Natural Resource Inventory

Franklin Township

Hunterdon County, New Jersey

Photo credit: Walter Chandoha

Environmental Commission
Franklin Township
Hunterdon County, New Jersey

Natural Resource Inventory

Franklin Township
Hunterdon County, New Jersey

This plan was prepared with the assistance of a
Smart Growth Planning Grant from the
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Adopted by the Franklin Township
Environmental Commission

August 31, 2009

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FRANKLIN TOWNSHIP ENVIRONMENTAL COMMISSION

Established April 3, 1970

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NATURAL RESOURCE INVENTORY

Adopted by the Environmental Commission

August 31, 2009

Franklin Township
Hunterdon County, New Jersey
202 Sidney Road
Pittstown, New Jersey 08867

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* * *

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NATURAL RESOURCE INVENTORY

Revised and adopted by the Land Use Board

March 10, 2010

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Franklin Township Natural Resource Inventory

Introduction.

The purpose of a Natural Resource Inventory (NRI), also known as an Environmental Resource Inventory (ERI), is to document and describe the natural resource characteristics and environmental features of a community, utilizing text, maps and geographical information system (GIS) data. The NRI identifies significant environmental resources and provides guidance for the protection, preservation and conservation of these resources. The document provides reference material for review of applications that come before the Land Use Board, including subdivisions, site plans and variances. It can also serve as a useful tool for property owners in evaluating their property.

Region and Demographics

Franklin Township is located at the center of Hunterdon County, and encompasses approximately 23.2 square miles, or 14,831 acres. Franklin Township shares boundaries with seven other municipalities: Alexandria, Clinton, Clinton Town, Delaware, Kingwood, Raritan, and Union.

Based on U.S. Census data, the population of Franklin Township was 2,990 persons in 2000. The table below provides a comparison of population growth in the Township and in Hunterdon County between 1970 and 2000. Population projections prepared by the Hunterdon County Planning Board in 2004 suggest that Franklin Township's population will continue to grow at a relatively moderate pace, with a projected population of 3,136 in 2010.

Population Growth, 1970-2000

	1980	Percent Change	1990	Percent Change	2000	Percent Change
Franklin Township	2,294	6.5%	2,851	24.3%	2,990	4.9%
Hunterdon County	87,361	25.3%	107,776	23.4%	121,989	13.2%

Source: 1970, 1980, 1990 and 2000 US Census

The number of housing units in Franklin Township in 2000 was 1,125 units, with approximately 93% of the housing stock consisting of single-family detached units. The majority of the housing stock was constructed after 1960, and 65.42% of the housing stock is comprised of large units, having seven or more rooms.

Aerial Photography.

The Aerial map of the Township is based on the NJ Office of Information Technology's 2007-2008 High Resolution Orthophotography mapping. Digital orthophotography is a process which converts a digitized perspective aerial photograph or other remotely sensed image data to a digital product that has been rectified for camera lens distortion, vertical displacement caused by terrain relief and variations in aircraft altitude and orientation. The aerial photograph is based on flyovers conducted in 2007 and 2008, and provides the basis for other resource maps, including soils, topography and land use/land cover mapping. The Aerial map for the Township also provides a good overview of existing land use and geographic features, including agricultural and open spaces, forested lands, surface water features, and developed lands. Imaged on the aerial photo are roads and tax parcels.

Peaceful Valley Orchards, photo by Elizabeth Riddle

Topography and Slopes.

The Elevation map depicts the overall topography of the Township. The more tightly configured lines indicate areas of steep slope. As shown on the Elevation map, the more rugged terrain is in the northern third of the Township. The highest elevations are found in the central and northeastern areas of the Township and are related to streams that cut through the terrain.

The topography of land is important in environmental planning in order to identify critical areas which should remain undeveloped as well as those which may be suitable for development. As depicted in the accompanying Slope map, the 0-5 percent slope category is found primarily in the southern portion of the Township. These areas produce the lowest peak rates of water run-off and contain the deepest soil over bedrock.

Slopes within the 5-15 percent range are found in 29.4% of the Township. Generally speaking, areas with slopes of 5-15 percent must be handled sensitively if they are to be developed without producing negative environmental impacts. These slopes must be treated selectively. They can be accommodated within tracts being developed, but it is preferable to avoid re-grading and improvements on the slopes, using them instead as sites for plantings, yard space, and perhaps an occasional, careful siting of a structure. The installation of foundations, basements, walkways, drives and utilities in these areas will prove to be more costly and will require more careful run-off and erosion management techniques. Additionally, a 12 percent slope is considered by the Soil Conservation Service to be the maximum slope suitable for septic tank fields.

Land with steep slopes of more that 15 percent occur in 8.6% of the Township. On these steep slopes, soils are very often thin and have relatively low natural fertility. It is not uncommon to find that most steep slopes are covered with forest growth. The trees hold the soil in place and provide forest floor mulch which absorbs rain water. The trees also absorb and evaporate large amounts of ground water and therefore make room for additional storage of water. Any disruption of this pattern can have far reaching implications with respect to ground water recharge and erosion.

Development in areas with very steep slope, particularly those above 25 percent should be limited. To the extent possible such land should be left in its natural condition or maintained in grass or tree cover. Disturbing the vegetation on steep slopes can produce severe erosion. Once eroded, it is extremely difficult to reestablish vegetation. Septic tank absorption fields function very poorly on steep slopes with the effluent running through the top layer of soil directly into nearby streams causing pollution of surface water. Driveway and road locations as well as structure placement on the sides of hills can also be difficult and costly.

Snowy Field, photo by Michel Gelinas

Geology.

The Bedrock Geology map indicates the three types of underlying geologic formations of the Township. The predominant formation is the Lockatong Formation, which underlies approximately 70% of the Township. The north/northeast part of the Township is underlain by the Stockton Formation, and the southwest portion of the Township is underlain by the Passaic Formation. As shown in the Surficial Geology map, the surface geology in Franklin is primarily comprised of weathered shale, mudstone, and sandstone. A more detailed description of the Township's geology is included in the Nitrate Dilution Modeling and Lot Size Analysis Report prepared by Uhl, Baron, Rana & Associates, appended to this NRI.

Geology is a prime determinant of radon, a radioactive gas that comes from the natural decay of uranium found in nearly all soils. Sustained exposure to radon can pose a long-term health hazard, specifically for lung cancer. As indicated on the Radon Potential map, Franklin is identified by the New Jersey Department of Environmental Protection (NJDEP) as having a high potential for high levels of radon (above 4.0 picocuries per liter of air) in homes. However, to determine the actual level of radon, on-site testing is required. The NJDEP recommends routine testing and radon mitigation, such as through active ventilation, for homes located in areas with a high potential for high levels of radon.

Soils.

The Soils map depicts the soil types found in Franklin Township as identified by the Natural Resources Conservation Service (NRCS), an office with the US Department of Agriculture. The limitations of each of these soil types for various forms of development are described in the table below. The factors which severely limit the use of the land are shallow depth to bedrock, high water table, flooding or stream overflow hazard areas, steep slopes and soil impermeability.

Soil Limitations for Development

Soil Series	SSURGO Mapping Units*	% in Twp.	Depth to Bedrock (feet)	Depth to SHWT (feet)	Septic System Limits	Limitations for Building Foundations	
						With Basements	Without Basements
Abbottstown	AbrA, AbrB	3.01	3.5 - 5+	.5 – 1.5	Severe	Severe	Moderate
Bedington	BefC2	0.03	4.5 - 5+	5+	Moderate	Slight	Slight
Birdsboro	BhnA, BhnB, BhnC2	0.21	5 - 10+	3+	Slight to Moderate	Slight	Slight
Bowmansville	BoyAt	2.62	3.5 - 10+	0 -1	Severe	Severe	Severe
Bucks	BucB, BucC2	2.02	3.5 – 5+	5+	Moderate	Slight	Slight
Califon	CakB	0.08	6 -10+	.5 – 2.5	Moderate	Moderate	Moderate
Chalfont	ChcA, ChcB, ChcC2, ChfB	17.93	3.5 – 6+	.5 – 1.5	Severe	Severe	Moderate
Croton	CoxA, CoxB, CoxBb	7.57	3.5 – 5+	0 - 1	Severe	Severe	Severe
Duffield	DufB	0.07	4 -7	4+	Slight	Slight	Slight
Hazelton	HdyB, HdyC2, HdyD, HdyDb, HdyEb	16.34	4 - 5+	4+	Moderate to Severe	Slight to Severe	Slight to Severe
Klinesville	KkoC, KkoD	0.76	1 – 1.5	3 – 5+	Severe	Severe	Moderate
Landsdale	LbmB, LbmC2, LbmD	6.66	3.5 – 5+	1 -2.5	Moderate to Severe	Slight to Moderate	Slight to Moderate
Meckesville	MemB	0.08	5 – 8+	5+	Moderate	Slight	Slight
Norton	NotB, BotC2	1.04	4 – 10+	5+	Severe	Moderate	Slight
Pattenburg	PdtB, PdtC2, PdtD, PdtE, PdtmB	2.24	1.5 – 8+	5+	Moderate to Severe	Slight to Severe	Slight to Severe
Penn	PeoB, PeoC2, PeoD, PepB	3.86	1.5 – 3.5	4+	Severe	Moderate	Slight to Moderate
Quakertown	QukA, QukB, QukC2, QukD2, QupC2	30.11	3.5 – 6+	5+	Moderate to Severe	Slight to Moderate	Slight to Moderate
Raritan	RarAr, RarB	0.93	5 – 7+	1 - 2	Severe	Severe	Moderate
Readington	RedB, RedC2	0.57	3.5 – 5+	1.5 – 3	Moderate	Moderate	Slight
Reaville	RehA, RehB, RehC2, RepwA	1.15	1.5 – 3.5	1 – 2	Severe	Severe	Moderate to Severe
Rowland	RorAt	2.04	4 – 6+	1 – 2.5	Severe	Severe	Severe

**Soil map units may include small areas of soil components or miscellaneous areas that are not identified in the name of the map unit. More information regarding these soil "inclusions" can be obtained from the USDA Soil Survey website: http://soils.usda.gov/technical/manual/print_version/chapter2.html#3c*

The soil series described below are the most prevalent in Franklin Township:

Quakertown
Quakertown soils comprise approximately 30% of the Township. The Quakertown series consists of deep, nearly level to moderately steep, well-drained soils formed in material weathered from silty sandstone. Permeability is moderate in the surface layer and moderately slow in the subsoil. Natural fertility is low.

Chalfont
The Chalfont series accounts for approximately 18% of Franklin's soils. These soils consist of deep, nearly level to strongly sloping, somewhat poorly drained, loamy soils that have a fragipan in the lower part of the soil. Permeability is moderate in the surface layer and moderately slow in the subsoil and substratum. Natural fertility is moderate.

Hazelton
Roughly 16% of the Township is comprised of the Hazelton soil series, which consists of deep, gently sloping to very steep, well-drained soils on uplands. These soils formed in material weathered from fine-grained sandstone that generally is high in feldspars. Hazelton soils have a moderately rapid permeability throughout the profile. Available water capacity is moderate and natural fertility is moderate.

Landsdale
Landsdale soils account for approximately seven percent of the Township. This soil series consists of deep, nearly level to moderately steep, well-drained, loamy soils. Permeability is moderate to moderately-rapid. Available water capacity is moderate to high and natural fertility is moderate.

Penn
The Penn series, which comprise approximately four percent of Franklin's soils, consists of moderately deep, gently sloping to moderately steep, well drained loamy soil that formed over red shale or siltstone on uplands. Permeability is moderate to moderately rapid in the surface layer and subsoil. Available water capacity is moderate to high depending on the depth of bedrock and the content of shale. Natural fertility is moderate.

Abbotstown
Abbotstown soils represent approximately three percent of the Township and consist of deep, nearly level to gently sloping, somewhat poorly drained soils. These soils are commonly loamy, have distinct mottles in the subsoil and are slowly permeable in the subsoil. Natural fertility is moderate, but root growth is restricted by the fragipan.

Watersheds and Streams.

The Township drains into two different watersheds – the Raritan River, which eventually empties into the Raritan Bay to the south east, and the Delaware River, which drains to the southwest. Approximately two thirds of Franklin is in the Raritan River basin and the balance is in the Delaware River basin. In both cases, the Township drainage areas are portions of the headwaters for those watersheds. Headwaters are particularly vulnerable to degradation because of the limited available flow, and any degradation in headwaters is transferred downstream throughout the entire surface water system.

Streams classified as Category One (C-1) Waters under the Surface Water Quality Standards (SWQS – N.J.A.C. 7:9B) are required to have a 300 foot buffer. The NJDEP also categorizes streams based on their trout production status. Non-Category One Trout Production and Trout Maintenance Waters are required to have a 150 foot buffer, and Non-Category One Non-Trout Waters are required to have a 50 foot buffer.

Trout status also applies to the wetlands that discharge into the streams under the Freshwater Wetlands Act Rules (N.J.A.C. 7:7A). A 150 foot wetlands transition area (buffer) is required for wetlands that discharge into FW2-TP (Freshwater Trout Production) streams. A 50 foot wetlands transition area is required for wetlands that discharge into FW2-TM (Freshwater Trout Maintenance) streams. No wetland transition area is required for wetlands that discharge into FW2-NT (Freshwater Non Trout) streams.

Huey Preserved Farm, photo by Garden State Preservation Trust

Watersheds and C-1 streams within Franklin Township are depicted in the accompanying map. The northern portion of the township contains the Sidney Brook and the Capoolong (or Cakepouline) Creek which are part of the Raritan watershed. The central part of the township has the headwaters of the Lockatong Creek, the Wickecheoke Creek and the Assiscong Creek, which drain to the Delaware watershed.

Protection of stream buffers (also referred to as a "riparian corridor" or "riparian area") is important because they serve a vital role in filtering pollutants from runoff and protection of groundwater. As part of a riparian corridor health assessment study conducted for the Upper Delaware Watershed Management Area, Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA) and North Jersey Resource Conservation and Development Council (North Jersey RC&D) has reported phosphorous removal rates by plants in a forested riparian area to be 80%. Similarly, riparian areas on hydric soils were shown to have a ground water nitrate removal rate of more than 80%.

Stream buffer protection is also important to limit erosion and the entrance of sediment into the stream, to preserve aquatic habitat, and to enhance flood mitigation. The stream buffer also has an important role in wildlife management. Shading of streams, for example, is important in controlling water temperature and maintaining fish populations. Deer and other fauna use riparian areas as migration routes, as well as water sources.

Moon Rise on Lake, photo by Michel Gelinas

Wetlands

Areas of wetlands within Franklin are largely associated with the various stream corridors that traverse the Township (see Wetlands map.) Wetlands areas comprise 10.3% of the Township's land area.

Regulation of freshwater wetlands falls under the jurisdiction of the NJDEP. The NJDEP has developed wetlands mapping that identifies wetlands based on three parameters. These include: (1) the land at least periodically and predominantly supports hydrophytes (vegetation characteristically found in saturated soils); (2) the soil substrate is primarily un-drained, hydric soil characterized by at least long periods of oxygen starvation; and (3) the substrate is a non-soil and is saturated or covered by shallow water at some time during the growing season.

The delineation of wetlands should not be considered conclusive from the mapping prepared by the NJDEP. Individual sites must be surveyed and flagged for wetlands as part of the development review process. Freshwater wetlands are considered environmentally sensitive lands and should not be developed. The Freshwater Wetlands Act (P.L. 1987, c. 156), placed all regulatory control of wetlands with NJDEP. The Department has produced rules which supersede local control for limited filling on sites with wetlands, upland buffers of up to 150 feet adjacent to wetlands, and procedures for minor encroachments.

Wetlands are one of the most productive ecosystems in the world and host a variety of aquatic and terrestrial species. In fact, approximately two-thirds of New Jersey's threatened and endangered species rely on wetlands.[1] Plant and animal habitat is just one of the functions of this ecosystem, wetlands are also responsible for water storage during periods of flooding since they are able to absorb the water similar to a sponge and then slowly release it. For example, an acre of wetlands can store up to 1.5 million gallons of water[2]. This serves to reduce flooding, allows for increased groundwater recharge and contributes to the flow of surface waterbodies. Additionally, wetlands serve as water filtration.

As water is absorbed by the wetland, the suspended sediment settles to the wetland floor and nutrients from sources such as fertilizer application, manure, leaking septic tanks, and municipal sewage are dissolved in the water or are absorbed by plant roots and microorganisms in the soil; other pollutants are also filtered out by sticking to soil particles.

Due to their ability to store flood waters, perform water filtration, provide scenic amenities and provide plant and animal habitat, protection of wetlands is critical.

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1 http://www.nj.nrcs.usda.gov/programs/wrp/

2 United State Environmental Protection Agency. *Functions and Values of Wetlands*. September 2001.

Flood Plains

The flood plain areas of the Township help to carry excess water during inundation of the normal stream channel. These flood plains occupy approximately 6% of the Township's land. The accompanying Flood Plains map is based on FEMA data that identifies the 100 year flood plain (defined as the area having a 1% chance of flooding annually) and the 500 year flood plain (defined as the area having a .02% change of flooding annually). As the currently available FEMA mapping does not line up with the Township base map, a Floodprone Areas map is also provided, based on previous mapping by USGS that approximates flood plain areas. New FEMA mapping will be available early in 2010. For a more detailed analysis of a particular site, FEMA's individual Flood Insurance Rate Maps (FIRM) should be consulted.

In the past, the Township's flood plains have experienced damage due to flooding. For this reason it is necessary to place controls on development in these areas. Development should be located away from flood plains to protect residents from serious loss. Equally important is the preservation of the environmentally sensitive aquatic communities which exist within stream corridors and flood plains. These communities are often the first link in the food chain of the aquatic as well as other ecosystems. It is important to limit development in these areas to preserve the flood carrying capacity.

Depth to Seasonal High Water Table

The Depth to Seasonal High Water Table (SHWT) indicates the distance between the surface and the highest groundwater level reached in most years.

If the SHWT is high, one foot or less from the surface, it can be considered a severe constraint to development. Even a SHWT between 1-3 feet proves to be an obstacle to development. These high water tables often correspond to the floodplain and wetland areas surrounding the streams, rivers, etc. Indeed, some may be wetlands that will be identified by field verification. In the areas where the SHWT is less than 3 feet, special considerations should be made regarding septic system design. A conventional septic system requires that the leachate field be at least 4 feet above the SHWT. This insures that there is a proper bacterial digestion of septic waste.

High water tables present a constraint to the location and effectiveness of septic systems, roadways and parking lots. The constant thawing and freezing of water in the winter months will ultimately damage asphalt and concrete structures. Areas of the Township with a seasonal high water table of 0 to 3 foot are primarily located in areas surrounding the streams, and in the southern third of the Township. (See Seasonal High Water Table map.)

Areas where the SHWT lies 3 feet or greater below the surface are considered to have minor constraints to development. The majority of lands in the central and northern area of the Township, outside of stream areas, have a SHWT of 6 feet or more.

Depth to Bedrock

Depth to bedrock is an important factor when determining suitable locations for road construction, building foundations and septic leachate fields. Construction costs will increase when developing in areas with shallow depth to bedrock due to increased blasting and special construction considerations. A shallow depth to bedrock (3 feet or less) will prove costly in developing septic systems. A solid sheet of bedrock close to the surface can cause untreated effluent to flow laterally along the rock and contaminate ground water.

As shown in the Depth to Bedrock map, the majority of the Township is comprised of areas where the depth to bedrock is more than 3 feet.

Hydrogeology

The Township's hydrogeology is discussed in the February 28, 2007 Draft Nitrate Dilution Modeling and Lot Size Analysis Report prepared by Uhl, Baron, Rana & Associates, Inc. (UBR) appended to this NRI.

Groundwater in bedrock aquifer systems is stored and transmitted within and through fractures, joints and bedding plane openings. The availability of groundwater in an individual hydrogeologic unit is a function of the degree of interconnection between fracture, joint, and fault openings. As noted in the Uhl report, the Lockatong Formation, which underlies the central portion of Franklin, comprises one of the lowest yielding aquifers in New Jersey, with an average well yield of 13 gpm, and an average well depth of 164 feet. The Stockton and Passaic Formation, which underlie the north/northeast portion and southwest portion of the Township, respectively, comprise moderately yielding aquifer systems.

Recharge is essential for replenishment of the underground water supply. The accompanying map shows the estimated groundwater recharge in the Township, based on land use land cover data, soil characteristics and precipitation data. As shown in the map, the northern area of the Township contains most of the lands with the highest recharge rate of 11 to 15 inches/year.

Septic Suitability

Soil suitability for the on-site disposal of waste water through individual subsurface septic systems is classified according to the type and depth of soil limiting zones in a particular soil. The depth of a soil limiting zone is determined by the hydraulic horizon or geologic strata. As shown on the Septic Suitability map, the great majority of the Township is considered to have very limited septic suitability. However, as indicated on the Sewer Service map, only three properties at the extreme northern corner of the Township are currently provided with sewer service.

The 2007 Draft Nitrate Dilution Modeling and Lot Size Analysis Report prepared by UBR indicates that to protect groundwater, the minimum lot sizes required to dilute nitrates from septic systems would range between 4.3 – 6.4 acres during a normal year, and 6.8 – 15.4 acres during a dry year. However, we note that the NJDEP has recently revised the anti-degradation standards for nitrate dilution and that the Hunterdon County Planning Board (HCPB) is currently working on a Wastewater Management Plan (WMP) to address these standards for all of the municipalities in the County except those in the Highlands. A draft of the WMP is expected to be completed in December, 2009.

Public and Agricultural Wells

The accompanying map shows the location of public community wells, public noncommunity wells and agricultural wells. Public community wells serve public community water systems which are defined as having at least 15 service connections used year round residents. Public noncommunity wells serve public noncommunity water systems which are used by individuals other than year round residents for at least sixty days of the year. Agricultural wells which are capable of withdrawing more that 100,000 gallons per day are regulated by the Dept of Agriculture.

To help prevent the contamination of ground water resources and protect drinking water supplies, the NJDEP has delineated Well Head Protection Areas (WHPA) for public wells. Each WHPA is dependent on the pumping rate of the well and the local geology. As indicated on the map, each WHPA consists of three tiers that identify the travel time for water to flow to a well and the related risk of contamination. No wellhead protection area is required for agricultural wells as they do not provide water for drinking purposes.

Known Contaminated Sites

The NJDEP maintains an inventory of Known Contaminated Sites which includes those sites and properties where contamination of soil or ground water has been identified by the NJDEP or where there has been, or there is suspected to have been, a discharge of contamination. The NJDEP GIS database identifies seven Known Contaminated Sites (KCS) in the Township, based on 2005 KCS data. One other site shown in Alexandria (Ortho Research Farm) appears to extend into Franklin, and a residential site shown in Kingwood is actually within the Township.

The description of the GIS database emphasizes that some of the cases listed in 2005 may have been fully remediated, and should no longer be included on the list. Additionally, new contaminated sites have been identified since the creation of the list, and are thus not included in the GIS mapping. A comparison of the current KCS inventory available online[3] with the GIS database indicates that four of the nine sites (all residential properties) from the 2005 listing have since been closed. Three other

[3] NJDEP Site Remediation Program, Known Contaminated Sites in New Jersey, May 2008 (http://www.nj.gov/dep/srp/kcsnj) .accessed March 12, 2009.

residential sites from the 2005 listing continue to be identified as active, and the Ortho Research Farm site also continues to be identified as active. Seven new residential or farmhouse properties, and one commercial property within the Township have been added to the active KCS list.

The Myers Property Superfund site is identified on both the 2005 and current KCS active site lists. This seven acre site, located along the Capoolong Creek, was historically used for pesticide and other chemical manufacturing. It was included on the Superfund National Priorities List in 1983, and EPA removed contaminated material including soil, drummed waste, asbestos, and debris in 1984. Additional clean up of contaminated soil and sediment, and removal of the buildings on the site was completed in 2005. A ground water extraction and treatment system has been in operation at the site since 1999.

Forest Resources

The map of Forested Areas shows upland forests in Franklin based on NJDEP's Land Use/Land Cover data. As indicated in this mapping, upland forests comprise 26.3 % of the Township.

Trees and forested areas provide numerous benefits. These benefits include environmental benefits, such as providing temperature and wind control, improving air quality, reducing erosion, providing animal habitat, and reducing noise and glare; economic benefits, such as providing wood products, promoting tourism, and enhancing property values; and aesthetic, psychological, and recreational benefits.

In Hunterdon County, deciduous mixed hardwood forests dominate the wooded landscape. Between 1972 and 1995, the County lost over 20% of its upland forests. In addition to the loss of forest cover, there has been increased fragmentation of forests into smaller isolated patches, which reduces the environmental benefits of trees and forests.[4] Forest fragmentation also creates edge habitats which increase deer populations and negatively impact native species and agricultural production.

Snowy Roadway, photo by Elizabeth Riddle

[4] *Hunterdon County Growth Management Plan*, adopted December 12, 2007, p. 27

NJDEP Landscape Project Habitat Data

Beginning in 2001, NJDEP initiated a habitat mapping system that categorizes, ranks, and maps wildlife habitat across the State. Through the release of Version 2.1, habitat areas were broken into five types (grassland, forest, forested wetland, emergent wetland, and beach) based on land use/land cover data and then ranked from zero to five according to their significance as habitat for priority, rare, threatened, and endangered species:

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

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

- Rank 2 is assigned to species-specific patches containing one or more occurrences of species considered to be species of special concern.

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

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

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

Ranks 3, 4, 5 are considered to be the most critical habitat areas as they contain habitat for threatened and endangered species. This system also specifically identifies wood turtle habitat, bald eagle foraging areas, and peregrine falcon nesting areas as habitat for imperiled species and species of special concern.

In 2008, the DEP released newly updated versions of this system based on 2002 Land Use/Land Cover (LU/LC) data. Version 3.0, which covers the Highlands and immediately adjacent areas, represents a new methodology for delineating habitat. Referred to as a "species-based patch approach", instead of combining the unique LU/LC classes into the five habitat types, the DEP assigns a specific set of LU/LC classes for each species which are then combined into a potential layer relating to species needs. Individual species occurrence areas are then intersected with the appropriate habitat patches. Finally, habitat patches are classified based on the status of the species present using the same 0 to 5 ranking criteria as in prior versions.[5] In

5 New Jersey's Landscape Project (Version 3.0 Highlands), p. 15

2008 the DEP also released Version 2.1 for the remainder of the State which updated Version 2.0 with 2002 LU/LC data and new species occurrence information.

Another significant policy change for the Landscape Project data was their inclusion throughout the revised Wastewater Management Plan Rules (N.J.A.C. 7:15 et seq.) revised through July 8, 2008. The rules require that habitat areas be mapped and submitted as part of a wastewater management plan. Landscape Project habitat areas with Ranks 3, 4, or 5 are specifically included in the definition of "environmentally sensitive" areas. The rules state that no amendment to a Water Quality Management Plan (WQMP) will be approved by the DEP if it will cause a negative impact to such areas.[6] Additionally, the rules now prohibit the inclusion of contiguous critical habitat areas of 25 acres or more within a sewer service area.[7] Cumulatively, these policies represent a marked shift at that State level from presenting the Landscape Project data as advisory information to including it as a critical feature within their regulatory framework, deserving of protection equal to that of wetlands or stream corridors.

Lilies at Cherryville, photo by Walter Chandoba

As Franklin Township is immediately adjacent to the Highlands region, it is covered by Version 3.0 of the Landscape Project Habitat data. Analysis of this data indicates that a total of 6,819 acres, representing 38.5% of the Township, are included in the most critical habitat areas (Rank 3, 4 and 5). Although the great majority of the critical habitat is classified as Rank 3 and Rank 4, there is also a small area of Rank 5 critical habitat located in the northwest corner of the Township.

6 N.J.S.A. 7:15-3.5(b)4
7 N.J.S.A. 7:15-5.24(b)1

Muehbauer Preserved Farm, photo by George Trogler

Agricultural Soils

The USDA classifies certain soils as being particularly well suited to agricultural uses. The two most prominent designations are *prime farmland soils* and *farmland soils of statewide importance.* According to the USDA Natural Resources Conservation Service, prime farmland soil:

> *... has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods, Prime Farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.*[8]

Farmland soils of statewide importance are described as:

> *... those soils in land capability Class II and III that do not meet the criteria as Prime Farmland. These soils are nearly Prime Farmland and economically produce high yields of crops when treated and managed according to acceptable farming methods, Some may produce yields as high as Prime Farmland if conditions are favorable.*[9]

[8] USDA, Natural Resources Conservation Service/New Jersey. *New Jersey Important Farmlands Inventory*. < http://www.nj.nrcs.usda.gov/technical/soils/primefarm.html> Accessed March 18, 2009.

[9] USDA, Natural Resources Conservation Service/New Jersey. *Soils of Statewide Importance.* <http://www.nj.nrcs.usda.gov/soils/technical/importantfarm.html> Accessed March 18, 2009.

The accompanying map of Farmland Soils illustrates the location of both of the prime farmland soils and the farmland soils of statewide importance within Franklin. In the Township, 33.7% of the land is comprised of prime farmland soils and 50.8% is comprised of farmland soils of statewide importance. Together, these agricultural soils represent almost 85% of the Township.

Cherryville Farms, photo by George Trogler

Agriculture Development Areas

The ADA Map details the Agricultural Development Area (ADA) for the Township, as designated by the Hunterdon County Agriculture Development Board and the State Agriculture Development Committee. The purpose of the ADAs is to identify where agricultural operations are likely to continue in the future and therefore be eligible for the farmland preservation program. The ADA is also used to identify areas in which agriculture is the preferred land use. The county requirements for designating the ADA are a minimum contiguous area of at least 250 acres; the predominance of prime or statewide important soils; land use that is reasonably free of non-farm development; and the absence of public sewers. Landowner consent is also required for a parcel to be included within the Hunterdon County ADA. As shown in the ADA Map, the majority of the Township is included in the ADA, with the borders generally corresponding to areas containing prime farmland soils or farmland soils of statewide importance.

Preserved Farmland and Open Space

In November 2007, the Township completed a draft Farmland Preservation Plan (FPP), which provides an overview of the agricultural land base and industry in the Township, and outlines existing and future farmland preservation efforts. As detailed in the FPP, the Township has preserved over 2,200 acres of farmland, including 12 sites preserved under the County Easement Purchase Program, four sites preserved under the Municipal Planning Implementation Grant (PIG) Program, two sites preserved utilizing State Agricultural Development Commission (SADC) Direct Easement Purchase funds, and four sites preserved via non profit programs and donation of easements. The FPP also identifies 17 sites, totaling over 1,700 acres, that are targeted for preservation under the municipal or County Planning Incentive Grant (PIG) programs.

In addition to preserved farmland, the FPP notes that there are presently 168.5 acres of public or private conservation/environmental open space, plus 122.6 acres of County open space and 77.6 acres of State open space, for a total of 368 acres of preserved open space in Franklin. The accompanying map shows the location of preserved farmland and open space sites within Franklin, including the farms targeted under the Township's and County PIG program.

Hot Air Balloon, photo by Michel Gelinas

Historic Resources

As detailed in the Township's Master Plan, the area that was to become Franklin Township was first part of Bethlehem Township, formed in about 1730, then part of Kingwood Township when it was divided from Bethlehem in 1746. A further division of Kingwood led to the creation of Franklin Township in 1845. Prior to European settlement, Hunterdon County was settled by Native American Indians, with the earliest historic periods dating approximately 10,000 years ago.

Franklin is fortunate to have a legacy of buildings and sites from the 18th and 19th century that keep the Township connected to its past. As indicated on the accompanying Historic Districts Map, there are three historic districts within Franklin Township that are listed on the National and State Registers of Historic Places.

A brief description of each district is provided in a 2002 publication prepared by the Hunterdon County Cultural & Heritage Commission:[10]

Pittstown Historic District
Pittstown, located along the Capoolong Creek, was originally called Hoff Mills. The name was changed to Pitts Town in honor of William Pitt, the British nobleman. The district includes the recently renovated Century Inn, which was originally constructed in 1801 by More Foreman to celebrate the new century. The Pittstown Historic District was listed on the State Register on August 17, 1990, and on the National Register on October 11, 1990.

Quakertown Historic District
Quakertown is an 18th century settlement of members of the Society of Friends (Quakers). It is dominated by the Quaker Meeting House – the third Meeting House on this spot – and its cemetery to the rear. The village consisted of two stores, a school, two blacksmith shops and about 30 dwellings in 1880. The Quakertown Historic District was listed on the State Register on February 20, 1990, and on the National Register on August 23, 1990.

Rockhill Agricultural Historic District
The Rockhill Agricultural Historic District is named for the Rockhill family who lived there as early as 1731 and owned 846 acres. The district, which is primarily located in Union Township, includes 18th century farms, stone houses, barns and outbuildings, The district was listed on the State Register on June 25, 1980, and on the National Register on April 5, 1984. An extension of the district to include the Kingstown Mill and the Myers House was proposed in 1996, but has not been listed on the State or Federal register.

10 Hunterdon Co. Cultural & Heritage Commission, *Historic Sites and Districts in Hunterdon County, NJ*, Fall 2002.

In addition to these three historic districts, the Lehigh Valley Railroad Historic District, designated on the State Register, crosses through the northern portion of the Township. The Landsdown property, located in the northeast portion of the Township has been designated as an historic site on the State and National Registers. The location of this property is shown in yellow on the attached Historic Properties Map.

Stone Barn, photo by Robert McGeary

Conclusion

The NRI should be used as a guide in reviewing development applications. It can be referenced by the Land Use Board, and can also be downloaded by applicants in preparing their submissions. It is recommended that the Township's application checklist be amended to add a requirement that the applicant refer to the NRI in the process of preparing their application. In addition, the findings of the NRI should be incorporated into Franklin's land development design standards and in the Township Master Plan.

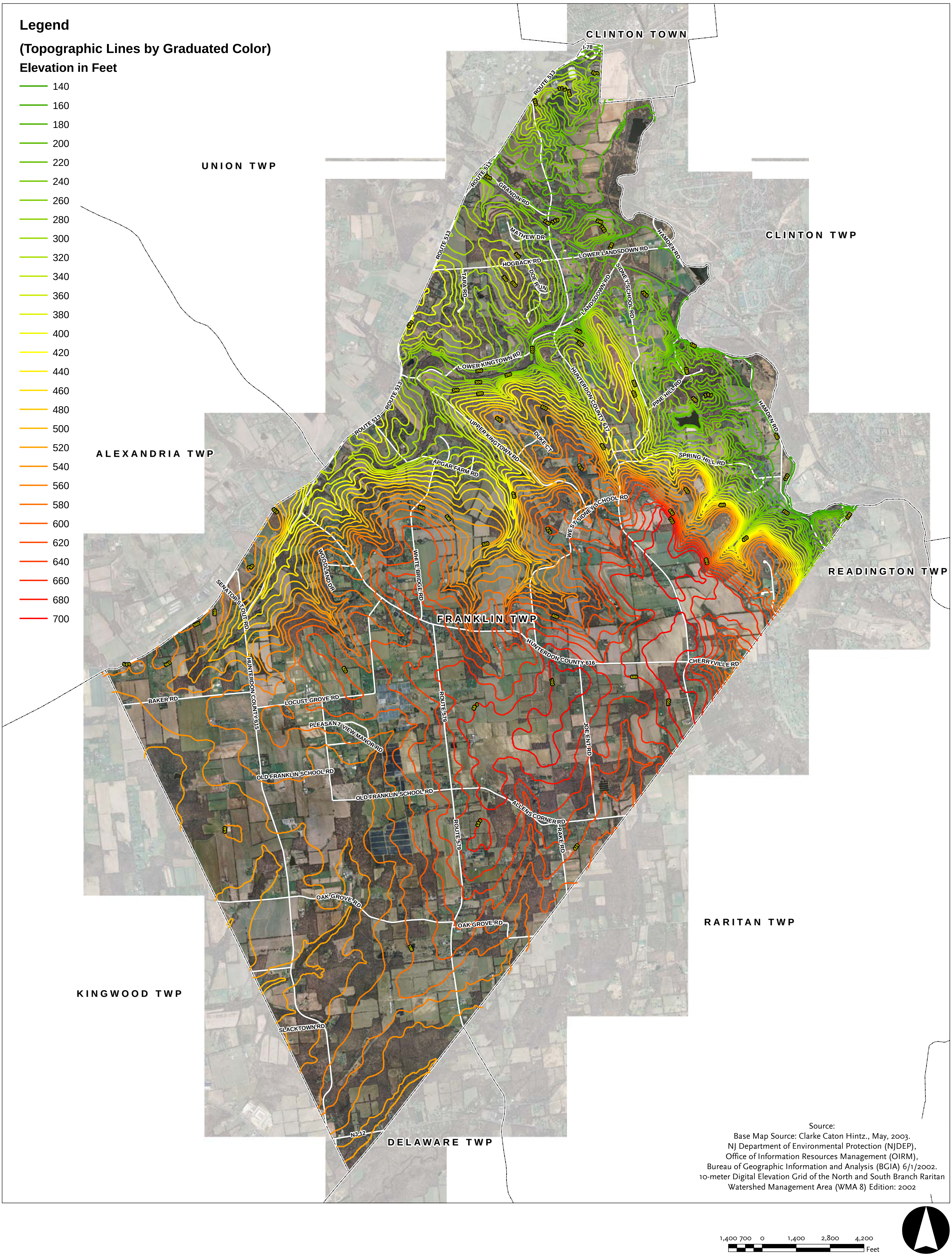
The NRI should also be utilized when the Township prepares any open space or farmland preservation grants.

Natural Resource Inventory

1 - Aerial

Franklin Township, Hunterdon County, NJ   December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



Natural Resource Inventory

2 - Elevation

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
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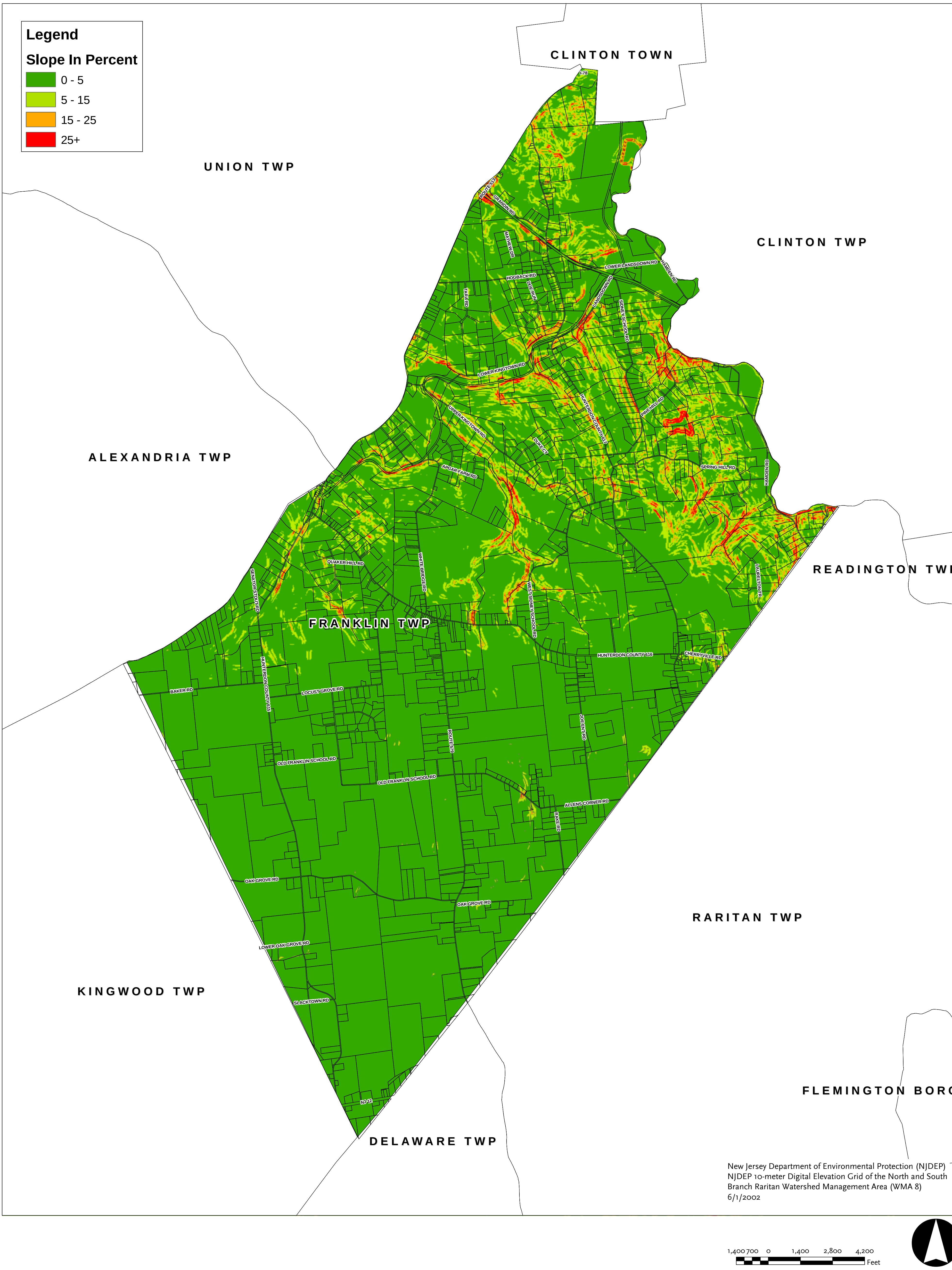
Planners
Landscape Architects



Natural Resource Inventory

3 - Steep Slopes

Franklin Township, Hunterdon County, NJ   December 2009

Clarke Caton Hintz
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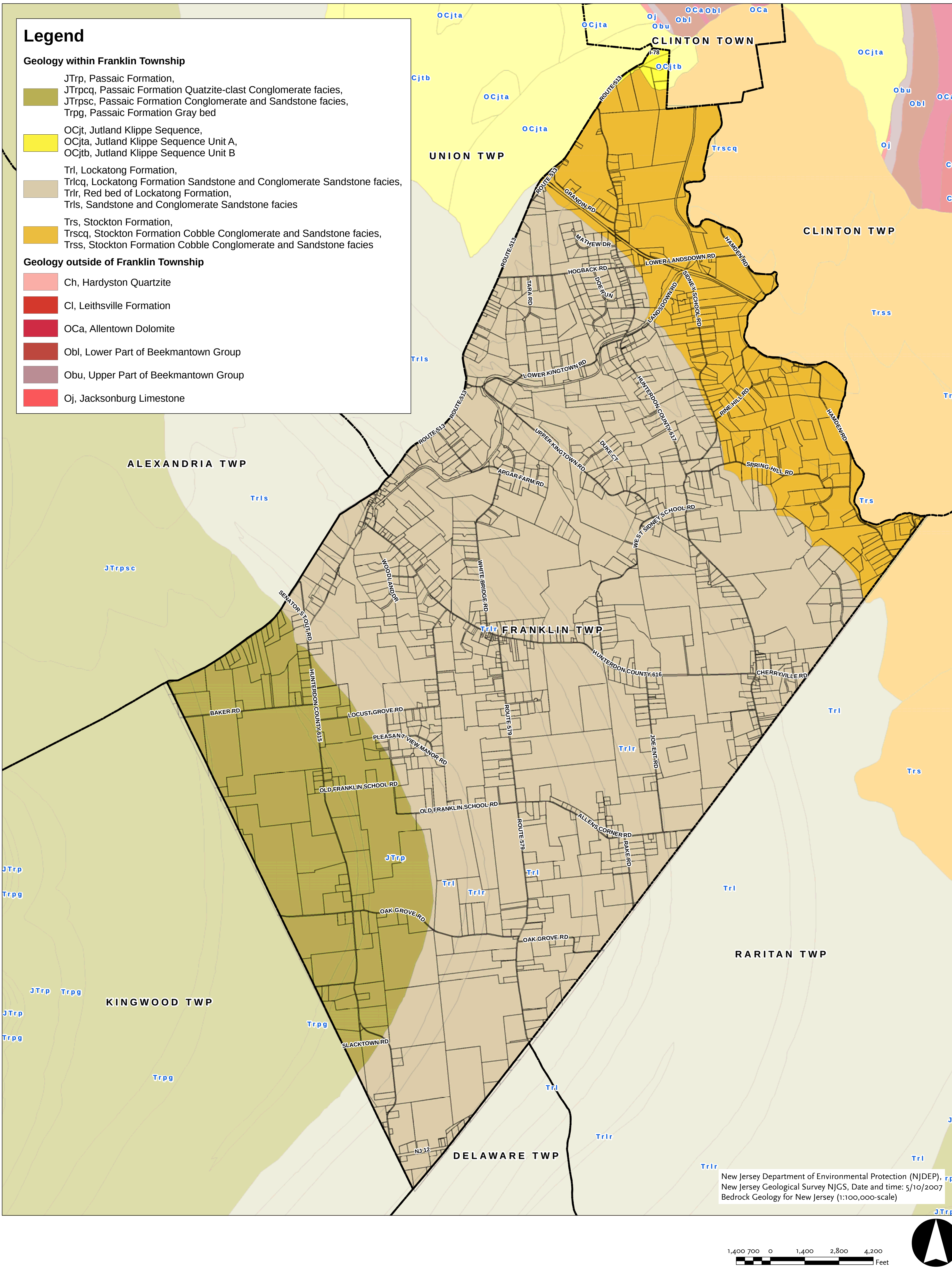
Planners
Landscape Architects



Natural Resource Inventory

4 - Bedrock Geology

Franklin Township, Hunterdon County, NJ December 2009

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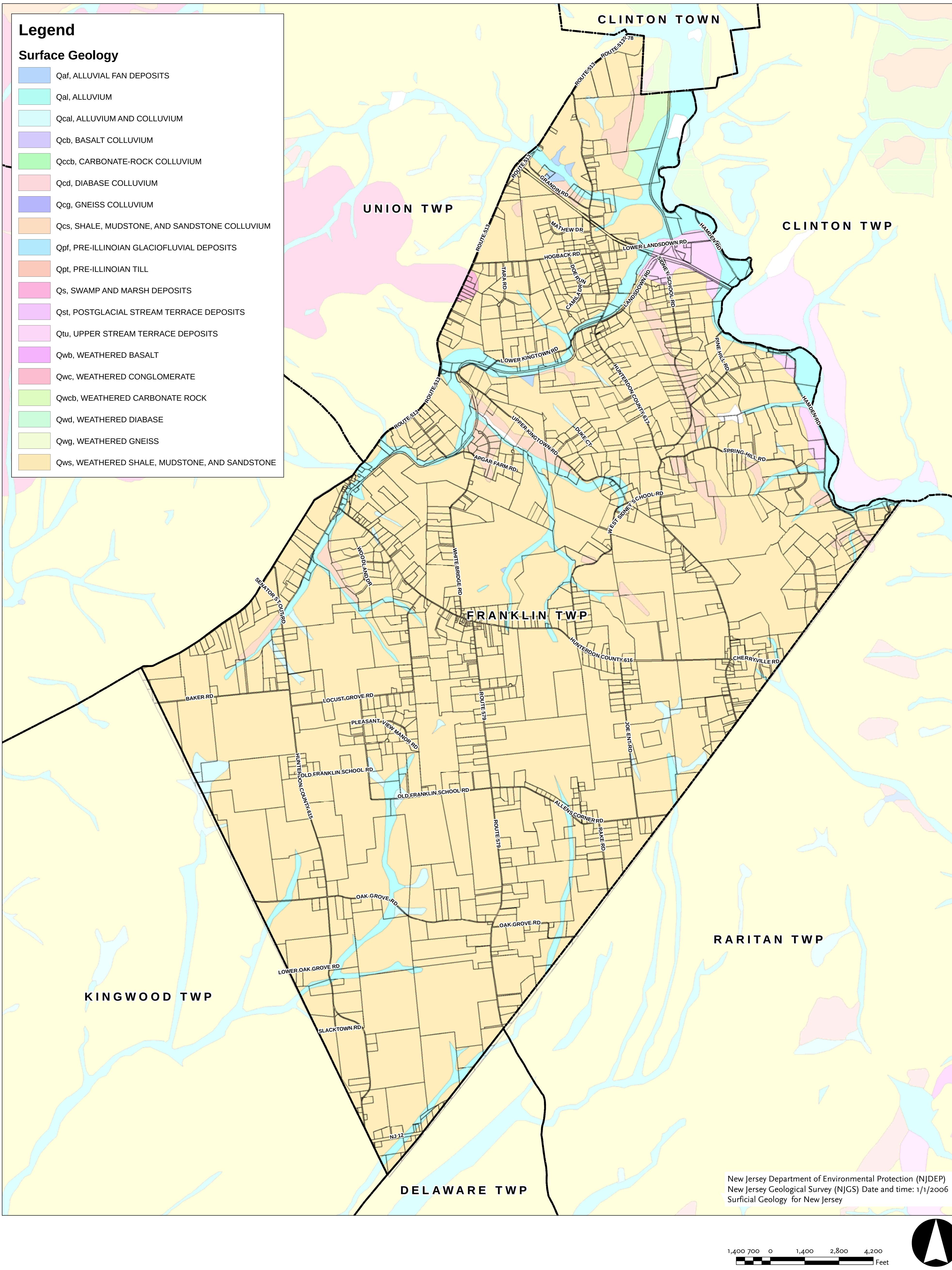

NATURAL RESOURCE INVENTORY

5 - Surficial Geology

Franklin Township, Hunterdon County, NJ December 2009

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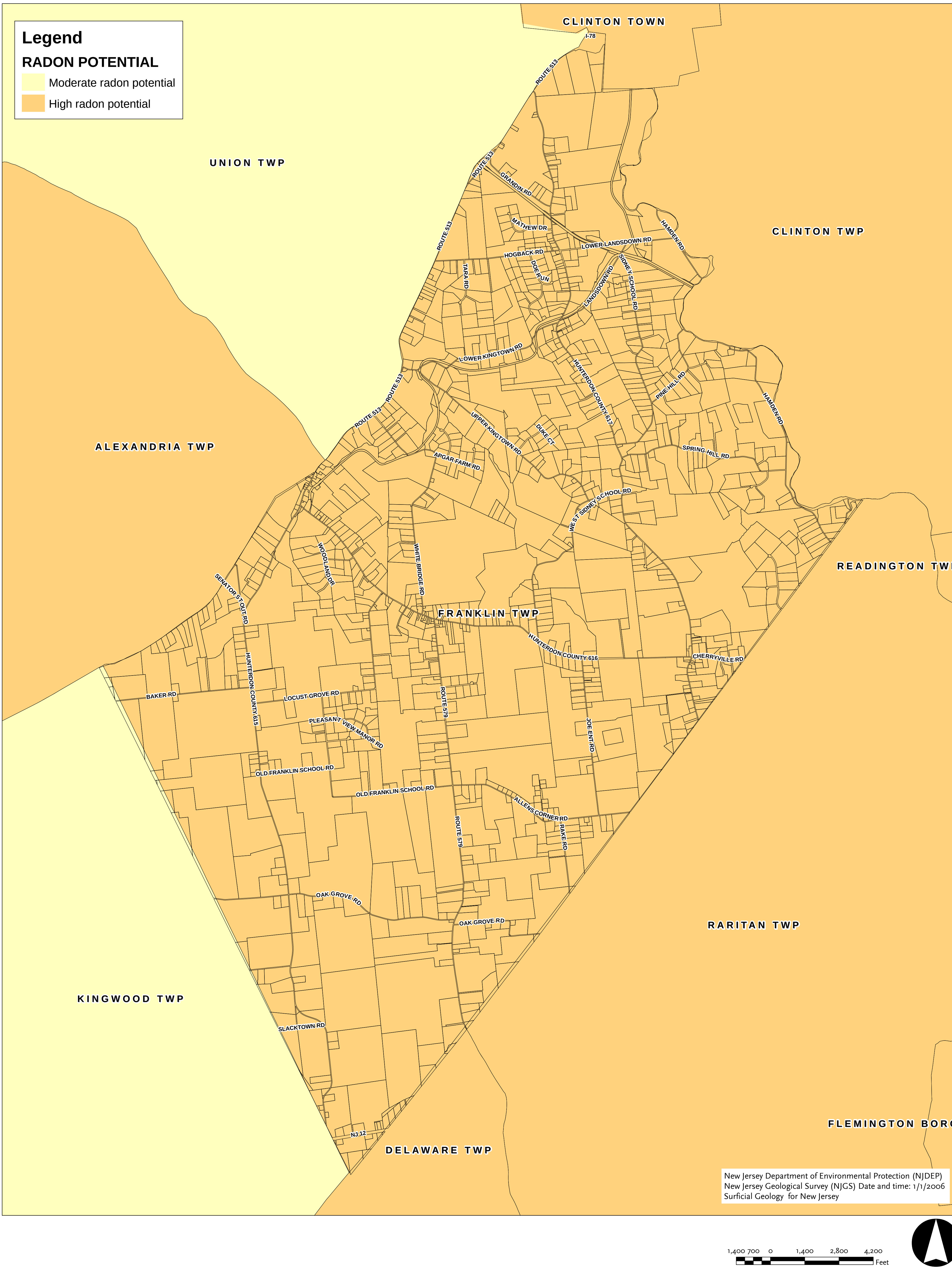
Architects
Planners
Landscape Architects

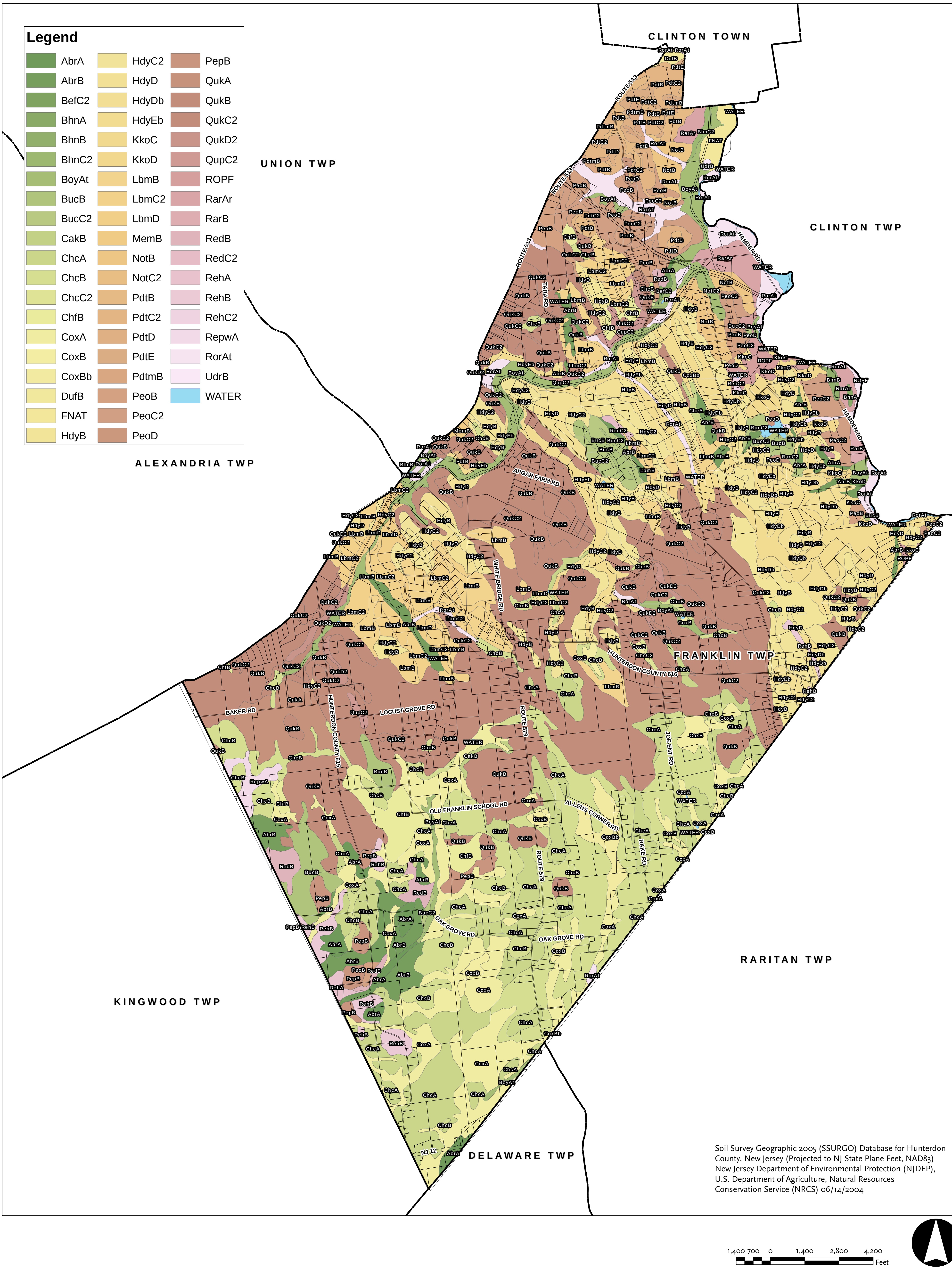


NATURAL RESOURCE INVENTORY

6 - Radon Potential

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects

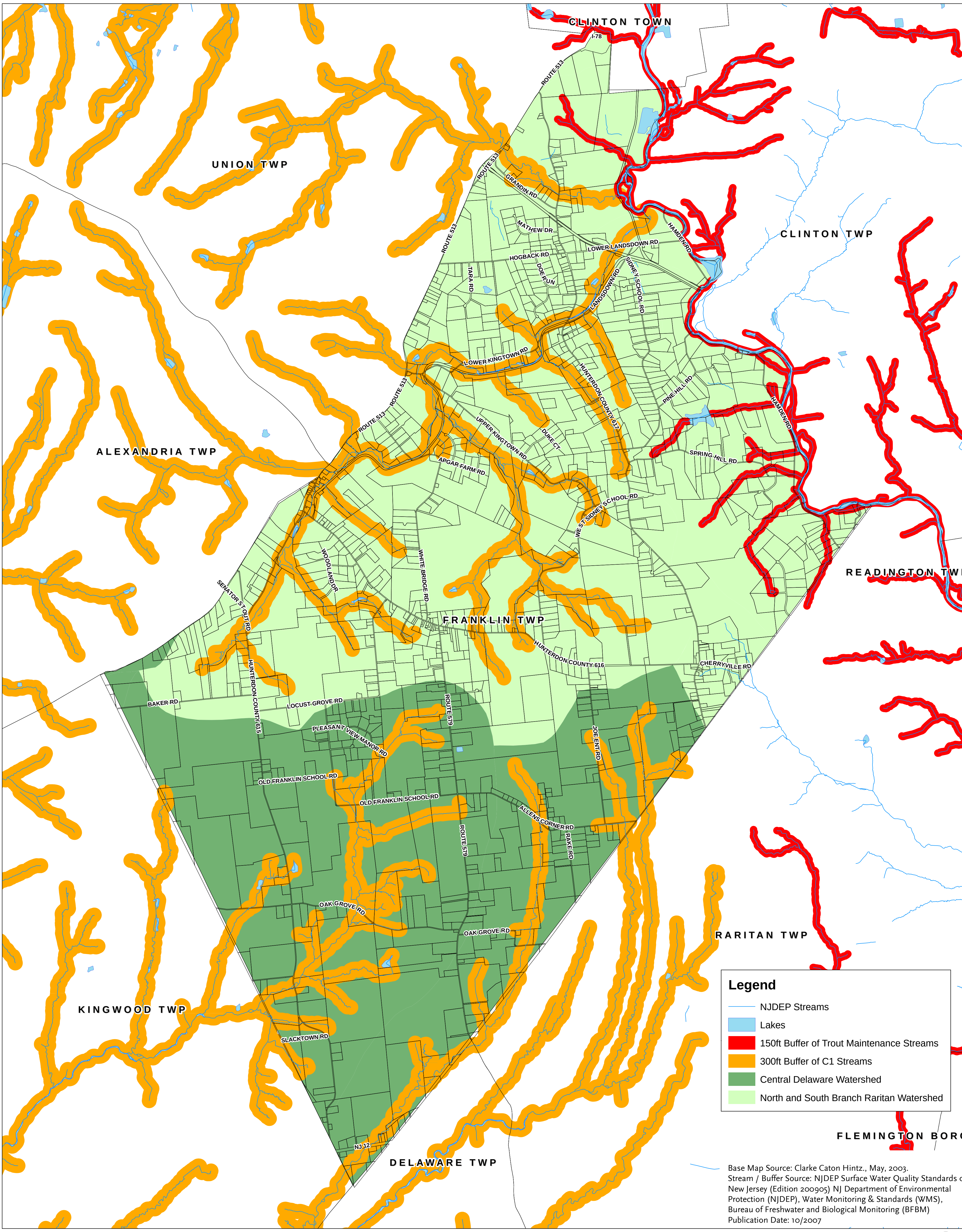


Natural Resource Inventory

7 - Soils

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



Note: The entire township is a headwaters for the Delaware River Basin and the Raritan River Basin..

1,400 700 0 1,400 2,800 4,200 Feet

Natural Resource Inventory

8 - Watersheds and C-1 Streams

Franklin Township, Hunterdon County, NJ December 2009

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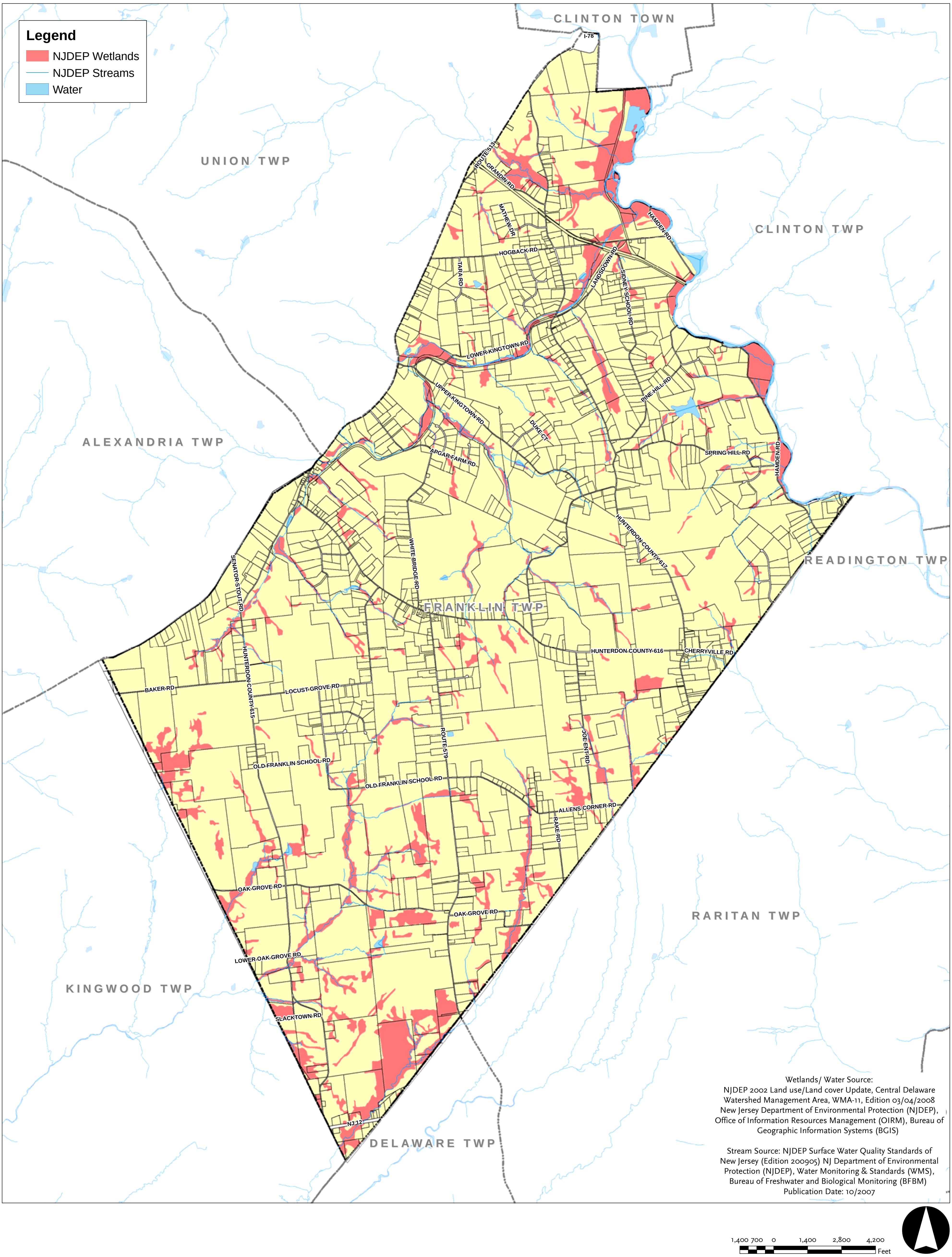
Architects
Planners
Landscape Architects



Natural Resource Inventory

9 - Wetlands

Franklin Township, Hunterdon County, NJ December 2009

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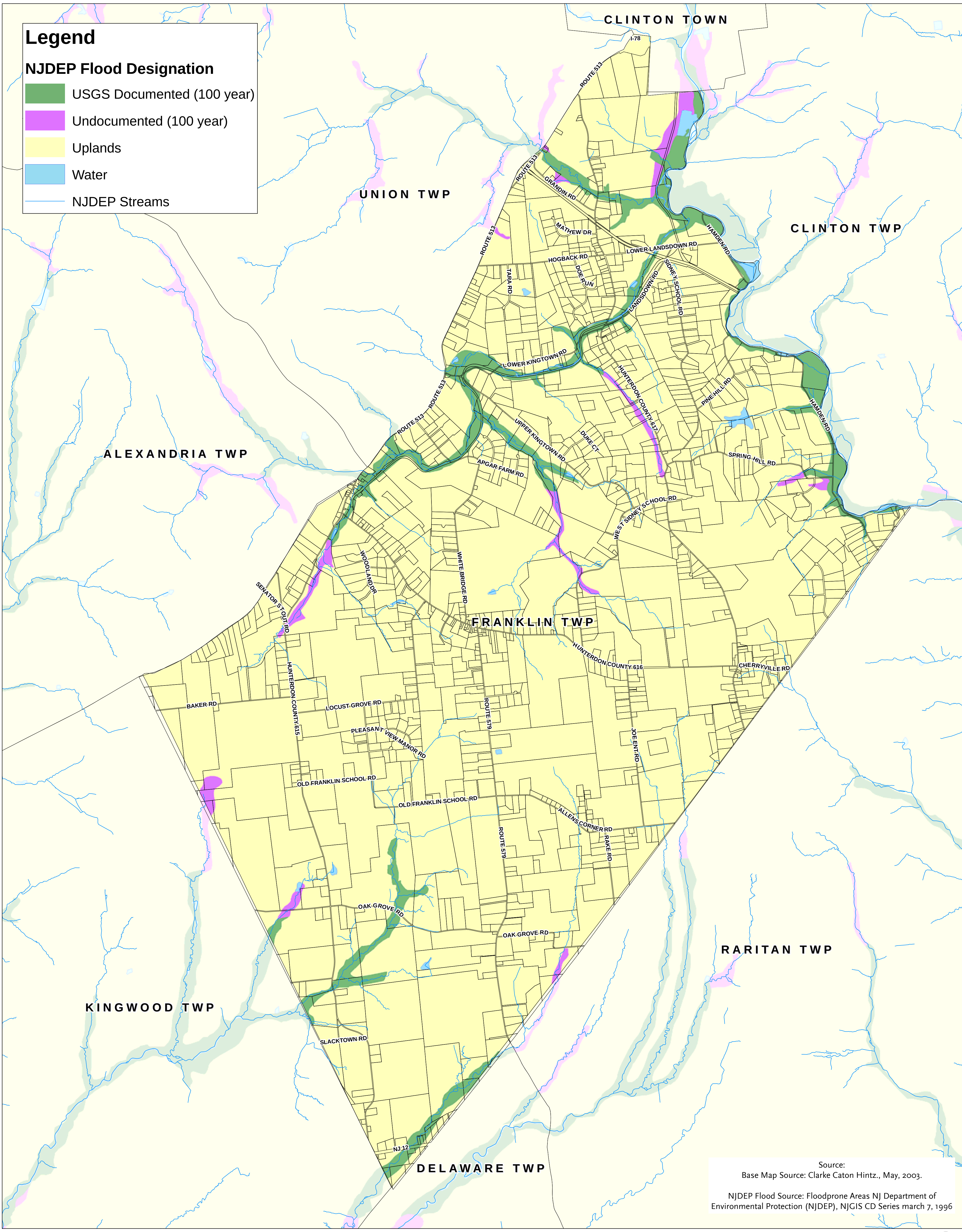
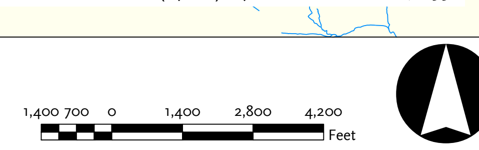
Landscape Architects





Natural Resource Inventory

10A - Floodprone Areas

Franklin Township, Hunterdon County, NJ December 2009

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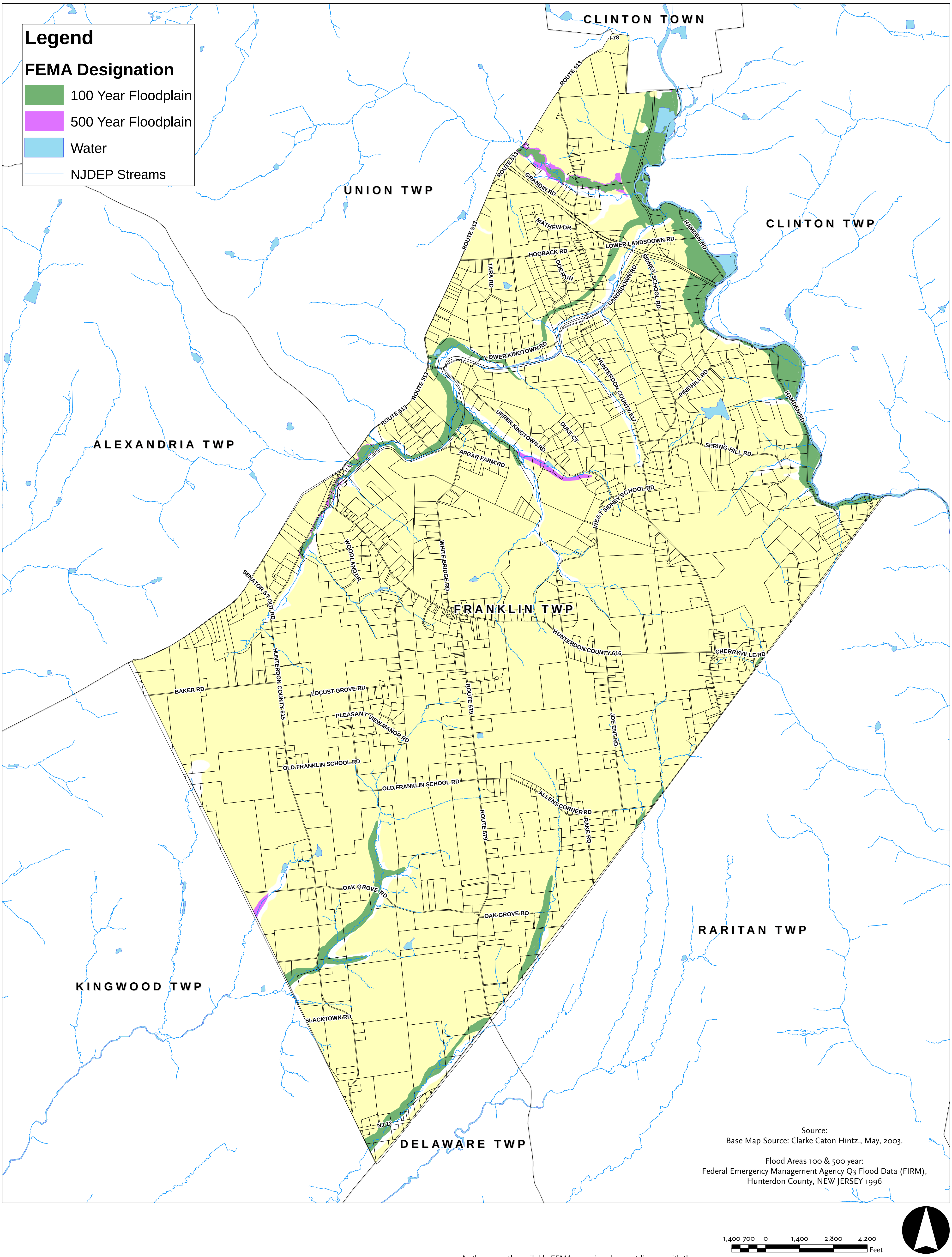
Landscape Architects



As the currently available FEMA mapping does not line up with the Township base map, a Floodprone Areas map is also provided, based on previous mapping by USGS that approximates flood plain areas. New FEMA mapping will be available early in 2010. For a more detailed analysis of a particular site, FEMA's individual Flood Insurance Rate Maps (FIRM) should be consulted.

Natural Resource Inventory

10B - Floodplains (FEMA)

Franklin Township, Hunterdon County, NJ December 2009

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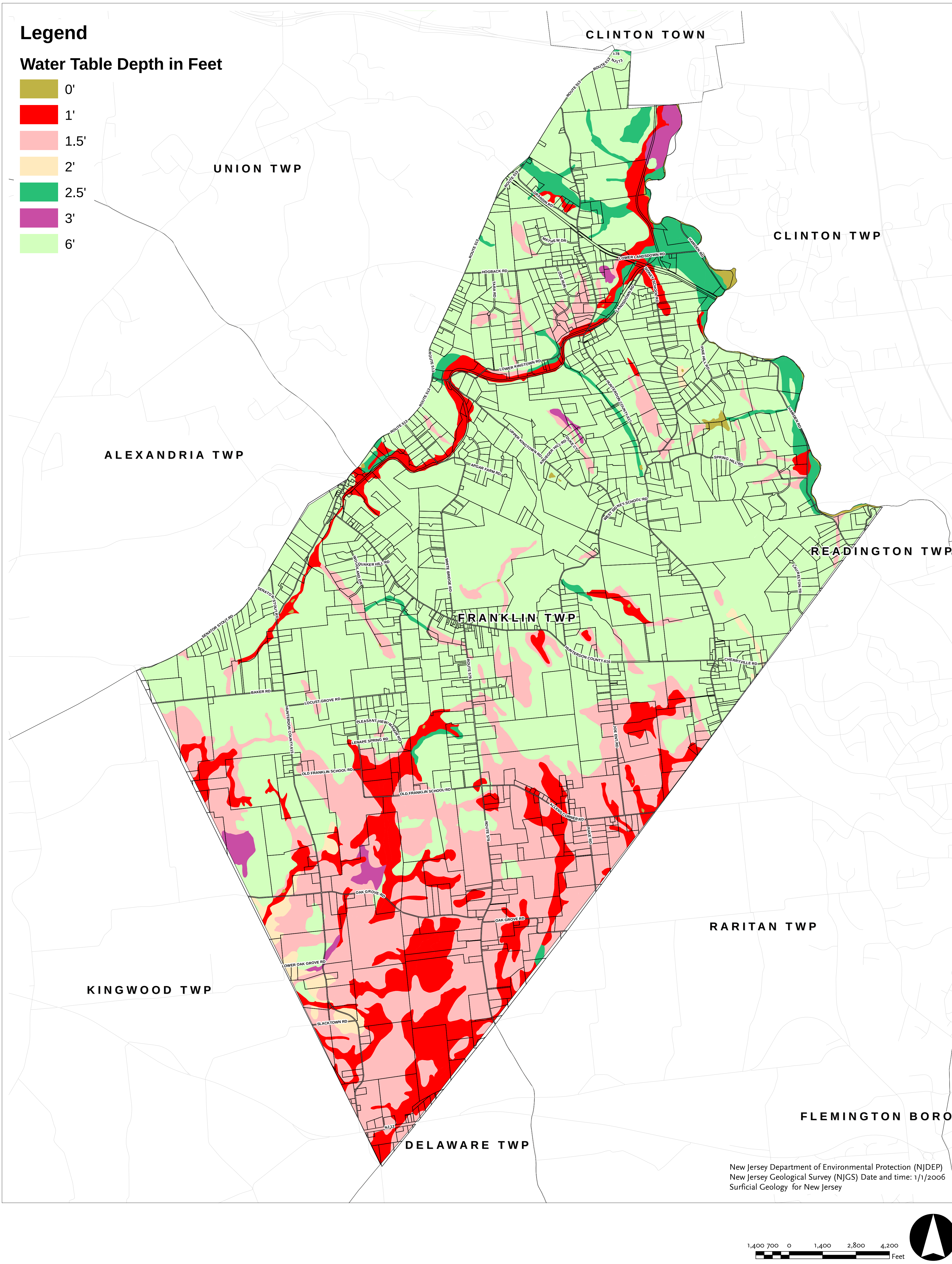
Landscape Architects



Natural Resource Inventory

11 - Minimum Depth to Seasonal High Water Table

Franklin Township, Hunterdon County, NJ December 2009

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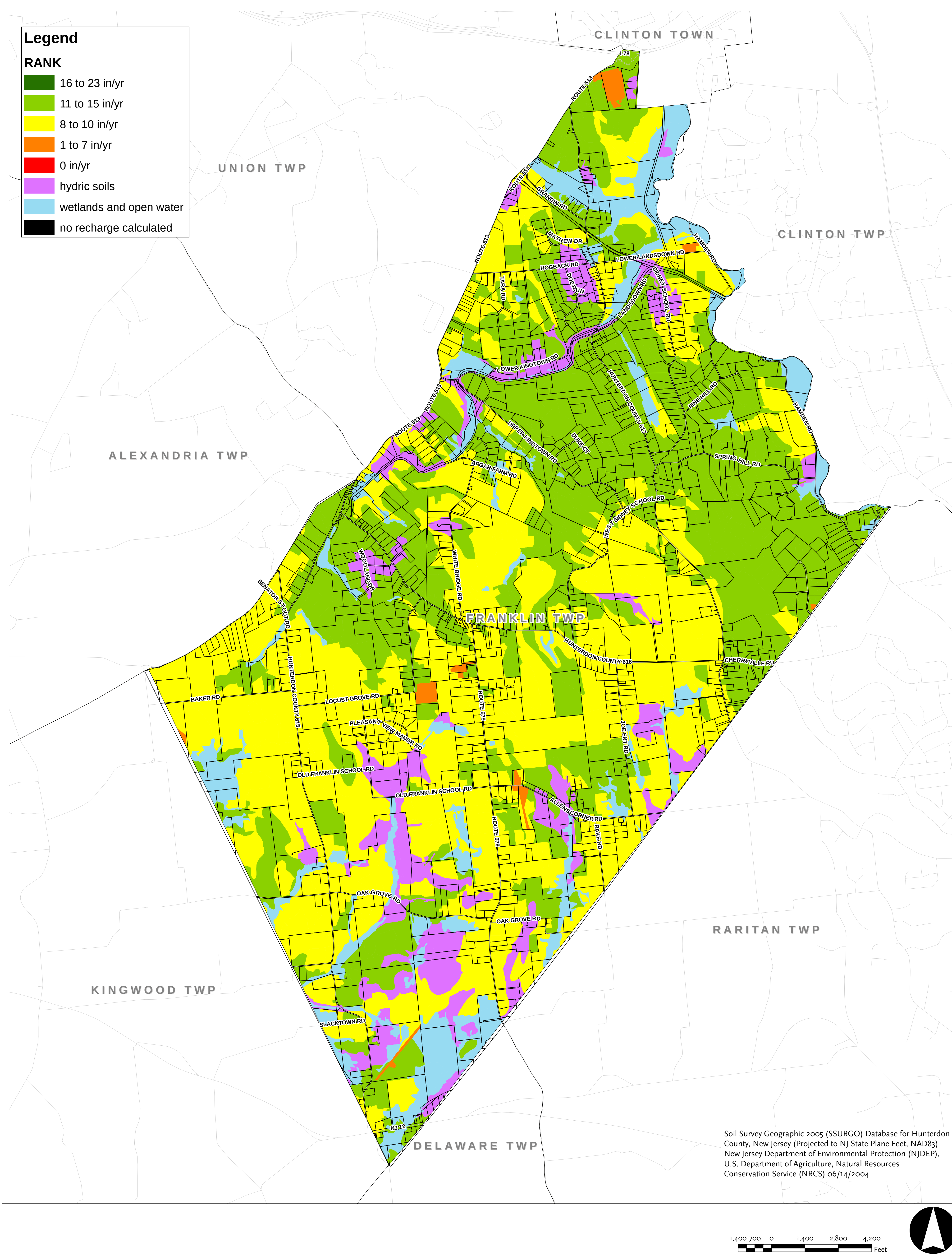
Landscape Architects

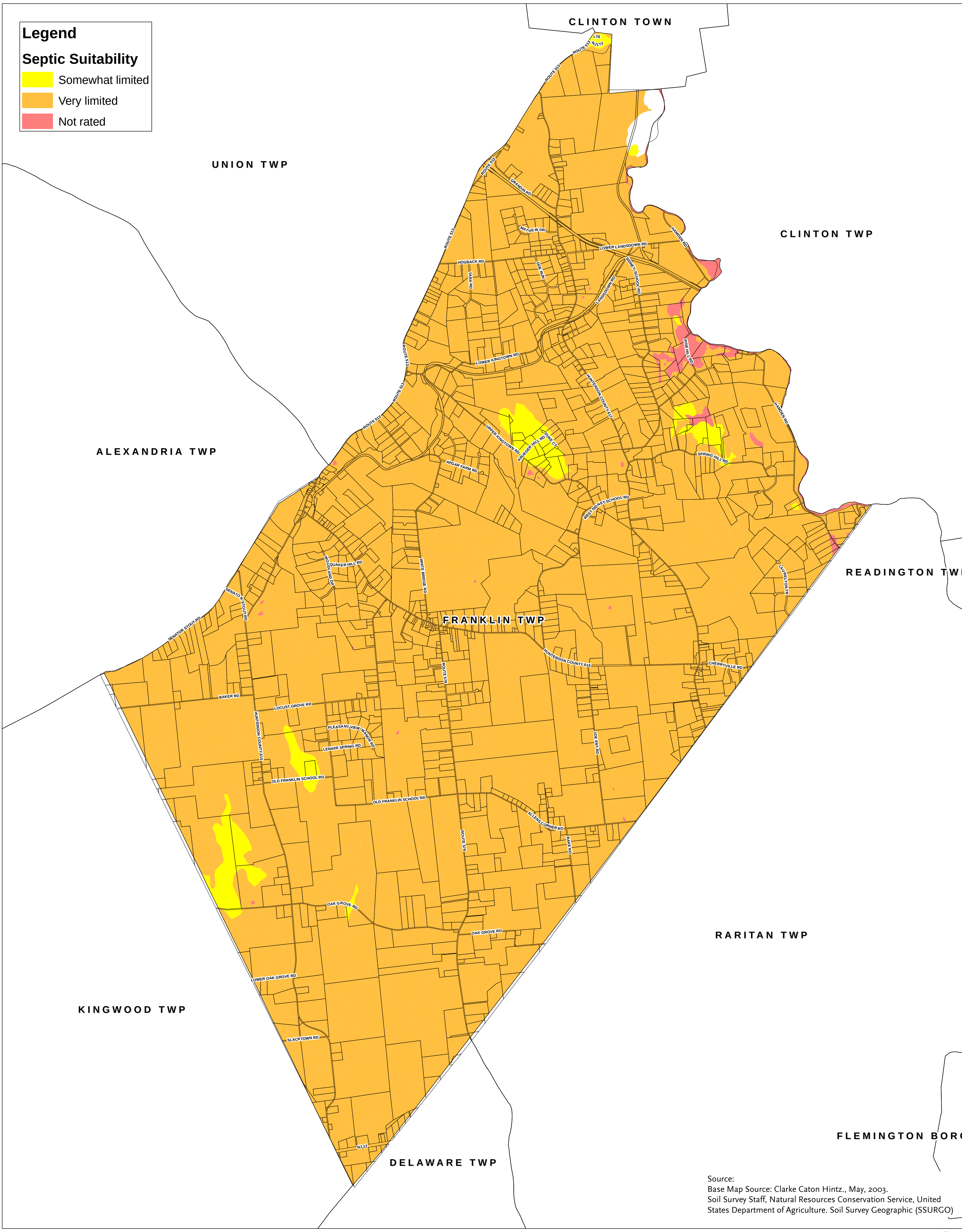


NATURAL RESOURCE INVENTORY

12 - Groundwater Recharge

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



1,400 700 0 1,400 2,800 4,200 Feet

NATURAL RESOURCE INVENTORY

13 - Septic Suitability (SSURGO)

Franklin Township, Hunterdon County, NJ December 2009

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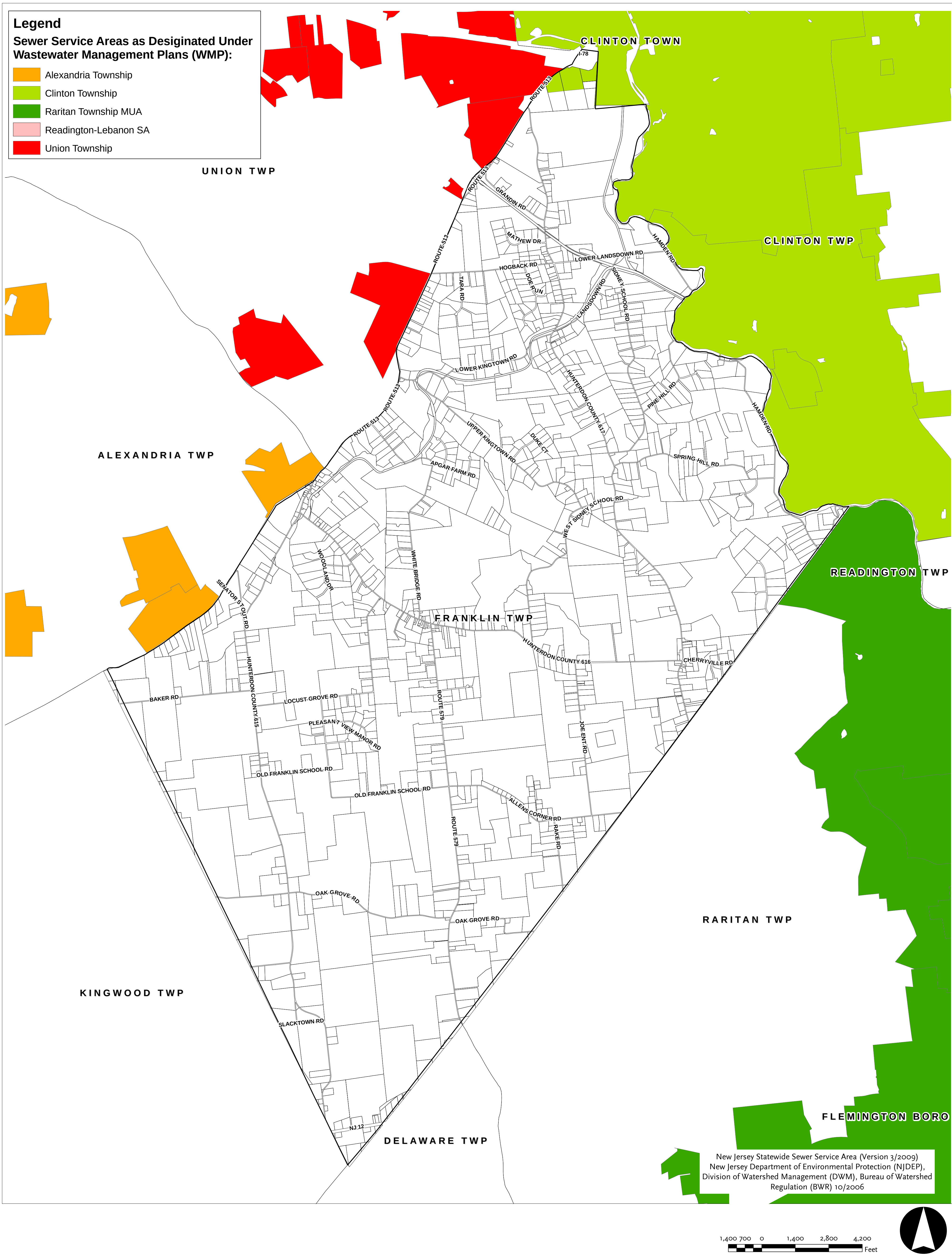
Landscape Architects

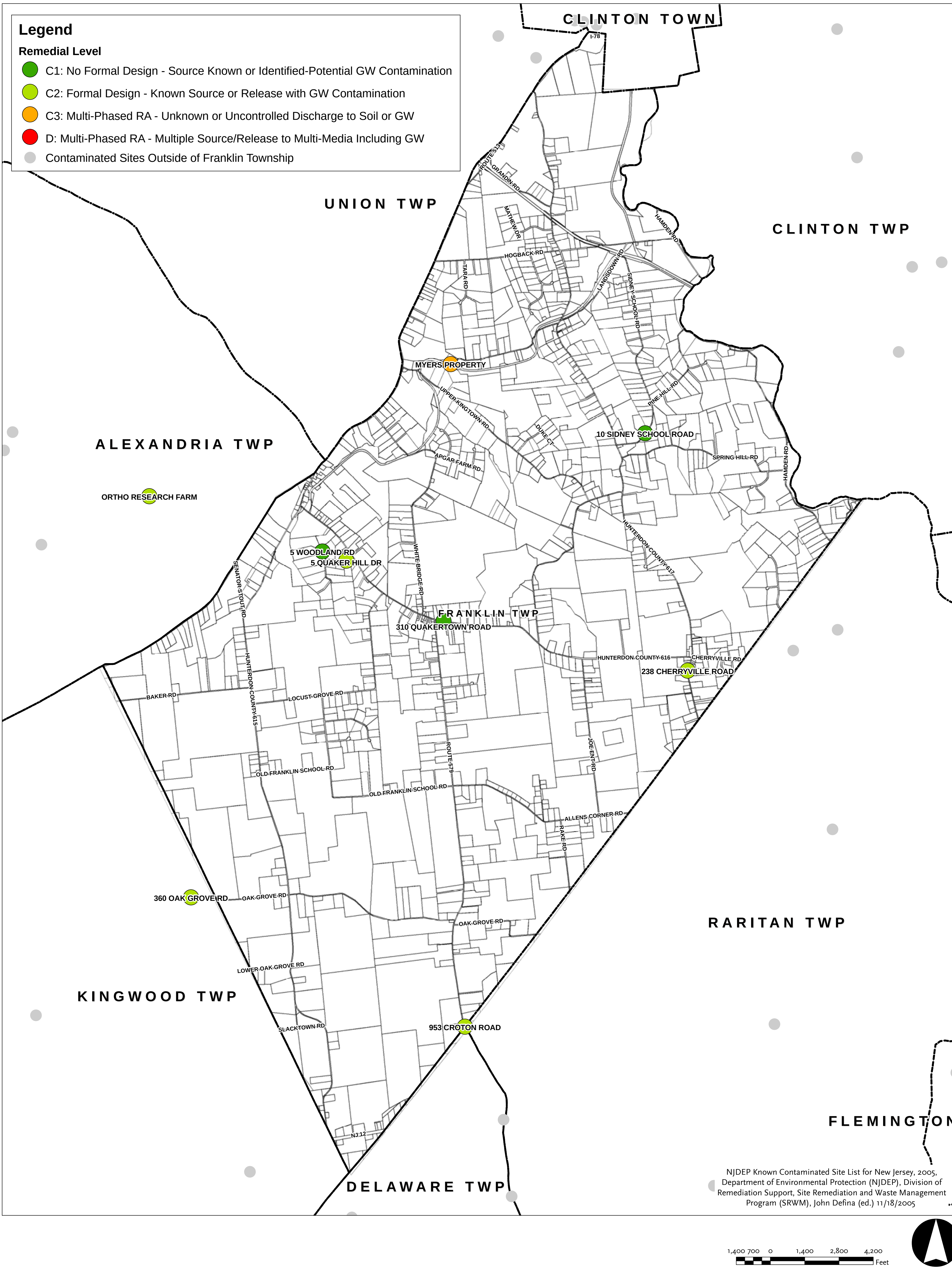


Natural Resource Inventory

14 - Sewer Service Areas

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



Draft Hunterdon County

15 - NJDEP Known Contaminated Sites (2005)

Franklin Township, Hunterdon County, NJ December 2009

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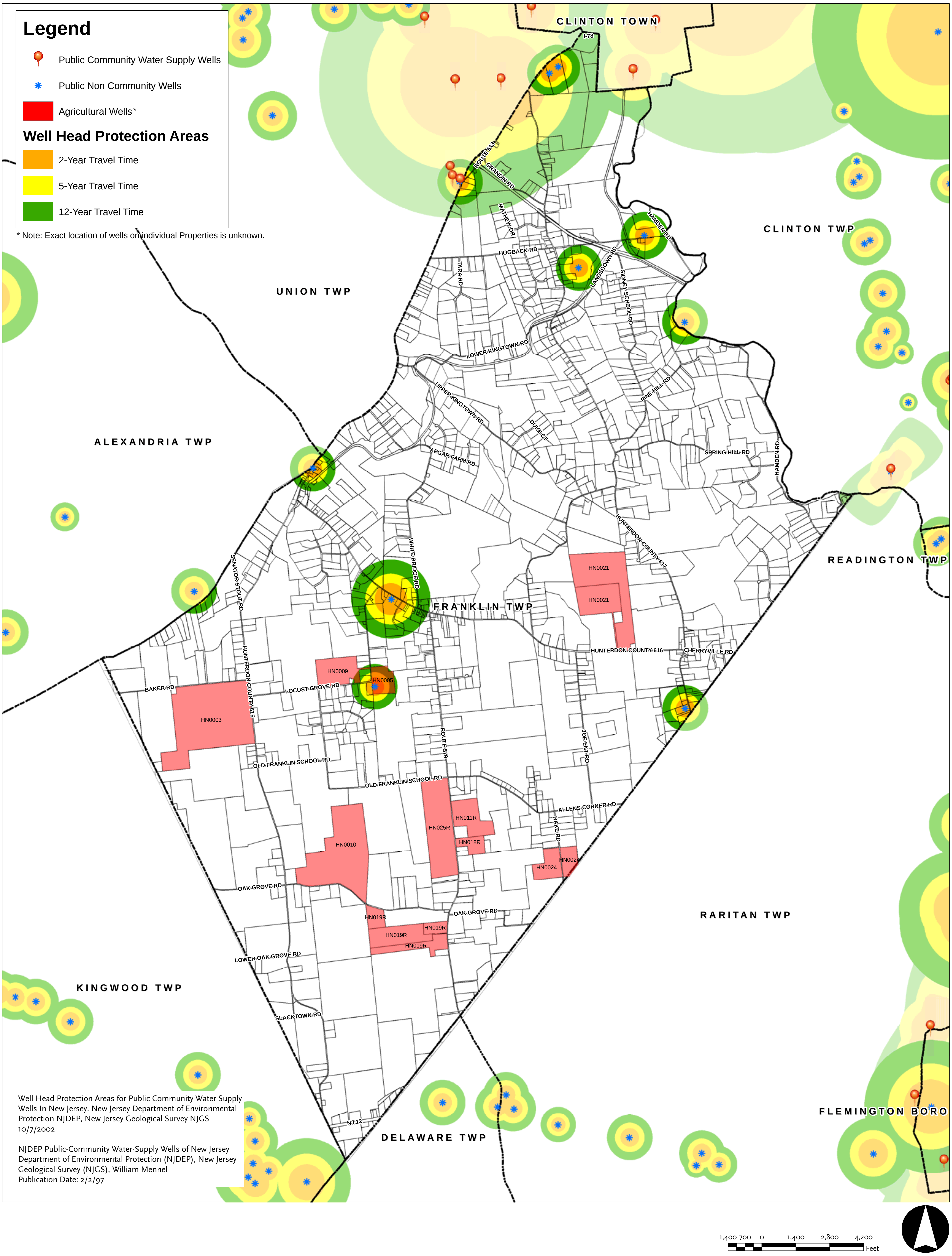
Landscape Architects



NATURAL RESOURCE INVENTORY

16 - Public and Agricultural Wells

Franklin Township, Hunterdon County, NJ   December 2009

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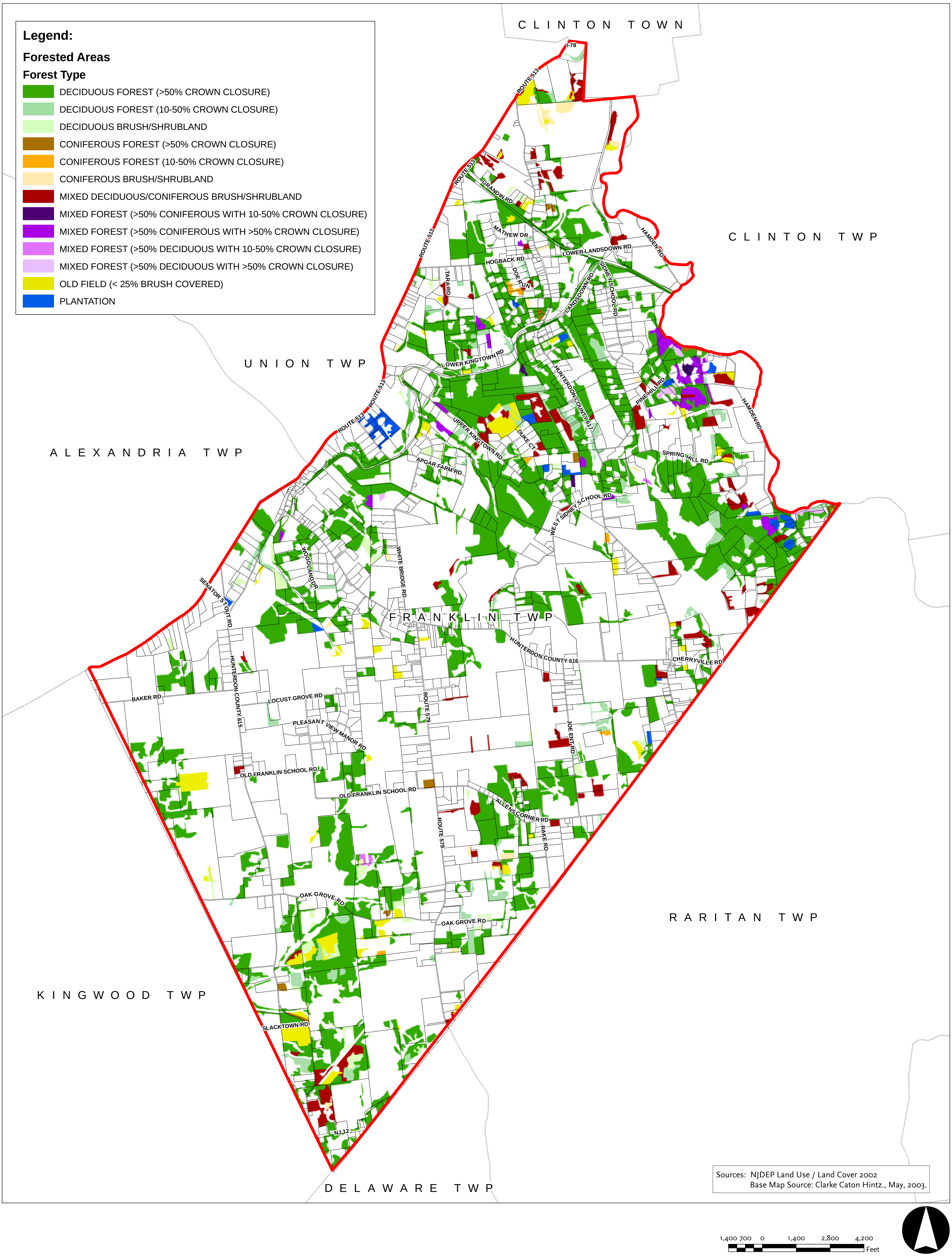
Landscape Architects



Natural Resource Inventory

17 - Forested Areas

Franklin Township, Hunterdon County, NJ December 2009

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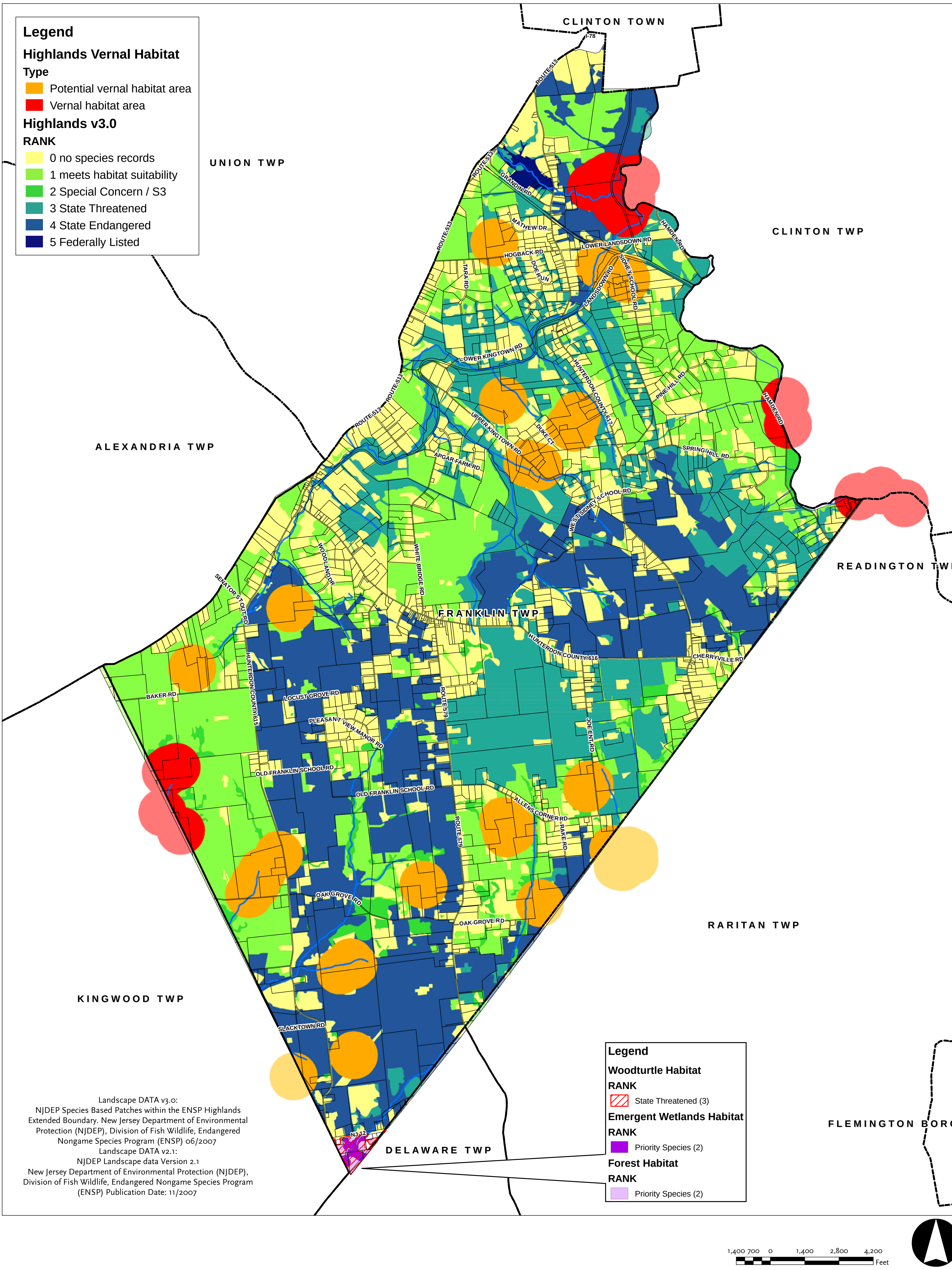
Planners
Landscape Architects

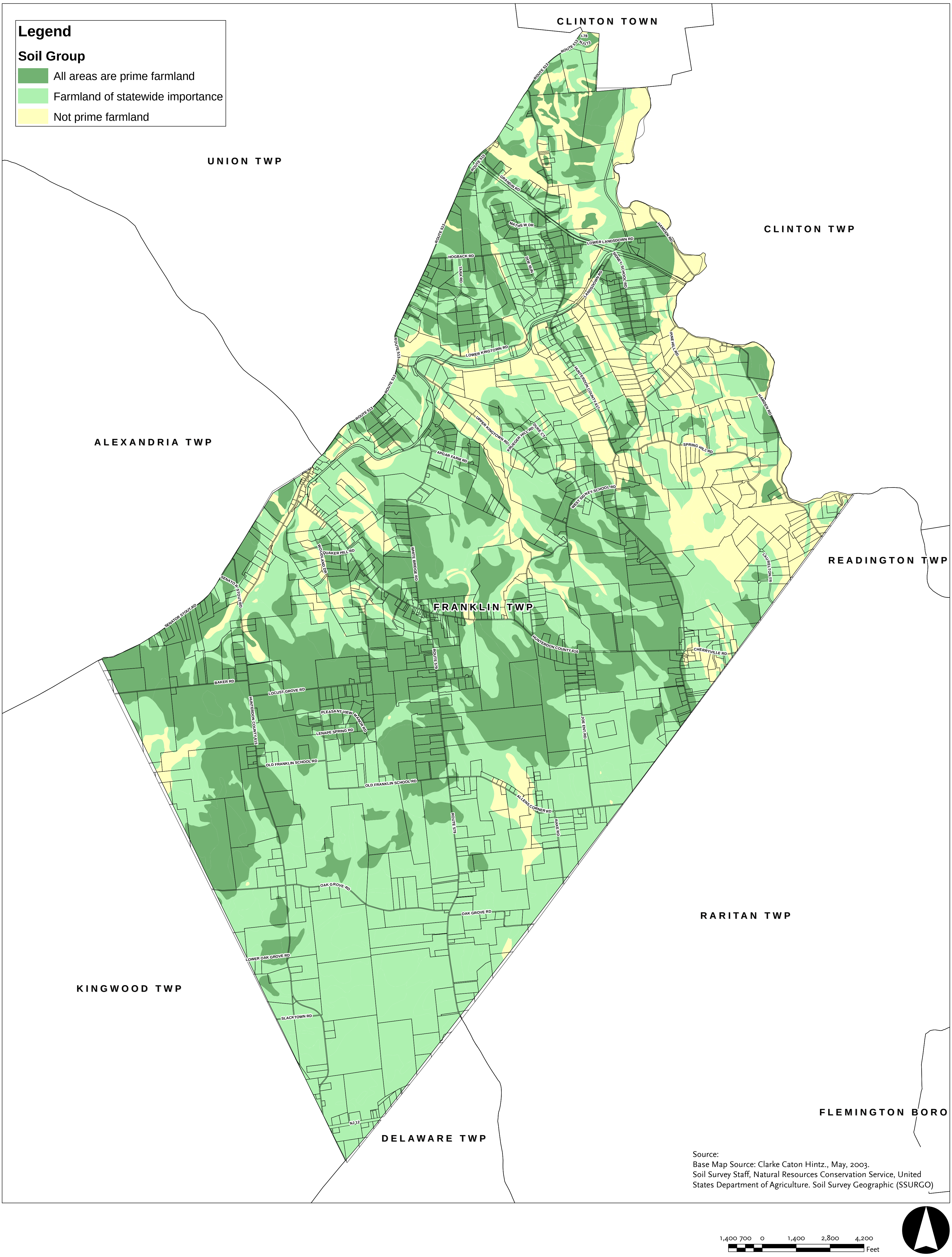


Natural Resource Inventory

18 - Landscape Project V3.0

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



Natural Resource Inventory

19 - Farmland Soils

Franklin Township, Hunterdon County, NJ December 2009

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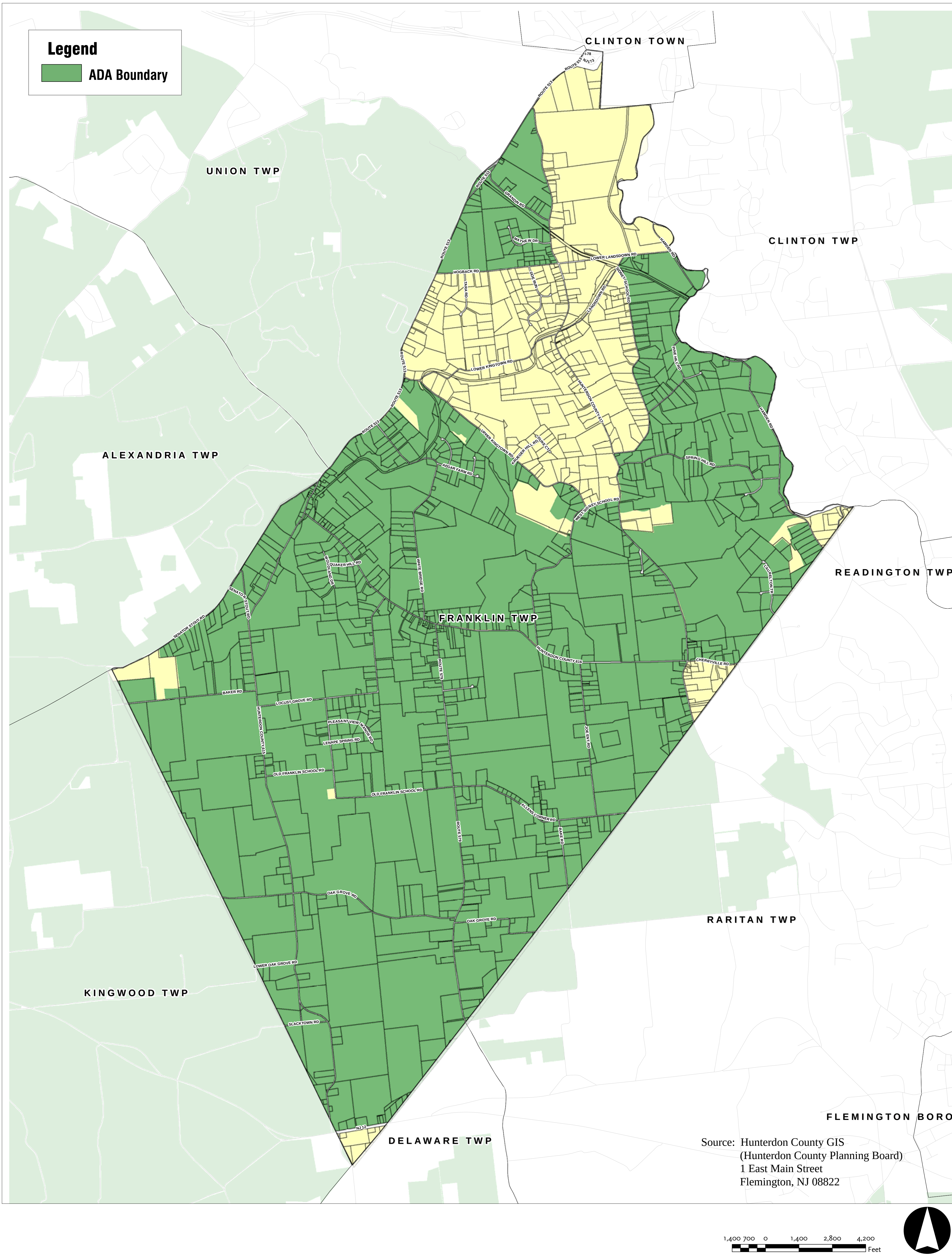
Landscape Architects

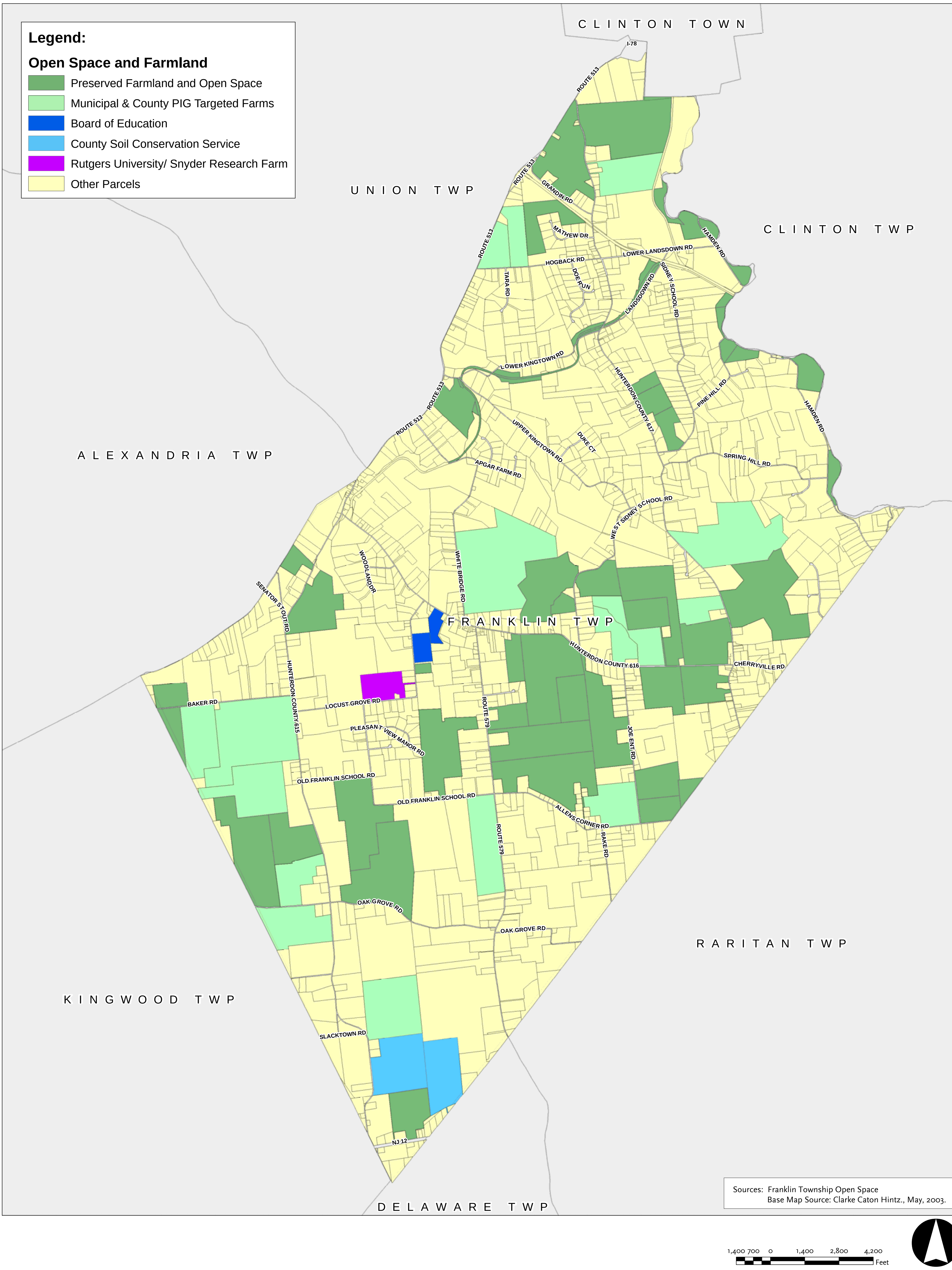


Natural Resource Inventory

20 - ADA Boundary

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



NATURAL RESOURCE INVENTORY

21 - Preserved Farmland & Open Space

Franklin Township, Hunterdon County, NJ December 2009

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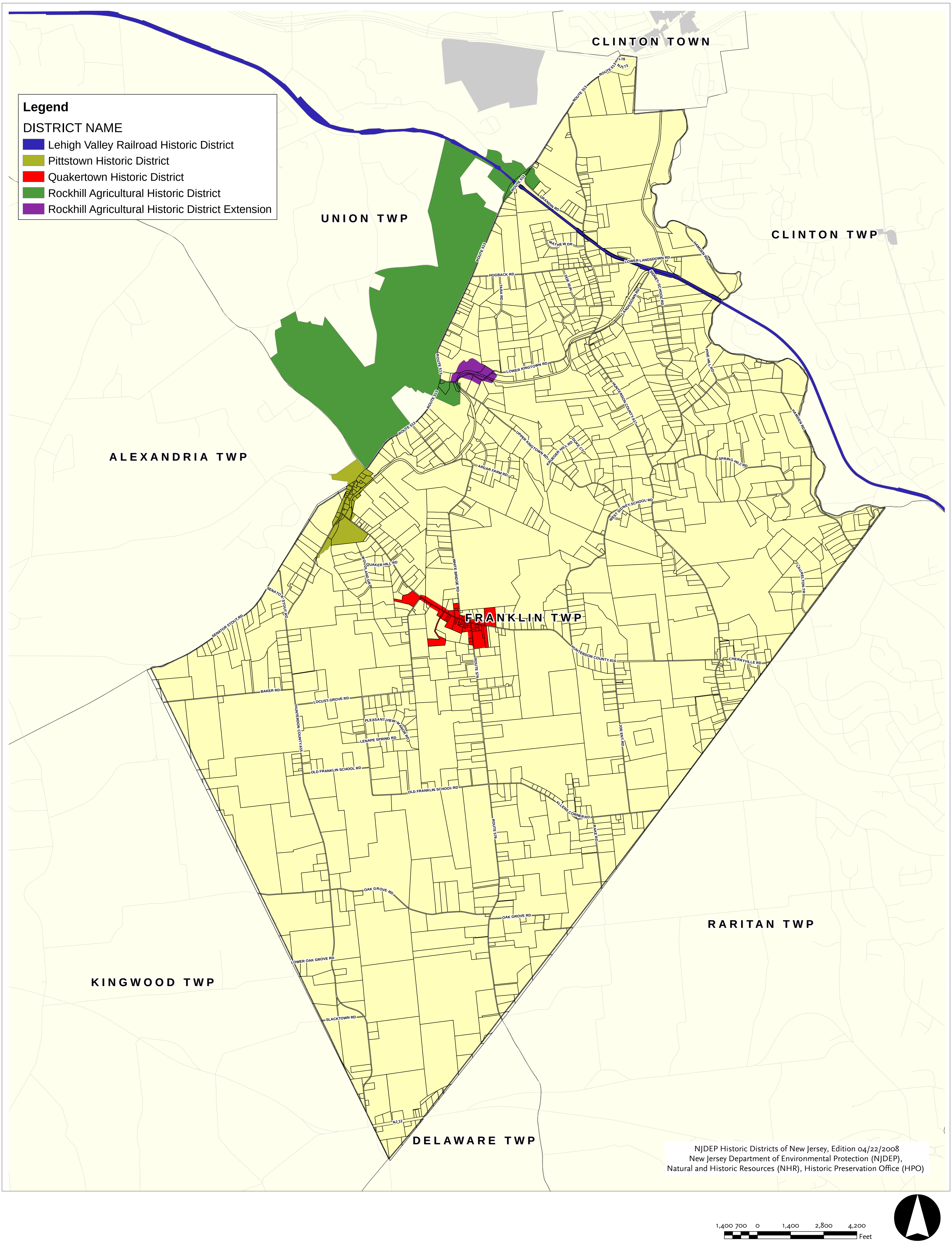
Landscape Architects

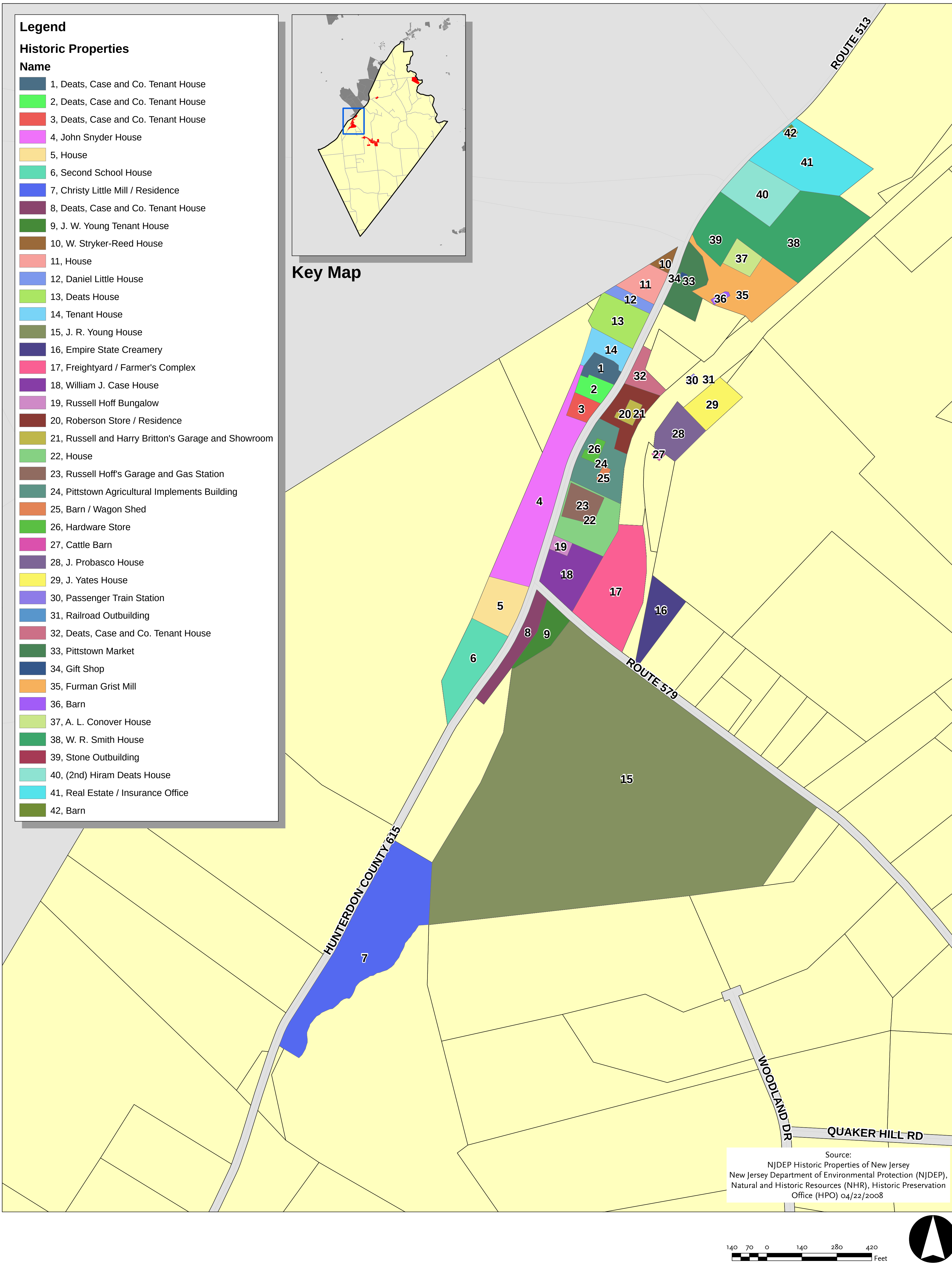


Natural Resource Inventory

22 - Historic Districts

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects

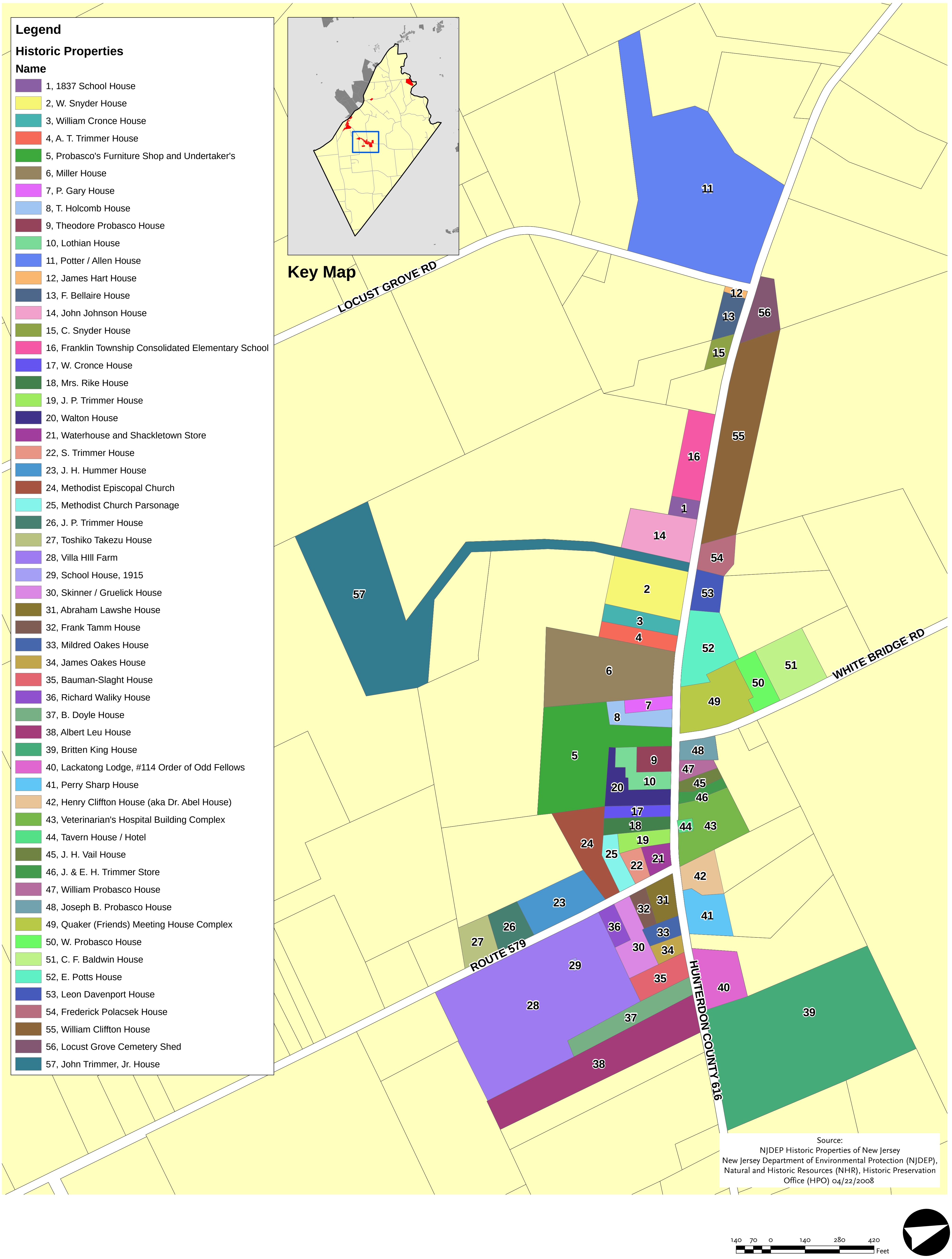


Natural Resource Inventory

23 - Historic Properties (1 of 3)

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects



Natural Resource Inventory

24 - Historic Properties (2 of 3)

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
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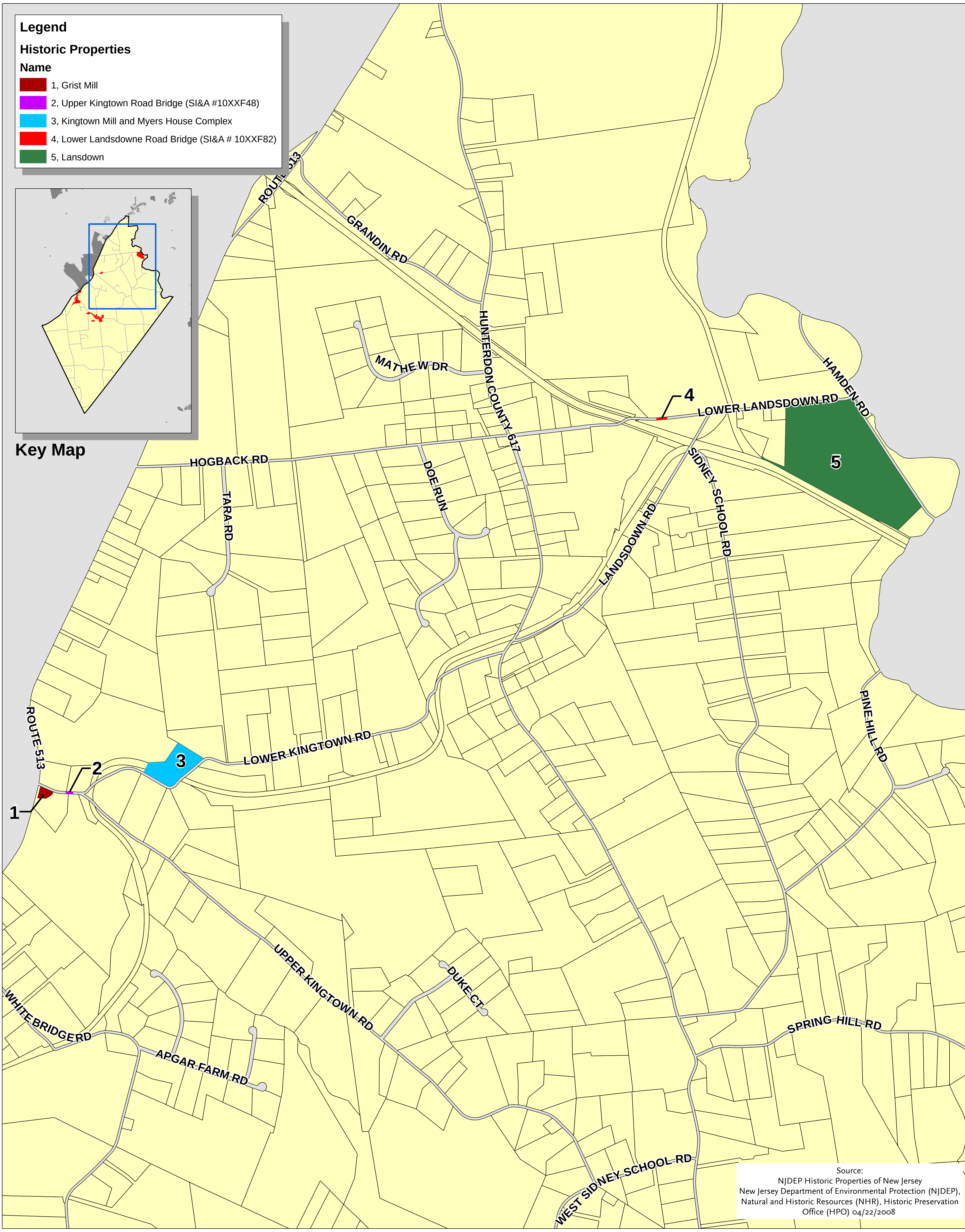
Landscape Architects



Natural Resource Inventory

25 - Historic Properties Map (3 of 3)

Franklin Township, Hunterdon County, NJ December 2009

Clarke Caton Hintz
Architects
Planners
Landscape Architects

Appendix A - Draft Nitrate Dilution and Lot Size Analysis Report, prepared by Uhl, Baron, Rana & Associates, dated February 28, 2007

NITRATE DILUTION MODELING AND LOT SIZE ANALYSIS
FRANKLIN TOWNSHIP, NEW JERSEY

1.0 INTRODUCTION AND BACKGROUND

In July 2006, Uhl, Baron, Rana & Associates, Inc. (UBR), a professional groundwater and environmental consulting firm, was retained by Franklin Township, Hunterdon County, New Jersey to:

1. Develop recharge estimates for the major geologic units underlying the Township for times of normal precipitation and below-normal precipitation (dry or drought periods) on the basis of existing studies that have been conducted for the geologic units underlying the Township;

2. Utilize these recharge estimates for nitrate dilution modeling for the major geologic units underlying the Township; and

3. Provide a range in lot sizes that meet the anti-degradation criterion for nitrate for the major geologic units underlying the Township during times of normal and below-normal precipitation.

2.0 STUDY AREA

Franklin Township is located in central Hunterdon County and is bounded by the Raritan River to the northeast; Raritan Township to the southeast; Delaware Township to the south, Kingwood Township to the southwest, and Alexandria and Union Townships to the west-northwest **(Figure 1** – Location Map and Major Stream Drainages).

The central part of the Township is characterized by an upland plateau area with the headwaters of the Lockatong, Wickecheoke and Assicong Creeks draining to the southwest and southeast. The northern part of the Township is traversed by Cakepoulth Creek and Sidney Brook which drain to the Raritan River to the east. **Figure 2** is a topographic map of the Township which also shows the major stream drainages.

Groundwater withdrawals are primarily for residential drinking water supply, farm uses such as livestock watering, small garden watering, institutional uses (schools, churches), small commercial uses, and irrigation for sod farms, landscaping and greenhouse farming.

There are no production wells within the Township that have an allocation permit for public and/or industrial supply. There are 13 agricultural water use permits within the Township with a total permitted capacity of 121.46 million gallons per month or 4.05 million gallons per day (mgd).

2.1 Geology

The Township is underlain entirely by bedrock units (sedimentary rocks) of Jurassic and Triassic age that include:

Trs, Trss, & Trscq – Stockton Formation;
Trl - Lockatong Formation;
Trls – Lockatong Sandstone and Conglomerate Sandstone facies;
Trlr – Lockatong Formation Red bed;
JTrp – Passaic Formation;
JTrpg – Passaic Formation Gray bed.

Franklin Township is underlain by Triassic-Jurassic (245 to 145 million years ago) sedimentary rocks. The oldest unit is comprised of the light-gray and yellow arkosic sandstone and sandstone conglomerates of the Stockton Formation. These bedrock units have a thin soil cover directly overlying weathered and competent bedrock. **Figure 3** is a geologic map of the Township.

The Stockton Formation (Trs, Trss & Trscq) underlies the north/northeastern part of the Township (3.37 mi^2 or 14.7 percent of the Township). This unit is predominately light-colored arkosic sandstone or a red-to-brown fine-grained siliceous sandstone. Interbedded with the sandstone are red shales and conglomerate.

The Lockatong Formation (Trl), as well as the Lockatong Sandstone and Conglomerate Sandstone facies (Trls) and Lockatong Formation Red bed (Trlr), underlie a significant portion of the Township (15.96 mi^2 or 69.7 percent) in its central and southeast areas. These formations interfinger with the upper beds of the Stockton Formation and the lower beds of the Passaic shales. The Lockatong units are principally comprised of dark gray and reddish brown argillite with mudstone and black shale.

The Passaic Formation (JTrp) is red shale with local beds of fine-grained red sandstone, siltstone, and black, gray or greenish shale. The Passaic Formation and the Passaic Formation Gray bed (JTrpg) underlie the southwest portion of the Township (3.57 mi^2 or 15.6 percent of the Township).

2.2 Hydrogeology

Groundwater in bedrock aquifer systems is stored and transmitted within and through fractures, joints, and bedding plane openings. The availability of groundwater in an individual hydrogeologic unit is a function of the degree and intensity of fracturing, and the degree of interconnection between fracture, joint and fault openings.

The Stockton Formation comprises a moderately yielding bedrock aquifer system in the Township. On the basis of an analysis (Kasabach, 1966) of 22 wells completed in the Stockton Formation and border conglomerates, average well yields were in the range of 10 (border conglomerates) to 21 (Stockton sandstone) gallons per minute (gpm) and average well depths ranged from 116 to 200 feet.

The Lockatong Formation comprises one of the lowest yielding aquifers in New Jersey, has no primary porosity or permeability, and all groundwater is transmitted through fracture and joint openings which are often widely spaced and tight. On the basis of an analysis (Kasabach, 1966) of 25 wells completed in the units of the Lockatong Formation, the average well yield was on the order of 13 gpm and the average well depth was 164 feet.

The Passaic Formation outcrops over a small portion of the Township and there is limited data available for wells completed in this formation in the Township. In general, the Passaic Formation has similar yield characteristics to the Stockton Formation and comprises a moderately yielding aquifer system.

3.0 GROUNDWATER RECHARGE ANALYSIS

3.1 Principal Aquifer Systems

The principal aquifer systems in the Township may be grouped from highest to lowest yielding as follows:

Stockton Formation
Passaic Formation
Lockatong Formation

3.2 Overview of Relevant Studies

There have been a number of studies and field-based projects that have evaluated groundwater recharge to the three types of bedrock units that comprise the principal aquifer systems underlying the Township. A brief overview of relevant studies and reports is provided below and the recharge values derived from these studies are provided in **Table 1**.

NJGS, 1974: The New Jersey Geological Survey published a study (Land Oriented Reference Data System (LORDS)) that evaluated groundwater recharge to all of the principal aquifer units in the state during periods of average and below-average precipitation. The recharge estimates for the three principal aquifer systems underlying the Township (Stockton, Lockatong and Passaic Formations) are summarized in **Table 1.**

Hordon, 1984 (Sourland Mountain Report); and M2 Associates, Inc. and Demicco and Associates, 2004 (Sourlands Smart Growth Project): Dr. Hordon evaluated groundwater recharge to the bedrock units in the study area (which included the Stockton, Lockatong and Passaic Formations) on the basis of streamflow hydrograph separation methods and the average well yield ratios for the rock types underlying the study area.

M2 Associates and Demicco and Associates provided an overview of several methodologies that are utilized to evaluate groundwater recharge including baseflow evaluation from hydrograph separation, flow duration analysis, as well as analyses conducted by researchers in the region (Posten, 1982 and 1984; and Hordon, 1984, 1987, and 1995) and work conducted by the United States Geologic Survey (USGS) (Schreffler, Curtis L., 1996). The 2004 Sourlands study arrived at groundwater recharge rates of 610 gpd/acre or 390,000 gpd/mi^2 in a normal year for the Stockton and Passaic Formations, and 260,000 gpd/mi^2 in a drought year for these formations. The derived groundwater recharge rates were 150,000 gpd/mi^2 in a normal year and 100,000 gpd/mi^2 for a drought year in the Lockatong Formation.

Hordon, 1987 and 1995: Dr. Hordon also evaluated data for the Wickecheoke and Lockatong Creeks in Kingwood and Delaware Township. Both of these creeks have their headwaters in Franklin Township and drain the central to southern parts of the Township before entering Delaware and Kingwood Townships. Dr. Hordon arrived at groundwater recharge rates in the range of 80,000 gpd/mi^2 for the geologic units (Lockatong Formation) that contribute to these two creek systems.

The groundwater recharge estimates derived from Dr. Hordon's studies and those of M2 and Demicco and Associates are summarized on **Table 1.**

Posten, S.E., 1982 and 1984: Posten conducted field studies for a small watershed (Walnut Brook) which lies just to the east of Franklin Township and is underlain by the Lockatong Formation. Posten arrived at groundwater recharge values of 300,000 gpd/mi^2 for a year of average or normal precipitation, and 92,000 gpd/mi^2 for a drought year in this formation, as shown on **Table 1**.

Schreffler, Curtis. L., 1996 (USGS Base-Flow Study): In an unstressed drainage basin with minor groundwater withdrawals (e.g. for private well residential use only), groundwater recharge is equivalent to dry weather stream base flow. In this study of the Neshaminy Creek drainage basin in Bucks County Pennsylvania, the USGS developed base-flow recurrence intervals for the Stockton and Passaic Formations. The USGS results are summarized on **Table 2**. In this table, the 2-year base-flow recurrence interval (314,000 gpd/mi^2 for the Passaic Formation) represents the magnitude of (normal) groundwater base-flow/recharge that will occur every 2 years or less. The 25-year recurrence interval (154,000 gpd/mi^2) represents the magnitude of (below-normal) groundwater base-flow/recharge that will occur every 25 years or less. The groundwater recharge values derived for normal and below-normal (drought) years in the Stockton and Passaic Formations in this study are also shown in the summary in **Table 1.**

Kingwood Township, 1993: The Kingwood Township Master Plan, prepared by Heritage Engineers, provides a summary of groundwater recharge estimates to the principal bedrock units underlying this township on the basis of a study conducted by the South Branch Watershed Association in 1976. Recharge estimates derived for the Lockatong and Passaic Formations from this study are summarized on **Table 1**.

Table 1: Summary of Recharge Estimates Derived From Major Studies

Study	**Stockton Formation Recharge gpd/mi^2**	**Passaic Formation Recharge gpd/mi^2**	**Lockatong Formation Recharge gpd/mi^2**
Sourlands Studies (Hordon, 1984, 1987, 1996 & M2 and Demicco, 2004)	260,000 - 390,000	260,000 - 390,000	80,000 – 150,000
LORDS (NJGS, 1974)	175,000 – 250,000	350,000 – 500,000	100,000 – 150,000
Walnut Brook Watershed (Posten, 1982 & 1984)	NA	NA	92,000 – 300,000
USGS Neshaminy Creek Basin Base-Flow Study (Schreffler, 1996)	189,000 - 627,000	154,000 - 314,000	NA
Kingwood Township Master Plan, 1993	NA	200,000 – 300,000	85,000 – 100,000

Table 2: Base-Flow Recurrence Intervals for Geologic Units or Groups in the Neshaminy Creek Basin (Schreffler (USGS, 1996).

Base-Flow Recurrence Interval

Base Flow in Gallons per Day/Square Mile (MGD/Mi^2)

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**
Passaic Formation	314,000	241,000	189,000	154,000	144,000
Stockton Formation	627,000	401,000	343,000	189,000	158,000

3.3 Recharge Estimates for Years of Normal and Below-Normal Precipitation

Stockton Formation: The recharge estimates for a year of below-normal precipitation (drought or dry period) are in the range of 175,000 to 260,000 gpd/mi^2, which are reasonably consistent. For a year of normal precipitation, the New Jersey studies by Hordon (1984) and M2 and Demicco (2004), and the NJGS (1974), arrived at recharge estimates of 250,000 and 390,000 gpd/mi^2. The Bucks County work by the USGS indicated a recharge estimate of 627,000 gpd/mi^2, which is more than double the two New Jersey estimates and has not been used in our analysis.

For the purposes of the Nitrate Dilution Modeling and Lot Size Analysis, a recharge value of **217,000 gpd/mi^2** (340 gpd/acre) was utilized for a dry year (average of the Sourland and NJGS studies). A recharge value of **320,000 gpd/mi^2** (500 gpd/acre) was developed for a year of normal precipitation (average of the Sourland and NJGS studies).

Lockatong Formation: The recharge estimates for a year of below-normal precipitation (drought or dry period) are in the range of 80,000 to100,000 gpd/mi^2 which are reasonably consistent. For a year of normal precipitation, the New Jersey studies by Hordon (1984) and M2 and Demicco (2004), the NJGS (1974), Posten (1984), and the South Branch Watershed Association (Kingwood Township, 1993) arrived at recharge estimates in the range of 100,000 to 300,000 gpd/mi^2. The 300,000 gpd/mi2 estimate by Posten (1982) for the Walnut Creek watershed is an outlier and 2-3 times the recharge estimates developed by others. As such, it has not been used in the analysis.

For the purposes of Nitrate Dilution Modeling and Lot Size Analysis, a recharge value of **90,000 gpd/mi^2** (140 gpd/acre) was utilized for a dry year (average of four studies on Table 1). A recharge value of **125,000 gpd/mi^2** (195 gpd/acre) was developed for a year of normal precipitation (average of Sourland, NJGS, and the Kingwood studies).

Passaic Formation: The recharge estimates for a year of below-normal precipitation (drought or dry period) are in the range of 154,000 to 350,000 gpd/mi^2. The 350,000 gpd/mi^2 recharge value developed by the NJGS (1974) is an outlier and was not used in the analysis. For a year of normal precipitation, the New Jersey studies by Hordon (1984) and M2 and Demicco (2004), the NJGS (1974), and the South Branch Watershed Association (Kingwood Township, 1993), and the Bucks County, Pennsylvania study by the USGS (Schreffler, 1996), arrived at recharge estimates in the range from 300,000 to 500,000 gpd/mi^2. The 500,000 gpd/mi^2 recharge value developed by the NJGS (1974) is an outlier and was not used in the analysis.

For the purposes of Nitrate Dilution Modeling and Lot Size analysis, a recharge value of **205,000 gpd/mi^2** (320 gpd/acre) was utilized for a dry year (average of Sourlands, NJGS, and Kingwood studies). A recharge value of **335,000 gpd/mi^2** (522 gpd/acre) was developed for a year of normal precipitation (average of Sourlands, USGS and Kingwood studies).

4.0 NITRATE DILUTION ANALYSIS AND LOT SIZE ANALYSIS

4.1 Background Nitrate Levels and Anti-Degradation Criterion

The New Jersey Ground Water Quality Standard for Nitrate is 10 milligrams per liter (mg/l) for Class II-A water – this is also the State's drinking water standard for Nitrate. As part of New Jersey's groundwater quality standards, the NJDEP established an anti-degradation policy to protect groundwater. This policy limits the discharge of contaminants to groundwater to a percentage of the difference between the background concentration and the quality criteria. For Class II-A groundwater, the limit is the background concentration plus 50 percent of the difference between the background concentration and the groundwater quality standard.

The Hunterdon County Health Department provided a database of Nitrate analyses for wells in Franklin Township which is provided in **Appendix A.** The average nitrate value for all of the tests is on the order of 3.0 milligrams per liter (mg/l). If the higher outlier values (greater than 7.0 mg/l) are taken out of the data set, the average nitrate value is on the order of 2.0 mg/l. This background value of 2.0 mg/l was utilized in arriving at the Township-specific anti-degradation Nitrate criterion of 6 mg/l.

4.2 Nitrate Dilution Modeling and Lot Size Analysis

The Trela-Douglas Model (1978) was used for the Nitrate Dilution Modeling and Lot Size Analysis for the three principal hydrogeologic units in the Township. Lot sizes were developed for periods of normal and below-normal precipitation (drought or dry periods). **Table 3** provides a summary of the modeling and lot size calculations.

For the Stockton Formation, calculated lot sizes range from 4.3 to 6.4 acres; for the Passaic Formation from 4.1 to 6.8 acres; and for the Lockatong Formation from 11.1 to 15.4 acres. The Lockatong Formation underlies a significant portion (approximately 70 %) of the Township.

Table 3: Nitrate Dilution Modeling and Lot Size Analysis

Aquifer System	Recharge (gpd/acre)	Calculated Lot Acreage
Stockton Formation Normal Year	500	4.3
Stockton Formation Dry Year	340	6.4
Passaic Formation Normal Year	522	4.1
Passaic Formation Dry Year	320	6.8
Lockatong Normal Year	195	11.1
Lockatong Dry Year	140	15.4

Trela-Douglas Model including GSR-32
VeCe= (Vi + Ve)Cq

Ve= 350 gallons per day; Volume of effluent = Household Occupants * Per capita water use [a]
Ce= 43.1 mg/L; Concentration of nitrate effluent [b]
Vi= Volume of recharge over lot = Lot size per home * Recharge rate
Cq= 6 mg/L; Anti-degradation Quality Criterion for Nitrate (mg/L)

Ve= HWu
Vi= AR

H= 3.5; Average number of household occupants (persons)
Wu= 100; Per capita water usage (gallons/person/day)
A= Lot size per home (acres)
R= Recharge rate (gallons/day/acre)

HWuCe= (AR + HWu) Cq
A = HWu(Ce-Cq)/ (RCq)

Example for the Stockton Formation Normal Year:
H = 3.5 persons
Wu= 100 gallons/person/day
Ce= 43.1 mg/L
R= 500 gallons/day/acre
Cq= 6 mg/L

A = 4.3 acres = 3.5*100(43.1-6)/(500*6)

[a] Water usage based on the NJDEP Safe Drinking Water Act Regulations NJAC 7:10-12.7 November 4, 2004.
[b] Mean of Reported Values for Total Nitrogen from Trela Douglas (1978) Table 1: Septic Effluent Quality as Reported by Various Investigators.

5.0 REFERENCES

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