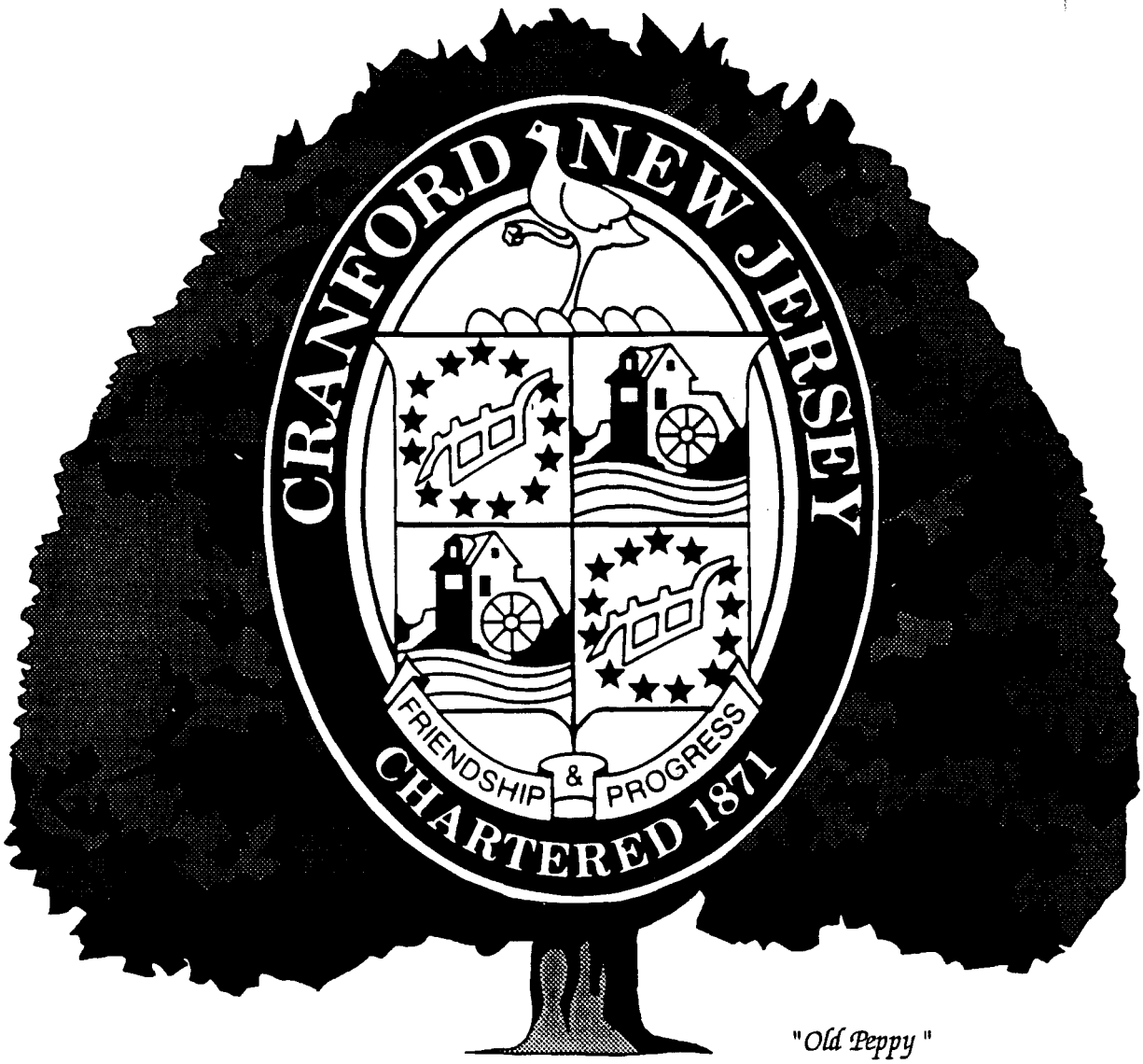
NATURAL RESOURCES INVENTORY



"Old Peppy"

TOWNSHIP OF CRANFORD
UNION COUNTY, NEW JERSEY
DECEMBER 1993

NATURAL RESOURCES INVENTORY

Prepared by the Environmental Commission
Township of Cranford
Union County, New Jersey

December 1993

ENVIRONMENTAL COMMISSION OF THE TOWNSHIP OF CRANFORD

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ACKNOWLEDGEMENTS

The Natural Resources Inventory (NRI) of the Township of Cranford was made possible through the approval and support of the Township Committee as well as a matching grant from the New Jersey Department of Environmental Protection and Energy, Office of Environmental Services.

Many of the Commissioners devoted extraordinary amounts of their time in producing this document. Much of the research for the NRI came from Commissioners Al Gessler, Roberta Kessler, Kurt Krause, Joe Musillo and Marie Seavy. Other Commissioners who aided in reviewing the text were John Jordan, Dave DesRochers, John Laucius and Nancy Selfridge. The painstaking work of managing the project, producing text and graphics, and tying together loose ends was borne by Commissioner Donald Ehrenbeck.

Special thanks go to Larry Fuhro, President of the Cranford Historical Society and John Duryee, Township Tax Assessor, for their contributions, and to Patricia Lynn for her invaluable assistance.

To all these hardworking individuals, I wish to extend my heartfelt thanks.

Nelson Dittmar
Chairman
Cranford Environmental Commission
December 1993

I. INTRODUCTION

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In 1969, Ian McHarg, considered by many to be the father of environmental planning, wrote the following:

> Among us it is widely believed that the world consists solely of a dialogue between men, or men and God, while nature is a faintly decorative backdrop to the human play. If nature receives attention, then it is only for the purpose of conquest, or even better, exploitation--for the latter not only accomplishes the first objective, but provides a financial reward for the conqueror.

Since that time, the American people have had an increasing understanding of nature and its processes and how we are interrelated. No longer is nature thought of as a commodity to be bought and sold. There is a greater sensitivity to the fact that Man's actions, no matter how small, can have a profound effect upon the natural world around us.

Because the Township of Cranford is almost completely developed, it is important to be aware of and consider the Township's remaining natural resources when evaluating both private and public actions. A Natural Resource Inventory (NRI) is a compilation of a municipality's environmental features and natural resource characteristics in both graphic and narrative formats. The NRI is a factual, unbiased document which seeks to provide baseline data for evaluating and measuring environmental issues within the Township, with the ultimate goal being the preservation of significant environmental resources.

The New Jersey Legislature created environmental commissions for the purpose of conducting research into the use and possible use of the open land areas of a municipality. These commissions may advertise, prepare, print and distribute books, maps, charts, plans and pamphlets when deemed necessary for their purposes. They 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.

As a result of an increasing sensitivity to our environment, the Cranford Environmental Commission has prepared this Natural Resource Inventory to aid in the identification of environmentally sensitive areas and to enable the Commission to work toward the protection of these areas. In addition, pursuant to the Municipal Land Use Law (N.J.S.A. 40:55D-27), whenever an Environmental Commission prepares an NRI and submits it to the local Planning Board and Board of Adjustment, these boards shall forward to the environmental commission informational copies of every development application submitted to either board. Although this referral is for informational purposes only, it will enable the Environmental Commission to comment on applications as they are before each board, resulting in a more proactive role for the Commission in the development of the Township.

The NRI will also serve as a database for the Environmental Commission, Planning Board and Board of Adjustment, as well as the Township's professional staff and planning consultant, when evaluating and making recommendations on development proposals. If utilized properly, the resulting process will enable the Township to protect appropriate resources. The document will also serve as a point of reference when the Township updates its Master Plan, as it is required to do every six years. In addition, the NRI can be utilized by concerned citizens and civic groups when planning community service projects.

This NRI will be distributed to various review boards, as well as to Township offices such as the library and schools. It is the Commission's hope that the resulting referral process will raise the environmental awareness of the membership of the Planning Board and the Board

of Adjustment, as well as that of any members of the public who attend the meetings of these boards.

This NRI contains a chapter on each of the following topics: the township's history, geography and regional setting; geology; vacant land and open space; soils; hydrology (groundwater and surface water); meteorology; vegetation and wildlife. In addition, maps of vacant land and open space, soils, wetlands and floodplains are included in the document.

II. GEOGRAPHY AND REGIONAL SETTING

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The Township of Cranford, a 4.79 square mile suburban residential community, is centrally located in Union County. It is approximately halfway between the cities of Elizabeth and Plainfield on a gently sloping plain east of the Watchung Mountains—three closely spaced basalt trap-rock ridges (see Figure 1). The Township is bounded on the north by Kenilworth and Springfield, on the east by Roselle and Roselle Park, on the south by Clark, Winfield Park and Linden, and on the west by Garwood and Westfield.

Cranford is conveniently located for travel, ten miles southwest of Newark International Airport and approximately 45 minutes from New York City. There is frequent daily bus and rail service from the Township to Newark and New York City. Three exits of the Garden State Parkway lead directly into Cranford, providing the Township with easy access to the New Jersey Shore region and other parts of the country via connections with highways such as the New Jersey Turnpike and Interstate Routes 78 and 80.

According to the 1990 Census, Cranford had a population of 22,624, a decline of almost eight percent from the 1980 figure of 24,573. Of the Township's 8,405 housing units, 6,695 are owner-occupied, and 6,689 are single family occupancy.

There is very little vacant developable land remaining in the Township. Notable exceptions include various isolated infill lots, an abandoned railroad yard on South Avenue East, a wooded area at the end of Cranford Avenue and the 26-acre Conservation Center on Birchwood Avenue. Although not developable, there are also several large county parks and some vacant land located along the Rahway River.

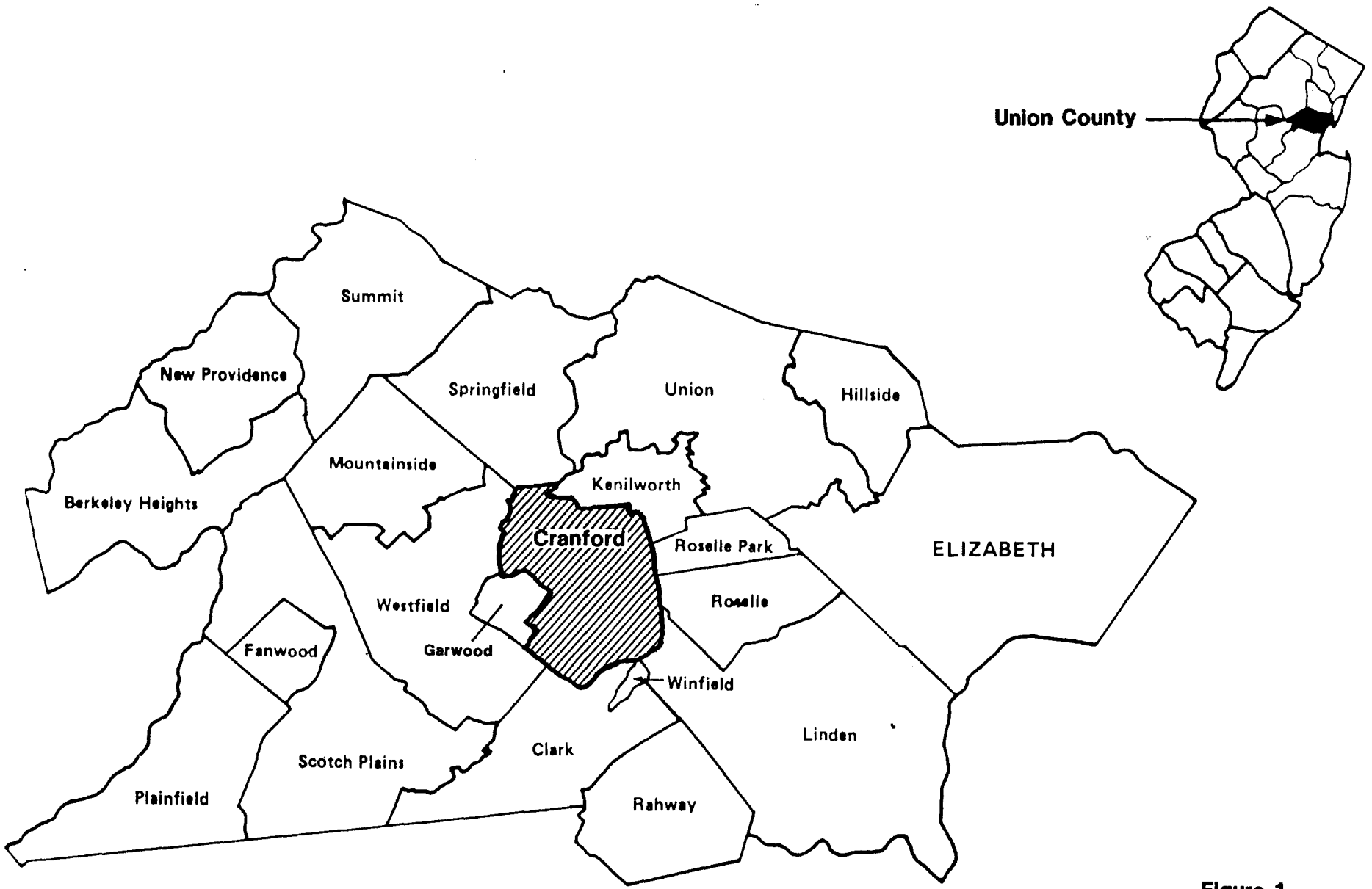

Figure 1

REGIONAL LOCATION

III. VACANT LAND AND OPEN SPACE

III. VACANT LAND & OPEN SPACE

The enabling legislation which created environmental commissions (N.J.S.A. 40:56A-1, et. seq.) states that a commission, among other responsibilities, "... 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..." Open space is defined by the Municipal Land Use Law as being:

> any parcel or area of land or water essentially unimproved and set aside, dedicated, designated or reserved for public or private use or enjoyment ... provided that such areas may be improved with only those buildings, structures, streets and off-street parking and other improvements that are designed to be incidental to the natural openness of the land.

The Environmental Commission utilized information provided by the Cranford Tax Assessor, the Township's Engineering Office and the Union County Planning Department to determine open areas. Aerial photographs of the Township were also reviewed and a field reconnaissance was conducted to verify the data. Although recreational areas associated with the Township's school system contain large areas of open land, they were not included in the inventory because they are, using a strict interpretation of the law, improved for uses such as baseball and soccer.

Vacant land and open space in the Township are depicted in Drawing No. 2. There is very little vacant developable land remaining in the Township. Notable exceptions include various isolated infill lots, an abandoned railroad yard on South Avenue East, a wooded area at the end of Cranford Avenue and the 26-acre Conservation Center on Birchwood Avenue. Although not available for development, there are also several large county parks in the

Township: Lenape and Nomahegan parks in northwest Cranford; Unami Park in southwest Cranford and the Rahway River Parkway, a linear system adjacent to the river for most of its length through town.

IV. HISTORY OF CRANFORD

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Situated in the geographic center of New Jersey's youngest county, Union, the Township of Cranford is bisected by the meandering Rahway River. The original Native American inhabitants called the area *Wawahakewany* or "place where eggs are found". Indeed, Cranford owes its existence to the river, for it was that feature which drew the first settlers here in the early 18th century. European settlers built mills along the river to grind grain and saw timber. The farm community became known as "Crane's Mills" due to the location of the two Crane family mills opposite one another near the junction of today's Springfield and North Union avenues. A low water crossing place on the river was also known as "Crane's Ford" and it is from this spot that the modern township takes its name. The last remaining mill on the Rahway River is at 347 Lincoln Avenue East in Cranford. The Williams-Droescher Mill is the longest continuously occupied industrial building in the state of New Jersey.

Cranford, or Crane's Mills as it was known then, served as headquarters for several Continental Army generals during the fierce winter of 1779-80. Crane's Mills was the center of an arc of 2,000 front line troops stretching from Newark to Perth Amboy. Many of these troops quartered in Crane's Mills. Their purpose was to provide an "early warning" front line of defense for Washington's army at Morristown.

For many years after the Revolution the Crane's Mills area remained a farming community. Hardwood forest predominated west of the river and farmland was under cultivation east of the river, an area known as "Williams Farms". The community was also known for sheep raising and apple growing, producing a potent applejack known as "Jersey Lightning".

Part of the village of Westfield since 1794, in the early 19th century the area became known as "Crane Town". From about 1849 to 1869 the town was called "Craneville". Tradition has it that the name was scrawled by school children in chalk on the side of the railroad depot and it stuck.

An influx of New Yorkers and Brooklynites seeking summer homes after the Civil War changed the area forever and led to the development of its suburban character. Real estate speculators bought up many of the farms and divided them into housing lots. This increase and change in the composition of the local population brought another name change in 1869. "Craneville" was thought to be too rural by the sophisticated newcomers. Various names were suggested and finally "Cranford" won out over "Riverdale" by a narrow margin. Soon after, the descendants of the Crane family, Josiah Sr. and Josiah Jr., led a movement to separate from Westfield. They successfully petitioned the state legislature, and in 1871 the Township of Cranford was officially established. Not long after the incorporation of the Township, its founders made an offer of money and land to the legislature to move the state capital from the banks of the Delaware River in Trenton to the banks of the Rahway River in Cranford. Their bid was rejected.

For some time Cranford was known as "The Venice of New Jersey" due to the route of the Rahway River through town. The appellation is credited to Roselle lawyer William Sulzer, who later became Governor of New York. In 1886, a small "River Carnival"— the first in an annual tradition—was held, and each year it became bigger and better. Thousands of people came to see the evening carnivals with lighted and decorated canoes and floats. These festivals were eventually discontinued because eager crowds trampled lawns and gardens.

Today the 22,624 inhabitants of the Township's 4.79 square miles are living in a community that looks to its past to see its future. A vigorous program of downtown renewal, including the state's first Special Improvement District, draws upon the Victorian past for its architectural features.

The following is a list of historic buildings and sites in the Township. Reference numbers are keyed to Figure 2.

1. Williams-Droescher Mill.

   Located at 347 Lincoln Avenue East, the Williams-Droescher Mill represents a 1910-1919 renovation of an earlier mill (c. 1740). The last remaining mill on the Rahway River, the mill is the longest continuously occupied industrial building in New Jersey. Over its lifetime, the mill has produced things such as blankets, wagon wheel hubs, cut stones, barber supplies, organ consoles and electronic parts. A horizontal Leffel water turbine (c. 1893) is still in place, and the building also shows evidence of a fire set by a Tory raiding party during the American Revolution. The mill is listed on both the State and National Registers of Historic Places.

2. Droescher Mill Park.

   Located on the east bank of the Rahway River north of the mill, this county park has several remnants of Severin Droescher's pre-World War I "Lincoln Park" development including stone walls, a river overlook, a pond, stone bridge supports and a stone gazebo.

3. The Crane-Phillips House.

   Located at 124 North Union Avenue, this building currently houses the museum of the Cranford Historical Society. This 1845 "Little House on the Rahway" is a Victorian country cottage originally assembled from outbuildings located across the street on the Josiah Crane farm. The honeymoon cottage of Josiah Crane, Jr., the house was later owned by inventor Henry Phillips, a seeker of perpetual motion. The house is believed to have been a "station" on the Underground Railroad. A trap-door leading to a large cistern is said to have been a hiding place for escaped slaves prior to the Civil War.

4. Josiah Crane Park.

   Located at the intersection of Springfield and North Union avenues, this park is on the site of the early 19th century farm of Josiah Crane, Sr., the "Father of Cranford". An

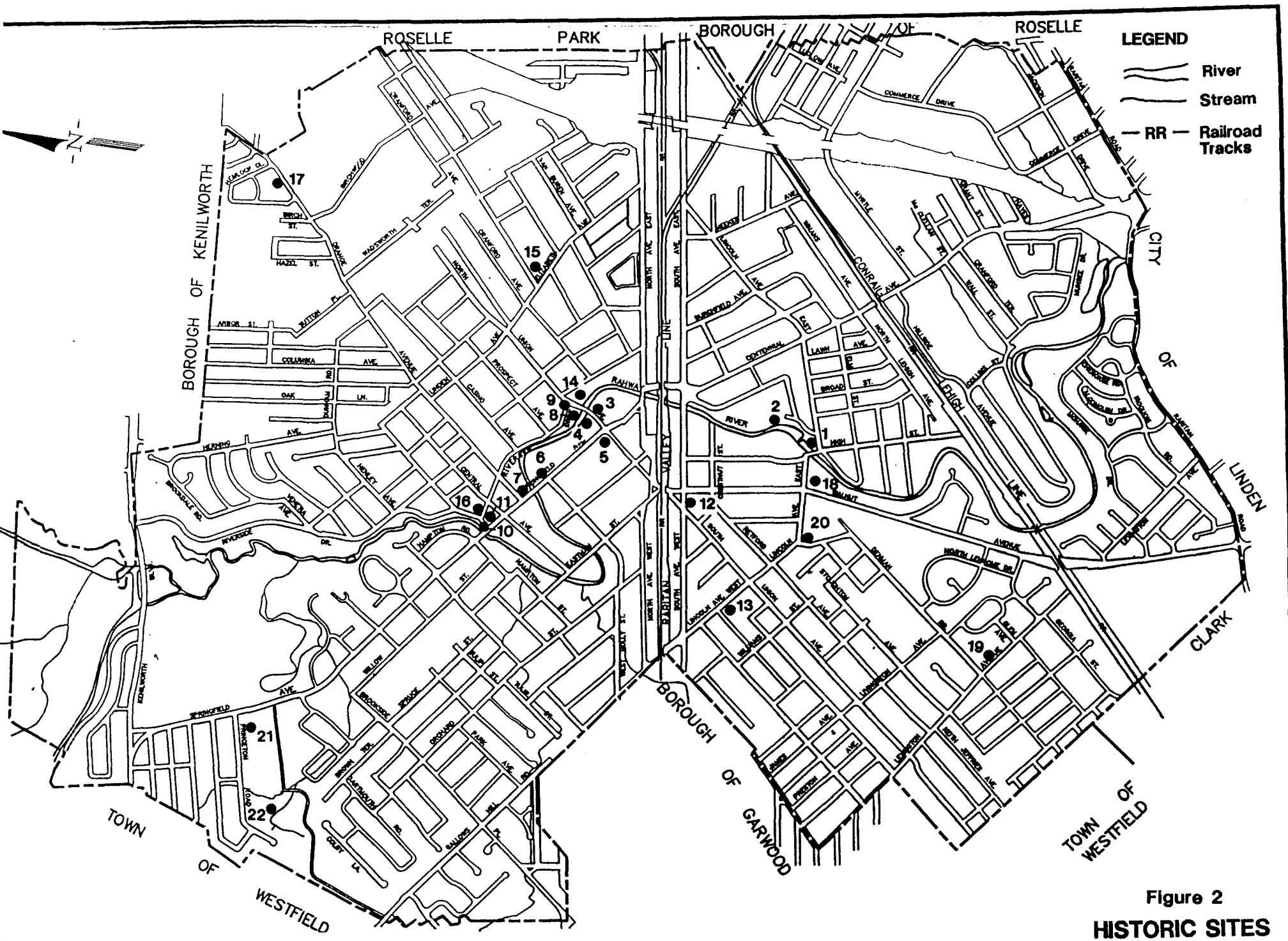

Figure 2

HISTORIC SITES

ancient tree and a ruined well are the only remnants of the original farm. The Crane-Phillips House located across the street was built largely from outbuildings taken from this site in the 1840s.

5. First Presbyterian Church.

Located at the intersection of Springfield and North Union avenues, across from Josiah Crane Park, this church is a local architectural landmark. Completed in 1894, the church is noted for its shingle architecture, interior and President McKinley stained glass window.

6. The Hanson House.

Located at 38 Springfield Avenue, this building is the former office and home of Cranford pediatrician Dr. Carl Hanson, a noted researcher in the field of strep throat. The building currently houses the annex, offices and library of the Cranford Historical Society, as well as numerous other community groups. Mrs. Hanson's Leet organ was manufactured in 1949 by the Leet Organ Company at Droescher's Mill.

7. Cranford Canoe Club.

Located at the intersection of Springfield and Orange avenues, this is the last remaining canoe club on the Rahway River. Once the center for social life on the river, it was recently purchased by the Township and is still being operated as a canoe livery.

8. Crane's Mills Site.

Located on the Rahway River just north of the North Union Avenue bridge, this was the site of the two Crane family mills that gave the village its first name; "Crane's Mills". A gristmill was located on the north bank of the river in what is today's Sperry Park. A sawmill was located on the south bank behind today's Gray's Funeral Home. Both mills flanked the c. 1720 dam known later as "Hansel's Dam" because it was behind the home of Charles Hansel (today's funeral home). Archaeological digs at both mill sites in the early 1970s uncovered foundations, machinery mounts, clay pipes, bottles, buttons and tools.

9. Revolutionary Cantonment Site.

Located at Sperry Park on Riverside Drive, a marker commemorates the winter of 1779-80 cantonment of Continental troops along the river here, part of a 2,000 man front protecting Washington's troops at Morristown. The front stretched in an arc from Newark to Perth Amboy, with Crane's Mills (Cranford) in the center. Several Continental Army generals headquartered here. Alexander Hamilton visited the Crane's Mills cantonment and Hessian prisoners are known to have passed through here.

10. Crane's Ford Monument.

Located on Riverside Drive at Springfield Avenue, the monument marks the site of Crane's Ford, the low-water crossing place on the Rahway River. Tradition has it that in the Revolution mounted sentinels stationed at this site carried warning of the approaching British to Washington at Morristown. The Township takes its name from this spot.

11. Memorial Park.

This Township park or "green" is on Springfield Avenue at Riverside Drive where memorials to the community's war dead are located. These include World War I, World War II, Korea and Vietnam. A circular marble monument memorializes P.O.W.'s and M.I.A.'s. A nearby tree is dedicated to the first Cranford serviceman who fell in Vietnam.

12. The Cranford Hotel.

Located at the intersection of Walnut and South Union avenues, this is the oldest business in Cranford, still operating after one hundred years. A restaurant and bar occupy the premises today. It originally opened as a hotel for railroad travelers on December 31, 1892.

13. The Cranford Pepperidge Tree.

The official Township tree, located on Lincoln Avenue West, is a much-photographed blackgum tree famed for its fiery fall foliage. Once a boundary tree, this 225 year old specimen is the second largest pepperidge tree in the northeastern United States.

14. The Linwood Carriage House.

Located at 12 Forest Avenue, this large Neo-Jacobean 19th century carriage house was once part of a larger estate known as "Linwood". The main house still exists and is located at the intersection of Forest and North Union avenues.

15. The Old Rectory.

This Italianate villa (c. 1860), located at 12 Bloomingdale Avenue, once served as the rectory for the Roman Catholic church that once stood at the corner of Bloomingdale and Elizabeth avenues.

16. The Pierson-Crane House.

This circa 1737 house, located at 420 Riverside Drive facing Memorial Park, was once occupied by Samuel Pierson, a member of General Washington's Life Guards. It was extensively remodeled and enlarged in the 19th century and again in 1929.

17. The Dunham-Oakey House.

This Revolutionary-era farmhouse with an 1820 addition is located at 1117 Orange Avenue. The home of one of the Dunhams and later occupied by Civil War veteran William Oakey, at various times in its history it functioned as a school, a boarding house and a brothel.

18. The Vreeland House.

This circa 1840 farmhouse, located at 306 Lincoln Avenue East, was built by James Vreeland just up the road from the mill he owned and operated (the Williams-Droescher Mill). The house is said to be haunted.

19. The Williams House.

This circa 1805 farmhouse, located at 506 Lexington Avenue, was the home of Squire Williams in 1828. The house sits at an angle to Lexington Avenue, indicating the position of the original farm road.

20. The Denman Homestead Site.

Located at the intersection of Denman Road and Lincoln Avenue West, this is the site of the home and farm of John Denman, the first European to cross the Rahway River and permanently settle in the Cranford area (1720). The third and last Denman house on this spot was razed in 1951. The Denman lands were primarily hardwood forests yielding fine timber well into the 1890's. Timber from the site went into the re-fitting of the U.S.S. Constitution for the War of 1812.

21. Revolutionary Hospital Site.

An army field hospital was located in the northwest portion of Crane's Mills from 1777 to 1780. The site is now part of the Union County College campus, near Princeton Road. The hospital was a log building similar to the reconstruction that can be seen today at Morristown.

22. Mastodon Site.

Two tusks (one measuring 4 feet, 3 inches) and several bone fragments from an ancient mastodon were found in 1936 in the swampy area directly behind what is now the parking lot of Union County College's main building.

V. GEOLOGY

represented by well-defined layers or beds of sand, silt, gravel and cobbles deposited by water from the melting ice cap.

Pleistocene sediments in Cranford are in the form of stratified drift, generally located in the northwest section of the Township. Life during the Pleistocene Epoch is indicated by the discovery of two tusks and miscellaneous bones of a mastodon in Cranford in 1936. These specimens, which now reside in the State Museum in Trenton, were obtained from the bed of a small stream in the swampy area directly behind what is now the parking lot behind the main building of Union County College. The larger tusk measured 4 feet 3 inches. Closely resembling an elephant, the mastodon typically lived in the forests which covered Cranford 25,000 years ago and became extinct at the end of the Pleistocene Epoch.

V. GEOLOGY

To better understand the geology of the Cranford area, one must have a concept of geologic time, which is measured in millions of years. As illustrated by Figure 3, geologic history has been divided into three eras: the *Paleozoic* ("ancient life"), the *Mesozoic* ("middle life"), and the *Cenozoic* ("recent life"). Each era is subdivided into time units known as *periods*. The Paleozoic has seven periods, the Mesozoic three and the Cenozoic two. Each of the twelve periods is further divided into smaller time units known as *epochs*. Except for the seven epochs which have been named for the periods of the Cenozoic era, those of other periods are not commonly referred to by specific names, but by the terms early, middle and late.

New Jersey can be divided into four geologic regions, known as physiographic provinces, which have distinctive rocks and landforms (see Figure 4). The Township of Cranford lies entirely within the Piedmont subdivision of the Appalachian Physiographic Province. Commonly known as the Piedmont Plateau, or Piedmont Plain, it is the eastern-most subdivision of the Appalachian Province and is approximately 1,500 square miles in area. Sloping from an altitude of approximately 400 feet above mean sea level at its northwestern extremity to sea level near Newark Bay, the Piedmont presents a low, hilly surface, broken by occasional ridges and gently rounded hills. These hills are separated by wide valleys which slope downward toward the east and southeast. In the Cranford area, the most notable of these ridges are the Watchung Mountains.

During the Late Triassic Epoch, a series of northeast-to-southwest trending basins were formed in the Piedmont Plateau from Nova Scotia to North Carolina. Rocks of Triassic age

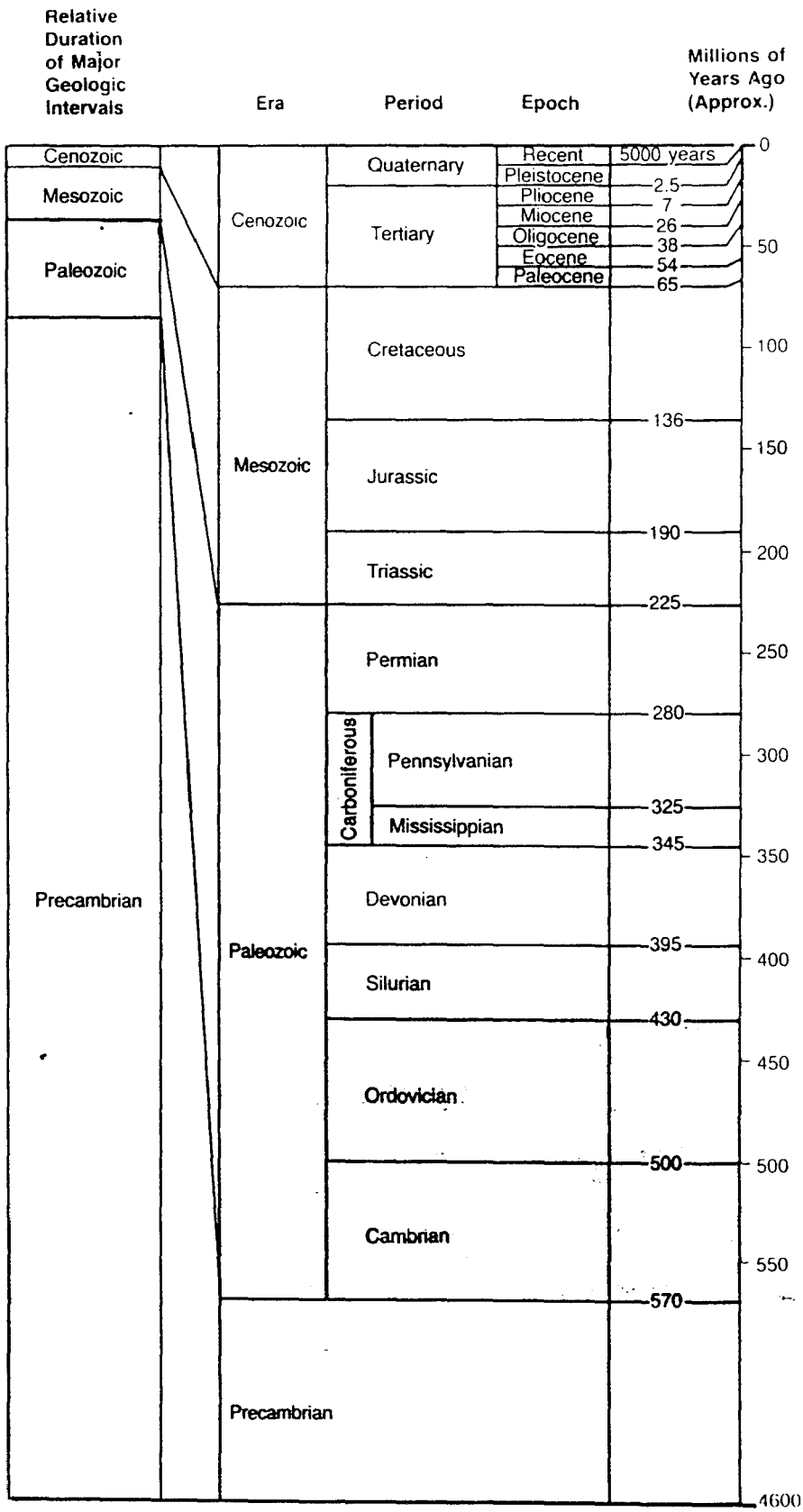

Figure 3

GEOLOGIC HISTORY

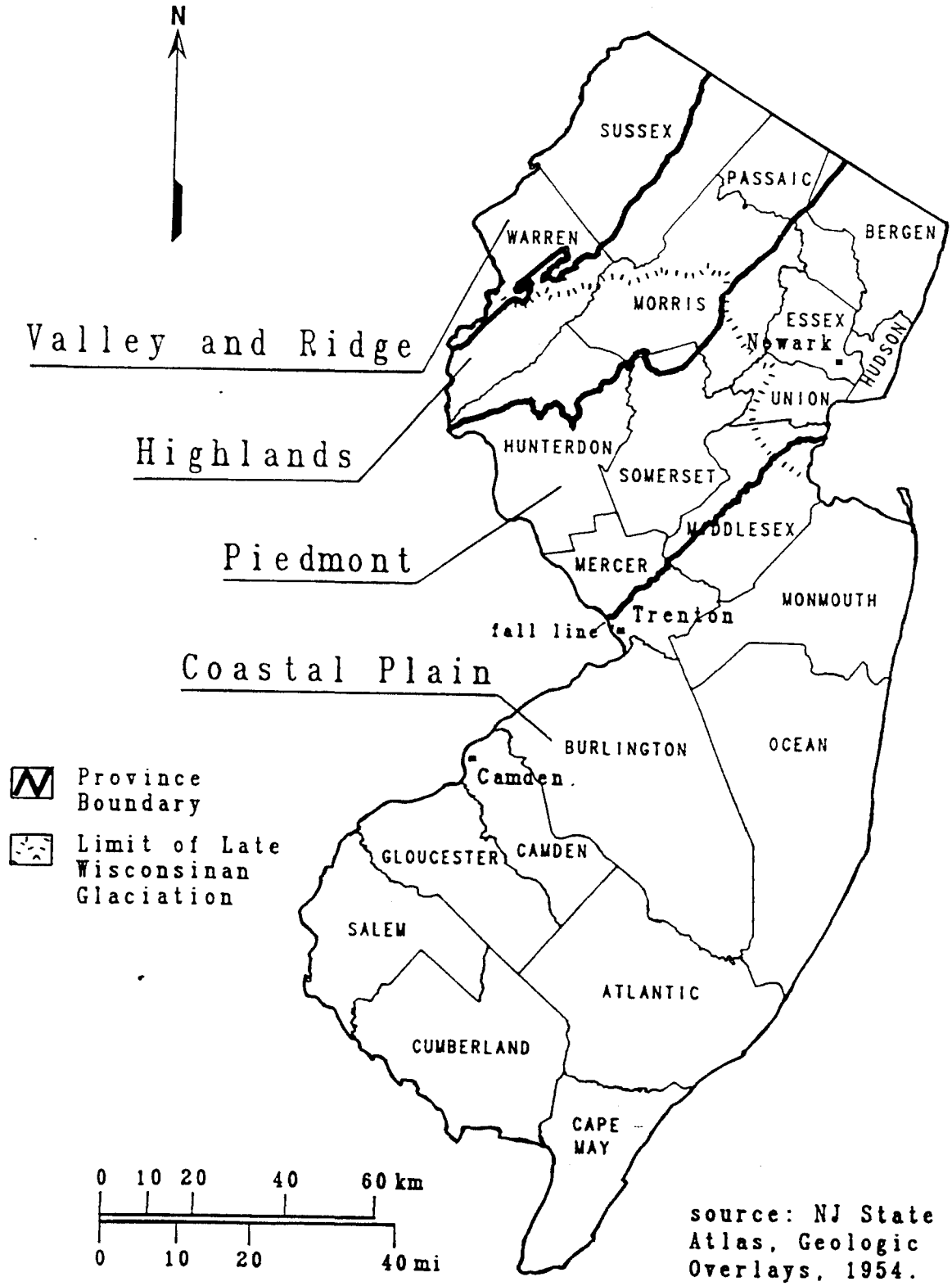

Figure 4

PHYSIOGRAPHIC PROVINCES

occupy these basins and are known as the Newark Group. In New Jersey, the Newark Group covers a band 16 to 30 miles in width and trends northeast-to-southwest, covering Cranford in its entirety. Within this band, the Newark Group contains 15,000 to 20,000 feet of various rock types that overlie rocks of Paleozoic and Precambrian age. All indications are that in the vicinity of Cranford, the Newark Group consists of rocks of late Triassic and early Jurassic age. Formerly known as the Brunswick Formation, these deposits were further subdivided in 1980 into four formations, each characterized by its own suite of rock types (Olsen, 1980). The formation underlying Cranford is known as the Passaic Formation. Composed of red sandstone and shale, the Passaic Formation has a characteristic reddish-brown color, the result of iron-bearing minerals which were oxidized during the cyclic wetting and drying of the sediments during their deposition.

Remnants of the Pleistocene Epoch are also present in Cranford. Commonly known as the Ice Age, this epoch represents the last million years of geologic history. The epoch is divided into four glacial and three interglacial stages. In the last glacial stage, the Wisconsin, ice advancing from the north and northeast covered the eastern half of Union County.

Glacial deposits generally fall into three categories: terminal moraine, which is the material pushed up by the leading edge of the advancing glacier and represented by low, irregular hills of unsorted boulders, gravel, sand and fines; ground moraine or unstratified drift, the material carried forward in and beneath the ice and finally being deposited from under its surface, represented by unsorted and heterogeneous silts and gravels, cobbles, and boulders predominantly derived from underlying red shales and sandstones; and stratified drift, the deposits from glacial meltwater which exhibit both sorting and stratification. Stratified drift is

VI. SOILS

VI. SOILS

Soils are an integral part of our environment. They are defined as discrete bodies produced by interactions of climate, vegetation and surfical geologic materials on the earth's surface. Soil characteristics vary from location to location, even within very short distances. These differences may range from very striking texture variations to more subtle color variations. Because soils are different, they will behave differently when used for foundations, pavements, or septic systems, and therefore must be managed differently.

There are two main groups of soils: residual, which is soil located in the place in which it was formed; and transported, which is soil brought by the action of water, wind and ice. As a result of several glaciations, most of the soil in Cranford is transported soil.

Five major factors contribute to soil formation:

Climate - Temperature and rainfall are responsible for variations in plant and animal life and govern rates of rock weathering and mineral decomposition.

Plant and Animal Life - Vegetation is responsible for the amount of organic matter, color, surface layers and nutrient level. Animals such as rodents are responsible for horizon mixing and assist in keeping the soil open and porous.

Parent Material - The unconsolidated matter from which soils are formed also determine the mineralogical and chemical composition of the soil.

Topography - The land's slope (degree of deviation from the horizontal) and position relative to the water table have a great influence on soil formation.

Time - Millions of years are required for the development of a soil from freshly exposed bedrock.

There are three broad groups of soils:

Sand

Loose and single grained. The individual grains can be easily seen or felt. Squeezed when dry, it will fall apart. Squeezed when moist, it will form a cast, but will crumble when touched.

Clays

A fine textured soil that usually forms very hard lumps or clods when dry and is quite plastic and usually sticky when wet.

Loams

A soil having a relatively even mixture of different grades of sand, silt and clay. It is mellow with a somewhat gritty feel, yet fairly smooth and slightly plastic. Squeezed when dry, it will form a cast, which will be firm and can be handled quite freely without breaking. A loam in which sand is dominant is classified as a *sandy loam*. In the same way, there are also *silt loams*, *silt-clay loams* and *clay loams*.

In Cranford, soils have been identified, evaluated and mapped through a cooperative effort of the U.S. Department of Agriculture's Soil Conservation Service, the Somerset-Union Soil Conservation District, the New Jersey Agricultural Experiment Station at Cook College, and the New Jersey Department of Agriculture. The Union County Soil Survey was published in draft form in February of 1992.

Soils are classified according to physical and behavioral characteristics. The main basis for soil classification is the soil profile, which is a vertical cut made to expose the various parts of the soil. Each profile is evaluated according to properties such as depth, color, mottling, texture, structure, consistency, reaction and boundary. Soil types that are found to have similar properties are then classified together in soil associations.

As depicted in Drawing No. 3, the following soil associations are present in Cranford: Boonton, Dunellen, Haledon, Hasbrouck, Parsippany, Raritan, Passaic, udifluvents, udorthents, and urban land. Detailed descriptions of each soil type appear below:

Boonton loam, 3 to 8 percent slopes

Boonton loam, 3 to 8 percent slopes (BoB) is a gently sloping, well drained to moderately well drained soil that was formed in glacial till. It is derived from red sandstone, shale, gneiss and basalt, although typically there are few of these stones on the surface. The permeability of this soil (its ability to transmit fluid) is moderate to slow, runoff is medium, and available water capacity is moderate. After heavy rains and in winter and early spring, a perched water table (a localized zone of saturation above the main water table) is at a depth of 18 to 72 inches. This soil is strongly acidic. Common trees found growing in this soil include red and white oaks, yellow poplar and white ash. This soil is well suited for lawns and landscaping.

Boonton-Urban Land-Haledon Association, gently sloping

This complex consists mostly of well drained or moderately well drained Boonton soils, areas of Urban land (areas where more than 90 percent of the surface is covered by asphalt or other impervious surfaces), and somewhat poorly drained Haledon soils. This complex has limitations for building sites and other engineering uses. Many areas require drainage improvement to protect against damage to structures such as foundations and retaining walls. Lateral seepage in the fragipan (a dense impermeable subsoil layer) commonly occurs in excavations, making the soils unstable. Roads severely affected by frost action are also common in this complex. This complex is limited by wetness for lawns, gardens, trees and shrubs.

Dunellen sandy loam, 3 to 8 percent slopes

This soil is gently sloping and well drained. The permeability of this soil is moderate to rapid, runoff is slow, its erosion hazard is medium and available water capacity is moderate. This soil is medium to very strongly acidic. Common trees found growing in this soil are oaks, with minor amounts of maple, black cherry, birch, beech and sweetgum. This soil is well suited for urban use, although a concern exists in that its rapid permeability may permit groundwater pollution, and that excavation sidewalls are unstable.

Dunellen-Urban land Complex, nearly level

This unit consists mostly of Dunellen soils with a wet substratum and areas of Urban land. Slopes are from 0 to 3 percent. This soil's permeability is moderate to rapid, available water capacity is moderate, runoff is slow and the erosion hazard is medium. From late winter through spring this soil has a water table at a depth of 48 to 72 inches, and it is considered to be medium to very strongly acidic. This unit is limited for urban use by its rapid permeability, which creates a potential for groundwater pollution. Excavation sidewalls should be considered unstable in this soil and should be shored. This unit is suited for lawns and landscape site development. The cost effectiveness of any applied drainage measures would only be marginal.

Haledon silt loam, 0 to 3 percent slopes

This soil is nearly level and somewhat poorly drained. Its permeability is moderate to slow, and a perched water table is at a depth of 6 to 18 inches from winter through late spring. In this soil, available water capacity is medium, runoff is slow and the erosion hazard is low. This soil is very strongly acidic and is best suited for use as a woodland. Common trees found in this soil include red maple, sweetgum, pin and white oak, and white ash. Urban uses in this soil

are limited by its slow permeability, seasonally perched water table, and potential for frost action. This soil is also severely limited for lawn and landscaping site development by wetness due to a perched water table and runoff from surrounding higher areas.

Haledon-Urban land-Hasbrouck Complex, gently sloping

This unit consists mostly of somewhat poorly drained Haledon soils, areas of Urban land, and poorly drained Hasbrouck soils. These strongly acidic soils have a slowly permeable fragipan which restricts vertical movement of water and root penetration. The permeability of the Haledon soil is slow to moderate, with a perched water table is at 6 to 18 inches depth from winter through late spring. Its available water capacity is moderate, runoff is slow and the erosion hazard is moderate. The permeability of the Hasbrouck soil is moderately slow to very slow, with a perched water table at the surface to 6 inches depth from fall through early summer. Its available water capacity is high, runoff is ponded and the hazard of erosion is low. The perched water table above the fragipan, ponding of surface water, and rare flooding are severe limitations of this unit for urban use. Drainage measures are needed to protect structures against damage and perennial plants with a tolerance to wetness give the best landscaping results.

Hasbrouck silt loam, 0 to 3 percent slopes

This soil is nearly level and poorly drained. The permeability of this soil is moderately slow to very slow, and a perched water table is at the surface to 6 inches depth from fall through early summer. Available water capacity is high, runoff is ponded and the erosion hazard is low. Trees commonly found in this soil include red maple, sweetgum, pin oak and yellow poplar. This soil is severely limited for urban use by its slow permeability, perched water table, frost action potential and its flooding and ponding hazard. This soil is also severely limited for lawn

and landscaping by wetness and runoff.

Parsippany - Urban land Complex, nearly level

This soil consists mostly of poorly drained Parsippany soils and areas of Urban land. The permeability of this soil is slow and its available water capacity is high. The erosion hazard is low and runoff is ponded. This soil is very strongly acid near the surface and slightly acid in the subsoil. Parsippany - Urban land Complex has a water table at or near the surface from fall through spring. Because of its high silt and clay content, this soil has poor workability, low stability and poor compaction characteristics, especially when wet. Landscaping in this soil is limited to plants that are tolerant of wetness.

Passaic silt loam, 0 to 3 percent slopes

This soil is level and poorly drained. The permeability of this soil is slow and its available water capacity is high. The erosion hazard is low, runoff is ponded, and there is a water table at or near the surface from fall through spring. This soil is severely limited for urban use by the high water table, slow permeability and potential for flooding. Landscaping in this soil is limited to plants that are tolerant of wetness and restricted rooting depth.

Raritan silt loam, 0 to 3 percent slopes

This soil is nearly level and somewhat poorly drained. Its permeability is moderately slow and its available water capacity is moderate. The erosion hazard is low, runoff is slow, and the soil is slightly to moderately acidic. A perched water table is at 6 to 36 inches depth from fall through early spring. Trees commonly found in this soil include sweetgum, red maple, and oak. This soil is severely limited for urban use by the high water table, moderately slow permeability and potential for flooding. Landscaping in this soil is limited to plants that are tolerant of

wetness.

Udifluvents, frequently flooded

This floodplain soil is moderately well to somewhat poorly drained and is, in most areas, nearly level. This soil's permeability is moderate to rapid. Commonly used as parkland, this soil has not been extensively developed because of the hazard of flooding and the probability of severe flood damage.

Udorthents, loamy

This mapping unit consists of areas that have been cut or filled during site preparation work for residential development, roadways or recreational areas. This unit is so variable that site-specific investigations are required to determine this unit's potential and limitations.

Udorthents, waste substratum

This mapping unit consists of areas that have been used for the disposal of refuse. It is a combination of highly variable fill material and refuse. This unit has poor potential for building purposes, as a result of the underlying refuse, which often generates gas. This unit is also subject to subsidence and organic materials decay. Any on-site development requires careful investigation.

Urban land

This unit is nearly level and consists of areas where more than 90 percent of the surface is covered by impervious surfaces. The remaining 10 percent of this unit is so variable that site-specific investigations are required to determine any limitations for building purposes.

VII. HYDROLOGY

VII. HYDROLOGY

Hydrology is the science of the properties, distribution, and circulation of water. Water is continually being exchanged between the oceans, the atmosphere and the continents. This circulation of the earth's water supply is known as the hydrologic cycle, or water cycle (see Figure 5). The hydrologic cycle is driven by the interaction of the atmosphere with solar energy and supplies nearly all of our water resources. Of the water on the earth, only a small fraction of one percent is in the entire atmosphere, but the freshwater phase of the hydrologic cycle is dependent upon this small percentage.

In general, the amount of precipitation ultimately determines the amount of water available for man's use. Some of the precipitation that falls on land evaporates where it falls, some is absorbed by plants that later transpire the water back to the atmosphere, some flows overland to streams, and some infiltrates into the ground to become groundwater. The groundwater is discharged to streams, which flow to the oceans where the water evaporates back into the atmosphere.

For the purposes of this chapter, only the two most commonly encountered types of water will be examined: groundwater and surface water.

GROUNDWATER

All of the groundwater in Cranford originates from local precipitation, which averages 42.34 inches annually. As precipitation infiltrates into the ground to become groundwater, it moves and becomes stored in rock or sediment, the amount depending upon the rock's porosity and permeability. Areas of rock strata or sediment that allow groundwater to move freely are

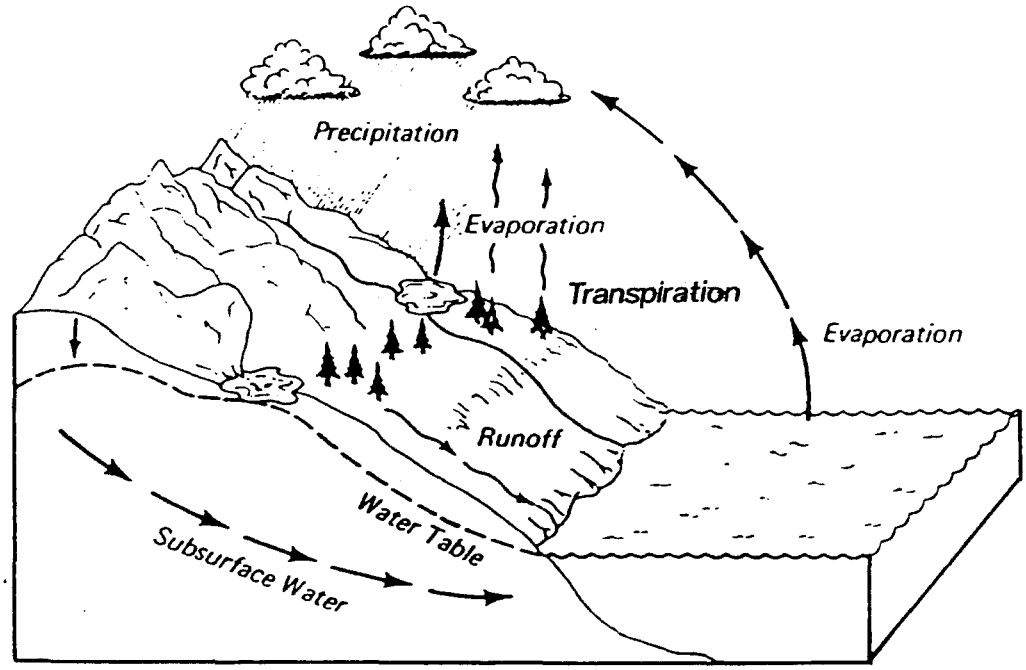

Figure 5

HYDROLOGIC CYCLE

called aquifers.

The Passaic Formation is the major aquifer underlying not only Cranford, but most of Union County as well. Water in this formation occurs in joints and fractures, which become progressively tighter and decrease in number with increasing depth. In the Passaic Formation groundwater occurs under both unconfined and confined conditions. Unconfined groundwater occurs mainly in upland areas where overlying unconsolidated sediments are thin or absent. In the lowlands of eastern Union County, the rocks are mantled by unconsolidated Pleistocene deposits that, in most places, contain silt and clay beds that confine the water in the underlying rocks. Whenever such confinement occurs, water beneath the impermeable layers is under artesian pressure. When the artesian head is above the land surface, a flowing well results.

There a total of 65 wells in Cranford (including monitoring wells). Located throughout the Township, these wells range in depth from 95 to 300 feet and draw water from several water-bearing zones in the Passaic Formation.

SURFACE WATER

Surface water in Cranford includes the Rahway River and its floodplain, as well as wetlands.

Cranford lies within the Passaic/Hackensack Drainage Basin, one of five major basins in the state. Within this basin, the Township lies within the Rahway River watershed, which is named after the main surface water system in the Township (see Figure 6). Measured from the headwaters to the City of Rahway, the Rahway River drains an area of 41 square miles, which includes parts of Middlesex, Union and Essex counties. The mainstem, 24 miles long, flows from Union to the Arthur Kill in Linden and is tidal from the Amtrak railroad bridge in

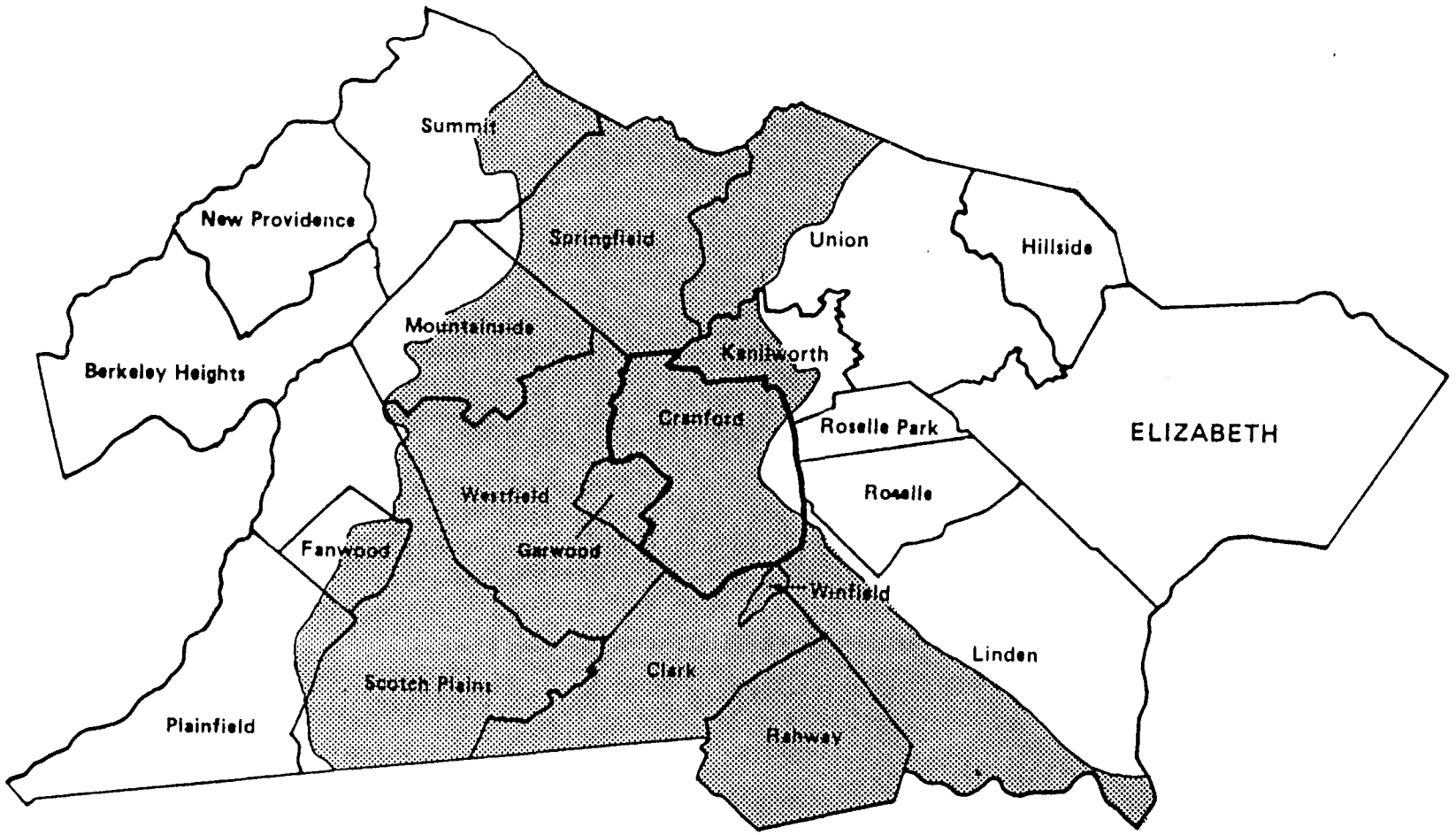

Figure 6

RAHWAY RIVER WATERSHED

Rahway down to the mouth. The major impoundments are the Middlesex Reservoir, Orange Reservoir, Lower and Upper Echo Lakes and Diamond Mill Pond.

All surface waters in New Jersey have been assigned designated uses that reflect national clean water goals. State-promulgated "Surface Water Quality Standards" set forth designated uses for these waters, use classifications, water quality criteria based upon such uses, and the State's policies concerning these uses. The freshwater criteria consist of the following indicators:

- bacterial quality
- chloride
- taste & odor producing substances
- floating solids and petroleum hydrocarbons
- temperature & heat dissipation areas
- total phosphorus
- radioactivity
- dissolved solids
- sulfate
- dissolved oxygen
- pH
- toxic substances
- turbidity
- suspended solids

In Cranford, the Rahway River has been classified as FW2-NT (fresh, non-trout). Designated uses in all FW2 waters include maintenance, migration and propagation of the natural biota; primary and secondary contact recreation; industrial and agricultural water supply; public potable water supply after such treatment as required by law; and any other reasonable uses.

To assess water quality conditions and trends, the State of New Jersey utilizes the water quality indexing procedure developed by the United States Environmental Protection Agency. The Water Quality Index (WQI) is based on a scale from 0 to 100, where 0 represents no

pollution or best conditions, and 100 equals gross pollution or worst case conditions[1]. Between these extremes the WQI scale is divided into excellent (0-10), good (11-25), fair (26-60), poor (61-80) and very poor (81-100) conditions (see Table 1).

Routine water quality monitoring is performed at three locations on the Rahway River: the West Branch at West Orange, near Springfield and in Rahway. According to the *1990 State Water Quality Inventory Report*, with a WQI of 38, the Rahway River has fair water quality along its length with generally improving conditions in the downstream direction. This figure remains unchanged from the value reported in the *1988 State Water Quality Inventory Report* (see Tables 2 and 3).

The Rahway River is not of swimmable quality. Due to a moderately degraded fish community it is considered to partially meet the fish propagation/maintenance use. The river's water quality is reflective of an urbanized stream. The presence of high nutrients, fecal coliform and biochemical oxygen demand is thought to be from nonpoint sources and municipal/industrial point sources. Of the 42 NJPDES permitted discharges on the river or its tributaries, 21 are upstream of Cranford and therefore impact the water quality of the river in the Township.

WETLANDS

Wet habitats occurring between uplands and deepwater areas are considered to be wetlands. They are commonly referred to by a number of terms based on their location and

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[1] The WQI transforms water data to a value between 0 (best) and 100 (worst) through the use of severity curves. The severity curve is a plot of the water quality constituent concentration (i.e. dissolved oxygen, phosphorus, etc.) versus pollution assessment (the 0 to 100 scale or index). The indices for each data value are then averaged and aggregated with the indices for the other indicators assessed to get a single WQI value for a location over time.

TABLE 1

WATER QUALITY INDEX (WQI) CLASSIFICATIONS

WQI	Classification/Condition	Description
0-10	Excellent	No or minimal pollution; water uses met throughout year.
11-25	Good	Generally low amounts of pollution; water uses periodically not met.
26-60	Fair	Pollution amounts vary from moderate to high levels; certain water uses prohibited.
61-80	Poor	Pollution in high amounts; water uses not met.
81-100	Very Poor	Pollution occurs at extremely high levels causing severe stress to streamlife, water uses not met.

Note: An index of 20 is equivalent to the level of water quality criteria.

TABLE 2

WATER QUALITY INDEX PROFILE 1988

Rahway River

WATER QUALITY INDICATORS

STATION		TEMP	OXYGEN	PH	BACTERIA	NUTRIENTS	SOLIDS	AMMONIA	METALS	OVERALL AVERAGE AND CONDITION
West Branch Rahway River at W. Orange	AVG WQI	2	15	2	47	27	20	2	9	41 Fair
	WORST 3 MONTHS	June-August	September-November	February-April	August-October	June-August	December-February	July-September	September-November	58 Fair August-October
Rahway River near Springfield	AVG WQI	2	32	3	48	18	14	2	9	43 Fair
	WORST 3 MONTHS	June-August	May-July	Feb-April	June-August	May-July	December-February	April-June	June-August	72 Poor May-July
Rahway River at Rahway	AVG WQI	3	15	5	40	18	11	3	15	29 Fair
	WORST 3 MONTHS	June-August	July-September	February-April	September-November	August-October	February-April	April-June	September-November	39 Fair June-August

LEGEND - Water Quality Index Description

WQI	Condition	Description			
0-10	Excellent	No or minimal pollution; water uses met throughout the year.	61-80	Poor	Pollution in high amounts; water uses not met.
11-25	Good	Generally low amounts of periodically not met.	81-100	Very Poor	Pollution occurs at extremely high levels; severe stress to stream life; water uses not met.
26-60	Fair	Pollution amounts vary from moderate to high levels; certain water uses prohibited.	ID	Insufficient Data	

An Index of 20 is equivalent to the level of water quality criteria.

TABLE 3

WATER QUALITY INDEX PROFILE 1990

Rahway River

WATER QUALITY INDICATORS

STATION		TEMP	OXYGEN	PH	BACTERIA	NUTRIENTS	SOLIDS	AMMONIA	METALS	OVERALL AVERAGE AND CONDITIONS
West Branch Rahway River at W. Orange	AVG WQI	2	15	2	47	27	20	2	9	41 Fair
	WORST 3 MONTHS	June-August	September-November	February-April	August-October	June-August	December-February	July-September	September-November	58 Fair August-October
Rahway River near Springfield	AVG WQI	2	32	3	48	18	14	2	9	43 Fair
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26-60	Fair	Pollution amounts vary from moderate to high levels; certain water uses prohibited.	ID	Insufficient Data	

An Index of 20 is equivalent to the level of water quality criteria.

characteristics, including salt marsh, tidal marsh, wet meadow, shrub swamp, bog, hardwood swamp, cedar swamp, and pitch pine lowland.

Because wetlands provide significant public benefits such as fish and wildlife habitat, flood protection, erosion control, water quality maintenance, and recreation, they are considered an important natural resource. Prior to about 1970, most people in New Jersey regarded wetlands as wastelands, whose best use could only be attained through alteration, i.e. draining for agriculture, dredging and filling for residential and industrial development, or for use as a sanitary landfill.

Activity in New Jersey's wetlands is regulated by the state's Freshwater Wetlands Protection Act and by Section 404 of the Federal Clean Water Act of 1977. The state law, which became effective on July 1, 1988, regulates the following activities in a freshwater wetland:

- removal, excavation, disturbance or dredging of soil, sand, gravel or aggregate material of any kind;
- drainage or disturbance of the water level or water table;
- dumping, discharging or filling with any materials;
- driving of pilings;
- placing of obstructions; or
- destruction of plant life which would alter the character of a freshwater wetland, including the cutting of trees.

Section 404 requires a permit from the U.S.Army Corps of Engineers for the discharge of dredged or fill material in wetlands.

The New Jersey regulations also established buffer zones, or *transition areas*, around wetlands to accommodate slight variations in freshwater wetland boundaries over time due to hydrologic or climatologic effects and to keep human activity at a distance from freshwater wetlands (see Figure 7). A transition area is determined according to the resource value of the wetland surrounding it: exceptional, intermediate or ordinary. Exceptional wetlands discharge into FW1 or FW2 Trout Production waters or their tributaries and have a 150-foot transition area. Intermediate wetlands are wetlands not defined as exceptional or ordinary and have a 50-foot transition area. Ordinary wetlands are isolated wetlands with three criteria: 1) they are not surface water tributary systems discharging into an inland lake, pond, river or stream, 2) they are surrounded by greater than 50 percent development, and 3) they are less than 5,000 square feet in area. These wetlands have no transition area.

Major factors creating wetlands vary throughout the state, but glaciation has played an important role in most areas. Most of northern New Jersey's wetlands were formed in glacial lakes and depressions during the post-glacial period. When the glacier receded, the glacial lakes drained and wetlands formed in the basins. In addition, human activity may also create wetlands by altering hydrologic regimes to flood former upland areas, where wetland plants quickly invade to take advantage of the wetter conditions. Wetlands also form in floodplains along rivers, which is generally the case in Cranford.

According to the United States Fish and Wildlife Service (FWS), wetlands can be divided into five general systems according to similar hydrologic and biological factors. The five systems are Marine, Estuarine, Riverine, Lacustrine and Palustrine. The Marine System consists of the open ocean and its associated coastline, while the Estuarine System encompasses salt and

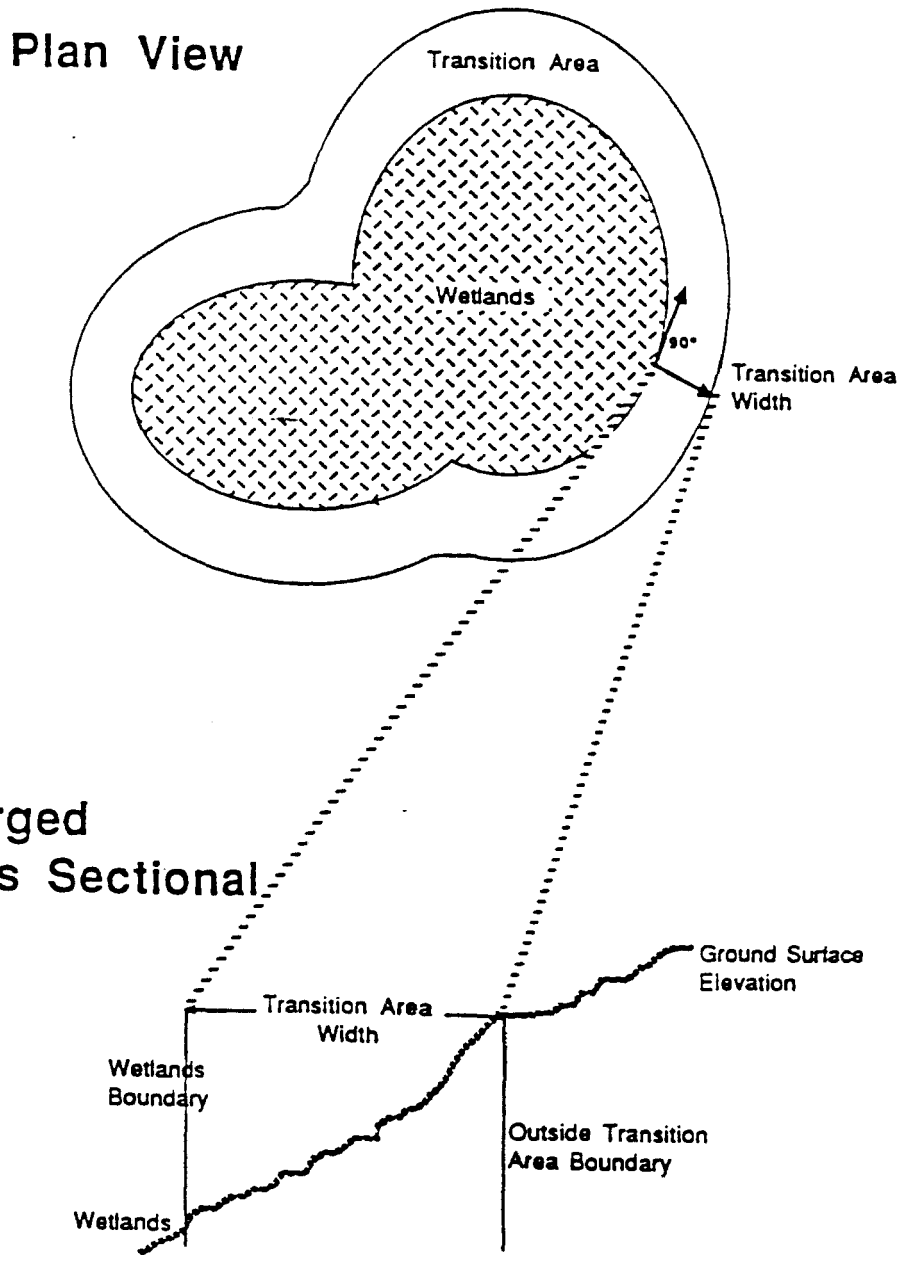

Figure 7

WETLAND BUFFER ZONES

brackish marshes and brackish waters of coastal rivers and bays. Freshwater wetlands fall into one of the remaining three systems: Riverine (e.g. rivers and streams), Lacustrine (e.g. lakes, reservoirs and large ponds) or Palustrine (e.g. marshes, bogs, swamps and small shallow ponds). Each system, with the exception of the Palustrine, is further divided into various subsystems.

With the exception of the wetlands located along the Rahway River and its associated smaller streams and creeks, which are in the Riverine System, the wetlands in Cranford are in the Palustrine System. Palustrine wetlands contain nontidal wetlands and are dominated by trees, shrubs, persistent emergents, emergent mosses or lichens.

Specifically, Cranford contains the following wetlands, located mostly in Nomahegan and Lenape parks and along the Rahway River (see Drawing 5):

- PEM1C Palustrine emergent, persistent, seasonal
- PSS1B Palustrine scrub/shrub, broad leaved deciduous, saturated
- PFO1A Palustrine forested, broad leaved deciduous, temporary
- PFO1B Palustrine forested, broad leaved deciduous, saturated
- PFO1C Palustrine forested, broad leaved deciduous, seasonal
- PFO1E Palustrine forested, broad leaved deciduous, seasonally saturated
- POWH Palustrine open water, permanent
- R2OW Riverine, lower perennial, open water
- $R2OW_x$ Riverine, lower perennial, open water, excavated
- MODL Lawns or Stormwater Management Areas not normally inundated

FLOODPLAINS

Flooding is a natural characteristic of rivers and streams. Flooding occurs when more

water flows down a stream than can be carried within its channel. The water then overflows the banks and spreads out within an area called the floodplain or flood hazard area. The limits of the floodplain are delineated by the rising slopes of the surrounding land. The floodplain is actually a normal part of the river during times of exceptional storm discharge. Most of the time however, the floodplain remains free of water.

In 1968, Congress authorized the establishment of the National Flood Insurance Program to protect property owners who were unable to get coverage through the private insurance industry. Revised in 1973 and currently under the administration of the Federal Emergency Management Agency (FEMA), the program requires state and local governments to adopt certain minimum land use measures to reduce or avoid future flood damage.

In New Jersey, the Department of Environmental Protection and Energy (DEPE) is authorized by the Flood Hazard Area Control Act and Flood Hazard Area Regulations to regulate activities that may affect the flow of water through the flood hazard area. Under the regulations, the flood hazard area is divided into two zones--the floodway and the flood fringe (see Figure 8). The floodway is the channel of a natural stream and portions of the floodplain adjoining the channel that are reasonably required to carry and discharge the flood water or flood flow of any natural stream. In New Jersey, the boundaries of the floodway are the same as those indicated in the FEMA studies. The flood fringe is the area outside the floodway.

During a flood, the floodway area would experience high velocities of moving water. The water alone could seriously damage any structure located in its path, but when combined with debris swept down from upstream, the effects are extremely hazardous. Any structures or fill placed in the floodway would increase the level of the floodwaters and cause damage in areas

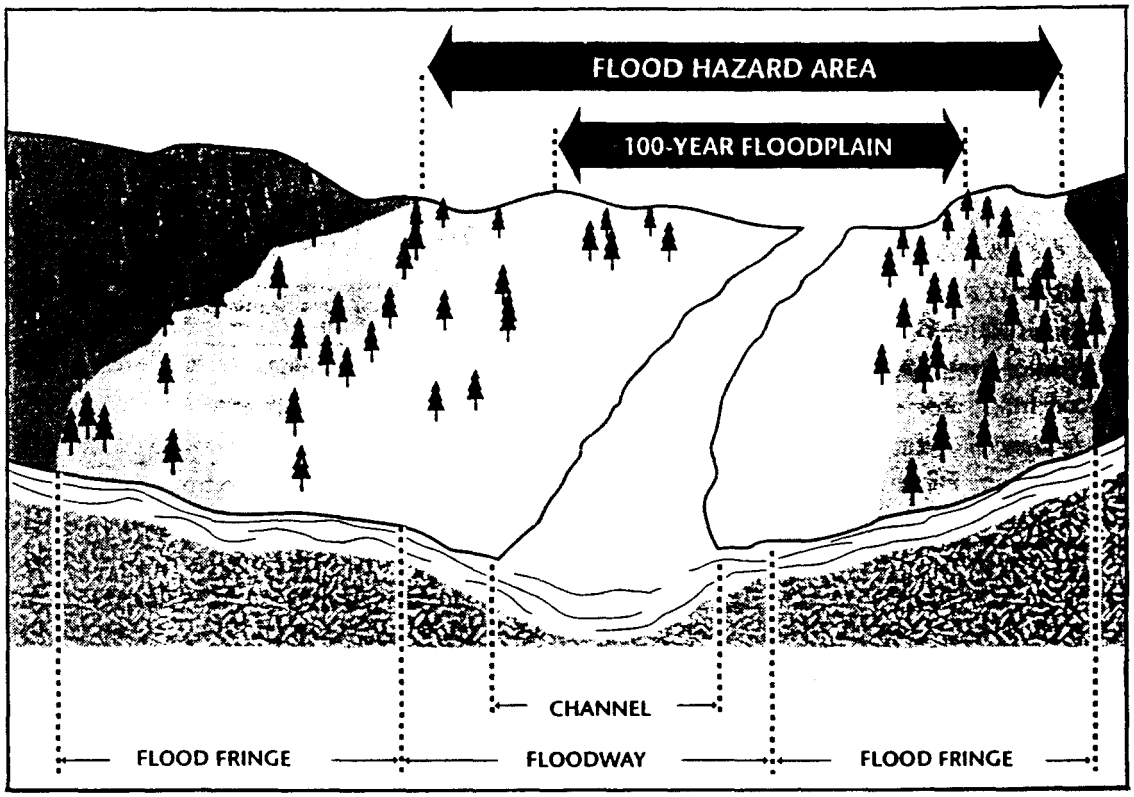

Figure 8
FLOOD HAZARD AREAS

previously outside the floodplain. Therefore, construction activity in the floodway is severely limited in order to preserve the floodwater-carrying capacity of the stream.

The flood fringe area would not be subject to the velocities experienced in the floodway, but would be subject to ponding water. Filling in this area would not result in significant rises in the water elevation upstream, but could, through the loss of flood water storage, cause a significant rise in the flood elevations downstream. Therefore, regulation of construction activity in the flood fringe is less restrictive than in the floodway but is restricted by the amount of fill that can be placed within its borders. Floodplain boundaries in Cranford are depicted in Drawing 4.

VIII. CLIMATIC CONDITIONS

VIII. CLIMATIC CONDITIONS

The climate of Cranford is typical of the Middle Atlantic seaboard. It may be classified as a modified continental type climate because the prevailing westerly winds are altered by air masses originating over the ocean and moving on shore. The moderating effect of the ocean is felt during both the winter and summer seasons. During this period, coastal storms accompanied by easterly winds can produce heavy precipitation, although moderate rainfall more commonly occurs.

A major regional weather characteristic is instability caused by high pressure air masses which move in from Canada and conflict with low pressure air masses moving from the south. This results in periodic cool spells during the summer and periods of relatively warm, spring-like weather in winter.

The storms experienced in Cranford are classified in four general groups: thunderstorms, cyclonic or transcontinental storms, extratropical storms, and hurricanes.

Thunderstorms normally occur with the most frequency in the months of July and August. They are usually of brief duration and are limited in area. These storms, when intense, can cause local flooding in areas of the Township where storm sewers are not of sufficient size to accommodate the resulting surge flows. The general path of these storms is in a northeasterly direction.

During autumn, winter and spring, cyclonic storms predominate. These storms are due to movements of transcontinental air masses with attendant high and low pressure areas. Intense storms of this type are potent flood producers over large areas because of their wide range.

These storms can cluster together and last for many days, depositing four, five or more inches of precipitation over their duration. The duration of these storms, coupled with the continuous rainfall, can cause the Rahway River to rise above the storm sewer stream encroachment near the end of the storm event. This slows storm sewer drainage and causes street flooding as a result. In extreme cases, the Rahway River rises so high that river water will enter the street, causing flooding that will linger until the river recedes below the storm sewer encroachment elevation.

Extratropical storms are due to the rapidly convective circulation that results when tropical marine air masses are lifted suddenly on contact with hills and mountains. They usually cause heavy rain in the summer and autumn seasons.

A hurricane is defined as a spiralling tropical low pressure system, formed by the release of latent heat from ocean water condensation, with sustained wind speeds of 74 m.p.h. or greater. Because of its size and duration, a fully developed hurricane is the most destructive of storms. Hurricanes only form in certain areas of the earth at specific times of the year. Those effecting the United States form in the western Atlantic Ocean, near the Cape Verde Islands, and in the western Carribean Sea. Hurricane season there runs from June 1 to November 30.

METEOROLOGICAL DATA

There are no official meteorological stations located in Cranford. The closest one is located at Newark International Airport, approximately 10 miles east northeast of the Township (located at 40° 42' North Latitude, 74° 10' West Longitude). This station measures and keeps records on various weather-related phenomena such as temperature, barometric pressure, relative humidity, wind and cloud cover. Summaries of each are presented below:

1. Temperature

The mean annual temperature at the Newark station is 54.0 degrees Fahrenheit. The coldest month is February, with an average temperature of 31.5 degrees Fahrenheit. July, with an average temperature of 76.7 degrees Fahrenheit, is the hottest month of the year (see Table 4). Temperature readings of above 90 degrees and below 0 degrees Fahrenheit are not unusual occurrences. The record high is 105 degrees Fahrenheit, first set in July of 1966 and equalled during July of 1993. The record low temperature of −8 degrees Fahrenheit was set in January of 1985. The average annual heating degree days is 4,972 and ranges from 5,577 to 4,086. The average annual cooling degree days is 1,091 and ranges from 1,490 to 982.

2. Barometric Pressure

Barometric pressure averages 1,016.1 millibars annually, with monthly averages ranging from 1,013.7 to 1,018.1 millibars (see Table 5).

3. Relative Humidity

Depending upon the time of day, the average annual relative humidity ranges between 53 and 73 percent (see Table 5).

4. Precipitation

An average of 42.34 inches of rain falls annually at the Newark station. Normally, this rainfall is distributed evenly throughout the year, with average monthly rainfall ranging from 2.9 to 4.3 inches each month. The maximum monthly rainfall was 11.84 inches, which was recorded in August of 1955. The minimum monthly rainfall was recorded in June of 1949 at

TABLE 4

Temperature - Degrees Fahrenheit

Month	Normal Daily Maximum	Normal Daily Minimum	Monthly Average	Record High	Record Low
January	38.2	24.2	31.3	74	-8
February	40.3	25.3	32.8	76	-7
March	49.1	33.3	41.2	89	6
April	61.3	42.9	52.1	94	16
May	71.6	53.0	62.3	98	33
June	80.6	62.4	71.5	102	43
July	85.6	67.9	76.8	105	52
August	84.0	67.0	75.5	103	45
September	76.9	59.4	68.2	105	35
October	66.0	48.3	57.2	92	28
November	54.0	39.0	46.5	85	15
December	42.3	28.6	35.5	72	-1
Annual	62.5	45.9	54.2	105	-8

Normal Degree Days

Month	Heating	Cooling
January	1045	0
February	902	0
March	738	0
April	387	0
May	140	56
June	0	199
July	0	366
August	0	326
September	36	132
October	254	12
November	555	0
December	915	0
Annual	4972	1091

TABLE 5

Monthly Normal Barometric Pressure

Month	Barometric Pressure (millibars)
January	1016.9
February	1016.9
March	1016.0
April	1013.7
May	1014.1
June	1014.0
July	1014.5
August	1015.9
September	1017.5
October	1018.1
November	1017.6
December	1018.1
Annual	1016.1

Monthly Normal Percent Relative Humidity

Month	0100 Hr.	0700 Hr.	1300 Hr.	1900 Hr.
January	70	74	58	64
February	69	72	54	60
March	66	69	50	57
April	66	66	48	54
May	72	70	51	58
June	72	71	51	58
July	73	72	52	59
August	76	75	53	62
September	77	78	55	64
October	76	79	53	64
November	73	77	56	64
December	72	74	59	64
Annual	72	73	53	61

0.07 inches. The maximum rainfall that occurred in a 24-hour period occurred in August of 1971 and amounted to 7.84 inches. Precipitation data is summarized in Table 6.

The abundant precipitation in the Cranford area has made groundwater recharge adequate and has helped the area's vegetative ground cover and tree population to temporarily retain water and minimize erosion.

Precipitation during the winter months often falls in the form of snow. The average annual snowfall in Cranford is about 27.1 inches. The monthly maximum of snow for the area is 29.1 inches, recorded in December of 1947. A portion of this amount (26.0 inches) was the result of a record 24-hour snowfall. Snow can be expected to fall from October to May. The average monthly snowfall at the Newark station is shown below:

SNOWFALL

Month	Snowfall (inches)
November	0.5
December	5.6
January	7.7
February	7.9
March	4.5
April	0.7
May	Trace
October	Trace

Rainfall of 0.01 inches or more occurs on an average of 121.7 days annually and ranges from 11.3 to 15.4 days per month. Snowfall of 1.0 inch or more occurs on an average of 7.1 days annually and ranges from 0.0 to 2.2 days per month.

TABLE 6

Monthly Average of Normal, Maximum, and Minimum Precipitation - Inches

Month	Normal Average	Maximum	Minimum	Daily Maximum
January	3.13	10.10	0.45	3.59
February	3.05	4.94	1.22	2.45
March	4.15	11.14	1.10	2.83
April	3.57	11.14	0.90	3.73
May	3.59	10.22	0.52	4.22
June	2.94	6.40	0.07	2.31
July	3.85	9.98	0.89	3.63
August	4.30	11.84	0.50	7.84
September	3.66	10.28	0.95	5.27
October	3.09	8.20	0.21	3.04
November	3.59	11.53	0.51	7.22
December	3.42	9.47	0.27	2.77
Annual	42.34	11.84	0.07	7.84

Montlhy Maximum and Daily Maximum of Snow, Ice Pellets, and Hail - Inches

Month	Maximum	Daily Maximum
January	27.4	17.8
February	26.1	20.0
March	26.0	17.6
April	13.8	12.8
May	Trace	Trace
June	0.0	0.0
July	0.0	0.0
August	0.0	0.0
September	0.0	0.0
October	0.3	0.3
November	5.7	5.7
December	29.1	26.0
Annual	29.1	26.0

5. Wind

The normal prevailing wind direction is from the west to east for eleven months of the year. January is the exception, when the prevailing winds are from the northeast. Average monthly wind velocity ranges from 8.7 miles per hour (mph) to 11.9 mph, with an annual average of 10.2 mph. The peak gust recorded at the Newark station was 83 mph. Average and peak wind data is presented in Table 7.

6. Cloud Cover

The mean annual amount of cloud cover is 62 percent. There is no data for the amount of cloud cover between sunset and sunrise. The following is a list of daytime cloud cover only:

AVERAGE PERCENT CLOUD COVER

Month	Average Cloud Cover
January	65
February	64
March	63
April	64
May	65
June	62
July	62
August	60
September	57
October	55
November	64
December	64
Annual	62

TABLE 7

Average and Peak Wind Data

Month	Normal Average Speed (mph)	Normal Prevailing Direction	Maximum Speed (mph)*	Direction (degrees)	Peak Gust (mph)	Direction
January	11.2	NE	52	300	53	W
February	11.5	NW	46	230	58	NW
March	11.9	NW	43	270	56	W
April	11.3	WNW	50	270	55	E
May	10.1	SW	50	320	58	NW
June	9.5	SW	58	260	83	W
July	8.8	SW	52	350	69	NW
August	8.7	SW	46	090	68	N
September	9.0	SW	51	050	67	W
October	9.4	SW	48	110	53	SW
November	10.2	SW	82	090	63	NW
December	10.8	SW	55	032	60	NW
Annual	10.2	SW	82	090	83	W

* - fastest observed in one minute.

Cranford has a wide variety of weather styles which contribute to the distinct seasonal differences experienced by the Township. These include rainfall, snowfall, thunderstorms, hailstorms and windstorms and are generally neither extreme nor severe. Table 8 presents a listing of the average duration of the distinct weather types by month.

TABLE 8

Mean Number of Varying Weather Days

Month	Rainfall (a)	Snowfall (b)	Thunderstorms	Heavy Fog (c)	Clear (d)	Partly Cloudy (d)	Cloudy (d)
January	10.9	2.2	0.2	2.1	7.8	7.8	15.4
February	9.7	1.9	0.2	1.7	7.3	7.5	13.4
March	11.2	1.2	1.0	1.4	8.0	8.6	14.4
April	11.0	0.2	1.5	1.0	7.3	8.9	13.8
May	11.9	0.0	3.7	1.7	6.3	10.7	13.9
June	10.3	0.0	4.9	1.2	6.8	10.9	12.3
July	10.1	0.0	6.0	0.5	6.6	12.2	12.2
August	9.4	0.0	4.6	0.5	7.8	11.5	11.7
September	8.3	0.0	2.2	0.8	9.6	9.0	11.3
October	7.8	0.0	1.1	2.0	10.8	8.6	11.7
November	10.1	0.2	0.5	1.8	7.6	8.3	14.1
December	10.9	1.4	0.2	1.8	8.0	8.0	15.0
Annual	121.7	7.1	26.2	16.5	94.0	111.9	159.3

Notes:

a = 0.01 inches or more.
b = 1.0 inches or more of snow, ice pellets, and hail.
c = 0.25 mile or less visibility.
d = sunrise to sunset.

IX. VEGETATION

IX. VEGETATION

Vegetation is defined as the total plant cover of a region. It is comprised of different species of plants that grow together.

Vegetation interacts with the other four components of the ecosystem (climate, geology and soil, animals, man) and is affected by each in a different way. *Climatic factors* such as precipitation, temperature, wind and light each impact vegetation for obvious reasons.

Geologic processes over millions of years have defined the physical relief of the land which in turn impacts vegetation because of its influence on drainage and exposure. Geologic processes also produce the earth's soil, the medium through which vegetation receives nourishment. Soil types differ greatly in their ability to hold water, in their supply of mineral elements and in their acidity. Each vegetative species has a specific range of both need and tolerance for these soil characteristics.

The interaction between *animals* and vegetation can be both beneficial and harmful and is usually quite obvious to even the casual observer. Beneficial effects result from the numerous organisms that live in the soil and improve soil quality (i.e. earthworms), from birds and insects that are necessary for plant reproduction (through fertilization), and from the various animals such as squirrels that play a vital role in seed transport. Harmful effects include defoliation from animals such as deer and cattle (not very common in the Township), and the damage that results from insects such as the gypsy moth or the parasite carried by the elm bark beetle.

Human activity has had the most profound impact upon vegetation. Man is both directly and indirectly dependent upon vegetation for food, air quality, water quality, climatic conditions,

and many types of clothing and cannot exist without it. In addition, man's development tendencies result in construction activity which usually clears the landscape of most vegetation and introduces many non-native species through landscaping. Finally, man's indiscriminate use of pesticides and other chemicals has caused irreparable to vegetation in some areas.

Based on combinations of environmental factors such as soil moisture, temperature, water salinity and water acidity, the natural land area of New Jersey can be divided into twelve major types of plant habitats (Robichaud and Buell, 1983). In terms of terrestrial plant habitat, Cranford is located in Type 5 and Type 7 of the Robichaud and Buell system, a commonly used classification system by biologists.

Type 5, North Jersey swamps and floodplains, occurs in the broad valleys of the larger rivers. In Cranford, Type 5 habitat is found along the floodplain and associated wetlands of the Rahway River. Red maple, elm, pin oak, swamp white oak, silver maple, black gum, and ash are the most common trees in Type 5 areas. Typical shrubs include the spicebush, witch hazel, arrowwood and viburnums. Common herbs include skunk cabbage, touch-me-not, may apple, jack-in-the-pulpit, spring beauties, trout lilies and the cardinal flower. Vines include poison ivy, Virginia creeper, Japanese honeysuckle, bittersweet and wild grape (see Table 9).

Type 7, North Jersey uplands, includes slopes, valleys and the ridge and valley sections as well as the flats of the Piedmont provence. There are four different types of plant communities in North Jersey upland areas: successional vegetation, the Mixed Oak forest, the Hemlock-Mixed Hardwoods forest, and the Sugar Maple-Mixed Hardwoods forest. In Cranford, Type 5 habitat is only represented by *successional vegetation* and the *Mixed Oak forest.*

TABLE 9

Vegetation Common to North Jersey Swamp and Floodplain Habitats

Community Structure	*Central N.J.*	*More Northern N.J.*
Typical Trees	Pin oak	Yellow birch
	Red maple	Red maple
	Ash	Ash
	Elm	Basswood
	Swamp white oak	Tulip tree
	Black gum	Black gum
	Silver maple	
	Also on Floodplains	
	Willow	Box elder
	Sycamore	River birch
Typical Shrubs	Spicebush	Alder
	Witch hazel	Willow
	Arrowwood	Buttonbush
	Viburnums	Spicebush
	Others	Witch hazel
		Others
Typical Herbs	Skunk cabbage	Skunk cabbage
	Spring herbs	Spring herbs
	Sedges & mosses	Sedges & mosses

Source: Robichaud and Buell, 1983

Successional Vegetation

Plant succession is a directional, cumulative change in the species that occupy a given area, through time (between 1 and 500 years). If significant changes in species composition for a given area do not occur within this time span, the community is said to be a mature or *climax community*. If a community does exhibit some directional, cumulative, nonrandom change during this time span, it is said to be a *successional* or *seral community*. Seral communities or species will replace one another until a climax community is achieved. The entire progression of seral stages, from the first one to occupy bare ground (the pioneer community) to the climax community, is called a succession or sere.

The most common reason for vegetational succession is man's intervention. Land that was formerly cultivated or otherwise developed is abandoned and left untouched and over time a series of different plant communities occupy the site, culminating in a mature forest. Table 10 illustrates the stages of succession and each stage's typical vegetation. Several vacant lots along both North and South avenues are local examples of the initial stages of vegetational succession.

The Mixed Oak Forest

The Mixed Oak forest gets its name from three species that in varying mixtures are most abundant among the large trees that form the forest canopy at heights from about 60 to 100 feet. The three are the red oak, white oak and black oak (see Table 10). Other typical trees include chestnut and scarlet oaks, several types of hickories, maples and yellow poplar. A striking feature of these forests is a lack of a well-developed younger generation of oak trees to replace the older trees in the future. Instead, red maple, ash and sugar maple are the more abundant

TABLE 10

Vegetation Common to Upland Habitats of North Jersey

Community Structure	*One of Three Forest Types Grown on Undisturbed Uplands*			*Successional Vegetation*
	Mixed Oak	*Sugar Maple-Mixed Hardwoods*	*Hemlock-Mixed Hardwoods*	*Stages of Succession*
Tree Dominants	Red oak White oak Black oak	Sugar maple and many of	Hemlock (Dominant) and many of	*Annual Herbs* Ragweed Foxtail grass Wild radish
Other Typical Trees	Chestnut oak Scarlet oak Hickories Red maple Sugar maple Ash Beech Tulip tree	Sweet birch Yellow birch Basswood Beech Ash Red Maple Red and White oaks Tulip tree Others	Sweet birch Yellow birch Basswood Beech Ash Red oak Sugar maple Red maple	Yellow rocket *Perennial herbs* Aster Goldenrod Little bluestem grass *Initial woody invaders* Red cedar or
Tree Understory	Dogwood (Dominant) Sassafras Hop hornbeam Iron wood	Hop hornbeam Dogwood Ironwood Sassafras	Few	Gray birch Large-toothed aspen and some Wild cherry Sassafras
Shrubs	Viburnums Spicebush Others	Viburnums Spicebush Others	Few	Red maple Shrubs
Herbs	Many spring & fall herbs	Many spring & fall herbs	Few Partridge berry Mosses	*Young Woodland* Mixed oak or tulip tree stand

Source: Robichaud and Buell, 1983

younger trees. The dominant understory (second layer) tree is the dogwood, while other typical species include sassafras and ironwood. Typical shrubs include the spicebush and viburnums such as the arrowwood and black haw, while the most common vines include poison ivy, Virginia creeper and wild grape. Common herbs usually found in this type of habitat in the spring include the may apple, spring beauties, jewelweed, jack-in-the-pulpit and solomon's seal. In the fall goldenrod, baneberry, New York fern, Christmas fern and partridge berry are common. The Mixed Oak forest is best represented in Cranford by the woods in Nomahegan and Lenape parks and along the Rahway River Parkway.

TREES

Trees have provided man with everything from basic food and shelter to aesthetic beauty since he first appeared on Earth. Today trees also reduce air and noise pollution and give texture to our often stark environment of concrete and steel. Most people, however, neither recognize the different species of trees nor appreciate the many uses man has found for them....

Another reason why you might want to study trees is that even a small woodlot is not just a simple aggregation of trees. There are infinitely complex relationships between trees, other living things, and their environment. Only as we begin to recognize the delicate balance of nature will the intensity with which we disrupt nature be abated (Ombrello).

As is the case with most older suburban towns, Cranford has an abundance of trees, not only along most of its streets, but in places such as Nomahegan Park and along the Rahway River as well. A common way to identify trees is by the leaf.

Principal trees in several of the larger parks in the Township (Nomahegan, Unami and McConnell) are as follows:

<u>Nomahegan Park</u>

American sycamore, American beech, yellow poplar, sweetgum, oak, kwanzam, black cherry, black birch and pin oak.

Unami Park

Sweetgum, oak and maple.

McConnell Park

Yellow poplar, white pine, oak, kwanzam and black cherry.

Some of the oldest trees in the Township include the "Pepperidge Tree", a 225 year old blackgum located on Lincoln Avenue at Lincoln Park; a 200 year old bur oak located at Cleveland Plaza; a 200 year old oak located on West End Place at Berkeley Place; a 175 year old shagbark hickory located at 15 Norman Place; a 150 year old northern catawba located at 1 Bloomingdale Avenue; a 200 year old pin oak located at 726 Gallows Hill Road adjacent to the tennis courts; and a 150 year old tulip tree in McConnell Park.

A fairly unusual tree found in the Township is the Ginkgo (*Ginkgo biloba*). The ginkgo, or maidenhair tree, is an introduced ornamental from China and is the last remaining species in its order (Ginkgoales). Although it seems like an ordinary tree, its leaves are fern leaves. Unlike other trees today, the ginkgo is a survivor from the age of dinosaurs. This ancient tree's pollen swims through rain or dew instead of being blown by wind or carried by insects. There are many ginkgo trees in Cranford, including one at 10 Manor Avenue and another on North Union Avenue opposite Riverside Drive.

X. WILDLIFE

X. WILDLIFE

Loss of habitat has been the single greatest cause of decline and extirpation of animal species in New Jersey. Consequently, the inventory and protection of wildlife habitats is of extreme importance if we are to protect our remaining heritage (Kane, 1981).

Cranford is fortunate to have protected park land and natural waterways to serve as habitats and breeding grounds for many types of animal life. The Township's wild animal population has remained stable over recent years, although there has been an increase in the number of deer in the Lenape Park area. This increase is attributable to a migration from the nearby Watchung Mountains and to habitat loss in other areas. The Township's usually large population of raccoons and skunks has decreased somewhat over the years, due in part to increased development and noise associated with suburban areas. These species, however, seem to be making a comeback as they become more accustomed to interaction with man and machine. Except for an occasional transient bald eagle or peregrine falcon, no state or federally listed or proposed threatened fauna has been identified in Cranford. Table 11 identifies species (other than birds) which have been observed or are expected to occur in the Township.

Because New Jersey (i) contains a naturally established diversity of habitat; (ii) lies along the Atlantic coastal flight pattern and (iii) defines the southern limit of many northern species and the northern limit of many southern species; the state enjoys a rich collection of bird life. The New Jersey Audubon Society lists 421 distinct species of birds in its official *New Jersey State Bird List of 1992*. This list includes several bird species which are "accidental" visitors from outside the United States. In Cranford, 190 of these birds (45 percent) have been identified

TABLE 11

Species Known or Expected to Occur in Cranford

Common Name	Scientific Name
	MAMMALS
Bat, Big Brown	*Eptesicus fuscus*
Bat, Hoary	*Lasiurus cinereus*
Bat, Red	*Lasiurus borealis*
Bat, Silver-haired	*Lasionycteris noctivagans*
Beaver	*Castor canadensis*
Chipmunk, Eastern (Striped Rat)	*Tamias striatus*
Cottontail, Eastern	*Sylvilagus floridanus*
Deer, Whitetail	*Odocoileus virginianus*
Fox, Red	*Vulpes lotor*
Groundhog (Grass Beaver)	*Marmota monax*
Hare, European	*Lepus europaeus*
Mink	*Mustela vison*
Mole, Eastern	*Scalopus aquaticus*
Mole, Starnose	*Condylura cristata*
Mouse, Deer	*Peromyscus maniculatus*
Mouse, House	*Mus musculus*

Mouse, White-Footed	*Peromyscus leucopus*
Muskrat	*Ondatra zibethica*
Myotis, Little Brown	*Myotis lucifugus*
Myotis, Small-footed	*Myotis subulatus*
Opossum	*Didelphis marsupialis*
Pipistrel, Eastern	*Pipistrellus subflavus*
Raccoon	*Procyon lotor*
Rat, Norway	*Rattus norvegicus*
Skunk, Striped	*Mephitis mephitis*
Squirrel, Eastern Gray	*Sciurus carolinensis*
Vole, Meadow	*Microtus pennsylvanicus*
Weasel, Longtail	*Mustela frenata*

REPTILES AND AMPHIBIANS

Copperhead	*Agkistrodon contortrix*
Frog, Bull	*Rana catesbelana*
Frog, Eastern Gray Tree	*Hyla versicolor*
Frog, Green	*Rana clamitans*
Newt, Eastern	*Notophthalmus viridenscens*
Salamander, Marbled	*Ambystoma opacum*
Salamander, Spotted	*Ambystoma maculatum*
Snake, Eastern Garter	*Thamophis sirtalis*

Snake, Milk	*Lampropeltis triangulum*
Snake, Rat	*Elaphe obsoleta*
Toad, American	*Bufo americanus*
Turtle, Eastern Box	*Terrapene carolina*
Turtle, Snapping	*Chelydra serpentina*

and may be seen, depending on the time of year (see Table 12). In viewing Table 12, the following reference symbols should be utilized:

- R - Refers to resident birds, such as the Blue Jay, Cardinal and Mockingbird, which are in Cranford year round. There are 37 different species of resident birds in Cranford.

- S - Refers to birds such as the Robin, Song Sparrow and Oriole, which are found in Cranford only in the summer. There are 55 different species of these birds found in Cranford.

- W - Refers to birds like the Slate Colored Junco, Purple Finch and Pine Siskin, which are found in the Township only in the winter. There are 20 different winter resident species found in town.

- T - Refers to birds such as the Bobolink, Meadow Lark and Bluebird which are transient in Cranford, that is, simply passing through town on their annual spring or fall migratory journeys. There are 78 different species in this group.

Table 12 also estimates the relative abundance of each bird species in the Township, as indicated by the following symbols:

- 1 - Very good chance for the bird to be encountered in the right habitat at the right time of year (Mallard Duck, Egret, Mocking Bird-55 species).

- 2 - Encountered as in 1 above, but not necessarily on any given day (Wood Duck, Pileated Woodpecker, Killdeer-73 species).

- 3 - Not seen every year, but often enough to check for its presence; may not be encountered for many years in a row (Bald Eagle, Snow Goose, Red Headed Woodpecker-52 species).

Table 12 was compiled by Henry Burk, a local amateur ornithologist.

The abundance of birdlife in Cranford, especially during the transient periods (Spring and Fall) is confirmed by the bird count presented in Table 13. The count was taken in Nomahegan and Lenape parks on May 14, 1990 by Richard Kane, the Director of the New Jersey Audubon Society. Since the count was made during a time favorable for transients, Table 13 includes both a large variety of species and a large number of individual birds. There are, for example,

TABLE 12
Audubon Bird Chart

NEW JERSEY BIRDS

OBSERVER:

YEAR | MO. | DAY

NEW JERSEY BIRDS					
Red-throated Loon					
Com. Loon	T	2			
Pied-billed Grebe	T	2			
Horned Grebe					
Red-necked Grebe					
N. Fulmar					
Cory's Shearwater					
Gr. Shearwater					
Sooty Shearwater					
Manx Shearwater					
Audubon's Shearwater					
Wilson's Storm-Petrel					
Leach's Storm-Petrel					
N. Gannet					
Am. White Pelican					
Brown Pelican					
Great Cormorant					
Double-crested Cormorant	T	3			
Am. Bittern					
Least Bittern					
Great Blue Heron	R	1			
Great Egret	S	1			
Snowy Egret	S	3			
Little Blue Heron	S	3			
Tricolored Heron					
Cattle Egret					
Green-backed Heron	S	1			
Black-crowned Night-Heron	S	2			
Yellow-crowned Night-Heron					
White Ibis					
Glossy Ibis					
Fulvous Whistling-Duck					
Tundra Swan					
Mute Swan	R	2			
Gr. White-fronted Goose					
Snow Goose	W	3			
Brant					
Canada Goose	R	1			
Wood Duck	R	2			
Green-winged Teal	T	2			
Am. Black Duck	T	2			
Mallard	R	1			
N. Pintail					
Blue-winged Teal	T	2			
N. Shoveler	T	3			
Gadwall	T	2			
Eurasian Wigeon					
Am. Wigeon	W	3			
Canvasback					

Redhead	W	3			
Ring-necked Duck	W	3			
Gr. Scaup	T	3			
L. Scaup	T	3			
Com. Eider					
King Eider					
Harlequin Duck					
Oldsquaw					
Black Scoter					
Surf Scoter					
White-winged Scoter					
Com. Goldeneye					
Barrow's Goldeneye					
Bufflehead					
Hooded Merganser	T	3			
Com. Merganser					
Red-breasted Merganser					
Ruddy Duck					
Black Vulture					
Turkey Vulture	R	2			
Osprey	T	2			
Am. Swallow-tailed Kite					
Mississippi Kite					
Bald Eagle	T	3			
N. Harrier	T	2			
Sharp-shinned Hawk	T	1			
Cooper's Hawk	T	2			
N. Goshawk	T	3			
Red-shouldered Hawk	T	2			
Broad-winged Hawk	T	1			
Swainson's Hawk					
Red-tailed Hawk	R	1			
Rough-legged Hawk	W	3			
Golden Eagle	T	3			
Am. Kestrel	R	2			
Merlin	T	3			
Peregrine Falcon	T	3			
Gyrfalcon					
Ring-necked Pheasant	R	2			
Ruffed Grouse					
Wild Turkey					
N. Bobwhite					
Yellow Rail					
Black Rail					
Clapper Rail					
King Rail					
Virginia Rail					
Sora					
Purple Gallinule					
Com. Moorhen					
Am. Coot					
Sandhill Crane					
Black-bellied Plover					
L. Golden-Plover					
Wilson's Plover					
Semipalmated Plover	T	2			
Piping Plover					
Killdeer	R	2			
Am. Oystercatcher					
Black-necked Stilt					

TABLE 12 Cont.

Audubon Bird Chart

Am. Avocet						Dovekie						
Gr. Yellowlegs	T	2				Com. Murre						
L. Yellowlegs	T	2				Thick-billed Murre						
Solitary Sandpiper	T	1				Razorbill						
Willet						Black Guillemot						
Spotted Sandpiper	S	1				Atlantic Puffin						
Upland Sandpiper						Rock Dove	R	1				
Whimbrel						Mourning Dove	R	1				
Hudsonian Godwit						Black-billed Cuckoo	S	2				
Bar-tailed Godwit						Yellow-billed Cuckoo	S	2				
Marbled Godwit						Com. Barn-Owl						
Ruddy Turnstone						E. Screech-Owl	R	2				
Red Knot						Great Horned Owl	R	2				
Sanderling						Snowy Owl						
Semipalmated Sandpiper						Barred Owl						
Western Sandpiper						Long-eared Owl						
Least Sandpiper	T	2				Short-eared Owl						
White-rumped Sandpiper						N. Saw-whet Owl	W	3				
Baird's Sandpiper						Com. Nighthawk	T	2				
Pectoral Sandpiper	T	3				Chuck-will's-widow						
Purple Sandpiper						Whip-poor-will	T	3				
Dunlin						Chimney Swift	S	1				
Curlew Sandpiper						Ruby-throated Hummingbird	S	2				
Stilt Sandpiper						Belted Kingfisher	R	1				
Buff-breasted Sandpiper						Red-headed Woodpecker	W	3				
Ruff						Red-bellied Woodpecker	R	1				
Short-billed Dowitcher						Yellow-bellied Sapsucker	T	2				
Long-billed Dowitcher						Downy Woodpecker	R	1				
Com. Snipe	T	2				Hairy Woodpecker	R	2				
Am. Woodcock	T	2				Black-backed Woodpecker						
Wilson's Phalarope						N. Flicker	S	1				
Red-necked Phalarope						Pileated Woodpecker	R	2				
Red Phalarope						Olive-sided Flycatcher	T	3				
Pomarine Jaeger						E. Wood-Pewee	S	1				
Parasitic Jaeger						Yellow-bellied Flycatcher	T	3				
Long-tailed Jaeger						Acadian Flycatcher	T	3				
Great Skua						Alder Flycatcher	S	3				
South Polar Skua						Willow Flycatcher	S	2				
Laughing Gull						Least Flycatcher	S	2				
Little Gull						E. Phoebe	S	1				
Com. Black-headed Gull						Great Crested Flycatcher	S	1				
Bonaparte's Gull						W. Kingbird						
Ring-billed Gull	W	1				E. Kingbird	S	1				
Herring Gull	R	1				Horned Lark						
Iceland Gull						Purple Martin	S	2				
L. Black-backed Gull						Tree Swallow	S	1				
Glaucous Gull						N. Rough-winged Swallow	S	2				
Great Black-backed Gull	R	1				Bank Swallow	T	2				
Black-legged Kittiwake						Cliff Swallow	T	3				
Gull-billed Tern						Barn Swallow	S	1				
Caspian Tern						Blue Jay	R	1				
Royal Tern						Am. Crow	R	1				
Sandwich Tern						Fish Crow	R	2				
Roseate Tern						Com. Raven						
Com. Tern						Black-capped Chickadee	R	1				
Arctic Tern						Carolina Chickadee						
Forster's Tern						Boreal Chickadee						
Least Tern						Tufted Titmouse	R	1				
Black Tern						Red-breasted Nuthatch	T	2				
Black Skimmer						White-breasted Nuthatch	R	1				

TABLE 12 Cont.
Audubon Bird Chart

Brown Creeper	T	2				N. Waterthrush	S	1			
Carolina Wren	R	1				Louisiana Waterthrush	S	2			
House Wren	S	1				Kentucky Warbler	T	3			
Winter Wren	W	2				Connecticut Warbler	T	3			
Sedge Wren						Mourning Warbler	T	3			
Marsh Wren	S	2				Com. Yellowthroat	S	1			
Golden-crowned Kinglet	W	1				Hooded Warbler	T	2			
Ruby-crowned Kinglet	T	1				Wilson's Warbler	T	2			
Blue-gray Gnatcatcher	S	2				Canada Warbler	S	1			
N. Wheatear						Yellow-breasted Chat	T	3			
E. Bluebird	T	2				Summer Tanager					
Veery	S	1				Scarlet Tanager	S	1			
Gray-cheeked Thrush	T	3				W. Tanager					
Swainson's Thrush	T	2				N. Cardinal	R	1			
Hermit Thrush	W	2				Rose-breasted Grosbeak	S	1			
Wood Thrush	S	1				Black-headed Grosbeak					
Am. Robin	S	1				Blue Grosbeak					
Varied Thrush						Indigo Bunting	S	2			
Gray Catbird	S	1				Dickcissel	T	3			
N. Mockingbird	R	1				Rufous-sided Towhee	S	2			
Brown Thrasher	S	2				Am. Tree Sparrow	W	2			
Water Pipit	T	3				Chipping Sparrow	S	1			
Cedar Waxwing	R	2				Clay-colored Sparrow					
N. Shrike						Field Sparrow	R	2			
Loggerhead Shrike						Vesper Sparrow					
European Starling	R	1				Lark Sparrow					
White-eyed Vireo	S	2				Savannah Sparrow	T	2			
Solitary Vireo	T	1				Grasshopper Sparrow					
Yellow-throated Vireo	S	2				Henslow's Sparrow					
Warbling Vireo	S	1				Sharp-tailed Sparrow					
Philadelphia Vireo	T	3				Seaside Sparrow					
Red-eyed Vireo	S	1				Fox Sparrow	T	2			
Blue-winged Warbler	S	1				Song Sparrow	R	1			
"Brewster's Warbler"						Lincoln's Sparrow	T	2			
"Lawrence's Warbler"						Swamp Sparrow	R	1			
Golden-winged Warbler	T	3				White-throated Sparrow	W	1			
Tennessee Warbler	T	2				White-crowned Sparrow	T	2			
Orange-crowned Warbler	W	3				Dark-eyed Junco	W	1			
Nashville Warbler	T	2				Lapland Longspur					
N. Parula	T	1				Snow Bunting					
Yellow Warbler	S	1				Bobolink	T	2			
Chestnut-sided Warbler	S	2				Red-winged Blackbird	S	1			
Magnolia Warbler	T	2				E. Meadowlark	T	3			
Cape May Warbler	T	2				Yellow-headed Blackbird					
Black-throated Blue Warbler	T	1				Rusty Blackbird	W	2			
Yellow-rumped Warbler	T	1				Boat-tailed Grackle					
Black-throated Green Warbler	T	1				Com. Grackle	S	1			
Blackburnian Warbler	T	2				Brown-headed Cowbird	S	1			
Yellow-throated Warbler						Orchard Oriole	S	2			
Pine Warbler	T	2				N. Oriole	S	1			
Prairie Warbler	T	2				Pine Grosbeak					
Palm Warbler	T	1				Purple Finch	W	2			
Bay-breasted Warbler	T	2				House Finch	R	1			
Blackpoll Warbler	T	1				Red Crossbill					
Cerulean Warbler	T	3				White-winged Crossbill					
Black-and-white Warbler	S	1				Com. Redpoll	W	3			
Am. Redstart	S	1				Pine Siskin	W	3			
Prothonotary Warbler	S	3				Am. Goldfinch	R	1			
Worm-eating Warbler	T	2				Evening Grosbeak	W	3			
Ovenbird	S	1				House Sparrow	R	1			

TABLE 13
May 14, 1990 Bird Count

No. of Birds	Common Name	Scientific Name
1	Great Egret	*Casmerodius albus*
2	Canada Goose (w/ 5 young)	*Branta canadensis*
1	Mallard Duck	*Anas platyrhynchos*
1	Osprey (overhead)	*Pandion haliaetus*
1	Solitary Sandpiper	*Tringa solitaria*
2	Spotted Sandpiper	*Actitis macularia*
2	Mourning Dove	*Zenaida macroura*
2	Yellow-billed Cuckoo	*Coccyzus americanus*
1	Chimney Swift	*Chaetura pelagica*
1	Downey Woodpecker	*Picoides pubescens*
1	Hairy Woodpecker	*Picoides villosus*
1	Northern Flicker	*Colaptes auratus*
1	Willow Flycatcher	*Empidonax traillii*
2	Least Flycatcher	*Empidonax minimus*
4	Eastern Kingbird	*Tyrannus tyrannus*
1	Tree Swallow	*Iridoprocne bicolor*
5	Barn Swallow	*Hirundo rustica*
5	Blue Jay	*Cyanocitta cristata*
2	American Crow	*Corvus brachyrhynchos*
1	Tufted Titmouse	*Parus bicolor*
1	Carolina Wren	*Thryothorus ludovicianus*
1	Veery	*Catharus fuscescens*
1	Swainson's Thrush	*Catharus ustulatus*
1	Wood Thrush	*Hylocichla mustelina*
5	American Robin	*Turdus migratorius*
10	Gray Catbird	*Dumetella carolinensis*
1	Northern Mockingbird	*Mimus polyglottos*
1	Brown Thrasher	*Toxostoma rufum*
8	Cedar Waxwing	*Bombycilla cedrorum*
1	Yellow-throated Vireo	*Vireo flavifrons*
4	Warbling Vireo	*Vireo gilvus*
2	Red-eyed Vireo	*Vireo olivaceus*
1	Blue-winged Warbler	*Vermivora pinus*
1	Tennessee Warbler	*Vermivora peregrina*
3	Northern Parula Warbler	*Parula americana*
8	Yellow Warbler	*Dendroica petechia*
3	Black-throated Blue Warbler	*Dendroica caerulescens*

TABLE 13
May 14, 1990 Bird Count

No. of Birds	Common Name	Scientific Name
1	Black-throated Green Warble	*Dendroica virens*
2	Canada Warbler	*Wilsonia canadensis*
1	Wilson's Warbler	*Wilsonia pusilla*
1	Bay-breasted Warbler	*Dendroica castanea*
2	Blackpoll Warbler	*Dendroica striata*
6	American Redstart	*Setophaga ruticilla*
1	Ovenbird	*Seiurus aurocapillus*
4	Northern Waterthrush	*Seiurus noveboracensis*
6	Common Yellowthroat	*Geothlypis trichas*
2	Scarlet Tanager	*Piranga olivacea*
1	Northern Cardinal	*Cardinalis cardinalis*
1	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
1	Savannah Sparrow	*Passerculus sandwichensis*
2	Song Sparrow	*Melospiza melodia*
25	Bobolink	*Dolichonyx oryzivorus*
7	Red-winged Blackbird	*Agelaius phoeniceus*
15	Common Grackle	*Quiscalus quiscula*
1	Orchard Oriole	*Icterus spurius*
8	Northern Oriole	*Icterus galbula*
10	House Finch	*Carpodacus mexicanus*
8	American Goldfinch	*Carduelis tristis*
2	House Sparrow	*Passer domesticus*

12 species of warblers with a total of 35 individual birds.

In writing about Nomahegan and Lenape parks, Mr. Kane and other representatives of the New Jersey Audubon Society stated: "These parks are adjacent and contiguous. Thus, they form a very large and somewhat unfragmented forested area. These are two of the larger tracts in the entire tributary/estuary system and, as such, should be carefully managed. These parks should remain as forested as possible. A checklist of birds would be a great project to encourage birders and other users to work in the area and report their findings".

XI. GLOSSARY

GLOSSARY

Aquifer — A body of permeable sediment or rock through which groundwater moves easily.

Artesian — A groundwater system where the groundwater is isolated from the surface by a confining layer and the water is under pressure.

Basalt — A fine grained igneous rock.

Cenozoic Era — A time span on the geologic calendar beginning about 65 million years ago and includes the present time.

Climate — A description of aggregate weather conditions; the sum of all statistical weather information that helps describe a place or region.

Connate Water — Water that is no longer in circulation or in contact with the present water cycle.

Cretaceous Period — A time span on the geologic calendar that began approximately 100 million years ago and lasted approximately 40 million years.

Ecosystem — A particular type of biological system in which climate, geology and soil, animals and man are related to each other and affected by their interactions.

Epoch — A unit of the geologic calendar that is a subdivision of a period.

GLOSSARY, Con't.

Era	A major subdivision on the geologic calendar; eras are divided into shorter units called periods.
Floodplain	The flat, low-lying portion of a stream valley subject to periodic inundation, the flood hazard area.
Floodway	The stream channel and the immediately adjacent portions of the floodplain which carry the bulk of the flood flow during storm events.
Flood Fringe	That portion of the floodplain located outside the floodway.
Fragipan	A natural soil subsurface horizon with high bulk density relative to the horizons above it.
Ground Moraine	An undulating layer of till deposited as the ice front retreats.
Groundwater	Water found beneath the surface of the earth within the zone of saturation.
Hydrologic Cycle	The circulation of water from the oceans to the atmosphere and back to the oceans by way of evaporation, runoff from streams and rivers, and groundwater flow.
Igneous Rocks	Rocks formed by the crystallization of molten magma.
Juvenile Water	Water derived from the interior of the earth that has not previously existed as atmospheric or surface water.

GLOSSARY, Con't.

Lithosphere	The outer layer of the earth approximately 100 kilometers thick of which the plates that contain the ocean basins and the continents are composed.
Mesozoic Era	A time span on the geologic calendar between the Paleozoic and Cenozoic eras-from about 225 to 65 million years ago.
Meteoric Water	Water derived from the atmosphere.
Miocene Epoch	An epoch in the tertiary period of geologic history which began approximately 13 million years ago and lasted approximately 12 million years.
Moraine	Sediments deposited directly by the ice of a glacier.
NJPDES Permit	New Jersey Pollutant Discharge Elimination System, a permit issued by the state Department of Environmental Protection and Energy to discharge pollutants into navigable waterways.
Paleocene Epoch	The oldest epoch in the tertiary period of geologic history, it ended approximately 55 million years ago.
Paleozoic Era	A time span on the geologic calendar between the Precambrian and Mesozoic eras-from about 600 to 225 million years ago.
Permeability	A measure of a material's ability to transmit fluid.
Perched Water Table	A localized zone of saturation above the main water table created by an impermeable layer.

GLOSSARY, Con't.

Period	A basic unit of the geologic calendar that is a subdivision of an era; periods may be divided into smaller units called epochs.
Physiographic Province	A region characterized by a particular assemblage of landforms, climate and geomorphic history.
Pleistocene Epoch	The most recent epoch in geologic history. It began approximately one million years ago and may continue into the present.
Porosity	The percentage of void (empty space) in earth material such as soil or rock.
Precambrian	All geologic time prior to the Paleozoic era.
Quaternary Period	A time span on the geologic calendar that began approximately 1 million years ago and is still in progress.
Sediment	The accumulation of soil particles that have settled out of flowing water.
Sedimentary Rocks	Rocks formed from the weathered products of pre-existing rocks that have been transported, deposited and lithified.
Silt	Finely divided particles of soil or rock often carried in cloudy suspension in water and eventually deposited as sediment.
Soil Horizon	A layer of soil that has identifiable characteristics produced by chemical weathering and other soil-forming processes.

GLOSSARY, Con't.

Soil Profile	A vertical section through a soil showing its succession of horizons and the underlying parent material.
Subsurface Water	All of the waters within the lithosphere.
Surface Water	Waters above the surface of the lithosphere.
Tertiary Period	A time span on the geologic calendar that began approximately 55 to 60 million years ago and ended approximately 1 million years ago.
Terminal Moraine	The end moraine marking the farthest advance of a glacier.
Till	Unsorted sediment deposited directly by a glacier.
Vegetative Succession	A directional, cumulative change in the species that occupy a given area, through time.
Water Table	The upper level of the saturated zone of groundwater.
Zone of Saturation	Zone where all open spaces in sediment and rock are completely filled with water.

XII. REFERENCES

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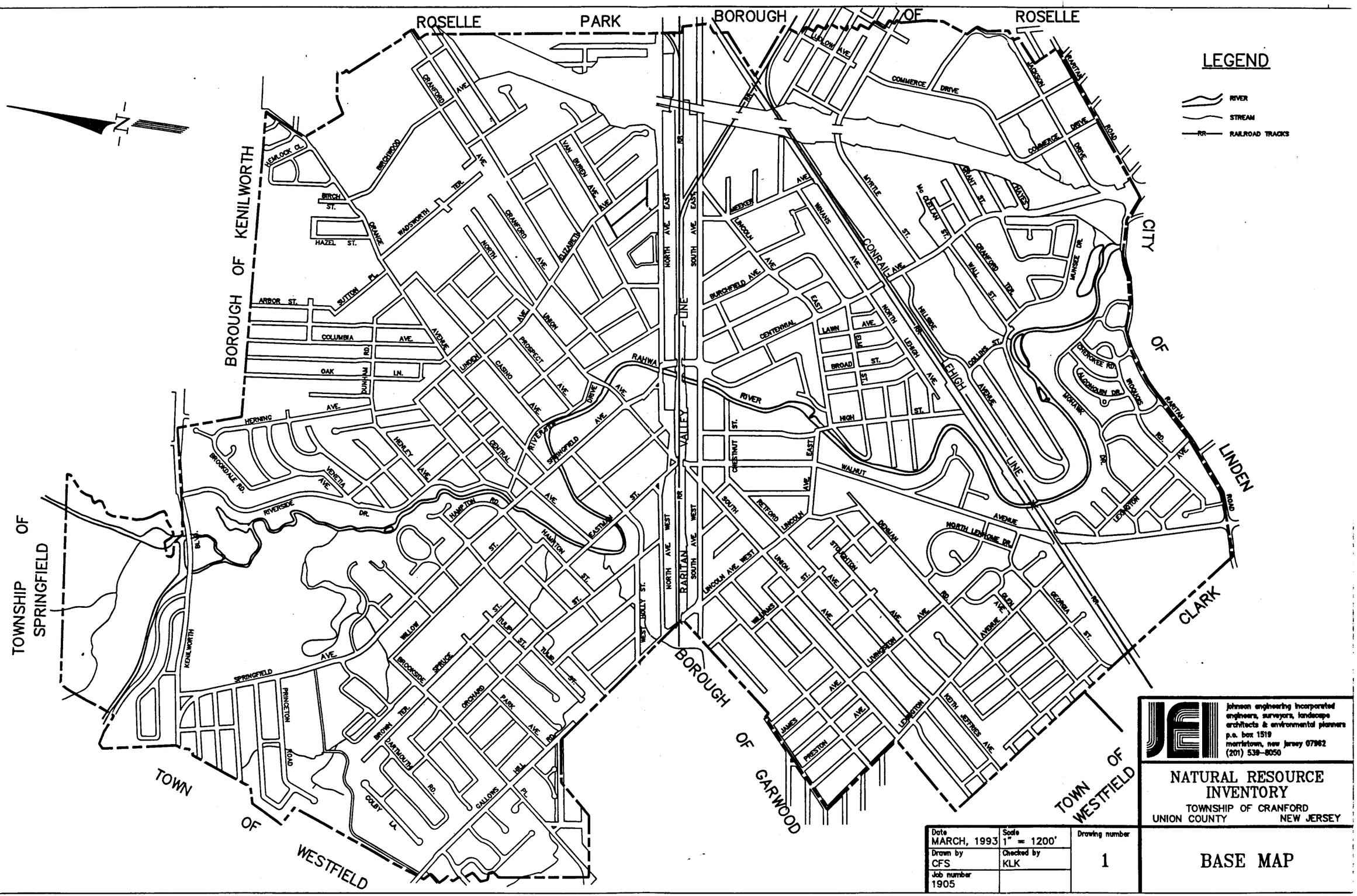
APPENDIX A

DRAWINGS



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NATURAL RESOURCE INVENTORY

TOWNSHIP OF CRANFORD
UNION COUNTY NEW JERSEY

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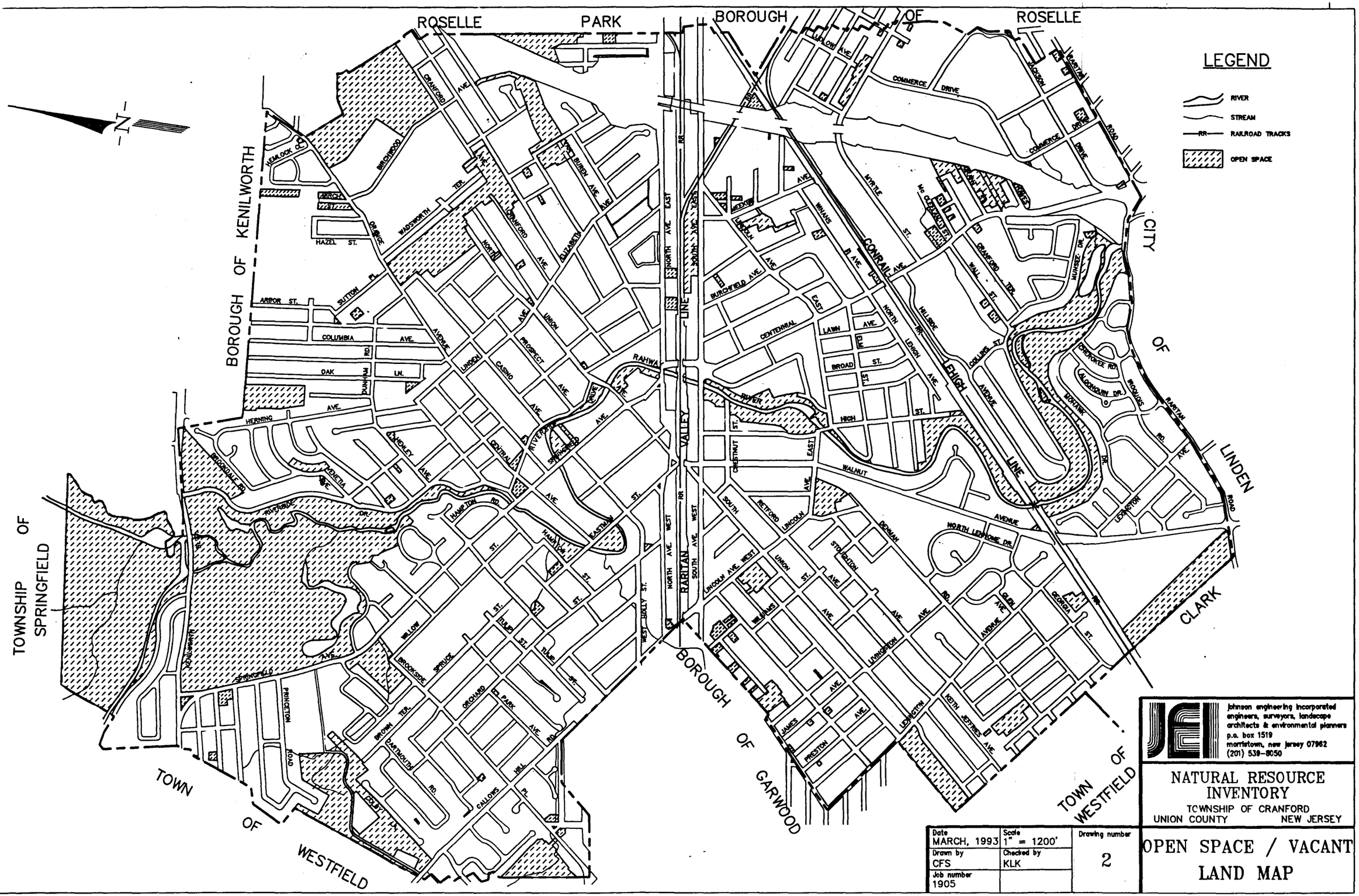

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OPEN SPACE / VACANT LAND MAP

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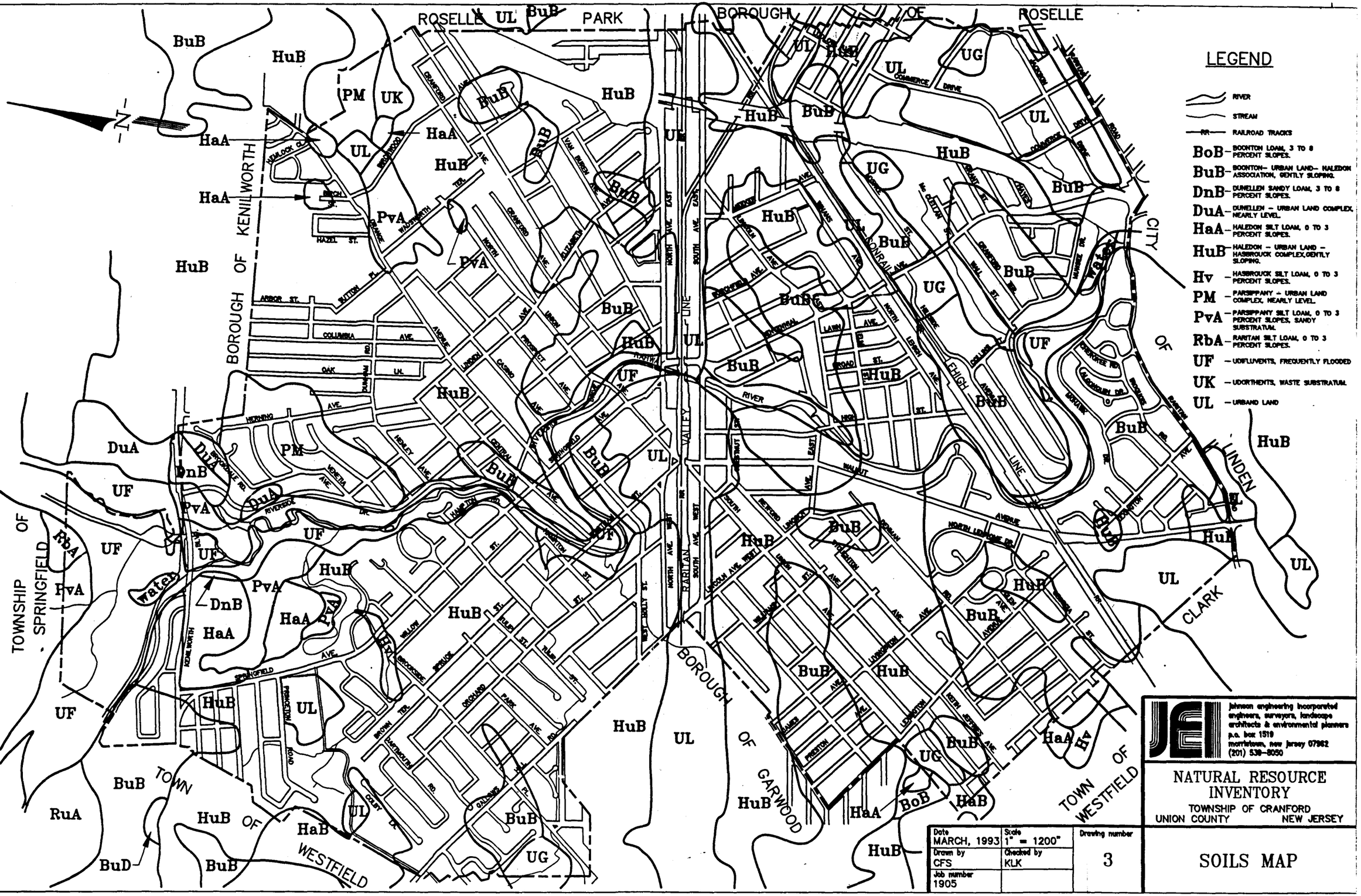

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UNION COUNTY NEW JERSEY

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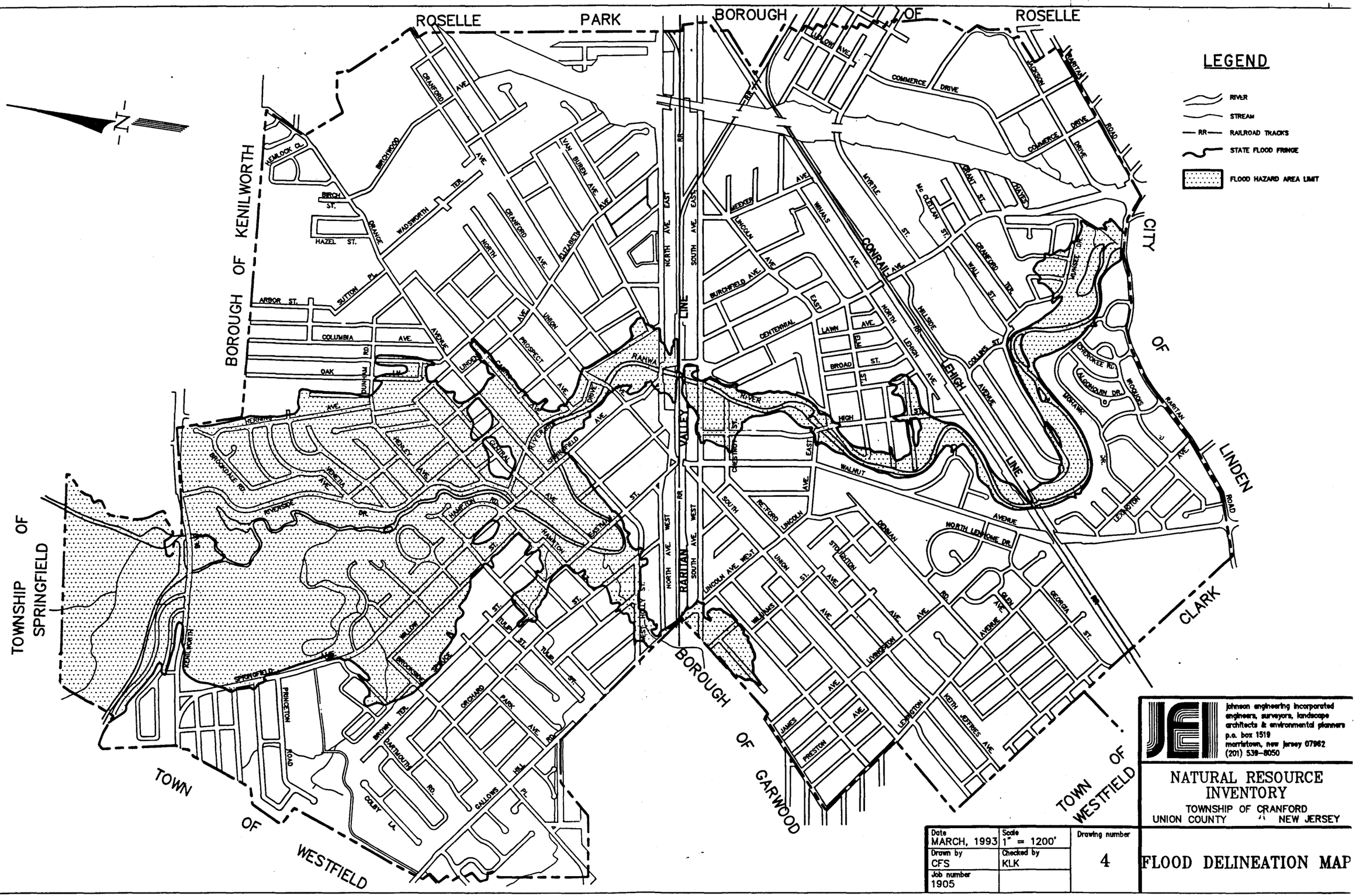
SOILS MAP



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UNION COUNTY NEW JERSEY

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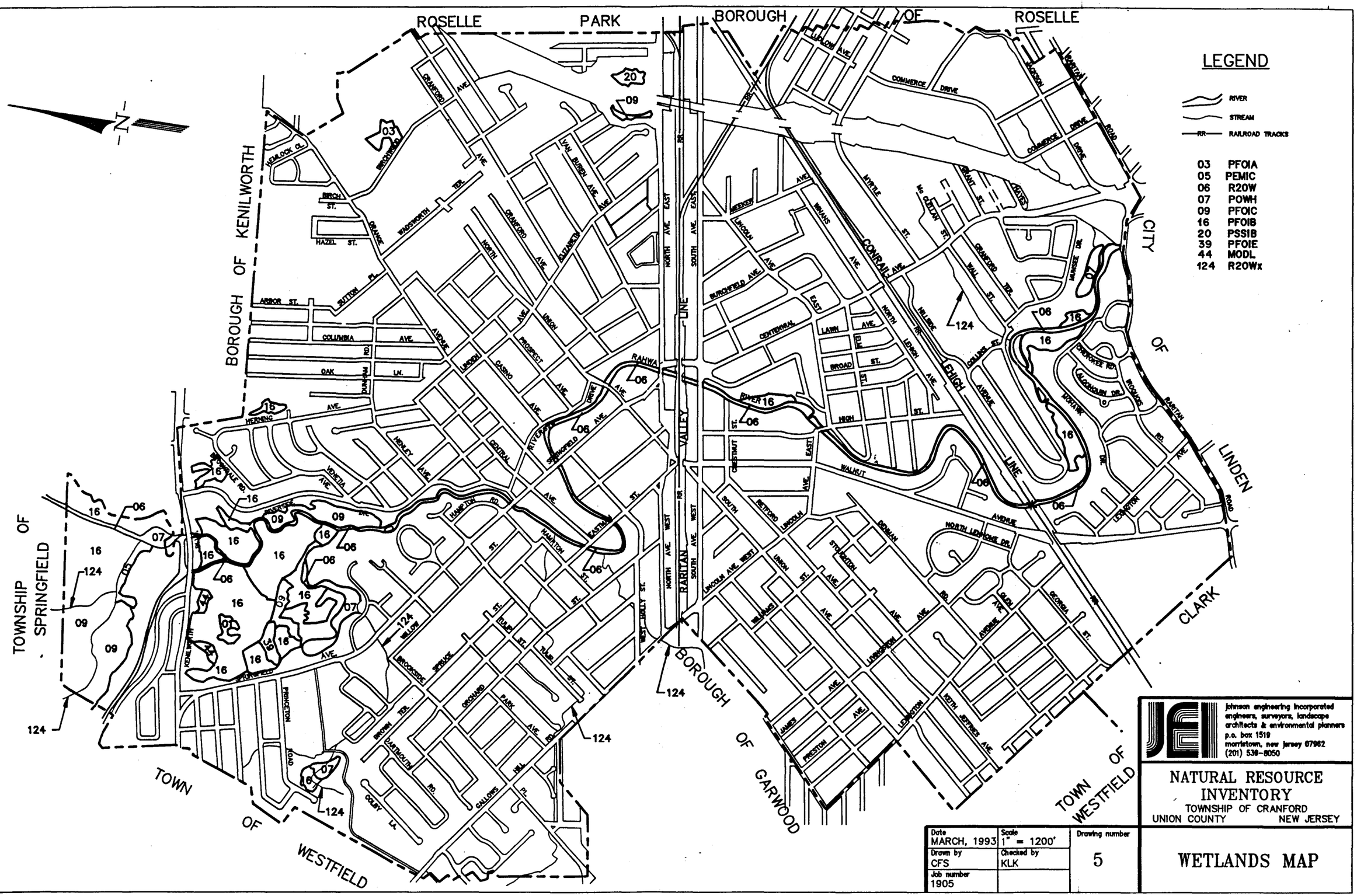

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UNION COUNTY NEW JERSEY

Date	Scale	Drawing number
MARCH, 1993	1" = 1200'	5
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WETLANDS MAP