: NJDEP 2007 Land Use/Land Cover

The following definitions set the classification parameters:

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

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

Deciduous, 10-50% Crown Closure
This category contains deciduous forest stands that have crown closure greater than 10%, but less than 50%.

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

Deciduous Brush/Shrubland
(>25% Brush Covered with Deciduous Species Predominant > 75%)
This category contains natural forested areas with deciduous species less than 20 feet in height. An area must have greater than 25% brush cover to be placed in this category.

This category also contains inactive agricultural areas that have been grown over with brush.

There are photographic signature differences between brushland and the pole or saw-timber stage trees (Categories 4100, 4200, 4300). Besides the obvious height difference visible on stereo viewing, larger trees display much larger crown diameters than brushland areas.

Mixed Deciduous/Coniferous Brush/Shrubland
(>25% Brush Covered with Mixture of Deciduous Coniferous Species <75% of 1 Type)
This category contains natural forested areas less than 20 feet in height with a mixture of coniferous and deciduous trees.

Old Field (<25% Brush Covered)
This category includes open areas that have less than 25% brush cover. The predominant cover types are grasses, herbaceous species, tree seedlings and/or saplings. Old fields are distinguished from inactive farmland (2130) by the amount of brush cover. If a field contains few woody stems (<5%), it should be placed in the inactive farmland category. An area should be placed in the Old Field category if the amount of brush cover requires extensive brush removal before plowing. In some cases, it may not be established that the previous use was agricultural.

Plantation – This category contains conifer stands that have been artificially planted. These include stands planted for timber harvesting or aesthetics. Crown closure estimates and they appear as uniform blocks (usually rectangular) of conifers.

Vegetation

The State of New Jersey is home to a wide range of different ecosystems, some large and dominating, others less pronounced and more vulnerable to development. The NJDEP indentifies and maps areas which are considered unique ecosystems; these are known as the Natural Heritage Priority Sites (NHP). At this time, East Hanover Township has been identified as containing no Natural Heritage Priority sites.

WILDLIFE

Critical Habitat

Areas of East Hanover Township may provide habitat that is suitable for threatened or endangered species. The Landscape Project (*Version 3.1 2012*) ranks patches of habitat using a numeric system (0 through 5), for the purpose of identifying habitat which may be suitable for threatened and endangered species. Habitat identified as Ranks 3 through 5 are considered environmentally significant by the NJDEP. The following is a description of each rank.

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

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

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

Rank 2 is assigned to species-specific patches containing one or more occurrences of species considered to be species of special concern (this rank represents "rare species" of wildlife as defined in the *Highlands Water Protection and Planning Act* rules).

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

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

According to the *NJDEP Landscape Project* East Hanover contains habitat patches of all ranks. The majority of endangered species habitat is Rank 4 (76%), or patches where a state listed endangered species has been observed. These patches are found along the northwestern border along the Whippany River, and throughout the northern tip of the Township. Another 13% of the ranked patches have been identified as Rank 5, or federal endangered species habitat, which is located in the southern tip of the Township. There are also patches of Ranks 3, 2, and 1 interspersed along the edges of the Rank 4 areas, representing 11% of the ranked patches in East Hanover Township. Those patches which are given a Rank 0 make up the remaining land in East Hanover (3,709 acres), and are

concentrated in the center and southeastern sections of the Township. Patches identified as representing suitable habitat for threatened and endangered species in East Hanover Township are located in the remnants of glacial Lake Passaic – Troy Meadows, Hatfield Swamp, and Black Meadows.

Table 22 presents a summary of habitat patches within East Hanover Township and the *Endangered Species Habitat Map (Map 11 in the Maps section)* illustrates their distribution within the Township.

Table 22. Critical Species Habitat in East Hanover Township

Rank	*Acres*	*Percent*
5	199.69	13.5%
4	1,118.60	75.9%
3	24.65	1.7%
2	4.56	0.3%
1	126.63	8.6%
Total:	**1,474.13**	**100.0%**

Source: NJDEP Landscape Project (Version 3.1 2012)

Threatened and Endangered Species

East Hanover Township is home to a wide array of wildlife including endangered and threatened species listed on both state and federal registers. The Indiana Bat, a federally listed endangered species, occupies East Hanover's forests for its maternal season, using them as a safe enclave in which birth and begin raising their young.(April through September).

There are four state listed endangered species that inhabit East Hanover, those being the Red-shouldered Hawk, Bobcat, Northern Harrier, Blue Spotted Salamander, and the Bald Eagle. East Hanover is also home to three state threatened species: the Wood Turtle, Barred Owl, and Savannah Sparrow. East Hanover also serves as the home to two r species, considered by the NJDEP as species of special concern. A full list of all species listed by the NJDEP Landscape Project can be found in *Table 23*.

Table 23. Threatened and Endangered Species in East Hanover					
Common Name	*Scientific Name*	*Class*	*NJ Landscape Project Rank*	*Federal Status*	*NJ Status*
Cooper's Hawk	Accipiter cooperii	Birds	2	NA	Special Concern
Great Blue Heron	Ardea herodias	Birds	2	NA	Special Concern
Barred Owl	Strix varia	Birds	3	NA	State Threatened
Savannah Sparrow	Passerculus sandwichensis	Birds	3	NA	State Threatened
Wood Turtle	Glyptemys insculpta	Reptile	3	NA	State Threatened
Bald Eagle	Haliaeetus leucocephalus	Birds	4	NA	State Endangered
Blue-spotted Salamander	Ambystoma laterale	Amphibian	4	NA	State Endangered
Bobcat	Lynx rufus	Mammals	4	NA	State Endangered
Northern Harrier	Circus cyaneus	Birds	4	NA	State Endangered
Red-shouldered Hawk	Buteo lineatus	Birds	4	NA	State Endangered
Indiana Bat	Myotis sodalis	Mammals	5	Federally Listed Endangered	State Endangered
Source: NJDEP Landscape Project (Version 3.1 2012)					

LAND USE

East Hanover Township is a residential community with much of its land, approximately 30%, assessed as residential or commercial use. The State of New Jersey owns 224 acres in the municipality located within Troy Meadows, Hatfield Swamp and along the Passaic River. Morris County operates Pinch Brook Golf Course (38 acres) in the Township and East Hanover Township has preserved 307 acres as parks and open space. The Land Conservancy of New Jersey and East Hanover Township co-own 160 acres known as the Hatfield Swamp Wildlife Preserve. Permanently preserved land totals 748 acres in East Hanover Township, or 14% of the municipality.

Wildlife Preserves, Inc. owns 203 acres within the Troy Meadows Natural Area in East Hanover Township which adjoins 1,300 acres it owns in Parsippany-Troy Hills Township. While these lands are enrolled in the NJDEP Green Acres tax abatement program, they are not permanently restricted, nor have any type of deed restriction place on them to prevent potential future development.

Public property totals 9% of the municipality, which includes any publicly held properties not designated as open space or preserved lands. Vacant (undeveloped) land makes up another 8% of the land in East Hanover. *Table 24* presents a summary of land use in East Hanover. (Note: Other land uses represent 36% of total land use in East Hanover Township and are not included in the summary table below). Preserved land in East Hanover Township is shown on the *Open Space Map (Map 12 in the Maps section).*

Table 24. Summary of Land Use in East Hanover Township

Type	*Acres*	*Percent*
Preserved Land	748	14%
Wildlife Preserves, Inc.	203	4%
Public Land	453	9%
Vacant	407	8%
Residential (>0.5 acres)	522	10%
Commercial & Industrial (>0.5 acres)	1,010	19%

Source: East Hanover Township Open Space and Recreation Plan Update (2010)

HISTORIC AND CULTURAL FEATURES

The landscape of East Hanover Township is shaped by the natural resources that helped establish thriving agricultural settlement in the area at the beginning of the 18th century. The rivers and wetlands that surround the Township provide some of the best soils and grounds for a pair of early European colonies, Hanover Neck in the north and Hanover Village in the south, that contain the bulk of the historic sites extant within East Hanover. Predominantly English Presbyterians from Long Island and Connecticut, the early European immigrants to East Hanover arrived starting in 1710. Though named for the British royal house (itself descended from the German state of Hannover), the settlements of Hanover Neck and Hanover Village were staunchly pro-independence during the Revolutionary period, encouraged by Pastor Jacob Green of the First Presbyterian Church, the first New Jersey figure of note to publicly endorse separation from Britain.

As other parts of eastern Morris County developed industrially and commercially, the Township remained much more agricultural, even as major traffic arteries such as Route 10 (opened in 1910) were laid out and attracting major manufacturing and retail outlets. In recognition of its primarily farming culture, East Hanover formally separated from Hanover Township to become its own municipality in 1928. Agriculture remained the principal land use for the Township until the 1950s, when residential and industrial development accelerated, encouraged by the establishment of pharmaceutical production and the building of a Nike air defense base, both in 1954. The last working farm, Lone Pines Farms, a dairy farm located on Route 10, ceased operation in 1985. Now, the memories of East Hanover's farming past are preserved within the boundaries of the Hanover Village Historic District, which encompasses the former agricultural community and contains a variety of structures built between the 18th and early 20th centuries.

The following are some of the significant historic sites located within East Hanover Township that contribute to the character of the municipality and offer insights into its history. They are gathered from a variety of sources including the National and State Registers of Historic Places, the Morris County Heritage Commission, and the East Hanover Township Historical Society. A more complete list is appended after the discussion of individual sites.

The significant historic locations or districts within East Hanover Township that are discussed are:

- Ellis Cook ("Halfway") House
- First Presbyterian Church of Hanover
- Old Parsonage

- Restland Memorial Chapel
- Adoniram Pruden House
- Hanover Neck School

Ellis Cook House ("Halfway House")

174 Mount Pleasant Avenue

A Colonial roadside tavern built in 1751 and owned by Colonel Ellis Cook of the Morris County militia. The nickname "Halfway House" is taken from its position halfway from farms in Sussex County and the destination markets in Newark. The structure is now surrounded by the Marion Rowley Garden, named in honor of the noted horticulturist who owned and lived in the house until 1990. The house and grounds are owned by the Township and are maintained by the East Hanover Historical Society.

First Presbyterian Church of Hanover

16 Hanover Road

A combination of Greek Revival and Gothic Revival elements, the current church, built in 1835, stands on the site of the original 1755 meeting house. Established in 1718, the Presbyterian congregation of Hanover Village is the oldest religious community within Morris County. The church serves as the focal point of the Hanover Village Historic District, a point emphasized when local residents fought the State of New Jersey to prevent the original course of Route 10 from running along Mount Pleasant Avenue, directly adjacent to church property.

Old Parsonage

27 Hanover Road

The parsonage of the First Presbyterian Church, built circa 1757, once housed Reverend Jacob Green, noted Revolutionary activist and chair of New Jersey's state constitutional committee. A noted anti-slavery advocate, the Rev. Green organized his congregation for abolition in spite of the opposition of powerful Morris County landowners who held slaves.

Restland Memorial Chapel

77 DeForest Avenue

Based on the chapel of one of England's oldest churches, St.Giles Church in Stoke Poges, this medieval-inspired design incorporates Saxon, Norman, and Early Gothic design elements. Built in 1938 with stone reportedly salvaged from the Nichols Mansion in Madison (destroyed in 1937), the Restland Chapel recalls the reflective quality of Thomas Grey's "Elegy Written in a Country Churchyard", said to be inspired by the poet's visit to St. Giles's graveyard.

Adoniram Pruden House

644 Ridgedale Avenue

A clapboard Colonial home, built in 1749 by Adoniram Pruden, one of the New England Presbyterian settlers of Hanover Neck, features original windows and a surviving brick oven. Due to a lack of maintenance, the house is in danger of deterioration, and the non-profit Morris County Trust for Historic Preservation has listed the structure on its 10 Most Endangered Historic Sites for 2011, along with the nearby David Douglas House (687 Ridgedale Avenue), another unprotected local landmark, and the Steppel Native American archaeological site.

Hanover Neck School

20 School Avenue

A 1911 Craftsman-style structure, it was built on the site of an early 1800s school. Built of stucco and wood, using the Craftsman aesthetic for natural materials, the school features Asian-inspired broad-flaring eaves and a double pediment gable portico. It currently serves as the headquarters building for the East Hanover Board of Education.

Identified Historic Sites

With its earliest settlement dating back to before the Revolutionary War, East Hanover's history is preserved by its early farmhouses and public structures that capture its importance during the Eighteenth and Nineteenth centuries as a farming community and stopover point on the way to bigger markets in Newark and Paterson.

Table 25. Identified Historic Sites in East Hanover Township

Common Name	*Source*	*Block/Lot*
Ellis Cook ("Halfway") House	NR	102 / 2
First Presbyterian Church of Hanover	NR	101 / 24
Hanover Village Historic District	NR	
Steppel Archaeological Site	SR	
Definis Archaeological Site	DOE	
Adoniram Pruden House	SHPO	5 / 7.01
Old Parsonage	MCHC	99 / 51
Restland Memorial Chapel	MCHC	96 / 104
Hanover Neck School	MCHC	55 / 2

NR: National Register of Historic Places
SR: State Register of Historic Places
DOE: Determination of Eligibility issued by the Keeper of the National Register
COE: Certification of Eligibility issued by New Jersey State Historic Preservation Officer
SHPO: State Historic Preservation Office Opinion provided
MCHC: Morris County Heritage Commission

PUBLIC INFRASTRUCTURE

The public infrastructure of a municipality includes services such as local and regional roads and highways, mass transit opportunities and public sewer and water supply.

The concept of natural resources as "green infrastructure" is a recent innovation in thinking about municipal planning, but it draws on the very oldest ideas in use, that of planning for infrastructure, particularly as traditional infrastructure depends on and is concerned with the delivery and handling of primary natural resources such as water. The greatest interaction with the natural environment and greatest demands on natural resources are generated through the operation of some of the principal systems that urban and suburban civilization provides: roads, sewers, water mains. To properly assess a municipality's impact on and influence from its natural setting, it is important to add in consideration of those services that a municipality is expected to provide and that place it in close cooperation with (or occasional opposition to) the ground on which it stands and the waters that sustain its life.

Transportation

East Hanover Township is bounded east and west by the waters and wetlands of the Passaic and Whippany Rivers. The early settlement of Hanover Neck was so named due to this constriction of traversable and farmable land by the marshy remains of Glacial Lake Passaic and its surviving waterways. Within their embrace, the Township's road network forms a classic grid of local, county, and State roads, tightly filling up available space as the Township transformed from agricultural to residential/commercial. At present, two major traffic arteries, Interstate Route 280 and NJ Route 10, cut across the northern and southern reaches of the Township and provide much of the non-local traffic flow. Even with these major automotive corridors, access to East Hanover is limited to seven "gateways" to the Township proper. Much effort has been expended on these traffic connection points, such as the improvements and realignments made to the entry/exit points on the Novartis campus that improved flow along and between Route 10 and Ridgedale Avenue. Maintenance work on the Eagle Rock Avenue (CR611) bridge will also temporarily disrupt another of the "gateways".

The American Association of State Highway and Transportation Officials (AASHTO) provides a functional classification system for roadways, based on the tradeoff between mobility (speed of travel) and access (ability to enter/exit). Arterial roads provide the highest level of service (traffic) at the greatest speed for uninterrupted travel, with some degree of access. Arterials may be further classified (principal/minor) by size and amount of service supported. Collector roads provide less developed levels of service at

lower speed, principally by collecting traffic from local roads and connecting them to arterial roads. Local roads consist of all non-arterial and non-collector roads, primarily providing access to local destinations, with less "through" traffic movement. Within East Hanover, the arterial and collector roads are as follows:

Table 26. Roadway Classification in East Hanover Township

Classification	*Roadway*	*Jurisdiction*
Principal Arterial (Freeway)	I-280	NJDOT
Principal Arterial	NJ Route 10	NJDOT
Minor Arterial	Eagle Rock Avenue (CR611)	Morris County
	Ridgedale Avenue (CR632)	Morris County
	Mt. Pleasant Avenue (CR610)	Morris County
	River Road	East Hanover Township
	DeForest Avenue	East Hanover Township
	Troy Road	East Hanover Township
Collector	Cedar Street	East Hanover Township

Source: East Hanover Township Master Plan, Confirmed by Township Engineer, James Giurintano (Birdsall Engineering)

As alternatives to automotive traffic, mass transit and pedestrian/bicycle routes can replace some of the demand on roadways by removing individual vehicles and consolidating commuters into mass conveyances or taking them out of the service areas of arterial roads entirely, either on foot or through bike lanes. Mass transit in East Hanover, however, is limited. Only three bus lines service the Township: NJ Transit Route #73, offering service between the Township and Newark/Penn Station - temporarily detoured due to the closure of Melanie Lane Bridge; NJ Transit Route 872, offering service to Morristown train station; and Community Coach Route #77, offering service to New York/Port Authority Bus Terminal. Rail service within the Township is limited to freight-only customers of the Morristown & Erie Railroad's Whippany branch. In consequence, only 3% of the Township's commuters use mass transit.

Pedestrian access and bikeways are also limited within East Hanover, with only a short network of walking and multi-use trails, primarily in the northern part of the Township, between Lurker Park and the NJDEP preserve at Troy Meadows on the Whippany River. The Melanie Lane Bridge upgrade project includes a new pedestrian walkway on the bridge itself, along with sidewalk installations on Melanie Lane to improve pedestrian circulation into the commercial district along Ridgedale Avenue. Within the *Morris County Master Plan*, there are proposals for a bike lane along Ridgedale Avenue from DeForest Avenue to the Florham Park border and a walking trail along the Whippany River.

Water Supply

East Hanover maintains its own water supply and distribution system, depending on three deep underground wells and one water tower with a capacity of one million gallons. Wells 1 and 2, located at the Public Utilities Department facility on Melanie Lane, are treated for removal of volatile organic compounds and manganese (a naturally occurring

substance), as well as disinfection (via chlorination) and water softening (for hardness removal). The water treatment plant for Wells 1 and 2 is currently undergoing a 4-year upgrade for routine maintenance such as replacement and cleaning of filters. Well 5, located off of Homestead Avenue, requires only disinfection and softening. A fourth well (5R), intended for emergency purposes, is also located near Well 5 and is now substituting for it as the principal well is being restored to eliminate clogging. A fifth well (Well 6) has been proposed at a site on Valley Road. This proposed well would not increase the water supply allocation but only offset losses when other wells are taken out of service for maintenance, and it awaits approval of its water allocation permit from NJ Department of Environmental Protection. A water storage tank on the old Nike base site off Hornung Court has been proposed for similar reasons of permitting maintenance on the existing water tower.

To protect its drinking water supply, East Hanover enacted wellhead protection areas in 2004 to establish zones of restricted use around its three municipal wells. The protection areas define places of groundwater travel in 2-, 5-, and 12-year periods, and within those areas the operation of certain industrial, commercial, or residential activities that involve potential groundwater pollutants is either proscribed or subject to various handling restrictions and best management practices including spill contingency plans and emergency notification procedures. *Map 7 (in the Maps section)* illustrates the wellhead protection areas within East Hanover.

During dry summer months, the municipal water supply is supplemented by purchases through an interconnection with New Jersey American (Short Hills) Water Company, which purchases continue to run as high as 3% of the total annual draw. Water restrictions for residents (lawns and gardens) and businesses were established by ordinance in 2003 and remain in effect. These restrictions have produced a noticeable (4-5%) rise in the water levels of the Township's wells since their enactment.

Wastewater

East Hanover maintains a sanitary sewer collection system, including ten pump stations. Currently, the pump stations are undergoing a 4-year upgrade project to replace and improve older pumps with new comminutors (grinding elements) to lessen blockage by solid objects. Wastewater is pumped to the Parsippany-Troy Hills Wastewater Treatment Plant, which has recently (2012) been upgraded to remove nitrates and phosphorus from the treated wastewater before discharge into the Rockaway River, for which upgrade the Township of Parsippany was awarded for Environmental Stewardship by NJ Department of Environmental Protection. A small part of the Township (portions of Mann Avenue and Florham Avenue) is treated by the Florham Park Sewage Treatment plant, and the larger industrial sites on Route 10, such as the Novartis campus are handled by the Hanover Sewerage Treatment Plant.

Stormwater Management

With its plethora of rivers and wetlands, the Township of East Hanover is concerned about the flow of stormwater (runoff) from its developed areas into the numerous

waterways and aquatic habitats that surround them. The Township adopted a *Stormwater Management Plan* in 2005 to incorporate recommended stormwater design and performance standards into all plans for new major developments (defined as projects that disturb one or more acres). The goals of the Stormwater Management Plan include reducing flood damage, maintaining groundwater recharge and the integrity of stream channels, and minimizing pollutants in runoff. The Plan seeks to accomplish its goals through a combination of structural (i.e., engineered) and non-structural design features. Structural elements include detention and retention basins and constructed stormwater wetlands. Non-structural elements include low-maintenance landscaping that retains native vegetation and natural drainage features and provides open-channel conveyances that discharge through and into stable vegetated areas. Use of fertilizers and pesticides is discouraged. Land area dedicated to non-structural stormwater management is also required to have a conservation restriction filed, dedicated to a government agency. The overall design must retain 100% of the average annual preconstruction groundwater recharge volume, as well as reduce the post-construction peak stormwater runoff rates are 50%, 75%, and 80% of the preconstruction rates for two-year, ten-year, and hundred-year storm events, respectively.

The Township maintains a separate system (MS4) of stormwater collection conduits along municipal roadways and within major public spaces. The stormwater collected is filtered for solids and floatables (solid objects, typically plastic or Styrofoam) at inlets (stormwater drains) and in catch basins within the system. A regular program of street sweeping helps to eliminate potential pollutants, including unwanted organic material and silts, before they enter the stormwater system. A recent decision to speed up purchase of a new sweeping vehicle capable of flushing and cleaning catch basins will significantly improve the reduction of solids and floatables.

Since the stormwater is discharged into the local waterways (Whippany River, Passaic River, Pinch Brook), the Township must obtain a NJ Pollutant Discharge Elimination System (NJPDES) permit from the NJ Department of Environmental Protection to ensure that the stormwater that is released meets all Federal and State standards for such outflows into waterways. To help meet the NJPDES permit standards, the Township has enacted ordinances to reduce stormwater flow by requiring drywells (where soil and water table conditions allow) for all new roof construction projects above 600 square feet and ordinances to prevent stormwater degradation by required covering of trash receptacles and dumpsters. The Township has also adopted a winter storm preparation program involving the use of salt brine pre-treatments of streets to prevent snow and ice from bonding to road surfaces and thus eliminating a course of rock salt spreading, reducing the amount used by the Township by 28-35 tons for each winter storm and reducing the discharge of salt into the waterways.

FLOOD HAZARD/FLOOD PRONE AREAS

Flood Zones in East Hanover

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

At the federal level, the Federal Emergency Management Agency (FEMA) evaluates and maps Special Flood Hazard Areas (SFHAs) and other flood zones. Communities can opt to participate in the National Flood Insurance Program (NFIP), which requires mandatory flood insurance in areas mapped as SFHAs. An SFHA is defined as "an area that would be inundated by the flood having a one percent chance of being equaled or exceeded in any given year," also known as the base flood or 100-year-flood zone. To put it another way, in SFHAs there is a 26% chance of flooding over the term of a 30-year mortgage. NFIP mapping also includes information on 500-year flood zones, which have a 0.2% chance in a given year. *(FEMA)*

The State of New Jersey, which features significant annual rainfall (45" average, state-wide) concentrated during the spring and late summer-early fall months, has numerous areas in which the risk of flooding is well recognized. East Hanover Township, tucked in between several of the State's larger rivers (Passaic, Whippany, and Rockaway) and with extensive low-lying wetlands, is one of the State's at-risk municipalities. To measure that risk, the State in cooperation with FEMA creates maps of the areas in which flooding is considered to occur on a basis frequent enough to warrant both concern for safety and for regulation of building, development, and other disturbance that would exacerbate the flooding potential of the area or of its downstream neighbors. The areas in which flooding is a significant risk and which are under regulation are known as Flood Hazard Areas.

The Township of East Hanover is a participating community in the NFIP. The FEMA Flood Insurance Rate Map (FIRM) mapping is updated every few years and is first released as preliminary mapping open to public comment. Once that version of the mapping has been adopted as the effective mapping, property owners may still request a review if they believe their property has been incorrectly mapped. Maps can be viewed or purchased online and can be downloaded as pdfs or digital data (DFIRM). For Morris County, preliminary DFIRM maps were distributed from FEMA in October 2010.

The *FEMA Flood Zones* map (*Map 13 in the Maps section*) uses the 2010 FEMA DFIRM (Preliminary Maps) data for East Hanover Township. There are 1,811 acres within Zone A/AE (the SFHA representing the 100-year flood zone) and 277 acres within Shaded Zone X (the area between the limits of the 100-year flood and the limits of the 500-year flood). Together, these flood zones represent 40% of the Township's total area. (*Table 27*)

Table 27. FEMA Flood Zones in East Hanover Township

Flood Hazard	*Acres*	*% of Total Municipal Area*
100-year Flood (1% annual chance)	1,811.22	35%
500-year Flood (0.2% annual chance)	276.84	5%
Total Flood Zones	***2,088.06***	***40%***
Total Township Acreage	5,182.80	

Source: FEMA DFIRM 2010 (Preliminary)

At the state level, New Jersey regulates flood prone areas through the New Jersey Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., and its rules, adopted November 5, 2007. The Act recognizes the importance not only of avoiding building in unsafe places but also of preserving the vegetation that "is essential for maintaining bank stability and water quality." The rules set standards for development in flood hazard areas and adjacent to surface waters "in order to mitigate the adverse impacts to flooding and the environment that can be caused by such development." *(NJDEP Division of Land Use Regulation)*

Under the New Jersey Flood Hazard Area Control Act, the State considers a Flood Hazard Area to consist of all land that lies below the height (elevation) at which the floodwaters of a 100-year storm event would crest, with an additional 25% volume of water added to account for both possible future flow increases (due to development or other factors) and as a safety margin. The Flood Hazard Area may be divided into an inner floodway (usually marked by strong water flows) and an outer flood "fringe" (lower water levels, slower and weaker flows). Structures, fill, and vegetation that are situated on land that lies below the flood hazard area design flood elevation are considered to be in or within a Flood Hazard Area. NJDEP's Bureau of Dam Safety and Flood Control creates the official State Flood Hazard Area maps. FEMA also defines and maps Special Flood Hazard Areas to cover the 100-year flood event risk locations, which maps are used to assist the Federal flood insurance program. In 2006, NJDEP and FEMA agreed to cooperate on updating the state and federal flood maps together.

The overlap of high-risk flooding and presence of waterways and wetlands is not coincidental. The central Passaic River basin in which East Hanover lies is a region of frequent, if not regular, flooding. The Passaic River drains a 932-square mile watershed, extending into Orange and Rockland Counties, New York, and the volume of water that flows down the Passaic and its many tributaries (Whippany, Rockaway, Ramapo rivers) is considerable during even normal rainfall events, especially if extended for longer durations or as part of a series of precipitation events.

As depicted, the "horseshoe" of waterways and wetlands that collar the northern end of the Township and that define the original "Hanover Neck" settlement is the site of the highest flood risk within the Township.

East Hanover and Tropical Storm Irene

Due to a combination of closely spaced severe thunderstorms and the addition of Tropical Storm Irene, August 2011 was the wettest month in New Jersey's meteorological records, with a total average rainfall of 16.6" inches, over 5" inches above any previous August and over 4.5" inches above the previous monthly rainfall record (12.0", October 2005). Although reclassified as a tropical storm (downgraded from hurricane status) when it made landfall in New Jersey, Irene forced coastal evacuations, closed or damaged roadways (such as Interstate 287), and triggered power outages that affected over one million New Jersey residents and, tragically, killed at least 12. By itself, Irene was the largest rainstorm in over a century, averaging 7" statewide. Within Morris County, the weather reporting station in Jefferson Township recorded 10.5" of precipitation, the most within the County. The Passaic, Pompton, Ramapo, and Rockaway Rivers all posted record high flood stages.

Within East Hanover, the flooding of the Passaic and Whippany Rivers during and following Irene forced the closure of multiple local and arterial roadways, as well as the evacuation of neighborhoods that lay close to these waterways. A list of the roadways affected most by Irene and the evacuation zones created is included here as *Tables Table* 28 and *Table* 29:

Table 28. East Hanover Township Roadways Closed Due to Tropical Storm Irene

Roadway	*Segment Affected*
Ridgedale Avenue	Intersection with Eagle Rock Avenue
Eagle Rock Avenue	Below Tuttle Avenue
River Road	Intersection with Cedar Street
Klinger Road	Below Stimis Lane
Troy Road	At Walter Avenue/Valley Road
Overlook Avenue	Between Ridgedale Avenue and River Road

Source: Carlo DiLizia, Township of East Hanover Health Officer

Table 29. East Hanover Township Neighborhoods Evacuated Due to Tropical Storm Irene

Principal Roadway	*Area(s) Affected*
Ridgedale Avenue	Northern end (parallel to I-280)
Phyldan Road	Below Pollis Drive
River Road	Between Eagle Rock Avenue and Birchwood Court
	Between Cedar Street and Merry Lane

Table 29. East Hanover Township Neighborhoods Evacuated Due to Tropical Storm Irene	
Principal Roadway	*Area(s) Affected*
Dixon Lane	Entire
Cedar Street	Below Fay Drive, including intersection
East Harvest Avenue	Entire
Jaclyn Drive	Above East Harvest Avenue
Stimis Lane	Entire
Klinger Avenue	Above Stimis Lane
Callahan Avenue	Entire, including intersection with Balsam Avenue
Peachtree Avenue	Approaching Callahan Avenue
Callahan Street	Northern end
Troy Road	Between Walter Avenue/Valley Road and Kahl Road
	Above Jackson Street
Melanie Lane	Near municipal border with Hanover Township
State Highway Route 10	At the Whippany River crossing
	At the Passaic River crossing
Samuel Street	Below Knollcroft Terrace
Brentwood Drive	Western end (approaching cul-de-sac)
Source: Carlo DiLizia, Township of East Hanover Health Officer	

KNOWN CONTAMINATED SITES

Soil and groundwater contamination by pollutants is tracked by the state and federal governments at varying degrees of contamination or potential contamination, including brownfields and other extensive or long-term remediation, point source facilities that require continuous monitoring (Community Right to Know) and point source occurrences that are specific and limited (Known Contaminated Sites).

Known Contaminated Sites

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

Known Contaminated Sites may include:

- Active sites with known contamination, these sites can have one or more active cases with any number of pending and closed cases,
- Pending sites with confirmed contamination which are those sites having one or more pending cases, no active cases, and any number of closed cases, and
- Closed sites with remediated contamination, which are those sites having only closed cases. Sites in this category have no active or pending cases.

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

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

There are 36 active sites and 7 pending sites with confirmed contamination in East Hanover. Currently, all contaminated sites within East Hanover are non-residential sites. The active and pending non-homeowner sites are listed in *Table 30* and *Table 31* below and mapped on the *Known Contaminated Sites (Non-Homeowner)* map (*Map 14 in the Maps section*).

Table 30. Active Sites with Confirmed Contamination in East Hanover Township

Site ID	*PI Number*	*PI Name*	*Address*
223962	292374	33 Mount Pleasant Avenue	33 Mt. Pleasant Ave
119262	157027	72 Eagle Rock Avenue	72 Eagle Rock Ave
42333	002534	AM International Varity Per Div	11 Mt. Pleasant Ave
20851	025754	Bronner Mfg & Tool Co	286 Ridgedale Ave
124115	025620	Calculagraph Co	272 Ridgedale Ave
54229	023208	Charm House Inc	389 Rt. 10
3872	014764	Chemical Components Inc - Hexagon Division	20 DeForest Ave
3859	000239	Delta Gas	532 Ridgedale Ave
66394	G000005161	Dorine Industrial Park	3 Merry Ln
16270	G000034764	Dynaloy Incorporated	7 Great Meadow Ln
49591	025462	East Hanover Airport	738 Ridgedale Ave
3864	012583	East Hanover Exxon	28 Ridgedale Ave
67242	G000011502	East Hanover Twp Regional Grd Wtr Contamination	Various locations
20066	008324	Ed Carney Ford Inc	189 Rt. 10
3866	008609	Exxon PMG 8152	6 Eagle Rock Ave
54102	022942	G&F Industrial Park	735 Littell Rd
220791	288264	Guidolume Mfg Furniture & Clock Ctr	353 Rt. 10
42086	001916	Hanover Supply Co	269 Rt. 10
51587	017284	Ingersoll Rand Equipment Sales	98 Rt. 10
448349	019910	Loews Theater Complex	145 Rt. 10
41617	019910	Municipal Building	411 Ridgedale Ave
14795	009506	Novartis Pharmaceuticals Corp	59 Rt. 10
29378	023302	Peters Construction Co	7 Melanie Ln
14780	001054	Pliva Inc	17 West St
55214	025430	PPF International	140 Rt. 10
3838	002545	Precision Rolled Products Inc	306 Columbia Tpke
437697	550154	PSE&G Electric Transmission	River Rd
437718	550178	PSE&G Electric Transmission	456 River Rd
435925	547799	PSE&G Electric Transmission Tower 84 4	River Rd
459709	580209	PSE&G Right-of-Way, Tower 83/3	600 Ridgedale Ave
15741	011835	Royal Lubricants Company Inc	215 Merry Ln
3860	014818	Sunoco 0006-9377	626 Ridgedale Ave
13604	016448	Sunoco 0006-9872	213 Rt. 10
3856	016429	Sunoco 0011-5709	264 Rt. 10
67490	G000014992	Wettstein Tool & Manufacturing Co	14 Merry Ln
3857	008608	Youseff Inc	349 Rt. 10

Source: NJDEP http://www.nj.gov/dep/srp/kcsnj/ March 27, 2013

In cases of known contamination where a high level of sensitivity exists, the Site Remediation Program's Office of Community Relations (OCR) assigns a Community Relations Coordinator to discuss concerns with the public about the remediation process

and to encourage communication between community members and NJDEP. Within East Hanover, PI Number 012583 (East Hanover Exxon) has been designated with an OCR Coordinator due to the detection of vapor intrusions from the contaminated site to a nearby educational daycare facility (Kiddie Academy of East Hanover, 33 Ridgedale Avenue).

Table 31. Pending Sites with Confirmed Contamination in East Hanover

Site ID	***PI Number***	***PI Name***	***Address***
431331	540992	181 Mount Pleasant Ave. Fuel Oil Spill	181 Mt. Pleasant Ave
67766	G000021960	East Hanover Construction Site	472 Ridgedale Ave
66431	G000005295	Foster Wheeler Energy Corporation	43 West St
66167	G000003197	Fritzsche Dodge & Olcott Incorporated	Merry Ln
21461	009995	JCP&L East Hanover	150 Ridgedale Ave
66461	G000005610	KDI Triangle Incorporated	31 Farinella Dr
67616	G000020062	Livingston Family Housing (Bldg 209)	Hornung Ct

Source: NJDEP http://www.nj.gov/dep/srp/kcsnj/ March 27, 2013

A new scoring system, called the Remedial Priority Scoring system, is being developed using computer modeling that will streamline the scoring and exclude certain minor categories. The RPS system was targeted for implementation in the fall of 2012. *(NJDEP)*

Brownfields

A brownfield is "any former or current commercial or industrial site, currently vacant or underutilized and on which there has been, or there is suspected to have been, a discharge of a contaminant." (*Brownfield and Contaminated Site Remediation Act*, N.J.S.A. 58:10B-1 et seq.) The State of New Jersey encourages municipalities and counties to redevelop their brownfields as part of Smart Growth initiatives.

The NJ Brownfield SiteMart website has 32 listings for East Hanover, 22 of which overlap the Known Contaminated Sites list.

Community Right to Know

The Community Right to Know (CRTK) program is responsible for collecting and disseminating data on hazardous substances produced, stored or used at companies in New Jersey. In 2012, The NJDEP Data Miner report on Community Right to Know for East Hanover lists 11 Right-to-Know facilities (though only 6 of them list the chemical compounds).

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Personal communication

James Giurintano, Birdsall Engineering, Township Engineer, East Hanover Township

Carlo DiLizia, Health Officer, East Hanover Township

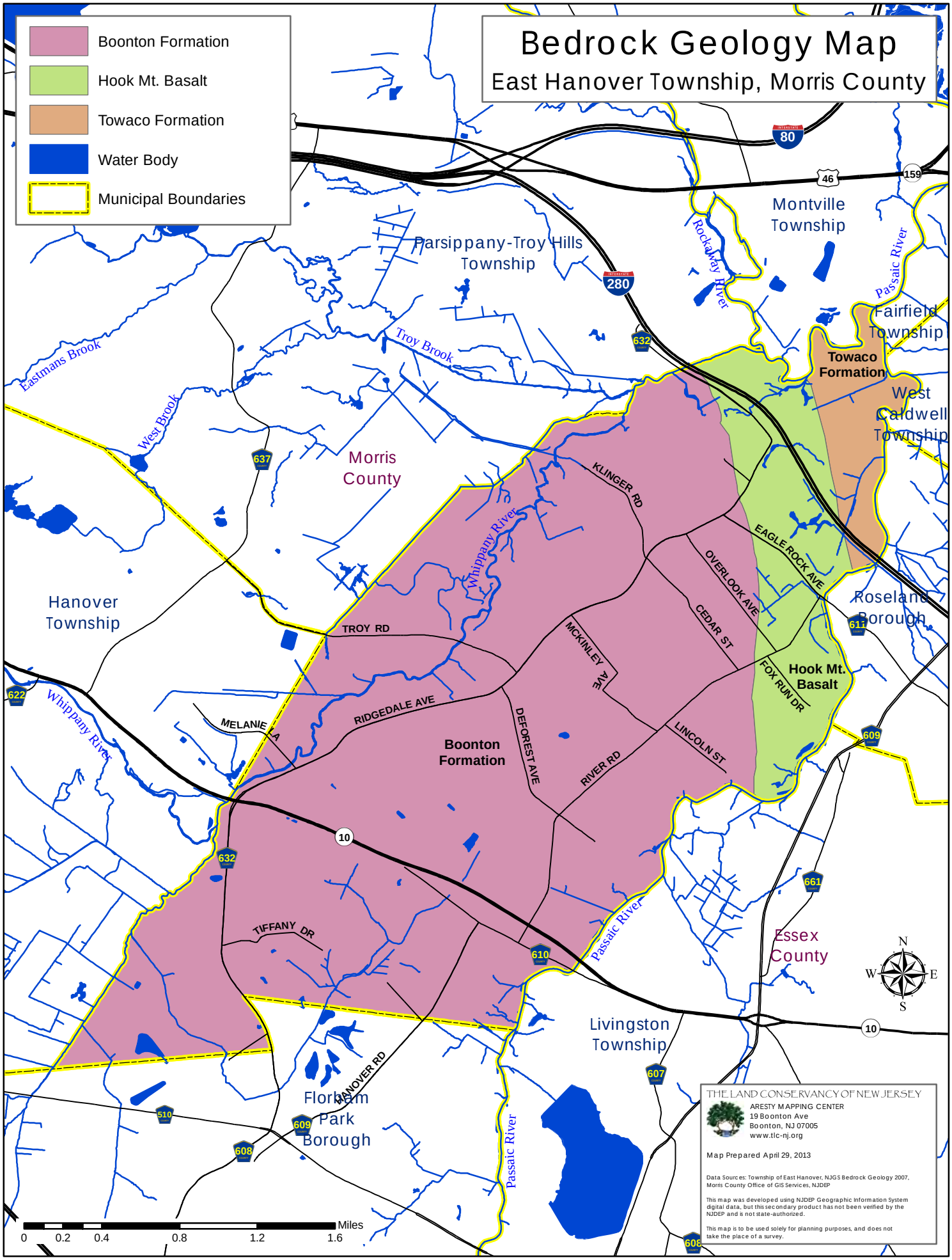
Bruce Allen, Superintendent of Public Utilities, East Hanover Township

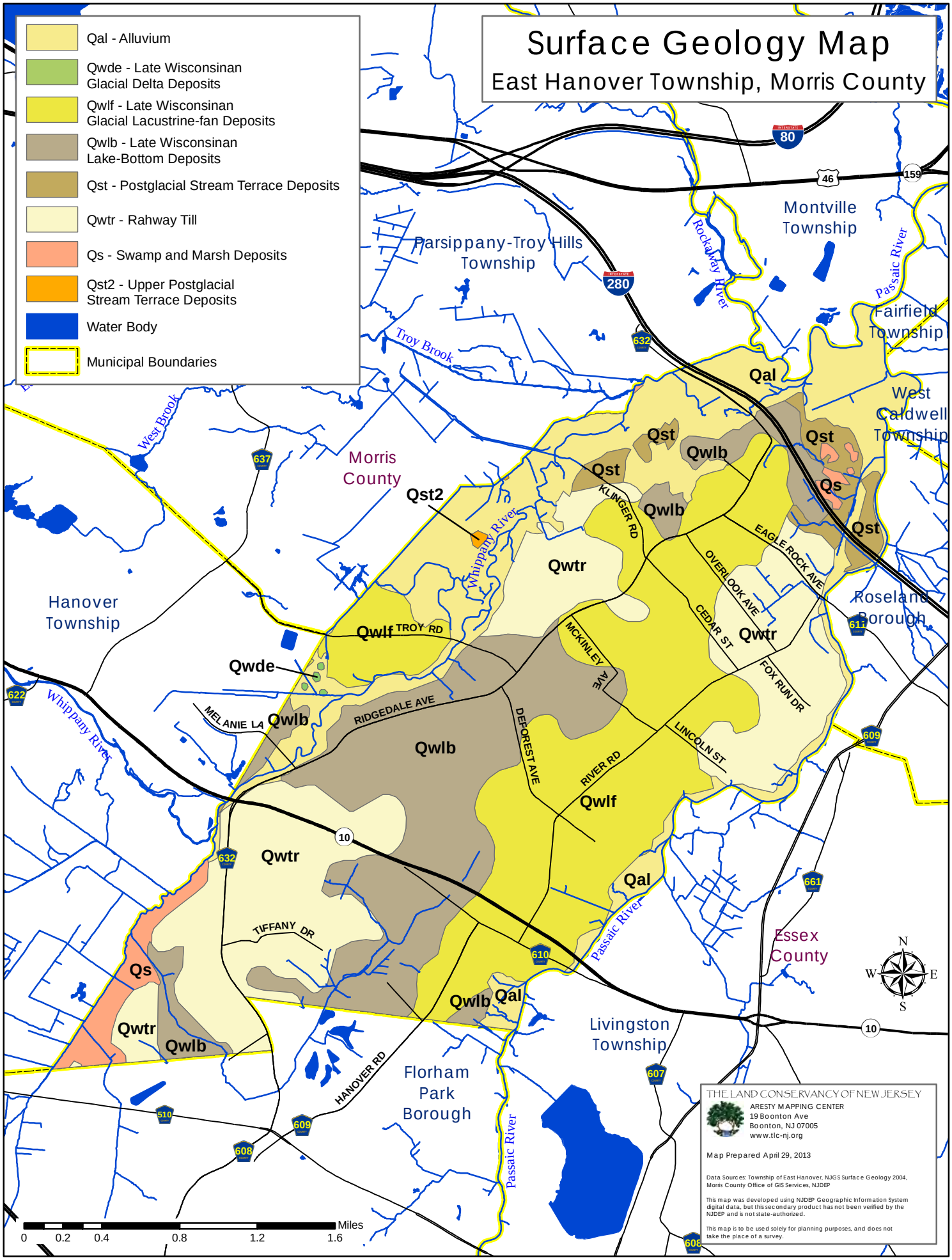
Marc Macaluso, Superintendent of Public Works, East Hanover Township

MAPS

1. **Bedrock Geology**
2. **Surface Geology**
3. **Topography**
4. **Watershed**
5. **Aquifer Recharge Potential**
6. **Bedrock and Surficial Aquifers**
7. **Public Wellhead Protection Areas**
8. **Soils Types**
9. **Wetlands**
10. **Land Use/Land Cover**
11. **Patches with Endangered Species Habitats Identified by the Landscape Project 2012**
12. **Open Space Map**
13. **FEMA Flood Zones (2010 DFIRM Preliminary)**
14. **Known Contaminated Sites (Non-Homeowner)**

Map 1. Bedrock Geology




Surface Geology Map
East Hanover Township, Morris County
Qal - Alluvium
Qwde - Late Wisconsinan Glacial Delta Deposits
Qwlf - Late Wisconsinan Glacial Lacustrine-fan Deposits
Qwlb - Late Wisconsinan Lake-Bottom Deposits
Qst - Postglacial Stream Terrace Deposits
Qwtr - Rahway Till
Qs - Swamp and Marsh Deposits
Qst2 - Upper Postglacial Stream Terrace Deposits
Water Body
Municipal Boundaries
Parsippany-Troy Hills Township
Montville Township
Fairfield Township
West Caldwell Township
Roseland Borough
Hanover Township
Morris County
Essex County
Livingston Township
Florham Park Borough
Rockaway River
Passaic River
Troy Brook
West Brook
Whippany River
KLINGER RD
EAGLE ROCK AVE
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CEDAR ST
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MCKINLEY AVE
LINCOLN ST
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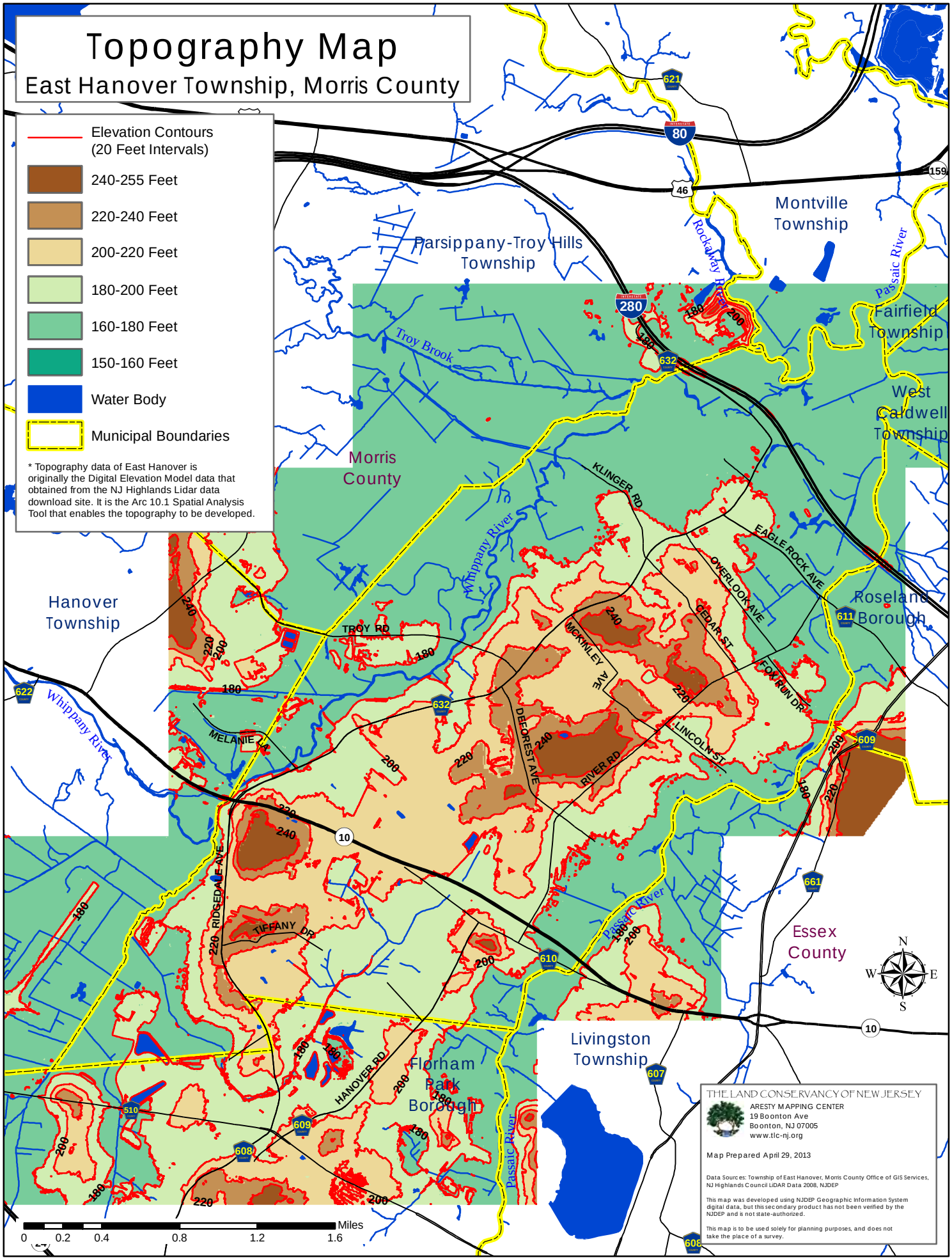
RIDGEDALE AVE
DEFOREST AVE
RIVER RD
MELANIE LA
TIFFANY DR
HANOVER RD
Miles
0 0.2 0.4 0.8 1.2 1.6
THE LAND CONSERVANCY OF NEW JERSEY
ARESTY MAPPING CENTER
19 Boonton Ave
Boonton, NJ 07005
www.tlc-nj.org
Map Prepared April 29, 2013
Data Sources: Township of East Hanover, NJGS Surface Geology 2004, Morris County Office of GIS Services, NJDEP
This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-authorized.
This map is to be used solely for planning purposes, and does not take the place of a survey.


Topography Map
East Hanover Township, Morris County
Elevation Contours
(20 Feet Intervals)
240-255 Feet
220-240 Feet
200-220 Feet
180-200 Feet
160-180 Feet
150-160 Feet
Water Body
Municipal Boundaries
* Topography data of East Hanover is originally the Digital Elevation Model data that obtained from the NJ Highlands Lidar data download site. It is the Arc 10.1 Spatial Analysis Tool that enables the topography to be developed.
Montville Township
Parsippany-Troy Hills Township
Fairfield Township
West Caldwell Township
Morris County
Hanover Township
Roseland Borough
Essex County
Livingston Township
Florham Park Borough
Rockaway River
Passaic River
Troy Brook
Whippany River
KLINGER RD
EAGLE ROCK AVE
OVERLOOK AVE
CEDAR ST
FOX RUN DR
MCKINLEY AVE
LINCOLN ST
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RIDGEDALE AVE
TIFFANY DR
HANOVER RD
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THE LAND CONSERVANCY OF NEW JERSEY
ARESTY MAPPING CENTER
19 Boonton Ave
Boonton, NJ 07005
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Map Prepared April 29, 2013
Data Sources: Township of East Hanover, Morris County Office of GIS Services, NJ Highlands Council LiDAR Data 2008, NJDEP
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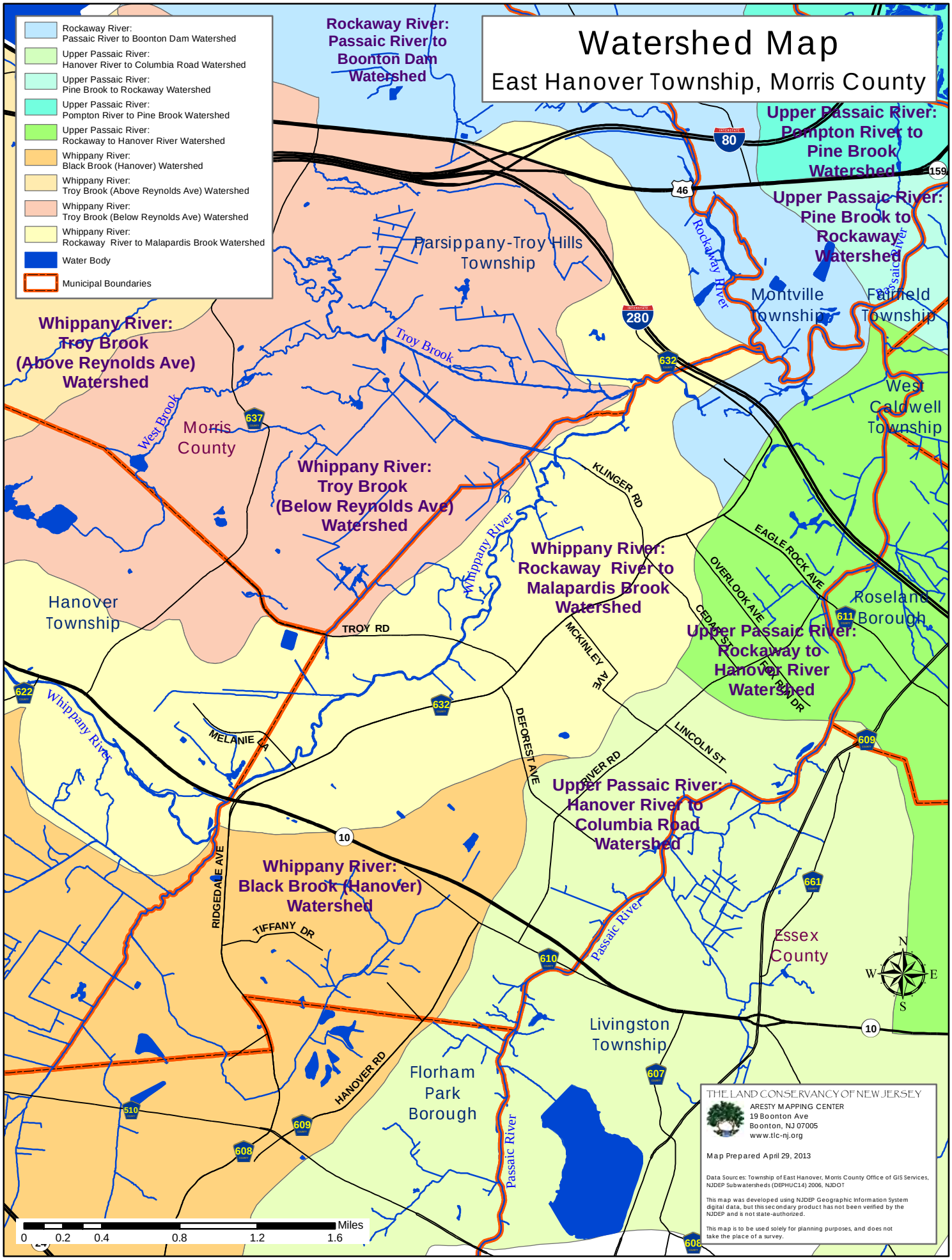
Watershed Map
East Hanover Township, Morris County
Rockaway River: Passaic River to Boonton Dam Watershed
Upper Passaic River: Pompton River to Pine Brook Watershed
Upper Passaic River: Pine Brook to Rockaway Watershed
Whippany River: Troy Brook (Above Reynolds Ave) Watershed
Whippany River: Troy Brook (Below Reynolds Ave) Watershed
Whippany River: Rockaway River to Malapardis Brook Watershed
Upper Passaic River: Rockaway to Hanover River Watershed
Upper Passaic River: Hanover River to Columbia Road Watershed
Whippany River: Black Brook (Hanover) Watershed
Rockaway River: Passaic River to Boonton Dam Watershed
Upper Passaic River: Hanover River to Columbia Road Watershed
Upper Passaic River: Pine Brook to Rockaway Watershed
Upper Passaic River: Rockaway to Hanover River Watershed
Whippany River: Black Brook (Hanover) Watershed
Whippany River: Troy Brook (Above Reynolds Ave) Watershed
Whippany River: Troy Brook (Below Reynolds Ave) Watershed
Whippany River: Rockaway River to Malapardis Brook Watershed
Water Body
Municipal Boundaries
Parsippany-Troy Hills Township
Montville Township
Fairfield Township
West Caldwell Township
Morris County
Hanover Township
Roseland Borough
Essex County
Livingston Township
Florham Park Borough
Rockaway River
Passaic River
Whippany River
Troy Brook
West Brook
KLINGER RD
EAGLE ROCK AVE
OVERLOOK AVE
CEDARSS FOR RD
MCKINLEY AVE
TROY RD
DEFOREST AVE
LINCOLN ST
RIVER RD
MELANIE LA
RIDGEDALE AVE
TIFFANY DR
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Boonton, NJ 07005
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Map Prepared April 29, 2013
Data Sources: Township of East Hanover, Morris County Office of GIS Services, NJDEP Subwatersheds (DEPHUC14) 2006, NJDOT
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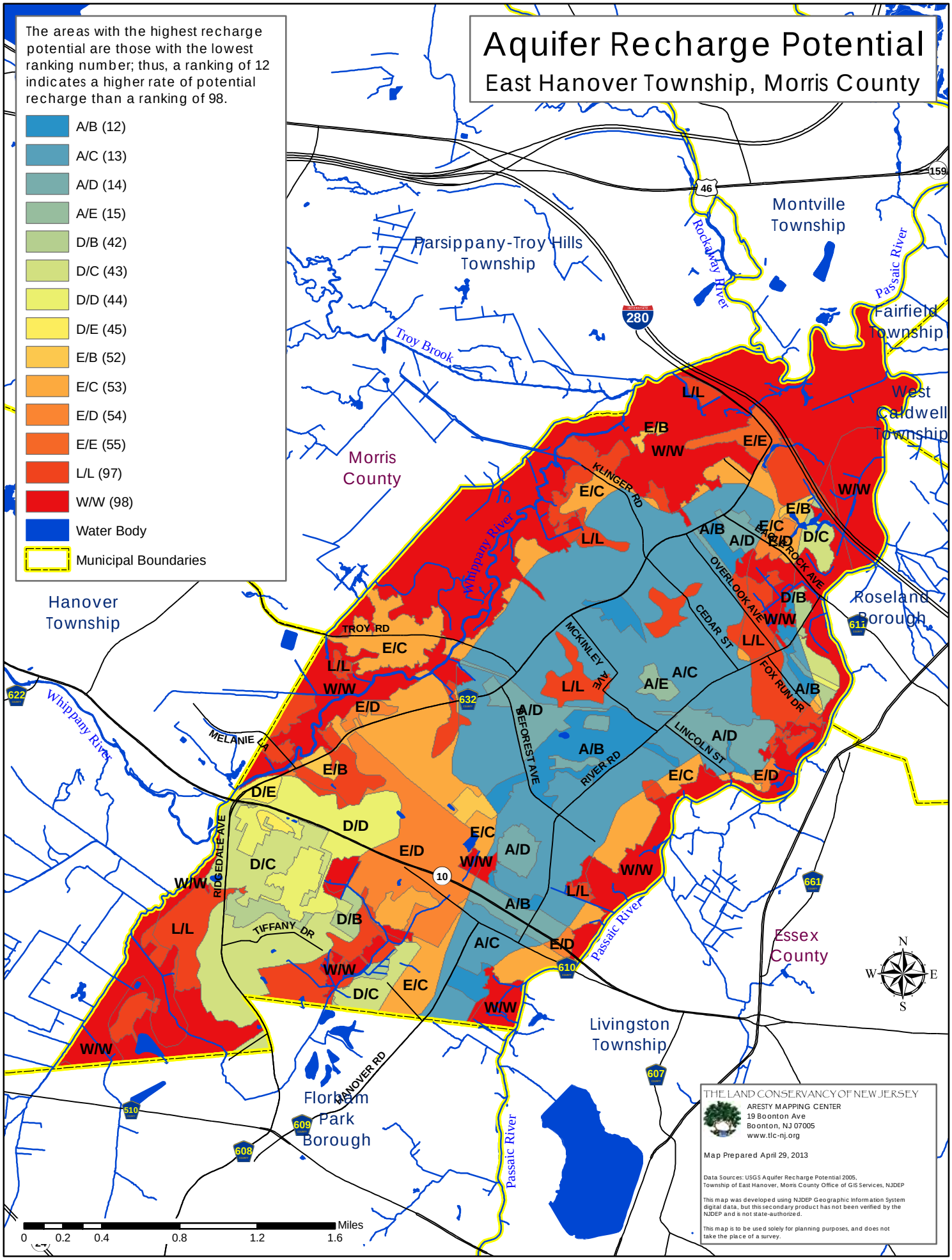
Aquifer Recharge Potential
East Hanover Township, Morris County
The areas with the highest recharge potential are those with the lowest ranking number; thus, a ranking of 12 indicates a higher rate of potential recharge than a ranking of 98.
A/B (12)
A/C (13)
A/D (14)
A/E (15)
D/B (42)
D/C (43)
D/D (44)
D/E (45)
E/B (52)
E/C (53)
E/D (54)
E/E (55)
L/L (97)
W/W (98)
Water Body
Municipal Boundaries
Parsippany-Troy Hills Township
Montville Township
Fairfield Township
West Caldwell Township
Morris County
Hanover Township
Roseland Borough
Essex County
Livingston Township
Florham Park Borough
Whippany River
Rockaway River
Passaic River
Troy Brook
KLINGER RD
TROY RD
MELANIE CT
RIDGEDALE AVE
TIFFANY DR
HANOVER RD
MCKINLEY AVE
BEFOREST AVE
RIVER RD
CEDAR ST
OVERLOOK AVE
EAGLEROCK AVE
FOX RUN DR
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Miles
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THE LAND CONSERVANCY OF NEW JERSEY
ARESTY MAPPING CENTER
19 Boonton Ave
Boonton, NJ 07005
www.tlc-nj.org
Map Prepared April 29, 2013
Data Sources: USGS Aquifer Recharge Potential 2005, Township of East Hanover, Morris County Office of GIS Services, NJDEP
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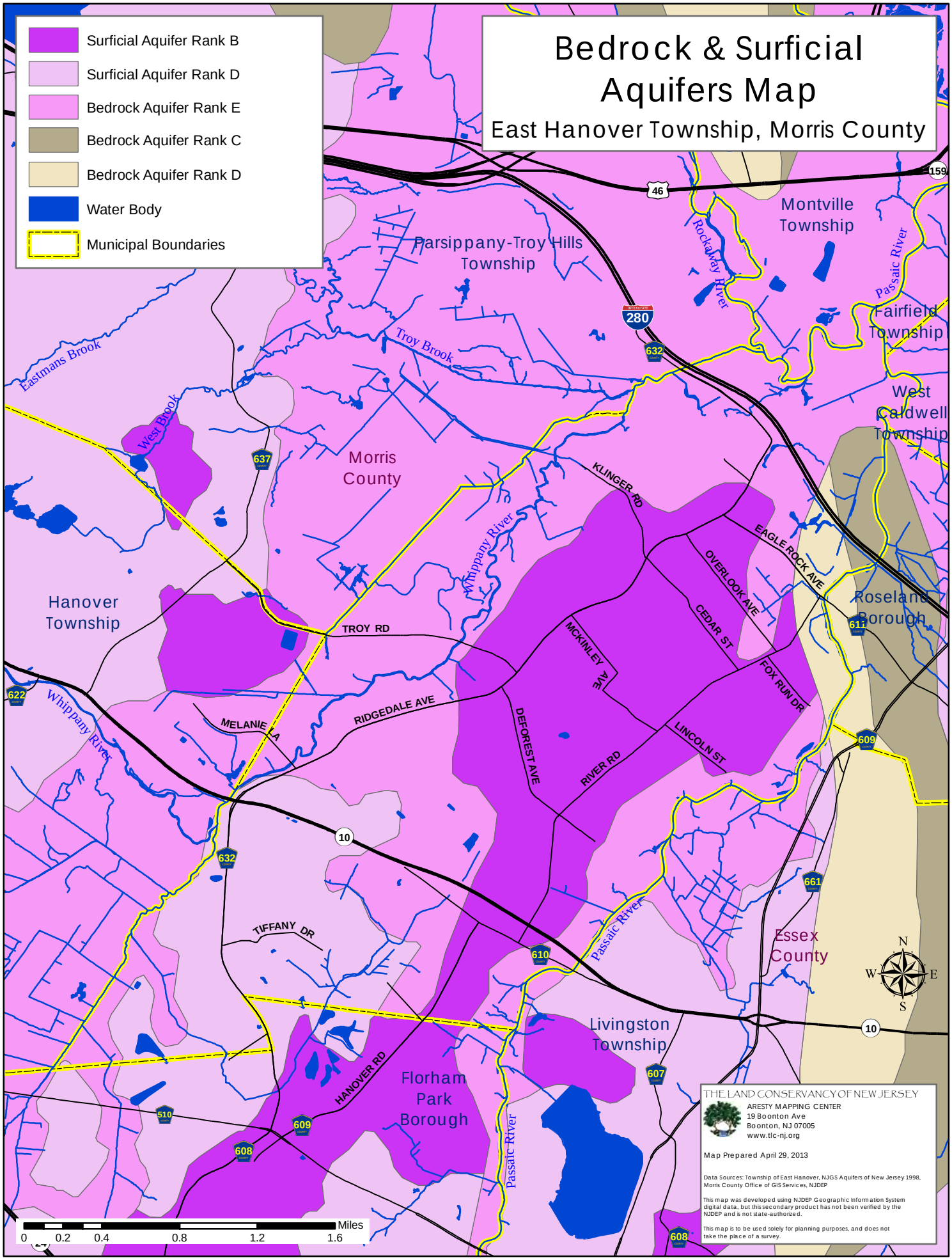
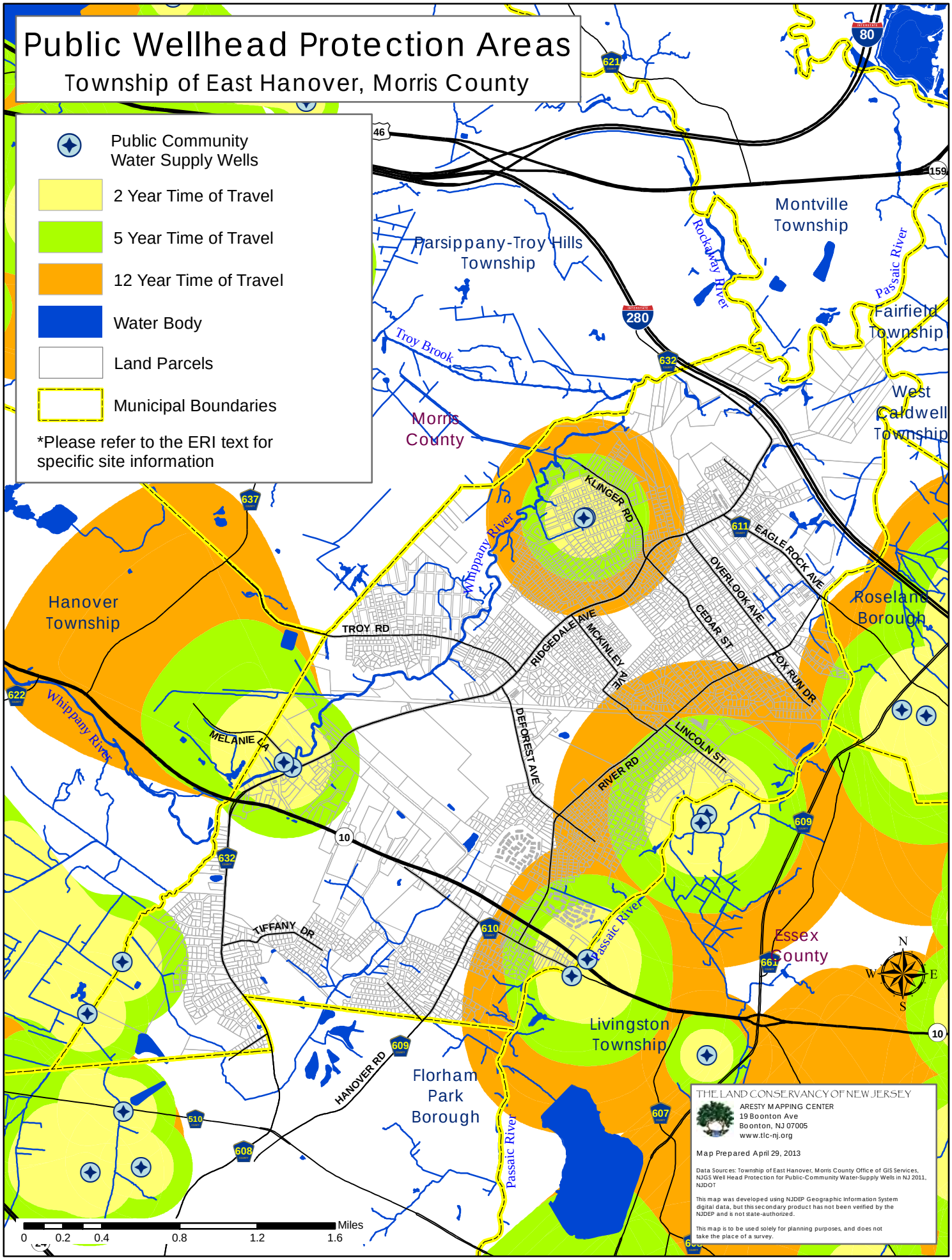
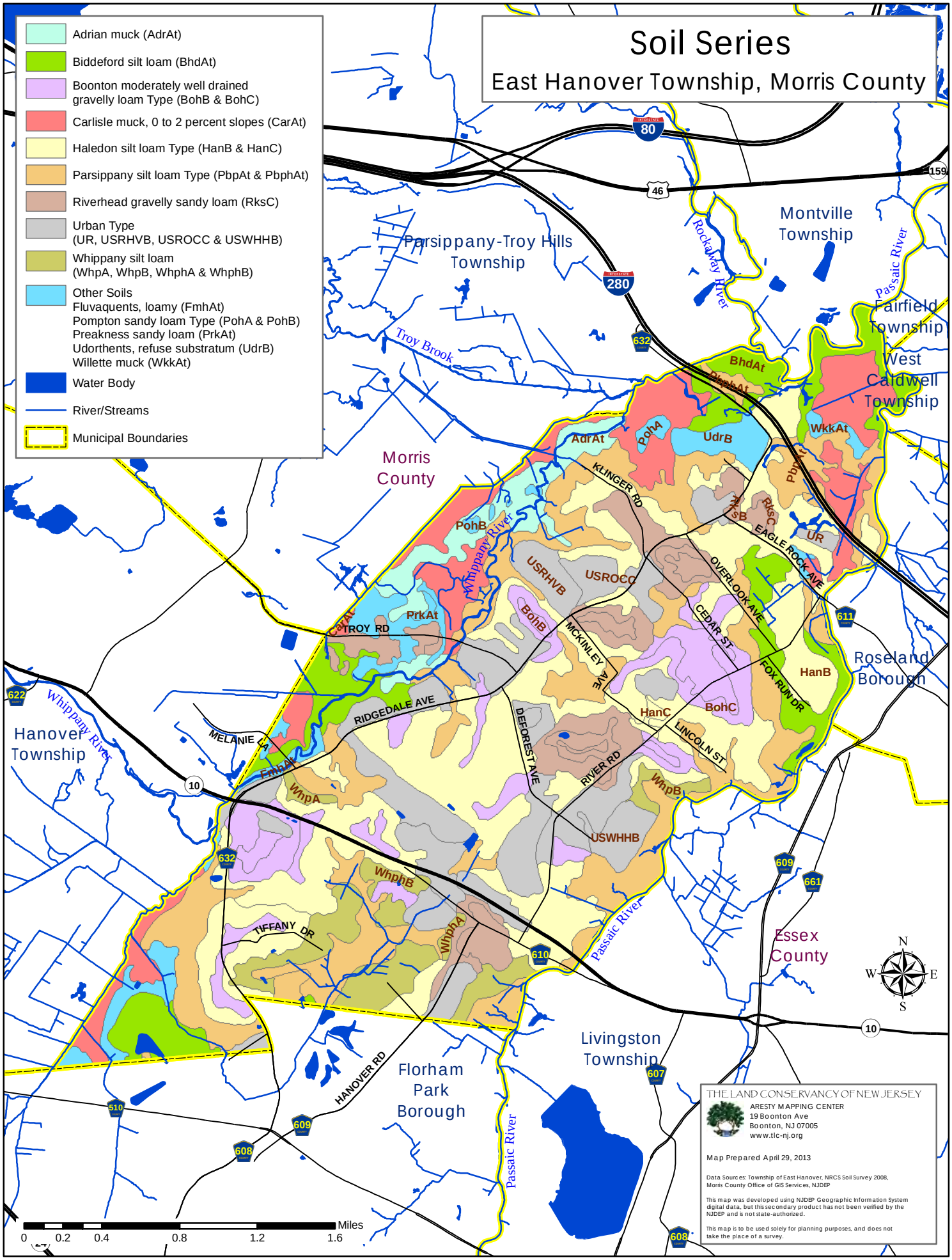
Map 6. Bedrock and Surficial Aquifers



Map 7. Public Wellhead Protection Areas




Soil Series
East Hanover Township, Morris County
Adrian muck (AdrAt)
Biddeford silt loam (BhdAt)
Boonton moderately well drained gravelly loam Type (BohB & BohC)
Carlisle muck, 0 to 2 percent slopes (CarAt)
Haledon silt loam Type (HanB & HanC)
Parsippany silt loam Type (PbpAt & PbphAt)
Riverhead gravelly sandy loam (RksC)
Urban Type (UR, USRHVB, USROCC & USWHHB)
Whippany silt loam (WhpA, WhpB, WhphA & WhphB)
Other Soils
Fluvaquents, loamy (FmhAt)
Pompton sandy loam Type (PohA & PohB)
Preakness sandy loam (PrkAt)
Udorthents, refuse substratum (UdrB)
Willette muck (WkkAt)
Water Body
River/Streams
Municipal Boundaries
Parsippany-Troy Hills Township
Montville Township
Fairfield Township
West Caldwell Township
Morris County
Roseland Borough
Hanover Township
Essex County
Florham Park Borough
Livingston Township
Rockaway River
Passaic River
Troy Brook
Whippany River
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PbphAt
AdrAt
PohA
UdrB
WkkAt
PbpAt
RksB
RksC
UR
PohB
USRHVB
USROCC
BohB
PrkAt
CarAt
FmhAt
WhpA
WhphB
WhphA
WhpB
USWHHB
HanB
HanC
BohC
KLINGER RD
EAGLE ROCK AVE
OVERLOOK AVE
CEDAR ST
FOX RUN DR
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LINCOLN ST
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DEFOREST AVE
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Miles
THE LAND CONSERVANCY OF NEW JERSEY
ARESTY MAPPING CENTER
19 Boonton Ave
Boonton, NJ 07005
www.tlc-nj.org
Map Prepared April 29, 2013
Data Sources: Township of East Hanover, NRCS Soil Survey 2008, Morris County Office of GIS Services, NJDEP
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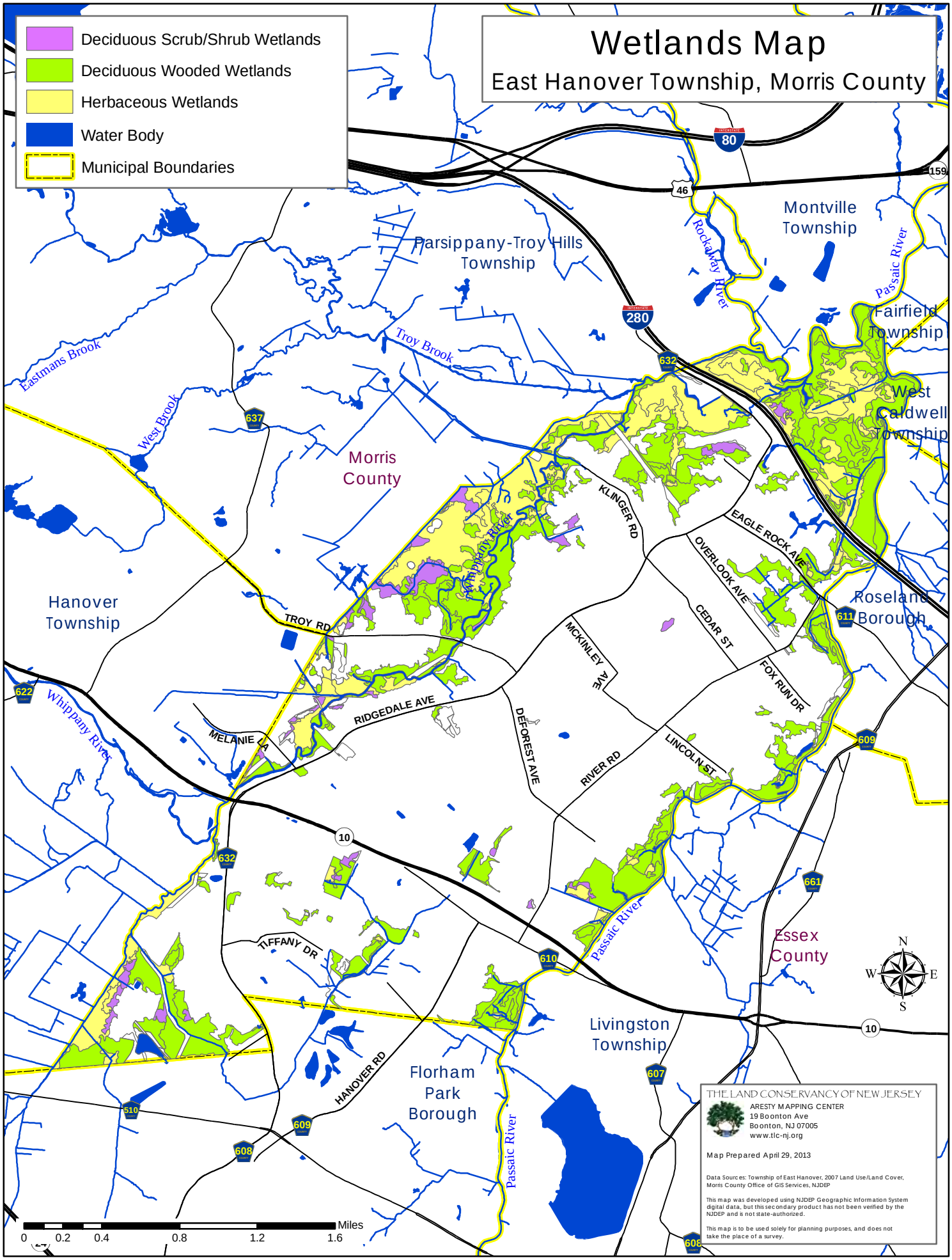
Wetlands Map
East Hanover Township, Morris County
Deciduous Scrub/Shrub Wetlands
Deciduous Wooded Wetlands
Herbaceous Wetlands
Water Body
Municipal Boundaries
Parsippany-Troy Hills Township
Montville Township
Fairfield Township
West Caldwell Township
Roseland Borough
Morris County
Hanover Township
Livingston Township
Florham Park Borough
Essex County
Eastmans Brook
West Brook
Troy Brook
Rockaway River
Passaic River
Whippany River
KLINGER RD
EAGLE ROCK AVE
OVERLOOK AVE
CEDAR ST
FOX RUN DR
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TROY RD
RIDGEDALE AVE
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Miles
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Boonton, NJ 07005
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Map Prepared April 29, 2013
Data Sources: Township of East Hanover, 2007 Land Use/Land Cover, Morris County Office of GIS Services, NJDEP
This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-authorized.
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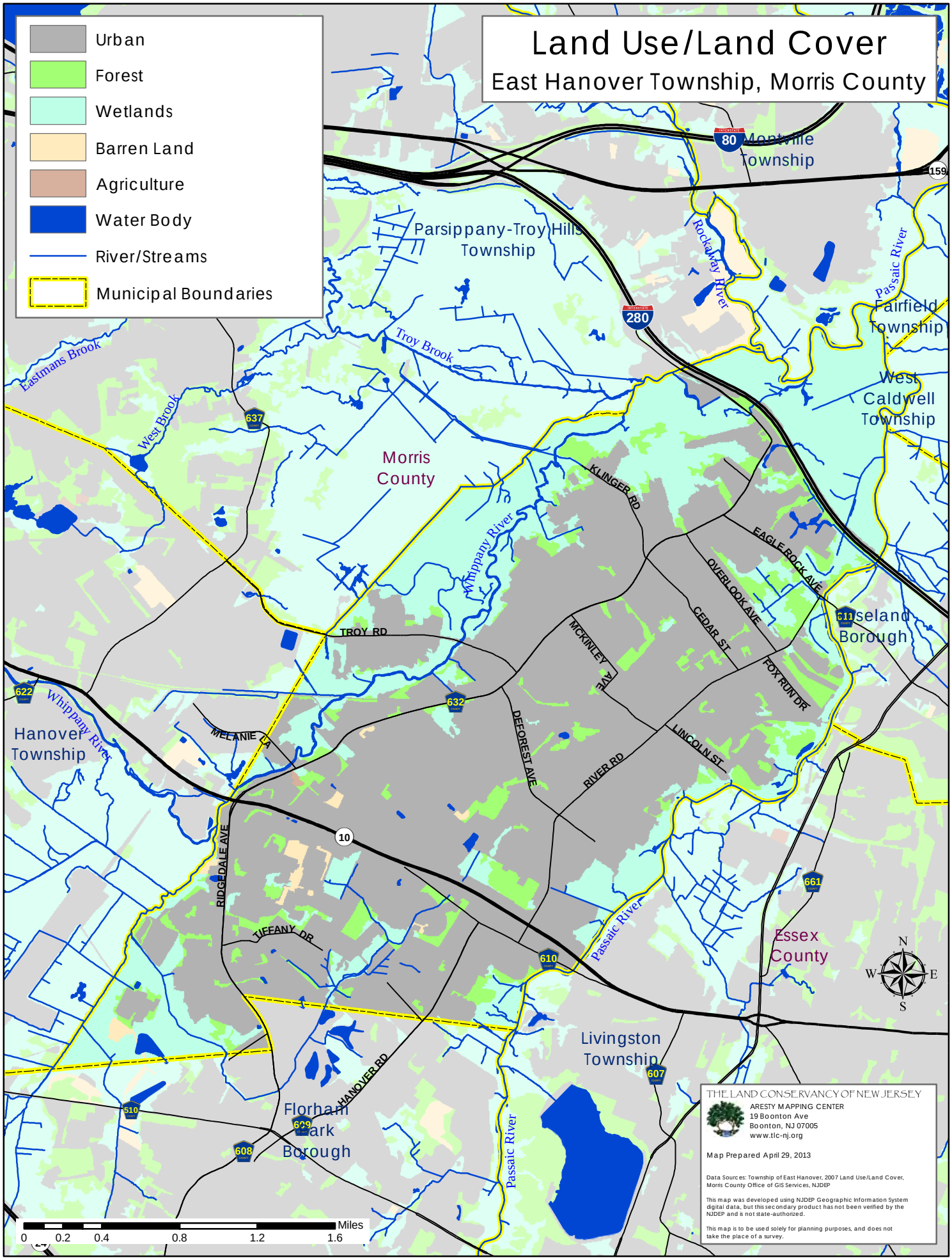
Land Use/Land Cover
East Hanover Township, Morris County
Urban
Forest
Wetlands
Barren Land
Agriculture
Water Body
River/Streams
Municipal Boundaries
Montville Township
Parsippany-Troy Hills Township
Fairfield Township
West Caldwell Township
Roseland Borough
Hanover Township
Florham Park Borough
Livingston Township
Morris County
Essex County
Rockaway River
Passaic River
Troy Brook
Eastmans Brook
West Brook
Whippany River
KLINGER RD
EAGLE ROCK AVE
OVERLOOK AVE
CEDAR ST
FOX RUN DR
MCKINLEY AVE
DEFOREST AVE
LINCOLN ST
RIVER RD
TROY RD
MELANIE LA
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THE LAND CONSERVANCY OF NEW JERSEY
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Map Prepared April 29, 2013
Data Sources: Township of East Hanover, 2007 Land Use/Land Cover, Morris County Office of GIS Services, NJDEP
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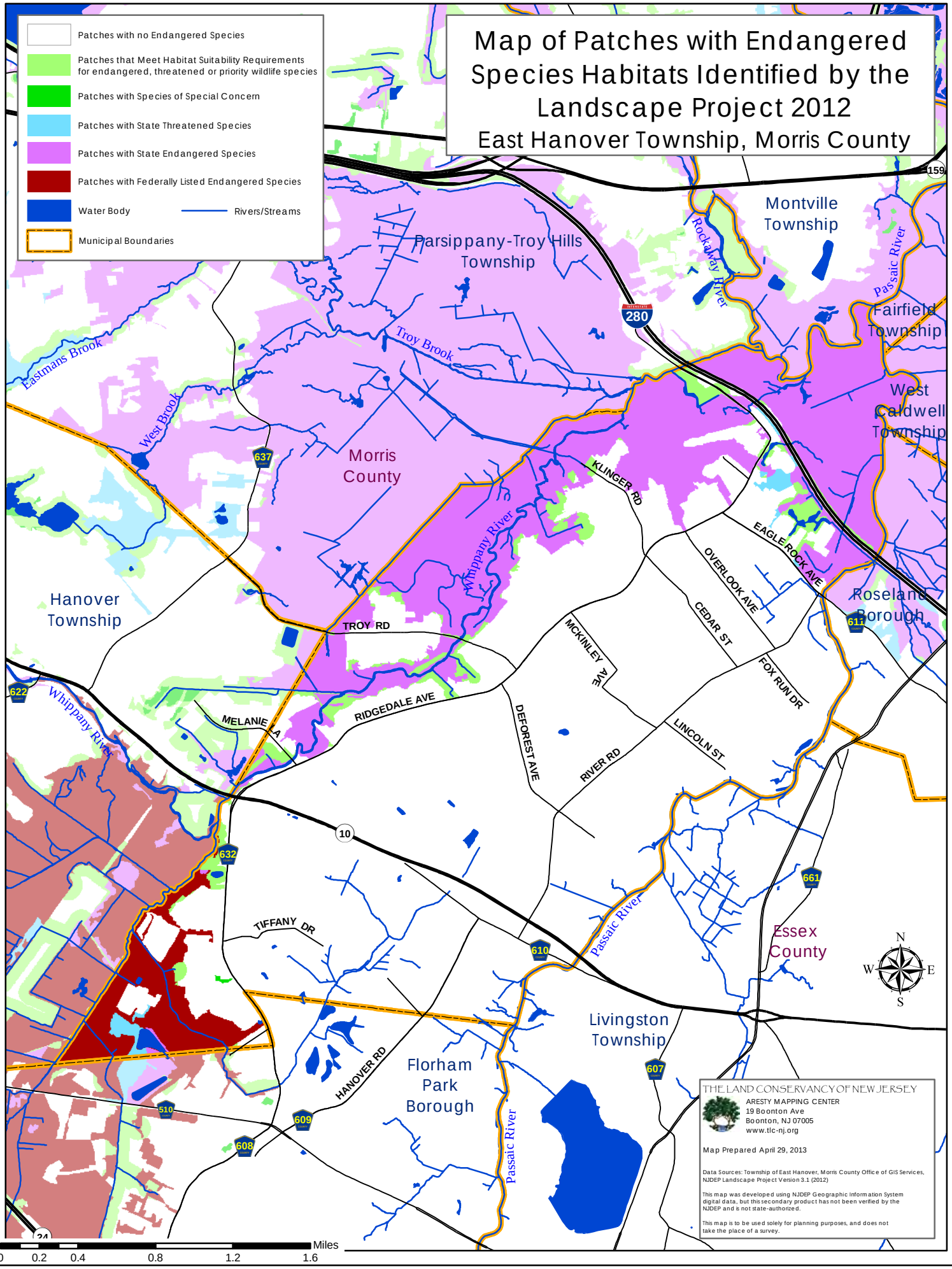
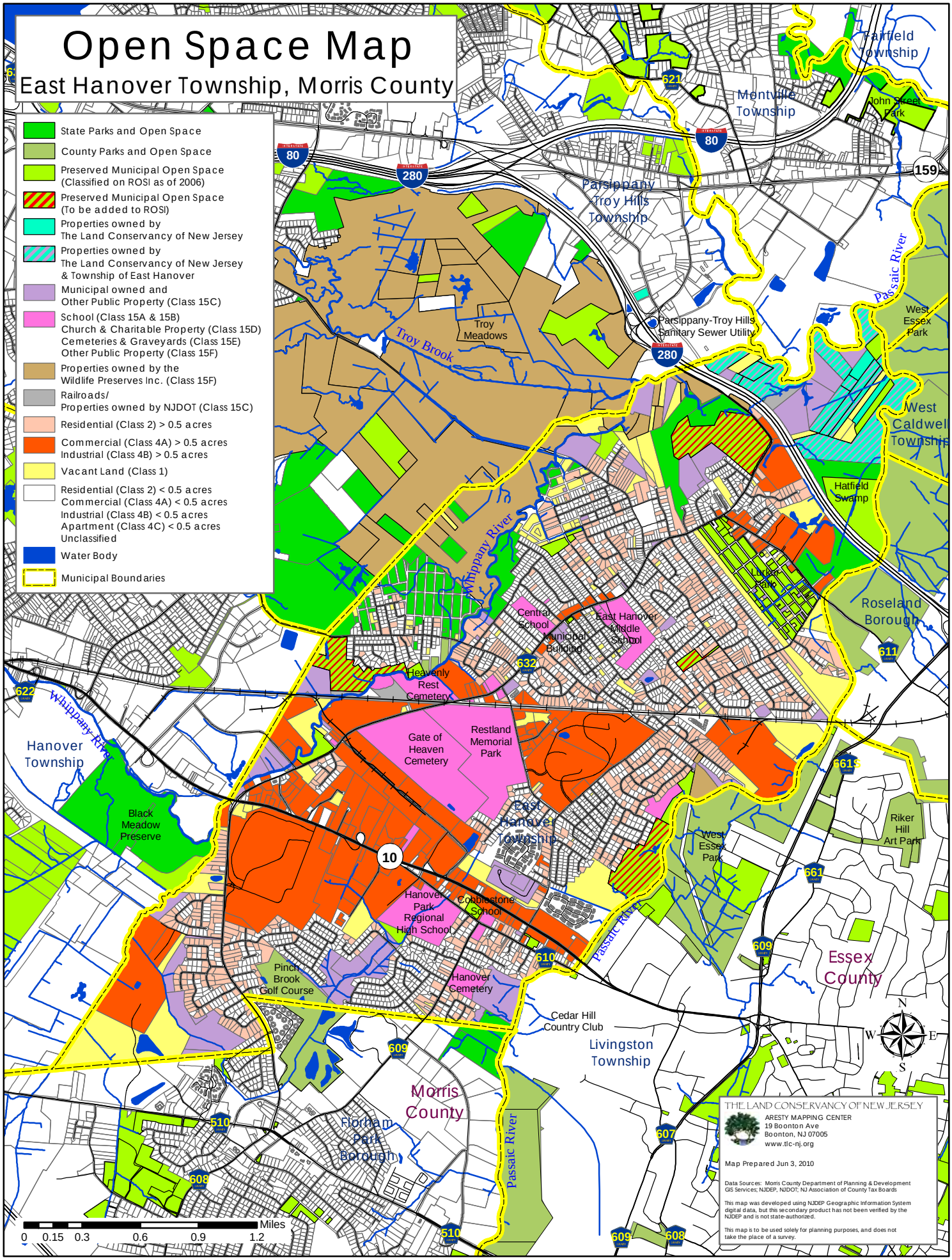
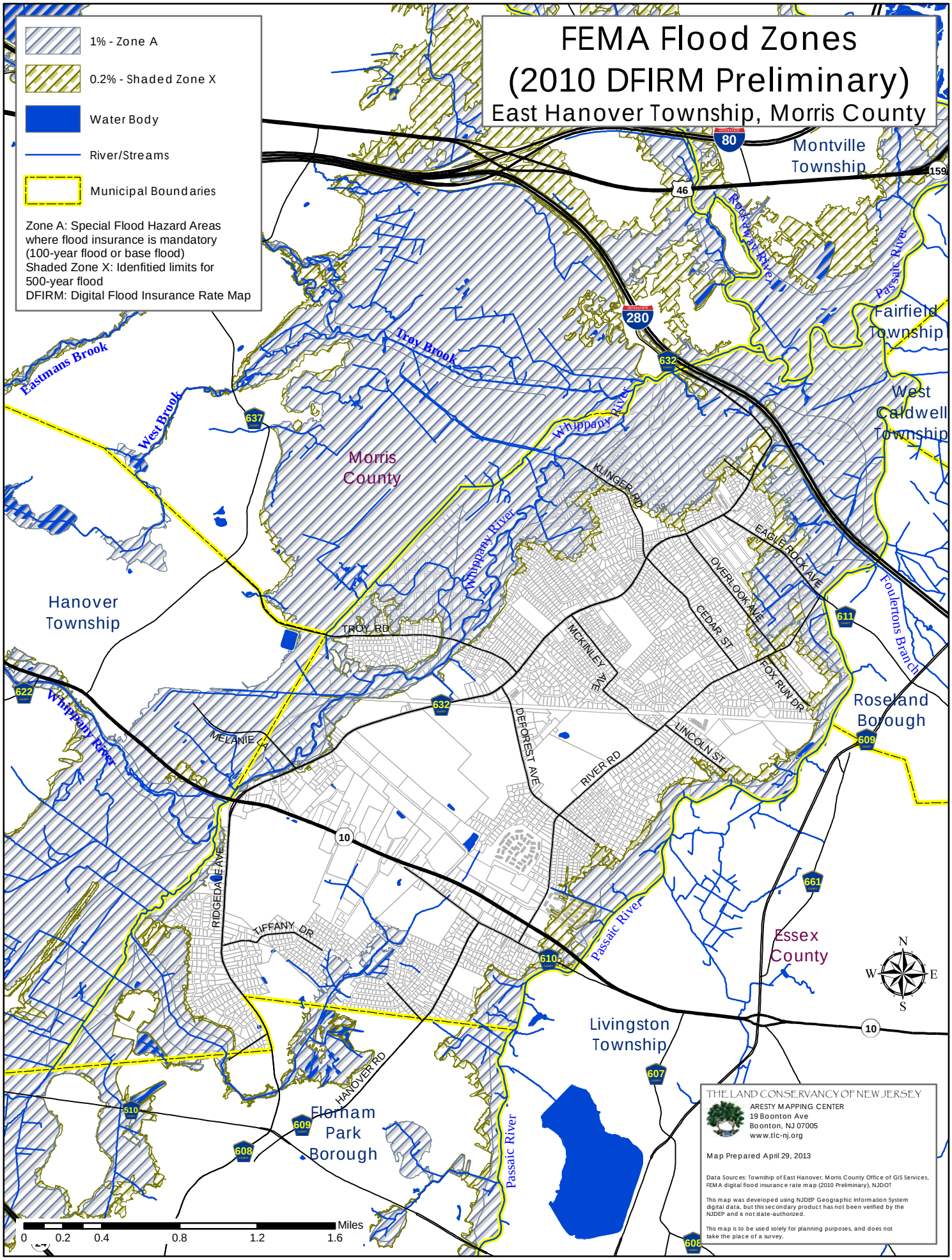
Map 11. Patches with Endangered Species Habitats Identified by the Landscape Project 2012

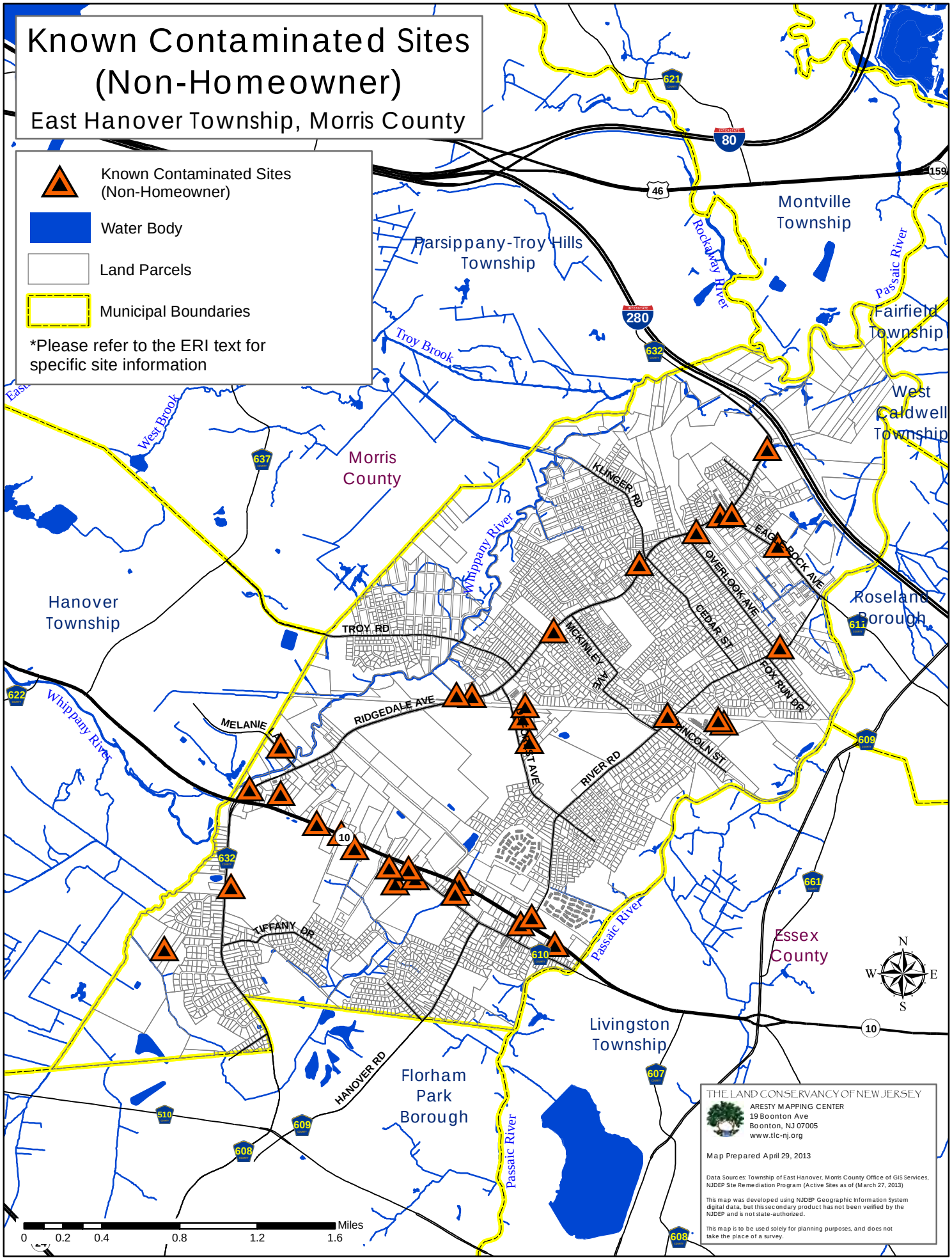


Map 12. Open Space



Map 13. FEMA Flood Zones (2010 DFIRM Preliminary)




Known Contaminated Sites (Non-Homeowner)
East Hanover Township, Morris County
Known Contaminated Sites (Non-Homeowner)
Water Body
Land Parcels
Municipal Boundaries
*Please refer to the ERI text for specific site information
Parsippany-Troy Hills Township
Montville Township
Fairfield Township
West Caldwell Township
Roseland Borough
Morris County
Hanover Township
Essex County
Livingston Township
Florham Park Borough
Rockaway River
Pascaic River
Troy Brook
West Brook
Whippany River
Passaic River
KLINGER RD
EAGLEROCK AVE
OVERLOOK AVE
CEDAR ST
FOX RUN DR
MCKINLEY AVE
TROY RD
RIDGEDALE AVE
MELANIE LN
LINCOLN ST
RIVER RD
TIFFANY DR
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THE LAND CONSERVANCY OF NEW JERSEY
ARESTY MAPPING CENTER
19 Boonton Ave
Boonton, NJ 07005
www.tlc-nj.org
Map Prepared April 29, 2013
Data Sources: Township of East Hanover, Morris County Office of GIS Services, NJDEP Site Remediation Program (Active Sites as of (March 27, 2013)
This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-authorized.
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