Natural Resources Inventory

Borough of Riverdale
Morris County, New Jersey

A Project of the
Pequannock River Coalition

April 2007

DRAFT

Acknowledgements

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Pequannock River Coalition

The Pequannock River Coalition is dedicated to the preservation of the Pequannock River as a as a natural, recreational, aesthetic and water supply resource by informing and educating the public on pertinent issues, and by promoting awareness of the river's resource value. This Inventory was developed by Coalition staff and volunteers to further these goals.

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Natural Resources Inventory

Borough of Riverdale, Morris County, New Jersey
April 2007

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I. Introduction

What is a Natural Resource Inventory?

A Natural Resource Inventory (NRI), also called an Environmental Resource Inventory or ERI, is a collection of information on the natural resources of a given area. It is intended to provide factual, unbiased documentation on the location, sensitivity and status of natural features ranging from basic geological data to the latest information on wildlife habitats.

The NRI is a valuable tool for municipal planning, and can be utilized by Planning/Zoning officials, Open Space Committees and other groups concerned with land use. According to the Association of New Jersey Environmental Commissions "*The planning board should adopt the ERI as part of the municipal master plan, either as an appendix or as part of a master plan conservation element. As part of the master plan, the ERI can provide the foundation and documentation for the development of resource protection ordinances and resource-based land use planning."*

They also note that the State Planning Commission requires an NRI for municipalities seeking Plan Endorsement, and that the Council for Affordable Housing (COAH) requires a petition for Plan Endorsement for third round COAH certification. In effect, this means an NRI is a necessary prerequisite for approved affordable housing plans.[1]

The NRI is intended to be a living document, with the potential and need for periodic updates as new and better information becomes available, or the status and condition of resources change.

[1] Association of New Jersey Environmental Commissions. 2006. *Environmental Resource Inventories.* U.S. Department of Agriculture. Association of New Jersey Environmental Commissions, Mendham, NJ. <http://www.anjec.org/html/tools-ERIs.htm

II. A Brief Natural History of Riverdale

Today Riverdale is known as a community of crossroads, connecting major highway systems of the New York metropolitan area. The same "crossroads" concept on a grander scale has been a central theme in Riverdale for millennia. The borough, although small in size (only 1,331 acres or 2.08 square miles), is the site of distinct geographic, geologic, and hydrologic borders where many unique features intersect.

The bedrock geology of New Jersey is divided into 3 separate zones: The Valley and Ridge province with its underlying sandstone, shale, limestone and conglomerate rock; the Highlands province with bedrock of granitic-gneiss, shale, limestone and quartzite; and the Piedmont, characterized by red sandstone, shale and basalt[1]. These rocks were formed over many millions of years beginning in the Precambrian, some 550 million years ago, through the collision and separation of plates in the earth's crust, mountain-building up-thrusts, later erosion, and weathering. Lake sedimentation has also played a role in the Piedmont province. This area - also known as the Newark Basin— was once the site of a vast shallow lake, collecting sediments from the surrounding hills and mountains.[2]

Riverdale lies at the juncture of the Piedmont and Highlands areas. This juncture is readily visible even to the casual observer, where the craggy hills of the Highlands in northern Riverdale give way dramatically to the rolling plain of the Piedmont.

Beyond the initial development of this underlying bedrock, the other great events forming the countryside of Riverdale were the recurring glaciers. In the past 2.5 million years North America experienced 4 glacial periods. The most recent is known as the Wisconsin Glacier. At its southernmost expansion this glacier reached central Morris County (covering all of Riverdale) about 18,000 years ago, and began to retreat only 11,000 years ago—a mere heartbeat in geologic time. The glaciers, with sliding ice sheets up to 2,000 feet thick, greatly influenced the landscape we see today, shaping our ground contours, waterways, and soils. High ridges were rounded lower, layers of jumbled stones and boulders known as "glacial till" were piled and tumbled into ravines (see Figure II-1). Glacial rivers carrying meltwater left silt, gravel, and sand deposits in the valleys hundreds of feet thick, forming important aquifers.[3]

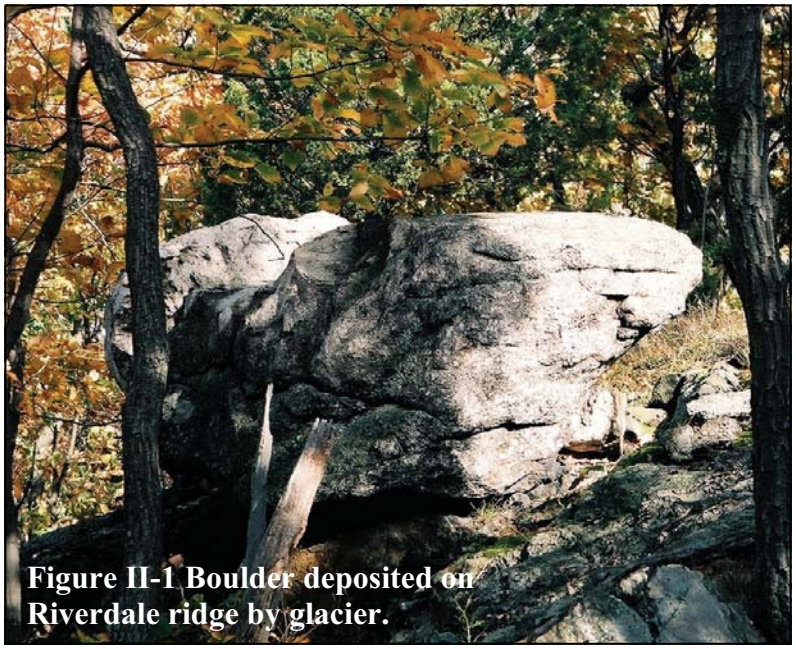

Figure II-1 Boulder deposited on Riverdale ridge by glacier.

Other than this overlap of geologic conditions, another vital "crossroads" of Riverdale is as a meeting of waters, where the

Pequannock River and Wanaque Rivers are combined and wedded with the Ramapo River to form the Pompton River. For many centuries floodplains in the Piedmont area adjoining these rivers have received loads of fluvial soils during flood events. These thick soils encourage riotous vegetation including stands of the most majestic trees in the region.

Native Americans occupied New Jersey for thousands of years before the first European settlers. The Delaware tribe (Lenni Lenape) held most of New Jersey at the time of their initial contact with Europeans. There were three major divisions or subtribes of the Delaware— the Munsee in northern New Jersey and adjacent portions of New York west of the Hudson, the Unalachtigo in northern Delaware, southeastern Pennsylvania, and southern New Jersey, and the Unami in the intermediate territory (including Riverdale), extending to the western end of Long Island. They were gradually crowded west by white settlers, reaching the Allegheny Mountains in Pennsylvania as early as 1724, and settling at points on the Susquehanna River about 1742.[3]

Dutch colonists first entered the area in the late 1600's and early 1700's. For early European settlers of Riverdale the split personality of this region made the different areas attractive for different purposes. The Highlands with their rugged topography created swift-flowing rivers ideal for water-powered mill sites, while the rock provided copper and iron ore sought in mining operations. The lower valleys in the Piedmont held rich soils perfect for agriculture.

In the 1700s road systems began to be created linking New Jersey's rural areas with the developing cities of Paterson and Newark. Again, Riverdale was at the crossroads where two of the most important roads met—the Paterson-Hamburg Turnpike and the Newark-Pompton Turnpike.

From this unique underlying natural and human history the initial pattern of development in Riverdale was created.[4]

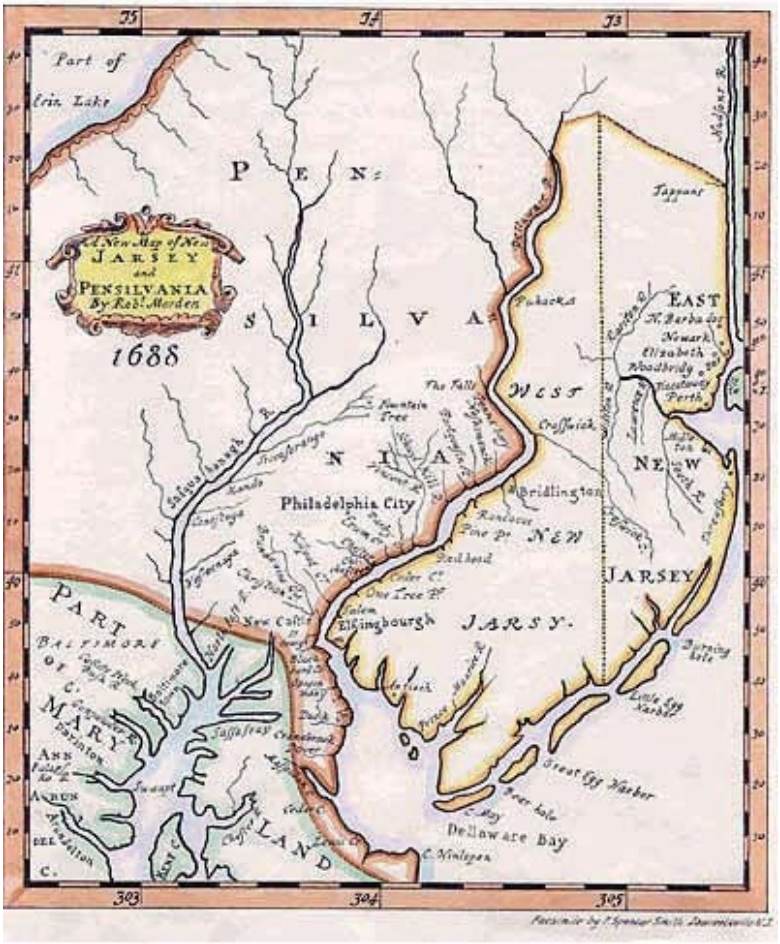

Figure II-2 "A New Map of New Jersey and Pennsylvania" by Robert Morden, 1688[6]

[1] Natural Resource Conservation Service. 2006. *New Jersey Soils Online Study Guide* U.S. Department of Agriculture. <http://www.nj.nrcs.usda.gov/partnerships/envirothon/soils/geology.html

[2] Schlische, Roy W. 2006. *Geology of the Newark Rift Basin.* Department of Geological Sciences, Rutgers University, Piscataway, NJ <http://geology.rutgers.edu/103web/Newarkbasin/NB_text.html

[3] *Ibid.*

[4] Access Genealogy. 2006. *Indian Tribal Records* <http://www.accessgenealogy.com/native/newjersey/index.htm

[5] Kury, Dr. Theodore W. 1972. *The Highlands Iron Industry During the Revolutionary Period* <http://www.njreporter.org/archive/wanj1972.html

[6]Morden, Robert 1688. *A New Map of New Jersey and Pennsylvania.* F.S. Smith, Lawrenceville, NJ

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III. Land Resources

Geology

Riverdale is at the juncture of two physiographic provinces; the Highlands province in northwestern Riverdale and the Piedmont province in the southeast (see Figure III-1).

The U.S. Geological Survey defines the Highlands Province as "..limited to exposures of Precambrian and Early Paleozoic metamorphic and igneous rocks throughout portions of northern New Jersey, southern New York, and most of Connecticut." Bedrock of the Highlands is composed of granitic-gneiss, shale, limestone, and quartzite. These rocks are among the region's most ancient, originating more than 550 million years ago.[1]

The Piedmont province, characterized by red sandstone, shale and basalt, is of more recent origin. At one time the super-continent Pangea was formed of all the continents we know today. In the late Triassic period (220 million years ago) Pangea began to separate. At the point where North America drifted apart from the continent of Africa a series of "rift" valleys developed where the continents pulled apart. One of these valleys would continue to widen, eventually becoming the Atlantic Ocean. Others filled completely with sediments eroded from surrounding higher lands. The Piedmont province—also known as the Newark Basin—is one of these valleys.[2]

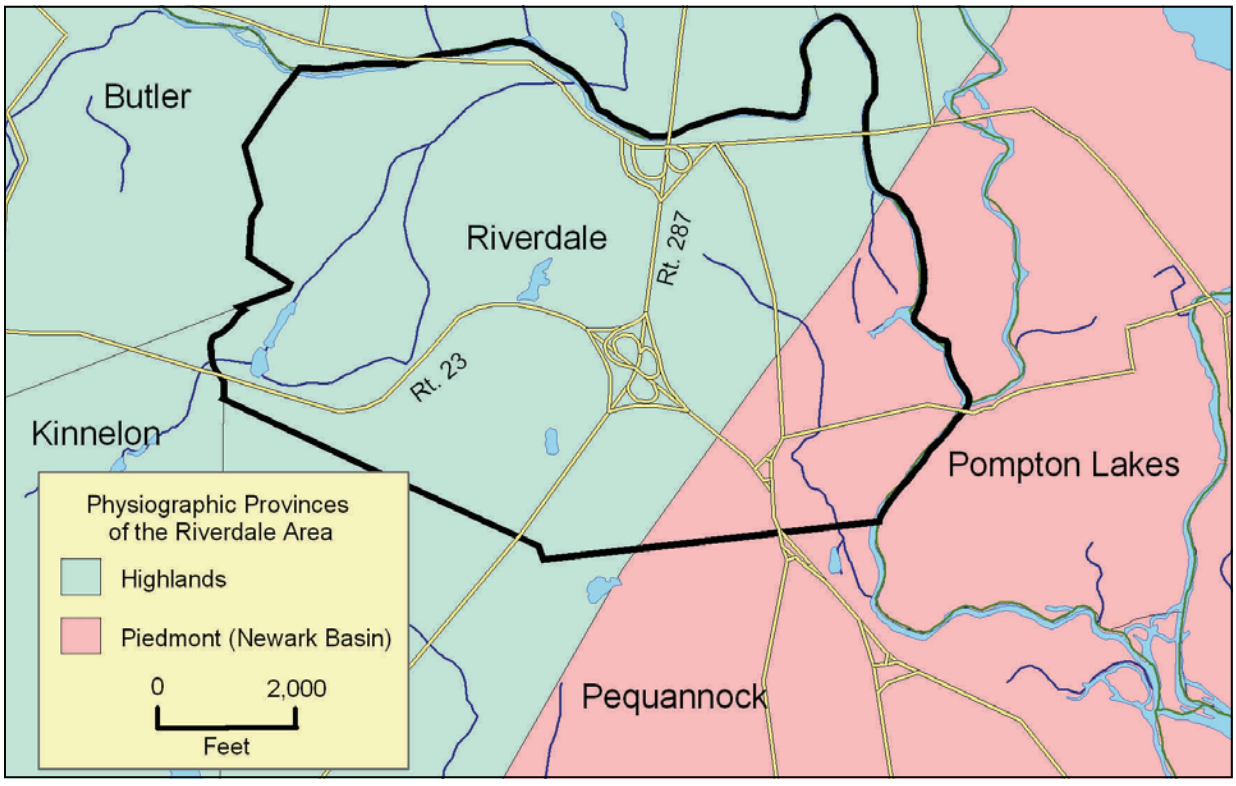

Figure III-1 Bedrock Geology of Riverdale
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

Soils

The soils of Riverdale are separated into 8 "Soil Series" categories as mapped in Figures III-2 through III-4. They are also divided by Hydrologic Soil Group based on water permeability, with group A as the most permeable and D as the least. Also noted in the descriptions of these soils is the presence of a "fragipan." A fragipan is a natural subsurface layer having a higher density than the soil above, that is slowly or very slowly permeable to water and greatly affects subsurface water drainage.[3]

The limitations of these soils for residential homes and small commercial buildings as provided by the Natural Resources Conservation Service (NRCS) are described as well. These limitations indicate the extent to which the soils are limited by all of the soil features that affect building site development. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.[4]

The largest area in Riverdale is the **Urban Land** category. Urban soils are those that have been altered by human activity such as grading or filling to such an extent that the original soil type has been altered. These can also be areas where a large percent of the land surface has been covered by impervious surfaces such as concrete, asphalt, and buildings.Urban lands are generally gently sloping to nearly level. Urban lands are impossible to characterize because of their disturbed nature. They are usually not assigned to a Hydrologic Soil Group although sometimes assigned to Group D.[5] The NRCS does not describe the limitations of these soils.

Similar human alteration created the **Pits, Gravel** soil series, identifying areas mined for sand, gravel and rock. Again, it is difficult to characterize these soils because they have been extensively disturbed. The NRCS does not describe the limitations of these soils.

Next largest in area to Urban Land is the **Rockaway** soil series. Rockaway soils are characterized as very deep and moderately drained to well drained. They are formed of glacial till on upland areas and range from gravelly sandy loam to extremely stony sandy loam. Slopes vary from gently sloping to very steep. These soils have a moderately developed fragipan. They make up the majority of the Hydrologic Soil Group C.[6] The NRCS describes these soils as "somewhat limited" to "very limited" for residential or commercial use due to steep slopes and, in some cases, shallow depth to water table.[7]

Rock outcrop soils are areas of exposed crystalline bedrock. They are assigned to Hydrologic Soil Group D.[8] This soil group has severe limitations for all uses.[9]

Otisville soils are found in the Piedmont area of southeastern Riverdale. These sandy soils are very deep and excessively drained and may be gently sloping or steep. They are formed from

the outwash material of the Wisconsin glacier. This soil is assigned to Hydrologic Soil Group A.[10] The NRCS describes these soils as "very limited" for residential or commercial use due to steep slopes and, in some cases, shallow depth to water table.[11]

Hibernia soils are limited to a few sites in central and northeastern Riverdale. Hibernia soils are very deep, coarse and loamy, somewhat poorly drained, and found in low positions on undulating uplands and at the base of steep slopes. They vary from gently sloping to steep, with a fragipan. They are assigned to Hydrologic Soil Group C.[12] The NRCS describes these soils as "somewhat limited" to "very limited" for residential or commercial use due to steep slopes.[13]

Alluvial soils are fine-grained, fertile soils deposited by water flowing over floodplains or in river beds. These are rich soils that can be found in aquatic communities. In Riverdale, alluvial soils are isolated to areas adjoining the Pequannock River and Pequannock River tributaries.[14] The NRCS describes these soils as "very limited" for residential or commercial use due to frequent flooding and shallow depth to water table.[15]

The **Pompton** soils are confined to a small area in northwest Riverdale. Pompton soils are deep, moderately well drained to somewhat poorly drained. They are coarse and loamy, composed of water-sorted sediments, mainly from granitic rock eroded by glacial ice sheets. In places, other source materials include red and brown shale and traprock. Typically they are nearly level to gently sloping. The permeability is moderately rapid and these soils are assigned to Hydrologic Soil Group B.[16] The NRCS describes these soils as "very limited" for residential or commercial use due to shallow depth to water table.[17]

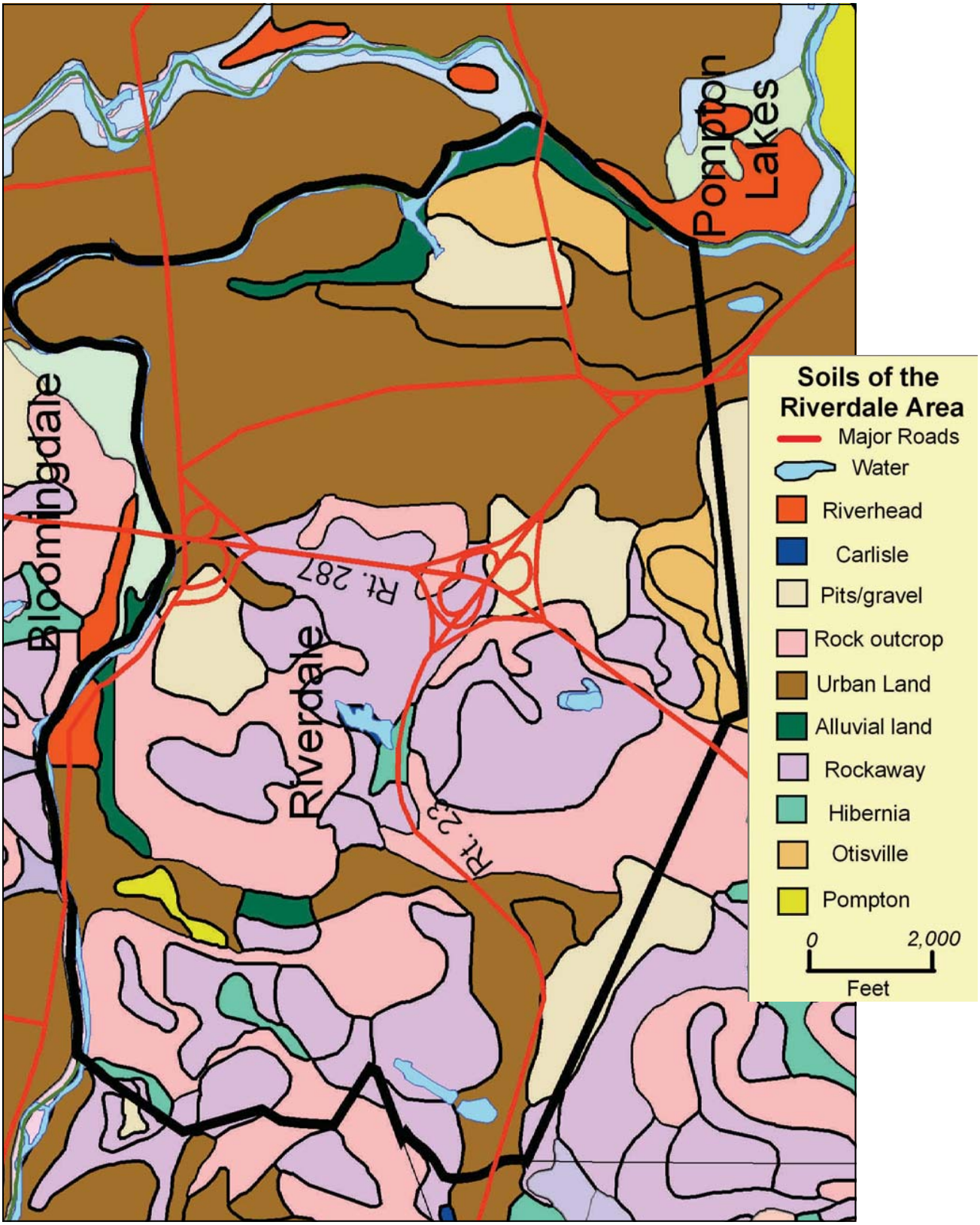

Figure III-2 Soils of the Riverdale Area

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

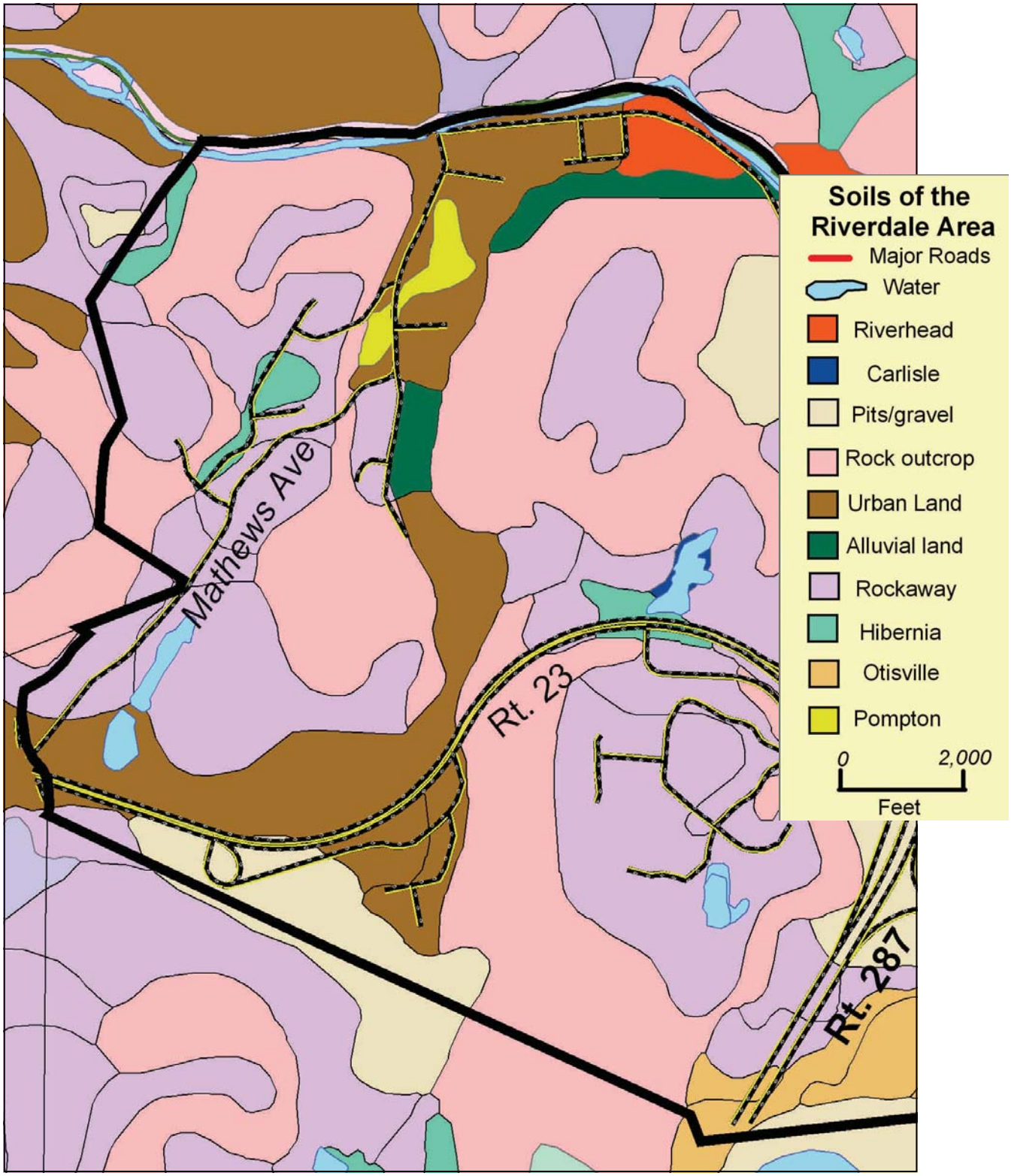

Figure III-3 Soils of Riverdale—West (detail)

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

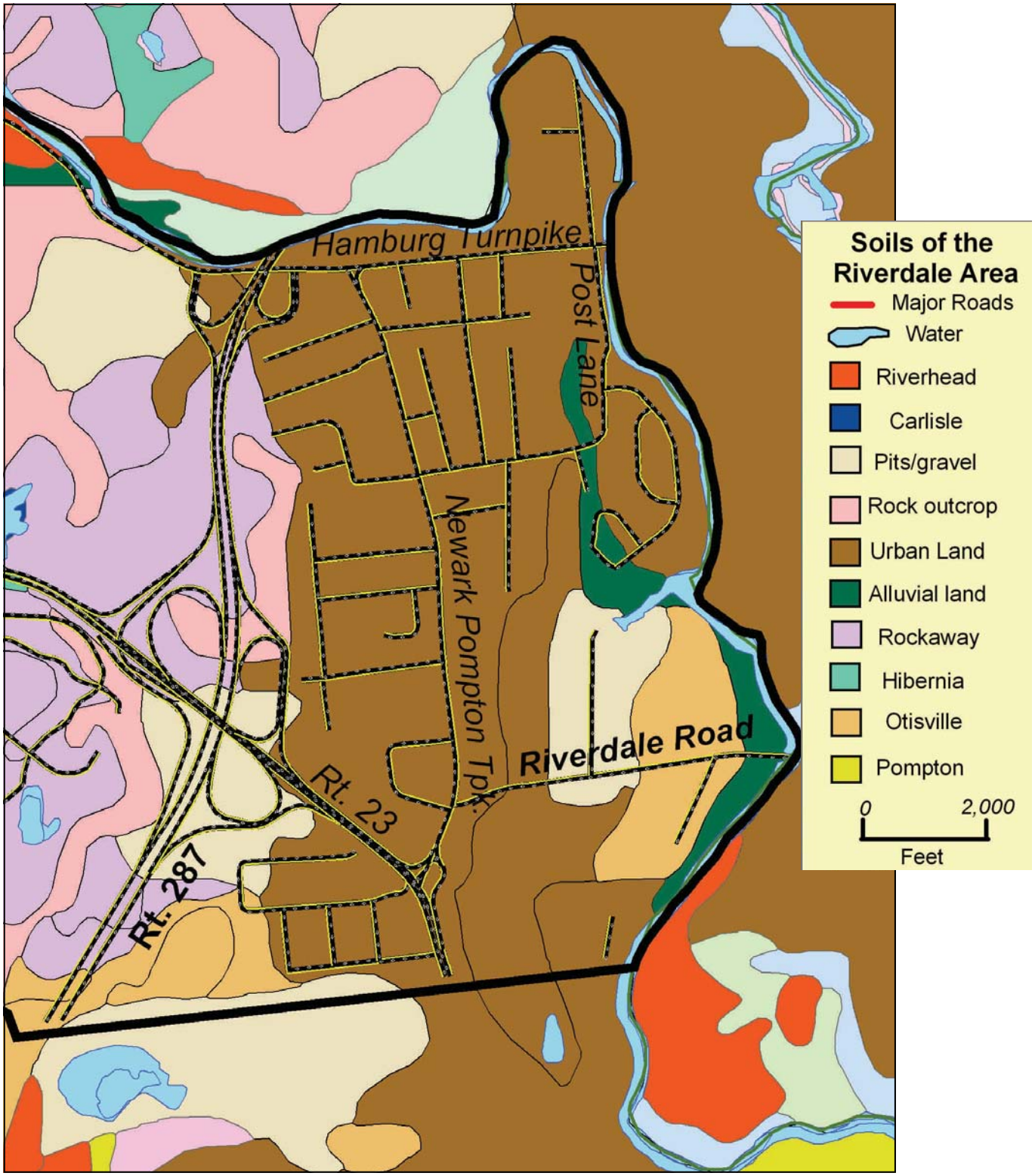

Figure III-4 Soils of Riverdale—East (detail)

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

Topography

The highest elevation in Riverdale is found in the Highlands portion of the Borough at about 550 feet. The lowest point is on the Pompton River near Pequannock at less than 200 feet. This topography is shown in Figure III-5.

A significant feature of land topography is "slope," representing the rate of change in elevation from one point to another. Steeply sloping land presents severe limitations to development where soils are generally thin and easily eroded. These areas may also host unique plant and animal communities.

Figure III-6 represents the degree of slope for lands in Riverdale. Not surprisingly, the steepest slopes are found in the Highlands area of western Riverdale. It should be noted that this map delineates slopes broadly. More detailed analysis of slopes is necessary in evaluating sites for development or other land uses.

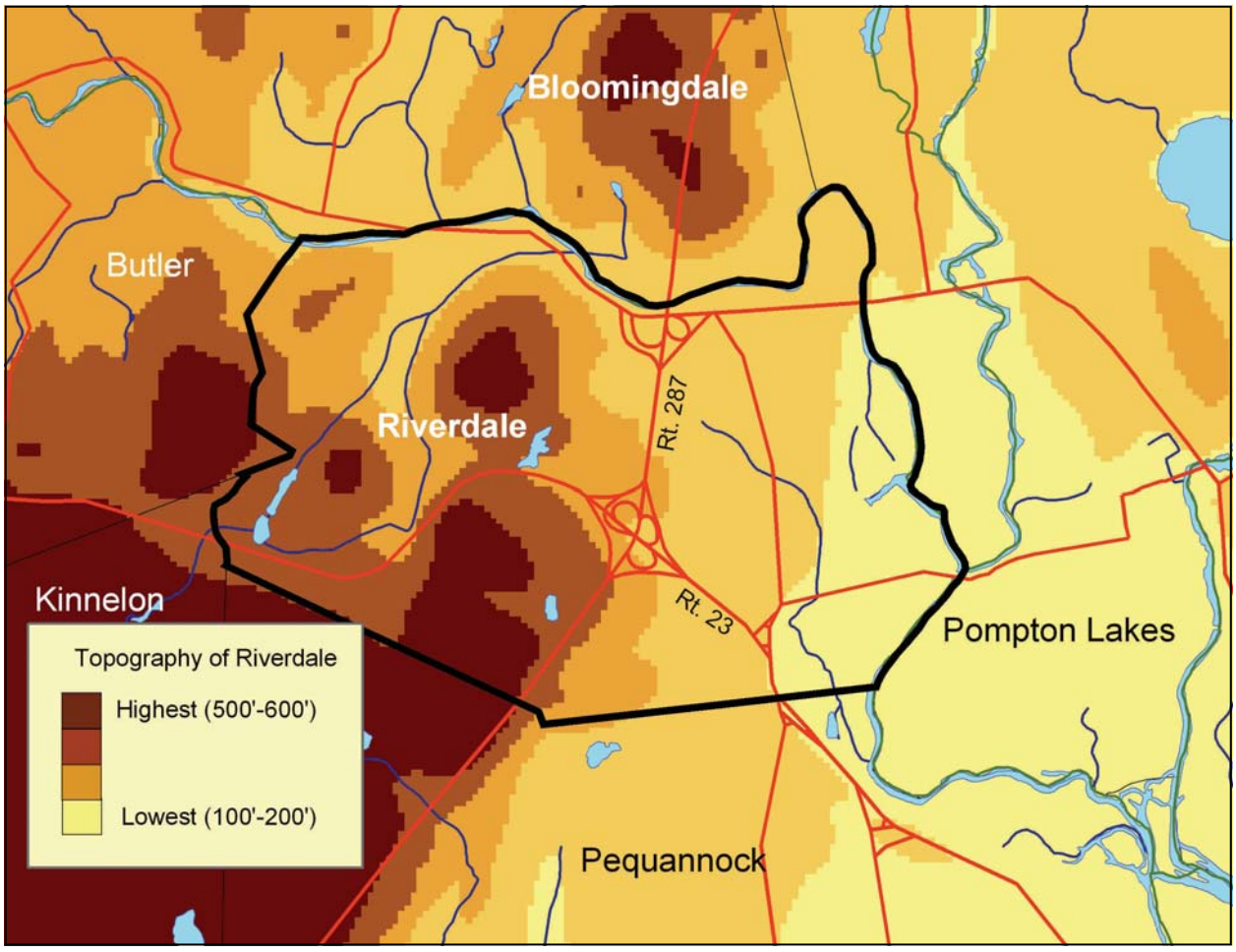

Figure III-5 Topography of Riverdale
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

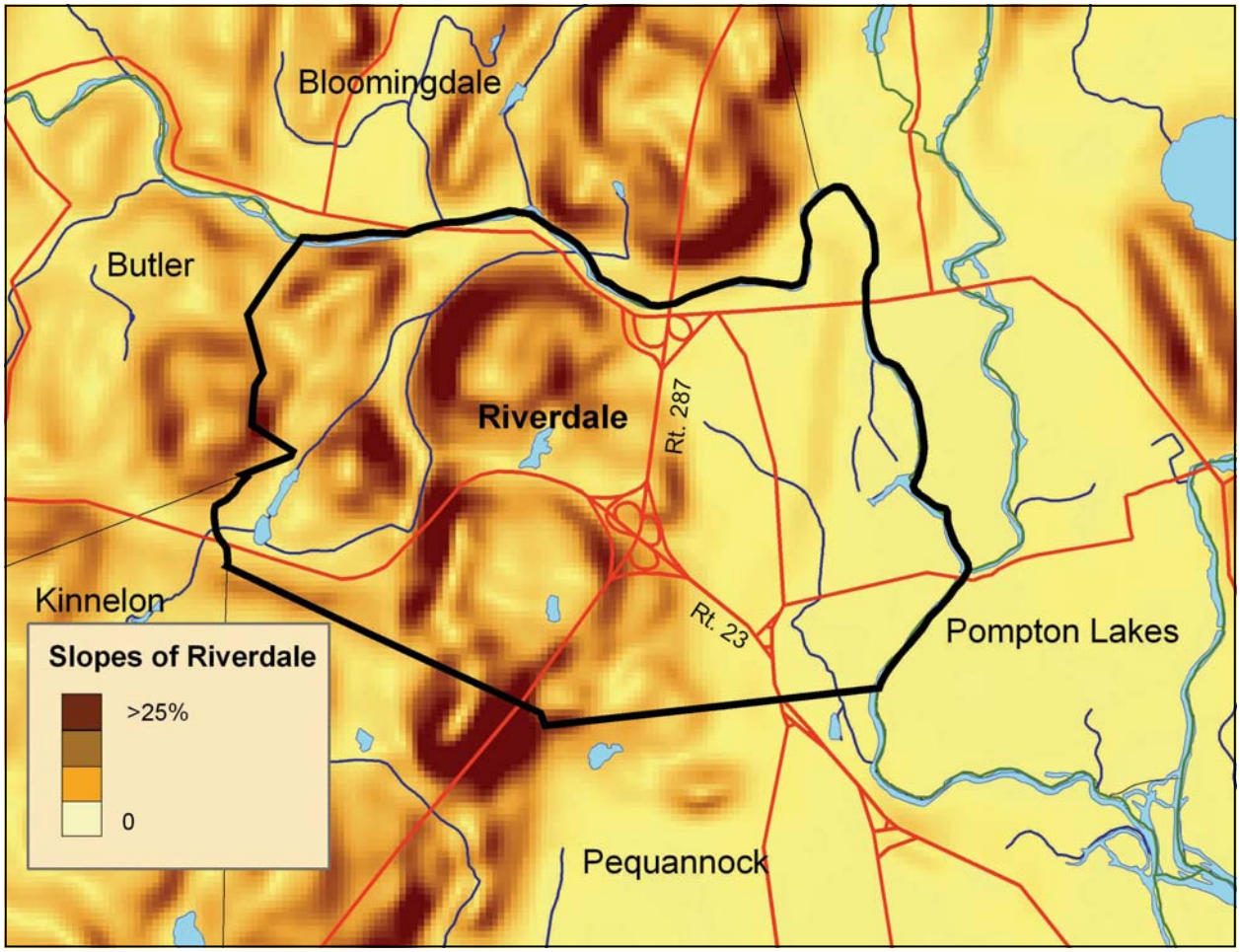

Figure III-6 Slopes in the Riverdale area

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

[1] U.S Geological Survey. 2003. *Geology of the New York City Region: A Preliminary Regional Field-Trip Guidebook* <http://3dparks.wr.usgs.gov/nyc
[2] *Ibid.*
[3] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[4] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/
[5] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[6] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[7] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/
[8] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[9] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/
[10] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[11] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/
[12] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[13] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/
[14] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[15] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/
[16] New Jersey Department of Environmental Protection. 2002. *Watershed Characterization and Assessment Watershed Management Area 3.* NJDEP, Trenton, NJ
[17] Natural Resources Conservation Service. 2006. *Dwellings and Small Commercial Buildings—Morris County, New Jersey.* United States Department of Agriculture, Natural Resources Conservation Service. <http://websoilsurvey.nrcs.usda.gov/app/

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IV. Water Resources

The Water Cycle

Citizens and businesses of Riverdale derive most of their potable water supply from groundwater sources within Riverdale. Where does this water originate and how is it replenished?

The water cycle (see Figure IV-1), also known as the "hydrologic cycle", has no real starting point. But, a good beginning for this discussion is in our oceans, since that is where most of Earth's water exists.[1]

The sun, which drives the water cycle, heats water in the oceans. Some of it evaporates as vapor into the air. Rising air currents take the vapor up into the atmosphere, along with water from "evapotranspiration", which is water transpired from plants and evaporated from the soil. The vapor rises into the air where cooler temperatures cause it to condense into clouds. Air currents move clouds around the globe, cloud particles collide, grow, and fall out of the sky as precipitation.[2]

Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snowpacks in warmer climates often thaw and melt when spring arrives, and the melted water flows overland as snowmelt. Most precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers and streams in valleys in the landscape, with streamflow moving water towards the oceans. Runoff also accumulates in lakes.[3]

However, not all runoff flows into rivers or lakes. Much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers (saturated subsurface rock, sand or gravel layers), which can store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as groundwater discharge, and some groundwater finds openings in the land surface and emerges as freshwater springs. Over time, though, all of this water keeps moving, some to reenter the ocean, where the water cycle continues in an endless loop.[4]

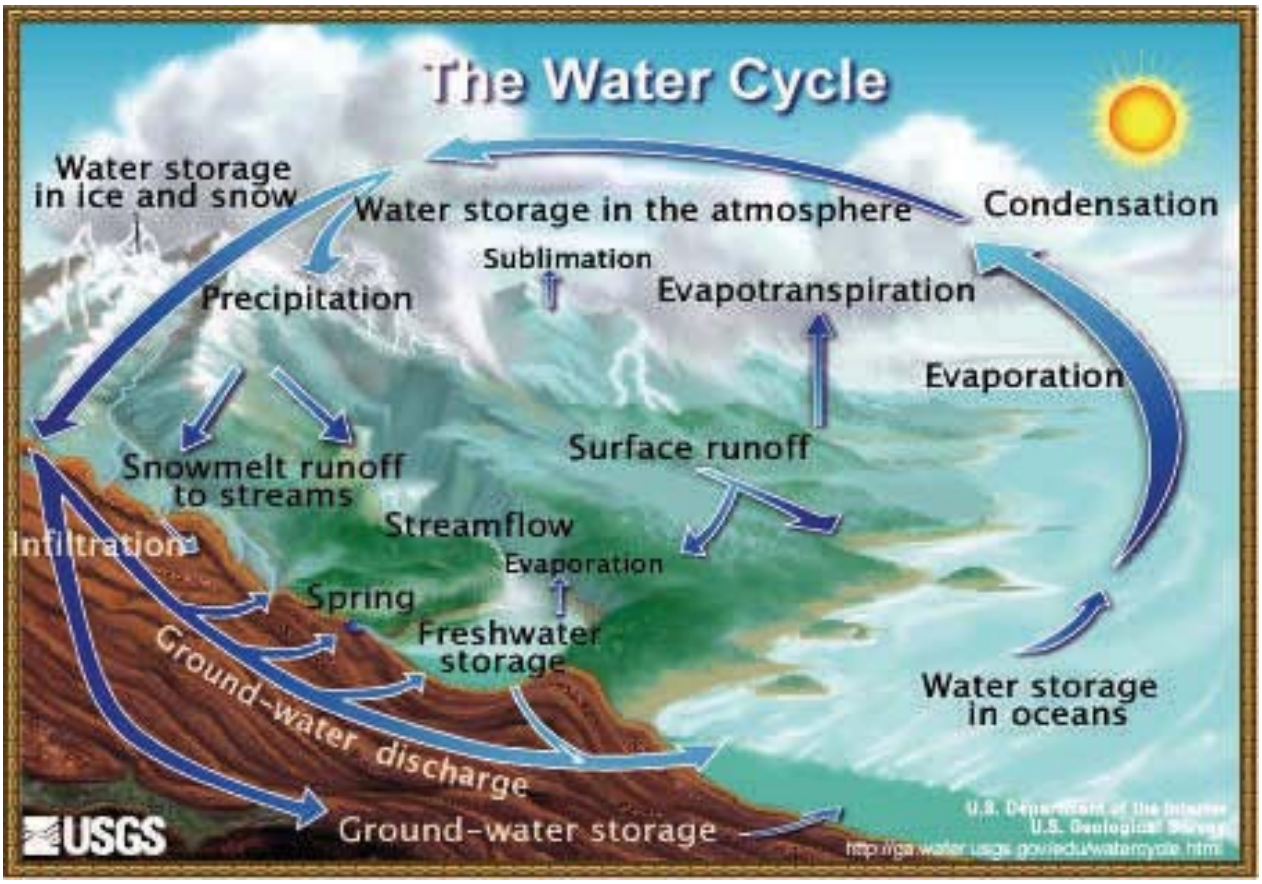

Figure IV-1 The Water Cycle[5]

Water Resources

Water resources in Riverdale can be divided into 3 categories—surface water, groundwater and wetlands. Each of these is vital to Riverdale citizens, as well as to fish and wildlife.

Surface Waters

The principal surface water of Riverdale is the Pequannock River. The Pequannock River is approximately 25 miles long with a contributing watershed of about 100 square miles (see Figure IV-2). Almost all of Riverdale is included in this watershed with the exception of a small area at the southern border in the Pompton River Watershed (see Figures IV-3 and IV-4).

The Pequannock River has its source in Sussex County in the Township of Vernon and ends in Riverdale where it enters the Pompton River. It passes through 11 communities including Vernon, Hardyston, Jefferson, Rockaway, West Milford, Butler, Kinnelon, Bloomingdale, Riverdale, Pompton Lakes, and Pequannock. For much of its length the river forms the boundary between Passaic County and Morris County.

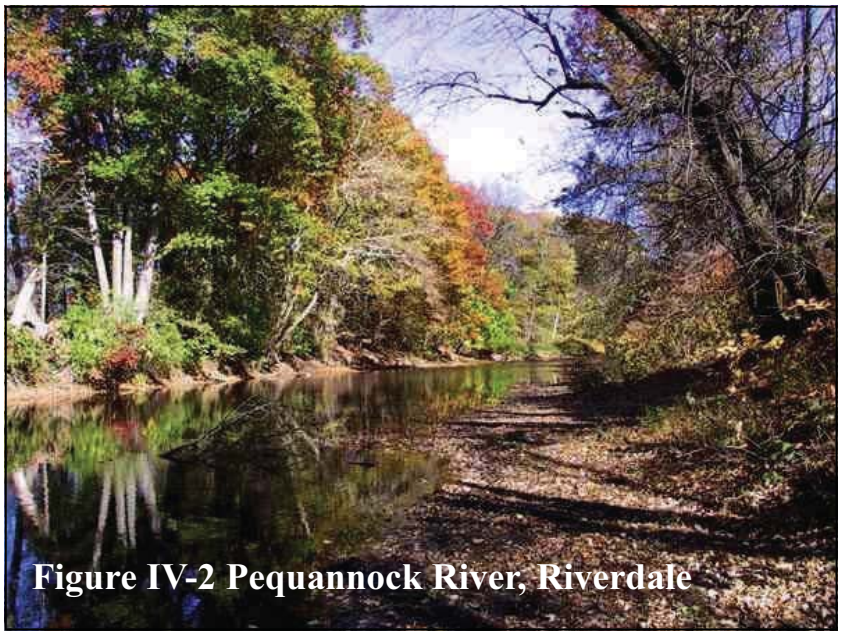

Figure IV-2 Pequannock River, Riverdale

The Pequannock River and its tributaries supply a number of important reservoirs including Canistear Reservoir, Oak Ridge Reservoir, Clinton Reservoir, Echo Lake, Charlottesburg Reservoir, and Butler Reservoir.

Flow rates on the Pequannock River are highly variable. During periods of heavy rainfall, flow rates increase. In droughts and periods of low rainfall these flows diminish. The U.S. Geological Survey maintains a permanent flow recording station on the Pequannock River in southern West Milford (Macopin Station), a few miles north of Riverdale. River flows are measured by the amount of water passing a specific point (cubic feet per second) or by the water depth (gage height). A flood state is reached on the Pequannock River when the gage height reaches 5.5 feet. A moderate flood stage is 6.5 feet and a major flood is at 7.5 feet.[6]

Data from this station shows the record high flow for the Pequannock River occurred on October 10, 1903 at 6,100 cubic-feet-per-second with a gage height of 9.4 feet. Other substantial floods occurred in 1968, 1972, 1973, 1984, 1988, 1996, 2003, and 2005.[7] Flooding has become more frequent as the Pequannock River watershed has been developed over time.

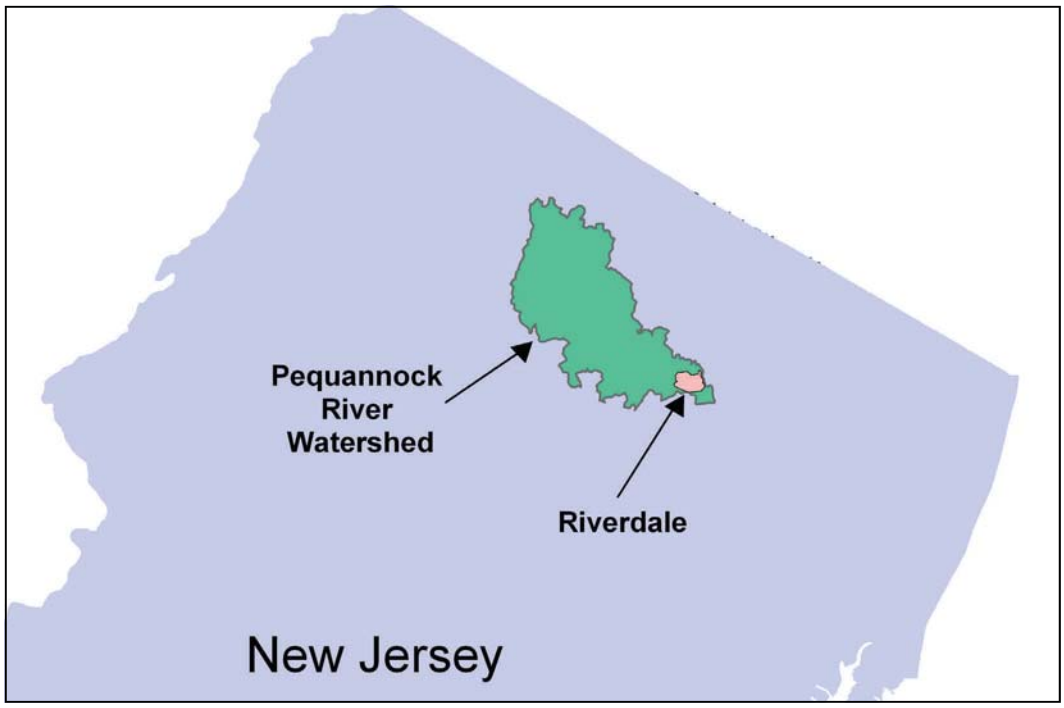

Figure IV-3 Pequannock River Watershed
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

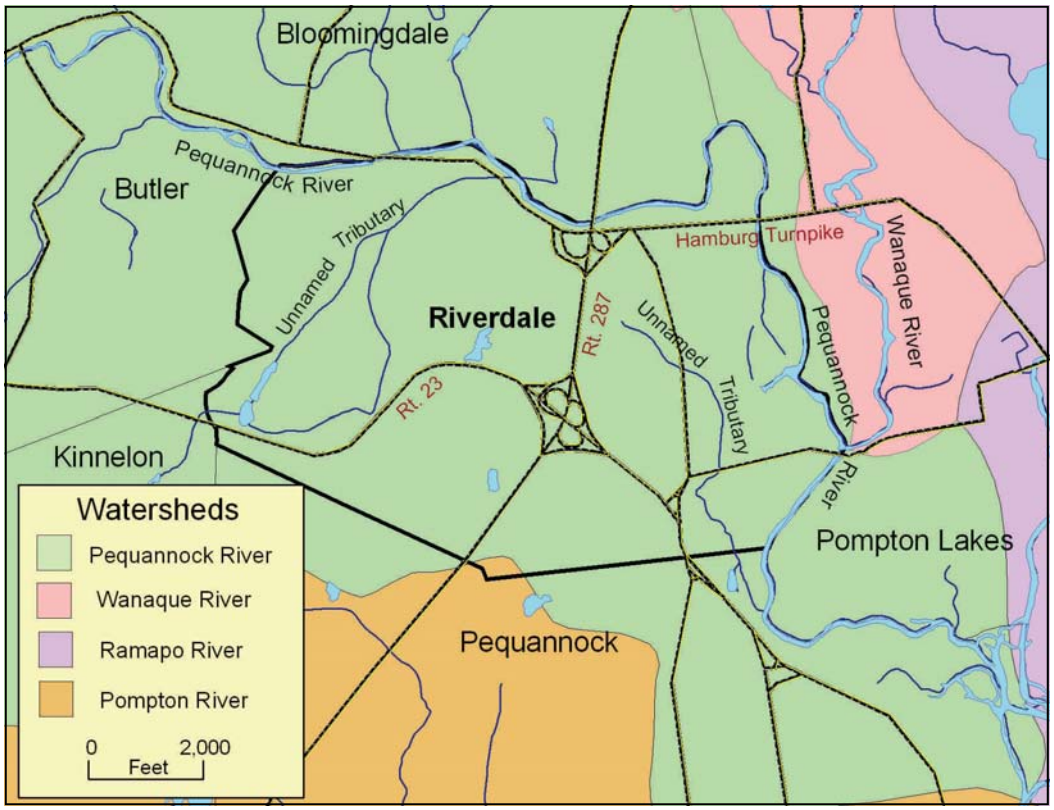

Figure IV-4 Watersheds in the Riverdale Area
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

At higher rates of flow, land areas adjacent to the Pequannock River may be covered with water. These areas are known as "flood plains" and have been mapped by the New Jersey Department of Environmental Protection. Flood plains are categorized by the typical frequency that flooding occurs there. For example, a "100-year" flood plain indicates that flooding occurs, on average, once every 100 years. Figure IV-6 depicts the 100-year and 500-year flood plain of the Pequannock River.

Flooding is a natural occurrence, and can be beneficial by building rich alluvial soils in floodplain areas. Floodplains provide an area for storage of floodwaters, thereby lessening the force and impact of flooding downstream (see Figure IV-5). However, upstream development can increase the frequency and magnitude of flooding beyond healthy limits. As more land is covered with impervious surfaces, more rainwater is prevented from soaking into the ground and is diverted instead to rivers and streams. It has been shown that if impervious cover exceeds 10 to 15 % of the total surface area of any watershed, the rate and volume of this runoff dramatically increases. This fuels increased flooding. Filling of floodplains reduces the natural storage areas of floodwaters while channelization of rivers and streams detaches waterways from the floodplain, exacerbating these problems.[8]

Low flows occur more often than floods. There are many records of a zero river flow at the Macopin Station recording site. However, a zero flow does not mean the Pequannock River is dry in Riverdale, since a number of small tributary streams below this recording station provide additional flows.

The classification of Riverdale's surface waters by the State of New Jersey is important. The State generally classifies surface waters in two ways—according to their sensitivity and by the aquatic life they support.

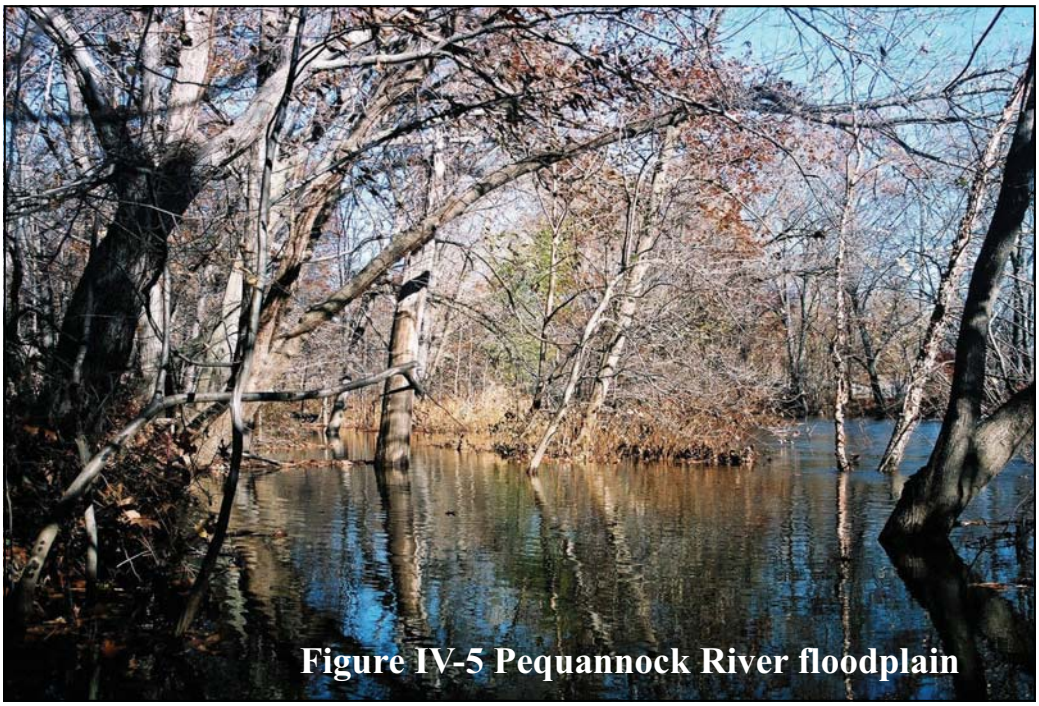

Figure IV-5 Pequannock River floodplain

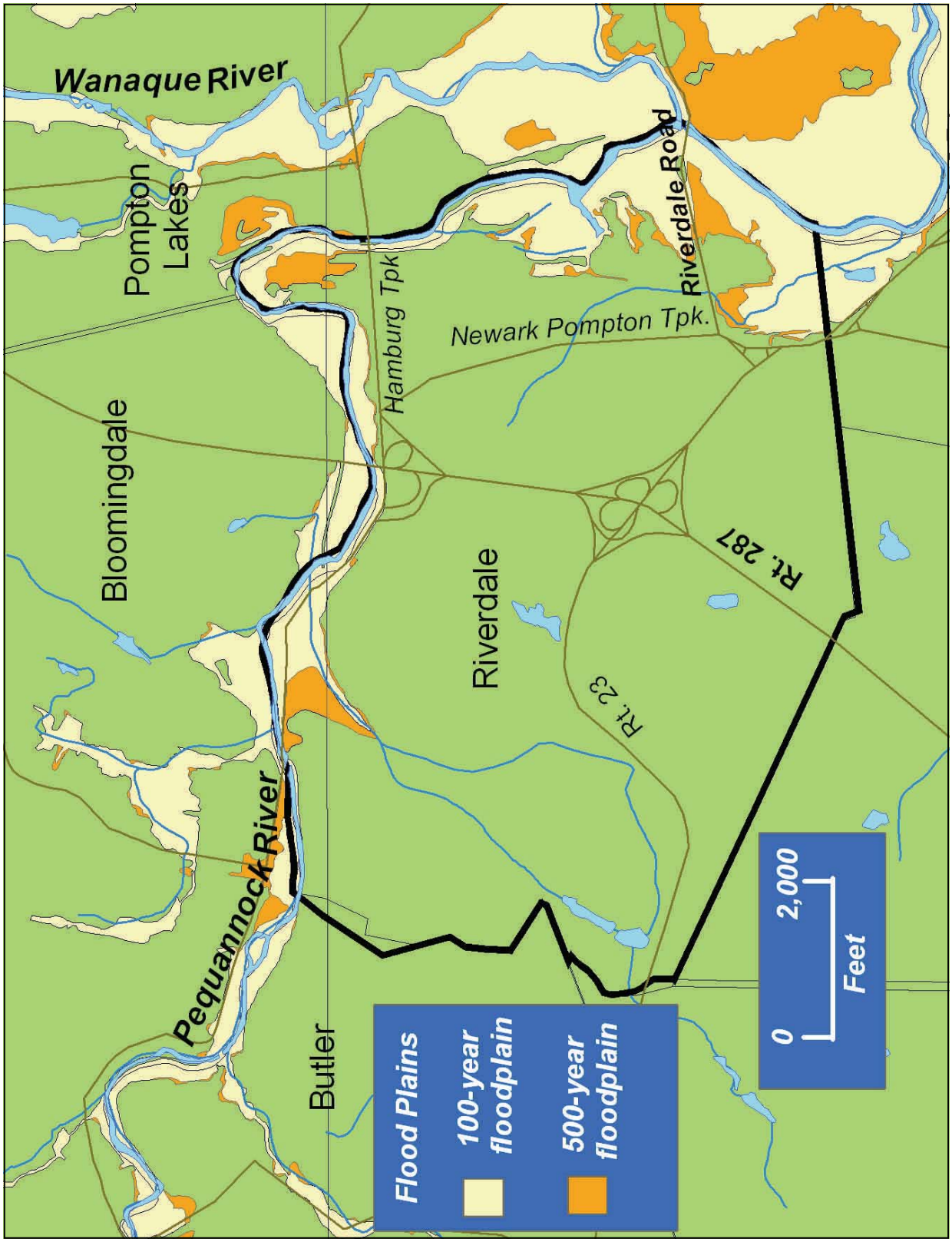

Figure IV-6 Floodplains in the Riverdale Area

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

The most sensitive surface waters are classified as "Category 1" or "C1." These Category 1 waterways are chosen "*...because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s).*"[9]

The second classification—the aquatic life designations—are based in the Riverdale area on the suitability of waterways for trout. These designations are "Non-trout" or "NT", "Trout Maintenance" or "TM", and "Trout Production" or "TP". Trout production waters are those that have spawning trout populations. Trout Maintenance waters have water quality sufficient to support trout year-round but have no documented evidence of trout spawning. Non-trout waters do not have water quality sufficient to support trout. Waterways without a specific designation receive the designation of the waterway they enter.[10] The aquatic life designation of surface waters in Riverdale as of 2006 is depicted in Figures IV-7. The value of water as fish and wildlife habitat is discussed in detail in section V of this inventory.

These designations are important for regulatory purposes. For example, under the N.J. Freshwater Wetlands Protection Act, wetlands draining to Category 1 waterways receive an "exceptional resource" classification requiring 150-foot protective buffers.[11] Category 1 waterways in Riverdale are shown in Figure IV-8. Under the N.J. Stormwater Management Rules, waterways in Category 1 watersheds (other than wetlands) receive 300-foot buffers to protect water quality.[12] These watershed areas are depicted in Figure IV-9. Virtually all lands in Riverdale are in a Category 1 watershed.

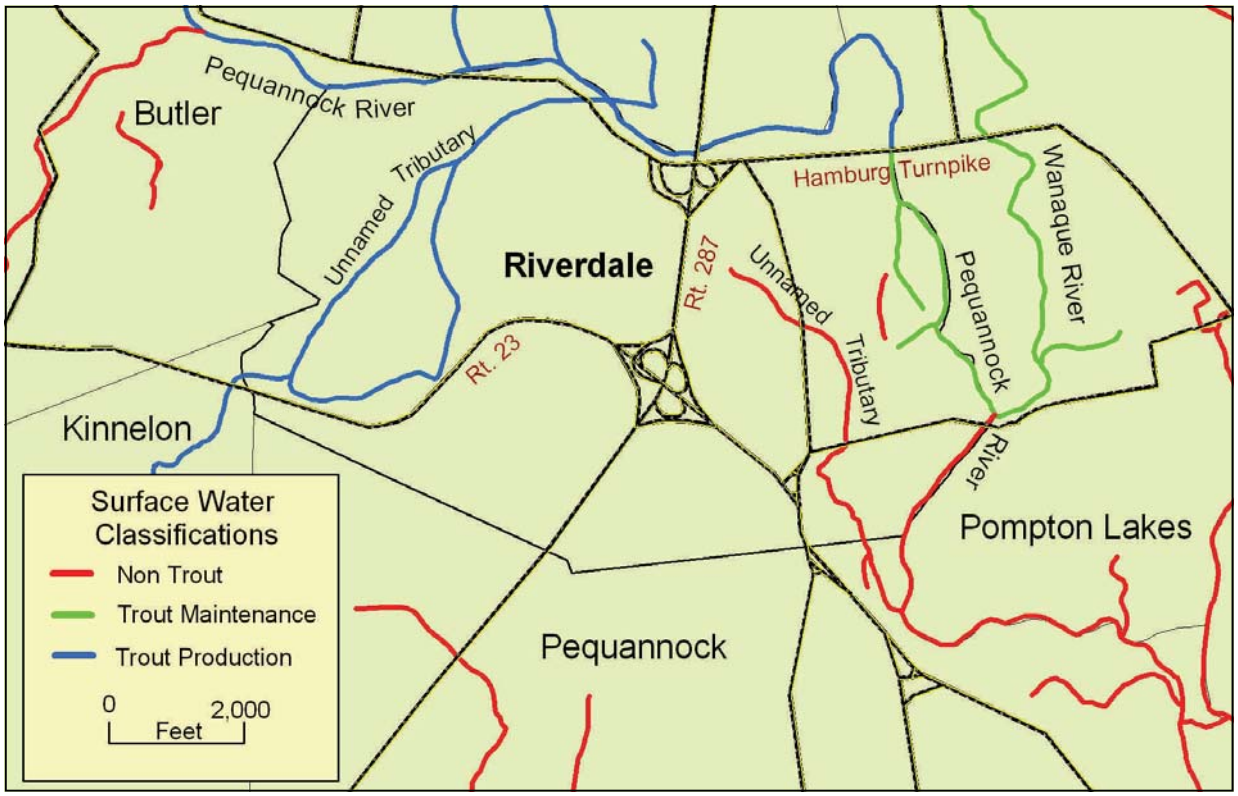

Figure IV-7 Surface waters of Riverdale - State classifications for aquatic life
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

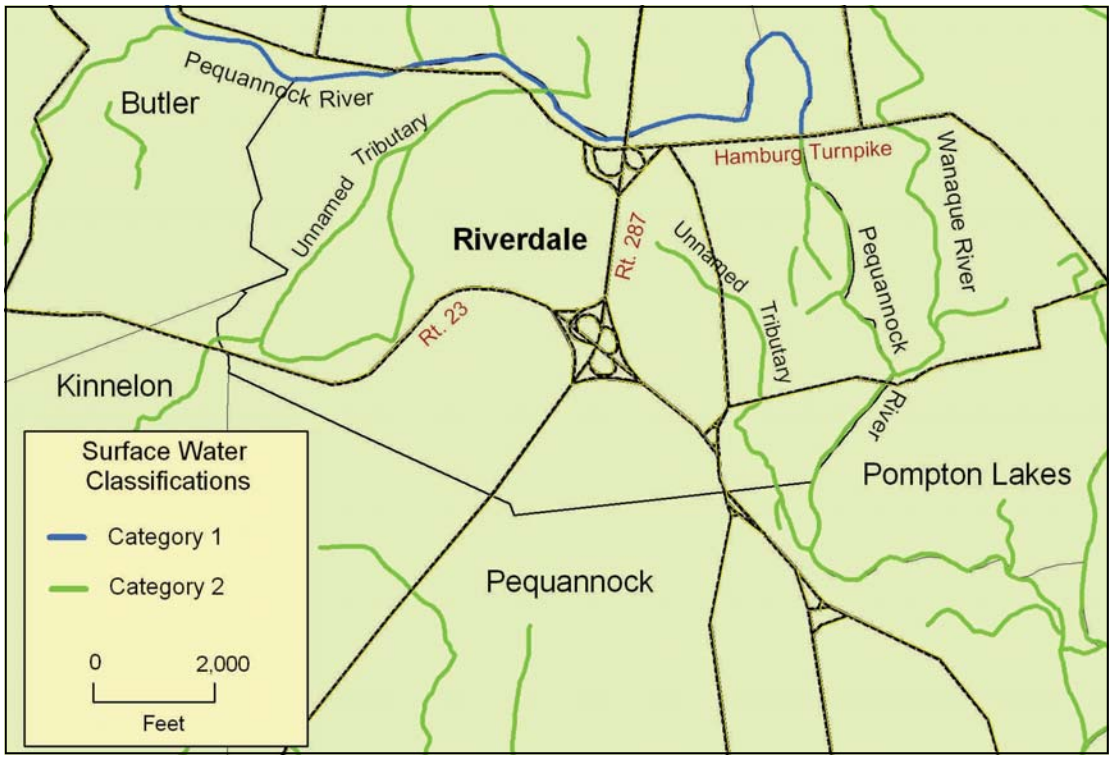

Figure IV-8 Category 1 waterways of Riverdale

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

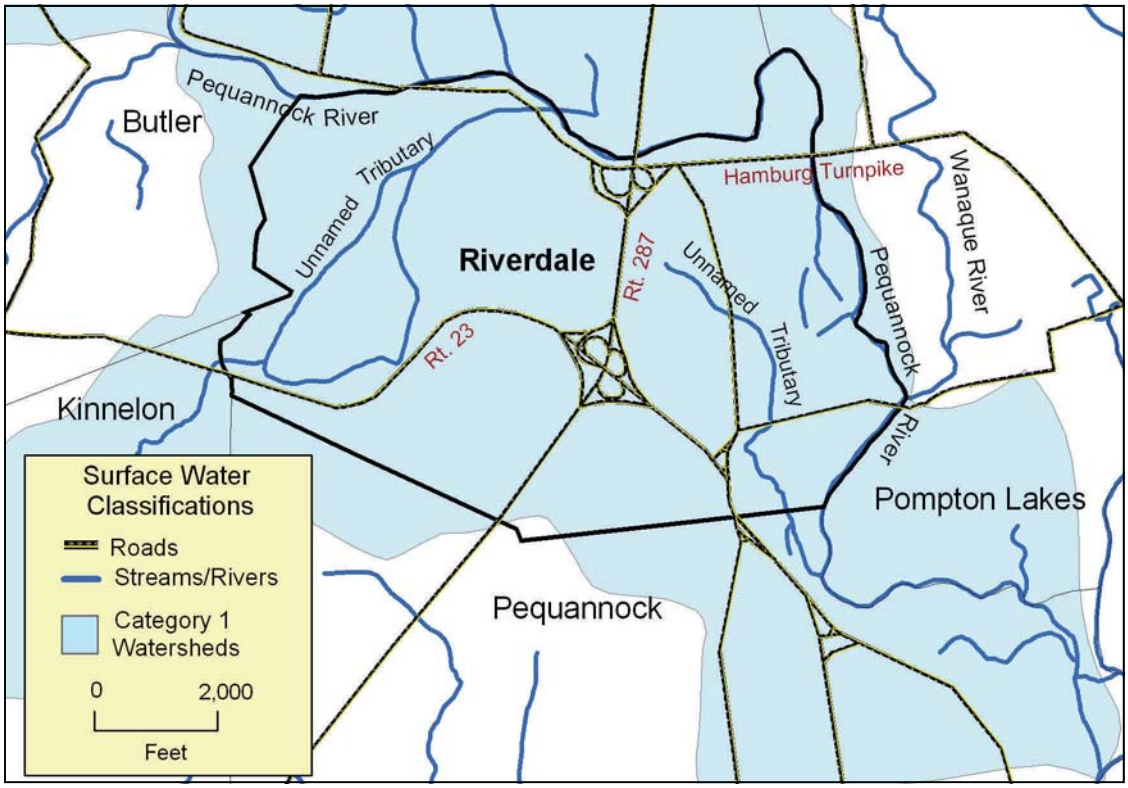

Figure IV-9 Category 1 Watersheds in Riverdale

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

The aquatic life designations such as "Trout Production" are also meaningful. Trout Production and Trout Maintenance waterways have stricter requirements under the N.J. Surface Water Quality Standards for such water quality elements as dissolved oxygen and water temperature.[13]

In addition to streams and rivers, Riverdale has other surface waterbodies in the form of ponds. (see Figure IV-11). It should be noted that Suntan Lake was greatly reduced in size since the DEP mapping in Figure IV-11 occurred.

A special type of pond is the "vernal pool." These are ponds that fill with spring rains and are typically dry by mid to late summer. Vernal pools provide critical spawning habitat for many species of amphibians including salamanders and frogs. Some, like the wood frog (see Figure IV-10) and spotted salamander, will breed only in these pools.[14] Although there are currently no mapped vernal pools in Riverdale, the potential for these pools exists in remaining forested tracts.

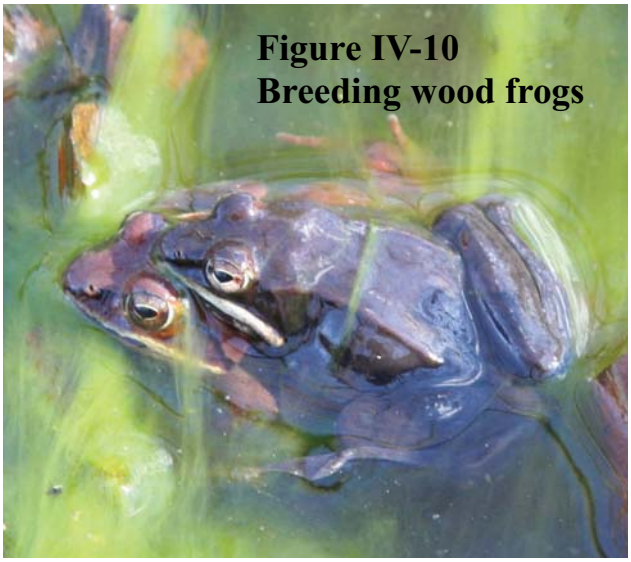

Figure IV-10
Breeding wood frogs

Since regulations often change, the information here should be used only as a general guide. The NJDEP should be consulted for the most up-to-date laws and restrictions.

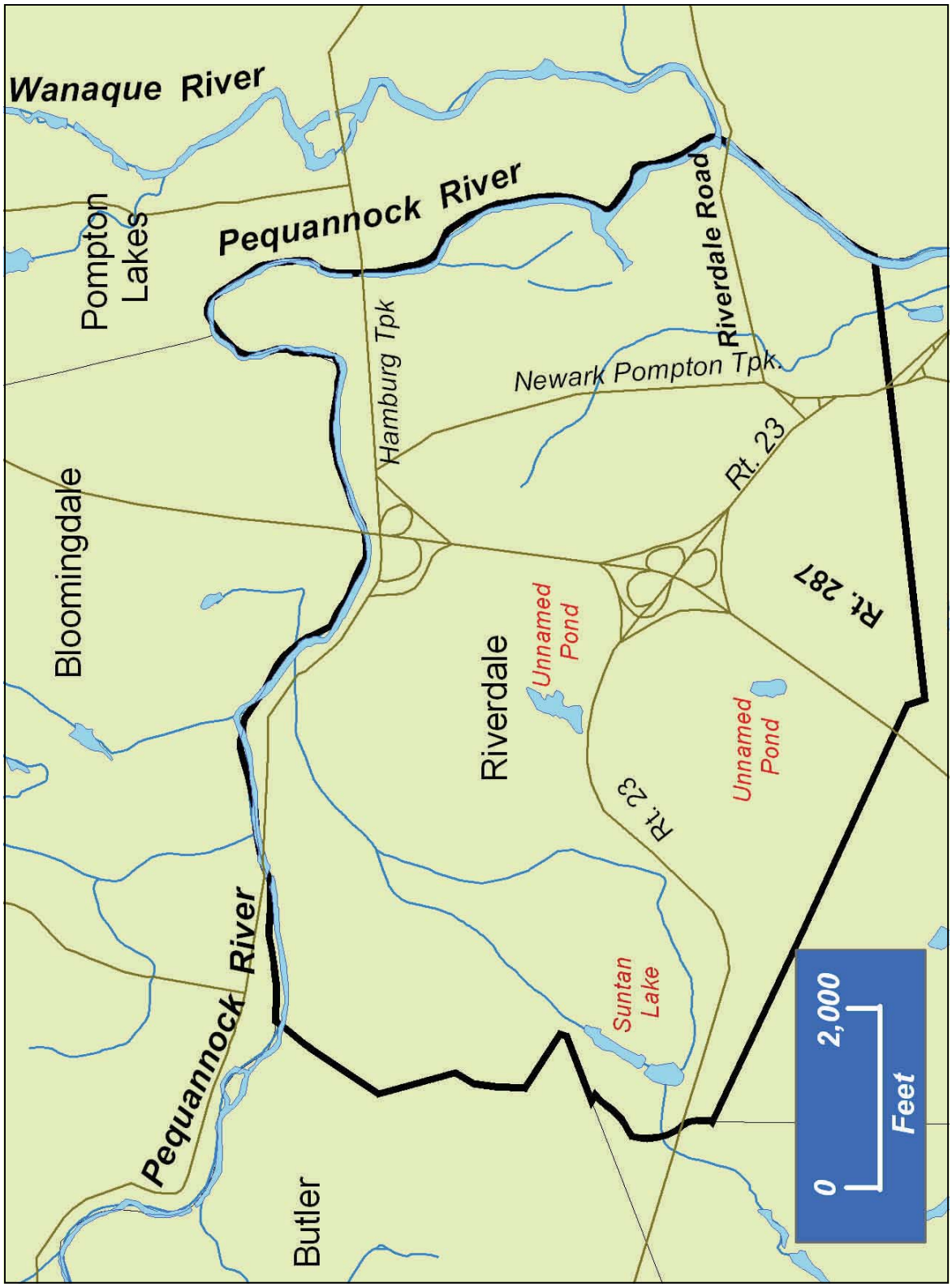

Figure IV-11 Rivers, streams, ponds and lakes
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

Groundwater

Groundwater is water that is found in subsurface aquifers rather than surface water bodies such as lakes or streams. Groundwater is extremely important to Riverdale as this source provides much of the Borough's potable supply, either from municipal or individual wells.

There are 2 main types of bedrock aquifers in Riverdale: Crystalline aquifers, (also known as the Highlands Aquifer), formed of igneous and metamorphic bedrock such as gneiss, schist, and granite; and Newark Basin aquifers (also identified as Brunswick Formation or Brunswick Conglomerate) consisting of soft red shale interbedded with coarse grained sandstone and conglomerate (see Figure IV-12). A third type of aquifer may occur where glacial deposits of sand, silt and gravel cover the underlying bedrock and form narrow belt-like deposits of small areal extent. In some places these deposits comprise channels up to 300 feet thick and can provide significant storage and yields of water.[15]

The replenishment or "recharge" of these underground water sources is dependent on several factors. An important one is precipitation in the form of rain or snow, since areas with abundant

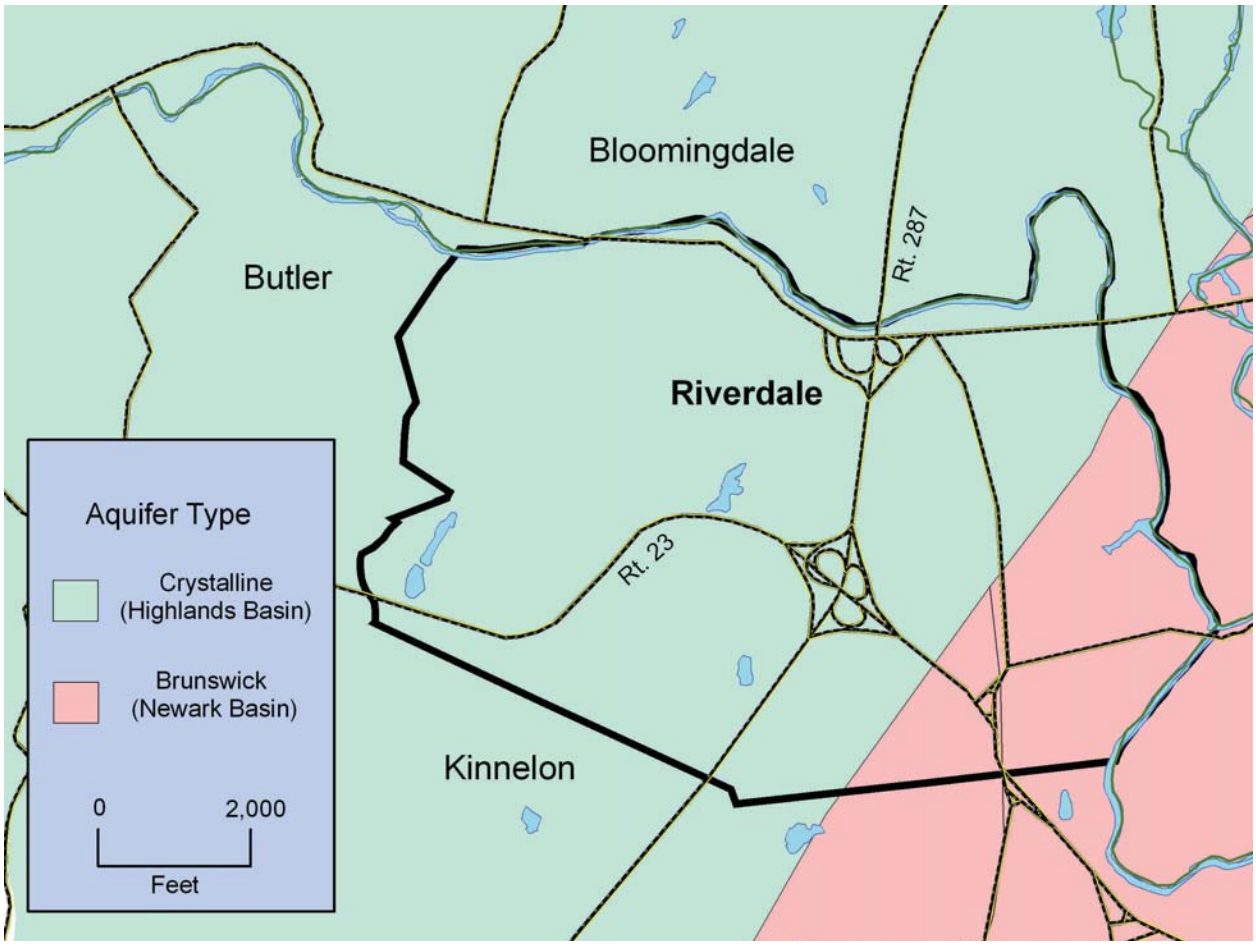

Figure IV-12 Aquifer Types
(This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.)

rainfall replenish underground aquifers more readily. Riverdale benefits from an ample rainfall averaging 47 inches per year. Another factor is the effect of evapotranspiration, meaning the use of water by plants and the impact of evaporation.[16]

Also important is the degree of slope, permeability of soils and the type of underlying bedrock. Steep slopes diminish recharge and increase runoff. The most permeable soils allow more water to penetrate into the ground and limit surface runoff. The permeability of Riverdale soils is depicted in Figure IV-13. The depth of these soils and their underlying bedrock is also critical. Thinner soils over hard, crystaline rock cannot retain the same amount of water as deep beds of sand and gravel over more porous shale or sandstone.[17]

A final element is the condition of the land. Forested land will have the highest recharge value since forests tend to increase the infiltration of water and reduce surface runoff. On the other hand, developed lands with large areas of impervious cover such as roads, parking lots, and buildings, prevent the penetration of water into soils and promote surface runoff. Land use in Riverdale is shown in Figure IV-14. These land uses are explored more fully in section VI of this inventory.[18]

The New Jersey Geological Survey has assembled these factors into a method for estimating ground water recharge. A map depicting their estimated recharge rates for Riverdale is shown in Figure IV-15. Unfortunately a large area of Riverdale's most important aquifer in the southwestern portion of the Borough has suffered the highest levels of development.

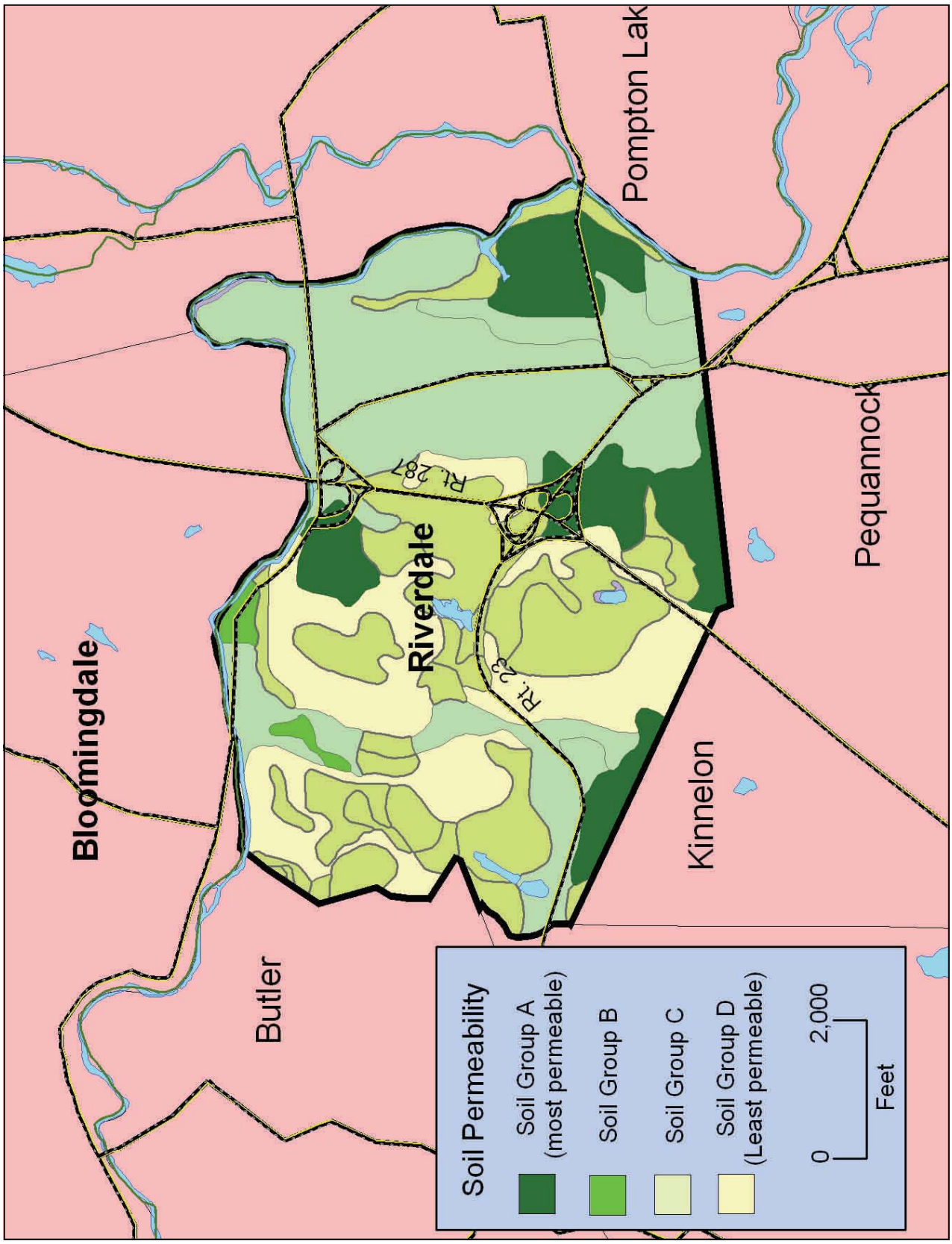

Figure IV-13 Soil Permeability in Riverdale

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

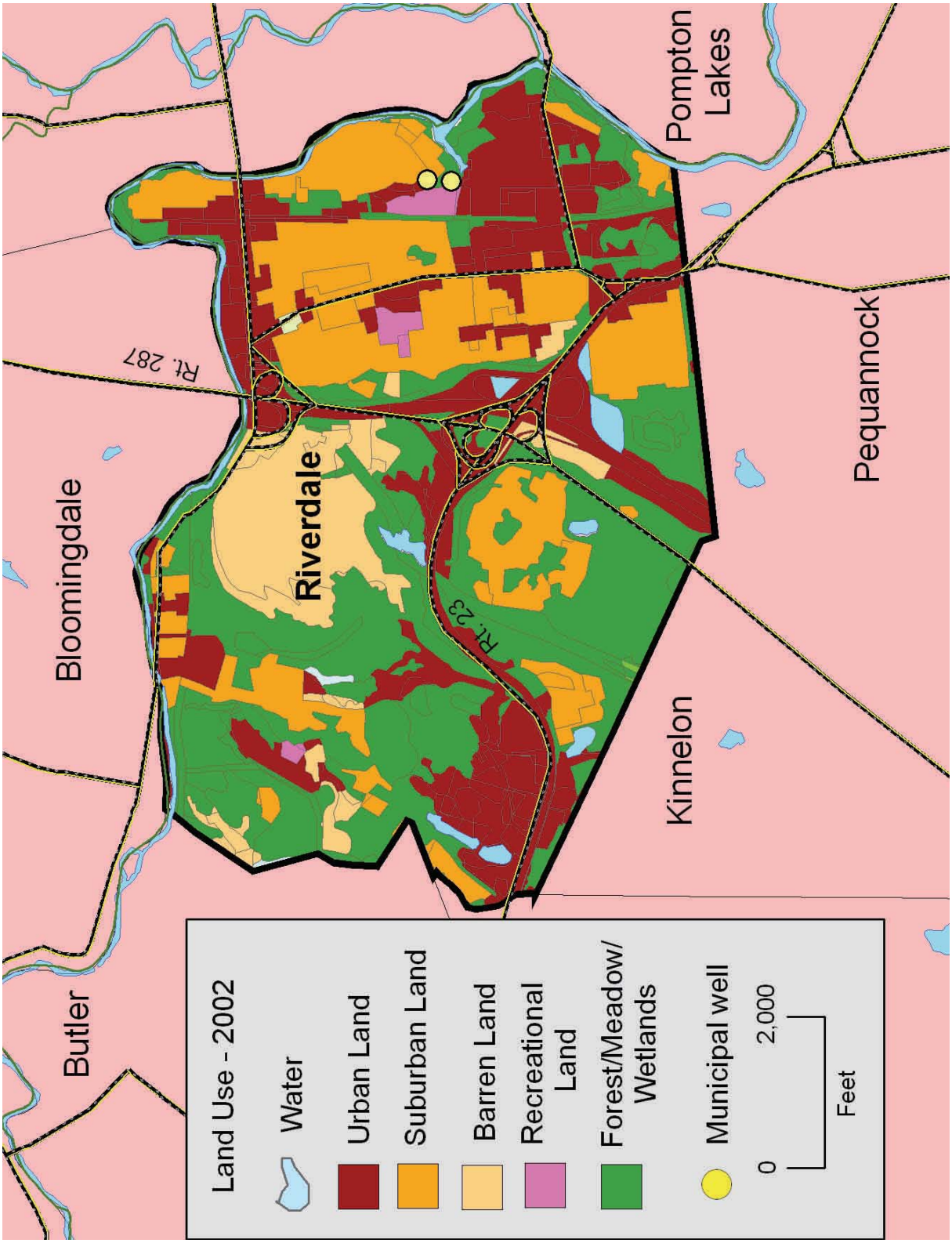

Figure IV-14 Land Use in Riverdale

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

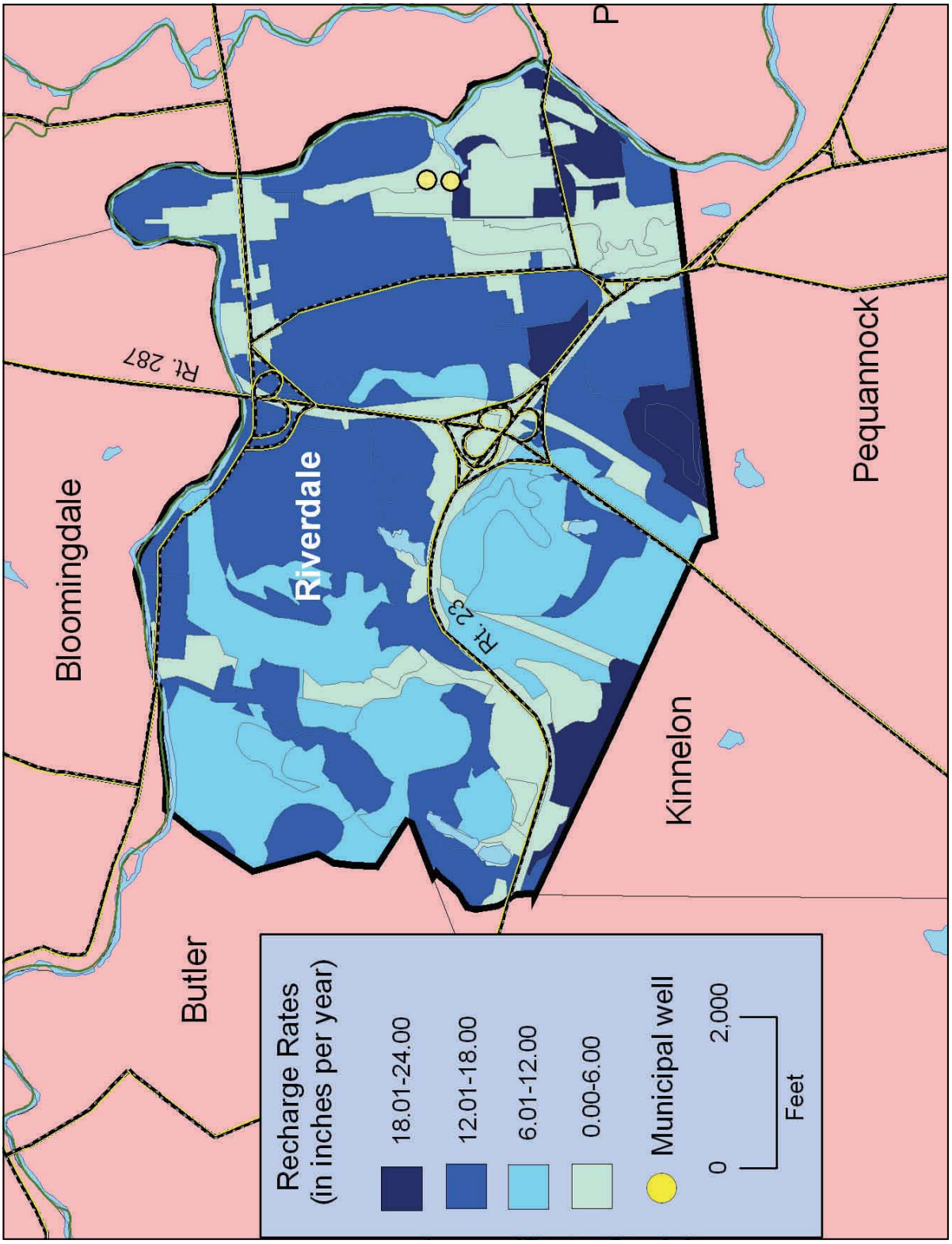

Figure IV-15 Groundwater Recharge in Riverdale

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