Bernards Township

Natural Resources Inventory

2014

FINAL DRAFT

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Bernards Township History

(Note: The following historical information was compiled from data received from The Historical Society of the Somerset Hills, and the Bernards Township Shade Tree Commission.)

Bernards Township lies in the heart of the Somerset Hills, it includes the localities of Basking Ridge, Liberty Corner and Lyons. It is a region of temperate climate and gentle topography and has a rare blend of historic interest and rural ambiance. Bernards Township is located in the northwest corner of Somerset County and is nine miles long and three miles wide, covering an area of 23.7 square miles. Bernards was actually a much larger property prior to 1806 when Warren Township established its own government and in 1921 Far Hills became an independent Township, as did Bernardsville in 1924—see **Figure 1**.

The Township's first inhabitants were the Lenni Lenape Indians, a branch of the Delawares. John Harrison, an agent of King James III of England in 1717, purchased the area from Chief Nowenoik of the Lenapes. He purchased a package of 3,000 acres for $50.00. William Penn bought the remainder of the land later that year. In 1733 the name Basking Ridge first appeared in ecclesiastic records of the Presbyterian Church and is recorded as being derived from the fact that "the wild animals of the adjacent lowlands were accustomed to bask in the warm sun of this beautiful ridge."

In 1760, King George II of England created Bernardston Township by charter. This was in honor of Sir Francis Bernard, provincial governor of New Jersey 1758-1760. Bernard was instrumental in solving one of the last disputes in the French and Indian Wars.

During the American Revolution, Basking Ridge was thought to be a secure place from the British Army as it was only seven miles from General Washington's army at Jockey Hollow. As many as 100 men from Bernards answered the call to arms and a liberty pole was installed on the village green in Annin's Corner and was renamed Liberty Corner.

In 1750 a classical school, designed to prepare young men for college was established in Basking Ridge by Dr. Samuel Kennedy, fourth pastor of the Presbyterian Church, and later run by his successor, Dr. Robert Finley. The school, known as the Basking Ridge Classical School for almost 50 years was conducted in the ministers' homes. Through contributions and partly at Dr. Finley's expense, the Brick Academy was built in 1809. Pupils came from many other states as well as New Jersey; local residents provided lodgings. The Academy was known as having contributing more men "to the bench, the bar, and the pulpit." The Academy would later serve as Public School District #12, then headquarters of two union groups, and from 1924 to 1975 was the municipal building for Bernards Township. Today it is the headquarters of the Historical Society of the Somerset Hills.

Two transportation-related events changed Bernards Township. In 1872 the railroad was completed, opening the area to those who wished to live in the country and work in the metropolitan environment. Almost 100 years later, construction of Route 287 and later Route 78, two Interstate Highways, made commuting much easier for those seeking to live in a residential climate.

An Act of Congress in 1925 created the Veterans Administration Hospital at Lyons, which opened its doors in 1930. It is a very large facility that treats veterans of wars, conflicts and service and also provides employment in the area. There is a long term nursing care unit, a hospital and other medical services available, all situated in a campus setting.

Clearly, Bernards Township remains a community rich in history with a rural tradition. Growth is monitored with a duty to retain the character of its villages. There is constant pressure toward new land development -- this will shape the future of Bernards Township.

(See FIGURE 1: BERNARDS TOWNSHIP HISTORICAL SIZE in map section.)

The Bernards Township Environmental Commission

The Bernards Township Environmental Commission was created by ordinance after the enactment of New Jersey legislation in 1968. The state statute regarding environmental commissions powers reads:

40:56A-2. Powers of commission

An **environmental commission** organized under this act shall have power to conduct research into the use and possible use of the open land areas of the municipality and may coordinate the activities of unofficial bodies organized for similar purposes, and may advertise, prepare, print and distribute books, maps, charts, plans and pamphlets which in its judgment it deems necessary for its purposes. It shall keep an index of all open areas, publicly or privately owned, including open marshlands, swamps and other wetlands, in order to obtain information on the proper use of such areas, and may from time to time recommend to the planning board or, if none, to the mayor and governing body of the municipality plans and programs for inclusion in a municipal master plan and the development and use of such areas.

L.1968, c. 245, s. 2, eff. Aug. 6, 1968. Amended by L.1972, c. 35, s. 3, eff. May 25, 1972."

Relative to the creation and maintenance of a Natural Resources Inventory, the statute further states:

40:56A-6. Studies and recommendations

An environmental commission shall have power to study and make recommendations concerning open space preservation, water resources management, air pollution control, solid waste management, noise control, soil and landscape protection, environmental appearance, marine resources and protection of flora and fauna.

L.1972, c. 35, s. 7, eff. May 25, 1972.

Given the authority by state statute, the Bernards Township Committee enacted an ordinance to create an environmental commission. The township ordinance reads as follows:

Bernards Township Ordinance SECTION 2-18 Environmental Commission

§ 2-18.1. Established

As provided by N.J.S.A. 40:56A-1 et seq., an Environmental Commission is hereby established in and for the Township of Bernards. (Ord. #216; Ord. #1304, 5-12-1998, amended)

§ 2-18.2. Members; Appointment

The Commission shall consist of seven (7) regular members, one of whom shall be a member of the Planning Board of the township. All seven (7) members shall be appointed by the Mayor. The Commission will yearly recommend one of its members to the Mayor, to serve as chairperson and

presiding officer. Following receipt of such recommendation, and with the advice of the Township Committee, the Mayor shall designate one of the members of the Commission to serve as its chairperson and presiding officer. The term of office of members of the Commission shall be three (3) years. The term of any member who is also a Planning Board member shall terminate if and when his term as Planning Board member shall previously expire. In addition, the mayor may appoint two (2) alternate members who shall be designated at the time of appointment as Alternate No. 1 and Alternate No. 2. The term of office of any alternate member shall be for two (2) years, except that the terms of the alternate members first appointed shall be two (2) years for Alternate No. 1 and one (1) year for Alternate No. 2. An alternate member may participate in discussions of all proceedings but may vote only in the absence or disqualification of a regular member. No vote may be delayed in order that a regular member may vote instead of an alternate member. All members shall hold office until their successors shall be appointed and qualified. Any member may be removed for cause by the Mayor or Township Committee. Vacancies occurring otherwise than by expiration of term shall be filled in the same manner as the original appointments for the unexpired portion of that term only. All members shall serve without compensation. (Ord. 216; Ord. 931; Ord. #1304, 5-12-1998, amended)

§ 2-18.3. Powers

The Environmental Commission shall have the power to conduct research into the use and possible use of the open land areas of the township and may coordinate the activities of unofficial bodies organized for similar purposes, and may advertise, prepare, print and distribute books, maps, charts, plans and pamphlets which in its judgment it deems necessary for its purposes. **It shall keep an index of all open areas, publicly or privately owned, including open marshlands, swamps and other wetlands, in order to obtain information on the proper use of such areas**, and may from time to time recommend to the Planning Board plans and programs for inclusion in a Township Master Plan and the development and use of such areas. (Ord. #216; Ord. #1304, 5-12- 1998, amended) **(Emphasis Added)**

§ 2-18.4. Acquisitions

The Environmental Commission may, subject to the approval of the Township Committee, acquire property, both real and personal, in the name of the township, by gift, purchase, grant, bequest, devise or lease for any of its purposes and shall administer the same for such purposes subject to the terms of the conveyance or gift. Such an acquisition may be to acquire the fee or any lesser interest, development right, easement (including conservation easement), covenant or other contractual right (including a conveyance on conditions or with limitations or reversions), as may be necessary to acquire, maintain, improve, protect, limit the future use of or otherwise conserve and properly utilize open spaces and other land and water areas in the township. (Ord. #216; Ord. #1304, 5-12- 1998, amended)

§ 2-18.5. Records and Reports

a. Public records. The records and minutes of the Environmental Commission shall be deemed public records.
b. Annual report. The Environmental Commission shall make, keep and preserve minutes and records of its meetings and activities and shall make an annual report to the Township

Committee before the 15th day of January of the succeeding year.

c. Other reports. Within 10 days after each meeting of the Environmental Commission**,** an exact copy of the minutes thereof shall be filed with the Township Clerk and with the Secretary of the Planning Board. (Ord. #216; Ord. #1304, 5-12-1998, amended)

§ 2-18.6. Appropriations and Expenses

The Township Committee may appropriate funds for the expenses incurred by the Environmental Commission**.** No expense shall be incurred or contract entered into by the Commission unless the funds therefore shall have been previously appropriated to the purpose thereof by the Township Committee, and no obligation shall be incurred for acquisition unless and until the Township Committee shall approve and consent to the same and make the appropriation necessary therefore. (Ord. #216; Ord. #1304, 5-12- 1998, amended)

§ 2-18.7. Employees.

The Commission may appoint such clerks and other employees as it may from time to time require and as may be within the limits of funds appropriated to it. (Ord. #216; Ord. #1304, 5-12-1998, amended)

§ 21-4.10. Environmental Commission (Relationship with Planning Board)

The Planning Board shall make available to the Environmental Commission for its review and comment an informational copy of every development plan submitted to the Planning Board. Failure of the Planning Board to make such informational copy available to the Environmental Commission shall not invalidate any hearing or proceeding. (Ord. #585, § 301J)

§ 21-5.5. Environmental Commission (Relationship with Zoning Board)

The Zoning Board of Adjustment shall make available to the Environmental Commission for its review and comment an informational copy of every development plan submitted to the Zoning Board of Adjustment. Failure of the Zoning Board of Adjustment to make such informational copy available to the Environmental Commission shall not invalidate any hearing or proceeding. (Ord. #585, § 302E)

Bernards Township Environmental Commission Mission Statement

Over the years, the role of the Environmental Commission has evolved. In 1999, the Commission developed a mission statement and a set of long-range goals. Following the adoption of these foundational statements, the Commission has annually developed a set of projects based on the Goals. The Mission Statement and the Goals developed in 1999 are as follows:

The Bernards Township Environmental Commission is responsible for ensuring that environmental issues in Bernards Township are given the right priority in order to protect and preserve natural resources of the town and surrounding areas including land, water, air, and bios

(flora and fauna).

Goals

The Commission accomplishes it's mission through: (a) taking proactive stances on local environmental matters, and strengthening the local planning process; (b) coordinating rational, balanced reviews of development applications for the appropriate township bodies; (c) increasing public awareness and understanding of local and regional environmental issues; and, (d) keeping abreast of, and being involved in, environmental issues that effect our surrounding areas and communities.

The Environmental Commission and GIS

Bernards Township has become one of the leaders in the state of New Jersey in the development and deployment of Geographical Information System (GIS). A GIS Forum was formed under the auspices of the Township's Director of Information Services, and the Environmental Commission appointed a member to the Forum. The Environmental Commission, with the knowledge and data of GIS began to update the Township's Natural Resources Inventory (NRI) in 2003. The Commission also began to utilize the GIS data in performing its reviews of Planning Board and Zoning Board applications.

This practice has continued with the 2014 revision.

GEOLOGY

New Jersey Geology

New Jersey's geology is uniquely diverse and interesting. The state can be divided into four geologic regions or physiographic provinces, each with distinctive rocks and landforms.

In the upper northwest corner of the state is the **Valley and Ridge Province**. Sedimentary layers of sandstone, shale and limestone that range in age from 345 to 750 million years old primarily characterize this Province.
To the east and south of the Valley and Ridge Province lies the **Highlands Province**. This Province contains mainly granite, gneiss, and small amounts of marble. These are the oldest rocks in the state being formed between 1.3 billion and 750 million years age.

Moving again south and east we find the **Piedmont Province** in which Bernards Township lies. Rocks of this Province are separated from the Highlands Province by a series of fault lines including the Ramapo Fault. The granite and gneiss extend from Mahwah through Boonton and Morristown and on to Gladstone.. The most northern corner of Bernards Township contains this type of granite formation (see Figure 1).

The bulk of the Township contains sandstone, siltstone, shale, conglomerate, diabase and basalt formations. South and East of the granite formation, sandstone, siltstone, shale, conglomerate, basalt and diabase of the Piedmont Province underlie a broad lowland interrupted by a long, generally northeast-southwest trending ridges and uplands. The geological formations and rocks of this Piedmont Province areof the Late Triassic and Early Jurassic age (230 to 190 million years old). The rocks rest on a large elongated crustal block that dropped downward in the initial stages of the opening of the Atlantic Ocean--one of a series of such blocks in eastern North America. (This means that the general area of Bernards Township once lay close the European continent prior to the westward movement of the North American tectonic plate several millions of years ago.) The down-dropped blocks formed valleys known as rift basins. Sediment eroded from adjacent uplands was deposited along rivers and lakes within the basins. These sediments became compacted and cemented to form conglomerate, sandstone, siltstone and shale. They commonly have a distinctive reddish- brown color.

In the course of rifting, the rock layers of the Piedmont Province became tilted northwestward, gently folded, and cut by several major faults.

Volcanic activity was also associated with rifting, as indicated by the basalt and diabase interlayering with the sandstone and shale. Diabase is a rock formed by the cooling of magma at some depth in the crust; basalt is formed by cooling of an identical magma that has been extruded onto the surface as lava. Both basalt and diabase are more resistant to erosion than the

enclosing sandstone and shale and therefore they form ridges and uplands. Diabase layers underlie the Palisades, Rocky Hill, Sourland Mountains, and Cushetunk Mountain. Basalt layers underlie the Watchung Mountains, Long Hill, and Hook Mountain. Valleys and lowlands between these ridges are underlain by sandstone and shale.

The basalt and diabase are extensively quarried for crushed stone. In the past, “brownstone” was widely quarried from sandstone units. Also, minor quantities for copper were extracted from sandstone and shale associated with the basalt and diabase. The diabase and basalt are generally poor aquifers, but the sedimentary rocks are, in places, capable of yielding large quantities of water.

Bernards Township Geology

In Bernards Township, the geology is composed of nearly equal parts of diabase and sandstone, shale, and siltstone layers. In the northern-most portion of the Township, we find granite. The diabase layers are located in the western and southern portions with a significant pocket in the center of the Township. The Millington Quarry (MQ) lies in the eastern portion of this central pocket. As evidenced by the MQ operations, the diabase layer in the Township runs quite deep. The remainder of the Township’s geological profile is one of siltstone, sandstone and shale--with the characteristic reddish color.

Bernards lies almost entirely in the Piedmont Province with only the very northeast portion of the Township in the Highlands Province.

(See FIGURE 2: BERNARDS GEOLOGY in map section.)

Topography

Figures 3 and 4 in the map section show the topography of Bernards Township at two foot intervals, with and without a parcel overlay respectively.

The topography of the township ranges from a low of nearly 43 feet below sea level at the base of the quarry, to a high of slightly over 675 feet above sea level along the southwest border with Bridgewater Township.

Rivers, Streams, Brooks and Watersheds

Bernards Township Watersheds and Sub-watersheds

Bernards Township lies in two major watersheds: the Upper Passaic River watershed, and the Upper Raritan River watershed. Only approximately 11%of the township lies in the Upper Raritan watershed. Included in the Upper Raritan watershed are the lower southwestern portions of the Township and an even smaller portion on the Far Hills border.

The bulk of the Township, 89%, is located in the Upper Passaic River watershed. (Note: the official NJDEP name of this Watershed Management Area is "The Upper Passaic, Whippany and Rockaway Rivers, within the Northeast Watershed Region". It is also designated as WMA6.) Bernards Township contains five sub-watershed areas as part of WMA6 as follows:

1) the Upper Passaic River above Osborn Mills;
2) the Upper Passaic River between the Dead River and Osborn Mills;
3) the Dead River below Harrisons Brook;
4) Harrisons Brook; and
5) the Dead River above Harrisons Brook.

Table 1 shown various statistics for each of these sub-watersheds, and Figure 5 in the map section is a graphical representation of the sub-watersheds along with the streams and parcels.

THE UPPER PASSAIC ABOVE OSBORN MILLS

The first sub-watershed, the Upper Passaic above Osborn Mills is the smallest of the Upper Passaic sub-watersheds in the Township comprising just over 6% of the township's area. It is in the upper northeast corner of Bernards Township and includes Osborn Pond, the Verizon corporate complex, properties north of Madisonville Road, and the parcels northwest of Interstate 287 and northeast of where Madisonville Road intersects with U.S. Route 202. The bulk of this sub-watershed is developed, although there are a small number of minor subdivisions possible. **Although small, this sub- watershed is extremely critical to the Upper Passaic River.** This is the only portion of the Upper Passaic in the Township that is classified by the NJDEP as FW1-Trout Producing, or a C1 classification. All the rest of the Upper Passaic River in the Township is classified as FW2-Non-Trout Producing. An FW1 classification means that the river is a spawning ground for native trout. The FW1 classification also means that any wetlands draining into this sub-watershed should automatically be classified as of Exceptional Resource Value (ERV) by the New Jersey Department of Environmental Protection.

With the new NJDEP regulations published and effective February 4, 2004, the buffer requirements on C1 classified streams in now 300 feet.

THE UPPER PASSAIC RIVER BETWEEN THE DEAD RIVER AND OSBORN MILLS

The next sub-watershed is that of the Upper Passaic River above the Dead River. This portion of the Upper Passaic forms the eastern boundary of the Township and is the second largest of the

Township's sub-watersheds draining over 24% of the township or approximately 3,800 acres. Numerous brooks and streams, most of which are unnamed, feed into the Upper Passaic in this sub-watershed.

One brook that is named is Penns Brook, which drains a large portion of the northern part of the Township. The Upper Passaic in this sub-watershed is classified by the NJDEP as FW2, non-trout producing but is stocked with freshwater trout every spring by the New Jersey Division of Fish and Wildlife. There are numerous open space, and undeveloped tracts (both public and private) that drain into this sub-watershed. Included in the list of undeveloped and open space properties are: The Basking Ridge Country Club (privately owned); the Lord Sterling Riding Stables (Somerset County owned); the Lord Sterling Environmental Center (Somerset County owned); the Crane Farm (Somerset County owned); the Bernards Township Municipal complexes on Collier Lane and South Maple Avenue (Township owned); the Cedar Hill and Ridge High School complexes (Bernards Township Board of Education owned); The Quarry (owned by Millington Quarry.); the tract which contains the Reverend Kennedy farmstead and numerous outbuildings, some of which date from the mid- to late 1700s (owned by Township-owned); and a portion of the Veterans Administration golf course (owned by the U. S. Federal Government, managed by the Bernards Township Recreation Department). These large open or undeveloped tracts account for approximately 45% of the sub-watershed area**.**

THE DEAD RIVER BELOW HARRISONS BROOK

The large majority of this sub-watershed lies in Warren Township as the Dead River forms the southern boundary of Bernards Township with Warren. It drains approximately 8% of the township or 1.23 thousand acres. The Dead River, in this sub- watershed, drains into the Upper Passaic River just north of Interstate 78 near the King George Exxon gas station. Numerous large parcels in this sub-watershed have been acquired by the Township through a variety of methods including, but not limited to: Green Acres funding, deeded from developers of Spring Ridge, The Cedars, and Society Hill Condominium Associations. The Dead River trail, constructed with many hours of volunteer help lies within this sub-watershed.

HARRISONS BROOK

The Harrisons Brook sub-watershed drains 3,300 acres of the central part of Bernards Township, which accounts for 21% of the township. At its southern extreme, it drains some of the most flood-prone parts of the Township including Newell Drive and the lowlands between Mount Airy Road and the Mount Airy Road extension. Major open areas within this sub-watershed include: the U.S. Veterans Administration Hospital property, the Somerset Hills YMCA, the Bernards Township Little League fields on Valley Road, and the two cemeteries on Mount Airy Road.

THE DEAD RIVER ABOVE HARRISONS BROOK

This major sub-watershed of the Upper Passaic River lies west of the Harrisons Brook sub-watershed and drains the bulk of the western portion of Bernards Township. It is the largest sub-watershed in the Township draining over 28% of Bernards or nearly 4,500 acres. In addition to draining approximately 70% of the Bernards Township portion of the Hills, including over 90% of the New Jersey National Golf Club in the Hills, this sub-watershed also drains many of the

remaining open space tracts in the Township. This sub-watershed abuts the portions of the Township that are contained in the Upper Raritan sub-watersheds that comprise approximately 11% of the Township's area.

OTHER SUB-WATERSHEDS

The 11% of the township not in the Upper Passaic watershed lies in the Upper Raritan and Lower Raritan watersheds. The relevant sub-watersheds are located along the western and southwestern borders of the township.

Permit Sites:

Introduction

The data presented in this Part represents sites regulated by NJDEP under one or more regulatory permitting programs. The NJDEP Department Integrated Facility File (DIFF) served as the database that supplied the list of sites that were captured using differential (mostly post-processed) GPS.

NJDEP Known Contaminated Site List, 2001

The following data was edited from the NJDEP GIS web site located at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/kcsl2001.zip

According to NJDEP data, in 2001 (last reported date), there are 24 known contaminated sites within Bernards Township. These sites are shown in the table below and are sorted by their Remedial Level codes as defined by NJDEP. Of these 24, two have a remedial level of "B", 14 have a remedial level of "C1", six a remedial level of "C2", and two have a remedial level of "C3". Bernards Township has no remedial level "D" sites as of 2001.

The "B" through "C2" sites all contain underground storage tanks for either oil or gasoline. At least one of these sites, Ridge Chevrolet should be removed from the list as the tanks and surrounding contaminated soil have been removed.

The two "C3" sites are the Pill Hill landfill (closed since 1993) and the Algonquin Gas Transmission Company sites.

The status of the 24 sites: 17 are listed as Active, five are Pending, and two, the gas tation on Stonehouse Road and the gas station at the intersection of I78 and Martinsville Road are listed as requiring No Further Action for the entire site.

Bernards Township Permit Sites--DIFF Data

The 1997 DIFF data (latest available from the NJDEP) shown lists 155 sites in Bernards Township that have one or more environment-related permits. Of the 155 permits, 44 are Federal EPA permits and the remaining 111 are NJDEP permits. The 44 Federal EPA permits contain two related to air quality--Millington Quarry (Quarry) and the Somerset Hills Memorial Park cemetery. Two Federal EPA permits are related to surface water quality-- The Bernards Township Sewerage Authority and the US Veterans Administration (VA) facility on Knollcroft Road. The bulk of the Federal EPA permit sites are related to environmental resource conservation and recovery. Two sites in the Township have multiple permit classifications--the Quarry and the VA.

SOILS AND CHARACTERISTICS

Types Of Soils

Introduction

The following data are extracts from the USDA Natural Resources Conservation Service website.

"Official soil series description" is a term applied to the description approved by the Natural Resources Conservation Service that defines a specific soil series in the United States. These official soil series descriptions are descriptions of the taxa in the series category of the national system of classification. They mainly serve as specifications for identifying and classifying soils. While doing survey work, field soil scientists should have all the existing official soil series descriptions that are applicable to their soil survey areas. Other official soil series descriptions that include soils in adjacent or similar survey areas are also commonly needed. Scientists in other disciplines, such as agronomists, horticulturists, engineers, planners, and extension specialists also use the descriptions to learn about the properties of soils in a particular area.

Following are the official soil series found in Bernards Township as shown on Figure 7 in the map section.

Amwell Series

The Amwell series consists of deep or very deep somewhat poorly and moderately well drained soils on uplands. They formed mainly in colluvial material from basic igneous rocks. Slopes range from 0 to 18 percent. Mean annual temperature is about 50 degrees F. and mean annual precipitation is about 40 to 48 inches.

TAXONOMIC CLASS: Fine-loamy, mixed, mesic Aquic Fragiudalfs

TYPICAL PEDON: Amwell gravelly silt loam - Brush and small trees mostly sprout growth. (Colors are for moist soil.)

The following are soil characteristic descriptions by soil depth.

A--0 to 3 inches; dark grayish brown (10YR 4/2) gravelly silt loam; strong fine granular structure; friable; many fine and large roots; 15 percent pebbles and cobblestones, mostly basalt; neutral; gradual wavy boundary. (1 to 3 inches thick)

E--3 to 14 inches; dark brown (10YR 4/3) gravelly silt loam; weak coarse sub-angular blocky structure; friable; many fine and large roots; 15 percent pebbles mostly basalt; moderately acid; clear wavy boundary. (0 to 12 inches thick)

Bt--14 to 21 inches; yellowish brown (10YR 5/4) clay loam, many coarse distinct light brownish gray (2.5Y 6/2) and few fine distinct brownish yellow (10YR 6/8) mottles; weak medium and coarse sub-angular blocky structure; friable, slightly sticky, slightly plastic, many

fine roots; 5 percent pebbles mostly basalt; few faint clay films on peds; moderately acid; abrupt wavy boundary. (5 to 18 inches thick)

Btxl--21 to 26 inches; brown (7.5YR 5/4) loam, many coarse prominent light brownish gray (2.5Y 6/2) mottles; weak thick platy and weak very coarse prismatic structure; brittle, firm; few roots concentrated in widely spaced vertical light brownish gray (10YR 6/2) streaks; 5 percent pebbles; few faint clay films on horizontal surfaces of peds; moderately acid; gradual wavy boundary. (4 to 30 inches thick)

Btx2--26 to 36 inches; dark yellowish brown (10YR 4/4) fine sandy loam; common coarse distinct light brownish gray (10YR 6/2) mottles; weak thick platy structure; brittle, very firm; 5 percent pebbles; few faint patchy clay films on horizontal surfaces of peds; moderately acid; gradual wavy boundary. (0 to 12 inches thick)

C1--36 to 46 inches; yellowish brown (10YR 5/6) fine sandy loam, few coarse distinct light brownish gray (2.5Y 6/2) and few fine olive yellow (2.5Y 6/6) mottles; massive; friable; 10 percent pebbles; moderately acid; gradual wavy boundary. (6 to 20 inches thick).

C2--46 to 60 inches; dark yellowish brown (10YR 4/4) fine sandy loam; massive; friable; 10 percent pebbles; moderately acid.

TYPE LOCATION: Somerset County, New Jersey; Bernards Township, east side of Mine Brook Road 200 yards north of interstate 287.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 30 to 50 inches. Depth to bedrock is more than 40 inches. Depth to the top of the fragipan ranges from 18 to 30 inches. The A horizon and upper part of the B horizon have fine earth fraction and rock fragments that are mostly of basic igneous rocks. In the lower B and C horizons the fine earth fraction and rock fragments are derived from either basic igneous rocks, shale or a diverse mixture of rocks. Rock fragments range from 0 to 25 percent by volume in the A and Bt horizons and from 5 to 50 percent in Bx and C horizons. Reaction is from strongly acid to neutral.

The Ap or A1 horizons has hue of 7.5YR or 10YR, value of 2 to 4, and chroma of 2 to 4 with the lowest values and chromas restricted to thin A1 horizons. Dry value is 6 or more. The A horizons are loam or silt loam with gravelly or cobbly analogs. The A2 and E horizons, if present, have hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 3 to 6. If cultivated, both are commonly mixed with the A1 to become the Ap horizon.

The Bt and Btx horizons have hue of 2.5YR to 10YR, value of 4 to 7, and chroma of 2 to 8. Low and high chroma mottles range from few to many and fine to coarse, and are present within the top ten inches of the argillic horizon. Textures of the Bt horizon are loam, silt loam, clay loam, silty clay loam, or gravelly analogs. The texture of the Btx horizon or fragipan ranges from silty clay loam to sandy loam and includes gravelly or cobbly analogs.
The C horizons have hue of 2.5YR to 10YR, value of 4 to 6, and chroma of 1 to 7. Textures are similar to the Bx horizon. In many places the lower solum and C horizons are in layers of contrasting materials.

GEOGRAPHIC SETTING: Amwell soils are in colluvial positions on lower slopes and extend from the base of steeper slopes onto upland flats or depressions. Slopes range from 0 to 18 percent. The soils developed in deposits, derived mostly from basic igneous rocks. The lower sola or substrata are either glacial drift or residuum weathered from shale or basic igneous rock. The climate is humid temperate. Average air temperature ranges from 50 to 55 degrees F., precipitation from 40 to 48 inches and frost free days from 160 to 190 days.

DRAINAGE AND PERMEABILITY: Amwell soils are somewhat poorly and moderately well drained. Permeability is slow. Internal drainage is slow. Runoff is slow to rapid depending on slope. Seepage of water on top of fragipan is common on slopes.

USE AND VEGETATION: Dominant use is woodland. Common trees are pin oak, red maple, elm, ash, and red oak. Few areas have been cleared and used for pasture or cultivated crops.

Birdsboro Series

The Birdsboro series consists of very deep, well drained, and moderately well drained soils. The soils formed in old alluvial deposits derived from red sandstone, shale, and siltstone. They are on terraces and alluvial fans with convex slopes of 0 to 15 percent. Permeability is moderate. Mean annual precipitation is 42 inches. Mean annual temperature is 53 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Oxyaquic Hapludults

TYPICAL PEDON: Birdsboro silt loam, on 3 to 8 percent southwest-facing slopes in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 10 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable, slightly sticky, slightly plastic; 2 percent rounded gravel; slightly acid; abrupt smooth boundary. (6 to 11 inches thick)

Bt1--10 to 19 inches; reddish brown (5YR 4/3) silty clay loam; moderate fine blocky structure; firm, slightly sticky, plastic; common faint clay films on faces of peds; extremely acid; clear wavy boundary. (4 to 11 inches thick)

Bt2--19 to 28 inches; reddish brown (5YR 4/4) loam; moderate medium and fine blocky structure; firm, slightly sticky, plastic; many faint clay films on faces of peds and in pores; 5 percent rounded gravel; extremely acid; clear wavy boundary. (5 to 25 inches thick)

Bt3--28 to 39 inches; reddish brown (5YR 4/4) loam; common medium prominent yellowish brown (10YR 5/6) and pale brown (10YR 6/3) mottles; moderate coarse blocky structure; firm, slightly sticky, plastic; many faint clay films on faces of peds and in pores; 2 percent rounded gravel; extremely acid; clear wavy boundary. (0 to 15 inches thick)

Bt4--39 to 46 inches; brown (7.5YR 4/4) sandy clay loam; many coarse prominent yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate coarse sub-angular blocky structure; firm, slightly sticky, slightly plastic; few faint clay films on faces of peds and in pores; very strongly acid; abrupt smooth boundary. (0 to 9 inches thick)

C--46 to 70 inches; reddish brown (5YR 5/4) very gravelly clay loam; common medium prominent yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; friable, slightly sticky, slightly plastic; 50 percent rounded gravel; very strongly acid.

TYPE LOCATION: Bedford County, Pennsylvania; St. Clair Township, 1 mile west of St. Clairsville and 200 feet southeast of the intersection of LR05060 and T540.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 30 to 50 inches. Depth to gravelly layers is more than 40 inches. Depth to bedrock is 6 to 20 feet or more. Gravel content ranges from 0 to 20 percent in the solum and from 0 to 70 percent in the C horizon. Reaction throughout the soil ranges from extremely acid through strongly acid, unless limed.

The A or Ap horizon has hue of 2.5YR through 10YR, value of 2 through 4, and chroma of 2 through 4. Dry value is more than 5. Texture is silt loam or loam in the fine-earth fraction.

The Bt horizon has hue of 2.5YR through 7.5YR, value of 3 through 5, and chroma of 3 through 6. Hue of 7.5YR is restricted to the lower part of the solum. Fine-earth textures are loam, silt loam, sandy clay loam, clay loam, and silty clay loam. Structure is weak or moderate, fine through coarse blocky or sub-angular blocky. Some pedons have a BC horizon up to 12 inches thick.

The C horizon has hue of 2.5YR through 10YR, value of 3 through 5, and chroma of 3 through 6. Fine-earth textures are sand, loamy sand, sandy loam, loam, silt loam, and clay loam. Some pedons have stratified layers of gravel.

GEOGRAPHIC SETTING: Birdsboro soils are on nearly level to sloping stream terraces and alluvial fans. Slopes range from 0 to 15 percent. They formed in old alluvial deposits derived from red sandstone, shale and siltstone. Climate is humid and temperate; mean annual precipitation ranges from 38 to 46 inches; average annual temperature ranges from 47 to 59 degrees F.; the growing season ranges from 140 to 200 days.

DRAINAGE AND PERMEABILITY: Well drained and moderately well drained. Runoff is slow to rapid. Permeability is moderate.

USE AND VEGETATION: Approximately 65 percent of the Birdsboro soils are cultivated or in pasture, 10 percent is wooded, mostly mixed hardwoods, and 25 percent is in non-agricultural uses.

Bowmansville Series

The Bowmansville series consists of very deep, poorly and somewhat poorly drained soils. They formed in recent alluvial deposits derived from upland soil materials weathered from dolerite or basalt. They are on floodplains with smooth slopes of 0 to 3 percent. Permeability is moderately slow above stratified sand and gravel. Mean annual precipitation is 43 inches. Mean annual temperature is 52 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, nonacid, mesic Aeric Fluvaquents

TYPICAL PEDON: Bowmansville silt loam, on a 2 slope in a pasture. (Colors are for moist soil.)

Ap--0 to 7 inches; reddish brown (5YR 4/4) silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; strongly acid; abrupt smooth boundary. (4 to 14 inches thick)

BA--7 to 16 inches; reddish brown (5YR 5/4) silt loam; common fine distinct pinkish gray (7.5YR 6/2 and reddish yellow (7.5YR 6/8) mottles; weak medium sub-angular blocky structure; firm, sticky, slightly plastic; strongly acid; clear wavy boundary. (4 to 15 inches thick)

Bg1--16 to 26 inches; pinkish gray (7.5YR 6/2) silt loam; common fine distinct strong brown (7.5YR 5/8) mottles; weak medium sub-angular blocky structure; firm, slightly sticky, slightly plastic; strongly acid; clear wavy boundary. (5 to 15 inches thick)

Bg2--26 to 35 inches; pinkish gray (5YR 6/2) silt loam; common medium distinct strong brown (7.5YR 5/8) mottles; weak coarse sub-angular blocky; structure; firm, slightly sticky, slightly plastic; strongly acid; clear wavy boundary. (4 to 15 inches thick)

Cg1--35 to 52 inches; pinkish gray (7.5YR 6/2) sandy loam; common medium distinct strong brown (7.5YR 5/6) mottles; weak thick plates breaking to weak medium sub- angular blocks; friable, slightly sticky, slightly plastic; strongly acid; clear wavy boundary. (10 to 30 inches thick)

2Cg2--52 to 66 inches; variegated pinkish gray (7.5YR 6/2) and strong brown (7.5YR 5/8) stratified sand and gravel; single grain; loose, non-sticky, non-plastic; strongly acid.

TYPE LOCATION: Lancaster County, Pennsylvania; in Cocalico Township, 2 miles northwest of Denver, 200 feet southeast of Swamp Road, at Cocalico Creek.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 18 to 59 inches. Depth to bedrock is more than 6 feet. Depth to strongly contrasting stratified sand and gravel is more than 40 inches. Organic carbon decreases irregularly with depth or is greater than 0.2 percent immediately above a strongly contrasting C horizon. Waterworn gravel ranges from 0 to 15 percent in the solum, 0 to 30 percent in the C horizon above 40 inches, and 0 to 90 percent below 40 inches. Reaction ranges from strongly acid through slightly acid in the solum and from strongly acid through neutral in the C horizon. Some pedons have thin layers of sand, silt, clay or gravel at depths less than 40 inches.

The A or Ap horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 through 4. Fine-earth texture is sandy loam, loam, or silt loam.

The B horizons are neutral or have hue of 5YR or 7.5YR, value of 3 through 6, and chroma of 0 through 2, with some sub-horizon within 30 inches having a chroma of 3 or more. Fine-earth textures are sandy loam, loam, silt loam, silty clay loam, and sandy clay loam.

The C horizon, above stratified sand and gravel, is neutral or has hue of 5YR through 10YR, value of 3 through 6, and chroma of 0 through 2. The fine-earth textures are sandy loam, loam,

silt loam, and silty clay loam. 2C horizons have colors like the C horizon and fine-earth textures range from silty clay loam through sand.

GEOGRAPHIC SETTING: Bowmansville soils are on nearly level flood plains. They formed in alluvial deposits derived from upland soil materials weathered from red and brown shale and sandstone or from dolerite or basalt. Climate is humid and temperate. Mean annual precipitation ranges from 40 to 46 inches; mean annual temperature ranges from 47 to 59 degrees F.; and the growing season ranges from 135 to 200 days.

DRAINAGE AND PERMEABILITY: Poorly drained and somewhat poorly drained. Surface water is ponded or runoff is very slow and slow. Permeability is moderately slow above stratified sand and gravel and moderately rapid in the stratified sand and gravel.

USE AND VEGETATION: Approximately 60 percent of the Bowmansville soils are in pasture. Wooded areas are in mixed hardwood trees.

Califon Series

The Califon series consists of moderately deep to deep moderately well drained and somewhat poorly drained soils that formed in deeply weathered, old till or colluvium derived predominantly from granitic gneiss. They occur on upland flats or on slopes in concave positions. Typically Califon soils have dark brown loam Ap horizons, mottled clay loam B2t horizons and mottled loam very firm Bx horizons extending below 40 inches.

TAXONOMIC CLASS: Fine-loamy, mixed, mesic Typic Fragiudults

TYPICAL PEDON: Califon loam - idle field. (Colors are for moist soil.)
Ap--0 to 10 inches, dark brown (10YR 4/3) loam; weak fine sub-angular blocky structure; firm; many fine roots; 2 percent hard pebbles of granite, quartzite and chert; medium acid; clear smooth boundary. (8 to 11 inches)

B1--10 to 16 inches, strong brown (7.5YR 5/6) heavy loam; weak medium sub-angular blocky structure; hard, firm; many fine roots; 2 per cent hard fragments of granite, quartzite and chert; old worm holes and large root cavities filled with Ap material; medium acid; gradual smooth boundary. (0 to 7 inches thick)

B2t--16 to 23 inches, strong brown (7.5YR 5/6) clay loam, few fine distinct brown (10YR 5/3) mottles; weak medium sub-angular blocky structure; very hard, firm; few fine roots; common medium and fine pores; 10 percent 1 to 2 inch diameter sub-angular fragments of granite, quartzite and chert, some soft, some hard; distinct thin dull clay films on faces of peds and in pores; strongly acid; clear smooth boundary. (12 to 18 inches thick)

Bx1--23 to 28 inches, strong brown (7.5YR 5/6) loam, many medium prominent yellowish brown (10YR 5/4) and strong brown (10YR 5/8) mottles; weak very coarse prismatic structure parting to moderate medium and thick platy structure; very hard, very firm; few fine roots; few fine roots; few fine pores; 10 percent strongly weathered fragments of granitic rock 1 to 2 inches in diameter; very pale brown (10YR 7/3) dull clay films on faces of peds; common black (N 2/)

manganese and iron stains; strongly acid; gradual smooth boundary. (5 to 10 inches thick)

Bx2--28 to 33 inches, yellowish brown (10YR 5/4) heavy loam; few medium and many fine faint strong brown (7.5YR 5/4) mottles; moderate medium and thick platy structure; hard, very firm; many fine pores; 10 percent strongly weathered thin glossy clay films on vertical and fragments of granitic rock; horizontal faces of peds; common black (N 2/) manganese and iron coatings; very strongly acid; gradual smooth boundary. (3 to 8 inches thick)

Bx3--33 to 43 inches, prominently mottled with equal parts of yellowish red (5YR 5/6), strong brown (7.5YR 5/6) and gray (5YR 5/1) heavy loam; moderate medium and thick platy structure; very firm; few fine pores; dull clay films on horizontal surfaces; 10 percent strongly weathered fragments of granitic rock; very strongly acid; abrupt smooth boundary. (0 to 12 inches thick)

Bx4--43 to 50 inches, strong brown (7.5YR 5/6) heavy loam, common medium distinct light brownish gray (10YR 6/2) mottles; very weak platy structure; very firm; few fine pores; 10 percent strongly weathered fragments of granitic gneiss, stones and boulders; patchy glossy clay films on faces of peds; clay pockets common; very strongly acid; clear smooth boundary. (0 to 20 inches thick)

C--50 to 75 inches, yellowish brown (10YR 5/8) sandy loam and bands of yellowish red (5YR 5/8) and very pale brown (10YR 7/3); common black stains (N 1/); massive; friable; many fine sharp fragments; strongly acid.

TYPE LOCATION: Hunterdon County, New Jersey; 1/4 mile east of Van Sickles Corner, south side of road, 30 feet west of fence, 50 feet in from road.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 35 to 60 inches. Depth to moderately or strongly expressed fragipan ranges from 20 to 30 inches. Depth to hard granitic gneiss bedrock ranges from 6 feet to 20 feet. Reaction ranges from medium to slightly acid near the surface, unless limed, and strongly to very strongly acid in the lower part of the solum and the C horizon. Individual horizons within the solum or C horizons have a few to 25 percent, mostly sub-angular or angular pebbles, cobblestones or stones. Silt, sand grains and coarse fragments are predominantly derived from granitic gneiss with sandstone, shale and siltstone fragments less common. Through clay in any one sub-horizon may range from 18 to 40 percent, the Bt horizon averages from 27 to 35 percent and the Bx horizon from 18 to 27 percent. The Ap horizon has hue of 10YR with values of 4 or 5 and chroma of 2 through 4. In uncultivated areas, thin A1 horizons are very dark grayish brown (10YR 3/2). The A horizons are loam or gravelly analogues.

Structure is weak or moderate, fine granular or fine sub-angular blocky. The Bt and Bx horizons have hues of 10YR or 7.5YR, values of 5 or 6, and chroma of 4 through 8. Mottles are few, common or many, fine or medium, distinct or prominent and range from light yellowish brown (10YR 6/4) through yellow (10YR 7/6) and brownish gray (10YR 6/2) but 2 chroma mottles are absent in the upper 10 inches of the argillic horizon. Very dark manganese stains are common. The Bt horizons are heavy loam, clay loam, heavy silt loam or sandy clay loam, usually with a gritty feel and gravelly equivalents. It has weak or moderate, medium sub-angular blocky structure. The Bt horizons are hard, friable or firm, and plastic. Textures of the Bx horizons are sandy clay loam,

heavy sandy loam, heavy loam and clay loam, all with a gritty feel. Structure in the upper part s weak very coarse prismatic parting to weak or moderate, thick or very thick platy. The prismatic structure fades out as depth increases. Thin clay films are common on secondary ped faces but are patchy in some sub-horizons.

The C horizons are similar to the Bt and Bx horizons but are generally more coarsely mottled. The C horizons are sandy loam, sandy clay loam, loam, clay loam and loamy sand. In pedons where the C horizon extends into saprolite may fine or very fine sharp pebbles are present. Structure is massive. The fragipan extends into the C horizon in some pedons.

GEOGRAPHIC SETTING: Califon soils are on upland flats or on 0 to 15 percent slopes in concave positions in the landscape of deeply weathered, old till or colluvium derived predominantly from granitic gneiss. Average annual air temperature is 45 to 55 degrees F. and average annual precipitation is 40 to 45 inches.

DRAINAGE AND PERMEABILITY: Califon soils are moderately well and somewhat poorly drained, are slowly permeable in the fragipan, moderately rapidly permeable in the saprolite.

USE AND VEGETATION: Only a small part of the Califon soils are now cultivated. They are used mainly for growing pasture, hay and woodland. Natural vegetation is red maple, pin oak, yellow poplar and elm.

Croton Series

The Croton series consists of deep, poorly drained soils on uplands. They formed in medium textured materials mainly over sandstone, siltstone, or shale. Slopes are 0 to 8 percent. Mean annual precipitation ranges from 40 to 48 inches. Mean annual air temperature ranges from 50 to 55 degrees F.

TAXONOMIC CLASS: Fine-silty, mixed, active, mesic Typic Fragiaqualfs

TYPICAL PEDON: Croton silt loam - cropland. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable, slightly sticky, slightly plastic; many roots; medium acid; clear smooth boundary. (7 to 10 inches thick)

Btg--9 to 18 inches; gray (N 5/) silty clay loam; many distinct mottles of gray (10YR 5/1) and strong brown (7.5YR 5/6); moderate medium prismatic structure parting to weak plates; very firm, plastic; few fine roots; clay films in voids; very strongly acid; clear smooth boundary. (6 to 15 inches thick)

Btxg--18 to 36 inches; brown (7.5YR 5/6) silty clay loam, light brownish gray (10YR 6/2) coatings on peds; many medium and coarse mottles of gray (N 4/); very coarse prismatic structure parting to moderate medium platy structure; brittle, very firm; few roots distributed along faces of peds; few faint clay films on faces of peds and in voids; 10 percent rock

fragments of fine shale and sandstone; strongly acid; gradual smooth boundary. (10 to 25 inches thick)

Cx--36 to 48 inches; brown (7.5YR 5/4) silty clay loam; massive; very firm; 15 percent rock fragments of very fine grained silty sandstone; strongly to moderately acid; abrupt smooth boundary. (0 to 20 inches thick)

R--48 inches; red (10R 4/6) shattered shale.

TYPE LOCATION: Hunterdon County, New Jersey; 1 mile north of Locktown, east of road on Ayre property, north of farm buildings midway to lane, about 25 feet into field from hedgerow.

RANGE IN CHARACTERISTICS: The solum ranges from 25 to 40 inches in thickness. Depth to the top of the fragipan is 15 to 25 inches, and depth to bedrock is from 3 1/2 to 5 feet. Some pedons have stones and large or very large flagstones scattered over the surface. Rock fragments range from 0 to 10 percent in horizons above the fragipan, 0 to 20 percent in the fragipan, and 0 to 35 percent in the C horizon. The B horizons range from 50 to 70 percent silt and most of the sand is very fine.

The Ap horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 1 to 4, and is one or two units higher in value when crushed and dry. It is silt loam or silty clay loam. Some pedons have E horizons that have hue of 5YR to 10YR, value of 6, and chroma of 1 or 2. Texture is similar to that of the Ap horizon. Some pedons also have A1 and A2 horizons. Where present, the color and textures are similar to the Ap horizon.

The Btg horizon has hue of 5YR to 10YR or is neutral, value of 4 to 7, and chroma of 0 to 2 and is mottled. It is silt loam or silty clay loam and contains less that 15 percent fine sand and coarser materials.

The Bx, Btx, or Btxg horizon has hue of 2.5YR to 10YR, value of 4 to 6, and chroma of 1 to 6, and is mottled. Faces of peds have dominant chromas of 2 or less. Texture is silt loam, loam, clay loam, or silty clay loam and contains from 0 to 20 percent coarse fragments.

The Cx or C horizon has hue of 10R to 5YR, value of 3 to 5, and chroma of 2 to 4. It contains coarse mottles with hue of 5YR to 10YR, value of 5 or 6, and chroma of 1 to 8. Texture is silt loam, loam, clay loam, or silty clay loam. Coarse fragments increase markedly as depth increases and are as much as 20 to 35 percent or more by volume near the base of the horizon. The C horizon is massive, dense, brittle and firm or very firm.

GEOGRAPHIC SETTING: Croton soils are on nearly level and sloping upland flats or in depressions. Slopes are 0 to 8 percent. The soils formed mostly in residuum weathered from fine-grained silty sandstones, argillites siltstones or red shales, but the upper soil horizons of some pedons formed in a thin silt layer deposited by either wind or water.
The climate is humid temperate. Average annual precipitation ranges from 40 to 48 inches, average annual air temperature from 50 to 55 degrees F. and average frost-free season from 160 to 190 days.

DRAINAGE AND PERMEABILITY: Drainage is poor. Runoff is slow and permeability is

slow in the fragipan. Excess water is perched above the fragipan in late winter and early spring but this has been used or has evaporated by summer.

USE AND VEGETATION: Wild vegetation is forest of pin oak, white oak, ash, beech and red maple. Cleared areas are used mostly as pasture, hay land or are idle. A small part is used for growing corn.

Klinesville Series

The Klinesville series consists of shallow, somewhat excessively drained soils formed in residuum derived from red shale, siltstone, slate, and fine-grained sandstone. They are on dissected uplands. Slopes range from 3 to 80 percent. Permeability is moderately rapid. Mean annual precipitation is 43 inches and mean annual temperature is 53 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, active, mesic Lithic Dystrudepts

TYPICAL PEDON: Klinesville very channery silt loam, cultivated. (Colors are for moist soil.)

Ap--0 to 5 inches; dark reddish brown (2.5YR 3/4) very channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; few fine roots; 50 percent shale fragments; very strongly acid; abrupt wavy boundary. (3 to 10 inches thick)

Bw--5 to 15 inches; reddish brown (2.5YR 4/4) extremely channery silt loam; weak medium sub-angular blocky structure; friable, slightly sticky, slightly plastic; few fine roots; 60 percent shale fragments; very strongly acid; clear wavy boundary. (3 to 10 inches thick)

C--15 to 19 inches; weak red (2.5YR 4/2) weathered fragments of shale and reddish brown (2.5YR 4/4) silt coatings; massive; friable; 90 percent shale fragments; strongly acid; clear wavy boundary. (0 to 6 inches thick)

R--19 inches; weak red (2.5YR 4/2) fractured acid shale bedrock.

TYPE LOCATION: Montgomery County, Pennsylvania; Upper Providence Township; about 1 1/4 miles east of Royersford.

RANGE IN CHARACTERISTICS: Solum thickness and depth to bedrock range from 10 to 20 inches. Rock fragments are dominantly red shale and range from 15 to 75 percent in the solum, and from 40 to 90 percent in the C horizon with an average of more than 50 percent in the textural control section. Where unlimed, soil reaction ranges from very strongly acid through moderately acid throughout. Illite and vermiculite are dominant clay minerals and the soil contains detectable amounts of chlorite, kaolinite and interstratified clay.

The A horizon has hue of 5YR through 10R, value of 2 through 4, and chroma of 2 through 4. Texture of the fine-earth fraction is silt loam or loam.

A thin grayish E horizon is in some pedons.

The B horizon has hue of 5YR through 10R, value of 3 through 5, and chroma of 3 through 6. Texture of the fine-earth fraction is silt loam or loam. Structure is weak or moderate fine or medium sub-angular blocky. Consistence ranges from friable to firm, from non-sticky to slightly sticky, and from non-plastic to slightly plastic.

The C horizon has hue of 5YR through 10R, value of 3 or 4, and chroma of 3 through 6. Texture of the fine-earth fraction is silt loam or loam.

GEOGRAPHIC SETTING: Klinesville soils are gently sloping to very steep upland soils on convex positions. Slopes range from 3 to 80 percent. Klinesville soils formed in weathered reddish shale with some slate, siltstone or fine-grained sandstone. The climate is humid temperate. Mean annual precipitation ranges from 36 to 50 inches; mean annual temperature ranges from 47 to 59 degrees F, and the growing season ranges from 130 to 200 days.

DRAINAGE AND PERMEABILITY: Somewhat excessively drained. Runoff is medium to very rapid and permeability is moderately rapid.

USE AND VEGETATION: Mainly forest or pasture. Locally the less sloping areas are used for growing hay and tilled crops. Common trees are chestnut oak, black oak and Virginia pine.

Lansdowne Series

The Lansdowne series consists of dark reddish brown silt loam

Ap horizons and yellowish red mottled silty clay loam to clay

B2 horizons of clay accumulation and are underlain by red shale bedrock below 40 inches.

TAXONOMIC CLASS: Fine, mixed, mesic Aquultic Hapludalfs

TYPICAL PEDON: Lansdowne silt loam - abandoned field.) Colors are for moist condition.)

Ap--0 to 9 inches, dark reddish brown (5YR 3/3) silt loam; moderate medium granular structure; friable; many fine roots; medium acid; abrupt smooth boundary. (4 to 10 inches thick)

B21t--9 to 14 inches, yellowish red (5YR 4/6) heavy silty clay loam; few fine distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; moderate medium sub-angular blocky structure; friable, plastic; few fine roots; common thin reddish gray (5YR 5/2) clay films on ped faces, root channels and in pores; 2 percent fine rounded glacial pebbles consisting of granite gneiss, quartzite and red shale; strongly acid; clear wavy boundary. (3 to 10 inches thick)

B22t--14 to 25 inches, yellowish red (5YR 4/6) silty clay; common medium distinct reddish gray (5YR 5/2) and reddish brown (2.5YR 4/4) mottles; moderate coarse angular blocky structure; friable, slightly sticky, plastic; common thin reddish gray (5YR 5/2) clay films on ped faces and in pores; 2 percent fine rounded pebbles consisting of granite gneiss, quartzite and red shale; strongly acid; clear wavy boundary. (10 to 20 inches thick)

B23t--25 to 38 inches, yellowish red (5YR 4/6) clay; common medium prominent reddish gray (5YR 5/2), yellowish brown (10YR 5/6) and light gray (10YR 6/1) mottles; moderate coarse prismatic structure parting to moderate coarse angular blocks; firm, plastic; common thin reddish gray (5YR 5/2) clay films on ped faces and in pores; 3 percent rounded pebbles consisting of granite gneiss, quartzite and red shale; few rounded quartzite cobbles; strongly acid; abrupt wavy boundary. (10 to 16 inches thick)

B24t--38 to 44 inches, dark red (2.5YR 3/6) silty clay; common medium prominent yellowish brown (10YR 5/6) and light gray (10YR 6/1) mottles; weak coarse prismatic structure; firm, plastic; few thin reddish gray (5YR 5/2) clay films on ped faces; strongly acid; clear wavy boundary. (0 to 10 inches thick)

IIC--44 to 55 inches, dusky red (10R 3/4) shaly clay loam; fine distinct gray (10YR 6/1) mottles; weak very coarse prismatic structure; firm, plastic; reddish gray (5YR 5/2) coatings along prism faces; 20 percent shale fragments; medium acid. (0 to 15 inches thick)

R--55 inches, dark red (2.5YR 3/6) jointed and partially weathered red shale bedrock. Reddish gray (5YR 5/2) coatings on fractured shale.

TYPE LOCATION: Somerset County, New Jersey; 150 yards east of Unionville Cemetery and 20 feet south of Dutchtown Zion Road, Montgomery Township.

RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 40 to 55 inches and is centered on 45 inches. Depth to hard shale bedrock is greater than 40 inches. Coarse fragments are dominantly rounded gravel and cobbles 1/4 to 6 inches in diameter and range from 2 to 15 percent by volume in solum. Weatherable fragments normally increase with depth. Reaction ranges from strongly acid in the upper part of the solum to medium acid in the lower part or in the C horizon unless limed. The Ap horizons are dark reddish brown (5YR 3/3) to very dark grayish brown (10YR 3/2).

Texture is a loam or silt loam. The consistence ranges from friable to firm, slightly sticky to sticky, and slightly plastic to plastic. The color of the B2 horizon ranges from dark reddish brown (2.5YR 3/4) to strong brown (7.5YR 5/6). Textures are heavy silty clay loam, silty clay, heavy clay loam and clay. Structure is moderate to strong medium to coarse blocky but grades to moderate coarse prismatic in the lower part of many pedons. The consistence ranges from friable to firm in the upper part, and firm to extremely firm in the lower part, and sticky to very sticky to very sticky and plastic or very plastic. The color or the C horizon ranges from dusky red (10YR 3/4) to reddish brown (5YR 4/3). Texture ranges from clay loam to sandy loam. Consistence is firm or very firm.

GEOGRAPHIC SETTING: The Lansdowne soils are on nearly level to gently rolling uplands. They occur on broad flats, in slight depressions and along drainage ways. The regolith is derived from old alluvium and glacial till mainly from red shale, and overlies red shale bedrock.

DRAINAGE AND PERMEABILITY: Lansdowne soils are moderately well and somewhat poorly drained. They have free water within 30 inches of the surface from October to June.

Runoff is slow on nearly level areas and medium on gently sloping areas. Permeability is slow.

USE AND VEGETATION: A large proportion is under cultivation. Principal crops are corn, soybeans, small grains, hay and pasture. a smaller proportion is in permanent pasture or in woodland. Undrained areas are idle in many places. In wooded areas the dominant species are pin oak, maple, white and black oak and white ash.

Mount Lucas Series

The Mount Lucas series consists of deep and very deep, moderately well and somewhat poorly drained soils formed in material weathered from diabase and other dark colored basic rocks. Slopes range from 0 to 25 percent. Permeability is slow. Mean annual precipitation is 42 inches. Mean annual temperature is 53 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, super active, mesic Aquic Hapludalfs

TYPICAL PEDON: Mount Lucas silt loam - woodland. (Colors are for moist soil unless otherwise noted.)

Oi--3 to 0 inches; leaves, twig and moss.

A--0 to 2 inches; very dark brown (10YR 2/2) silt loam; moderate very fine granular structure; very friable, non-sticky, non-plastic; 5 percent rock fragments up to 2 inches in diameter; moderately acid; abrupt wavy boundary. (1 to 4 inches thick)

E--2 to 9 inches; yellowish brown (10YR 5/4) silt loam; moderate fine granular structure; friable, slightly sticky, non-plastic; 10 percent rock fragments up to 2 inches in diameter; moderately acid; clear wavy boundary. (0 to 5 inches thick)

BE--9 to 13 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine sub-angular blocky structure; friable, slightly sticky, slightly plastic; 10 percent rock fragments up to 1 inch in diameter; moderately acid clear wavy boundary. (0 to 5 inches thick)

Bt1--13 to 20 inches; strong brown (7.5YR 5/6) clay loam; moderate medium and fine sub-angular blocky structure; friable, slightly sticky, slightly plastic; common faint clay films on faces of peds; 10 percent rock fragments up to 1 inch in diameter; moderately acid; clear wavy boundary. (6 to 11 inches thick)

Bt2--20 to 34 inches; brown (7.5YR 4/4) clay loam; many medium and coarse prominent mottles of yellowish red (5YR 5/8), red (2.5YR 4/6), and grayish brown (10YR 5/2); moderate medium sub-angular blocky structure; friable, sticky, plastic; common faint clay films on faces of peds and in pores; 10 percent rock fragments; moderately acid; abrupt wavy boundary. (6 to 18 inches thick)

BC--34 to 38 inches; dark brown (7.5YR 4/4) clay loam; common medium distinct mottles of gray (10YR 6/1) and yellowish red (5YR 5/6); weak medium sub-angular blocky structure; friable, slightly sticky, slightly plastic; few faint clay films on faces of peds and in pores; 10 percent rock fragments; slightly acid; abrupt wavy boundary. (0 to 5 inches thick)

C1--38 to 54 inches; dark brown (7.5 4/4) gravelly clay loam and sandy loam; layers or streaks of reddish brown (5YR 4/4) and gray (10YR 5/1); weak coarse sub-angular blocky structure; friable, slightly sticky, slightly plastic; few faint clay films on faces of peds; 30 percent rock fragments of diabase; slightly acid; abrupt wavy boundary. (5 to 18 inches thick)

C2--54 to 60 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; single grained; friable, non-sticky, non-plastic; 25 percent rock fragments of weathered diabase; slightly acid.

TYPE LOCATION: Montgomery County, Pennsylvania; New Hanover Township, 1/2 mile northeast of Anise, near Hildebrand Road, 800 feet north of the intersection of Finn Road.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 25 to 50 inches. Depth to bedrock is greater than 48 inches. Angular rock fragments of diabase and some quartzite and other rocks range from less than 0 to 30 percent in the solum and from 5 to 60 percent in the C horizon. The upper part of the solum ranges from strongly to slightly acid and the lower part from moderately acid to neutral. The dominant clay mineral is kaolinite with appreciable amounts of illite and montmorillonite.

The Ap horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 through 4. Texture is silt loam or loam in the fine-earth fraction.

The Bt horizon has hue of 7.5YR or 5YR, value of 5 or 6, and chroma of 3 through 6. Texture ranges from silty clay loam to sandy clay loam in the fine-earth fraction and contains 18 to 30 percent clay. It has prismatic or sub-angular blocky structure.

The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 through 6. Texture ranges from silt loam to loamy coarse sand in the fine-earth fraction. Depth to loamy sand is greater than 40 inches.

GEOGRAPHIC SETTING: Mount Lucas soils are nearly level to moderately steep soils. They occupy upland flats and concave lower slopes with dominant slope gradients of 0 to 25 percent. They developed in materials weathered from diabase and other dark colored basic rocks. The climate is humid temperate with mean annual precipitation of 38 to 46 inches, mean annual temperature of 50 to 55 degrees F., and a frost-free season of 170 to 200 days.

DRAINAGE AND PERMEABILITY: Moderately well and somewhat poorly drained with medium runoff and slow permeability.

USE AND VEGETATION: Approximately 50 percent cleared and in general farm crops. Woodland areas are oak-hickory type mixed hardwoods.

Neshaminy Series

The Neshaminy series consists of deep and very deep, well drained soils formed in materials weathered from diabase and other dark colored basic rocks. Permeability is moderately slow.

Mean annual precipitation is 42 inches. Mean annual temperature is 50 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, super active, mesic Ultic Hapludalfs

TYPICAL PEDON: Neshaminy channery silt loam - forested, very stony. (Colors are for moist soil unless otherwise noted.)

Oi--3 to 1 inches; litter of hardwood leaves.

Oe--1 to 0 inches; black, partially decomposed leaf mold.

A--0 to 2 inches; brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; 25 percent rock fragments, mostly stone size; strongly acid; clear wavy boundary. (1 to 4 inches thick)

E--2 to 11 inches; yellowish brown (10YR 5/4) channery silt loam; weak fine granular structure; friable, slightly sticky, slightly plastic; 20 percent rock fragments, mostly stone size; strongly acid; gradual wavy boundary. (4 to 11 inches thick)

BE--11 to 14 inches; brown (7.5YR 5/4) channery silt loam; moderate medium sub- angular blocky structure; friable, slightly sticky, slightly plastic; 20 percent rock fragments, mostly stone size; moderately acid; clear wavy boundary. (0 to 4 inches thick)

Bt1--14 to 21 inches; strong brown (7.5YR 5/4) channery clay loam; moderate medium sub-angular blocky structure; firm, slightly sticky, plastic; many prominent clay films; few black coatings; 25 percent rock fragments, mostly stone size; moderately acid; gradual wavy boundary. (5 to 9 inches thick)

Bt2--21 to 39 inches; yellowish red (5YR 5/6) channery clay loam; moderate medium blocky structure; firm, sticky, plastic; many distinct clay films in upper part, common distinct in lower part; 25 percent rock fragments, mostly stone size, moderately acid; abrupt irregular boundary. (10 to 25 inches thick)

Bt3--39 to 52 inches; yellowish red (5YR 5/6) channery sandy clay loam; moderate medium blocky structure; friable, slightly sticky, slightly plastic; few faint clay films; 30 percent rock fragments, mostly stone size; moderately acid; abrupt irregular boundary. (5 to 15 inches thick)

C--52 to 54 inches; yellowish red (5YR 4/6) very channery sandy loam; massive; friable, non-sticky, non-plastic; 50 percent weathered soft rock fragments; moderately acid; abrupt irregular boundary. (0 to 15 inches thick)

R--54 inches; hard, fine-grained diabase bedrock.

TYPE LOCATION: Montgomery County, Pennsylvania; Marlborough Township, 1.7 miles northeast of Sumneytown, 200 feet east of Dalmont Lake, near old rifle range.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. Depth to

bedrock is 4 to 6 feet or more. Rock fragments of sub-rounded diabase and angular quartzite range from 0 to 40 percent in individual horizons of the upper part of the solum and from 0 to 60 percent in the lower part and C horizons. Diabase fragments are up to 20 inches in size but quartzite fragments are usually less than 3 inches. The soil, where unlimed, ranges from very strongly acid through moderately acid in the upper part of the solum and from strongly acid through slightly acid in the lower part of the solum and in the C horizon.

The A horizon has hue of 5YR through 10YR, value of 2 through 5 and chroma of 1 through 3. The E horizon has value of 4 through 5 and chroma of 2 through 4. Ap horizons have value of 3 through 5 and chroma of 2 through 4. A horizons range in texture from silty clay loam to loam in the fine-earth fraction.

The B horizon has hue of 2.5YR through 7.5YR, value of 4 or 5, and chroma of 4 through 8. Texture is silty clay loam, loam, clay loam, sandy loam, or sandy clay loam in the fine- earth fraction. Sand content usually increases with depth. Structure is sub-angular blocky or angular blocky.

The C horizon has hue of 2.5YR through 7.5YR, value of 3 through 5, and chroma of 4 through 6. The C horizon is variegated in some pedons. It is silt loam, loam, clay loam, sandy clay loam, or sandy loam in the fine-earth fraction.

GEOGRAPHIC SETTING: Neshaminy soils are nearly level to steep soils on uplands. Slope gradients range from 1 to 45 percent. They have developed in materials weathered from diabase and other dark colored basic rocks. The climate is temperate and humid; mean annual air temperature ranges from 45 to 55 degrees F., mean annual precipitation ranges from 38 to 46 inches, and the frost-free season ranges from 170 to 200 days.

DRAINAGE AND PERMEABILITY: Well drained. Permeability is moderately slow. Runoff ranges from slow to very rapid.

USE AND VEGETATION: The soil is used for cropland, hay, and pasture. Some of the soil has been developed for urban or suburban communities. Stony and steep areas are mostly in woodland of mixed hardwoods, dominated by oaks and hickories.

Norton Series

The Norton series consists of deep well drained soils on uplands. They formed in fine textured red till or colluvium. Slope ranges from 0 to 20 percent. Norton soils are very slowly permeable.

TAXONOMIC CLASS: Fine, mixed, sub-active, mesic Ultic Hapludalfs

TYPICAL PEDON: Norton loam - cultivated. (Colors are for moist soil.)

Ap--0 to 10 inches, reddish brown (5YR 4/3) loam, (5YR 5/3) dry; weak fine granular structure; friable; 2 percent quartzose pebbles; strongly acid. (8 to 12 inches thick)

B1--10-14 inches, weak red (2.5YR 4/2) silty clay loam; weak coarse sub-angular blocky

structure vertically elongated parting to moderate fine sub-angular and angular blocky structure; extremely hard in place, friable when removed, slightly sticky, plastic; some roots in crevices; patchy clay films; 5 percent shale fragments and some quartzose pebbles; strongly acid; gradual smooth boundary. (2 to 6 inches thick)

B21t--14 to 24 inches, dark reddish brown (2.5YR 3/4) heavy silty clay loam; 30 percent reddish brown (2.5YR 4/4) and 2 percent black (N 2/) mottles; moderate medium prismatic structure parting to moderate thick platy structure; extremely hard, very firm, sticky, plastic; roots in crevices; dense; small black dull clay films; 2 percent quartzose pebbles; strongly acid; clear wavy boundary. (3 to 12 inches thick)

B22t--24 to 44 inches, weak red (2.5YR 4/3) heavy silty clay loam; weak and moderate, coarse and medium, imperfect prismatic structure and a few horizontal partings; extremely hard, very firm, sticky, plastic; very few roots; dense; thick shiny clay films on faces of all peds; 5 percent quartzose pebbles; very strongly acid; diffuse smooth boundary. (15 to 25 inches thick)

B23t--44 to 63 inches, weak red (2.5YR 4/3) and yellowish red (5YR 4/6) silty clay loam; massive and some weak coarse prismatic structure; extremely hard, very firm, sticky, plastic; dense; 5 percent quartzose pebbles; thin smooth clay films on faces of all peds; very strongly acid; clear wavy boundary. (10 to 25 inches thick)

IIC--63 to 70 inches, dark reddish brown (2.5YR 3/4) shaly loam; massive; 20 percent fragments of red shale 1/2 to several inches across, on coating surfaces; medium acid; gradual irregular boundary. (0 to 15 inches thick)

IIR--70 inches, coarsely fractured red shale with all crevices somewhat thinly coated.

TYPE LOCATION: Somerset County, New Jersey; Hillsboro Township; 50 feet south of barn west side of Beekman lane, 1/2 mile north of New Amwell Road, 2250 feet south of Lehigh Valley Railroad.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 80 or more inches. Depth to bedrock is 3 1/2 to 10 feet. Coarse fragments are dominantly pebbles or cobblestones of quartz or gneiss. Most pedons contain a few fragments of shale in the solum but the amount increases sharply in the C horizon. Coarse fragments range from 0 to 15 percent in the A and B horizons and 2 to 90 percent in the C horizon. The soil ranges from very strongly acid to medium acid where unlimed. The Ap horizon ranges from dark reddish brown (2.5YR 3/4) through dark reddish gray (5YR 4/2). The A1 horizon is black (5YR 2/1) or nearly black; and the A2 horizon reddish brown (5YR 4/4) to dark reddish brown (5YR 3/3). The A horizons are loam or silt loam. The Bt horizon has hues of 10R and 2.5YR, values of 3 or 4 and chromas of 3 through 6. It is mainly heavy silty clay loam but the range includes heavy clay loam and clay. Sub-horizons of the argillic horizon range from 30 to 50 percent clay and the upper 20 inches averages more than 35 percent. The upper part of the B horizon commonly has moderate medium prismatic structure parting to moderate medium platy and strong to moderate medium sub-angular and angular blocky structure; the lower part is generally massive, and some pedons have thin vertical cracks. The soil is very firm and few roots reach beyond a depth of 24

inches except those that are in cracks. The C horizon dominantly has hues of 2.5YR, values of 3 and chroma of 4. It ranges from shaly or very shaly loam to sandy loam.

DRAINAGE AND PERMEABILITY: Norton soils are well drained. Runoff is slow on the predominantly gentle slopes. They are slowly permeable. Water may be perched over the dense Bt horizon for short periods.

USE AND VEGETATION: Most of the soil has been cleared and cropped chiefly to small grain, corn, soybeans and hay or is in pasture. Wild vegetation consists mainly of oaks, hickories, beech and maple.

Parker Series

The Parker series consists of very deep, somewhat excessively drained soils that formed in residuum derived from granitic gneiss bedrock. They occur on gently sloping to very steep slopes of ridges and hills. Slopes range from 3 to 70 percent.

TAXONOMIC CLASS: Loamy-skeletal, mixed, mesic Typic Dystrochrepts

TYPICAL PEDON: Parker very gravelly sandy loam, on a 24 percent slope, wooded. (Colors are for moist soil.)

0i--10 to 7 inches; tree leaves and twigs from oak, yellow poplar and ash. (0 to 8 inches thick)

0e--7 to 0 inches; black (10YR 2/1) partially decomposed organic matter in spaces between angular stones, gravel and cobbles; strongly acid. (0 to 7 inches thick)

A--0 to 5 inches; dark brown (7.5YR 3/2) very gravelly sandy loam; strong coarse granular structure; friable; many fine and few large roots; 50 percent angular stones, cobbles and gravel; strongly acid; abrupt irregular boundary. (2 to 8 inches thick)

Bw1--5 to 20 inches; brown (7.5YR 4/4) very gravelly loam; moderate coarse granular structure; very friable; few fine and many large roots; 50 percent angular gravel, cobbles and stones; strongly acid; diffuse irregular boundary. (10 to 20 inches thick)

Bw2--20 to 31 inches; dark yellowish brown (10YR 4/4) very gravelly sandy loam; moderate coarse granular and moderate fine sub-angular blocky structure; very friable; few fine and large roots; 50 percent angular stones, cobbles and gravel; very strongly acid; diffuse irregular boundary. (5 to 15 inches thick)

C--31 to 65 inches; yellowish brown (10YR 5/4) extremely gravelly sandy loam; weak coarse granular structure; very friable; few fine roots; 60 percent angular stones, cobbles and gravel, mostly hard and unweathered; very strongly acid.

TYPE LOCATION: Morris County, New Jersey; 870 feet north of Hanover Avenue across the road from junction with Raynor Road.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 20 to 40 inches. Depth to solid bedrock ranges from 4 to 10 feet or more. Rock fragments range from 35 to 70 percent by volume through the solum and 60 to 90 percent in the C horizon. Rock fragment sizes commonly range from gravel through stones but individual pedons are dominated by either gravel, cobbles or stone fragments. Rock fragments on the soil surface range to extremely stony. The silt and sand fractions are dominated by quartz, feldspar and various Ferro-magnesium minerals derived from granitic gneiss or similar rocks. The soil usually contains very small amounts of mica. The fine-earth fraction of the control section typically has 10 to 18 percent clay. Texture of the fine-earth fraction throughout the solum and substratum is loam or sandy loam. Some pedons have a few faint clay films on faces of peds and in voids and bridging between sand grains. The soil is very strongly acid or strongly acid unless limed.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 through 4. It commonly has moderate or strong, medium or coarse granular structure.

Some pedons have an E horizon that has hue of 7.5YR or 10YR, value of 2 through 6, and chroma of 1 through 6.

The B horizon has hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 3 through 6. The abundant rock fragments interrupt structure, but the fine-earth fraction has moderate, medium and coarse granular or weak, fine or medium sub-angular blocky structure.

The C horizon has hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 3 through 6. Color patterns appear to be related to differential weathering of the banded gneiss (or related types) bedrock. Some pedons have a Cr horizon.

GEOGRAPHIC SETTING: Parker soils formed in residuum derived from granitic gneiss bedrock. They are on ridges and hills in the uplands. Slopes of 15 percent are common but the range extends from 3 to 70 percent. The mean annual temperature ranges from 45 to 55 degrees F.; mean annual precipitation ranges from 40 to 48 inches; and the frost-free season ranges from 150 to 190 days.

DRAINAGE AND PERMEABILITY: Somewhat excessively drained. Moderately rapid permeability. Runoff is moderate to rapid.

USE AND VEGETATION: Less than half of the Parker soils are cleared of trees and stones for growing crops. Most cleared areas are idle for a number of years and are in various stages of second growth forest dominantly of dogwood and red cedar. On Parker soils which have not been cleared but have been repeatedly logged, the vegetation is the oak-hickory forest.

Parsippany Series

The Parsippany series consists of deep, poorly drained soils in extinct lake basins and near streams. They formed in silty and clayey sediments. Slope ranges from 0 to 8 percent. Permeability is moderate in the surface horizons, slow or very slow in the subsoil and moderately rapid to very slow in the substratum. Parsippany soils are subject to seasonal flooding. Mean

annual temperature is about 50 degrees F. and mean annual precipitation is about 46 inches.

TAXONOMIC CLASS: Fine, mixed, active, mesic Aeric Endoaqualfs

TYPICAL PEDON: Parsippany silt loam - in woodland at an elevation of about 235 feet. (Colors are for moist soil.)

A--0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam; weak very fine granular structure; friable, slightly sticky, non-plastic; many fibrous and few medium and coarse roots; strongly acid; clear wavy boundary. (1 to 7 inches thick)

ABg--2 to 4 inches; dark gray (10YR 4/1) silt loam; moderate medium and fine sub- angular blocky structure; friable, slightly sticky, non-plastic; common fine and medium roots; many silt and sand grains stained with very dark grayish brown (10YR 3/2); very strongly acid; gradual wavy boundary. (0 to 6 inches thick)

Bg--4 to 9 inches; gray (10YR 6/1) silty clay loam; moderate medium sub-angular blocky structure; firm, slightly sticky, plastic; many medium and fine roots; few vertically oriented gray streaks; sand and silt grains stained or coated; many coarse prominent strong brown (7.5YR 5/6) masses of iron accumulation and common fine faint dark gray (10YR 4/1) iron depletions; very strongly acid; gradual wavy boundary. (0 to 10 inches thick)

Btg1--9 to 18 inches; gray (5YR 5/1) silty clay; moderate medium sub-angular blocky structure and moderate fine angular blocky structure; firm, slightly sticky, very plastic; few fine roots; few vertically oriented gray streaks; many prominent clay films in channels and on faces of peds; many brown (7.5YR 4/4) masses of iron accumulation and many brown (7.5YR 5/2) iron depletions on faces of peds and interiors of peds; moderately acid; gradual wavy boundary. (3 to 40 inches thick)

Btg2--18 to 29 inches; reddish brown (5YR 4/4) silty clay; moderate coarse sub-angular blocky structure; very firm, slightly sticky, slightly plastic; few fine roots; few prominent reddish brown (5YR 4/3) clay films and few black (N 2/) stains on faces of peds; few vertically oriented gray streaks; 3 percent fine gravel composed mostly of granitic gneiss and shale; moderately acid; many coarse distinct strong brown (7.5YR 5/6) masses of iron accumulation and common coarse prominent grayish brown (10YR 5/2) iron depletions; gradual wavy boundary. (0 to 20 inches thick)

BC--29 to 50 inches; nearly equal portions of brown (7.5YR 5/4) and strong brown (7.5YR 5/6) silty clay loam; weak thick platy structure to massive in the lower part; very firm, sticky, plastic, few roots mostly in or near vertically oriented streaks; very few prominent clay films in voids and along some vertical streaks; few vertically oriented reddish brown (5YR 4/3) and brown (7.5YR 5/2) streaks; cut mass sprinkled with black or rust colored dots; slightly acid; gradual wavy boundary. (0 to 21 inches thick)

C--50 to 70 inches; reddish brown (5YR 4/3) varied silt loam with few 1/2 to 1 inch lamellae of very fine sand and silt; massive; firm; neutral.

TYPE LOCATION: Somerset County, New Jersey; 250 feet east of Dead River Road, 100 feet

south of Dead River at edge of a woodlot. USGS Bernardsville quadrangle; latitude 40 degrees, 39 minutes, 4 seconds N. and longitude 74 degrees, 32 minutes, 45 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 30 to 60 inches with a lower boundary that ranges from clear to diffuse. Depth to bedrock is more than 6 feet. Coarse fragments are generally lacking but range to 5 percent in sub-horizons within the solum and to 20 percent in the C horizon. Unless limed, the reaction is very strongly or strongly acid near the surface and increases with depth to slightly acid to mildly alkaline in the C horizon. Lamellae or varves are evident within the series control section.

The O horizon, where present, has hue of 7.5YR or 10YR, value of 2, and chroma of 1 or 2. In lieu texture is slightly, moderately, or highly decomposed plant material.

The A horizon has hue of 5YR to 10YR, value of 2 to 4, and chroma 1 to 3. Ap horizons have hues of 5YR to 10YR, values of 3 to 5 moist and 6 or 7 dry, and chroma of 1 or 2. Texture is silt loam or silty clay loam. The A horizons have weak or moderate medium or fine granular or sub-angular blocky structure and are friable or very friable. Some pedons have strong fine granular structure.

The B horizons have hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 to 6, with low chroma dominant in the upper part. Also, hues of 10YR are only in the upper part. Redoximorphic features are common or many, medium or coarse throughout the B horizon or the horizon is variegated with nearly equal proportions of two or three colors. Texture in individual sub-horizons ranges from silt loam to clay but the weighted average clay content in the textural control section is more than 35 percent.

The C horizon has hue of 2.5YR to 7.5YR, value of 3 to 6, and chroma of 3 to 6. Redoximorphic features range from few to many and faint to distinct. Texture ranges from clay to sandy loam above 40 inches and loamy sand to silty clay below.

GEOGRAPHIC SETTING: Parsippany soils are nearly level to gently sloping and generally within large basins. Slope is 0 to 8 percent. These soils formed in silty and clayey sediments containing a high proportion of fines derived from weathered basalt, shale and granitic materials. The climate is humid temperate. Average annual precipitation is 40 to 48 inches and the growing season is about 140 to 170 days. Mean annual temperature is about 45 to 50 degrees F.

DRAINAGE AND PERMEABILITY: Poorly drained. Surface runoff is negligible to high. Permeability is moderate in the surface horizons, slow or very slow in the subsoil and moderately rapid to very slow in the substratum. Saturated hydraulic conductivity is moderately low to high in the surface horizons and low to moderately high in the subsoil and low to high in the substratum. The water level is at or near the surface throughout the winter and early spring and following periods of heavy rainfall. Flooding is none to frequent and occurs in most areas of Parsippany soils but particularly adjacent to major streams.

USE AND VEGETATION: A small portion is used for crops, hay and pasture, but most Parsippany soils are in woodland. Originally swamp white oak, elm, ash, and swamp maple grew on these soils.

Penn Series

The Penn series consists of moderately deep, well drained soils formed in materials weathered from non-calcareous reddish shale, siltstone, and fine-grained sandstone normally of Triassic age. Slopes range from 0 to 60 percent. Permeability is moderate or moderately rapid. Mean annual precipitation is 43 inches. Mean annual temperature is 55 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, super-active, mesic Ultic Hapludalfs

TYPICAL PEDON: Penn silt loam - cropland. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 8 inches; dark reddish brown (2.5YR 3/4) silt loam; weak fine and medium granular structure; friable, non-sticky, slightly plastic; many roots; many pores; 10 percent shale and siltstone fragments; slightly acid; clear wavy boundary. (6 to 12 inches thick)

Bt1--8 to 11 inches; reddish brown (2.5YR 4/4) channery silt loam; weak fine and medium sub-angular blocky structure; friable, slightly sticky, slightly plastic; common roots; many pores; common faint clay films on faces of peds; 15 percent shale and siltstone fragments; slightly acid; gradual wavy boundary. (2 to 6 inches thick)

Bt2--11 to 17 inches; reddish brown (2.5YR 4/4) channery silt loam; moderate fine and medium sub-angular blocky structure; friable, slightly sticky, slightly plastic; few roots; many faint clay films on faces of peds; 25 percent shale and siltstone fragments; moderately acid; clear wavy boundary. (4 to 14 inches thick)

Bt3--17 to 21 inches; weak red (10R 4/4) channery silt loam; weak medium sub-angular blocky structure; firm, slightly sticky, slightly plastic; few faint clay films on faces of peds; common black coatings on rock fragments; 40 percent shale and siltstone fragments; moderately acid; clear wavy boundary. (0 to 9 inches thick)

C--21 to 34 inches; weak red (10R 4/4) channery silt loam; weak medium sub-angular blocky structure; firm, slightly sticky, slightly plastic; few faint clay films on faces of peds; common black coatings on rock fragments; 40 percent shale and siltstone fragments; strongly acid. (0 to 14 inches thick)

Cr--34 inches; dusky red (10R 3/3) soft ,fractured, shale and siltstone bedrock.

TYPE LOCATION: Montgomery County, Pennsylvania; Perkiomen Township, 1 mile N of Trappe, 4000 feet N intersection of U.S. Route 422 and Church road, 200 feet E of Church road in field.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 17 to 34 inches. Depth to bedrock ranges from 20 to 40 inches. Rock fragment content, by volume, ranges from 2 to 30 percent in the A horizon, from 5 to 50 percent in individual horizons of the B, and from 30 to 90 percent in the C horizon, the control section average is less than 35 percent. The soil, where unlimed, ranges from extremely through strongly acid in the upper part of the solum, is strongly acid or moderately acid in the lower part of the solum, and ranges from strongly acid through

slightly acid in the C horizon.

The Ap horizon has hue of 7.5YR through 10R, value of 3 or 4, and chroma of 2 through 4. Texture is silt loam or loam in the fine-earth fraction.

The B horizon has hue of 10R through 5YR, value of 3 through 6, and chroma of 2 through 6. Texture is silt loam, loam or silty clay loam in the fine-earth fraction.

The C horizon has hue of 10R through 5YR, value of 3 or 4, and chroma of 2 through 4. Texture is silt loam, loam, or sandy loam in the fine earth-fraction.

GEOGRAPHIC SETTING: Penn soils are on nearly level to steep moderately dissected uplands. Slopes range from 0 to 60 percent. They formed in materials weathered from non-calcareous reddish shale, siltstone, and fine-grained sandstone, normally of Triassic age. The climate is humid temperature. Mean annual precipitation ranges from 38 to 48 inches, mean annual air temperature ranges from 50 to 59 degrees F, and the frost free season ranges from 170 to 200 days.

DRAINAGE AND PERMEABILITY: Well drained; runoff is medium to very rapid and permeability is moderate or moderately rapid.

USE AND VEGETATION: About 75 percent cleared and largely used for rotation cropland. Woodlands are mixed hardwoods dominated by oaks.

Raritan Series

The Raritan series consists of very deep, moderately well and somewhat poorly drained soils formed in sediments from red non-calcareous shale, siltstone, and sandstone. Slopes range from 0 to 15 percent. Permeability is moderately slow. Mean annual precipitation is 42 inches. Mean annual temperature is 53 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Aquic Fragiudults

TYPICAL PEDON: Raritan silt loam - cropland. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 9 inches; dark brown (7.5YR 4/2) silt loam; weak fine granular structure; friable; few water rounded quartz pebbles; strongly acid; abrupt smooth boundary. (8 to 10 inches thick)

BA--9 to 14 inches; strong brown (7.5YR 5/6) silt loam; moderate fine and medium sub- angular blocky structure; friable, slightly sticky and slightly plastic; few faint clay films on faces of peds; 5 percent rock fragments; strongly acid; clear wavy boundary. (0 to 6 inches thick)

Bt1--14 to 20 inches; yellowish red (5YR 5/6) clay loam; moderate medium sub-angular blocky structure; firm, slightly sticky and slightly plastic; common thin clay films on faces of peds and in pores; few dark coatings; 5 percent rock fragments; strongly acid; clear wavy boundary. (4 to 8 inches thick)

Bt2--20 to 27 inches; reddish brown (5YR 5/4) clay loam; common medium distinct strong brown (7.5YR 5/6) and reddish gray (5YR 5/2) mottles; moderate medium blocky structure; firm, slightly sticky and slightly plastic; common thin clay films on faces of peds and in pores; few dark coatings; 5 percent rock fragments; strongly acid; abrupt wavy boundary. (5 to 9 inches thick)

Btx--27 to 43 inches; reddish brown (5YR 4/3) clay loam; grayish brown (10YR 5/2), prism coatings and common medium distinct red (2.5YR 4/6), reddish gray (5YR 5/2), and dark brown (7.5YR 4/4) mottles; weak very coarse prismatic structure separating to moderate medium blocky and weak thin platy; brittle; very firm, slightly sticky, slightly plastic; common distinct clay films on faces of peds and in pores; common dark coatings; 10 percent rock fragments; very strongly acid; clear wavy boundary. (12 to 25 inches thick)

2C--43 to 55 inches; reddish brown (5YR 4/3) and pinkish gray (5YR 6/2) stratified sand, silt and gravel; massive; very strongly acid.

TYPE LOCATION: Montgomery County, Pennsylvania, Douglass Township, 1 mile northeast of Boyertown.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 42 to 56 inches. Depth to unconforming material is more than 40 inches. Depth to the fragipan ranges from 20 to 30 inches. Depth to bedrock ranges from 5 to 20 feet. The amount of water rounded gravel in the solum ranges from 0 to 15 percent and from 0 to 50 percent in the C horizon. The solum and substratum range from very strongly acid through moderately acid, unless limed.

The **Ap** horizon has hue of 5YR through 10YR, value of 3 through 5, and chroma of 2 through 4. In undisturbed areas a thin A horizon has a value of 2 through 4 and chroma of 1 through 3. Texture is silt loam, loam or fine sandy loam in the fine-earth fraction.
Structure is typically weak or moderate fine or medium granular. Consistence is friable. Reaction varies with cultural practices.

The **BA** and **Bt** horizons have hue of 2.5YR through 7.5YR, value of 4 or 5, and chroma of 3 through 6. Btx horizons and mottles have hue of 2.5YR through 10YR, value of 4 through 7, and chroma of 1 through 6. Low chroma mottles occur at depths less than 16 inches or in the upper 10 inches of the argillic horizon. Texture is typically loam, silt loam, or clay loam in the fine-earth fraction but the range includes silty clay loam and sandy clay loam. Structure is weak to moderate medium sub-angular blocky. Consistence is friable to firm becoming very firm and brittle with depth. Structure of the fragipan is typically weak to moderate very coarse prismatic parting to moderate medium blocky.

The **C** horizon has color similar to the **B** horizon but tending to be lower in value and chroma. Texture of the stratified sediments range from silty clay loam to gravel.

GEOGRAPHIC SETTING: Raritan soils are on nearly level to sloping stream terraces, usually above present overflow. Slopes range from 0 to about l5 percent. The soils are formed in sediments washed largely from reddish, non-calcareous shale, siltstone and sandstone uplands. The climate is humid temperate with mean annual precipitation of 38 to 46 inches, mean annual air temperatures of 50 to 55 degrees F., and a frost-free season of 150 to 200 days.

DRAINAGE AND PERMEABILITY: Moderately well and somewhat poorly drained with medium runoff and moderately slow permeability.

USE AND VEGETATION: Largely cleared and in general farm crops with considerable acreage in urban and industrial use. Woodlands are oak type mixed hardwoods.

Reaville Series

The Reaville series consists of moderately deep, moderately well, and somewhat poorly drained soils formed in residuum weathered from red Triassic, interbedded shale, siltstone, and fine-grained sandstone. Slopes range from 0 to 15 percent. Permeability is slow. Mean annual precipitation is 43 inches. Mean annual temperature is 55 degrees F. **TAXONOMIC CLASS:** Fine-loamy, mixed, active, mesic Aquic Hapludalfs

TYPICAL PEDON: Reaville channery silt loam - cropland. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 9 inches; reddish brown (5YR 4/3) channery silt loam; weak fine granular structure; friable, slightly plastic; common fine roots; 15 percent rock fragments of shale up to 1 inch long; slightly acid; clear smooth boundary. (8 to 10 inches thick)

Bt1--9 to 13 inches; reddish brown (2.5YR 4/4) channery silt loam; few fine faint light reddish brown (5YR 6/3) mottles; weak fine sub-angular blocky structure; friable, slightly sticky, slightly plastic; few fine roots; few faint clay films on faces of peds; 20 percent rock fragments of shale; slightly acid; clear wavy boundary. (2 to 10 inches thick)

Bt2--13 to 15 inches; reddish brown (2.5YR 4/4) channery silt loam; common fine distinct yellowish red (5YR 5/8) and reddish gray (5YR 5/2) mottles; moderate medium sub-angular blocky structure parting to weak medium platy; firm, slightly sticky, slightly plastic; few medium roots; common distinct clay films on faces of peds; 30 percent rock fragments of shale; slightly acid; clear wavy boundary. (1 to 6 inches thick)

C--15 to 25 inches; dusky red (10R 3/4) very channery silt loam; common fine distinct reddish gray (5YR 5/2) mottles; massive; firm; 50 percent rock fragments of shale; slightly acid; gradual wavy boundary. (4 to 16 inches thick)

R--25 inches; weak red (10R 4/4) interbedded shale and siltstone.

TYPE LOCATION: Adams County, Pennsylvania; Freedom Township, 5 miles southwest of Gettysburg, just north of Route T327, 1/8 mile west of intersection with Township Route 328.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 12 to 24 inches. Depth to bedrock ranges from 20 to 40 inches. Rock fragments of shale range from 2 to 30 percent in the Ap horizon, 2 to 45 percent in the Bt horizon, and from 30 to 90 percent in the C horizon; the weighted average is less than 35 percent by volume in the particle- size control section. Where unlimed, the solum ranges from very strongly acid through slightly acid. Illite is the dominant

clay mineral, but the soil contains small amounts of kaolinite, vermiculite, and interstratified minerals.

The **Ap** horizon has hue of 2.5YR through 7.5YR, value of 3 or 4, and chroma of 2 through 4. Texture is silt loam in the fine-earth fraction.

The **B** horizon has hue of 10R through 5YR, value of 4 through 6, and chroma of 3 or 4. It has mottles with hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 2 through 8.
Texture is silt loam or silty clay loam in the fine-earth fraction.

The **C** horizon has hue of 10R to 5YR, value of 3 to 4 and chroma of 2 to 4. Fine earth texture is silt loam, loam or silty clay loam.

GEOGRAPHIC SETTING: Reaville soils are on interfluves with very little dissection. Slope ranges from 0 to 15 percent. The soil formed in residuum weathered from red interbedded, Triassic shale, siltstone, and fine- grained sandstone. The climate is humid and temperate; mean annual precipitation ranges from 40 to 46 inches, mean annual temperature ranges from 50 to 60 degrees F., and the growing season ranges from 150 to 200 days.

DRAINAGE AND PERMEABILITY: Moderately well and somewhat poorly drained. Surface runoff is medium to slow. Permeability is slow.

USE AND VEGETATION: Mostly cleared and cultivated. Hay, small grain, and corn are the principal crops, and some areas are in pasture. General farming and dairy farming are the main enterprises. The native vegetation was mixed hardwoods, predominantly oaks.

Riverhead Series

The Riverhead series consists of very deep, well-drained soils formed in glacial outwash deposits derived primarily from granitic materials. They are on outwash plains, valley trains, beaches, and water-sorted moraines. Slope ranges from 0 to 50 percent slopes.
Mean annual temperature is 51 degrees F. and mean annual precipitation is 47 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Typic Dystrudepts

TYPICAL PEDON: Riverhead sandy loam, on a 2 percent slope in an area used for recreation. (Colors are for moist broken soil).

Ap-- 0 to 12 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; friable; many fine roots in upper part; moderate to strong platy structure in firm plow pan in lower 4 inches; strongly acid; abrupt smooth boundary. (6 to 13 inches thick.)

Bw-- 12 to 27 inches; strong brown (7.5YR 5/6) sandy loam; very weak medium sub- angular blocky structure parting to weak fine granular; friable; few fine roots; many fine pores; less than 5 percent gravel; strongly acid; clear wavy boundary. (12 to 24 inches thick.)

BC1-- 27 to 32 inches; yellowish brown (10YR 5/4) loamy sand; very weak fine granular structure; very friable; few fine roots; 10 percent gravel; strongly acid; abrupt smooth boundary. (0 to 10 inches thick.)

2BC2-- 32 to 35 inches; yellowish brown (10YR 5/4) gravelly loamy sand; massive; friable; few fine roots; 30 percent gravel; strongly acid; abrupt smooth boundary. (0 to 10 inches thick.)

2C1-- 35 to 40 inches; brown (7.5YR 4/4) sand; single grain; loose; 10 percent fine gravel; strongly acid; abrupt smooth boundary.

2C2-- 40 to 65 inches; very pale brown (10YR 7/4) coarse and medium sand stratified with 2-inch layers of gravel, 8 to 24 inches apart; single grain; loose; strongly acid.

TYPE LOCATION: Suffolk County, New York; Town of Brookhaven, "Camp Wilderness of Boy Scouts of America", 0.9 mile south of New York Highway 25, 0.3 mile north of junction of County Road 21 with Longwood Road. USGS Bellport, NY topographic quadrangle, Latitude 40 degrees, 52 minutes, 7 seconds N. and Longitude 72 degrees, 56 minutes, 7 seconds W. NAD 1927.

RANGE IN CHARACTERISTICS: Thickness of the solum is from 20 to 40 inches. Depth to bedrock is more than 60 inches. Rock fragments, primarily gravel, range from 0 to 35 percent in the A horizon; 0 to 35 percent in the B horizon; and 5 to 40 percent in the C horizon. Some C horizons, below 40 inches, range from 5 to 60 percent rock fragments.

The **Ap** horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. Some pedons have a thin A horizon with hue of 10YR, value of 2 through 4, and chroma of 1 or 2. Texture is sandy loam, fine sandy loam, or loam in the fine-earth fraction. Structure is weak or moderate granular and consistence is friable or very friable. Reaction ranges from extremely acid through moderately acid.

The **Bw** horizon has hue of 7.5YR through 2.5Y, with value of 4 through 6, and chroma of 3 through 6. Texture is sandy loam or fine sandy loam in the fine-earth fraction with more than 50 percent fine sand and coarser. It has weak sub-angular blocky structure or it is massive. Consistence is friable or very friable. Reaction ranges from extremely acid through moderately acid. Some pedons have a thin **AB** or **BA** horizon.

The **BC** and **2BC** horizons have hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 3 through 6. Textures are loamy sand, fine sandy loam, or sandy loam in the fine-earth fraction with coarser texture restricted to the **2BC** horizon. They have weak granular or sub-angular blocky structure or they are massive. Consistence is friable or very friable. Reaction ranges from very strongly acid through moderately acid.

The **C** or **2C** horizon has hue of 7.5YR through 2.5Y, value of 3 through 7, and chroma of 3 through 6. Texture is coarse sand, sand, or loamy sand in the fine-earth fraction or it is stratified sand and gravel. Layers of loamy fine sand are present in some pedons. Some pedons also have a loamy **3C** horizon below 40 inches with fine-earth textures of sandy loam or fine sandy loam. Reaction ranges from very strongly acid through neutral.

Neutral reactions are restricted to depths greater than 30 inches.

GEOGRAPHIC SETTING: Riverhead soils are nearly level to steep soils on outwash plains, valley trains, beaches, and water-sorted moraines. Slope ranges from 0 to 50 percent. The soils developed in 20 to 40 inches of water-sorted sandy loam or fine sandy loam relatively low in gravel content over stratified gravel and sand. Mean annual temperature ranges from 48 to 55 degrees F., mean annual precipitation ranges from 38 to 55 inches, and mean annual frost-free days ranges from 135 to 220 days. Elevation ranges from 50 to 1350 feet above sea level.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is low to medium. Permeability is moderately rapid in the solum and very rapid in the substratum. In pedons that have a loamy substratum, permeability of the substratum below 40 inches is rapid.

USE AND VEGETATION: Most of these soils have been cleared and are used for crops, or are in suburban development. Principal crops are potatoes, cauliflower, cabbage, corn, and hay. Native vegetation is black, white, and red oaks; American beech; and sugar maple.

Rowland Series

The Rowland series consists of very deep, moderately well and somewhat poorly drained soils formed in alluvial sediments weathered from red and brown shale, sandstone, and conglomerate. Slopes range from 0 to 3 percent. Permeability is moderate to moderately slow above about 40 inches and moderately rapid in the underlying stratified sand and gravel. Mean annual precipitation is 44 inches. Mean annual temperature is 51 degrees F. **TAXONOMIC CLASS:** Fine-loamy, mixed, super active, mesic Fluvaquentic Dystrudepts

TYPICAL PEDON: Rowland silt loam - cultivated (Colors are for moist soil unless otherwise noted.)

Ap--0 to 10 inches; dark reddish brown (5YR 3/4) silt loam; weak fine granular structure; very friable, slightly plastic; many fine roots; moderately acid; abrupt smooth boundary. (8 to 12 inches thick)

BA--10 to 16 inches; reddish brown (5YR 4/4) silt loam; weak fine sub-angular blocky structure; friable, slightly sticky, slightly plastic; many fine roots; many fine pores; moderately acid; clear wavy boundary. (4 to 14 inches thick)

Bw--16 to 28 inches; reddish brown (5YR 5/4) silt loam; common fine distinct brown (7.5YR 5/2) and light gray (10YR 7/2) mottles; weak medium sub-angular blocky structure; friable, slightly sticky, slightly plastic; few medium roots; many fine pores; strongly acid; clear wavy boundary. (10 to 18 inches thick)

C1--28 to 44 inches; weak red (2.5YR 5/2) silty clay loam; common medium distinct brown (7.5YR 5/4) and gray (N 5/0) mottles; massive; firm, sticky, plastic; few faint silt and clay films in pores; 10 percent gravel; moderately acid; clear wavy boundary. (0 to 18 inches thick)

C2--44 to 65 inches; weak red (2.5YR 5/2) stratified sand and gravel; moderately acid.

TYPE LOCATION: Adams County, Pennsylvania; Mount Joy Township; near Route 429; stream bank along Plum Creek.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 24 to 40 inches. Depth to stratified sand and gravel is more than 40 inches. Water worn pebbles constitute 0 to 10 percent of the solum, 0 to 25 percent of the **C** horizon, and 30 to 90 percent of the **2C** horizon. Stratified sand, silt, clay or gravel are in some pedons at depths less than 40 inches. Reaction ranges from very strongly to moderately acid throughout.

The **Ap** horizon has hue of 2.5YR through 7.5YR, value of 3 through 5, and chroma of 2 through 6. Texture ranges from silt loam to sandy loam in the fine-earth fraction.

The **B** horizon has hue of 2.5YR through 7.5YR, value of 3 through 6, and chroma of 3 through 8. Distinct mottles of both low and high chroma are within 24 inches of the surface. Texture is silt loam, loam, silty clay loam, or sandy clay loam in the fine-earth fraction. It has weak fine, medium or coarse sub-angular blocky structure, or is massive.

The **C** horizon above the stratified sand and gravel has hue of 2.5YR through 7.5YR, value of 3 through 6, and chroma of 2 through 8. Low chroma mottles are common. It ranges from sandy loam or sandy clay to silt loam or silty clay loam in the fine earth- fraction. It is massive. The **2C** horizon is dominated by stratified sand and gravel but includes lenses of silt or clay.

GEOGRAPHIC SETTING: Rowland soils are formed on relatively narrow nearly level flood plains in alluvial sediments washed from nearby gently sloping to sloping uplands underlain mainly with red and brown shale, sandstone, and conglomerate. The climate is humid temperate. Mean annual precipitation ranges from 40 to 48 inches, mean annual temperature ranges from 47 to 55 degrees F., and the frost-free season ranges from 135 to 200 days.

DRAINAGE AND PERMEABILITY: Moderately well and somewhat poorly drained. Runoff is slow. Permeability is moderate to moderately slow above about 40 inches and moderately rapid in the unconforming stratified sand and gravel. The water table fluctuates between 2 and 6 feet. These soils are flooded by streams during wet periods.

USE AND VEGETATION: Mostly cleared and in pasture or cropland. Wooded areas are in mixed hardwoods.

Watchung Series

The Watchung series consists of very deep, poorly drained soils on upland flats and depressions. They formed in residuum from basic rocks. Slope ranges from 0 to 8 percent. Mean annual temperature is 50 degrees F., and mean annual precipitation is 40 inches.
TAXONOMIC CLASS: Fine, smectitic, mesic Typic Albaqualfs

TYPICAL PEDON: Watchung silt loam, very stony - Pasture (Colors are for moist soil unless otherwise indicated)

Ap-- 0 to 7 inches, dark grayish brown (10YR 4/2) silt loam; common fine distinct strong brown

(7.5YR 5/6) mottles; moderate fine granular structure; friable, sticky, slightly plastic; many fine and medium roots; 15 percent by volume gabbro stones; strongly acid; clear wavy boundary. (5 to 10 inches thick)

Eg-- 7 to 9 inches, gray (10YR 5/1) silt loam; common medium distinct brown or dark brown (7.5YR 4/4) mottles; weak very thin platy structure; friable, sticky, slightly plastic; many fine and medium roots; 15 percent by volume gabbro stones; few fine black concretions; moderately acid; abrupt wavy boundary. (2 to 7 inches thick)

Btg1-- 9 to 14 inches, gray (10YR 5/1) silty clay; many medium prominent yellowish brown (10YR 5/6) mottles; strong medium prismatic and angular blocky structure; very firm, sticky, plastic; roots between prisms; thin continuous clay films; interiors of a few prisms are strong brown (7.5YR 5/6); 15 percent by volume gabbro stones; few fine black concretions; moderately acid; gradual wavy boundary.

Btg2-- 14 to 24 inches, gray (N 5/) clay; many coarse prominent yellowish brown (10YR 5/8) mottles; strong medium prismatic and angular blocky structure; firm, sticky, plastic; roots between prisms; thin continuous clay films; interiors of a few prisms are yellowish brown (10YR 5/6); 15 percent by volume gabbro stones; few fine black concretions; moderately acid; clear wavy boundary.

Btg3-- 24 to 33 inches, gray (5Y 5/1) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; strong coarse prismatic and weak thin platy structure; firm, sticky, plastic; roots between prisms; thin continuous clay films; 5 percent by volume stones; few dark reddish brown (5YR 2/2) stains and fine concretions; slightly acid; clear wavy boundary. (Combined thickness of the Bt is 17 to 20 inches)

BC-- 33 to 51 inches, yellowish brown (10YR 5/6) silty clay; few fine prominent gray (N 5/) mottles; moderate coarse prismatic and weak thin platy structure; firm, sticky, plastic; few roots; traces of clay films; 5 percent gabbro stones by volume; few dark reddish brown (5YR 2/2) stains and fine concretions; neutral; gradual broken boundary. (0 to 22 inches thick)

C1-- 51 to 56 inches, strong brown (7.5YR 5/6) silt loam; few fine prominent gray (N 5/) mottles; massive, with a few vertical fractures filled with dark gray silt; firm, sticky, plastic; very few roots; 10 percent by volume gabbro and quartzite cobbles; slightly acid; clear broken boundary. (O to 10 inches thick)

C2-- 56 to 66 inches, yellowish brown (10YR 5/4) silt loam, many pale brown (10YR 6/3) and strong brown (7.5YR 5/6) mottles; massive; firm, sticky, slightly plastic; 10 percent by volume gabbro and quartzite cobbles; slightly acid.

TYPE LOCATION: Cecil County, Maryland; about 1.6 miles northwest of Rising Sun.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 24 to 55 inches and the lower boundary of the argillic horizon is within 40 inches of the surface. Depth to bedrock is more than 60 inches. Rock fragment content ranges from 0 to 15 percent throughout the profile including up to 15 percent of cobbles and stones. Some pedons have up to 40 percent rock fragments.

The **A** and **E** horizons have hue of 10YR through 5Y, value of 3 through 5, and chroma of 1 through 4, with value of 3 confined to thin A horizons or Ap horizons that dry to a value of 6. Some are mottled. The **A** and **E** horizons are loam, silt loam or silty clay loam in the fine earth fraction. They are very strongly to slightly acid.

The **Bt** horizon has hue of 7.5YR to 5Y or is neutral, value of 4 through 6, and chroma of 0 to 3; chroma of 3 is confined to depths below 30 inches. Mottles in the **Bt** horizon range from fine to coarse, distinct to prominent, and common to many. The **Bt** horizon is clay or silty clay except sub-horizons may be silty clay loam. It is strongly acid to neutral.

The **C** horizon has hue of 7.5YR to 5Y or is neutral, value of 4 to 6 and chroma of 0 to 6. Mottles and variegations have contrasting chroma. The **C** horizon is silt loam, loam, clay loam, or silty clay loam. Some pedons have fragments of saprolite. It is moderately acid to neutral.

GEOGRAPHIC SETTING: Watchung soils are level to gently sloping soils on upland flats and depressions in the northern Piedmont Plateau. Slopes are less than 8 percent. The soils formed in residuum from basic rocks, most commonly gabbro, diabase and diorite. The climate is temperate and humid, with a mean annual temperature of 45 to 55 degrees F., and mean annual precipitation of 40 inches.

DRAINAGE AND PERMEABILITY: Poorly drained. Runoff is slow to medium. Permeability is moderately slow to moderate in the **A** and **C** horizons and slow in the **B** horizon.

USE AND VEGETATION: Some areas are in corn and pasture. Native vegetation is northern red oak, pin oak, willows, box elder, sedges, ironweed and Joe-pye-weed.

Whippany Series

The Whippany series consists of very deep, somewhat poorly drained soils formed in silty and clayey sediments derived principally from shale, basalt, and granite. Slope ranges from 0 to 8 percent. Saturated hydraulic conductivity is moderately low. Mean annual temperature is about 50 degrees F. and mean annual precipitation is about 45 inches.
TAXONOMIC CLASS: Fine, mixed, active, mesic Aquic Hapludalfs

TYPICAL PEDON: Whippany silt loam cultivated, in an area of Whippany silt loam, 0 to 3 percent slopes at an elevation of about 260 feet. (Colors are for moist soil.)

Ap--0 to 9 inches; dark grayish brown (10YR 4/2) heavy silt loam; moderate medium granular structure; very friable; many fibrous roots; nearly all grains stained; slightly acid; abrupt smooth boundary. (6 to 10 inches thick)

Bt1--9 to 15 inches; strong brown (7.5YR 5/6) clay; moderate medium sub-angular blocky structure; firm, plastic, sticky; many fibrous roots; few patches of skeletons near top which diminish with increasing depth; few faint clay films on faces of peds; many coarse prominent light brownish gray (10YR 6/2) and pale brown (10YR 6/3) iron depletions; moderately acid; gradual wavy boundary. (0 to 7 inches thick)

Bt2--15 to 27 inches; strong brown (7.5YR 5/6) clay; moderate medium sub-angular blocky structure; firm, very plastic, sticky; common fibrous roots; few distinct clay films on faces of peds; vertically oriented pale colored streaks 6 to 24 inches apart; common coarse distinct dark yellowish brown (10YR 4/4) and light brownish gray (10YR 6/2) iron depletions; slightly acid; gradual wavy boundary. (5 to 20 inches thick)

Bt3--27 to 40 inches; brown (7.5YR 4/4) clay; moderate medium sub-angular blocky structure; firm, plastic, sticky; few distinct clay films on most faces of peds; widely spaced vertically oriented pale colored streaks; few coarse distinct light brownish gray (10YR 6/2) iron depletions; slightly acid; clear wavy boundary. (10 to 15 inches thick)

C--40 to 60 inches; reddish brown (5YR 4/4) silty clay loam; massive; friable; few coarse distinct pale brown (10YR 6/3) and pinkish gray (7.5YR 6/2) iron depletions; iron depletions are generally horizontally oriented and associated with stratification; neutral.

TYPE LOCATION: Morris County, New Jersey; Harding Township, 100 feet east of Pleasant Plains Road, 50 feet south of field boundary, 1/4 mile south of right angle turn, Mills Bockhoven farm. USGS Bernardsville topographic quadrangle; latitude 40 degrees 42 minutes 38 seconds N. and longitude 74 degrees 30 minutes 17 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 30 to 50 inches. Depth to bedrock is more than 5 feet. Coarse fragments are commonly lacking but range up to 5 percent above 40 inches and up to 30 percent below. Base saturation 50 inches below the top of the argillic horizon, ranges from 60 to 90 percent. Unless limed, reaction ranges from strongly acid to moderately acid near the surface and increases with depth to slightly acid through slightly alkaline in the **C** horizon.

The **A** horizon has hue of 7.5YR to 2.5Y, value of 2 to 4, and chroma of 2. Values of 3 are restricted to **A1** horizons which are less than 6 inches thick. Texture ranges from silty clay loam to loam. Some pedons have a **BE** or **E** horizon with hue of 5YR or 10YR, value of 3 to 5, and chroma of 2 to 4 with similar textures to the A horizon.

The **Bt** or **Btg** horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 4 or 6. Low and high chroma redoximorphic features are strongest on faces of peds and interiors within the top 10 inches of the argillic horizon and diminishes with increasing depth. Individual sub-horizon textures range from silty clay loam to clay with the weighted percent clay for the **Bt** horizon more than 35 percent.

The **C** horizon has hue of 5YR to 7.5YR, value of 3 to 5, and chroma of 3 or 4. Textures are stratified loam, silt loam, clay loam or silty clay loam above 40 inches and range to loamy sand or gravelly loamy sand below 40 inches.

GEOGRAPHIC SETTING: Whippany soils are on slight elevations on terraces or gently sloping peripheral areas within large topographic basins. These soils formed in silty and clayey sediments containing a high proportion of fines derived from weathered shale, basalt and granite materials. Slope is 0 to 8 percent. The climate is humid temperate. Average annual precipitation is 40 to 48 inches and the growing season is about 140 to 170 days. Mean annual temperature ranges from 45 to 55 degrees F.

DRAINAGE AND PERMEABILITY: Whippany soils are somewhat poorly drained. Runoff is negligible to very high. Permeability is slow. Saturated hydraulic conductivity ranges from moderately low or moderately high. The water table is at or near the surface briefly during late winter and early spring and drops to a depth of at least 4 feet in the summer.

USE AND VEGETATION: Natural vegetation is maple, sweet gum, pin oak, elm and swamp white oak. Where cleared, these soils have been extensively used for hay and pasture and in areas with improved drainage, corn, soybeans and other cultivated crops are grown.

Hydric Soils

Introduction

The definition of 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. The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. Soils that are sufficiently wet because of artificial measures are included in the concept of hydric soils. Also, soils in which the hydrology has been artificially modified are hydric if the soil, in an unaltered state, was hydric. Some series, designated as hydric, have phases that are not hydric depending on water table, flooding, and ponding characteristics.

Field Indicators are soil characteristics that are documented to be strictly associated only with hydric soils. Field Indicators are an efficient on-site means to confirm the presence of hydric soil. The Field Indicators are designed to identify soils that meet the hydric soil definition without further data collection. Some hydric soils exist for which no Field Indicators have yet been recorded and documented, and to identify these soils as hydric, evidence must be gathered to demonstrate that the definition is met. Additional Field Indicators are being developed and tested.

Hydric Soil lists have a number of agricultural and nonagricultural applications. These include assistance in land-use planning, conservation planning, and assessment of potential wildlife habitat. A combination of the hydric soil, hydrophytic vegetation, and hydrology criteria defines wetlands as described in the National Food Security Act Manual (Soil Conservation Service, 1994) and the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). Therefore an area that meets the hydric soil criteria must also meet the hydrophytic vegetation and wetland hydrology criteria in order for it to be classified as a jurisdictional wetland.

Definition Of Hydric Soil

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.

The following criteria reflect those soils that are likely to meet this definition.

Criteria For Hydric Soils

1.All Histels except Folistels and Histosols except Folists, or
2.Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
3.Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
4.poorly drained or very poorly drained and have either:
5.water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
6.water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
7.water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
8.Soils that are frequently ponded for long duration or very long duration during the growing season, or
9.Soils that are frequently flooded for long duration or very long duration during the growing season.

Hydric Soils And Drainage Characteristics In Bernards

Figures 8 and 9 in the map section are a graphical representation of the hydric soils and drainage characteristics in Bernards Township. The hydric soils are primarily in the areas surrounding the streams and rivers of the township. The areas of most concentration are those bordering the Upper Passaic River closest to The Great Swamp, and the area north of the Dead River. These same areas also define the parts of the Township where the soil drains poorly. The large tracts in the northeastern and southeastern portions of the Township that are both hydric and have a poorly drained characteristic are owned by Somerset County, the Township and the Basking Ridge Country Club.

For all other areas in the Township that have hydric soils and are characterized as **Somewhat Poorly, Poorly,** or **Very Poorly**, great care should be taken regarding any development or increase in impervious surface area. Since these areas do not drain well, there is a tendency to flood, or have a high runoff during periods of high rainfall. This exacerbates the possibility of flooding in the Township's rivers and streams, and their surrounding properties.

The maps show that the high clay content areas in Bernards Township are primarily in wetlands areas and in areas on both sides of Liberty Corner Road. Most of the remainder of the town are shown to have moderate levels of clay.

Average Depth To Bedrock

The average depth to bedrock shown in Figure 11 in the map section was found by taking the numeric average of the high and low depth to bedrock for each soil section. The average depth ranges from 0 inches, as is found in the quarry, to 86 inches, as found along the Passaic River. The predominant average falls in two depths; 30 inches and 60 inches.

Average Depth To High Water Table

The average depth to the high water table is shown in Figure 12 in the mapsection. The values for each soil section were calculated by taking the numeric average of the high water table depth- high and -low as found in the USDA SSURGO data. The average depth values range from 0 feet along the Upper Passaic River in Lord Sterling Park and along the Dead River below Harrisons Brook. In the wetlands areas of the Township, the average depth to the high water table is predominantly on the order of six (6) inches.

CRITICAL HABITAT AREAS

Introduction

This Part contains information from the NJDEP Fish and Wildlife Division's "Landscape Project" as part of its Endangered and Non-game Species Program (ENSP). The following paragraphs are excerpted from the Landscape Project Report documentation.

New Jersey is the most densely populated state in the nation. One of the consequences of this distinction is the extreme pressure that is placed on our natural resources. As the population grows, we continue to lose or impact the remaining natural areas of the state. As more and more habitat is lost, people are beginning to appreciate the benefits — and necessity — of maintaining land in its natural state.

For example, we now know that wetlands are critical for recharging aquifers, lessening the damage from flooding and naturally breaking down contaminants in the environment. Forests and grasslands protect the quality of our drinking water, help purify the air we breathe and provide important areas for outdoor recreation. Collectively, these habitats are of critical importance to the diverse assemblage of wildlife found in New Jersey, including more than 60 species classified as threatened or endangered.

In 1994 the N.J. Division of Fish, Game and Wildlife's Endangered and Non-game Species Program adopted a landscape level approach to rare species protection. The goal is to protect New Jersey's biological diversity by maintaining and enhancing rare wildlife populations within healthy, functioning ecosystems."

The Purpose of The Landscape Project

The Landscape Project has been designed to provide users with peer reviewed, scientifically sound information that is easily accessible and can be integrated with planning, protection and land management programs at every level of government — state, county and municipal, as well as nongovernmental organizations and private landowners. Landscape maps and overlays provide basis for proactive planning, such as the development of local habitat protection ordinances, zoning to protect critical habitat, management guidelines for rare species protection on public and private lands and land acquisition projects. Most importantly, the critical habitat information that Landscape Project products provide can be used for planning purposes *before* any actions, such as proposed development, resource extraction (such as timber harvests) or conservation measures, occur.

Uses for Landscape Project maps

The ENSP has developed maps that identify critical rare species habitats based on land use classifications and rare species locations. The maps will enable state, county, municipal and private agencies to identify important habitats and protect them in a variety of ways:

Prioritize conservation acquisitions: Critical area maps can be used to prioritize land parcels for purchase through acquisition programs such as Green Acres, Farmland Preservation and the U.S. Fish and Wildlife Service's refuge system.

Guide regulators and planners: Critical area maps provide land-use regulators and state, county and local planners with the tools they need to enhance protection through the regulatory and planning process.

Provide citizens with conservation tools: Landscape Project products provide the tools to guide citizen actions to protect rare species habitat at the local level. By combining critical area maps with other GIS data layers such as roads, development and publicly owned lands, important areas in need of protection can be easily identified.

Guide stewardship of already-conserved areas: New Jersey already has nearly 1 million acres of open space. These lands are managed by a variety of agencies and organizations, both public and private. Critical area maps identify important rare species habitats on these lands. ENSP biologists work hand in hand with land managers and landowners to develop appropriate best management practices for the long-term conservation of rare species.

New Jersey's Landscape Regions

Since animals require large expanses of natural habitat for their long-term survival, the Landscape Project focuses on large areas called landscape regions that are ecologically similar with regard to their plant and animal communities. Utilizing an extensive database that combines rare species location information with land use/land cover classification data, ENSP has identified and mapped areas of critical habitat for rare species within each landscape region. These landscape maps provide a highly accurate, reliable and scientifically sound basis for habitat protection within each landscape.

One of the Landscape Project's unique features is its focus on the big picture, and not just on individual locations of rare species as they become threatened. The project's protection strategy begins with already conserved areas such as publicly owned areas and regulated wetlands. By identifying and protecting critical habitats adjacent to these already-conserved areas, large, contiguous blocks of habitat will be protected. Thus, within large landscapes, the Landscape Project identifies critical wildlife habitats that must be preserved now if we want to assure the conservation of New Jersey's rare wildlife for future generations.

Skylands Landscape

This landscape encompasses all or part of Sussex, Warren, Hunterdon, Passaic, Morris and Somerset counties. This region contains extensive tracts of contiguous upland and wetland forests that support diverse animal populations including red-shouldered hawks, goshawks, cerulean warblers, timber rattlesnakes and long-tailed salamanders. Bog turtles and great blue herons are found throughout the extensive freshwater wetland systems found over this region.

Bernards lies within this region.

Threatened Or Endangered Species In Bernards Township

The following threatened or endangered species are delineated by the Landscape Project as being located in Bernards Township. The maps in Figures 13 and 14 in the map section show the specific areas where these species are known to have habitat and are thus classified as critical habitat. Figure 13 shows the Landscape Project critical habitat areas by Rank— with only those areas with Rank 2 or higher being shown. Figure 14 shows the critical habitat areas by specific species (with the Rank shown in the Legend).

Following are brief NJDEP write ups on the six threatened or endangered species found in Bernards Township which consist of:

The Bog Turtle—Rank 5: Federally Threatened
The Barred Owl—Rank 4: State Threatened
The Blue Spotted Salamander—Rank 4: State Threatened
The Red-Shouldered Hawk—Rank 4: State Threatened
The Wood Turtle—Rank 3: State Endangered

BOG TURTLE, CLEMMYS MUHLENBERGII

Status:
State: Endangered
Federal: Threatened Identification

The bog turtle is a tiny, dark turtle with a distinct orange patch behind the tympanum (ear membrane) on either side of the head. The scutes (scale-like horny layers) of the carapace (upper shell) are brown or black and may have yellow or reddish centers. Likewise, the plastron (underneath shell) is brownish black with a light yellow or mahogany center. The limbs are brown and may be mottled with variable amounts of dark yellow, orange, or red blotching. Bog turtles, one of the smallest and most secretive of North America's turtles, measure only 7.6 to 10 cm (3.0 to 3.9 in.) long as adults. The male bog turtle has a concave plastron while that of the female is flat or slightly convex. In addition, the male has a long, thick tail and long foreclaws.

Habitat

Bog turtles inhabit calcareous (limestone) fens, sphagnum bogs, and wet, grassy pastures that are characterized by soft, muddy substrates (bottoms) and perennial groundwater seepage. Bog turtle habitats are well-drained and water depth rarely exceeds 10 cm (four in.) above the surface. Flora associated with bog turtle habitats include sedges (Carex spp.), rushes (Juncus spp.), mosses, and grasses. These habitats may also contain red maple (Acer rubrum), alder (Alnus spp.), skunk cabbage (Symplocarpus foetidus), cattail (Typha spp.), willow (Salix spp.), highbush blueberry (Vaccinium corymbosum.), jewelweed (Impatiens capensis), swamp rose (Hibiscus palustris), dogwoods (Cornus spp.), shrubby cinquefoil (Potentilla fruticosa), buttonbush (Cephalanthus occidentalis), rice-cut grass (Leersia oryzoides), wool-grass (Scirpus cyperinus), arrowhead (Sagittaria spp.), watercress (Nasturtium officinale), St. Johnswort (Hypericum spp.), blue vervain (Verbena hastata), sundew (Drosera spp.), pitcher plant (Sarracenia purpurea), cinnamon

fern (Osmunda cinnamomea), and sensitive fern (Onoclea sensibilis). Because open areas are favored for basking and nesting, vegetative succession may cause the dispersal or loss of bog turtle colonies.

Many of the emergent wetlands inhabited by bog turtles have served as pastures during historic or current times. Grazing by livestock maintains the successional stage and softens the ground, creating favorable conditions for these turtles. Although controlled grazing is beneficial, overgrazing can result in excessive fecal runoff that may degrade water quality or encourage the growth of undesirable plant species.

Linear drainage ditches provide an alternative habitat for bog turtles in some areas of the state. These ditches, which have healed over time, may support remarkably high bog turtle densities.

Status and Conservation

Due to population declines, restricted habitat preference, habitat loss, and collecting, the bog turtle was listed as an endangered species in New Jersey in 1974. Declining throughout its range, this turtle is also listed as threatened in Maryland, North Carolina, South Carolina, and Georgia and endangered in Massachusetts, Connecticut, New York, Pennsylvania, Delaware, and Virginia. In 1997, the U.S. Fish and Wildlife Service included the bog turtle on its list of federally threatened species. The New Jersey Natural Heritage Program considers the bog turtle to be, "globally, either very rare and local throughout its range or found locally in a restricted range or because of other factors making it vulnerable to extinction throughout its range," and, "imperiled in New Jersey because of rarity" (Office of Natural Lands Management 1992).

Since the 1970s, biologists have studied the life history, habitat use, and distribution of the bog turtle in New Jersey. Current conservation efforts include habitat management, population monitoring, land acquisition, and landowner outreach. Since most bog turtle populations occur on private lands, biologists devote substantial amount of time educating private landowners about bog turtle conservation. Private landowners can benefit from having bog turtles on their land through various federal cost-sharing programs, which provide funding for habitat management and improvement. Biologists from the New Jersey Endangered and Non-game Species Program (ENSP) are presently implementing a watershed-based management strategy for the protection of critical bog turtle areas.

BARRED OWL, STRIX VARIA

Status:
State: Threatened
Federal: Not listed Identification

On still spring evenings, the hooting and eerie caterwauling of barred owls resonate throughout the remote, swampy woodlands of New Jersey. The resounding song of the barred owl, often represented as "who cooks for you, who cooks for you allll," is often accompanied by loud "hoo-ah" calls and yowling reminiscent of monkeys. Barred owls may vocalize throughout the year, but are most expressive during courtship, from late February to early April. These owls often call at night but may also vocalize during the day.

The barred owl is a large fluffy-looking owl with brown barring on the upper breast and brown

streaking on the lower breast and belly. The upper parts are brown with buffy- white barring. The tail is patterned with alternating bands of brown and buff-gray. The throat is white and the round head lacks ear tufts. The facial disk is grayish-white with a brown outline. The large facial disk funnels sounds towards the owl's proportionally gigantic ears, providing it with extraordinary hearing for detecting minute noises, such as the rustling of mice in the dark. Unlike all other eastern owls excluding the barn owl, the eyes of the barred owl are dark brown. The hooked bill is buff yellow. The feet and toes are feathered and the talons are dark brownish-black. Sexes are similar in plumage and, although there is much overlap, females may be larger than males. Juveniles resemble adults.

Barred owls fly with slow, moth-like wing beats that are interspersed with glides. In flight, the head appears large and the wings are broad and rounded. Soft feathers and serrated edges on the outer wing feathers minimize noise, enabling these and all other owls to fly silently--an advantage that enables them to surprise their prey. The barred owl can be distinguished from most other New Jersey owls by its plumage, large size, distinctive vocalizations, and habitat selection. The great horned owl (Bubo virginianus), a common breeding species in the state, is also a large owl but has rich brown plumage and yellow eyes. The ear tufts of great horned owls may not be noticeable in flight, making them appear round-headed like a barred owl. The call of the great horned owl is a melancholy “hoo-hoo-hoo.” Great horned owls, which often reside in forested uplands or near human habitation, are less restrictive in their habitat choice than barred owls. The barn owl (Tyto alba), the only other New Jersey owl with dark eyes, is white below and golden brown above. In addition, the barn owl, which resides in open fields and grasslands, has a narrow body, long unfeathered legs, and a heart-shaped facial disk.

Habitat

Traditionally known as the “swamp owl,” the barred owl is a denizen of remote, contiguous, old-growth wetland forests. These owls require mature wet woods that contain large trees with cavities suitable for nesting. Barred owl habitats typically have an open understory through which the owls can fly and hunt. The lack of large nesting cavities is often the primary limiting factor for barred owls. Consequently, these owls may nest immediately outside of a wetland or in sub-climax wetland forests if adequate nest sites are unavailable within a mature wetland forest. Barred owls are typically found in remote wilderness areas that may also contain other rare species such as the red shouldered hawk (Buteo lineatus) or the Cooper’s hawk (Accipiter cooperii). Barred owls typically shun human activity by avoiding residential, agricultural, industrial, or commercial areas. In northern New Jersey, barred owls favored sites that were at least 500 meters (1640 ft.) from human habitation and had little or no forest clearings or trails (Bosakowski 1987).

In southern New Jersey, barred owls inhabit both deciduous wetland forests and Atlantic white cedar (Chamaecyparis thyoides) swamps associated with stream corridors. Often such lowland forests are buffered by surrounding pine or pine/oak uplands that may protect the owls from human disturbance and provide additional foraging habitat. Mixed hardwood swamps are often dominated by red maple (Acer rubrum) and black gum (Nyssa sylvatica) and may include highbush blueberry (Vaccinium corymbosum), swamp magnolia (Magnolia virginiana), or greenbrier (Smilax spp.) in the shrub layer. Although barred owls utilize white cedars for roosting, they infrequently provide cavities that are large enough for nesting owls.

In northern New Jersey, barred owls inhabit hemlock ravines and mixed deciduous wetland or riparian forests. Oak hardwood forests containing white oak (Quercus alba), red maple, black birch (Betula lenta), black willow (Salix nigra), hickory (Carya spp.), white ash (Fraxinus americana), basswood (Tilia americana), tulip poplar (Liriodendron tulipifera), black cherry (Prunus serotina), and black gum may be occupied. Barred owls may also inhabit northern hardwood forests that contain sugar maple (A. saccharum), birch (Betula spp.), and beech (Fagus grandifolia). Dense stands of hemlock (Tsuga canadensis), white pine (Pinus strobus), Norway spruce (Picea abies), or other conifers provide cover for roosting owls and protection from harsh weather. Barred owls prefer flat, lowland terrain and avoid rocky slopes and hillsides. As a resident species, barred owls establish territories with fairly stable boundaries that are continuously maintained throughout the year. In eastern North America, home range sizes of 86 to 370 hectares (213 to 914 acres) have been documented for barred owls (Johnsgard 1988).

Status and Conservation

The barred owl was traditionally a common resident within the deep wooded swamps of New Jersey. Historically, these owls were shot as trophies or because of alleged poultry predation. Collectors also looted young owls and eggs. Despite human persecution, the barred owl persisted virtually unscathed until the early 1940s when the cutting of old growth forests and the filling of wetlands greatly reduced habitat throughout the state.
Rampant habitat loss and associated barred owl population declines continued for the next several decades. Consequently, these owls were lost from many historic breeding locales.

Due to population declines and habitat loss, the barred owl was listed as a threatened species in New Jersey in 1979. The New Jersey Natural Heritage Program considers the barred owl to be "demonstrably secure globally," yet "rare in New Jersey" (Office of Natural Lands Management 1992). Currently, barred owl populations appear to be declining due to development and fragmentation of large tracts of private forested lands. The barred owl population has been estimated at 37 pairs in South Jersey and 75 pairs in North Jersey (Sutton and Sutton 1985, Bosakowski 1988). But recent surveys in South Jersey indicate as much as a 30 percent decline there.

BLUE-SPOTTED SALAMANDER, AMBYSTOMA LATERALE

And

TREMBLAY'S SALAMANDER, A. (2) LATERALE-JEFFERSONIANUM

Status:
State: Endangered
Federal: Not listed Identification

The blue-spotted salamander is a member of a group of subterranean amphibians known as "mole salamanders." Likened to the coloration and pattern of old-time enameled pots and pans, blue-spotted salamanders are dark blue with light blue flecking on the sides and tail. These salamanders have large heads with protruding eyes and robust, stocky bodies supported by sturdy limbs. Adults measure 10 to 14 cm (4 to 5.5 in.) in length (Conant and Collins 1991).

Habitat
Blue-spotted salamanders inhabit mature hardwood forests such as red maple

(Acer rubrum) swamps and oak/birch woodlands. These forests, which provide ponds suitable for breeding, are often slightly above swamp or marshland levels. They contain a deep humus layer with sandy and silt loams, gravelly, loamy sand, or muck soil types.
Tree species may include pin oak (Quercus palustris), black oak (Q. velutina), northern red oak (Q. rubra), red maple, black willow (Salix nigra), and gray birch (Betula populifolia). Typically, the ground is littered with rotting logs, boards, rocks, or leaves, beneath which the salamanders dwell within moist depressions or subterranean burrows.
Temporary woodland ponds, marshy sedge ponds, and roadside ditches may serve as breeding pools. Ephemeral breeding ponds typically have a muddy substrate (bottom) and contain leaf litter and fallen twigs with limited wetland vegetation. Marshy breeding ponds consist of dense submergent (underwater) vegetation and tussocks of emergent vegetation. The water must be deep enough to prevent the ponds from drying up before the juveniles emerge from the water, yet be shallow enough to avoid inhabitation by predatory fish. One breeding pond located in Morris County measured 35 m (115 ft.) long by 27 m (89 ft.) wide and was 98 cm (39 in.) deep at the lowest point (Zappalorti 1983). Other occupied ponds in this county contained water at depths of 15 to 25 cm (6 to 10 in.) (Nyman et al. 1988).

Status and Conservation

Due to its restricted range within the state and the severe threats of habitat loss and pesticide use, the blue-spotted salamander was listed as an endangered species in New Jersey in 1974. The New Jersey Natural Heritage Program considers the bluespotted salamander to be "demonstrably secure globally," yet "critically imperiled in New Jersey" (Office of Natural Lands Management 1992). At the end of the last ice age the ranges of the blue-spotted and another species of mole salamander, the Jefferson salamander, overlapped, which produced a series of hybrids that share many of the physical characteristics of the two parent species. One of the hybrids was found to be an all-female species that required male blue-spotted salamanders to reproduce. This hybrid was known as 'Tremblay's salamander.' Because of its close association and supposed reliance upon blue-spotted salamanders for reproduction, Tremblay's salamander was once listed as an endangered species in New Jersey. However, recent investigation into the genetics of the hybrids demonstrated that the Tremblay's salamander was not a true species but instead part of a dynamic hybrid complex that is still in taxonomic debate (Klemens and Bogart 1997).

RED-SHOULDERED HAWK, BUTEO LINEATUS

Status:
State: Endangered (breeding population), Threatened (non-breeding population)
Federal: Migratory Non-game Bird of Management Concern

The red-shouldered hawk is a crow-sized buteo, or soaring hawk. The adults are strikingly plumed, with rufous (brownish red) shoulder patches and a rufous barred breast. Rufous lesser and median upperwing coverts form the "red shoulders" evident on this species. The flight feathers of adults are barred black and white and show a white crescent-shaped window across the primaries, which is visible in flight. The underparts, which are rufous with white barring, often exhibit thin, dark streaks on the chest. The head and back are dark brown. The black tail is bisected by several narrow white bands. Although females average slightly larger than males, plumage is similar for both sexes. The call of the red-shouldered hawk is a series of nasal drawn-

out “aahhh” cries.

Juvenile red-shouldered hawks can be distinguished from adults by their overall browner, less brilliant plumage. The shoulder patches of juveniles are paler rufous and the crescents across the primaries are tawny. The underparts are whitish with variable amounts of brown streaking. The tail is brown with several thin pale bands. Adult plumage appears in the second year.

The red-shouldered hawk is a long-tailed buteo with squared-off wings and a protruding head. Characterized by quick choppy wingbeats interspersed with short glides, the flight style of this hawk is similar to that of an accipiter. When soaring, most buteos hold their wings straight out, whereas the red-shouldered hawk bows its wings forward.

Habitat

Mature wet woods such as hardwood swamps and riparian forests typify red-shouldered hawk breeding habitat. Nesting territories, which occur in deciduous, coniferous, or mixed woodlands, are typically located within remote and extensive old growth forests containing standing water. Consequently, breeding barred owls (Strix varia) and Cooper’s hawks (Accipiter cooperii) are often found in habitats containing red-shouldered hawks.

Red-shouldered hawks select large deciduous and, to a lesser extent, coniferous trees for nesting. Nests have been documented in oak (Quercus spp.), pine (Pinus spp.), maple (Acer spp.), ash (Fraxinus spp.), beech (Fagus grandifolia), birch (Betula spp.), basswood (Tilia americana), chestnut (Castanea dentata), hemlock (Tsuga canadensis), elm (Ulmus spp.), cherry (Prunus spp.), hickory (Carya spp.), and tulip poplar (Liriodendron tulipifera). Forest characteristics include a closed canopy of tall trees, an open subcanopy, and variable amounts of understory cover.

Red-shouldered hawks inhabit wetland forest types unique to the different physiographic regions throughout northern and southern New Jersey. In north Jersey, they occupy riparian forests, wooded wetlands, beaver meadows, and mesic (slightly moist) lowland forests. Within the Pequannock Watershed, red-shouldered hawks are found in stream bottomlands and coniferous or mixed forests containing eastern hemlock or white pine (Pinus strobus). Nests are predominately located in wilderness areas where there are abundant wetlands, small forest openings, and limited areas of large open water such as lakes. In the Pequannock Watershed, red-shouldered hawks avoid areas of human inhabitation, steep uplands, dry slopes, open water, areas with limited conifers, and areas with too many or too few forest openings. Although red-shouldered hawks require extensive tracts of forested habitat for nesting, territories may also contain edges where the birds forage.

The majority of red-shouldered hawk nests in southern New Jersey are contained within vast contiguous freshwater wetlands. Hardwood or mixed hardwood/cedar swamps containing red maple (Acer rubrum), black gum (Nyssa sylvatica), sassafrass (Sassafras albidum), sweetbay magnolia (Magnolia virginiana), and Atlantic white cedar (Chamaecyparis thyoides) are occupied by red-shouldered hawks. Often, such large forested tracts are surrounded by oak/pine forests or agricultural fields. Although red- shouldered hawks nest in large contiguous tracts of wet old growth forests in Cumberland County, they occupy younger wet woods, often on private property safeguarded from high levels of human activity, in Cape May County.

An-area sensitive species, the red-shouldered hawk typically nests away from residences, roads, and development. In the Pequannock Watershed, red-shouldered hawk nests were located an average of 1,013 m and a standard deviation of plus or minus 614 m (3,324 # 2,014 ft.) from the nearest building; and an average of 812 m and a standard deviation of plus or minus 634 m (2,664 # 2,080 ft) from the nearest road (Bosakowski et al. 1991). Red-shouldered hawks avoid small fragmented woodlots and forests that do not contain trees large enough for nesting.

Red-shouldered hawks require large contiguous wooded tracts of 100 to 250 hectares (250 to 620 acres) (Johnsgard 1990). Eastern populations occupy breeding home ranges of 109 to 339 hectares (270 to 838 acres) (Crocoll 1994). In the Pequannock Watershed, red-shouldered hawk breeding densities were estimated at one nest per 450 hectares (1,112 acres) with an average distance of 1.2 to 1.6 km (0.75 to 1.0 mi.) between nests in areas containing the highest breeding concentrations (Bosakowski et al. 1991). Home range sizes of males exceed those of females, during both the breeding and nonbreeding seasons. Individuals of either sex may expand their home ranges while rearing young or throughout the winter months. During the nonbreeding season, red-shouldered ha wks are less restrictive in their habitat use. They inhabit the traditional wetland forests occupied during the breeding season as well as uplands, fragmented woods, smaller forests, open areas, and edges.

Status and Conservation

The red-shouldered hawk was once considered a common resident of wet lowland forests in New Jersey. Only a century ago, bounties were placed on birds of prey, which were accused of poultry and game predation. This unfortunate practice, coupled with egg collecting and the placement of wild red-shouldered hawks in captivity, may have caused initial population declines. The clearing of forests and filling of wetlands exacerbated red-shouldered hawk declines, which were noted as early as the mid-1920s. Reduced numbers of red-shouldered hawks wintering in New Jersey were documented from the early 1950s to the 1970s, as development increased and forest contiguity and patch size decreased. As a result, the red-shouldered hawk, with an estimated 100 breeding pairs in the state, was listed as a threatened species in New Jersey in 1979. In 1982, the U.S. Fish and Wildlife Service listed the red-shouldered hawk as a Migratory Non-game Bird of Management Concern due to population declines and restricted habitat requirements. In addition, the red-shouldered hawk was included on the National Audubon Society's Blue List of Imperiled Species from 1972 to 1986, the final year of the list.

During the 1980s, habitat loss continued to pose an increasing threat, causing red- shouldered hawk populations to decline ever further. By the late 1980s and early 1990s, the state's breeding population was estimated at only 36 pairs, nearly one-third the population size at the time of original listing. As a result, the breeding population of the red-shouldered hawk was reclassified as endangered in 1991. The nonbreeding population remained listed as threatened. The New Jersey Natural Heritage Program considers the red-shouldered hawk to be "demonstrably secure globally," yet "imperiled in New Jersey because of rarity" (Office of Natural Lands Management 1992). Habitat loss and declines of red-shouldered hawks in the Northeast have resulted in the listing of this species as threatened in New York and of special concern in Connecticut.

WOOD TURTLE, CLEMMYS INSCULPTA

Status:
State: Threatened
Federal: Not listed Identification

As the taxonomic name insculpta indicates, the wood turtle is distinguished by the sculpted or grooved appearance of its carapace, or upper shell. Each season a new annulus, or ridge, is formed, giving each scute (a scale-like horny layer) a distinctive pyramid-shaped appearance. As the turtle ages, natural wear smoothes the surface of the shell. While the scutes of the carapace are brown, the plastron, or underneath shell, consists of yellow scutes with brown or black blotches on each outer edge. The legs and throat are reddish-orange. The male wood turtle has a concave plastron while that of the female is flat or convex. The male also has a thicker tail than the female. Adult wood turtles measure 14 to 20 cm (5.5 to 8.0 in.) in length (Conant and Collins 1991).

Habitat

Unlike other turtle species that favor either land or water, the wood turtle resides in both aquatic and terrestrial environments. Aquatic habitats are required for mating, feeding, and hibernation, while terrestrial habitats are used for egg laying and foraging.
Freshwater streams, brooks, creeks, or rivers that are relatively remote provide the habitat needed by these turtles. Consequently, wood turtles are often found within streams containing native brook trout (Salvelinus fontinalis). These tributaries are characteristically clean, free of litter and pollutants, and occur within undisturbed uplands such as fields, meadows, or forests. Open fields and thickets of alder (Alnus spp.), greenbrier (Smilax spp.), or multiflora rose (Rosa multiflora) are favored basking habitats. Lowland, mid-successional forests dominated by oaks (Quercus spp.), black birch (Betula lenta), and red maple (Acer rubrum) may also be used. Wood turtles may also be found on abandoned railroad beds or agricultural fields and pastures.

Nevertheless, wood turtle habitats typically contain few roads and are often over one-half of a mile away from developed or populated areas (Zappalorti et al. 1984). Individuals from relict or declining populations are also sighted in areas of formally good habitat that have been fragmented by roads and development.

Status and Conservation

Historically, the wood turtle was a fairly common species within suitable habitat in New Jersey. By the 1970s, however, declines were noted as wood turtles were absent from many historic sites due to habitat loss and stream degradation. Consequently, the wood turtle was listed as a threatened species in New Jersey in 1979. The New Jersey Natural Heritage Program considers the wood turtle to be “demonstrably secure globally,” yet “rare in New Jersey” (Office of Natural Lands Management 1992). Since the late 1970s, biologists have monitored and surveyed wood turtle sites in New Jersey, providing valuable data regarding the life history, reproduction, and habitat use of these turtles in the state. There is, however, a continuing need to examine the productivity and juvenile survival of wood turtles, which may be threatened by disturbance or predation.

In 1995, the wood turtle was proposed for inclusion on the federal endangered species list.

Despite declines in several northeastern states, populations were considered stable enough throughout the species' entire range to deny listing. However, the wood turtle was considered by the U.S. Fish and Wildlife Service as a species that, "although not necessarily now threatened with extinction may become so unless trade in them is strictly controlled" (U.S. Fish and Wildlife Service 1995). As a result, international trade of these turtles is strictly monitored and regulated through the CITES Act (Convention on International Trade in Endangered Species of Wild Flora and Fauna Act). The New Jersey Endangered Species Act prohibits the collection or possession of wood turtles.

Ground-Water Recharge

Ground-Water Resources Source

Ground water is the water below the surface of the land that supplies water to wells and springs. In Somerset County, ground water is derived largely from precipitation falling as rain or snow. Part of the water falling as rain or snow finds its way into the soil zone and percolates downward to the zone of saturation, part of the water enters the soil but is returned to the atmosphere by evaporation or transpiration without becoming a part of the ground-water body, and part of the water is carried away as surface runoff by streams.

The ground water percolates slowly through the rocks in a direction determined by the topography and geologic structure until it is discharged through wells or springs, through seeps directly into streams, or by evaporation and transpiration in the valley areas.

Principles of Occurrence

The rocks and surficial deposits that form the outer crust of the earth are not solid throughout, but contain numerous voids or interstitial openings, which may contain air or water. The number, size, shape, and arrangement of these openings in the different kinds of rocks vary greatly, and the water-bearing characteristics of rocks vary accordingly.

The mode of occurrence of ground water in any area, then, is primarily dependent upon the geology of the region.

The amount of water that can be stored in a rock is determined by the porosity of the rock. The amount of water a rock formation may hold is determined by its porosity, but the rate at which it will yield water is determined by its permeability.

Below a certain level in the earth's crust, the permeable rocks generally are saturated with water under hydrostatic pressure and are said to be in the zone of saturation. The upper surface of the zone of saturation is called the water table. All the rocks above the water table are in the zone of aeration, which ordinarily consists of three parts: the belt of soil water; the intermediate, or vadose zone; and the capillary fringe.

Unconfined Water

Unconfined or free ground water is ground water in the zone of saturation that does not have an impermeable or confining body restricting its upper surface and the upper surface of which is the water table. This surface is not a static level but is a sloping surface that shows irregularities on a subdued scale similar to those of a land surface. Changes in permeability and unequal amounts of recharge to and discharge from the ground-water reservoir also cause irregularities in the water table. In fine-grained granular materials the small openings above the water table are generally filled by capillary water for a distance of several inches to several feet above the water table, but the position of the water table is shown by the level at which water will stand in a well. In rock formations containing unconfined ground water in fissures, fractures, or solution channels, the

zone of capillary water above the water table is generally thin.

Confined Water

Ground water is considered confined if it occurs in permeable zones between relatively impermeable confining beds. Slightly permeable confining beds are probably much more abundant than impermeable confining beds and considered over a wide area it is probable that no bed is strictly impermeable.

In areas where alternating permeable confines water and impermeable beds, a well may pass through several zones of saturation, each of which has sufficient permeability to supply water to a well. Confined water in permeable formations tends to move in the direction of dip of the formation. The quality and the quantity of water obtainable from these confined beds varies considerably, even in short distances, because of changes in lithology and degree of weathering, and in the amount of fracturing and solution that have occurred.

Ground-Water Recharge

The addition of water to the underground reservoir is called recharge and may be accomplished in several ways. Local precipitation is the principal source of recharge. Lesser amounts are contributed by influent seepage from streams and ponds and by subsurface inflow from adjacent areas.

Recharge and Disposition of Precipitation

Runoff, including both direct runoff and ground-water discharge into streams, accounts for only a small part of the precipitation except after prolonged or intense rains. The amount of water discharged by transpiration and evaporation depends on the temperature, humidity, vegetative covering, wind velocity, depth to the water table below land surface, and the length of time the processes of evaporation have access to the moisture. areas, this accounts for about 85% of the precipitation.

Ground water recharge (GWR) is defined as the amount of water in inches that infiltrates the ground and reaches the water table regardless of the underlying geology. It supports aquifer recharge, stream base flow and wetlands.

Ground-water recharge = (recharge factor x climate factor) - recharge constant

The recharge factor and constant are determined by the cross tabulation of LULC and soil series. The climate factor is determined by the municipality and is a ratio of precipitation over potential evapo-transpiration.

Combining all the county coverages of each WMA and then “clipping” the result with the WMA boundary created the WMA coverages. Calculated ground-water recharge values from each area in the coverages were rounded to the nearest inch and ranked into 5 categories based upon the natural breaks in the percentage of total volume.

Other attributes included in the coverages are soil symbols, hydrologic soil group, hydric soil indication, soil descriptions (where found); LULC category codes, climate factor, municipality and the statewide GWR rankings which were generated by combining all of the county GWR coverages and ranking the result.

Bernards Township Ground-Water Recharge

The normal annual precipitation in Bernards Township is approximately 51 inches or nearly 900 million gallons of water per square mile, or approximately 21.4 billion gallons of precipitation on the entire Township. Only a very small part of this reaches the zone of saturation. Of this precipitation, a part runs off directly, a part is discharged by evaporation and transpiration, and a part is added as recharge to the ground-water reservoir, later being discharged into streams or by transpiration and evaporation, or pumped from wells.

Figure 15 in the map section shows the values of ground-water recharge for Bernards Township. This map was created by "clipping" the NJ-DEP ground-water recharge maps for Somerset county with the Bernards Township municipal outline. These data were released by the DEP in late 2003 along with an EXCEL spreadsheet that calculates the recharge value for a given parcel (see below). This is a new tool for use by the Township Engineering Department and supports the state's new storm water management regulations that became effective 2/4/2004. The figure shows that at most, only 17-19 inches of the nearly 51 inches of precipitation in Bernards Township reach the recharge areas underground. This amount of recharge water (31% if the total) only occurs in 2.1% of the township. The next amount of precipitation reaching the groundwater areas accounts for 26.9% of the total precipitation and occurs in nearly 27% of the township. The table below summarizes the data from the groundwater recharge information available from the NJDEP.

It is important to note that only 15.3% of the nearly 21.4 billion gallons of precipitation actually reach the recharge areas. As discussed above, nearly 85% of the precipitation is dissipated through evaporation, transpiration and runoff. The ranks have already taken into account the runoff due to impervious surfaces and soil characteristics, e.g., impermeability.

LANDUSE/LAND COVER (1995)

General Category Descriptions

The six categories included here represent the six general categories that are part of the Anderson classification system, and which are represented in the New Jersey landscape. These are: **URBAN LAND, AGRICULTURE, FOREST, WATER, WETLANDS (6000),** and **BARREN LAND**.

Urban Land

The URBAN LAND category includes most of what normally would be considered developed land. **Residential areas, commercial areas, services and institutions, industrial areas, and those developed for transportation and utilities are the primary land uses included in the URBAN category.**

In addition, there area several open land categories that are included here. Developed recreation areas, whether they be part of a park, educational facility, or private concern such as a golf course, are included in the URBAN series. Lastly, there are such areas as large landscaped lawns in corporate business and service centers, parks and residential areas. These areas do not have buildings and pavement characteristic of more highly developed categories, but are given an URBAN code to distinguish them from undeveloped open areas that exist outside an urban setting. The impact of these areas on environmental quality can be suspected to be different than undeveloped areas outside of an urban setting.

Not included in the URBAN category are disturbed wetlands discussed. Business parks, large educational institutions, golf courses, transportation right of ways, among other urban categories, often include sections that while not having typical wetlands vegetation, do show obvious signs of soil saturation, and which extend over areas that do have hydric soils.

Agriculture

Included is all land areas associated with agricultural production. The greatest amount of these lands would be areas used in the active cultivation of crops, both row and field crops. Also included, however, are pasturelands and grazing lands associated with horse or cattle raising operations, orchards, vineyards, nurseries and other horticultural areas, and confined feeding operations. In addition, other lands used in support of the agricultural activities, such as the farmsteads, associated barns, stables, and corrals, among others, are also included.

As with the URBAN category, there are also AGRICULTURAL lands that are considered WETLANDS for regulatory purposes. These areas are generally under active cultivation, and so do not support typical wetland vegetation. But these areas do exist on saturated, hydric soils, and are absent the wetland vegetation only because of the active cultivation. The acreage of these AGRICULTURAL wetlands is included in the general category of WETLANDS, below, and not in the category of AGRICULTURE.

Forests

Included is all upland areas covered by woody vegetation. The vegetation may be primarily deciduous, coniferous or a mixture of both, and include scrub/shrub and brush areas as well as mature tree stands of various densities. Also included in this category are early stage forest successional stands, commonly referred to as old fields. These do not normally have a significant amount of mature trees on them, but are placed in this category because of their potential development to forests.

Not included in the FOREST category, and in the figures given below, are forested wetlands. New Jersey has many types of deciduous, coniferous and mixed species forests that exist on saturated, hydric soils. These forested lands are considered WETLANDS.

Water

Included is both tidal and non-tidal open water bodies of the state. Freshwater lakes, ponds, and reservoirs, and salt and brackish water ponds and enclosed tidal bays, such as Barnegat Bay, are mapped as WATER. Also included are portions of rivers and streams that are greater than 80 ft. in width.

Included in the boundaries of several of the coastal Watershed Management Areas are portions of Delaware and Raritan Bays, and a three-mile strip of the Atlantic Ocean. These open water areas are not, however, included in any of the acreage figures given below for the WATER category.

Wetlands

Wetlands are those areas that exist where the water table is at, near or even above the soil surface for significant time periods of the year. The soil is, therefore, generally saturated, and only plant types capable of growing under saturated conditions are found. Wetlands serve a variety of ecological functions, and are given special attention in the NJDEP mapping programs, and in environmental protection strategies.

A large number of specific WETLAND types are included here. Bogs, herbaceous swamps, wet meadows, forested wetlands, scrub/shrub and brush covered wetlands, vegetated pond margins, and inter tidal marshes, among others, are mapped. Although not normally thought of as occupying saturated areas, vegetated dune communities are also included under the WETLANDS category to highlight their importance.

Also included in the acreage values given below, are the disturbed WETLAND categories under NJDEP regulatory programs.

Barren Land

The BARREN LAND category includes a wide variety of specific types, but all are characterized by a general lack of any significant vegetative cover. Included are both naturally occurring barren areas, such as beaches and rock outcrops, as well as artificially created barren areas, where vegetation has been artificially removed. Cleared but undeveloped urban lands,

transitional areas, mines, dumps and quarries are also included in the general category of BARREN LAND.

Bernards Township Data

Figures 16 and 17 in the map section show the land use/land cover for Bernards Township. (Figure 16) and the amount of change that occurred between 1986 and 1995 (Figure 17). Table 9 below shows the changes for each major category described in the previous sections of this chapter.

CLIMATE

Precipitation and temperature data is collected by the National Weather Service which is part of the National Oceanic and Atmospheric Administration (NOAA).

Bernards Township Precipitation and Temperature Statistics

The Bernards Township data shown in Figure 18 in the map section is based in data from The Weather Channel. The rationale for using Weather Channel data as opposed to NOAA data is one of granularity. The NOAA data is only collected for Atlantic City and Newark, while the Weather Channel data has many more monitoring stations. In particular, the data shown in Figure 18 is from data for Morristown, NJ, which reflects both altitude and urban-ness differences between Newark and the higher elevations and lesser amounts of large, urban structures.

The data for Bernards Township shows the warmest month is July, and the coolest is January, however, September recorded the highest temperature in 1953. Precipitation data shows that May and July are generally the wettest, and February is generally the driest.

Hardiness Zones

The 2003 edition of the USDA hardiness map has 15 zones (four more than the 1990 version of the map), each of which represents a 10 degree Fahrenheit (F) difference in average annual minimum temperature. The expansion of the map to 15 zones is making it possible for the first time to assign hardiness codes to sub-tropical and tropical plants, which previously had to be listed by the minimum temperatures at which they would survive.

Bernards Township, which lies in the northern portion of the County, is entirely in Hardiness Zone 6.

Vernal Pools

Vernal pools are temporary bodies of water that flood each year for a few months during the spring and summer. Vernal, or "spring" pools fill up with melting snow and early rains, then usually dry up by mid to late summer. Some relatively deep pools may remain flooded for a few years but become completely dry in seasons with very low rainfall.

(Autumnal pools fill during the fall with rising groundwater.)

Because vernal pools are not permanently flooded, they do not support fish populations and thus provide safe breeding sites for several amphibian and invertebrate species, including wood frogs, spotted salamanders, and fairy shrimp. These species have evolved life cycles that depend on temporary pools.

Vernal pools vary in size, ranging from several square feet to several acres. They can be found in a variety of sites, such as isolated depressions in the woods, kettle holes, and gravel pits. Many are within larger wetlands, such as oxbows in river floodplains and pools in forested swamps or scrub-shrub wetlands. Their common characteristics are the absence of fish, temporary flooding regime, and the presence of vernal pool species. Suitable pools must have enough leaf litter and other debris to provide food sources and cover for the species that breed in them.

Vernal Pool Species

The short flooding duration of vernal pools favors species that can carry out their breeding cycle very quickly. In New England, these species include wood frogs, spring peepers, and spotted, blue-spotted, Jefferson's, and marbled salamanders. Other salamanders that may be found in vernal pools include the **eastern spotted newt** and **four-toed salamander**.

Many invertebrates also breed in vernal pools. **Fairy shrimp**, which are small crustaceans, are the only species that are unique to these habitats in our area.

Spotted, **Blanding's**, and **wood turtles** may use vernal pools during the breeding season of wood frogs and mole salamanders. These turtle species wander extensively on land searching for food during the spring, summer, and fall. In early spring, they seek out vernal pools to take advantage of the amphibian and invertebrate eggs and larvae in them. Relatively deep vernal pools may serve as over-wintering sites for some Blanding's and spotted turtles.

WETLANDS, FLOODPLAINS, and BUFFERS

Freshwater Wetlands

Wetlands are commonly referred to as swamps, marshes, or bogs. However, many wetlands in New Jersey are forested and do not fit the classic picture of a swamp or marsh.

New Jersey protects wetlands under the New Jersey Freshwater Wetlands Protection Act, N.J.S.A. 13:9B. This law also protects transition areas or "buffers" around freshwater wetlands. New Jersey also protects coastal wetlands under a different law.

Wetlands protect drinking water by filtering out chemicals, pollutants, and sediments that would otherwise clog and contaminate our waters. They soak up runoff from heavy rains and snow melts, providing natural flood control. They then release stored floodwaters during droughts. Wetlands provide critical habitats for a major portion of the state's fish and wildlife, including endangered, commercial and recreational species. Wetlands provide high quality open space for recreation and tourism.

The New Jersey freshwater wetlands program protects freshwater wetlands, and upland areas within 150 feet of wetlands (sometimes called "buffers"), from development that will impair the wetlands' ability to provide the values listed above.

Bernards Wetlands

Approximately 20% of Bernards Township consists of wetlands of one type or another according to NJDEP data, which is shown, in Figure 20 in the map section.

The following is a characterization of the types and percentages of wetlands in Bernards Township. Table 10 shows that the vast majority of wetlands in the Township, nearly 75%, are deciduous-wooded wetlands. They occur near brooks and streams and contain maple and oak trees. Next in size are 380 acres of wetlands classified as deciduous scrub/shrub wetlands.

These wetlands are primarily areas on new growth from previously cleared forest areas. Herbaceous wetlands comprise nearly 200 acres and are the third largest in Bernards. Other wetlands types make up a very small portion of the Township.

Riparian Buffers

Bernards Township Committee has developed a stream buffer conservation easement ordinance to better protect the stream buffers and enhance the water quality of the adjacent streams.

The regulations have been enacted to provide reasonable controls governing the restoration, conservation, disturbance, and management of existing stream buffers for all perennial (flows continuously) and intermittent (does not always have water in it) streams, and all lakes and ponds in the municipality.

The establishment of the stream buffer conservation easement is applicable when a property owner or other applicant is requesting a Construction Permit from the Construction Code Office, or has applied to the Planning Board or Board of Adjustment for a Development Plan.

The measurement of the stream buffer conservation easement shall extend a minimum of 75 feet from each defined edge of an identified watercourse or surface water body—see Figure 20. Within this easement certain activities shall be prohibited or limited, including:

Cutting or removal of trees and vegetation
Using fertilizers, pesticides, or herbicides
Erecting any permanent structure

Bernards Township Floodplains

Figure 21 in the map section shows the various floodplains within Bernards Township. The underlying data for this mapping comes from the Federal Emergency Management Agency as part of the National Flood Insurance Program. Approximately 2,800 acres of the Township are in one of the three flood prone categories. The "Highly Flood prone" category accounts for over 2,400 acres, or almost 16% of the Township. The remaining two categories account for less than 350 acres or 2.2% of the Township area.

OPEN SPACE INVENTORY

Introduction

For the purposes of this section, open space will mean any land in Bernards Township that is: (a) owned by a government agency, i.e., the Federal government, the State of New Jersey, Somerset County, or Bernards Township; (b) owned by private interests and has a predominantly recreational use; or, (c) owned by private interests and has a predominantly conservation use. Figure 22 in the map section is a map of the open space in Bernards Township that falls into one of these categories. *It should be noted that these categories are not mutually exclusive and that a large number of them fall in all three categories. Therefore, one should not look a t the statistical data in each of the following sections and add them up to get a total picture of open space in the township.*

The following sections discuss land that is owned by the township, is open space or conservation areas, and passive and active recreational lands. The source for this information is the Bernards Township Engineering Department.

Bernards Township Owned Parcels

Over the years, as development has reduced the amount of open space in Bernards Township, the township Planning Board (on behalf of the township) and the Township Committee have acquired numerous properties for a variety of purposes including: office and administrative space; recreational space; and, open space. The parcels in this category range in size from 0.01 acres to 149 acres for Mountain Park at the corner of Mountain Avenue and Martinsville Road. The majority of the parcels in this category have been deeded to the township by developers as part of the subdivision process. Most of these parcels are less than five acres.

The majority of the large parcels in this category have been acquired through the Open Space Trust Fund (see below). The township owns approximately 1,450 acres, or about 9% of the total acres comprising Bernards Township.

Open space and Conservation Areas

This category includes all lands that are classified as open space and conservation areas in the township. This includes much of the land owned by the township, excluding those properties used exclusively for administrative buildings, e.g., the Engineering complex on South Maple Avenue.

It does include Somerset County properties and US Government properties in addition to the township properties. This category consists of just over 2,739 acres or approximately 18% of the township acreage. The largest property in this category is the Somerset County Lord Sterling property, which consists of 840 acres. Other significant properties I this category include the Veterans Administration property on Valley Road, and several Somerset County properties south of Interstate 78.

Passive and Active Recreational Space

This third category is the largest in the Open Space group. It consists of approximately 3,377 acres, or 22% of the township. In addition to the properties included in the first two categories discussed above, this category includes private recreational properties. The two notable private recreational properties are the Basking Ridge Country Club on Madisonville Road, and the New Jersey National Golf Club in The Hills off of Allen Road. These two properties consist of nearly 640 acres of additional recreational space in the township.

TABLE 1: STATISTICAL DETAILS OF THE BERNARDS TOWNSHIP SUB- WATERSHED AREAS

SubWatershed Name	Area(sq.ft.)	Perimeter in feet	Acres	Square Miles	Percent of Total
Dead River (above Harrisons Brook)	195,294,164.85	78,190.78	4,483.3	7.005	28.8%
Passaic R Upr (Dead R to Osborn Mills)	165,728,829.64	88,295.34	3,804.6	5.945	24.4%
Harrisons Brook	142,362,599.03	62,563.86	3,268.2	5.107	21.0%
Dead River (below Harrisons Brook)	53,482,790.90	56,426.22	1,227.8	1.918	7.9%
Passaic R Upper (above Osborn Mills)	41,450,598.53	33,630.96	951.6	1.487	6.1%
Middle Brook-West Branch	26,927,469.09	23,054.27	618.2	0.966	4.0%
Raritan R NB (Rt 28 to Lamington R)	20,325,348.26	23,175.59	466.6	0.729	3.0%
Raritan R NB (Lamington R to Mine Bk)	19,850,032.50	21,323.28	455.7	0.712	2.9%
Raritan R NB(incl Mine Bk to Peapack Bk)	6,778,901.46	16,302.46	155.6	0.243	1.0%
Middle Brook EB	5,674,781.50	11,311.06	130.3	0.204	0.8%
Totals	**677,875,515.75**	**414,273.80**	**15,561.9**	**24.315**	**100.0%**

TABLE 2: NJDEP CONTAMINATED SITES

#	SITE_ID	NAME	ADDRESS	CLASS	STATUS
1	NJD98	GETTY SERVICE STATION BERNARDS	18 STONEHOUSE RD	NFA-A	1999-06-08 00:00:00
2	NJL6	BERNARDS TOWNSHIP PUBLIC WORKS	277 MAPLE AVE S	ACT INVE	1998-07-09 00:00:00
3	NJ836	US VETERANS ADMINISTRATION	KNOLLCROFT & VALLEY	PEN DIN	1997-12-15 00:00:00
4	NJL8	97 SPENCER ROAD	97 SPENCER RD	PEN DIN	1997-03-11 00:00:00
5	NJD9	EXXON SERVICE STATION BERNARDS	19 E HENRY ST	PEN DIN	2000-03-10 00:00:00
6	NJL8	665 MARTINSVILLE RD	665 MARTINSVILLE RD	ACT INVE	2001-01-08 00:00:00
7	NJL8	87 PEACHTREE ROAD	87 PEACHTREE RD	ACT INVE	2000-05-30 00:00:00
8	NJL80	RIDGE CHEVROLET	44 S FINLEY AVE	PEN DIN	2000-05-26 00:00:00
9	NJL8	11 N ALWARD AVE	11 N ALWARD AVE	ACT INVE	2000-07-05 00:00:00
10	NJL8	32 RANKIN AVENUE	32 RANKIN AVE	ACT INVE	2000-06-14 00:00:00
11	NJL8	16 S ALWARD AVE	16 S ALWARD AVE	ACT INVE	2000-08-03 00:00:00
12	NJL8	40 WHITENACK RD	40 WHITENACK RD	ACT INVE	2000-10-12 00:00:00
13	NJL8	39 WEXFORD WAY	39 WEXFORD WAY	ACT INVE	2000-10-16 00:00:00
14	NJL8	79 PEACHTREE RD	79 PEACHTREE RD	ACT INVE	2000-11-30 00:00:00
15	NJL8	139 WHITENACK RD	139 WHITENACK RD	ACT INVE	2000-11-29 00:00:00
16	NJL8	20 SPRUCE ST	20 SPRUCE ST	ACT INVE	2000-12-11 00:00:00
17	NJD00	SOMERSET HILLS MEMORIAL PARK	MT AIRY RD	ACT INVE	1994-06-09 00:00:00
18	NJD9	EXXON SERVICE STATION BERNARDS	I78 & KING GEORGE RD	ACT INVE	1990-05-01 00:00:00
19	NJL6	MOBIL SERVICE STATION BERNARDS	RTE 78 & MARTINSVILLE	NFA-A	1997-11-26 00:00:00
20	NJD9	MOBIL SERVICE STATION BERNARDS	1 MADISONVILLE RD &	ACT INVE	1988-05-21 00:00:00
21	NJL8	18 BERTA PL	18 BERTA PL	ACT INVE	2000-08-07 00:00:00
22	NJL8	53 SPENCER RD	53 SPENCER RD	ACT INVE	1999-05-27 00:00:00
23	NJD98	ALGONQUIN GAS TRANSMISSION	25 STONEHOUSE RD	ACT INVE	1998-10-05 00:00:00
24	NJL00	BERNARDS TOWNSHIP SANITARY	PILL HILL RD	PEN DIN	1993-05-19 00:00:00

TABLE 3: BERNARDS TOWNSHIP DIFF DATA-1997

JO	DIF	EPA	CDS	CER	PCS	RCRA	NAME	STREET A	DA
T020JP	180200286000						146 SPENCER RD	146 SPENCER RD	8/
T020K	180200334000						16 SPRUCE ST	16 SPRUCE ST	8/
T020JU	180200305000						237 NORTH MAPLE AVENUE	237 N MAPLE AVE	8/
T020F7	180200198001						29 CULBERSON RD	29 CULBERSON RD	8/
T020F9	180200232000						502 LYONS RD	502 LYONS RD	9
T020F8	180200231000						518 MINE BROOK RD	518 MINE BROOK RD	9
T020D9	180200	NJD9814850		NJD981485014			519 S MAPLE AVE	519 S MAPLE AVE	2
T020J0	180200289000						7 BROOK RIDGE DRIVE	7 BROOK RIDGE DR	8/
T020K	180200323000						71 MAPLE AVENUE NORTH	71 N MAPLE AVE	8/
T020JD	180200293000						94 LAKE ROAD	94 LAKE RD	8/
T020G7	180200251000						97 SPENCER RD	97 SPENCER RD	8/
T020B5	180200	NJD9806478				NJD	ALGONQUIN GAS TRANSMISSION CO	25 STONEHOUSE RD	8/
T0200E	180200	NJD9866182				NJD	AMOCO SERVICE STATION	VALLEY RD & CHUR	12/
T020A	180200106000						ANDREWS WILLIAM RESIDENCE	85 BERKELEY CIR	1
T02001	180200024000						APPLE TREE LANDSCAPE & DESIGN	476 LYONS RD	9
T020D	180200152000						AT&T COMMUNICATIONS INC	131 RT 202	1
T020ES	180200193000						AT&T COMMUNICATIONS INC	131 MORRISTOWN RI	8
T020B9	180200	NJD0207716				NJD	AT&T COMMUNICATIONS INC	295 N MAPLE AVE	1
T020FT	180200	NJP0009078				NJP	AT&T COMMUNICATIONS INC	219 MT AIRY RD	8/
T020FM	180200219000						AT&T COMMUNICATIONS INC	645 MARTINSVILLE R	8/
T020G9	180200250001						AT&T COMMUNICATIONS INC	246 MADISONVILLE I	9
T020B0	180200068000						AT&T COMMUNICATIONS INC UNDERI	MOUNTAIN RD	12/
T020HI	180200273000						BARTH MICHAEL	BLK 133 LT 4	9
T020FV	180200225000						BENNINGTON BUILDERS	55 CHILDS RD	9
T020A2	180200065000						BERNARDS TWP BD OF E OAK ST ELEN	W OAK ST	1
T020A0	180200	NJD9807758				NJD	BERNARDS TWP BD OF ED CEDAR HIL	PEACHTREE RD	2
T0200H	180200004000						BERNARDS TWP BD OF ED LIBERTY C	CHURCH ST	12/
T020BN	180200124000						BERNARDS TWP BD OF ED MAINT WAI	COLLYER LA	8/
T020A1	180200	NJ00002629				NJ0	BERNARDS TWP BD OF ED RIDGE HS V	S FINLEY AVE	1
T020A1	180200047000						BERNARDS TWP BD OF ED WM ANNIN	70 QUINCY RD	1
T020A1	180200	NJR0000018				NJR	BERNARDS TWP DPW	277 S MAPLE AVE	2
T020D2	180200243000						BERNARDS TWP FIRE DEPT BASKING I	55 S MAPLE AVE	8/
T0200N	180200009000						BERNARDS TWP MUNICIPAL COMPLEX	COLLYER LA	1
T020E8	180200203000						BERNARDS TWP PILL HILL RECYCLIN	PILL HILL RD	8/
T020B2	180200079000						BERNARDS TWP SEWER AUTH	COLLYER LA	8/
T0200C	180200012000						BERNARDS TWP SEWER AUTH E OAK	E OAK ST	1
T020C0	180200	NJ00228			NJ0022845		BERNARDS TWP SEWER AUTH HARRIS	MARTINSVILLE RD	2
T02002	180200025000						BERNARDS TWP SEWER AUTH MADIS	MADISONVILLE RD	9
T020A9	180200057000						BERNARDS TWP SEWER AUTH PUMP S	STONEHOUSE RD	2
T020A0	180200053000						BERNARDS TWP SEWER AUTH S MAPL	S MAPLE AVE	2
T020HI	180200200000						BERNARDS TWP SLF	MEEKER RD	8/
T020CI	180200131000						BERNARDS TWP STONEHOUSE RD GAI	STONEHOUSE RD	8/
T020CI	180200095000						BOND LANDSCAPING CONSTRUCTION	16 ACKEN RD	2
T020D.	180200156000						BURKE REMODELING INC	105 FAIRVIEW DR	12/
T020C8	180200149000						BYRNE LANDSCAPING	18 TANGLEWOOD LA	2
T020FN	180200	NJ00001297				NJ0	CARGILL MARINE & TERMINAL INC	150 ALLEN RD	8/
T0200S	180200015000						CAVALLARO RICHARD A	28 FAWN LA	12/
T020AV	180200061000						CHARLIE VINCENT LANDSCAPE CO	3251 VALLEY RD	2
T020A1	180200052000						CHURCH OF JAMES	184 S FINLEY AVE	1
T020JZ	180200308000						CHURCH OF ST JAMES	1845 FINELEY AVE	8/
T02003	180200026000						COMMONWEALTH WATER CO BERNAI	MADISONVILLE RD	9
T020HI	180200267000						CONGIANO SALVATORE	BLK 138 LT 2	9
T020K	180200329000						PIPIA ANTHONY F	157 ANNIN RD	8/
T020B8	180200089000						PLASTICS DECORATING SUPPLY INC	49 WOODSTONE RD	2
T020K	180200325000						PRESBYTERIAN CHURCH OF BASKING	2 E OAK ST	8/
T020CI	180200	NJD9866207				NJD	PRESBYTERIAN CHURCH OF LIBERTY	45 CHURCH ST	12/
T020C0	180200146000						PRO FORM PRINTING INC	196 JAMESTOWN RD	2
T02007	180200029000						R BRAVOCO INC	375 MOUNTAIN RD	9
T020BV	180200	NJD9811383				NJD	RIDGE CHEVROLET-OLDSMOBILE	44 S FINLEY AVE	1
T0200P	180200	NJD9865729				NJD	RIDGE EXXON SERVICE STATION	19 E HENRY ST	1
T020CN	180200	NJR0000081				NJR	RIDGE OAK SENIOR HOUSING	150 MANCHESTER DI	2
T020J3	180200311000						RIDGE PRESENTATION SYSTEMS INC	48 JUNIPER WAY	8/
T0200T	180200016000						RJ DARCHE ASSOCIATES	96 GOLTRA DR	12/
T020BE	180200122000						RR1 ASSOCIATES INC	45 DAWN DR	12/
T0200Z	180200	NJD9821843				NJD	SAMARAT DRY CLEANING & LAUNDR	26 LYONS MALL	
T020C2	180200140000						SCHERING PLOUGH CORP HEALTHCA	110 ALLEN RD	12/
T020F0	180200221000						SCI TECH APPLICATIONS	33 VILLAGE DR	8/
T0200F	180200002000						SEAL SPOUT CORP	ALLEN RD	12/
T020C4	180200144000						SEALING TECHNOLOGY INC	29 BEECHWOOD RD	1
T020J9	180200315000						SNABLE AL	96 S MAPLE AVE	8/
T020JK	180200101000						SOMERSET CNTY	MARTINSVILLE RD	9
T020K	180200321000						SOMERSET CNTY PARK COMM LORD S	S MAPLE AVE	8/
T020A1	180200	3	3403500067				SOMERSET HILLS MEMORIAL PARK	93 S FINLEY AVE	1
T020CI	180200	NJR0000026				NJR	SOMERSET HILLS MEMORIAL PARK	MT AIRY RD	1
T0200N	180200010000						ST JAMES SCHOOL	COLLYER LA & FINLI	1
T0200C	180200100000						ST MARKS EPISCOPAL CHURCH	140 S FINLEY AVE	1
T020BI	180200	NJD0631403				NJD	STAVE CHEMICAL CO INC	20 MARILYN ST	1

T020H	180200058000					STONEHOUSE ROAD GARAGE	STONEHOUSE RD	1
T020H	180200280000					SWENOR RUSSELL W	3187 VALLEY RD	8/
T02009	180200033000					TAMKE TREE EXPERTS INC	MARTINSVILLE RD	12/
T020B	180200	NJD9807642			NJD	TESTPAK INC	287 CHILDS RD	8/
T020B	180200	NJD9865874			NJD	TEXTAR PAINTING CORP	I-287 & N MAPLE AVE	
T020C	180200	NJD9865874			NJD	TEXTAR PAINTING CORP	I-287 & MADISONVIL	
T020BI	180200	NJD9865874			NJD	TEXTAR PAINTING CORP	I-287 SB OVER N FINI	
T020BA	180200	NJD9865873			NJD	TEXTAR PAINTING CORP	I-287 NB OVER N FINI	
T020DI	180200	NJD9865873			NJD	TEXTAR PAINTING CORP	I-287 & WASHINGTON	
T020B	180200	NJD9865873			NJD	TEXTAR PAINTING CORP	I-287 S OVER W OAK	9
T020A	180200	NJD9865873			NJD	TEXTAR PAINTING CORP	I-287 N OVER OAK ST	
T020A	180200	NJD9865873			NJD	TEXTAR PAINTING CORP	I-287 SB OVR MT AIR	12/
T020A	180200	NJD9865873			NJD	TEXTAR PAINTING CORP	I-287 NB OVR MT AIR	12/
T02008	180200	NJD0469439			NJD	THE PINGRY SCHOOL	MARTINSVILLE RD	12/
T020H	180200276000					TOTTEN GLENN	30 N MAPLE AVE	9
T020EI	180200	NJD9807764			NJD	TRICORNER AUTO BODY INC	1 CHURCH ST	12/
T020C	180200	NJD9866202			NJD	TULLS SERVICE GARAGE	130 S FINLEY AVE	
T020B	180200075000					TWO BROOKS FARM	LYONS PL	
T020C	180200141000					UNITED BUSINESS SCHOOL INC	85 WOODWARD LA	1
T020C	180200125000					US GOLF ASSOC MUSEUM EXEC OFFIC	LIBERTY CORNER RI	12/
T020H	180200	NJ83600103	NJ8360010385		NJ8	US VETERANS ADMIN MEDICAL CTR	KNOLLCROFT RD &	1
T020JT	180200	NJ00210		NJ0021083		US VETERANS AFFAIRS MEDICAL CTR	15 KNOLLCROFT RD	8/
T020B	180200	NJD9807767			NJD	VARNAI KARL JR	18 MT AIRY RD	
T020K	180200319000					VILLAGE GREEN LAWN CARE	25 LYONS PL	9
T0200I	180200	NJD9827410			NJD	WILLS MOBIL SERVICE STATION	1 MADISONVILLE RD	
T020C	180200135001					YMCA OF SOMERSET HILLS	140 MT AIRY RD	

MAPS

MISCELLANEOUS MAPS

Sewer Districts Map

Figure 23 shows the four sewer districts in Bernards Township. The largest district is owned and operated by the Bernards Township Sewerage Authority. The second largest sewer district was created as part of The Hills development and covers that portion of Bernards Township in The Hills area. The remaining part of this sewer district is in Bedminster Township. Two smaller sewer districts also exist in Bernards: the US Government Veterans Administration property has its own sewerage facility, and the Warren Township sewerage authority covers a small portion of the township.

Aerial View Map

Aerial maps for the township have been around for many years, but only since the late 1980s have aerial maps in digitized form been available. The first digitized maps of the township were from the state of New Jersey in the late 80s. These maps were at 250-foot resolution. In 1994, the first townships created digitized maps were done. These maps were in black and white at were at 100-foot resolution. In 2003, the latest fly-over maps were created-again at 100-foot resolution, but this time in color. A composite of these 2003 aerials with a parcel overlay is shown in **Figure 24**.

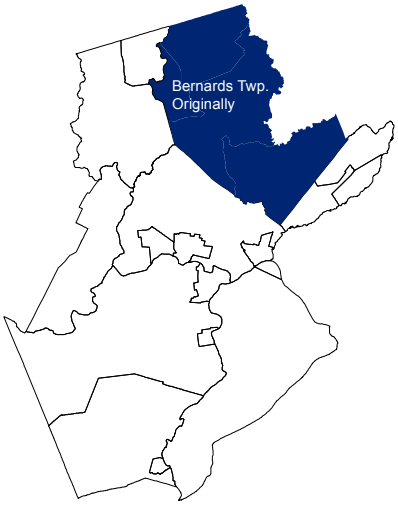
Zoning Map

The final map in this section, **Figure 25**, deals with the various land use zones in the township. It is color coded to show the various commercial, office, residential, and public zone in the township. The map is based on township ordinances and the zone classification found on the township tax maps. The most recent modification to the zones was the adoption of an ordinance redefining the various public use zones from one zone to five.

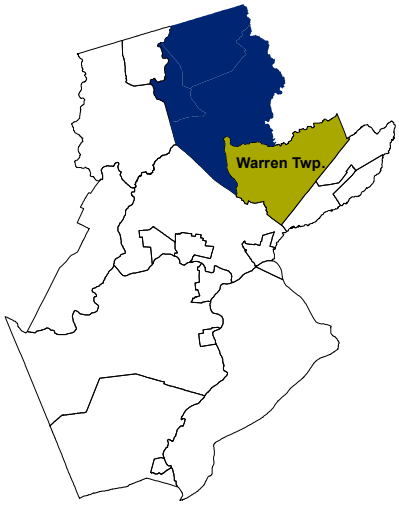
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory

Figure 1
Bernards Township Historical Size

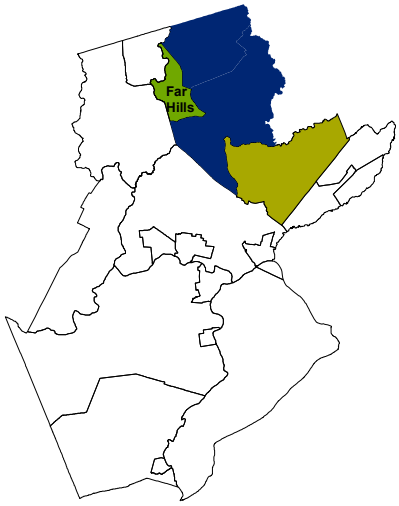
Note: Other Somerset County Municipalities are shown as they are today, and not as they may have been at the historical references shown.



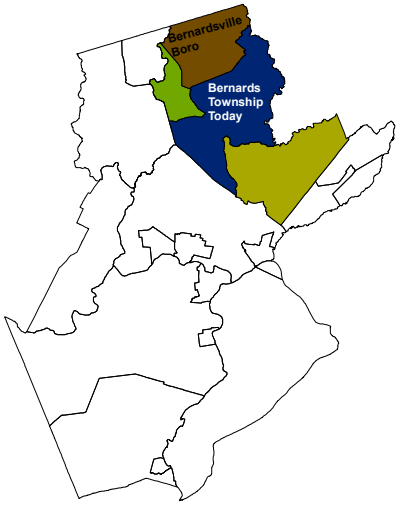
Bernards Township Prior 1806



Bernards Township After 1806



Bernards Township After 1921



Bernards Township After 1924

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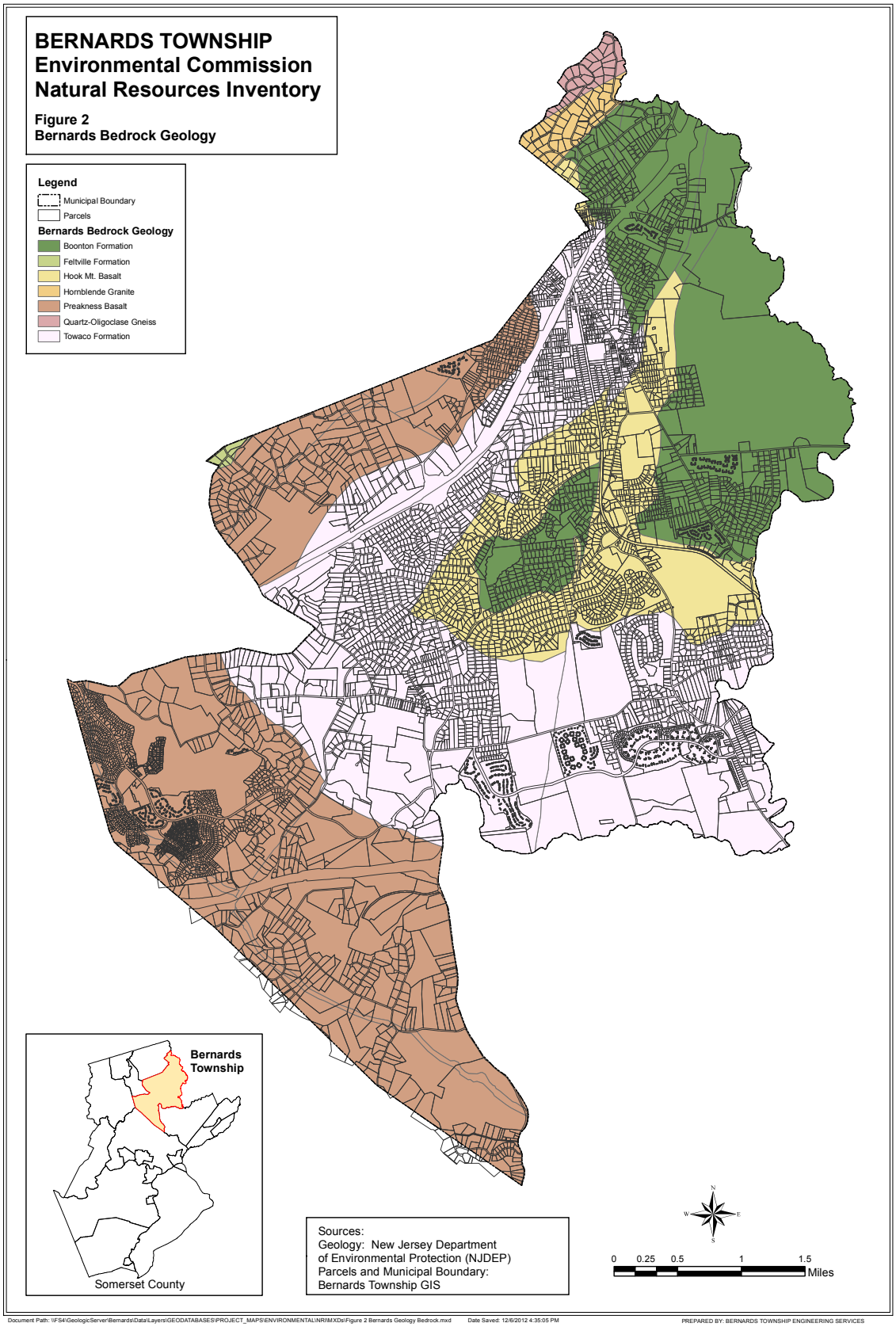
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 2
Bernards Bedrock Geology
Legend
Municipal Boundary
Parcels
Bernards Bedrock Geology
Boonton Formation
Feltville Formation
Hook Mt. Basalt
Hornblende Granite
Preakness Basalt
Quartz-Oligoclase Gneiss
Towaco Formation
Bernards Township
Somerset County
Sources:
Geology: New Jersey Department of Environmental Protection (NJDEP)
Parcels and Municipal Boundary: Bernards Township GIS
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0 0.25 0.5 1 1.5
Miles
Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRIM\XDs\Figure 2 Bernards Geology Bedrock.mxd
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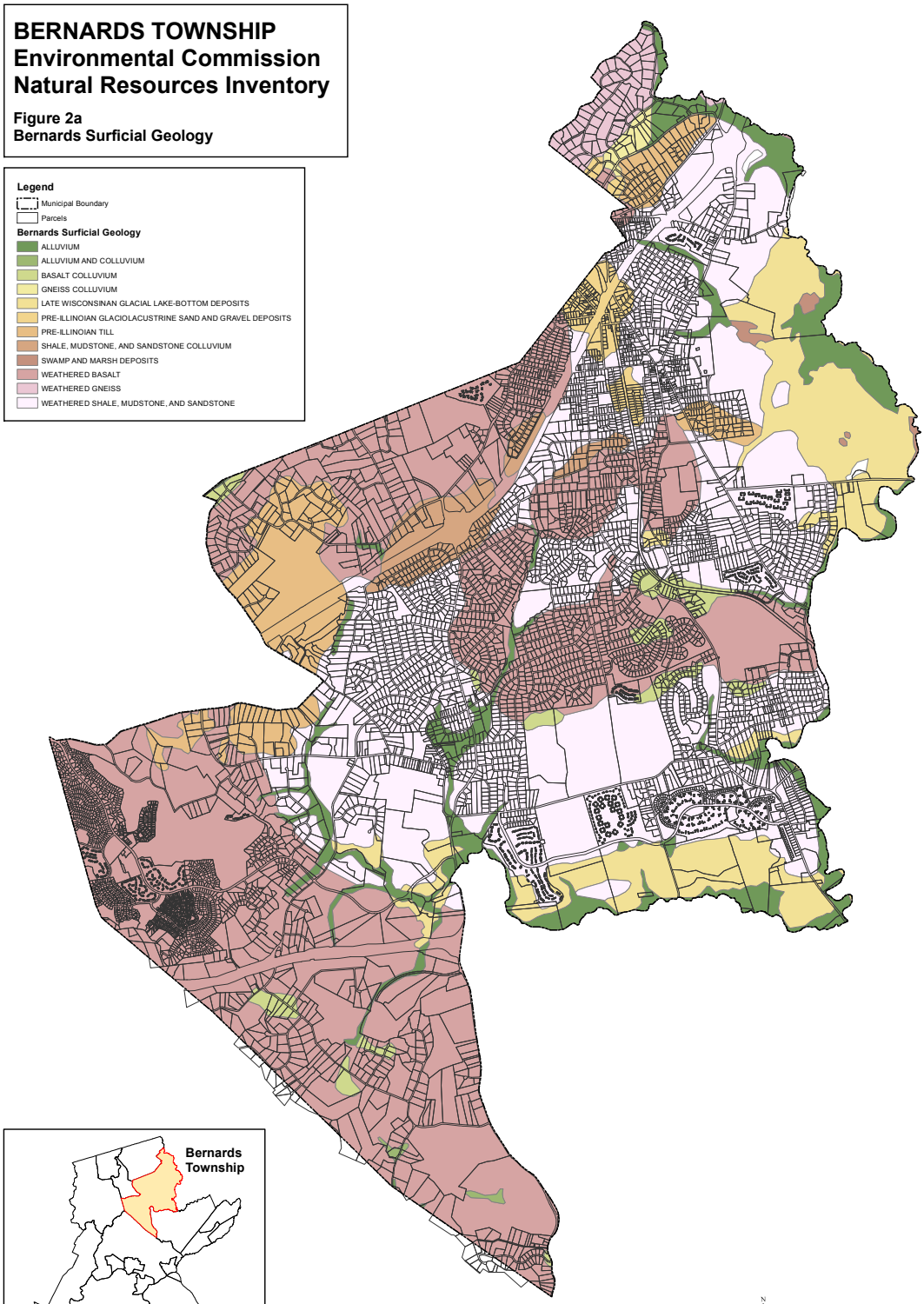
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory

Figure 2a
Bernards Surficial Geology



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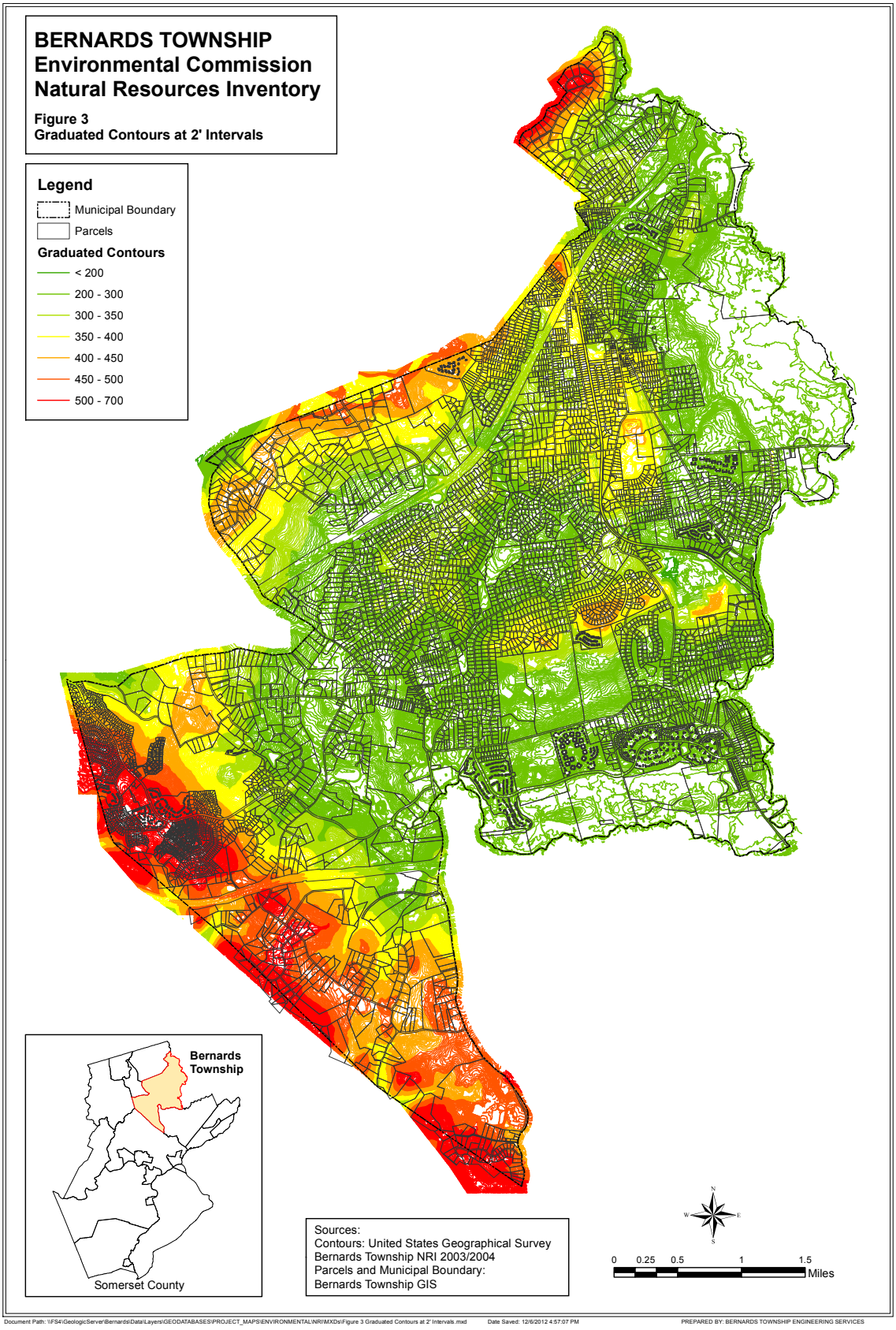
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 3
Graduated Contours at 2' Intervals
Legend
Municipal Boundary
Parcels
Graduated Contours
< 200
200 - 300
300 - 350
350 - 400
400 - 450
450 - 500
500 - 700
Bernards Township
Somerset County
Sources:
Contours: United States Geographical Survey
Bernards Township NRI 2003/2004
Parcels and Municipal Boundary:
Bernards Township GIS
N
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0 0.25 0.5 1 1.5
Miles
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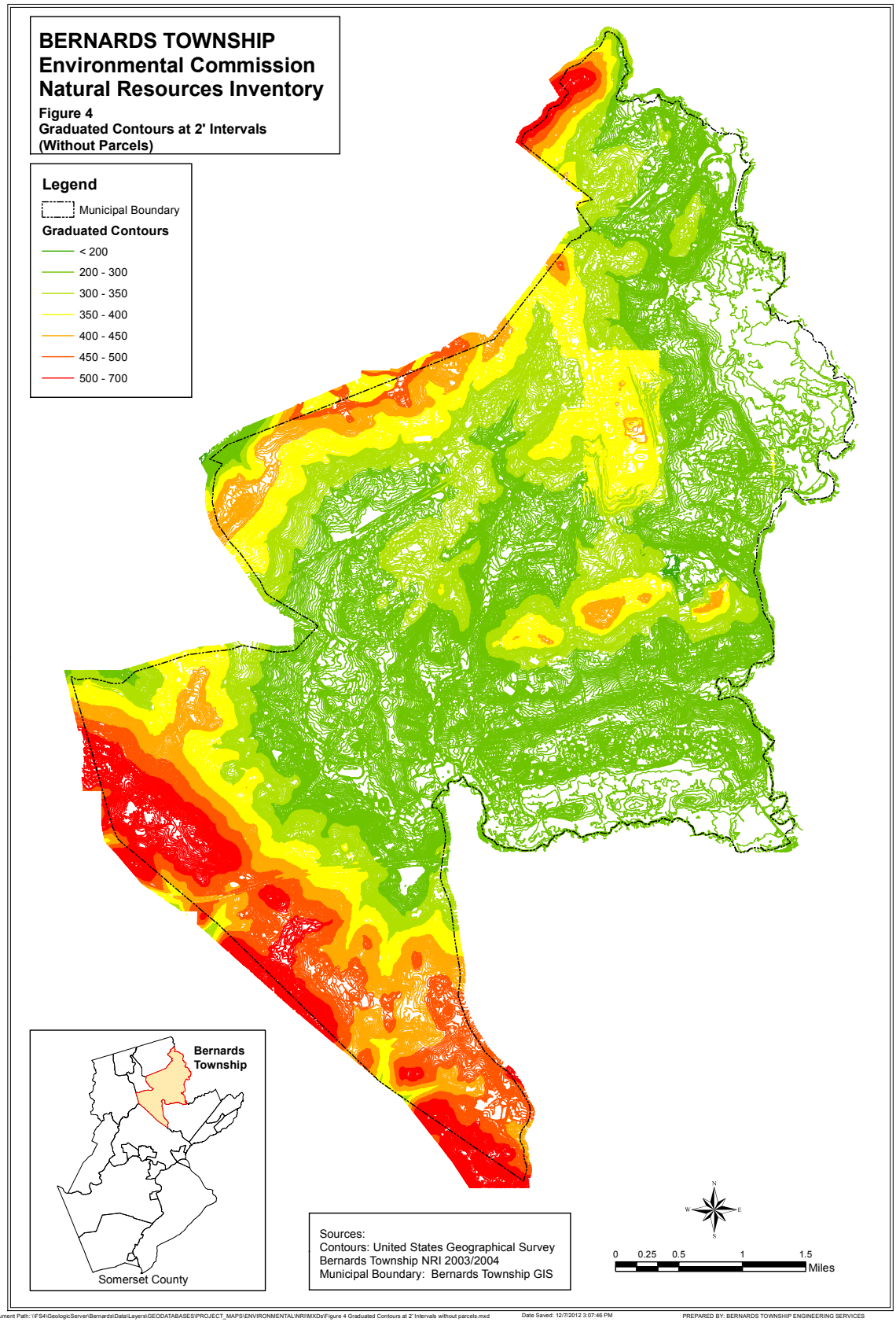
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 4
Graduated Contours at 2' Intervals
(Without Parcels)
Legend
Municipal Boundary
Graduated Contours
< 200
200 - 300
300 - 350
350 - 400
400 - 450
450 - 500
500 - 700
Bernards Township
Somerset County
Sources:
Contours: United States Geographical Survey
Bernards Township NRI 2003/2004
Municipal Boundary: Bernards Township GIS
N
W
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S
0 0.25 0.5 1 1.5
Miles
Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRI\MXDs\Figure 4 Graduated Contours at 2' Intervals without parcels.mxd
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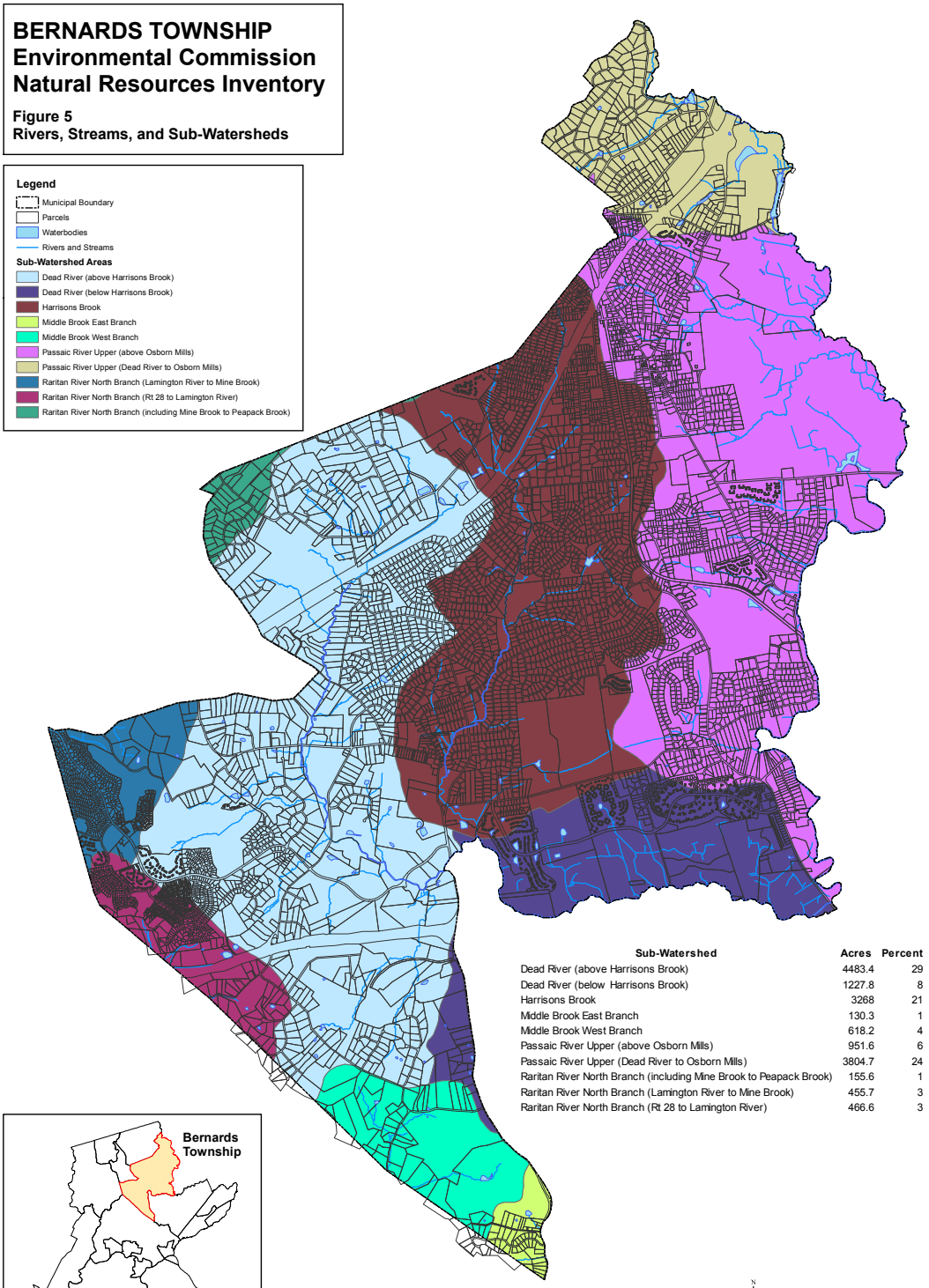
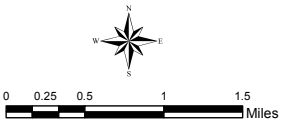
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory

Figure 5
Rivers, Streams, and Sub-Watersheds



Sub-Watershed	Acres	Percent
Dead River (above Harrisons Brook)	4483.4	29
Dead River (below Harrisons Brook)	1227.8	8
Harrisons Brook	3268	21
Middle Brook East Branch	130.3	1
Middle Brook West Branch	618.2	4
Passaic River Upper (above Osborn Mills)	951.6	6
Passaic River Upper (Dead River to Osborn Mills)	3804.7	24
Raritan River North Branch (including Mine Brook to Peapack Brook)	155.6	1
Raritan River North Branch (Lamington River to Mine Brook)	455.7	3
Raritan River North Branch (Rt 28 to Lamington River)	466.6	3

Sources:
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Waterbodies: NJDEP, OIRM, BGIS
Sub-Watershed: NJDEP, NJGS
Parcels & Municipal Boundary: Bernards Township GIS



Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRI\MXDs\Figure 5 Rivers Streams SubWatersheds.mxd Date Saved: 12/10/2012 10:16:19 AM

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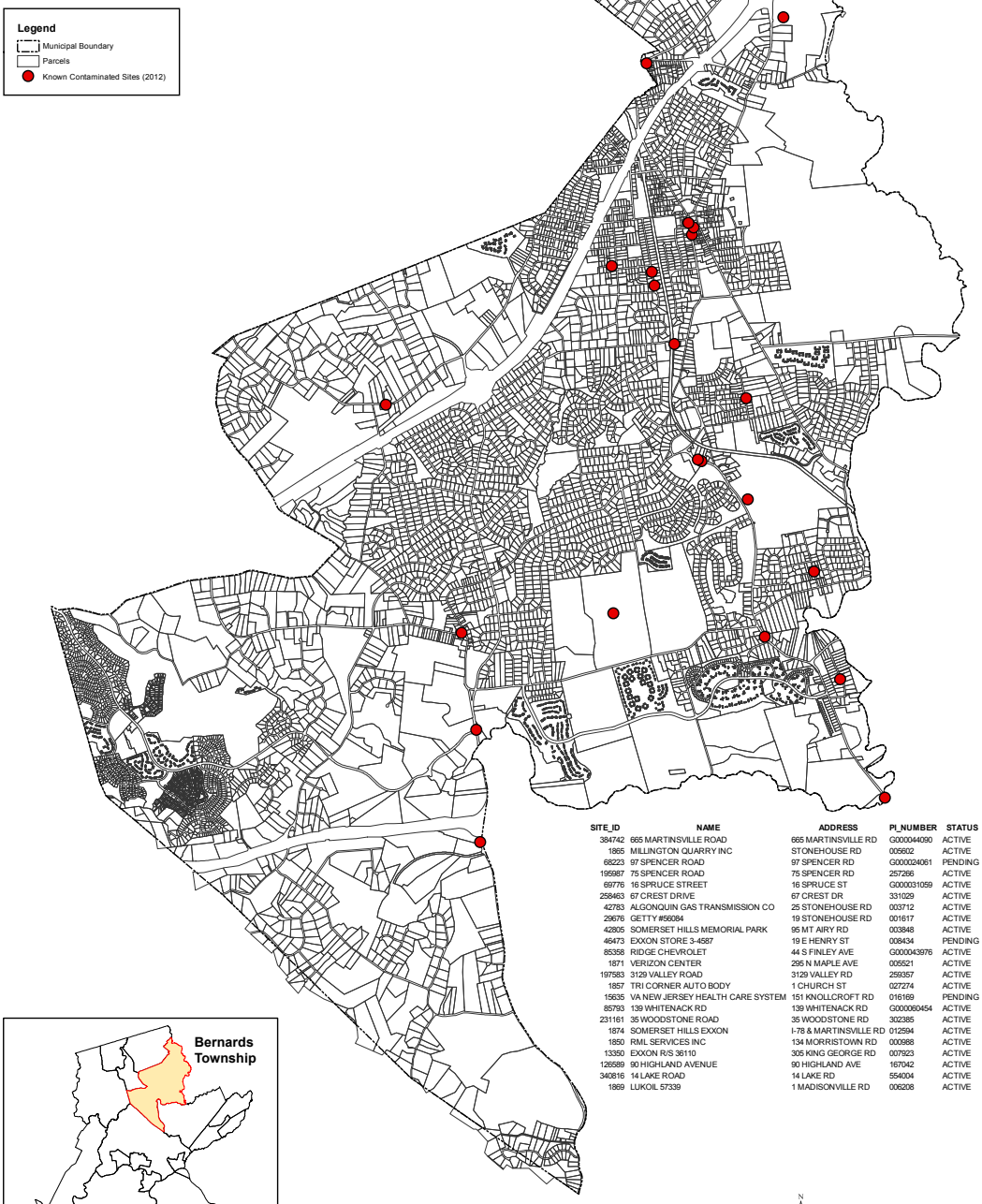
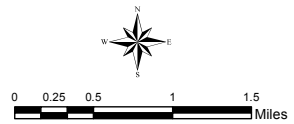
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory

Figure 6
Environmental Permitted Sites



SITE_ID	NAME	ADDRESS	PI_NUMBER	STATUS
384742	665 MARTINSVILLE ROAD	665 MARTINSVILLE RD	G000044090	ACTIVE
1865	MILLINGTON QUARRY INC	STONEHOUSE RD	005932	ACTIVE
68223	97 SPENCER ROAD	97 SPENCER RD	G000024061	PENDING
195987	75 SPENCER ROAD	75 SPENCER RD	257266	ACTIVE
69776	16 SPRUCE STREET	16 SPRUCE ST	G000031059	ACTIVE
258463	67 CREST DRIVE	67 CREST DR	331029	ACTIVE
42783	ALGONQUIN GAS TRANSMISSION CO	25 STONEHOUSE RD	003712	ACTIVE
29676	GETTY #56084	19 STONEHOUSE RD	001617	ACTIVE
42805	SOMERSET HILLS MEMORIAL PARK	96 MT AIRY RD	003848	ACTIVE
46473	EXXON STORE 3-4587	19 E HENRY ST	008434	PENDING
85358	RIDGE CHEVROLET	44 S FINLEY AVE	G000043976	ACTIVE
1871	VERIZON CENTER	295 N MAPLE AVE	005521	ACTIVE
197583	3129 VALLEY ROAD	3129 VALLEY RD	259357	ACTIVE
1857	TRI CORNER AUTO BODY	1 CHURCH ST	027274	ACTIVE
15635	VA NEW JERSEY HEALTH CARE SYSTEM	151 KNOLLCROFT RD	016169	PENDING
85793	139 WHITENACK RD	139 WHITENACK RD	G000080454	ACTIVE
231161	35 WOODSTONE ROAD	35 WOODSTONE RD	302385	ACTIVE
1874	SOMERSET HILLS EXXON	I-78 & MARTINSVILLE RD	012594	ACTIVE
1850	RML SERVICES INC	134 MORRISTOWN RD	000988	ACTIVE
13350	EXXON R/S 36110	305 KING GEORGE RD	007923	ACTIVE
126589	90 HIGHLAND AVENUE	90 HIGHLAND AVE	167042	ACTIVE
340816	14 LAKE ROAD	14 LAKE RD	554004	ACTIVE
1869	LUKOIL 57339	1 MADISONVILLE RD	006208	ACTIVE

Sources:
Known Contaminated Sites (2012): NJDEP
Parcels and Municipal Boundary:
Bernards Township GIS



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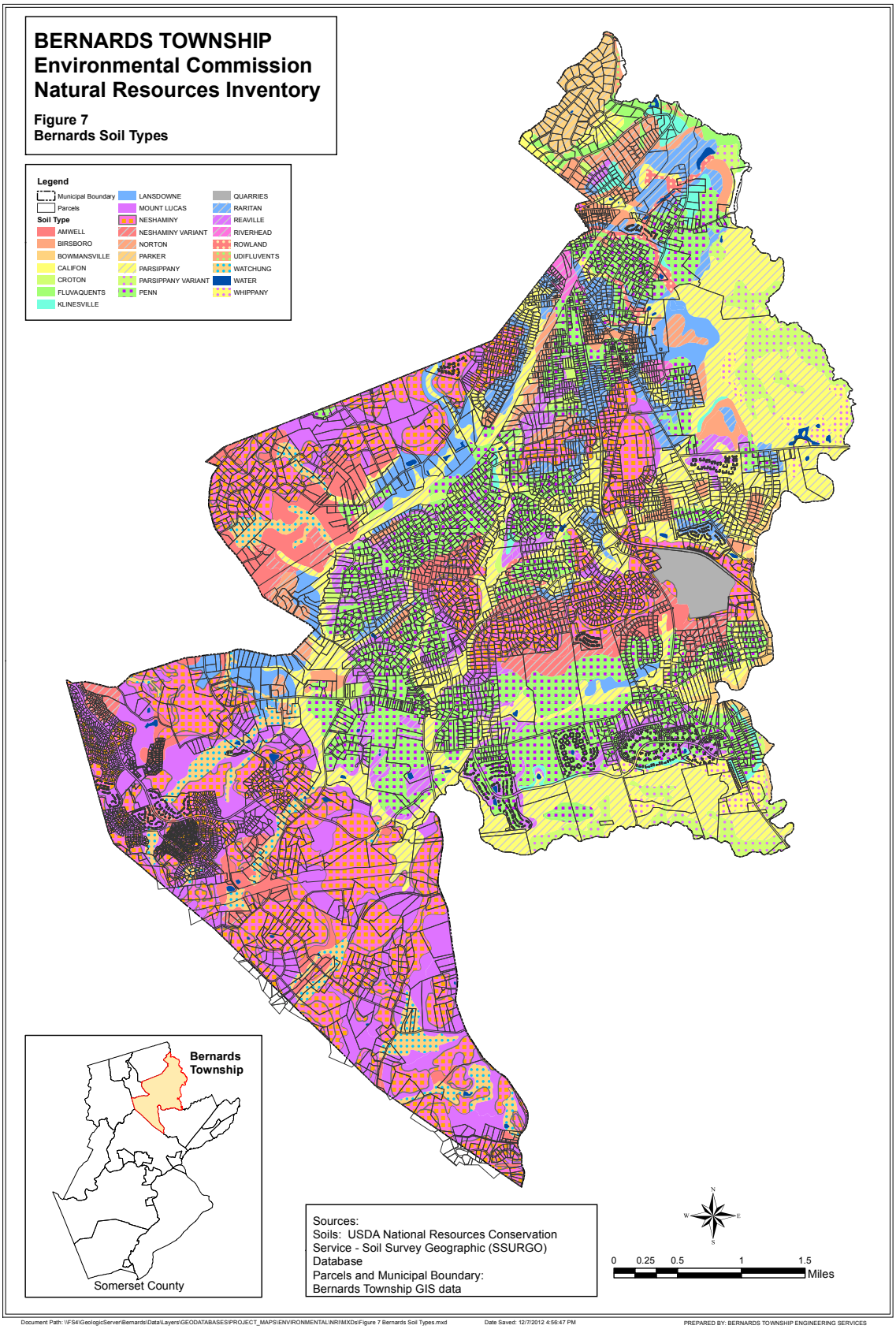
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 7
Bernards Soil Types
Legend
Municipal Boundary
Parcels
Soil Type
AMWELL
BIRSBORO
BOWMANSVILLE
CALIFON
CROTON
FLUVAQUENTS
KLINESVILLE
LANSDOWNE
MOUNT LUCAS
NESHAMINY
NESHAMINY VARIANT
NORTON
PARKER
PARSIPPANY
PARSIPPANY VARIANT
PENN
QUARRIES
RARITAN
REAVILLE
RIVERHEAD
ROWLAND
UDIFLUVENTS
WATCHUNG
WATER
WHIPPANY
Bernards Township
Somerset County
Sources:
Soils: USDA National Resources Conservation Service - Soil Survey Geographic (SSURGO) Database
Parcels and Municipal Boundary:
Bernards Township GIS data
N
W
E
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0.25
0.5
1
1.5
Miles
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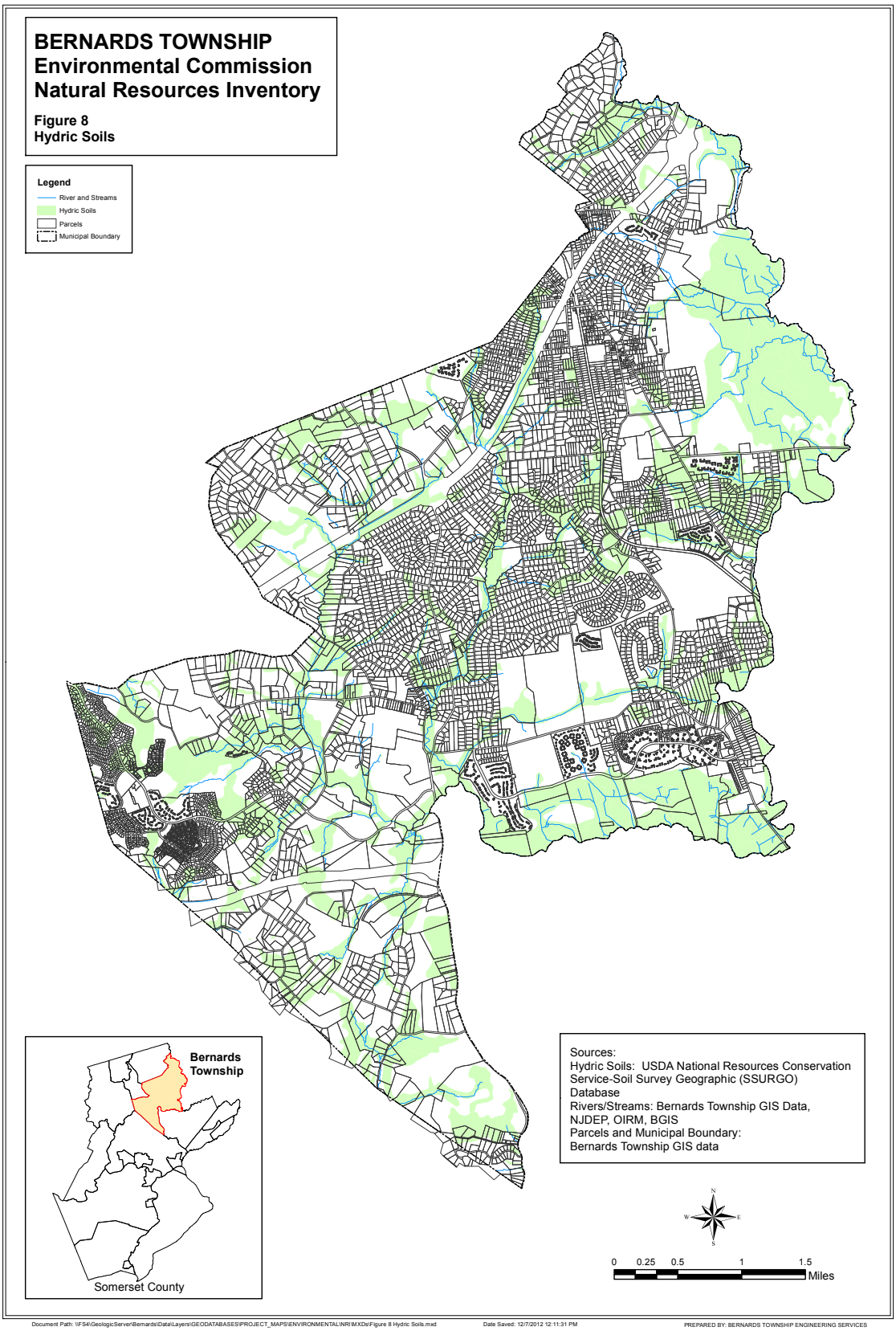
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 8
Hydric Soils
Legend
River and Streams
Hydric Soils
Parcels
Municipal Boundary
Bernards Township
Somerset County
Sources:
Hydric Soils: USDA National Resources Conservation Service-Soil Survey Geographic (SSURGO) Database
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Parcels and Municipal Boundary: Bernards Township GIS data
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Miles
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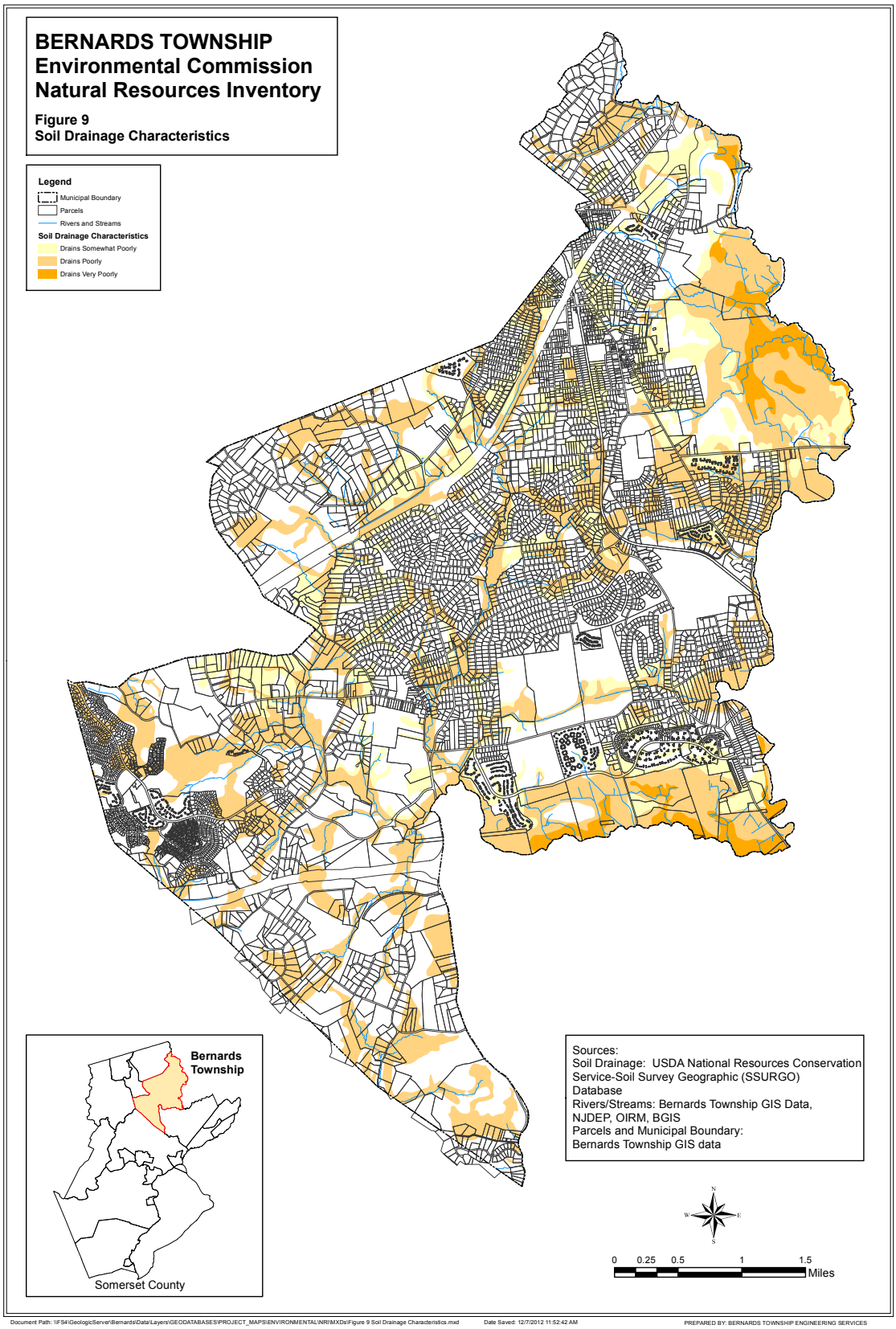
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 9
Soil Drainage Characteristics
Legend
Municipal Boundary
Parcels
Rivers and Streams
Soil Drainage Characteristics
Drains Somewhat Poorly
Drains Poorly
Drains Very Poorly
Bernards Township
Somerset County
Sources:
Soil Drainage: USDA National Resources Conservation Service-Soil Survey Geographic (SSURGO) Database
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Parcels and Municipal Boundary:
Bernards Township GIS data
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0 0.25 0.5 1 1.5
Miles
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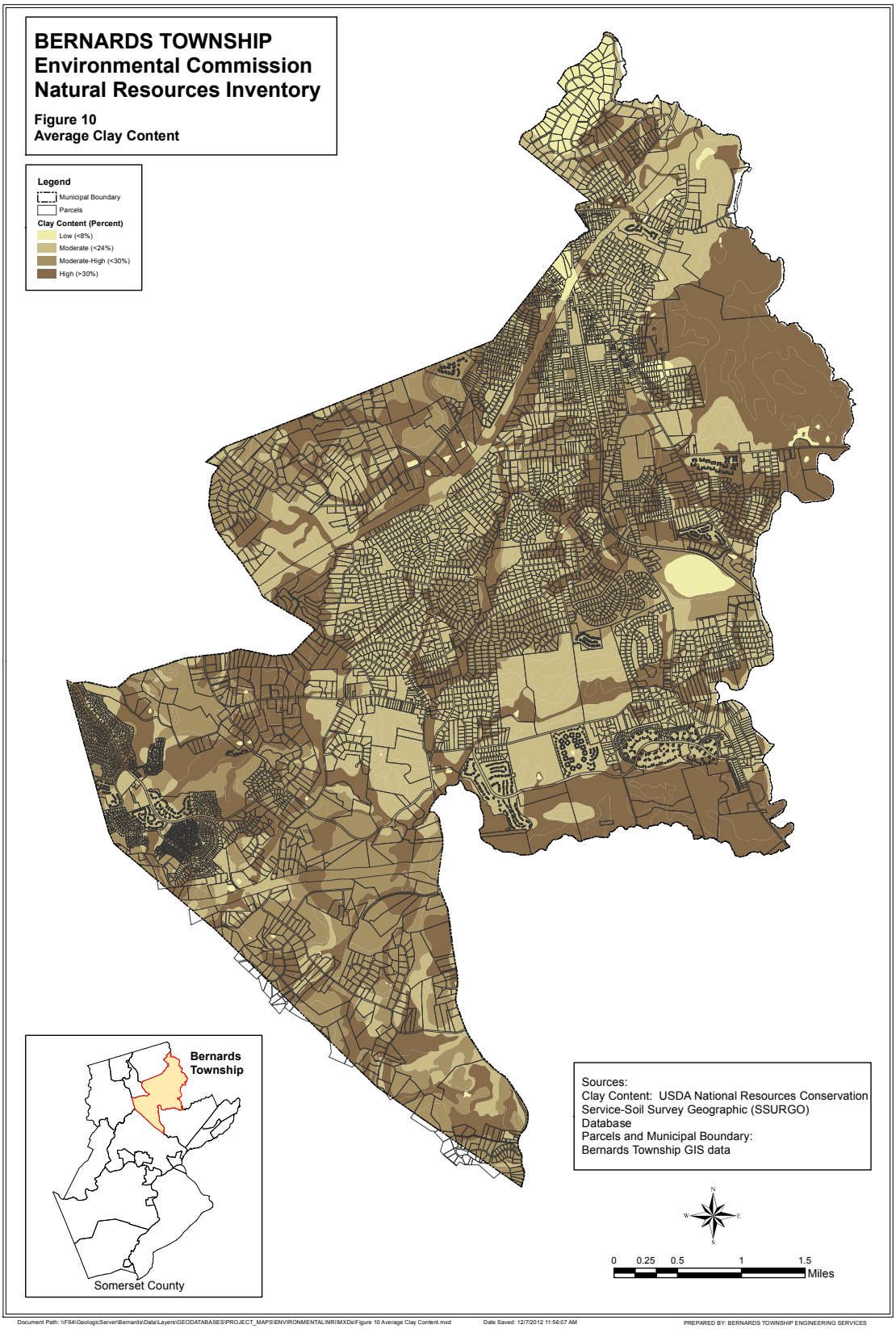
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 10
Average Clay Content
Legend
Municipal Boundary
Parcels
Clay Content (Percent)
Low (<8%)
Moderate (<24%)
Moderate-High (<30%)
High (>30%)
Bernards Township
Somerset County
Sources:
Clay Content: USDA National Resources Conservation Service-Soil Survey Geographic (SSURGO) Database
Parcels and Municipal Boundary:
Bernards Township GIS data
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Miles
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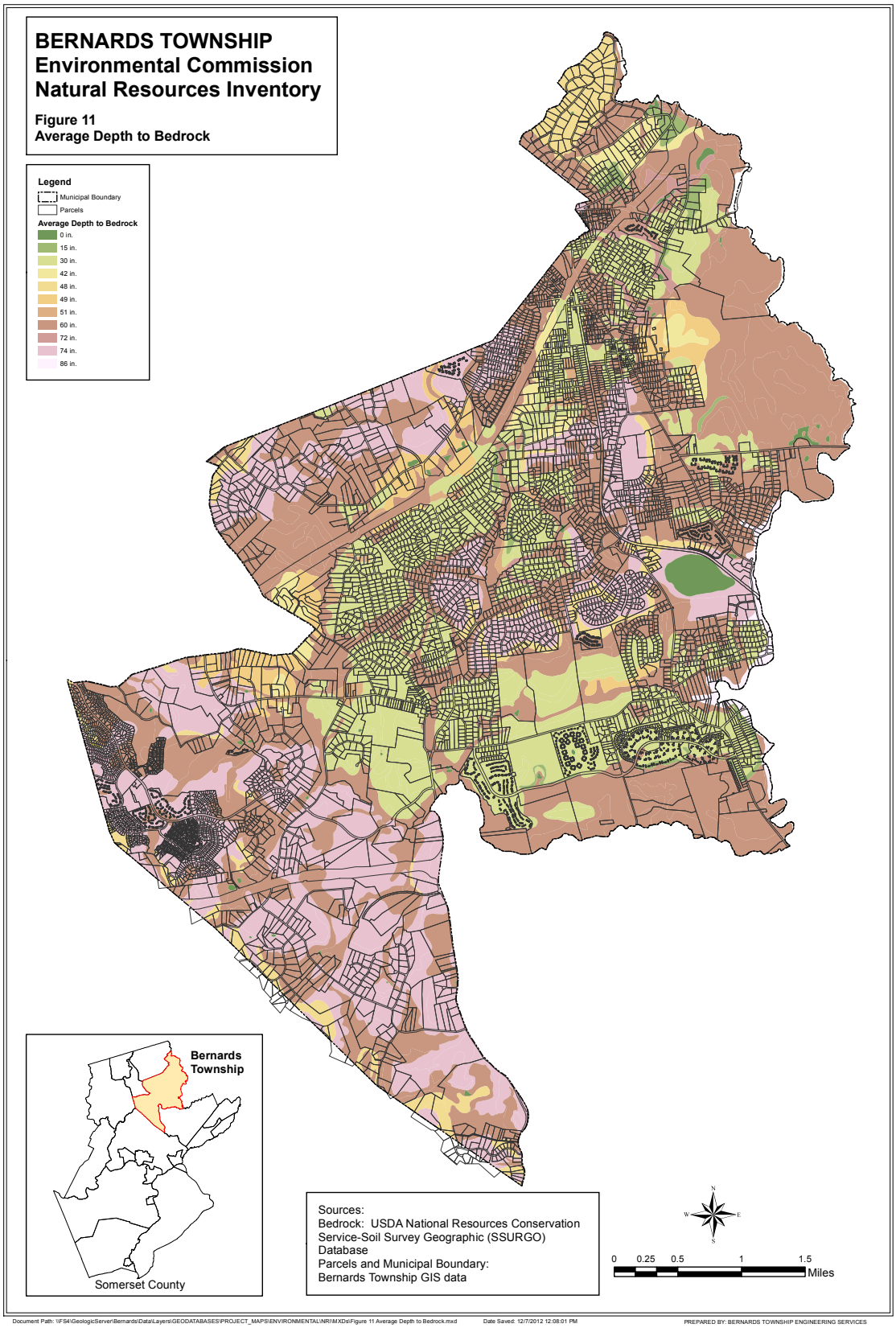
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 11
Average Depth to Bedrock
Legend
Municipal Boundary
Parcels
Average Depth to Bedrock
0 in.
15 in.
30 in.
42 in.
48 in.
49 in.
51 in.
60 in.
72 in.
74 in.
86 in.
Bernards Township
Somerset County
Sources:
Bedrock: USDA National Resources Conservation Service-Soil Survey Geographic (SSURGO) Database
Parcels and Municipal Boundary:
Bernards Township GIS data
N
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0 0.25 0.5 1 1.5
Miles
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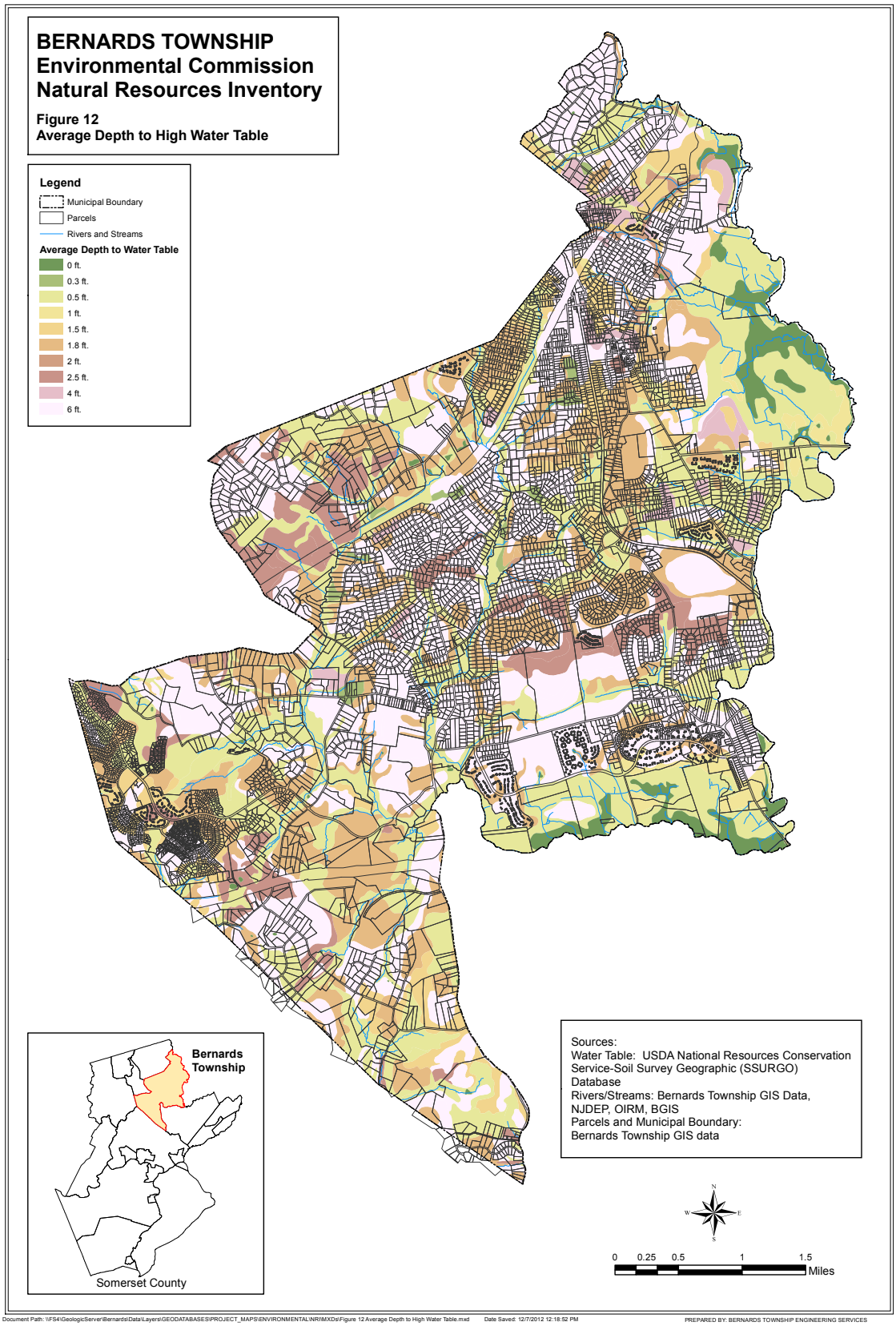
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 12
Average Depth to High Water Table
Legend
Municipal Boundary
Parcels
Rivers and Streams
Average Depth to Water Table
0 ft.
0.3 ft.
0.5 ft.
1 ft.
1.5 ft.
1.8 ft.
2 ft.
2.5 ft.
4 ft.
6 ft.
Bernards Township
Somerset County
Sources:
Water Table: USDA National Resources Conservation Service-Soil Survey Geographic (SSURGO) Database
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Parcels and Municipal Boundary: Bernards Township GIS data
N
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0 0.25 0.5 1 1.5
Miles
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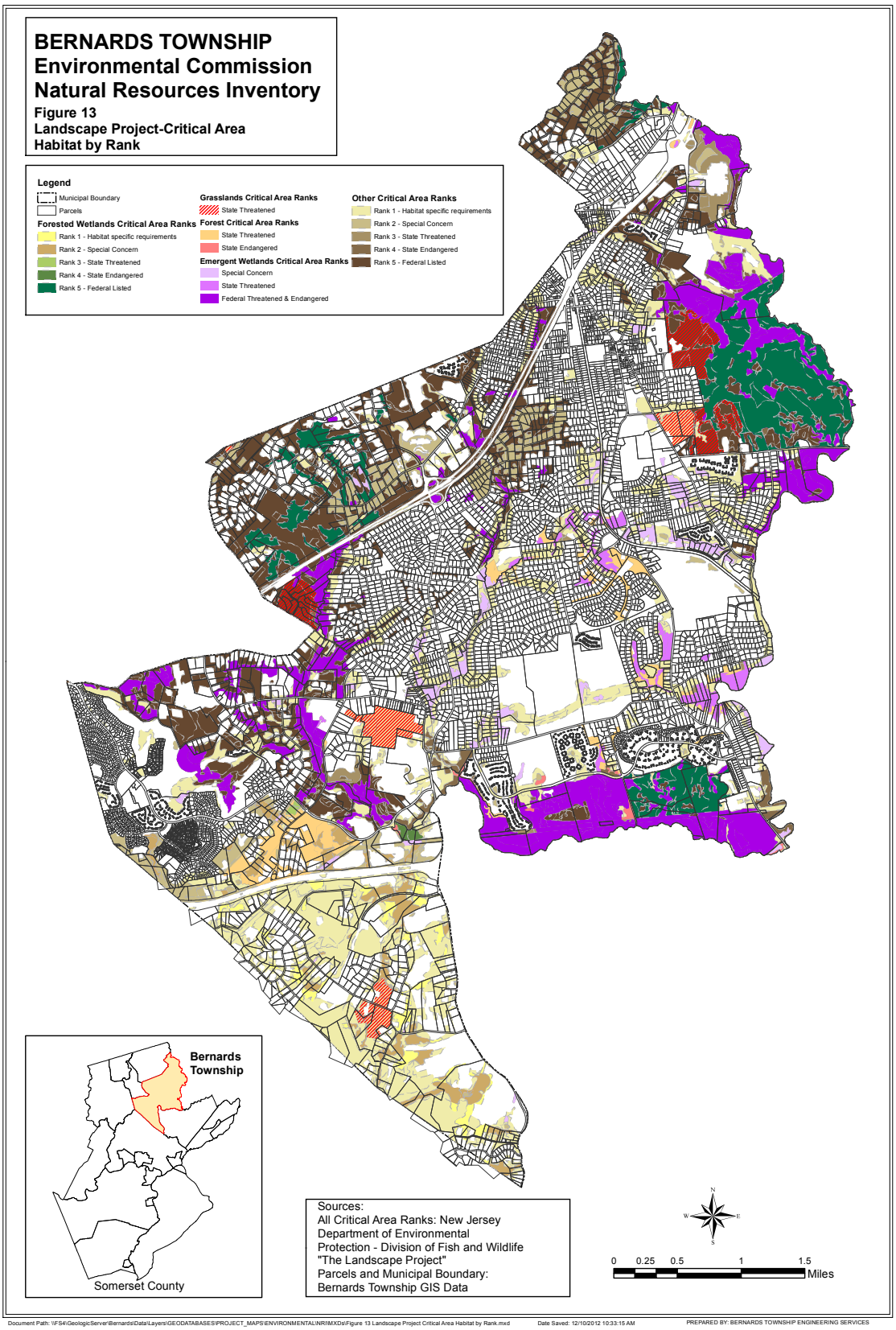
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 13
Landscape Project-Critical Area
Habitat by Rank
Legend
Municipal Boundary
Parcels
Forested Wetlands Critical Area Ranks
Rank 1 - Habitat specific requirements
Rank 2 - Special Concern
Rank 3 - State Threatened
Rank 4 - State Endangered
Rank 5 - Federal Listed
Grasslands Critical Area Ranks
State Threatened
Forest Critical Area Ranks
State Threatened
State Endangered
Emergent Wetlands Critical Area Ranks
Special Concern
State Threatened
Federal Threatened & Endangered
Other Critical Area Ranks
Rank 1 - Habitat specific requirements
Rank 2 - Special Concern
Rank 3 - State Threatened
Rank 4 - State Endangered
Rank 5 - Federal Listed
Bernards Township
Somerset County
Sources:
All Critical Area Ranks: New Jersey Department of Environmental Protection - Division of Fish and Wildlife "The Landscape Project"
Parcels and Municipal Boundary: Bernards Township GIS Data
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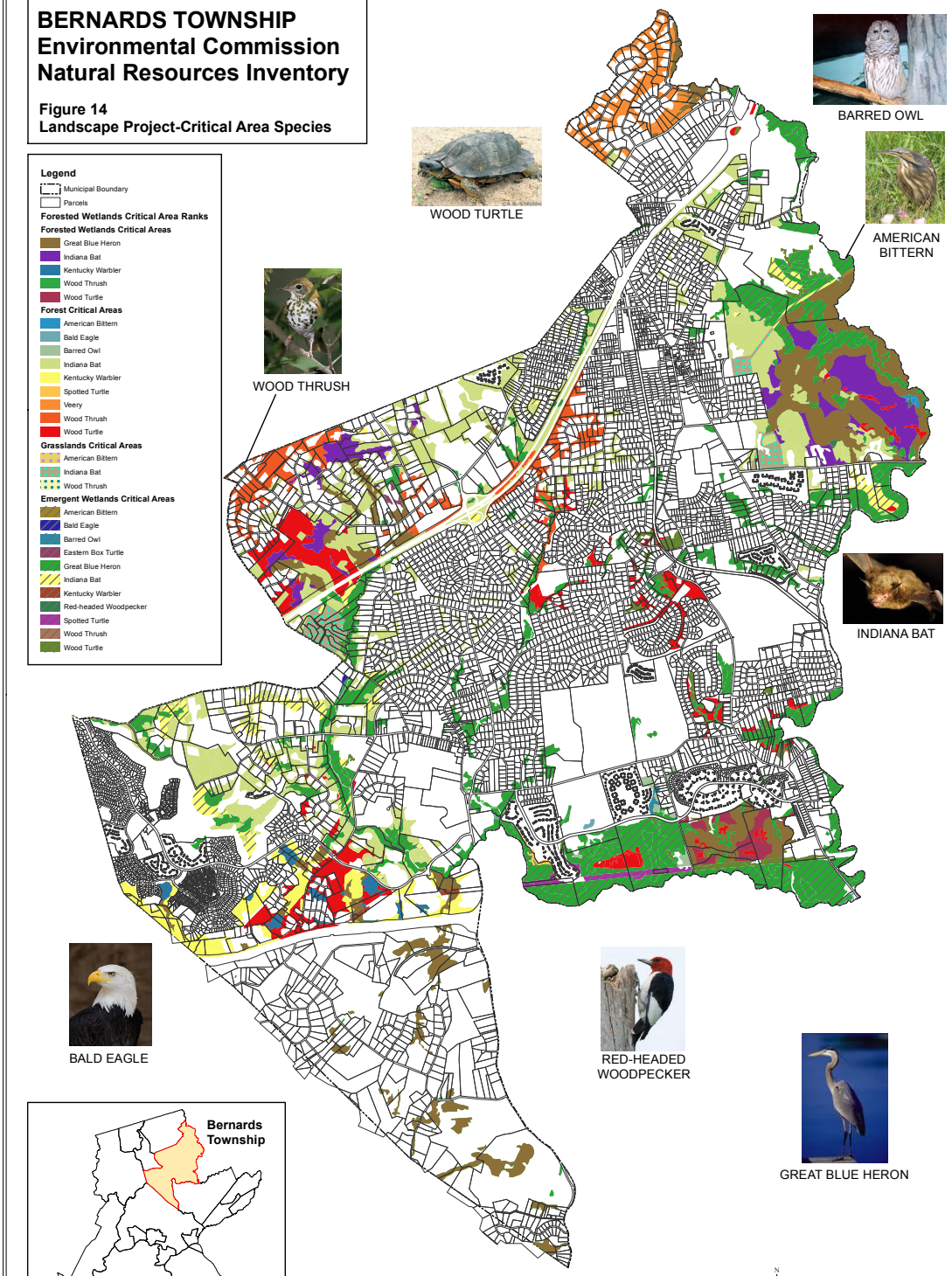
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory

Figure 14
Landscape Project-Critical Area Species



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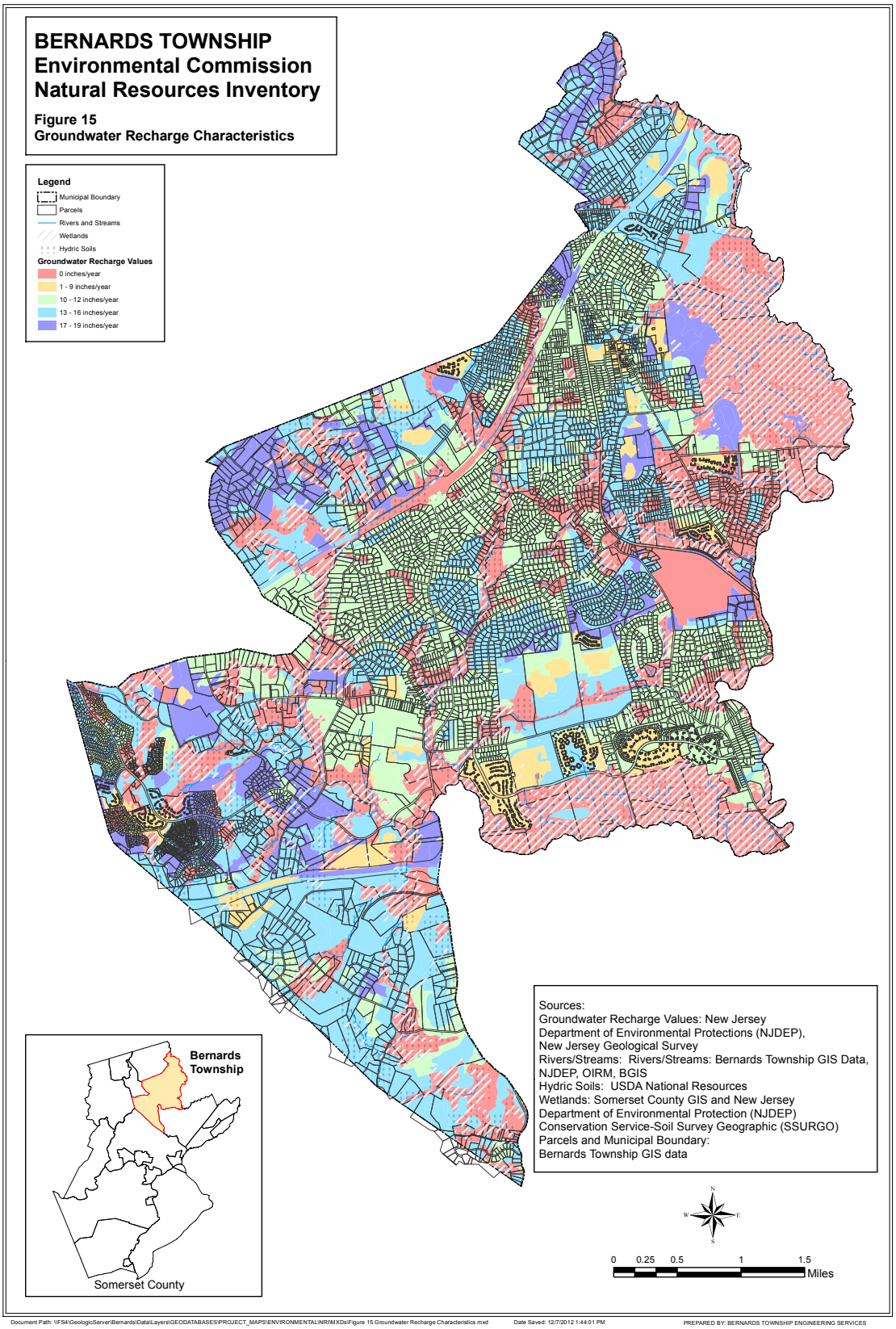
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 15
Groundwater Recharge Characteristics
Legend
Municipal Boundary
Parcels
Rivers and Streams
Wetlands
Hydric Soils
Groundwater Recharge Values
0 inches/year
1 - 9 inches/year
10 - 12 inches/year
13 - 16 inches/year
17 - 19 inches/year
Bernards Township
Somerset County
Sources:
Groundwater Recharge Values: New Jersey Department of Environmental Protections (NJDEP), New Jersey Geological Survey
Rivers/Streams: Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Hydric Soils: USDA National Resources
Wetlands: Somerset County GIS and New Jersey Department of Environmental Protection (NJDEP)
Conservation Service-Soil Survey Geographic (SSURGO)
Parcels and Municipal Boundary:
Bernards Township GIS data
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Miles
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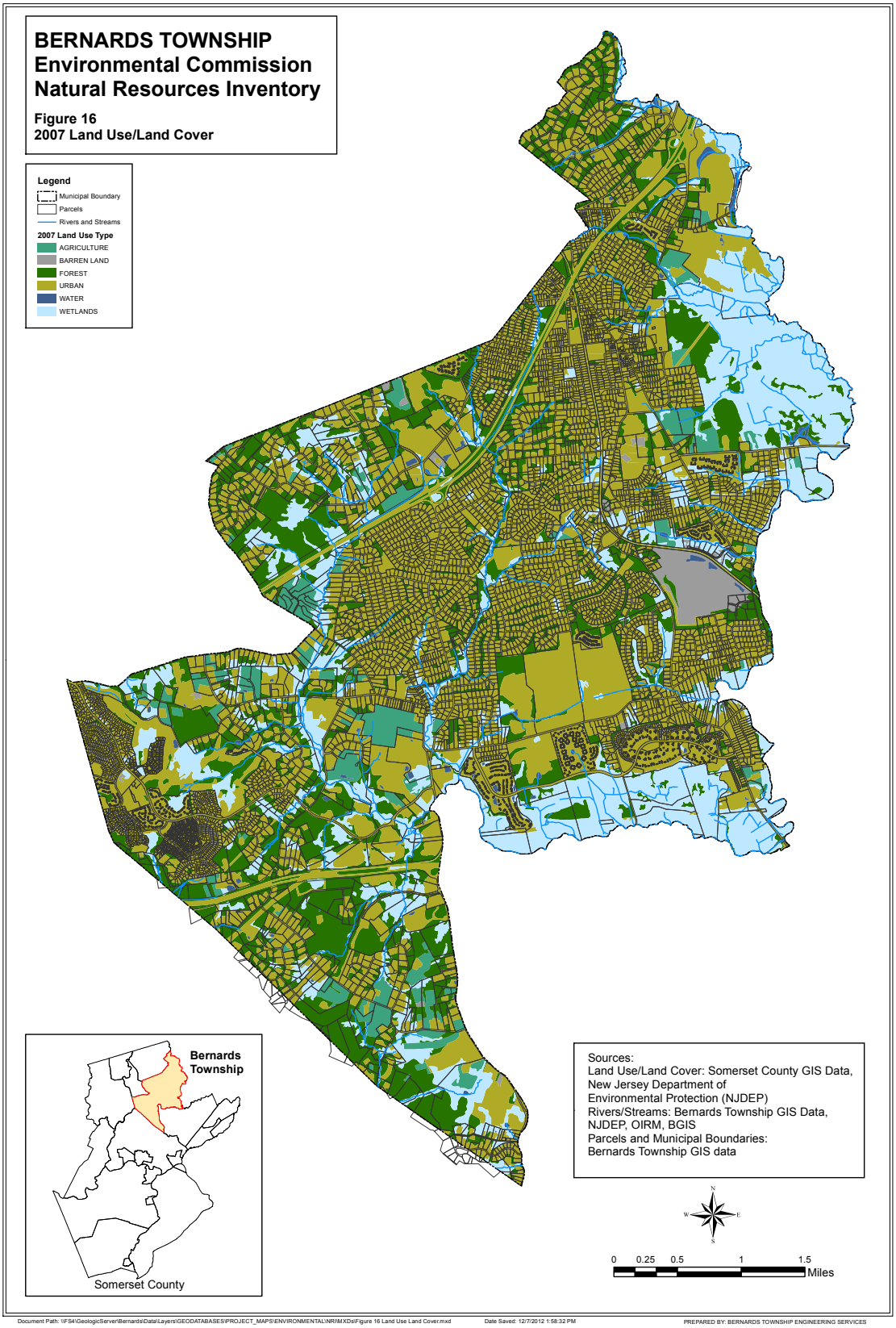
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 16
2007 Land Use/Land Cover
Legend
Municipal Boundary
Parcels
Rivers and Streams
2007 Land Use Type
AGRICULTURE
BARREN LAND
FOREST
URBAN
WATER
WETLANDS
Bernards Township
Somerset County
Sources:
Land Use/Land Cover: Somerset County GIS Data, New Jersey Department of Environmental Protection (NJDEP)
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Parcels and Municipal Boundaries: Bernards Township GIS data
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Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NR\MXDs\Figure 16 Land Use Land Cover.mxd
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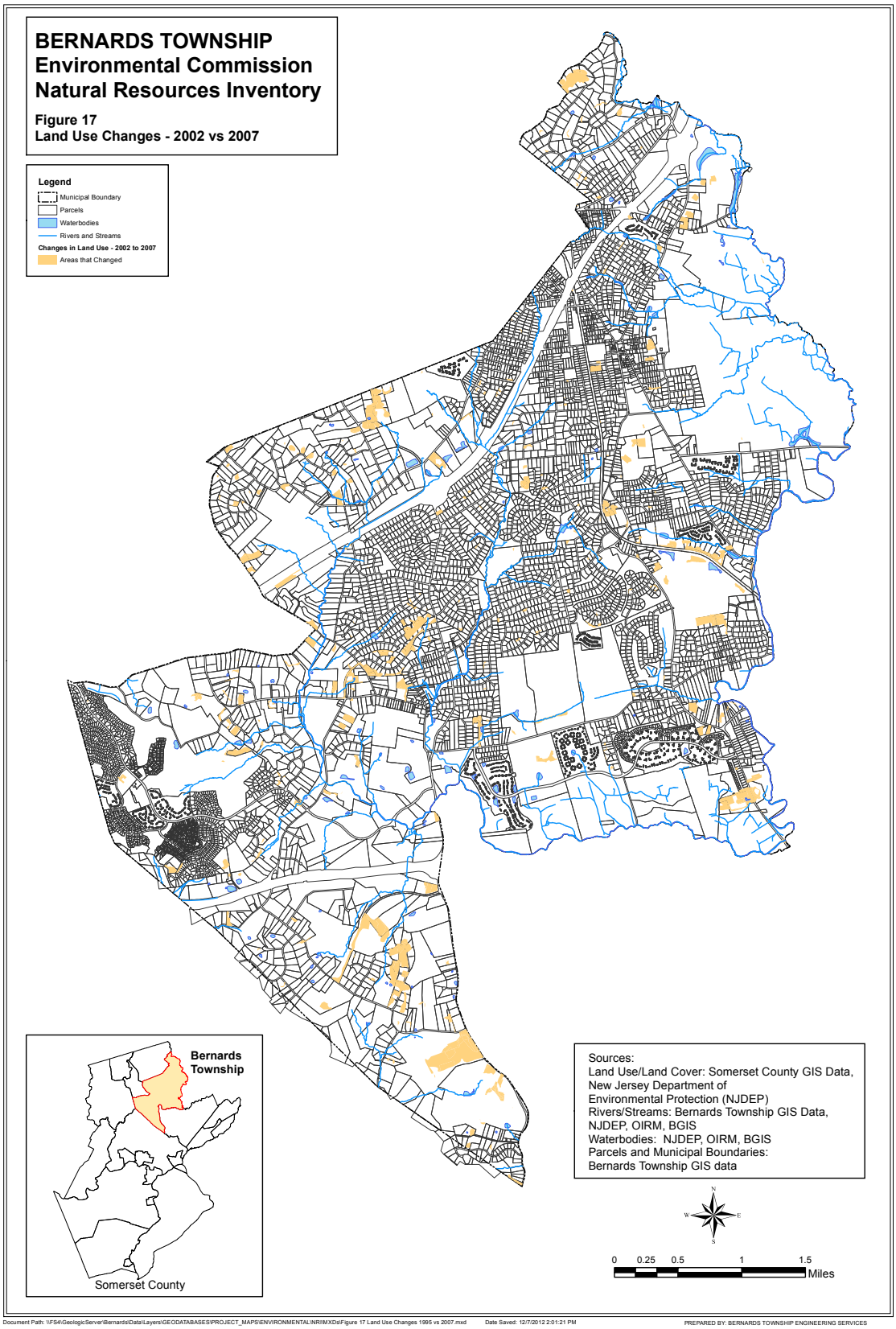
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 17
Land Use Changes - 2002 vs 2007
Legend
Municipal Boundary
Parcels
Waterbodies
Rivers and Streams
Changes in Land Use - 2002 to 2007
Areas that Changed
Bernards Township
Somerset County
Sources:
Land Use/Land Cover: Somerset County GIS Data, New Jersey Department of Environmental Protection (NJDEP)
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Waterbodies: NJDEP, OIRM, BGIS
Parcels and Municipal Boundaries: Bernards Township GIS data
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Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NR\MXDs\Figure 17 Land Use Changes 1995 vs 2007.mxd
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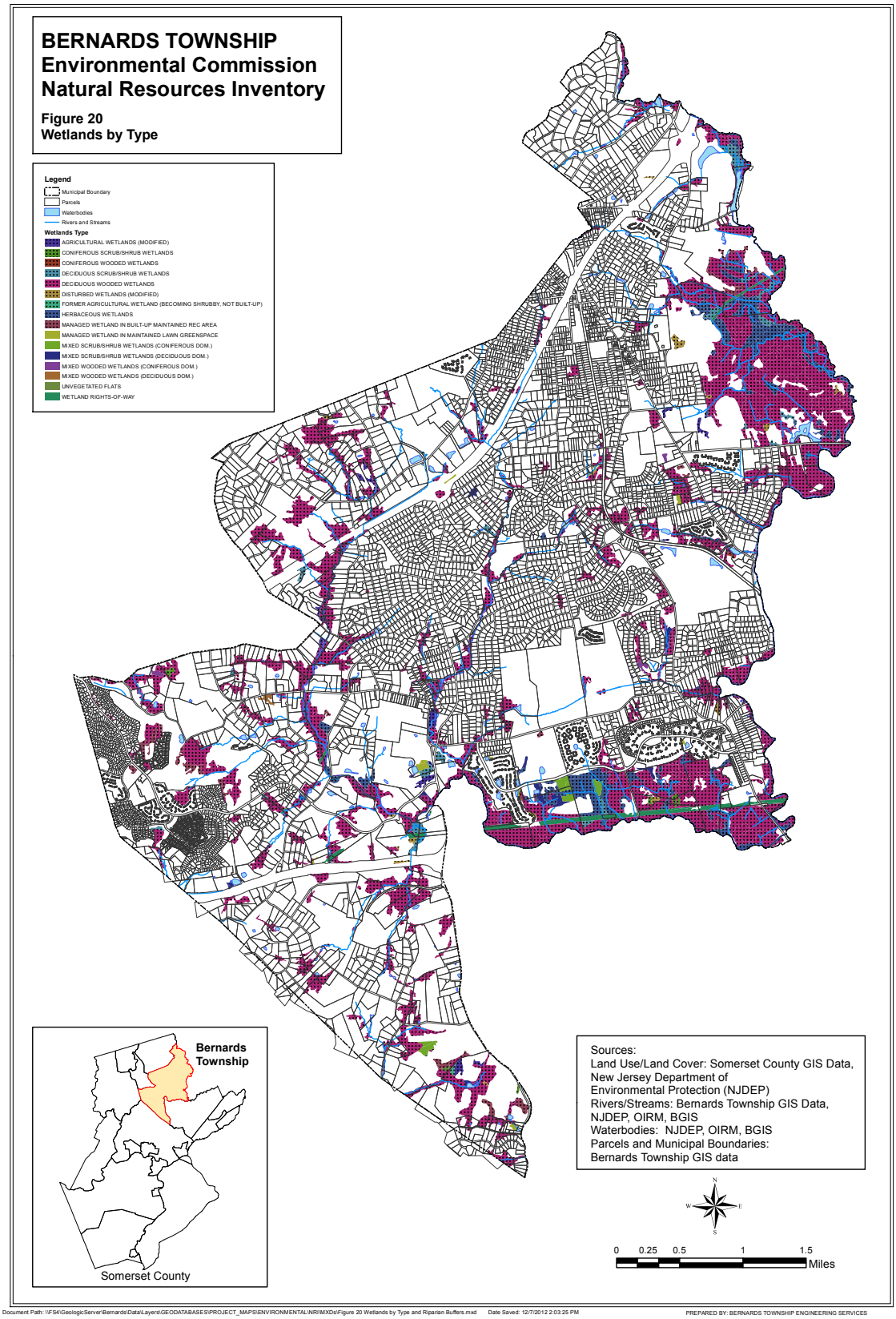

Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRI\MXDs\Figure 20 Wetlands by Type and Riparian Buffers.mxd Date Saved: 12/7/2012 2:03:25 PM

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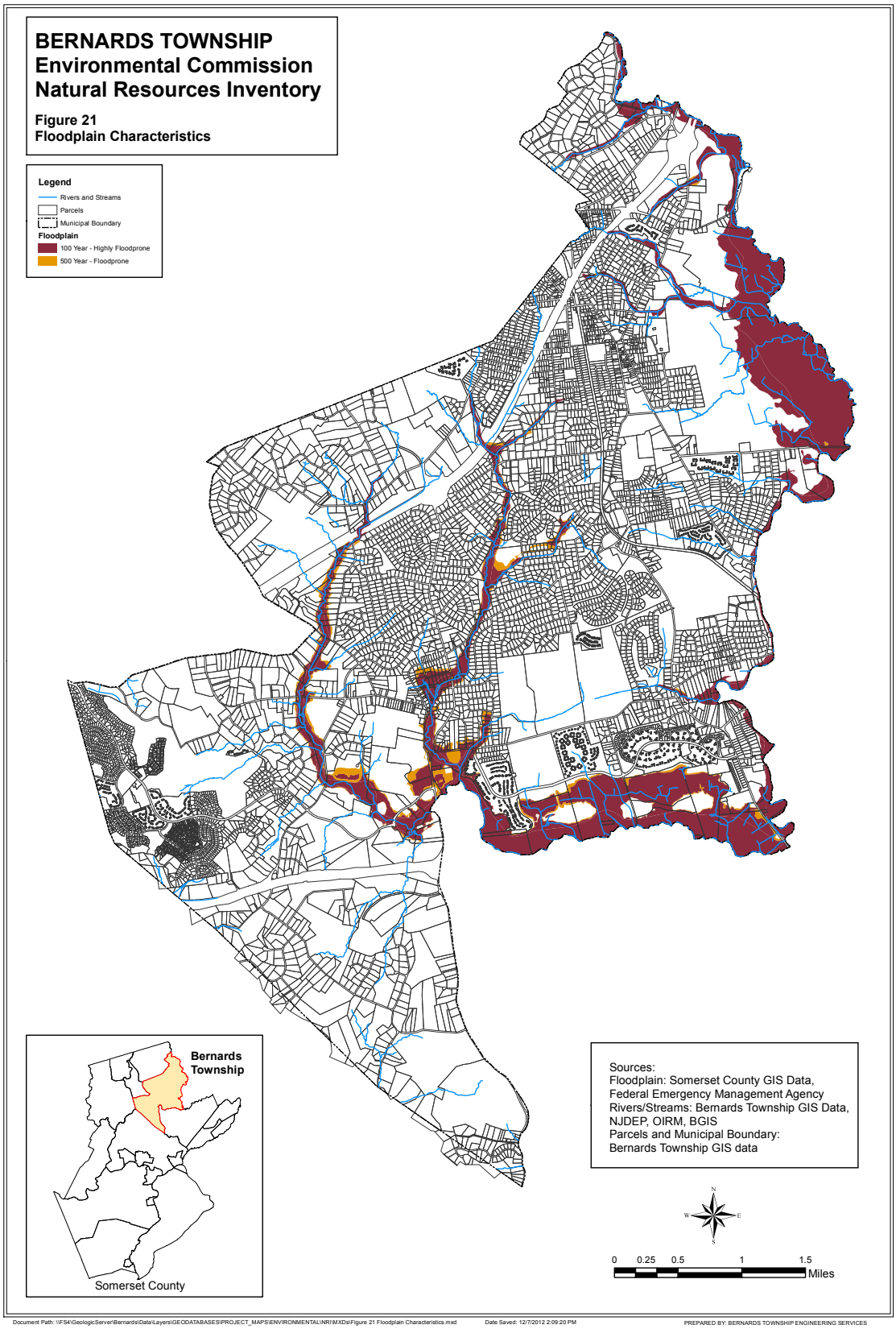
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 21
Floodplain Characteristics
Legend
Rivers and Streams
Parcels
Municipal Boundary
Floodplain
100 Year - Highly Floodprone
500 Year - Floodprone
Bernards Township
Somerset County
Sources:
Floodplain: Somerset County GIS Data, Federal Emergency Management Agency
Rivers/Streams: Bernards Township GIS Data, NJDEP, OIRM, BGIS
Parcels and Municipal Boundary: Bernards Township GIS data
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Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRI\MXDs\Figure 21 Floodplain Characteristics.mxd
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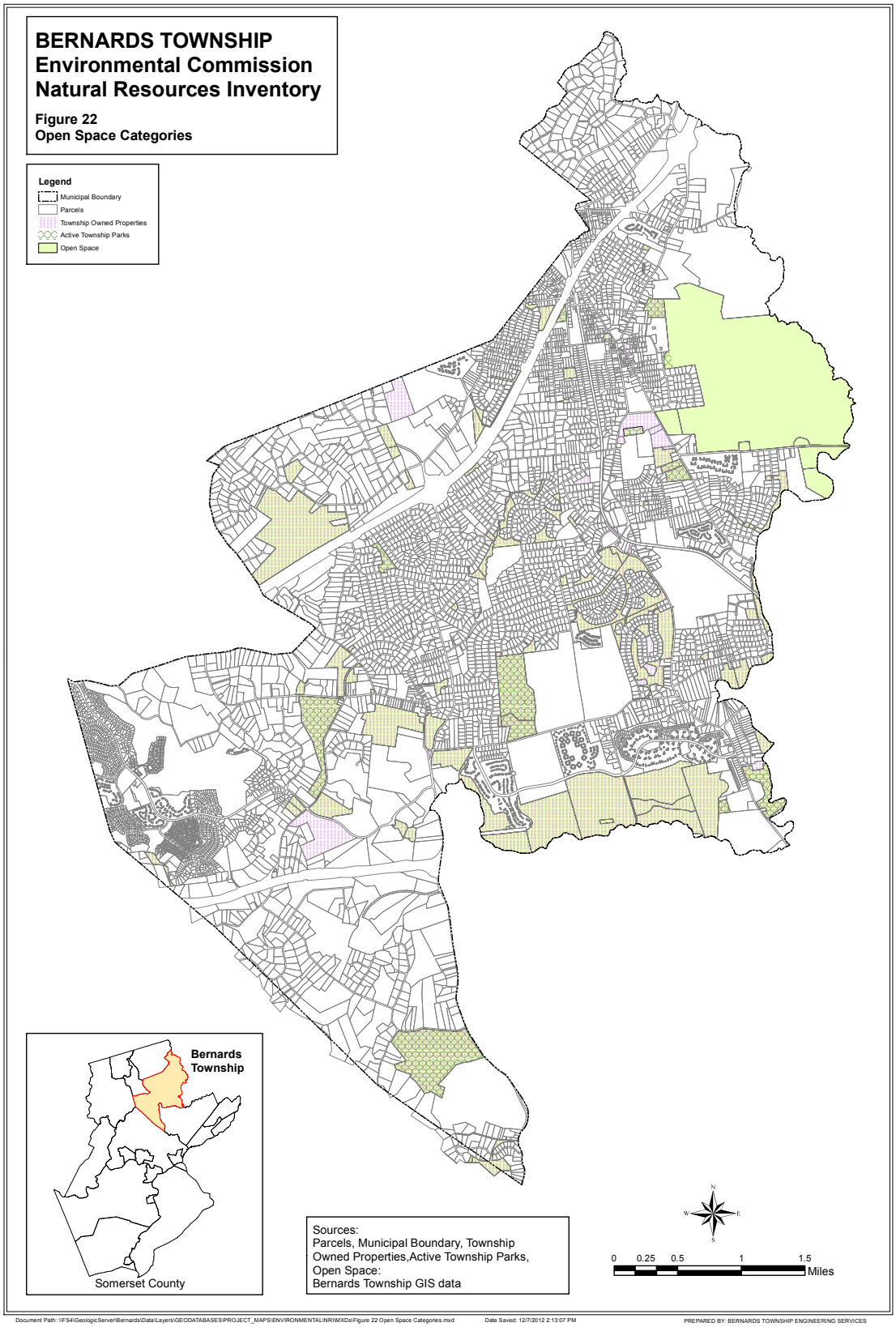
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 22
Open Space Categories
Legend
Municipal Boundary
Parcels
Township Owned Properties
Active Township Parks
Open Space
Bernards Township
Somerset County
Sources:
Parcels, Municipal Boundary, Township Owned Properties,Active Township Parks, Open Space:
Bernards Township GIS data
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Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRI\MXDs\Figure 22 Open Space Categories.mxd
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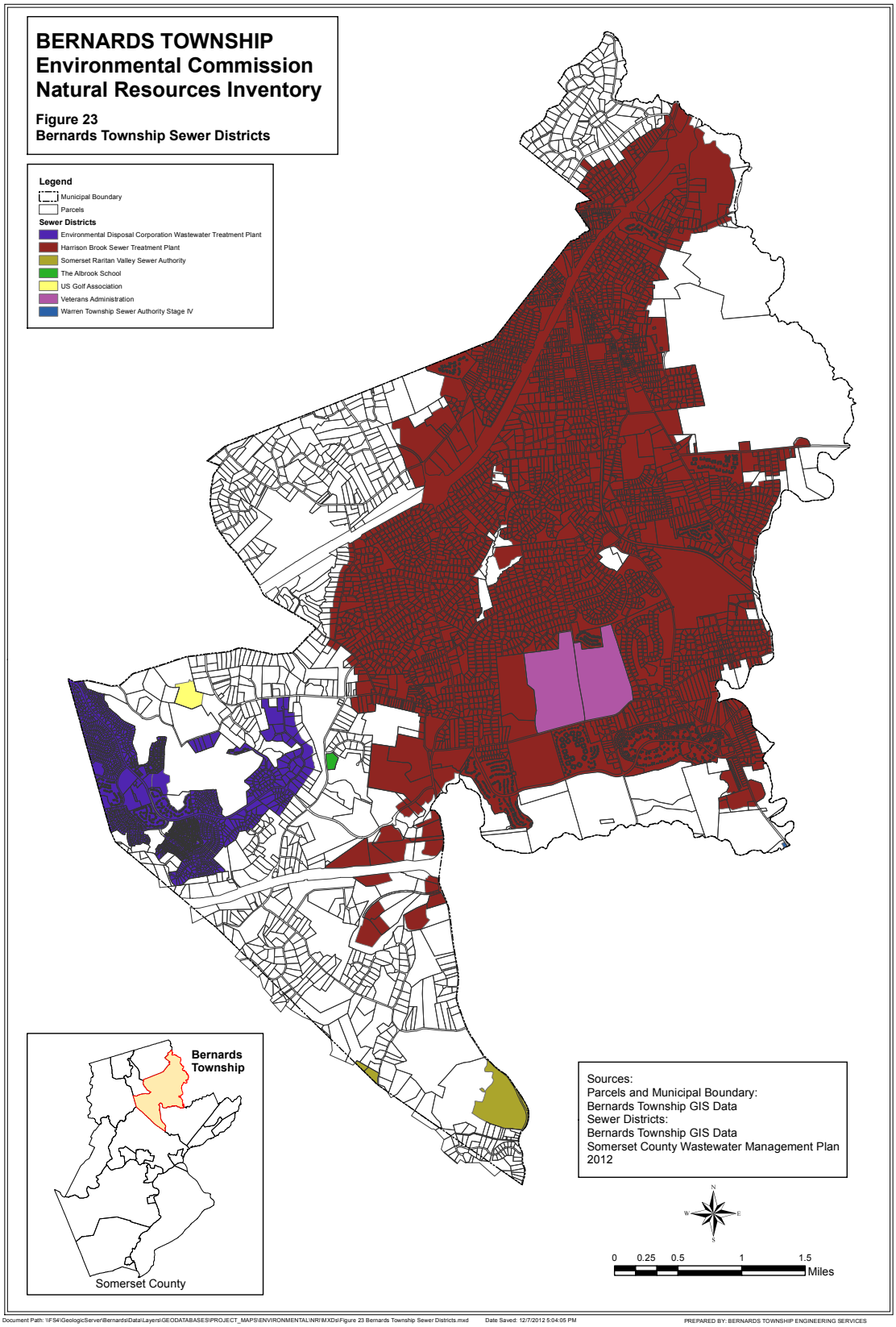
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 23
Bernards Township Sewer Districts
Legend
Municipal Boundary
Parcels
Sewer Districts
Environmental Disposal Corporation Wastewater Treatment Plant
Harrison Brook Sewer Treatment Plant
Somerset Raritan Valley Sewer Authority
The Albrook School
US Golf Association
Veterans Administration
Warren Township Sewer Authority Stage IV
Bernards Township
Somerset County
Sources:
Parcels and Municipal Boundary:
Bernards Township GIS Data
Sewer Districts:
Bernards Township GIS Data
Somerset County Wastewater Management Plan 2012
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Miles
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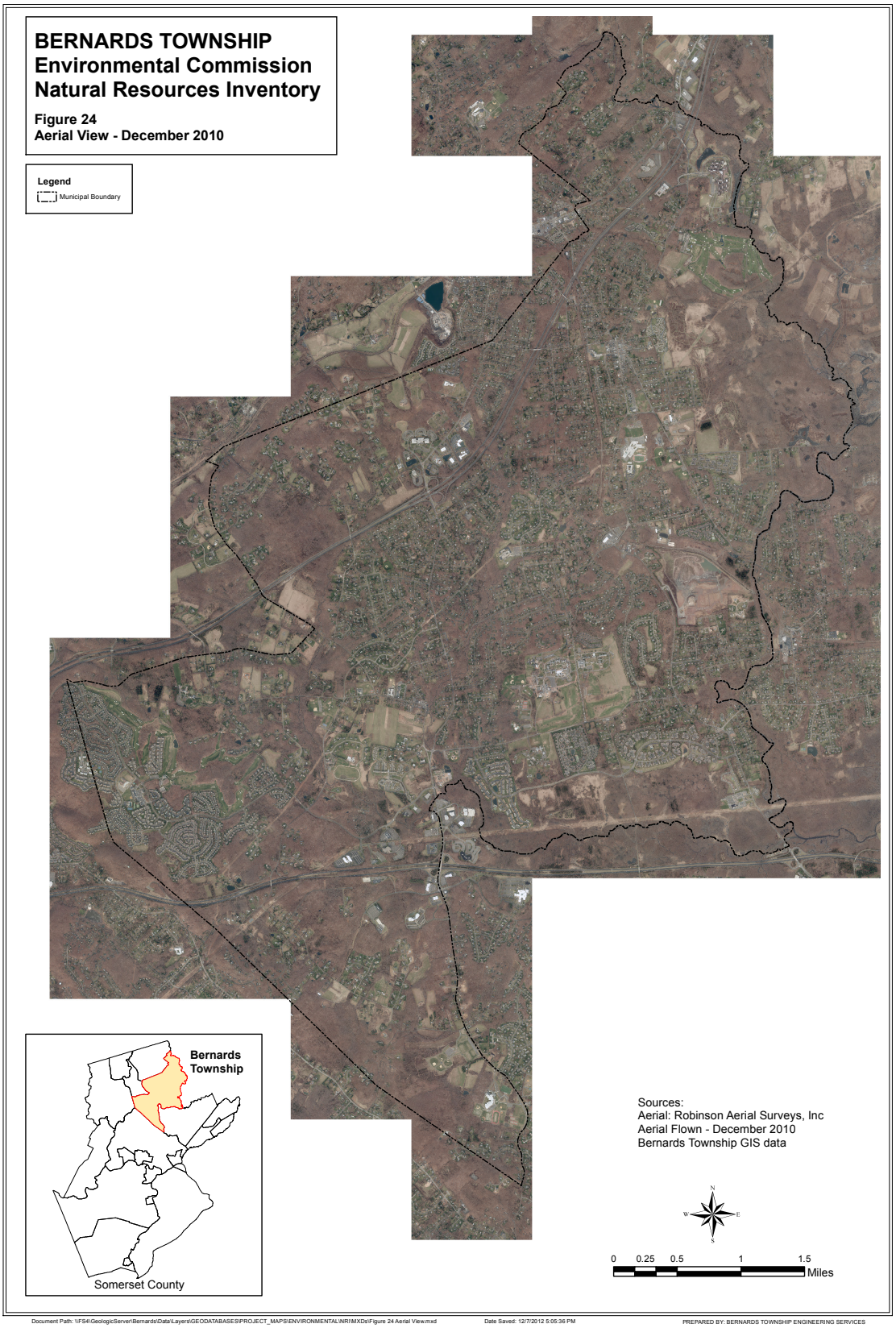
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 24
Aerial View - December 2010
Legend
Municipal Boundary
Bernards Township
Somerset County
Sources:
Aerial: Robinson Aerial Surveys, Inc
Aerial Flown - December 2010
Bernards Township GIS data
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Miles
Document Path: \\FS4\GeologicServer\Bernards\Data\Layers\GEODATABASES\PROJECT_MAPS\ENVIRONMENTAL\NRI\MXDs\Figure 24 Aerial View.mxd
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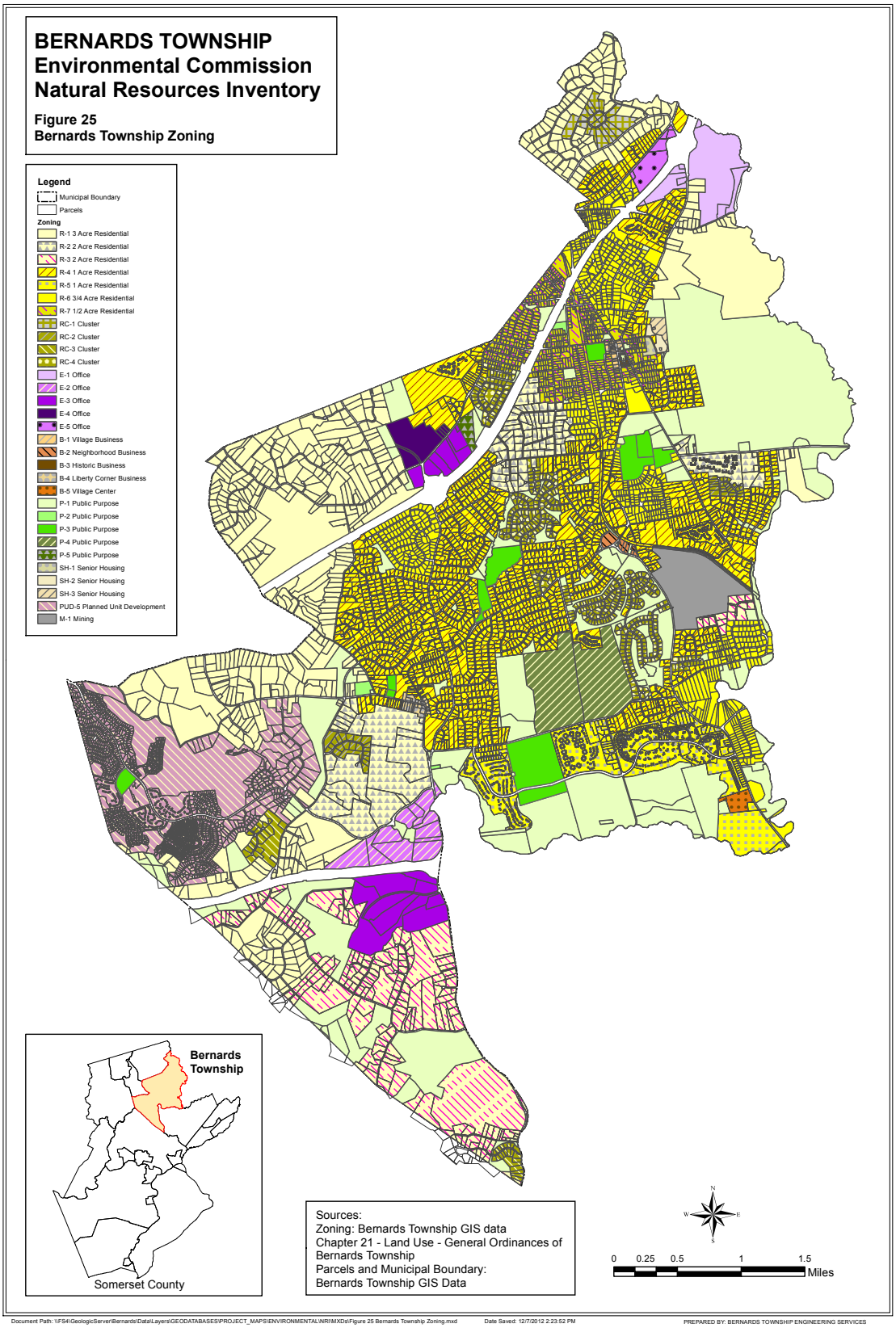
BERNARDS TOWNSHIP
Environmental Commission
Natural Resources Inventory
Figure 25
Bernards Township Zoning
Legend
Municipal Boundary
Parcels
Zoning
R-1 3 Acre Residential
R-2 2 Acre Residential
R-3 2 Acre Residential
R-4 1 Acre Residential
R-5 1 Acre Residential
R-6 3/4 Acre Residential
R-7 1/2 Acre Residential
RC-1 Cluster
RC-2 Cluster
RC-3 Cluster
RC-4 Cluster
E-1 Office
E-2 Office
E-3 Office
E-4 Office
E-5 Office
B-1 Village Business
B-2 Neighborhood Business
B-3 Historic Business
B-4 Liberty Corner Business
B-5 Village Center
P-1 Public Purpose
P-2 Public Purpose
P-3 Public Purpose
P-4 Public Purpose
P-5 Public Purpose
SH-1 Senior Housing
SH-2 Senior Housing
SH-3 Senior Housing
PUD-5 Planned Unit Development
M-1 Mining
Bernards Township
Somerset County
Sources:
Zoning: Bernards Township GIS data
Chapter 21 - Land Use - General Ordinances of Bernards Township
Parcels and Municipal Boundary:
Bernards Township GIS Data
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Miles
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