

NATURAL RESOURCES INVENTORY

TOWNSHIP OF UPPER

CAPE MAY COUNTY, NEW JERSEY



NOVEMBER 2006

**ADOPTED BY THE TOWNSHIP OF UPPER PLANNING BOARD ON
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Natural Resources Inventory

Upper Township

Cape May County, New Jersey

November 2006

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EXECUTIVE SUMMARY

Upper Township has never prepared an inventory of natural resources, although such resources were sometimes mentioned in Master Planning documents. A detailed natural resources inventory serves to inform the planning process by providing a factual basis for land use decision-making. The mapping and description of sensitive areas facilitates the proper use and protection of existing natural areas, the appropriate development of the few remaining vacant, privately-owned land parcels and the redevelopment of developed lands. This inventory can serve in the refinement of zoning regulations and land use ordinances. The identification and understanding of natural systems and their inherent and regulatory limitations for development serve to prevent future environmental problems and associated mitigation costs. The inventory can identify possibilities for regional partnerships and planning activities that can improve environmental conditions and quality of life in the Township.

Located on the Outer Coastal Plain of New Jersey, Upper Township occupies a land area of 69 square miles. It is located along the northerly boundary of Cape May County, New Jersey and is surrounded by the municipalities of Dennis Township, Woodbine Borough, Sea Isle City, Maurice River Township, Corbin City, Estell Manor and Ocean City. The Township encompasses two areas subject to special regulation by the State of New Jersey: the Pinelands Area and the Coastal Zone.

Geologically, the Township is underlain by the unconsolidated sediments of the Cohansey and Cape May Formations. The Cohansey Aquifer System provides drinking water to residents. The Holly Beach water bearing zone provides water for the irrigation of golf courses and other less sensitive uses. Two major watersheds divide the Township, the Tuckahoe River Watershed and the Atlantic Coastal Watershed. Surface waters include Tuckahoe Lake, the Tuckahoe River, Tarkiln Brook, Mill Creek, Black Run, Halfway Creek, Cedar Swamp Creek, Willis Thorofare and Hughes Creek. These waters are generally of good to excellent quality. A large portion of the municipality lies within the floodplains of these water bodies.

Large expanses of wetlands are present. These wetlands include High and Low Saltmarsh, Brackish and Freshwater Tidal Marshes, Pitch Pine Lowland Forest Community, Pine Barren Shrub Swamps / Shrub Thickets, South Jersey Fens/Pine Barren Savannas, Coastal Plain Intermittent Ponds, Hardwood Swamp and Atlantic White Cedar Swamps. There are also a number of upland plant communities present. These include Marine Intertidal Gravel/Sand Beach Communities, Dunegrass Community, Beach Heather Community, Shrub Thicket Community, Dune Woodland Community, Southern Coastal Plain Mixed Oak Forest Communities, Dry Oak-Pine Forest Communities and Pine-Oak Forest Communities. The great floral diversity in plant communities is mirrored by a similar diversity in fauna, particularly for birds and butterflies. Numerous threatened and endangered plants and animals are documented to occur in Upper Township.

Large portions of Upper Township are included within nine Natural Heritage Program Priority Sites. The US Fish and Wildlife Service ("USFWS") has identified three major habitat complexes that occur in Upper Township and its environs. These areas contain nesting and foraging areas for several threatened and endangered species. Several rare plant communities are also present. Much land is protected in Upper Township. Extensive wetlands areas and other sensitive areas are encompassed within Belle Plain State Forest, a State Park at the southerly end of Ocean City Island, the Cape May Refuge, and the Tuckahoe River Waterfowl Management Area.

Not only is the natural heritage of Upper Township significant, but the Township has retained a great deal of its historical heritage. Over one hundred properties have been identified in Upper Township that contain historic resources. There is significant potential for historic and prehistoric archaeological resources to be present. The sum of these resources and the awareness thereof helps to establish a sense of place for Upper Township citizens. This



inventory can provide the framework for planning the future of the Township. Valuable environmental resources can be preserved and the restoration of degraded resources can be undertaken.

The mapping and description of sensitive areas facilitates the proper use and protection of existing natural areas, the appropriate development of the few remaining vacant, privately-owned land parcels and the redevelopment of developed lands. This inventory can serve in the refinement of zoning regulations and land use ordinances. The identification and understanding of natural systems and their inherent and regulatory limitations for development serve to prevent future environmental problems and associated mitigation costs. The inventory can identify possibilities for regional partnerships and planning activities that can protect environmental resources as well as the quality of life in the Upper Township.



1.0 INTRODUCTION

1.1 Township Location

Upper Township is located in the northern portion of Cape May County which occupies a peninsula at the southern tip of the State of New Jersey (see Figure 1). All of Cape May County lies within the Coastal Plain Physiographic Province, characterized by the presence of unconsolidated deposits laid down over a long period of time. Upper Township occupies a land area of 69 square miles and is bordered to the southwest and south by Dennis Township, Woodbine Borough and Sea Isle City (Cape May County); to the west by Maurice River (Cumberland County); Corbin City and Estell Manor (Atlantic County) to the north; and to the east by Ocean City (Cape May County).

1.2 Regulatory Jurisdictions

The State of New Jersey has established several areas within the State for extra protection. These are the Pinelands Area, the Coastal Zone, the New Jersey Meadowlands and the Highlands Region. Rules and regulations have been promulgated by the State to regulate development in these areas. Upper Township is completely encompassed within the Pinelands and the Coastal Zone. The boundary between the two regulatory jurisdictions is shown on Figure 1.

As described in the Coastal Area Facility Review Act (CAFRA) - N.J.S.A. 13:19, the CAFRA boundary begins in the north at the intersection of State Route 49 and the Tuckahoe River extends southeasterly to its intersection with State Route 50. It continues southeasterly along State Route 50 to its intersection with County Road 610 (Dennisville Road). The boundary follows Dennisville Road in a southwesterly direction to its intersection with State Route 47 at Dennisville. The Coastal Zone is to the east of this boundary and the Pinelands are to the west of the boundary. This boundary is depicted on Figure 1.

The Federal Coastal Zone Management Act of 1972 gave States the authority to devise strategies and policies to manage development and use of coastal land and water areas. The Coastal Zone in New Jersey is regulated under the Coastal Permit Program Rules (N.J.A.C. 7:7) and the Coastal Zone Management Rules (N.J.A.C. 7:7E). The three major coastal statutes giving authority for the development of these rules are the Wetlands Act of 1970, the Waterfront Development Law and the Coastal Area Facility Review Act. The Freshwater Wetlands Protection Act allows the regulation of activities in freshwater wetlands within the Coastal Zone, as well as in other parts of the state. Lands that are tidally flowed are owned by the State of New Jersey. Most activities proposed below the mean high water line of any tidal water body require review and approval from the New Jersey Department of Environmental Protection ("NJDEP") Bureau of Tidelands. The United States Army Corps of Engineers also regulates activities conducted below the mean high water line and within wetlands that are tributary to a tidal water body and located within 1,000 feet from the mean high water line.

The remainder of Upper Township is located within the Pinelands Area. The authority to regulate development in the NJ Pinelands derives from the Pinelands Protection Act (NJSA 13:18A). This Act established the boundaries of the Pinelands Area and its sub-areas: the Pinelands Protection area and the Pinelands Preservation area and the Pinelands National Reserve. The Act also created the NJ Pinelands Commission, which is the regulatory agency for development in the Pinelands Area. Development in the Pinelands is regulated under the Pinelands Comprehensive Management Plan (NJAC 7:50).

The Pinelands National Reserve is an area located outside of the regulated Pinelands Area. In Upper Township this area overlaps the Coastal Zone. It is actually a federally designated area, consisting of approximately one million



acres of land. This area was established under Section 502 of the National Parks and Recreation Act of 1978 (PL 95-625). Under a Memorandum of Agreement between the NJ Pinelands Commission and the NJDEP Land Use Regulation Program, the latter agency is the lead agency in review of development applications in the Pinelands National Reserve Area. The NJ Pinelands Commission is a reviewing agency and may provide comments on development in this area.

1.3 Existing Land Use and Land Cover

The existing land use patterns within Upper Township are depicted on Figure 2. This figure is based upon tax lot parcel property classification codes. Based upon this map, over 46 percent of the Township lands are publicly owned properties. Residential properties comprise over 6,200 acres or about 14 percent of the Township lands. Commercial and industrial properties include a smaller area of almost 1,700 acres or about 3.7 percent of the Township lands. Vacant undeveloped properties under private ownership total about 7,800 acres or 16.7 percent of the land area. Cape May County provides funds for farmland preservation. At least five farms have been preserved in Upper Township to date.

Based on the Land Use/Land Cover Map (Figure 3), it is evident that most land in the Township is publicly-owned, consisting of environmentally constrained land and wildlife management areas. The Township has approximately 24% of its total land mass covered by freshwater wetlands and another 24% constrained by tidal wetlands. The most significant region of undevelopable land is located along the entire eastern portion of the municipality. This stretch of land is situated between the Garden State Parkway and the barrier islands and is constrained by tidal wetlands. There is limited development in these areas; most of the land consists of very small pockets of vacant lots and commercial development located along Route 623 (Roosevelt Blvd.) leading to the barrier island communities. The other sizable areas of undevelopable lands are located adjacent to the Great Cedar Swamp, Lake Tuckahoe and the Belleplain State Forest.

The existing residential development consists mainly of single-family homes with the most concentrated areas located in Seaville, Petersburg and Marmora/Beesley's Point/Palermo centers. The barrier island community of Strathmere represents the Township's highest density of residential development with an average lot size of 8,000 square feet. It is no surprise that most of Upper Township's commercial developments are located along its major roadways. A considerable amount of retail, office and service related development is located along the Route 9 corridor. The larger shopping centers and retail stores are located in Seaville and Marmora/Beesley's Point/Palermo. In addition there are commercial uses, which are primarily mining operations, along Route 610 and Route 664 in the southern portion of the Township adjacent to Woodbine Borough.

Tuckahoe has some village commercial development along Route 50 and Route 47 in the village center. This area is planned for future economic growth buttressed by the recent renovation of the Tuckahoe train station with planned extension of excursion rail service from Cape May City (when the rail line is extended). Currently rail service is provided between Tuckahoe and Richland in Atlantic County.

2.0 PHYSICAL RESOURCES AND CONDITIONS

The environmental setting of a region is the sum of the physical and biological features and processes that characterize the region. The physical conditions including the location, topography, geology, soils, water resources, etc. directly influence the overlying biotic communities that occur in an area. These physical conditions affect the types of development or other human activities that are right for a particular site. Knowledge of these resources is important in long-term planning for appropriate land use.

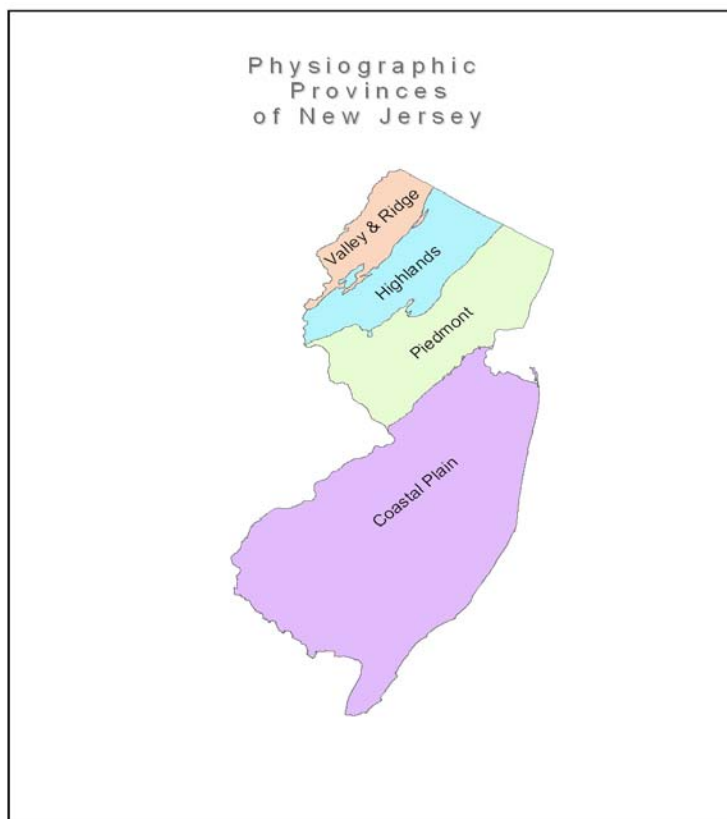


2.1 Physiographic Landscape and Geology

Areas that have similar rock types, geologic structures, landforms, and histories are organized into regions called Physiographic Provinces. New Jersey has five Physiographic Provinces, which make it a complex State for its small size. From northwest to southeast across the State, the provinces are (1) the Valley and Ridge, (2) Highlands, (3) Piedmont, (4) Inner Coastal Plain, and (5) Outer Coastal Plain. Refer to Illustration 1 which shows the Physiographic Provinces of New Jersey. Each name is descriptive of the rock belt that it identifies. Upper Township is located within the Outer Coastal Plain Physiographic Province, the largest of the physiographic provinces in New Jersey. Its location within the Outer Coastal Plain provides the framework for a discussion of the geologic history of the Township (NJGS 2006).

The geology of the Coastal Plain is characterized by unconsolidated sand, gravel, silt, and clay thickening seaward from a featheredge at the Fall Line to more than 6,500 feet (ft) thick in southern Cape May County (Gill and Farlekas, 1976). As a geologic formation, the Coastal Plain exists, not just in New Jersey, but along the entire Atlantic Coast from Maine to the Gulf of Mexico. Differences in the amount and type of erosion coupled with variability in underlying rock composition distinguish differences in sediments and shoreline types along its length. In general, the Atlantic Coastal Plain is flat and slopes gently seaward. John Tedrow describes the Coastal Plain in New Jersey as having moderate elevation with 80% – 90% lying below the 100 foot contour on a topographic map (Tedrow 1986). Low ridges of sand parallel the coast offshore and are physically separated from the coast by quiet water lagoons. Nearly 300 barrier islands exist between Massachusetts and Texas.

Illustration 1 – Physiographic Provinces of New Jersey





Millions of years ago, continents moved together and split apart with enormous forces. Tall mountains formed as a result of tectonic plates colliding and forcing surfaces upward. Remnants of the most recent mountains formed are what we call the Appalachian Mountain Range. The Appalachian Range forms an inland ridge parallel to the East.

The "Fall Line" refers to the boundary between the Piedmont and Inner Coastal Plain. As a variety of forces, such as rain and snow, freeze and thaw, act on the mountains, small particles are worn away and carried in rain water, river flows and wind, to be deposited eastward along the edge of the continental bedrock. Geologists are able to analyze the sediments. Samples have been collected by boring deep holes, analyzed, dated, identified and restudied again as new technology provides greater understanding. Many layers of sediment and particles form the Coastal Plain, which is a nearly horizontal surface which gently slopes to the edge of the Continental Shelf before steeply falling off under the Atlantic Ocean.

Over time, sea level fluctuates and acts upon the sediments. Wave action intensity increases with storms. During periods of higher ocean levels, which can completely cover the Coastal Plain sediments, marine deposits are added. The sediments are classified based on differences or similarities and the distinctions used to develop names for the layers. It would appear that the shoreline is a stable platform; however, geology is an on-going dynamic process. Change has occurred in the past, continues to take place at the present time and will continue into the future. The geological classification for the surface sediment layer, or veneer, is called the Cape May Formation and is described by Tedrow as a "terraced" sediment layer, outcropping along the edge of the Cape May Peninsula. As a veneer, the Cape May Formation is a thin covering overlying the productive Cohansey Formation. The Cape May deposits are visible inland on the edges of the many streams. The deposits were laid down during a time when the level of the ocean was 30 to 50 feet lower than today (Tedrow 1986). Underlying the Cape May Formation and overlying the entire Cape May Peninsula is the Cohansey Formation which will be discussed in greater detail due to its importance as a drinking water reservoir. Refer to Figure 4 to view the extent of the formation within Upper Township. The Cohansey Coastal Plain Sediments are described on the Bedrock Geology Map "...as sediments that were laid down during the Miocene Era. The description includes sand, white to yellow with local gravel and clay. Locally stained red or orange brown by iron oxides and / or cemented into large blocks of ironstone. Unweathered clay is typically dark gray, but weathers white in thin beds of ironstone. The unit is a mixture of marine and non-marine sediments. Sand, consisting of quartz and siliceous rock fragments, is found as medium-size grains and sorted from fine to coarse grains (Owens, et. al. 1998).

Crossbedding occurs, particularly in non marine deposits. In some marine deposits, abundant burrows are present. The burrows have been identified as belonging to the fossil, *Ophiomorpha nodosa*. Studies of pollen found in the sediment provide information about plants which existed at the time the sediment was deposited (Owens, et al 1998). It should be noted that the Cohansey Unit, found on both the surface and subsurface in the Coastal Plain depending on location, is often associated with the older Kirkwood Formation (Owens, et al 1998).

2.2 Topography and Slopes

Upper Township exhibits very little topographic relief. According to United States Geological Survey ("USGS") Topographic mapping, elevations range from 0 feet on Township beaches to about 15 feet above sea level in the westernmost portion of the Township (USGS a, b, c & d 1977). Slopes are minimal. Steep slopes only occur where they are manmade, such as along roadway embankments.

2.3 Soils

The term "soil" is used to describe the earthy material that is found in the garden. Upon greater reflection, it becomes apparent that there is more to the story. New Jersey is a small state but also a long state which allows it to display a variety of processes which have affected land masses since the beginning of time. The processes have



created different landforms and topography. The eastern coast of the United States has undergone mountain building with volcanic eruptions followed by weathering from storms and glaciers. The soils of Upper Township were formed in the sediments laid down in glacial outwash plains and marine sediments laid down when the ocean covered the current land area. Coastal Plain soils, as indicated in the Geology section, represent a “geologic-ecologic” blend. Unlike soils in the northern part of the State which can be identified with a particular location, the Coastal Plain soils are influenced by greater variability during geologic formation and subsequent modification.

The Soil Conservation Act of 1935 led to the establishment of the Soil Conservation Service and with it a focus on new characteristics. Today we draw on a combination of factors to describe soils. The United States Department of Agriculture (“USDA”) has taken the lead in describing the characteristics of soils in New Jersey. Because of the complexity, soils are described as groups with similar characteristics, often based on location. (NRCS 2006)

The soils types found in Upper Township are mapped on Figure 5 and described below.

Appoquinimink-Transquaking-Mispillion complex (AptAv), 0 to 1 percent slopes very frequently flooded. This soil is very poorly drained and annual ponding is frequent. The parent material consists of loamy stream sediments over herbaceous material. This soil type is considered hydric.

Aura sandy loam (AugA), 0 to 2 percent slopes. This soil is well drained. Annual flooding and annual ponding are none. The parent material consists of old loamy or gravelly alluvium. This soil is prime farmland. This soil is not considered hydric.

Beaches (BEADV), 0 to 15 percent slopes. This soil is excessively drained. Annual flooding is very frequent, and ponding is none.

Berryland and Mullica soils (BEXAS), 0 to 2 percent slopes. Both annual flooding and ponding are occasional. Parent material consists of sandy stream deposits. This soil is not suitable for crops. This type is considered a hydric soil.

Dennisville sandy loam (DenA), 0 to 2 percent slopes. This soil is well-drained. There is no annual flooding nor annual ponding.

Downer loamy sand (DocB), 0 to 5 percent slopes. This soil is well-drained. Annual flooding and annual ponding do not occur. The parent material consists of loamy and gravelly stream deposits.

Downer sandy loam (DoeA), 0 to 2 percent slopes. This soil is well drained. Annual flooding and ponding do not occur.

Evesboro sand (EveB), 0 to 5 percent slopes. The parent material consists of sandy wind and stream deposits. The soil is excessively drained with no annual flooding or ponding.

Fort Mott sand (FobB), 0 to 5 percent slopes. The soil is well drained. Annual flooding and ponding do not occur. This soil is farmland of statewide importance.

Galloway loamy sand, (GamB), 0 to 5 percent slopes. The soil is somewhat poorly drained. There is no annual flooding nor ponding. This soil is farmland of statewide importance.

Hammonton sandy loam (HboA), 0 to 2 percent slopes. This soil is moderately well drained. There is no annual flooding nor annual ponding. This soil is prime farmland.

Hammonton loamy sand (HbmB), 0 to 5 percent slopes. This soil is moderately well drained. This soil has low potential productivity for cultivated crops. This soil is farmland of statewide importance.

Hooksan sand (HorDr), 2 to 15 percent slopes. This soil is excessively drained. Annual flooding is rare, and annual ponding is none. This soil is not suitable for cultivated crops.

Ingleside loamy sand (IngB) 0 to 5 percent slopes. This soil is well drained. Annual flooding and ponding do not occur. This soil has medium potential productivity for cultivated crops.



Ingleside sandy loam (InnA), 0 to 2 percent slopes. This soil is well drained. Annual flooding and ponding do not occur. This soil has medium potential productivity for cultivated crops. This soil is prime farmland.

Manahawkin muck (MakAt), 0 to 2 percent slopes. This soil is very poorly drained. Annual flooding is frequent, and ponding is frequent. This soil is not suitable for cultivated crops. This soil is farmland of unique importance. This is a hydric soil.

Mispillion-Transquaking-Appoquinimink (MmtAv), 0 to 1 percent slopes. This soil is poorly drained. Annual flooding is very frequent, and annual ponding is frequent. This soil is not suitable for cultivated crops. This soil is farmland of unique importance and is a hydric soil.

Pawcatuck-Transquaking complex (PdwAv), 0 to 1 percent slopes. This soil is very poorly drained. Annual flooding is very frequent and ponding is frequent. This soil is not suitable for cultivated crops. This soil is farmland of unique importance and is a hydric soil.

Psammments*, sulfidic substratum (PstAt), 0 to 3 percent slopes. This soil is excessively drained. Annual flooding and annual ponding are frequent. This soil is not suitable for cultivated crops.

Psammments*, wet substratum (PsvAr), 0 to 3 percent slopes. This soil is excessively drained. Annual flooding is rare and annual ponding is none. The soil is not suitable for cultivated crops.

Swainton sandy loam (Swbma), 0 to 2 percent slopes. This soil is well drained. Annual flooding and ponding are none. This soil has low potential productivity for cultivated crops, but still is classified as prime farmland.

Swainton sandy loam (SwbmB), 2 to 5 percent slopes. This soil is well drained. Annual flooding and ponding do not occur. This soil has low potential productivity for cultivated crops, but still is classified prime farmland.

Transquaking mucky peat (TrkAv), 0 to 1 percent slopes. This soil is very poorly drained. Annual flooding is very frequent and annual ponding is frequent. This soil is not suitable for cultivated crops. This soil is farmland of unique importance and is a hydric soil.

Udorthents, refuse substratum (UdrB), 0 to 8 percent slopes. This soil is moderately well drained. Annual flooding and ponding do not exist. This soil is not suitable for cultivated crops.

Urban land-Psammments, sulfidic substratum complex (USPSAS), 0 to 2 percent slopes. This soil is excessively drained. Annual flooding is occasional, and annual ponding is none. This soil is not suitable for cultivated crops. The Urban Land soil type is used to describe areas where much of the surface has been covered over by buildings or asphalt pavement.

Urban land-Psammments, wet substratum (USPSBR), 0 to 8 percent slopes. This soil is excessively drained. Annual flooding is rare and annual ponding is none. This soil is not suitable for cultivated crops. The Urban Land soil type is used to describe areas where much of the surface has been covered over by buildings or asphalt pavement.

Figure 5 shows the soil survey mapping units. The table below shows the limitations of Upper Township soils for certain types of development.

Mapping Units	Depth to Seasonal High Water Table (feet)	Septic Limitations	Erosion Potential (Kw)	Limitations for Building Foundations
Appoquinimink Transquaking Mispillion	0	Very limited	0.37	Severe
Aura Sandy Loam	10	Very limited	0.24	Slight
Beaches	3 - 12	Not rated	0.1	Not rated
Berryland Mullica	0	Very limited	0.10	Severe
Dennisville Sandy Loam	4	Very limited	0.32	Slight
Downer Loamy Sand	4	Very limited	0.28	Slight



Table 1: Development Limitations of Soils (continued)

Mapping Units	Depth to Seasonal High Water Table (feet)	Septic Limitations	Erosion Potential (Kw)	Limitations for Building Foundations
Downer sandy Loam	>6	Very limited	0.28	Slight
Evesboro Sand	>6	Very limited	0.10	Slight
Fort Mott Sand	6	Very limited	0.15	Slight
Galloway Loamy Sand	1.75	Very limited	0.17	Moderate
Hammonton Sandy Loam	1.5	Very limited	0.10	Moderate
Hooksan Sand	6	Very limited	0.10	severe
Ingleside Sandy Loam	3.5	Very limited	0.20	Slight/ Moderate
Ingleside Sandy Loam	3.5	Very limited	0.20	Slight/ Moderate
Manahawkin Muck	0	Very limited	0.10	Severe
Pawcatuck Transquaking Complex	0	Very limited	0.10	Severe
Psamments, Sulfidic Substratum	0	Very limited	0.20	Slight
Psamments, Wet Substratum	1.5	Very limited	0.28	Slight
Swainton Sandy Loam	6	Very limited	0.32	Slight
Transquaking Mucky Peat	0	Very limited	---	Severe
Urban Land	---	---	---	Not rated
Urban land-Psamments, Sulfidic Substratum	0	Very limited	0.20	Not rated
Udorthents, refuse substratum	>6	Very limited	0.37	Not rated

2.3.1 Contamination Sites

Locations which were identified in NJDEP databases were used to compile the list identified as contaminated sites. Often soils are contaminated at these sites, by leaky underground chemical or fuel storage tanks or by surface spills. Information gathered from the databases indicates that the contaminant source is often unknown and the potential for groundwater contamination is present. Three cases with available contaminant specifics have been included in the list.

The NJDEP websites called "Data Miner" and "Public Records, (OPRA)" which can be accessed from the home page (<http://www.state.nj.us/dep/index.html>) can provide greater information concerning the status of each incident.

Please reference "Site I.D. #" from the list below to find the map key number in the map legend of Contaminated Sites Map on Figure 6.

Table 2: Known Contaminated Sites List

Site #	Site ID	Site Name	Site Address	Date
01	NJL000075192	Route 50 Ground Water Contamination	Rte 50	3/8/1999
02	NJD000726729	Atlantic City Electric Company	900 Shore Rd (Rte 9)	7/11/2000
03	NJD980588610	NJ Marine Sciences Consortium	1731 Rte 9 S	12/17/1997
04	NJL000066282	29 Tyler Road	29 Tyler Rd	3/12/1998
05	NJL000052035	Garden State Parkway Mile Marker 27	Gs Pwy Mm 27	11/23/1992
06	NJL000052043	Garden State Parkway Mile Marker 23.1	Gs Pwy Mm 23.1	11/23/1992
07	NJL900001272	Upper Township Sanitary Landfill	Butter Rd	6/2/1993



Table 2: Known Contaminated Sites List (continued)				
Site #	Site ID	Site Name	Site Address	Date
08	NJD986608982	Exxon Service Station Upper Township	Rte 50	5/26/1998
09	NJL600054001	Upper Township Division	Rte 610	2/19/1999
10	NJL600065619	Wawa Food Market	Rte 50 & Hope Corson Rd	11/29/1988
11	NJD986566479	Texaco Service Station Upper Township	Rte 9 & Roosevelt Blvd	8/22/1983
12	NJL800007437	NJ Department Of Transportation	Rte 50 & 3rd Ave	6/18/1993
13	NJD092343276	Whippoorwill Campground	810 S Shore Rd	8/2/1994
14	NJL000070631	Beesley's Point Grd Wtr Contamination	Maple Shade Ln & Grant Ave	5/4/1994
15	NJD986566651	Cape May County MUA Sanitary Landfill	Kearney Ave	9/30/1998
16	NJL000071175	Allendale Road Ground Water Contam	Allendale Rd	9/13/1994
17	NJL800604670	15 Dirt Rd	15 Dirt Rd	1/4/2001
18	---	Sam's Gulf	1875 Rte. 50	2006

3.0 WATER RESOURCES AND CONDITIONS

Water is a critical resource for life. Groundwater provides wells with drinking water and contributes the base flow of streams and water bodies. Groundwater is found below the ground surface in the spaces between soil and sediment particles in unconsolidated sediment and in the cracks and pore space within bedrock. Surface water, in contrast to groundwater, is water flowing in natural channels carved into the surface of the earth. We refer to this water as streams, rivers, or creeks. Surface water has many uses, including drinking water and recreation for humans. It provides habitat for fish and other aquatic life. Historically, surface water also had an enormous role in waste disposal until surface waters became degraded and required remediation. Groundwater also has been subject to degradation by underground septic disposal, over application of fertilizers and pesticides and leaking underground fuel and other chemical storage tanks. This experience has shown that it is technically and economically much easier to take steps to avoid contamination than it is to restore the resource to the original state. The groundwater and surface water resources of Upper Township are described below.

3.1 Ground Water Resources

3.1.1 Aquifers

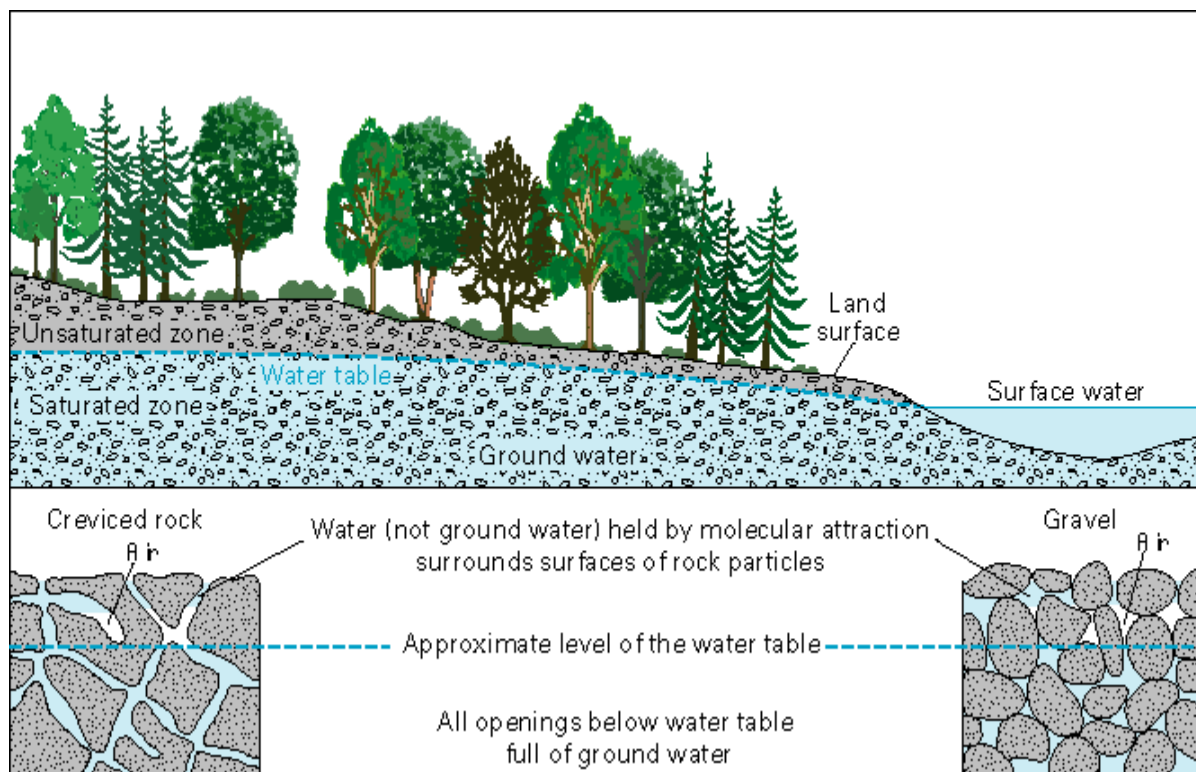
An aquifer is defined by the USDA as "A water-bearing bed or stratum of permeable rock, sand, or gravel capable of fielding considerable quantities of water to wells or springs." Ground water, located mostly out of sight, is one of our most important resources. The underground rock, described in the Geology section and accompanying soils which are described more fully in the Soil section, provide a framework for storing ground water. Between the rock and within the soil are spaces or openings that store water and allow fresh water, or precipitation, to replenish or recharge the supply.

Rainfall is able to flow through the pores or empty spaces between the rock and soil to add to or replenish (recharge) the existing ground water supply. When the process of recharge occurs quickly, we say the rock or soil is permeable. Water, in useful amounts, which naturally collects within soil or rock under ground and that can be removed easily by pumping (as in a well) is called an aquifer. If ground water seeps out onto the surface, it is called a spring.

The diagram below shows how the ground below the water table (the blue area) is saturated with water. The "unsaturated zone" above the water table (the greenish area) still contains water (plant roots live in this area), but it is not totally saturated with water.



Illustration 2 - Groundwater



Source: USGS.GOV/EDU

Sometimes there is another layer which is not as permeable and does not allow rain to easily flow into stored ground water. This is an example of a confining layer and its presence defines a "confined aquifer". Freshwater aquifers along the coast of the Atlantic Ocean, such as those located in Cape May County, are bordered by saltwater. Ground-water withdrawals from these aquifers can cause movement of surrounding saltwater, and saltwater intrusion has been documented throughout the east coast. Withdrawals can change the patterns of ground-water flow and discharge to coastal ecosystems, which may alter the salinity of coastal waterways and wetlands.

In Cape May County, five ground water reservoirs or freshwater aquifers have been mapped and studied by County, State and Federal agencies such as USGS. These aquifers are named as follows:

- Holly Beach is a shallow water bearing zone that is in direct contact with seawater
- Estuarine Sand Aquifer (about 50' thick)
- Cohansey aquifer (varies from 60' – 180' thick)
- RioGrande water bearing zone (50' – 100' thick)
- Atlantic City Sand (800' thick)

The sediments underlying Cape May County consist mostly of unconsolidated gravel, sand, silt, clay and shell fragments. In most cases, these materials are permeable and readily allow rainfall to recharge ground water supplies, in most cases. These sediments are also capable of storing large amounts of water. Residents in Upper Township supply water to their homes from individual wells which draw water from the Cohansey Aquifer.



The Cohansey aquifer system is composed of fine to coarse sand and gravel sediments that vary from 60 feet to 180 feet thick. In general, this aquifer is described as unconfined. However, in the area of Upper Township, two confining or low permeability layers do exist, creating partially confined water bearing layers. A veneer, identified on Figure 4 as the Cape May Formation, is the uppermost layer. The confining layers contain increased amounts of silt and clay which reduce permeability and slow recharge. The Cohansey aquifer is very productive.

The Holly Beach water bearing zone which is at or near sea level, is in direct connection with seawater and therefore has limited use for freshwater supply. However, Holly Beach supplies non-potable uses, i.e. golf course and agriculture irrigation. Lower level water bearing layers, identified above, are not included in Upper Township's potable water source.

One of the principal water resource issues within this management area is drinking water supply. The resource is largely dependent upon ground water that is in turn highly vulnerable to saltwater intrusion from the west, south and east, especially in the southern portion of the peninsula. The expected increase in population (projected to 68 percent by 2040) will put further stress on the already overextended water supply.

The USGS in cooperation with NJDEP have studied water supply issues and released the report entitled *Hydrogeologic Framework, Availability of Water Supplies, and Saltwater Intrusion, Cape May County, New Jersey, Water-Resources Investigations Report 01-4246* in 2002 which was consulted for this Inventory. The report provides guidelines for future withdrawal volumes and recommended well locations in order to safeguard potable water supplies in the future. Alternative strategies for safeguarding freshwater include conservation and groundwater recharge using recycled supplies.

3.1.2 Aquifer Recharge

The NJ Geological Survey ("NJGS") has developed a method to estimate ground water recharge for Cape May County. Land-use, soil and climate data were combined to generate ground water recharge rates shown on the Water Resources Map (Figure 7). New Jersey receives an average of 44 inches of precipitation annually, of which approximately 15 to 39 inches recharge the ground-water reservoir by seeping into the ground.

3.1.3 Wellhead Protection Area

For a community such as Upper Township, in which water is supplied by a well drilled into the aquifer or underground water reservoir, knowledge about potential contamination and how contaminants can travel help safeguard the water supply. Safeguarding the susceptible area to prevent contaminants from entering the water supply reservoir is important for both individual wells and larger wells serving multiple dwellings. Wells become vulnerable to contamination when contaminated groundwater accrues within the area that a well draws water from. The NJDEP has mapped "Wellhead Protection Areas" around public wells, so that extra care can be taken in the development of these areas.

The USGS has developed a "Tier System" to distinguish three zones or horizontal surface areas that can add to recharge as the well intake pipe influences infiltration. Having established the area of land and the influence of well water withdrawal, based upon geology and soil characteristics, flow analysis has been generated for movement over 2 years, 5 years and 12 years. The colored tiers, one for each time period, provide a visual guide to the surface area which needs protection to safeguard a well's supply of water.

Figure 7 depicts wells that have been studied in Upper Township as part of the Wellhead Protection Program. The three areas around the well are distinguished by colors. Each colored ring or Tier designates the time interval which will allow a substance to travel horizontally to the water supply reservoir when influenced by water withdrawal.



Wellhead Protection Areas for larger community wells are shown in Red (2 year, Tier #1), Yellow (5 year as Tier 2) and Green (defining the 12 year area of horizontal movement of Tier #3. Understanding how drinking water is susceptible to contamination is the first step in developing protection for the supply.

The Wellhead Protection and Aquifer sections describe recharge as it relates to the highly permeable soils (sands / sediments) found in Upper Township. The factors facilitating recharge are the same issues influencing contamination when chemicals or hazardous materials are exposed to the open ground. In addition to estimates of ground water recharge rates, NJDEP has mapped sites where ground water contamination has been identified. The known ground water contaminated sites are included on the Water Resources Map for planning purposes. A separate map (Figure 7) provides the location of all known contaminated sites found in Upper Township.

The information is presented under a general heading (groundwater contamination) but has been further divided into areas under remediation in the Site Remediation Program (SRP) and areas where levels of specific contaminants have been exceeded relative to New Jersey Ground Water Quality Standards. A complete list of "Classification Exception Areas" (CEA) can be found on NJDEP website at <http://www.state.nj.us/dep/srp/regs/guidance.htm#cea>. Currently Known Extent (CKE) are represented on the Water Resources Map (Figure 7). Well Restriction Areas (WRAs) are also shown.

3.2 Wetlands

Wetlands occur between dry uplands and land permanently inundated with water (USFWS 1985). Activities in wetlands have been regulated under Section 404 of the Clean Water Act, since its passage in 1972. For the purpose of the regulation of wetlands, the Federal definition follows. Wetlands are

"Those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil condition" (EPA, 40 CFR 230.3 and CE 33 CFR 328.3).

The NJDEP has taken over the regulation of wetlands in the State. Wetlands which are regulated under New Jersey's Freshwater Wetlands Protection Act (N.J.A.C. 7:7A) are identified and delineated using the Army Corps of Engineer's three-parameter approach. Wetlands must exhibit evidence that the seasonal high water table occurs near the surface, wetlands vegetation must be present and evidence that water stands or flows through the area should be evident (Federal Interagency Committee for Wetland Delineation 1989).

The freshwater wetlands (FWW) included in this data set were originally mapped under the Fresh Water Wetlands Mapping Program, an effort undertaken to support the Freshwater Wetlands Protection Act, which was enacted in 1988. Using aerial photography captured in 1986 as the basis, a comprehensive, mapped inventory of non-tidal wetlands within New Jersey was produced. Mapped wetlands were classified according to the U.S Fish and Wildlife Service Cowardin Classification System. While these wetland delineations are not regulatory lines, they represent important resource data in determining potential wetland resources. In 1995, NJDEP acquired aerial imagery, and began updating the Land Use/Land Cover ("LU/LC") layer from 1986. The 1986 layer was examined with the new imagery, and areas of change delineated, with any new line work and land use codes needed to map the changes added to the base data set. This updated LU/LC layer is identified as the 1995/97 LU/LC update. This information is shown on Figure 2.

Approximately 24% of total land mass in Upper Township is occupied by Freshwater Wetlands (see Figure 8), and a similar amount of land mass contains Saltwater Wetlands. Freshwater Wetlands are found associated with the Tuckahoe River and Great Cedar Swamp, both of which are discussed in detail within this report.



Saltwater wetlands have formed adjacent to the main tidal water bodies of:

- Ludlum Bay
- Corson's Sound
- Peck Bay
- Great Egg Harbor Bay

The U.S. Fish and Wildlife Service has designated several wetlands on the Cape May Peninsula as priority wetland sites under the Federal Emergency Wetlands Resources Act of 1986, including Cape Island/Pond Creek, Great Cedar Swamp (Cape May National Wildlife Refuge), Great Egg/Jarvis, and Sewall Point (USFWS, SNE-NYB Coastal Program 1997).

Freshwater wetlands are regulated by the NJDEP, under the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:27A). Some activities are prohibited in wetlands, while other activities are allowed, but are restricted in areal extent. In some cases mitigation is required for the disturbance or destruction of wetlands. In these cases, either wetlands must be created, an existing wetlands must be enhanced or a monetary donation to a wetlands mitigation bank must be made.

The NJDEP also determines the size of a wetlands buffer assigned to freshwater wetlands. Activities in these buffers are also regulated. The buffer assigned is zero feet for human made ditches and swales. A buffer width of one hundred and fifty feet is assigned to exceptional resource value wetlands. Wetlands known to contain threatened or endangered animal species would be assigned this larger buffer width. Intermediate resource value wetlands receive a buffer of fifty feet.

3.3 Watersheds

The New Jersey Department of Environmental Protection defines "Watershed as the area of land that drains into a body of water such as a river, lake, stream or bay. It is separated from other systems in the area by high points such as hills or slopes. It includes not only the waterway itself but also the entire land area that drains to it."

The high points in the land that direct the flow of surface water within Upper Township form the boundaries of the Tuckahoe River drainage area. The Tuckahoe River is the largest river and collects much of the surface water drainage in Upper Township. The Tuckahoe River drainage basin contributes to the larger Great Egg Harbor Watershed Management Area, WMA #15. Watershed Management Areas are a designation used by NJDEP. The remaining land area in Upper Township is located within the Cape May Watershed Management Area #16. This basin drains lands located parallel to the Atlantic Coast. Refer to Figure 9 to view the boundaries of the two watersheds and view Watershed Management Areas boundaries within Cape May.

In addition to Watershed Management Area designations, Hydrologic Unit Codes (HUC 11 and HUC 14) are identifiers used by the USGS. Surface water management is based on the concept of watersheds and HUC 11 and HUC 14 codes are displayed on Figure 9. HUC 11 codes define Great Egg Harbor Basin (HUC 11: 02040302060040) and Cape May Basin (HUC 11: 02030902940020) watersheds. The subwatersheds of the HUC 11 watersheds subdivide Upper Township into smaller drainage areas within the larger Great Egg Harbor and Cape May Watersheds.

3.3.1 Great Egg Harbor Watershed

The Tuckahoe River discharges into Great Egg Harbor Bay, located in Atlantic County which also includes the watersheds of the Great Egg Harbor River, the Tuckahoe River, Absecon Creek and Patong Creek.



3.3.2 Tuckahoe River

The Tuckahoe River, as the largest contributor to Great Egg Harbor Bay, is the largest river in the Great Egg Management Area (WMA #15) and Upper Township. The river fans upstream into expansive marshes and lowland forests. The drainage area of the Tuckahoe River upstream of Route 49 is 1023.8 acres. The drainage area of the Tuckahoe River below Route 49 is 6,431.2 acres. Tarkiln Brook drains 1764.4 acres. The Mill Creek/Black Run sub-watershed covers 4503.1 acres. Halfway Creek drains 2433.9 acres. Cedar Swamp Creek/Cedar Swamp upstream of Route 50 drains 8850.9 acres and 4230.7 acres below Route 50. The combined subwatersheds for Willis Thorofare and Hughes Creek includes 3154.50 acres.

3.3.3 Atlantic Coastal Plain Watershed

Watershed Management Area 16 includes watersheds draining Cape May County south and east of the Tuckahoe River Watershed. The region contains minimal surface water flow. Ground water and shellfish harvesting water quality are the principal water issues. No fixed physical/chemical fresh (surface) water monitoring locations are currently located within this management area. The area includes the following watersheds: Dennis Creek, Delaware Bay Coastal Drainage, and Cape May Atlantic Coastal Drainage.

3.4 Surface Water Quality

Cape May County, located at the southern-most point of New Jersey, contains a continuation of the Atlantic Coastal Plain along its eastern border. The County is 267 square miles in area and is bounded on the north by Atlantic and Cumberland Counties, on east by the Atlantic Ocean and on the west and south by the Delaware Bay. The region is characterized by a low-lying, gently rolling plain whose highest point is 54 feet above sea level and whose surface is largely covered by wet soils and wetlands. Large swamps (Great Cedar, Timber and Beaver Swamps) occupy the north-central part of the County. Most, if not all streams are tidal in their lower reaches and terminate by flowing into fresh water swamps that, in turn, discharge into saltwater marshes near the shore.

Surface waters in the Pinelands portion of Upper Township include streams, lakes, and bogs. The streams are slow-moving with sand and gravel substrates. Ground water discharge comprises 89% of annual stream discharge. This groundwater input keeps the streams relatively cool (about 25°C [77°F] in summer). Water quality is generally exceptionally good. Surface water is colored brown like tea. Acidity of pinelands waters is high, with an average pH of 4.4. Indigenous fish and amphibian communities are tolerant of the acidity of the waters. Many non-indigenous plant and animal species cannot colonize these waters, due to acidity. However, elevated levels of pH, biochemical oxygen demand, magnesium, calcium, nitrates, and phosphates occur in wetlands disturbed by agricultural, residential, and urban land uses (USFWS, SNE-NYB Coastal Program 1997).

The NJDEP has established use designations in its Surface Water Quality Standards (N.J.A.C. 7:9-4.1). These designations are described briefly below.

- FW – signifies fresh waters and include all non-tidal and tidal waters with a salinity of less than 3.5 parts per thousand.
- FW-1 – fresh waters that originate in and are wholly within federal or state parks, forests, fish and wildlife lands, and other special holdings, that are to be maintained in their natural state of quality and not subject to any man-made wastewater discharges.
- FW-2 – refers to fresh waters that are not designated FW1 or PL.
- PL – includes all waters within the boundaries of the Pinelands Area, as established in the Pinelands Protection Act.



- SE – is a general surface water classification of waters with a salinity greater than 3.5 parts per thousand.
- C1 (Category One) - waters are to be protected "...from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s)" (N.J.A.C. 7:9-4.1-1.4, p. 3).

Waters that are classified by the NJDEP as Category One waters receive extra protection under the State's Stormwater Management Rules (N.J.A.C.7:8). These rules apply to development projects that involve the disturbance of at least one acre of land or the placement of one quarter acre of impervious cover on a site. A special water resource protection area must be established along all waters designated Category One. This includes perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC 14 drainage area. The area will consist of a 300-foot special buffer on each side of the waterway.

Table 3: Surface Water Quality Classifications of Upper Township Waters	
Water body	Water Quality Classification
Tuckahoe Lake	FW2-NT(C1)
Tuckahoe River (Source to Pinelands Protection and Preservation Area boundary at Rt. 49)	PL
Tarkiln Brook (within the Pinelands)	PL
Mill Creek (within the Pinelands)	PL
Back Run (within the Pinelands)	PL
Unnamed	PL
Great Egg Harbor	FW2-NT/SE1(C1)
Cedar Swamp Creek	FW2-NT/SE1
Halfway Creek	FW2-NT/SE1

Under the jurisdiction provided by Public Law 90-542, Congress signed Public Law 102-536 to designate segments of The Great Egg Harbor River and its tributaries as components of the National Wild and Scenic Rivers System in October 1992. As the first New Jersey river to receive the National Park Service designation to protect remaining selected free-flowing rivers with outstanding natural, cultural and/or recreational value, participating municipalities receive assistance in preparing a management plan to serve as the foundation for long term protection of the resource.

As an included tributary in the Great Egg Harbor National Scenic and Recreational River Plan, the Tuckahoe River is under the protection of the Wild and Scenic Rivers Act. Due to variations in requirements, specific segments of the Tuckahoe River and nearby Cedar Swamp Creek have been classified as shown below.

Table 4: Wild and Scenic Rivers in Upper Township			
River/Tributary	Segment	Miles	Classification
(Lower) Tuckahoe River	Confluence to Route 50 bridge	9 miles	Scenic
(Upper) Tuckahoe River	Route 50 bridge to Route 49 bridge	7.3 miles	Recreational
Cedar Swamp Creek	Confluence to headwaters	6.0 miles	Scenic



3.5 Floodways and Floodplains

According to the Federal Emergency Management Agency ("FEMA") mapping, much of easterly portion of Upper Township is located within the 100-year floodplains of the Atlantic Ocean, Great Egg Harbor Bay, Ludlam Bay, Peck Bay, Cedar Swamp Creek, the Tuckahoe River and its tributaries. Publicly-owned lands encompass a large portion of the areas prone to flooding. Strathmere and lands located adjacent to the Tuckahoe River to the west of the extensive wetland area located at the confluence of Cedar Swamp Creek and the Tuckahoe River are areas that contain development within floodplains. Strathmere and other coastal areas are subject to tidal flooding with wave action. The NJDEP regulates development in floodplains and the Flood Hazard area Control Act Rules (N.J.A.C. 7:13)

4.0 BIOLOGICAL RESOURCES

Biological resources include the botanical (plant) and zoological (animal) related attributes of an area. Botanical resources include the flora (e.g., checklist and analysis of species), and vegetation (plant communities) and the zoological resources include the invertebrate and vertebrate animals and animal communities. Rare, threatened, and endangered species and species of special concern also are considered within this section.

4.1 Botanical Resources

Upper Township extends geographically from the Atlantic Ocean shoreline to approximately 8.9 miles inland. Freshwater streams and rivers become brackish then salty. Wetlands range from tidal salt marshes to freshwater cedar bogs. Forests grade from Coastal Plain Oak and Oak-Pine Forests to Pine Barren Forest types. Successional vegetation, which colonizes sites after human or natural disturbance, runs a similar gamut from coastal to interior types. Since a large proportion of Upper Township consists of protected lands, many of its plant communities are of exceptional quality, containing threatened and endangered plants and community types. The Township is subdivided into two areas with special regulatory jurisdictions, the Coastal Zone and the Pinelands Area. It, therefore, seems natural to organize this discussion of plant communities into coastal and inland types.

4.1.1 Coastal Plant Communities

Plant communities can be broadly divided into upland and wetlands communities. In coastal areas, extremely dry or xeric sandy soils are typical. These harsh conditions strongly limit the number of vegetation species able to grow on beaches and coastal sand dunes. The composition of wetland communities in coastal areas is controlled by the concentration of salt in adjacent water bodies. Important wetland types include the Low Tidal Salt Marsh and High Tidal Salt Marsh, which compose the Salt Marsh Complex and the Brackish Tidal Marsh (Breden 1989, Collins & Anderson 1994). Also notable in coastal areas are subtidal aquatic plant communities, such as eelgrass beds. Activities in the latter community type are regulated by the NJDEP under the Rules on Coastal Zone Management (N.J.A.C. 7:7E-1.1 et seq). Upland coastal communities include the Marine Intertidal Gravel/Sand Beach Community (Breden 1989). The Dunegrass Community, the Beach Heather Community, the Shrub Thicket Community and the Dune Woodland Community (Collins & Anderson 1994).

The tables below list the typical plant species that occur in each of the major coastal plant communities likely to be present in Upper Township.

The Marine Intertidal Gravel/Sand Beach Community occurs between the mean low water line and the spring high tide line on ocean beaches. Plants in this community must be tolerant of salt-spray and periodic inundation with salty ocean waters. This community is a part of necessary habitat for feeding and nesting shorebirds (Breden 1989).



Table 5: Plants of the Marine Intertidal Gravel/Sand Beach Community (after Breden 1989, p. 166)

Common Name	Scientific Name	Common Name	Scientific Name
Herbs		Herbs	
Sea Rocket	<i>Cakile edentula</i>	Seaside Spurge	<i>Euphorbia polygonifolia</i>
Saltwort	<i>Salsola kali</i>	Sandbur	<i>Cenchrus tribuloides</i>
American Beachgrass	<i>Ammophila breviligulata</i>	Slender Seapurslane	<i>Sesuvium maritimum</i>

Sand is continually shifting on ocean beaches. Windblown and storm-driven sand form ridges of sand called dunes. The dunes are above the normal high tide levels, but plants still must be tolerant to salt spray. In natural dune systems, several parallel dune ridges are present. The nearest dunes to the ocean are called primary dunes. Conditions on the primary dunes are the most dynamic. Plants here must tolerate frequently shifting sands. The Dunegrass Community described below is most well-developed on the primary dune. American Beachgrass is often the dominant plant on the primary dune, particularly the foredune (portion of dune facing the ocean). This species is healthiest when sand is shifting and accreting (Collins & Anderson 1994).

Table 6: Plants of the Dunegrass Community (after Collins & Anderson 1994, p. 213)

Common Name	Scientific Name	Common Name	Scientific Name
Herbs		Herbs	
American Beachgrass (Dunegrass)	<i>Ammophila breviligulata</i>	Sea Rocket	<i>Cakile edentula</i>
Sandbur	<i>Cenchrus tribuloides</i>	Seaside Spurge	<i>Euphorbia polygonifolia</i>
Long-spined Sandbur	<i>Cenchrus longispinus</i>	Sandgrass	<i>Triplasis purpurea</i>
Saltwort	<i>Salsola kali</i>	Sea-beach Panic Grass	<i>Panicum amarum</i>
Seaside Goldenrod	<i>Solidago sempervirens</i>	Sedge	<i>Carex kobomugi</i>
Cocklebur	<i>Xanthium strumarium</i>	Beach Pea	<i>Lathyrus japonicus</i>
Dusty Miller	<i>Artemisia stelleriana</i>	Slender Seapurslane	<i>Sesuvium maritimum</i>

Secondary and tertiary dunes ideally are present landward of the primary dune. Here sands are more stable. Plants are also more protected from saltspray. American beachgrass loses its vigor on the secondary and tertiary dunes. Here Beach Heather often dominates. The most common plants found in the Beach Heather Community are listed below.

Table 7: Plants of the Beach Heather Community (after Collins and Anderson 1994, pp. 216)

Common Name	Scientific Name	Common Name	Scientific Name
Shrubs and Vines		Shrubs and Vines	
Virginia Creeper	<i>Parthenocissus quinquefolia</i>	Poison Ivy	<i>Toxicodendron radicans</i>
Herbs		Herbs	
Beach Heather	<i>Hudsonia tomentosa</i>	Sea-beach Three-awn	<i>Aristida tuberculosa</i>
American Beachgrass (Dunegrass)	<i>Ammophila breviligulata</i>	Sea Rocket	<i>Cakile edentula</i>
Sandbur	<i>Cenchrus tribuloides</i>	Seaside Spurge	<i>Euphorbia polygonifolia</i>
Long-spined Sandbur	<i>Cenchrus longispinus</i>	Sandgrass	<i>Triplasis purpurea</i>
Saltwort	<i>Salsola kali</i>	Sea-beach Panic Grass	<i>Panicum amarum</i>
Seaside Goldenrod	<i>Solidago sempervirens</i>	Sedge	<i>Carex kobomugi</i>
Cocklebur	<i>Xanthium strumarium</i>	Beach Pea	<i>Lathyrus japonicus</i>



Table 7: Plants of the Beach Heather Community (after Collins and Anderson 1994, pp. 216) (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Dusty Miller	<i>Artemesia stelleriana</i>	Slender Seapurslane	<i>Sesuvium maritimum</i>
Little Bluestem	<i>Schyzachyrium scoparium</i>	Cocklebur	<i>Xanthium strumarium</i>
Prickly Pear	<i>Opuntia humifusa</i>	Beach Pinweed	<i>Lechea maritime</i>
Trailing Wild Bean	<i>Strophostyles helvola</i>	Others	
Lichens and Mosses		Lichens and Mosses	
Thorn Lichen	<i>Cladonia uncialis</i>	Coastal Reindeer Lichen	<i>Cladina submitis</i>
Others			

Farther from the ocean, where the land receives less salt spray and soils are less xeric, woody plants can take hold. Tree species may even be present, though they will be stunted to the degree that salt spray reaches them. Tree heights rarely exceed 15 feet (Collins & Anderson 1994).

Table 8: Plants of the Shrub Thicket Community (after Collins and Anderson 1994, pp. 218)

Common Name	Scientific Name	Common Name	Scientific Name
Trees		Trees	
Red Cedar	<i>Juniperus virginiana</i>	Black Cherry	<i>Prunus serotina</i>
American Holly	<i>Ilex opaca</i>		
Shrubs and Vines	Shrubs and Vines	Shrubs and Vines	Shrubs and Vines
Scrub Oak	<i>Quercus ilicifolia</i>	Bayberry	<i>Myrica pensylvanica</i>
Beach Plum	<i>Prunus maritime</i>	Shadbush	<i>Amelanchier canadensis</i>
Highbush Blueberry	<i>Caccinium corybosum</i>	Winger Sumac	<i>Rhus copallina</i>
Virginia Creeper	<i>Parthenocissus quinquefolia</i>	Poison Ivy	<i>Toxicodendron radicans</i>
Herbs		Herbs	
Common Greenbriar	<i>Smilax rotundifolia</i>	Sea-beach Three-awn	<i>Aristida tuberculosa</i>
American Beachgrass (Dunegrass)	<i>Ammophila breviligulata</i>	Sandgrass	<i>Triplasis purpurea</i>
Sandbur	<i>Cenchrus tribuloides</i>	Seaside Spurge	<i>Euphorbia polygonifolia</i>
Long-spined Sandbur	<i>Cenchrus longispinus</i>	Sandgrass	<i>Triplasis purpurea</i>
Dusty Miller	<i>Artemesia stelleriana</i>	Little Bluestem	<i>Schyzachyrium scoparium</i>
Prickly Pear	<i>Opuntia humifusa</i>	Beach Pinweed	<i>Lechea maritime</i>

Dune Woodlands develop in the swales between the secondary and tertiary dunes. These communities occur where soil moisture is more available than in other types of dune plant communities. Little salt spray reaches these plants allowing for more robust growth and the appearance of less salt-tolerant species.

Table 9: Plants of the Dune Woodland Community (after Collins and Anderson 1994, pp. 220)

Common Name	Scientific Name	Common Name	Scientific Name
Trees		Trees	
Red Cedar	<i>Juniperus virginiana</i>	Black Cherry	<i>Prunus serotina</i>
American Holly	<i>Ilex opaca</i>	Red Maple	<i>Acer rubrum</i>
Hackberry	<i>Celtis occidentalis</i>	Sassafras	<i>Sassafras albidum</i>
Pitch Pine	<i>Pinus rigida</i>		



Table 9: Plants of the Dune Woodland Community (after Collins and Anderson 1994, pp. 220) (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Shrubs and Vines	Shrubs and Vines	Shrubs and Vines	Shrubs and Vines
Scrub Oak	<i>Quercus ilicifolia</i>	Bayberry	<i>Myrica pensylvanica</i>
Beach Plum	<i>Prunus maritime</i>	Shadbush	<i>Amelanchier canadensis</i>
Highbush Blueberry	<i>Caccinium corybosum</i>	Winger Sumac	<i>Rhus copallina</i>
Virginia Creeper	<i>Parthenocissus quinquefolia</i>	Poison Ivy	<i>Toxicodendron radicans</i>
Others			
Herbs		Herbs	
Switchgrass	<i>Panicum virgatum</i>	Sea-beach Three-awn	<i>Aristida tuberculosa</i>
Little Bluestem	<i>Schyzachyrium scoparium</i>	Others	

The upland coastal plant communities of Upper Township represent important habitat for threatened and endangered shorebirds. Portions of these habitats are included within two NJDEP Natural Heritage program Priority Sites: Corson Inlet North Site and Corson Inlet South and Whale Beach.

Coastal and estuarine wetlands differ from inland wetlands in that they are subject to periodic tidal influences. Variations in the salinity of these waters determine the composition of tidally-influenced plant communities. The dominant wetland community types include the High Marsh, Low Marsh and Brackish Tidal Marsh. Wide areas of coastal marshes can be viewed while crossing the bridge over the Great Egg Harbor River into Upper Township.

The frequency of tidal inundation distinguished the High Marsh from the Low Marsh Community. The High Marsh Low Marsh Community is flooded twice daily by tides. The High Marsh is generally inundated only during spring high tides, which occur twice monthly or during coastal storms. Water evaporates from the Marsh and salts are left behind. Therefore, soils tend to be saltier in this community. The High Marsh is fringed by a drier area that floods even less frequently. Woody plants begin to colonize this zone. The plants from the latter zone are included in the list of plants commonly found in the High Marsh Community (Collins & Anderson 1994).

Table 10: Plants of the High Marsh Community (after Collins and Anderson 1994, pp. 206)

Common Name	Scientific Name	Common Name	Scientific Name
Shrubs and Vines	Shrubs and Vines	Shrubs and Vines	Shrubs and Vines
Marsh Elder	<i>Quercus ilicifolia</i>	Bayberry	<i>Myrica pensylvanica</i>
Groundsel Bush	<i>Baccharis halimifolia</i>		
Herbs		Herbs	
Salt-meadow grass	<i>Spartina patens</i>	Spike Grass	<i>Distichlis spicata</i>
Big Cordgrass	<i>Spartina cyanosuroides</i>	Black Grass	<i>Juncus gerardi</i>
Perennial Salt Marsh Aster	<i>Aster tenuifolius</i>	Sea Lavender	<i>Limonium carolinianum</i>
Salt Marsh Bulrush	<i>Scirpus robustus</i>	Seaside Goldenrod	<i>Solidago sempervirens</i>
Beaked spike-rush	<i>Eleocharis rostellata</i>	Salt Marsh Cockspur Grass	<i>Echinochloa walteri</i>
Orache	<i>Atriplex patula</i>	Seaside Gerardia	<i>Agalinus maritima</i>
Salt Marsh Sand Spurrey	<i>Spergularia maritime</i>	Sea-pink	<i>Sabatia stellaris</i>
Slender Glasswort	<i>Salicornia europaea</i>	Woody Glasswort	<i>Salicornia virginica</i>
Switchgrass	<i>Panicum virgatum</i>	Rose Mallow	<i>Hibiscus moscheutos</i>
Seaside Mallow	<i>Kosteletzkya virginica</i>	Others	



The Low Marsh Community are flooded by tides twice a daily. Because of the frequent flushing, salts do not accumulate in soils to the degree that they do in the High Marsh. The common plants of the Low Marsh are listed below.

Table 11: Plants of the Low Marsh Community (after Collins and Anderson 1994, pp. 204)			
Common Name	Scientific Name	Common Name	Scientific Name
Herbs		Herbs	
Salt-marsh Cordgrass	<i>Spartina alterniflora</i>	Spike Grass	<i>Distichlis spicata</i>
Salt-meadow grass	<i>Spartina patens</i>	Black Grass	<i>Juncus gerardi</i>
Big Cordgrass	<i>Spartina cynosuroides</i>	Sea Lavender	<i>Limonium carolinianum</i>
Perennial Salt Marsh Aster	<i>Aster tenuifolius</i>	Seaside Mallow	<i>Kosteletzkya virginica</i>
Slender Glasswort	<i>Salicornia europaea</i>	Woody Glasswort	<i>Salicornia virginica</i>
Orache	<i>Atriplex patula</i>	Salt Marsh Sand Spurrey	<i>Spergularia maritima</i>
Salt-marsh Fleabane	<i>Pluchea odorata</i>	Switchgrass	<i>Panicum virgatum</i>
Few others			

As one moves farther up tidal rivers and estuaries, freshwater meets and mixes with salt water from the ocean. Plant communities are subject to varying salinities, depending on distance upstream, seasonal changes in stream discharge rate, droughts and storms. Plant communities will intergrade from salt marsh to freshwater marsh communities. Plants of Brackish Tidal Marsh Communities characterized by intermediate salinities or mesohaline conditions are listed in the table below.

Table 12: Plants of the Brackish Tidal Marsh Community (after Collins and Anderson 1994, pp. 208, Breden 1989, p. 170)			
Common Name	Scientific Name	Common Name	Scientific Name
Shrubs		Shrubs	
Marsh Elder	<i>Quercus ilicifolia</i>	Indigo Bush	<i>Amorpha fruticosa</i>
Groundsel Bush	<i>Baccharis halimifolia</i>	Few others	
Herbs	Herbs	Herbs	Herbs
Common Reed	<i>Phragmites australis</i>	Narrow-leaved cattail	<i>Typha angustifolia</i>
Rose Mallow	<i>Hibiscus moscheutos</i>	Water Hemp	<i>Amaranthus cannabinus</i>
Salt Marsh Cordgrass	<i>Spartina alterniflora</i>	Big Cordgrass	<i>Spartina cynosuroides</i>
Annual Salt Marsh aster	<i>Aster subulatus</i>	Salt Marsh Bulrush	<i>Scirpus robustus</i>
Three-square	<i>Scirpus pungens</i>	Olney's three-square	<i>Scirpus americanus</i>
Eastern Grasswort	<i>Lilaeopsis chinensis</i>	Salt Marsh Bulrush	<i>Scirpus cylindricus</i>
Herbwilliam	<i>Ptilimnium capillaceum</i>	Salt-marsh Fleabane	<i>Pluchea odorata</i>
Others			

Upstream of the further reach of salty ocean waters, tidal influence extends into strictly freshwater areas. Here plants no longer need to be salt-tolerant, but they must endure daily inundations and fluctuating water levels. The plant community that develops under these conditions is called a Freshwater Tidal Wetland Community.



Table 13: Plants of the Freshwater Tidal Marsh Community (after Collins and Anderson 1994, pp. 208, Breden 1989, p. 170)

Common Name	Scientific Name	Common Name	Scientific Name
Shrubs		Shrubs	
Buttonbush	<i>Cephalanthus occidentalis</i>	Indigo Bush	<i>Amorpha fruticosa</i>
Silky Dogwood	<i>Cornus amomum</i>	Swamp Rose	<i>Rosa palustris</i>
Few others			
Herbs	Herbs	Herbs	Herbs
Wild Rice	<i>Zizania aquatica</i>	Narrow-leaved cattail	<i>Typha angustifolia</i>
Broad-leaved cattail	<i>Typha latifolia</i>	Halber-leaved Tearthumb	<i>Polygonum arifolium</i>
Common Reed	<i>Phragmites australis</i>	Nodding Beggar-ticks	<i>Bidens cernua</i>
Blue Flag	<i>Iris versicolor</i>	Arrow-leaved Tearthumb	<i>Polygonum sagittatum</i>
Rose Mallow	<i>Hibiscus moscheutos</i>	Water Hemp	<i>Amaranthus cannabinus</i>
Bur-marigold	<i>Bidens laevis</i>	Great Ragweed	<i>Ambrosia trifida</i>
Jewelweed	<i>Impatiens capensis</i>	Sneezeweed	<i>Helenium autumnale</i>
Pickernelweed	<i>Pontederia cordata</i>	Arrow arum	<i>Peltandra virginica</i>
Rice Cutgrass	<i>Leersia oryzoides</i>	Spatterdock	<i>Nuphar advena</i>
Woolgrass	<i>Scirpus cyperinus</i>	Broad-leaved Arrowhead	<i>Sagittaria latifolia</i>
Ddotted Smartweed	<i>Polygonum punctatum</i>	Sweet Flag	<i>Acorus calamus</i>
Others			

The NJDEP Natural Heritage Program has recognized the importance of tidally influenced wetland communities found in Upper Township are valuable in their own right and as habitat for threatened and endangered plant and animal species. Many acres of tidal wetlands are included within Natural Heritage Priority Sites within the Township boundaries.

Aquatic Plant Communities, which occur in fresh, brackish or saline estuarine waters are important plant communities, since they provide habitat for numerous aquatic creatures. These communities are called Submerged Aquatic Vegetation (SAV) Beds. Construction, dredging and other activities are limited or prohibited in SAV Beds under the NJDEP's Rules on Coastal Zone Management. The table below lists the dominant plant species in these communities. Plant species will vary with salinity.

Table 14: Plants of Submerged Aquatic Vegetation Beds (after Collins and Anderson 1994, pp. 208, Breden 1989, p. 170)

Common Name	Scientific Name	Common Name	Scientific Name
Eelgrass	<i>Zostera marina</i>	Widgeon Grass	<i>Ruppia maritima</i>
Slender Pondweed	<i>Potamogeton pusillus</i>	Redhead Grass	<i>Potamogeton perfoliatus</i>
Water Celery	<i>Vallisneria americana</i>	Naiad	<i>Najas flexilis</i>
Horned-pondweed	<i>Zannichellia palustris</i>		

4.1.2 Inland Plant Communities

Inland plant communities can be found in Upper Township beyond the influence of tides, coastal winds or salt spray. The westerly portion of the Township is located within the New Jersey Pinelands. This is an ecological, as well as a jurisdictional designation. While the jurisdictional boundary of the Pinelands Area does not encompass the entire



geographic area that would include all inland communities in Upper Township, ecologically they are pinelands communities. Pinelands vegetation is strongly influenced by the low-nutrient status of the sandy soils and frequent forest fires. Upland communities that are found in Upper Township include pine-oak forests and oak-pine forests, with pines predominating in areas with higher fire frequencies (USFWS, SNE-NYB Coastal Program 1997).

The Mesic Coastal Plain Forest will occur in upland areas with soils less xeric than typical Pinelands soils. Three sub-types have been observed: the Oak-Heath Forest, the Mixed Oak-Beech Forest and the Southern Coastal Plain Forest. The Southern Coastal Plain Mixed Oak Forest sub-type is most commonly found in Cape May and Cumberland Counties. The dominant vegetation species observed in the Mesic Coastal Plain Forest are listed in the table below (Breden 1989). There are excellent examples of old growth Mesic Coastal Plain Mixed Oak forest in the Great Cedar Swamp Macrosite (NJDEP, NHP 2001d).

Table 15: Plants of the Southern Coastal Plain Mixed Oak Forest Community (after Collins and Anderson 1994, p. 187., Breden 1989 p. 199)

Common Name	Scientific Name	Common Name	Scientific Name
Dominant Trees		Dominant Trees	
White Oak	<i>Quercus alba</i>	Black Oak	<i>Quercus velutina</i>
Chestnut Oak	<i>Quercus prinus</i>	Scarlet Oak	<i>Quercus coccinea</i>
American Holly	<i>Ilex opaca</i>	Sassafras	<i>Sassafras albidum</i>
Southern Red Oak	<i>Quercus falcata</i>		
Other Trees		Other Trees	
Persimmon	<i>Diospyros virginiana</i>	Black Cherry	<i>Prunus serotina</i>
American Beech	<i>Fagus grandifolia</i>	Flowering Dogwood	<i>Cornus florida</i>
Sweetgum	<i>Liquidambar styraciflua</i>	Swamp Chestnut Oak	<i>Quercus michauxii</i>
Willow Oak	<i>Quercus phellos</i>	Water Oak	<i>Quercus nigra</i>
Shrubs and Vines		Shrubs and Vines	
Early Lowbush Blueberry	<i>Vaccinium pallidum</i>	Black Huckleberry	<i>Gaylussacia baccata</i>
Highbush Blueberry	<i>Vaccinium corymbosum</i>	Bayberry	<i>Myrica pensylvanica</i>
Downy Juneberry	<i>Amelanchier arborea</i>	Sweet Pepperbush	<i>Clethra alnifolia</i>
Pinxter Flower	<i>Rhododendron periclymenoides</i>	Glaucous Greenbriar	<i>Smilax glauca</i>
Swamp azalea	<i>Rhododendron viscosum</i>	Japanese Honeysuckle	<i>Lonicera japonica</i>
Mountain Laurel	<i>Kalmia latifolia</i>	Virginia Creeper	<i>Parthenocissus quinquefolia</i>
Common Greenbriar	<i>Smilax rotundifolia</i>	Poison Ivy	<i>Toxicodendron radicans</i>
Few others			
Herbs		Herbs	
Bracken fern	<i>Pteridium aquilinum</i>	Rattlesnake Weed	<i>Hieracium venosum</i>
Pennsylvania Sedge	<i>Carex pensylvanica</i>	Cow-wheat	<i>Melampyrum lineare</i>
Spotted Wintergreen	<i>Chimaphila maculate</i>	Stemless Lady's Slipper	<i>Cypripedium acaule</i>
Partridgeberry	<i>Mitchella repens</i>	Christmas Fern	<i>Polystichum achrostichoides</i>
Sweet Cicely	<i>Osmorhiza claytoni</i>	Marginal Woodfern	<i>Dryopteris marginalis</i>
Montropa uniflora	<i>Aster divaricatus</i>	Bracken Fern	<i>Pteridium aquilinum</i>
Mayapple	<i>Popophyllum peltatum</i>	Few others	



In the Pine Barrens of New Jersey, the typical sandy soils tend to be extremely dry or xeric. Where fires are infrequent, oaks will begin to dominate over pines. A Dry Pine Oak Forest tends to develop in these areas.

Table 16: Plants of the Dry Oak-Pine Forest Community (after Collins and Anderson 1994, p. 180-180, Whittaker 1998, p. 318-319)

Common Name	Scientific Name	Common Name	Scientific Name
Dominant Trees		Dominant Trees	
White Oak	<i>Quercus alba</i>	Black Oak	<i>Quercus velutina</i>
Chestnut Oak	<i>Quercus prinus</i>	Post Oak	<i>Quercus illicifolia</i>
Other Trees		Other Trees	
Pitch Pine	<i>Pinus rigida</i>	Shortleaf Pine	<i>Pinus echinata</i>
Southern Red Oak	<i>Quercus falcata</i>	Sassafras	<i>Sassafras albidum</i>
Scarlet Oak	<i>Quercus coccinea</i>	Few other	
Shrubs and Vines		Shrubs and Vines	
Scrub Oak	<i>Quercus illicifolia</i>	Dwarf Chestnut Oak	<i>Quercus prinoides</i>
Early Lowbush Blueberry	<i>Vaccinium pallidum</i>	Black Huckleberry	<i>Gaylussacia baccata</i>
Dangleberry	<i>Gaylussacia frondosa</i>	Bayberry	<i>Myrica pensylvanica</i>
Lowbush Blueberry	<i>Vaccinium vacillans</i>	Sheep Laurel	<i>Kalmia angustifolia</i>
Few others			
Herbs		Herbs	
Bracken fern	<i>Pteridium aquilinum</i>	Rattlesnake Weed	<i>Hieracium venosum</i>
Pennsylvania Sedge	<i>Carex pensylvanica</i>	Cow-wheat	<i>Melampyrum lineare</i>
Little Bluestem	<i>Schizachyrum scoparium</i>	Goat's Rue	<i>Tephrosia virginica</i>
Wild Indigo	<i>Baptisia tinctoria</i>	Christmas Fern	<i>Polystichum achrostichoides</i>
Sweet Cicely	<i>Osmorhiza claytoni</i>	Marginal Woodfern	<i>Dryopteris marginalis</i>
White Wood Aster	<i>Aster divaricatus</i>	Indian Pipe	<i>Monotropa uniflora</i>
Few others			

In the Pine Barrens of New Jersey, the typical sandy soils tend to be extremely dry or xeric. Where fire frequencies are not extreme, a Dry Pine Oak Forest tends to dominate the landscape.

Table 17: Plants of the Pine-Oak Forest Community (after Breden 1989 p.195, Collins and Anderson 1994, p. 174-175, Olsson 1998 p.250, Whittaker 1998, p. 319)

Common Name	Scientific Name	Common Name	Scientific Name
Dominant Trees		Other Trees	
Pitch Pine	<i>Pinus rigida</i>	Shortleaf Pine	<i>Pinus echinata</i>
Other Trees		Other Trees	
		Black Oak	<i>Quercus velutina</i>
Chestnut Oak	<i>Quercus prinus</i>	Post Oak	<i>Quercus stellata</i>
White Oak	<i>Quercus alba</i>	Scrub Oak	<i>Quercus illicifolia</i>
Scarlet Oak	<i>Quercus coccinea</i>	Sassafras	<i>Sassafras albidum</i>
Few others			
Shrubs and Vines		Shrubs and Vines	
Scrub Oak	<i>Quercus illicifolia</i>	Eastern Teaberry	<i>Gaultheria procumbens</i>
Blackjack Oak	<i>Quercus marilandica</i>	Staggerbush	<i>Lyonia mariana</i>



Table 17: Plants of the Pine-Oak Forest Community (after Breden 1989 p.195, Collins and Anderson 1994, p. 174-175, Olsson 1998 p.250, Whittaker 1998, p. 319) (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Dangleberry	<i>Gaylussacia frondosa</i>	Black Huckleberry	<i>Gaylussacia baccata</i>
Early Lowbush Blueberry	<i>Vaccinium pallidum</i>	Glaucous Greenbriar	<i>Smilax glauca</i>
Sweet Fern	<i>Comptonia peregrina</i>	Common Greenbriar	<i>Smilax rotundifolia</i>
Lowbush Blueberry	<i>Vaccinium vacillans</i>	Wild Indigo	<i>Baptisia tinctoria</i>
Heath	<i>Arctostaphylos uva-ursi</i>	Trailing arbutus	<i>Epigaea repens</i>
Few others			
Herbs		Herbs	
Golden Heather	<i>Hudsonia ericoides</i>	Little Bluestem	<i>Schizachyrum scoparium</i>
Bracken fern	<i>Pteridium aquilinum</i>	Rattlesnake Weed	<i>Hieracium venosum</i>
Pennsylvania Sedge	<i>Carex pensylvanica</i>	Frostweed	<i>Helianthemum canadense</i>
Wild Indigo	<i>Baptisia tinctoria</i>	Goat's Rue	<i>Tephrosia virginica</i>
Sweet Goldenrod	<i>Solidago odora</i>	Ipecac Spurge	<i>Euphorbia ipecacuanhae</i>
Pine Barren's Sandwort	<i>Arenaria caroliniana</i>	Marginal Woodfern	<i>Dryopteris marginalis</i>
Stiff Aster	<i>Aster linariifolius</i>	Few others	

Lowland areas in the Upper Township support a variety of wetland communities, including Atlantic White Cedar Swamps, Hardwood Swamps, Pitch Pine Lowland Forests, Shrub Swamp/Shrub Thicket, South Jersey Fens/Pine Barren Savannas and Coastal Plain Intermittent Ponds (USFWS, SNE-NYB Coastal Program 1997).

Pitch Pine Lowlands These fringe swamps along streams in the pine barrens and occur in depressions and other poorly drained sites (USFWS, SNE-NYB Coastal Program 1997).

Table 18: Plants of the Pitch Pine Lowland Forest Community (after Breden 1989 p.185-186, Collins and Anderson 1994, p. 161, Whittaker 1998, p. 317)

Common Name	Scientific Name	Common Name	Scientific Name
Dominant Tree		Dominant Tree	
Pitch Pine	<i>Pinus rigida</i>	Atlantic White Cedar	<i>Chamaecyparis thyoides</i>
Other Trees		Red Maple	<i>Acer rubrum</i>
		Sweet Bay Magnolia	<i>Magnolia virginiana</i>
Sour Gum	<i>Nyssa sylvatica</i>		
Scrub Oak	<i>Quercus illicifolia</i>	Few others	
Shrubs and Vines		Shrubs and Vines	
Highbush Blueberry	<i>Vaccinium corymbosum</i>	Black Huckleberry	<i>Gaylussacia baccata</i>
Dangleberry	<i>Gaylussacia frondosa</i>	Staggerbush	<i>Lyonia mariana</i>
Dwarf Huckleberry	<i>Gaylussacia dumosa</i>	Swamp Doghobble	<i>Leucothoe racemosa</i>
Swamp Azalea	<i>Rhododendron viscosum</i>	Maleberry	<i>Ligonia ligustrina</i>
Early Lowbush Blueberry	<i>Vaccinium pallidum</i>	Glaucous Greenbriar	<i>Smilax glauca</i>
Sweet Fern	<i>Comptonia peregrina</i>	Wild Indigo	<i>Baptisia tinctoria</i>
Lowbush Blueberry	<i>Vaccinium vacillans</i>	Trailing arbutus	<i>Epigaea repens</i>
Sheep Laurel	<i>Kalmia angustifolia</i>	Leatherleaf	<i>Chamaedaphne calyculata</i>
Sand Myrtle	<i>Leiophyllum buxifolium</i>	Sweet Pepperbush	<i>Clethra alnifolia</i>
Winterberry	<i>Ilex verticillata</i>	Inkberry	<i>Ilex glabra</i>
Common Greenbriar	<i>Smilax rotundifolia</i>	Wintergreen	<i>Gaultheria procumbens</i>



Table 18: Plants of the Pitch Pine Lowland Forest Community (after Breden 1989 p.185-186, Collins and Anderson 1994, p. 161, Whittaker 1998, p. 317) (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Few others			
Herbs		Herbs	
Bracken Fern	<i>Pteridium aquilinum</i>	Swamp Dewberry	<i>Rubus hispidus</i>
Turkeybeard	<i>Xerophyllum asphdeloides</i>	Walter's Sedge	<i>Carex walteriana</i>
Cinnamon Fern	<i>Osmunda cinnamomea</i>	Others	

The plant species composition of Shrub Swamps or Shrub Thicket Communities (nomenclature from different authors) vary according to the physical landscape conditions under which the community develops. These communities fringe lakes, canals and hardwood swamps. They develop in abandoned cranberry bogs, overgrown ponds and along the dikes constructed for small roadways through wetland areas, such as cranberry bogs. In addition, if Coastal Plain Intermittent Ponds are dominated by shrubs they are considered to be Shrub Swamps. The plant species list below encompasses the shrub communities that develop under these differing conditions. (Olsson 1998)

Table 19: Plants of the Pine Barren Shrub Swamp / Shrub Thicket Community (after Breden 1989 p. 180, Olsson 1998, p. 254-256)

Common Name	Scientific Name	Common Name	Scientific Name
Tree Saplings		Tree Saplings	
Red Maple	<i>Acer rubrum</i>	Atlantic White Cedar	<i>Chamaecyparis thyoides</i>
Sour Gum	<i>Nyssa sylvatica</i>	Sweet Bay Magnolia	<i>Magnolia virginiana</i>
Shrubs and Vines		Shrubs and Vines	
Highbush Blueberry	<i>Vaccinium corymbosum</i>	Staggerbush	<i>Lyonia mariana</i>
Dangleberry	<i>Gaylussacia frondosa</i>	Possum Haw	<i>Viburnum nudum</i>
Chokecherry	<i>Pyrus arbutifolia</i>	Buttonbush	<i>Cephalanthus occidentalis</i>
Serviceberry	<i>Amelanchier canadensis</i>	Leatherleaf	<i>Chamaedaphne calyculata</i>
Winged Sumac	<i>Rhus copallina</i>	Swamp Doghobble	<i>Leucothoe racemosa</i>
Sheep Laurel	<i>Kalmia angustifolia</i>	Maleberry	<i>Ligonia ligustrina</i>
Inkberry	<i>Ilex glabra</i>	Glaucous Greenbriar	<i>Smilax glauca</i>
Few others			
Herbs		Herbs	
Juniper Polytrichum Moss	<i>Polytrichum juniperinum</i>	Eastern Showy Aster	<i>Aster spectabilis</i>
Common Sheep Sorrel	<i>Rumex acetosella</i>	Swamp Dewberry	<i>Rubus hispidus</i>
Bracken Fern	<i>Pteridium aquilinum</i>	Dodder	<i>Cuscuta gronowii</i>
Broomsedge Bluestem	<i>Andropogon virginicus</i>	Virginia Chainfern	<i>Woodwardia virginica</i>
Deertongue	<i>Panicum clandestinum</i>	Cranberry	<i>Vaccinium macrocarpon</i>
Button Sedge	<i>Carex bullata</i>	Blunt Mannagrass	<i>Glyceria obtusa</i>
Swamp Loosestrife	<i>Decodon verticillatus</i>	Others	
Mosses and Lichens		Mosses and Lichens	
Toothed Sphagnum Moss	<i>Sphagnum cuspidatum</i>	Sphagnum Moss	<i>Sphagnum flavicomans</i>
Sphagnum Moss	<i>Sphagnum subnitens</i>	Sphagnum Moss	<i>Sphagnum fallax</i>
Cup Lichen	<i>Cladonia squamosa</i>	Sphagnum Moss	<i>Sphagnum magellanicum</i>
Others			



South Jersey Fens/Pine Barren Savannas are grass and sedge- dominated wet meadow communities that occur in floodplains of Pine Barrens streams. Naturally-formed levees tend to separate this community from the streams by a levee. The primary water source for fens/savannahs tends to be groundwater seepage with occasional flooding from adjacent streams (Breden 1989). This plant community has been declining in area. Formerly occupying thousands of hectares, it now covers approximately 400 hectares (1,000 acres) at present. Without natural or human disturbance, pine barren savannas are converted over time into shrub and forested swamps (USFWS, SNE-NYB Coastal Program 1997).

Table 20: Plants of the South Jersey Fens/Pine Barren Savannas Community (after Breden 1989 pp. 179-180, Collins and Anderson 1994, pp. 163-164, Olsson 1998, p. 254-256)

Common Name	Scientific Name	Common Name	Scientific Name
Tree Saplings		Tree Saplings	
Atlantic White Cedar	<i>Chamaecyparis thyoides</i>	Red Maple	<i>Acer rubrum</i>
Pitch Pine	<i>Pinus rigida</i>	Few others	
Shrubs and Vines		Shrubs and Vines	
Highbush Blueberry	<i>Vaccinium corymbosum</i>	Cranberry	<i>Vaccinium macrocarpon</i>
Dangleberry	<i>Gaylussacia frondosa</i>	Leatherleaf	<i>Chamaedaphne calyculata</i>
Dwarf Huckleberry	<i>Gaylussacia dumosa</i>	Sheep Laurel	<i>Kalmia angustifolia</i>
Few others			
Herbs		Herbs	
Woolgrass	<i>Scirpus cyperinus</i>	Twig Rush	<i>Cladium mariscoides</i>
Button sedge	<i>Carex bullata</i>	Cottongrass	<i>Eriophorum virginicum</i>
White Beak-rush	<i>Rhynchospora alba</i>	Featherbristle Beaksedge	<i>Rhynchospora ologantha</i>
Slender Beaksedge	<i>Rhynchospora gracilentia</i>	Torrey's Beak Rush	<i>Rhynchospora torreyani</i>
Bog Aster	<i>Aster nemoralis</i>	White-fringed orchis	<i>Habenaria blephariglottis</i>
Blunt Mannagrass	<i>Glyceria obtuse</i>	Eastern Showy Aster	<i>Aster spectabilis</i>
Forked Rush	<i>Juncus dichotomus</i>	Nuttall's Lobelia	<i>Lobelia nuttallii</i>
Canada Rush	<i>Juncus canadensis</i>	Beardgrass	<i>Andropogon glomeratus</i>
Golden crest	<i>Lophiola aurea</i>	Bog Asphodel	<i>Narthecium americanum</i>
Netted Nutrush	<i>Scleria reticularis</i>	Goldencrest	<i>Lophiola americana</i>
Carolina Oatgrass	<i>Danthonia epilis</i>	Wooly Rosette Grass	<i>Panicum scabriusculum</i>
Rice Cutgrass	<i>Leersia oryzoides</i>	Virginia Narsh St. Johnswort	<i>Hypericum virginicum</i>
Lance-leaved Sabatia	<i>Sabatia difformis</i>	Coppery St. Johnswort	<i>Hypericum denticulatum</i>
Marsh St. Johnswort	<i>Triadenum virginicum</i>	Redroot	<i>Lachnanthes caroliniana</i>
St. Johnswort	<i>Hypericum gentianoides</i>	Redroot	<i>Lachnanthes tinctoria</i>
Pipewort	<i>Eriocaulon spp.</i>	Golden Club	<i>Orontium aquaticum</i>
Round-leaved Sundew	<i>Drosera rotundifolia</i>	Spatulate-leaved Sundew	<i>Drosera intermedia</i>
Thread-leaved Sundew	<i>Drosera filiformis</i>	Calopogon	<i>Calopogon spp.</i>
Livid Sedge	<i>Carex livida</i>	Short-leaf Milkwort	<i>Polygala brevifolia</i>
Pitcher Plant	<i>Sarracenia purpurea</i>	Orange Milkwort	<i>Polygala lutea</i>
Crodd-leaved Milkwort	<i>Polygala cruciata</i>	Horned Bladderwort	<i>Utriculariacornuta</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>	Virginia Chain Fern	<i>Woodwardia virginica</i>
Slender Yellow-eyed grass	<i>Xyris torta</i>	Threeway Sedge	<i>Dulichium arundinaceum</i>
Curly Grass Fern	<i>Schizaea pusilla</i>	Southern Bob Clubmoss	<i>Lycopodium appressum</i>
Meadow Beauty	<i>Rhexia virginica</i>	Toothed Flatsedge	<i>Cyperus dentatus</i>



Table 20: Plants of the South Jersey Fens/Pine Barren Savannas Community (after Breden 1989 pp. 179-180, Collins and Anderson 1994, pp. 163-164, Olsson 1998, p. 254-256) (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Brownfruit Rush	<i>Juncus pelocarpus</i>	Coastal Sedge	<i>Carex exilis</i>
Yellow Asphodel	<i>Nartheceum americanum</i>	New Jersey Muhli	<i>Muhlenbergia torreyana</i>
Many others			
Mosses and Lichens		Mosses and Lichens	
Sphagnum Moss	<i>Sphagnum pulchrum</i>	Sphagnum Moss	<i>Sphagnum portoricense</i>
Sphagnum Moss	<i>Sphagnum papillosum</i>	Sphagnum Moss	<i>Sphagnum capillaceum</i>
Sphagnum Moss	<i>Sphagnum quinquefarium</i>	Sphagnum Moss	<i>Sphagnum pylaesii</i>
Sphagnum Moss	<i>Sphagnum compactum</i>	Sphagnum Moss	<i>Sphagnum tenellum</i>
Sphagnum Moss	<i>Sphagnum flavicomans</i>	Sphagnum Moss	<i>Sphagnum magellanicum</i>
Rapp's Cup Lichen	<i>Cladonia calycantha</i>	Florida Cup Lichen	<i>Cladonia floridana</i>
Others			

Coastal Plain Pond Communities are rare, generally sedge-dominated communities. They are important since they provide habitat for a number of rare plants and sometimes animal. These ponds can be natural in origin or man-made where excavation to the water table has occurred, Water levels are subject to seasonal fluctuations. When ponds dry out and cannot support fish species they are considered to be intermittent or vernal ponds. Vernal habitats are important for breeding amphibians (USFWS, SNE-NYB Coastal Program 1997).

Table 21: Plants of the Coastal Plain Intermittent Pond Community (after Breden 1989 p. 176, USFWS, SNE-NYB Coastal Program 1997)

Common Name	Scientific Name	Common Name	Scientific Name
Herbs		Herbs	
Netted Nutrush	<i>Scleria reticularis</i>	New Jersey Muhli	<i>Muhlenbergia torreyana</i>
Walter's Sedge	<i>Carex walteriana</i>	Warty Panic Grass	<i>Panicum verrucosum</i>
Witchgrass	<i>Panicum capillare</i>	Pink Tickseed	<i>Coreopsis rosea</i>
Smooth Sawgrass	<i>Cladium mariscoides</i>	Cypress Panic Grass	<i>Panicum mattamuskeetense</i>
Smallfruit Spikerush	<i>Eleocharis microcarpa</i>	Canby's Lobelia	<i>Lobelia canbyi</i>
Little Floatingheart	<i>Nymphoides cordata</i>	Slender Arrowhead	<i>Sagittaria teres</i>
Wright's Rosette Grass	<i>Panicum wrightianum</i>	Jointed Spikesedge	<i>Eleocharis equisetoides</i>
Shortbeak Beaksedge	<i>Psilocarya nitens</i>	Boykin's Lobelia	<i>Lobelia boykinii</i>
Mudbank crowngrass	<i>Paspalum dissectum</i>	Narrowleaf Primrose-willow	<i>Ludwigia linearis</i>
Hirst's Panicgrass	<i>Panicum hirstii</i>	Wrinkled Jointtail Grass	<i>Manisuris rugosa</i>
Small's Yelloweyed grass	<i>Xyris smalliana</i>	Others	
Mosses and Lichens		Mosses and Lichens	
Lescur's Sphagnum	<i>Sphagnum macrophyllum</i>	Florida Sphagnum	<i>Sphagnum macrophyllum</i> var. <i>floridanum</i>
Sphagnum Moss	<i>Sphagnum lescurii</i>	Others	

Hardwood swamps are often contiguous with cedar swamps and may replace cedar swamps after extensive logging (USFWS, SNE-NYB Coastal Program 1997).. According to Collins and Anderson (1994), natural succession in the wetlands of the Outer Coastal Plain proceeds from shrub swamp to cedar swamp to a hardwood swamp community. The Outer Coastal Plain Hardwood Swamp Community is generally dominated by Red Maple. In Cape May County



the southeastern species Water Oak and Willow Oak reach their northern range in these communities (USFWS, SNE-NYB Coastal Program 1997). There are excellent examples of old growth hardwood swamp in the Great Cedar Swamp Macrosite (NJDEP, NHP 2001d).

Table 22: Plants of Outer Coastal Plain Hardwood Swamp Community (after Collins and Anderson 1994, pp. 158)

Common Name	Scientific Name	Common Name	Scientific Name
Dominant Trees		Dominant Trees	
Red Maple	<i>Acer rubrum</i>	Sweet Gum	<i>Liquidambar styraciflua</i>
Sour Gum	<i>Nyssa sylvatica</i>		
Other Trees		Other Trees	
Atlantic White Cedar	<i>Chamaecyparis thyoides</i>	Southern Red Oak	<i>Quercus falcate</i>
Pitch Pine	<i>Pinus rigida</i>	Pin Oak	<i>Quercus palustris</i>
Sweet Bay Magnolia	<i>Magnolia virginiana</i>	American Holly	<i>Ilex opaca</i>
Few Others			
Shrubs and Vines		Shrubs and Vines	
Highbush Blueberry	<i>Vaccinium corymbosum</i>	Fetterbush	<i>Eubotrys racemosa</i>
Spicebush	<i>Lindera benzoin</i>	Swamp Azalea	<i>Rhododendron viscosum</i>
Sweet Pepperush	<i>Clethra alnifolia</i>	Winterberry	<i>Ilex verticillata</i>
Naed Witherod	<i>Viburnum nudum</i>	Poison Sumac	<i>Toxicodendron vernix</i>
Poison Ivy	<i>Toxicodendron radicans</i>	Common Greenbriar	<i>Smilax rotundifolia</i>
Japanese Honeysuckle	<i>Lonicera japonica</i>	Swamp Doghobble	<i>Leucothoe racemosa</i>
Others			
Herbs		Herbs	
Swamp Dewberry	<i>Rubus hispidus</i>	Woodreed	<i>Cinna arundinacea</i>
Slender Spike Grass	<i>Chasmanthium laxum</i>	Primrose-leaved violet	<i>Viola primulifolia</i>
Royal Fern	<i>Osmunda regalis</i>	Bog Fern	<i>Thelypteris simulta</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>	Netted Chain Fern	<i>Woodwardia areolata</i>
Virginia Chain Fern	<i>Woodwardia virginica</i>	Others	

Often occurring along Outer Coastal Plain streams in New Jersey, Atlantic White Cedar Swamp Communities form bands up to 1,000 feet wide from headwaters to the extent of tidal influence. This community is characterized by dense stands of Atlantic White Cedar and few others trees. Thick hummocks and mats of Sphagnum mosses cover much of the ground (USFWS, SNE-NYB Coastal Program 1997).

Table 23: Plants of Coastal Plain Atlantic White Cedar Swamp Community (after Breden p. 185, Collins and Anderson 1994, pp. 153-154)

Common Name	Scientific Name	Common Name	Scientific Name
Dominant Trees		Dominant Trees	
Atlantic White Cedar	<i>Chamaecyparis thyoides</i>	Red Maple	<i>Acer rubrum</i>
Other Trees		Other Trees	
		Pitch Pine	<i>Pinus rigida</i>
Sweet Bay Magnolia	<i>Magnolia virginiana</i>	Few Others	
Shrubs and Vines		Shrubs and Vines	
Highbush Blueberry	<i>Vaccinium corymbosum</i>	Fetterbush	<i>Eubotrys racemosa</i>
Spicebush	<i>Lindera benzoin</i>	Swamp Azalea	<i>Rhododendron viscosum</i>



Table 23: Plants of Coastal Plain Atlantic White Cedar Swamp Community (after Breden p. 185, Collins and Anderson 1994, pp. 153-154) (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Sweet Pepperush	<i>Clethra alnifolia</i>	Winterberry	<i>Ilex verticillata</i>
Dangleberry	<i>Gaylussacia frondosa</i>	Sheep Laurel	<i>Kalmia angustifolia</i>
Leatherleaf	<i>Chamaedaphne calyculata</i>	Inkberry	<i>Ilex glabra</i>
Maleberry	<i>Ligonia ligustrina</i>	Poison Sumac	<i>Toxicodendron vernix</i>
Common Greenbriar	<i>Smilax rotundifolia</i>	Few others	
Herbs		Herbs	
Pitcher Plant	<i>Sarracenia purpurea</i>	Spatulate-leaved Sundew	<i>Drosera intermedia</i>
Bladderwort	<i>Utricularia spp.</i>	Round-leaved Sundew	<i>Drosera rotundifolia</i>
Golden Club	<i>Orontium aquaticum</i>	Bog Fern	<i>Thelypteris simula</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>	Netted Chain Fern	<i>Woodwardia areolata</i>
Royal Fern	<i>Osmunda regalis</i>	Arethusa	<i>Arethusa bulbosa</i>
Long Sedge	<i>Carex folliculate</i>	Virginia Chain Fern	<i>Woodwardia virginica</i>
Collin's Sedge	<i>Carex collinsii</i>	Many others	
Mosses and Lichens		Mosses and Lichens	
Sphagnum Moss	<i>Sphagnum pulchrum</i>	Sphagnum Moss	<i>Sphagnum flavicomans</i>
Sphagnum Moss	<i>Sphagnum fallax</i>	Sphagnum Moss	<i>Sphagnum recurvum</i>
Santee Lichen	<i>Cladonia santensis</i>	Sphagnum Moss	<i>Sphagnum magellanicum</i>
Others			

4.1.3 Rare Vegetation Communities and Species

The State's Natural Heritage Program maintains a database of rare plant communities and rare plant species. According to this database, three types of rare plant communities occur in Upper Township. These are:

- Northern Peatland Coastal Plain Pond Community
- Coastal Plain Intermittent Pond Community
- Freshwater Tidal Marsh Complex.

The rare form of Coastal Plain Pond Community is dominated by *Carex striata* var. *brevis*. The Freshwater Tidal Marsh and the Coastal Plain Intermittent Pond have been described above. The rare form of the Coastal Plain Intermittent Pond Community is dominated by *Eleocharis* species including *E. olivacea*, *E. microcarpa*, *E. robinsii* and *Xyris difformis* var. *difformis*.

The NJDEP's Natural Heritage Program contains a number of rare species that are likely to occur in Upper Township. These rare species are listed in the table below. The species labeled as endangered are species native to New Jersey, whose survival in the State or nation is in jeopardy (NJDEP, NHP 2006). The remaining species are rare, but not officially designated as threatened or endangered.

Table 24: Rare Plants of Upper Township (Lord 2006)

Common Name	Scientific Name	Status	Common Name	Scientific Name	Status
Koehn's Toothcup	<i>Ammania latifolia</i>	E	Narrowleaf Primrose-willow	<i>Ludwigia linearis</i>	
White Milkweed	<i>Asclepias variegata</i>		Sea-beach Evening-primrose	<i>Oenothera humifusa</i>	E



Table 24: Rare Plants of Upper Township (Lord 2006) (continued)

Common Name	Scientific Name	Status	Common Name	Scientific Name	Status
Whorled Milkweed	<i>Asclepias verticillata</i>		American Mistletoe	<i>Phoradendron leucarpum</i>	
Baratt's Sedge	<i>Carex baratii</i>		Canby's Lobelia	<i>Rhexia aristosa</i>	E
Elliptical Rushfoil	<i>Croton wildenowii</i>		Slender Horned-rush	<i>Rhyncospora inundata</i>	
Parker's Pipewort	<i>Eriocaulon parkeri</i>		Large Marsh Pink	<i>Lobelia canbyi</i>	
Dog-fennel Thoroughwort	<i>Eupatorium capillifolium</i>		Schizaea pusilla	<i>Curly Grass Fern</i>	
Marsh Rattlesnake-master	<i>Eryngium aquaticum</i> var. <i>aquaticum</i>	E	New England Bulrush	<i>Schoenoplectus novae-angliae</i>	
Pine Barren Boneset	<i>Eupatorium resinosum</i>	E	Whorled Nut-rush	<i>Scleria verticillata</i>	E
Pine Barren Gentian	<i>Gentiana autumnalis</i>		Bog Buttons	<i>Sclerolepis uniflora</i>	
Swamp Pink	<i>Helomias bullata</i>	E	Seabeach Purslane	<i>Sesuvium maritimum</i>	
Minute Duckweed	<i>Lemna perpusilla</i>	E	Purple Bladderwort	<i>Utricularia purpurea</i>	
Sandplain Flax	<i>Linum intercursum</i>		Reversed Bladderwort	<i>Utricularia resupinata</i>	E
Awned Meadow Beauty	<i>Sabatia dodecandra</i> var. <i>dodecandra</i>		Britton's Coast Violet	<i>Viola Brittoniana</i> var. <i>brittoniana</i>	
Seabeach Amaranth	<i>Amaranthus pumilus</i>	E			

As the previous discussion indicates, the botanical resources of Upper Township are extremely rich. The location of Upper Township provides for a diversity of physical conditions. Extensive stream networks extending from the Pine Barrens to the ocean with varying salinities allows many types of wetlands to develop. Uplands extending from dry fire-prone inland areas to beaches also allows for great diversity in upland plant community types.

4.1.4 Zoological Resources

As with plant resources, Upper Township can support a great diversity of wildlife, including many threatened and endangered species. Many species are present at the northerly limits of their range. Since Upper Township encompasses habitats ranging from ocean beaches and dunes to cedar swamps and pine savannahs, specialized coastal and inland species, as well as common and widespread species have the potential to be present.

4.1.5 Aquatic Animals

The surface waters of Upper Township range from salty ocean waters to brackish rivers and creeks to freshwater rivers and streams and ponds. The vertebrate aquatic biota, or animals with backbones are the fishes. The State of New Jersey supports the populations of 85 freshwater fish. The waters of the Township are not known to support trout populations, since they require cooler waters than those present in Upper Township. However, Brook Trout are known to occur in South Jersey streams, since it is tolerant of relatively low pH. Anadromous fish, such as American eel (*Anguilla rostrata*), Herring or Shad (*Alosa spp.*) migrate upstream and breed in the freshwater portions of rivers discharging to saltwater bays and the ocean. Clupeid species have been observed in the Tuckahoe River drainage moving upstream to spawn (NJDEP, DFW, Bureau of Freshwater Fisheries 2000).

Water quality is excellent in Pinelands stream waters. Pinelands waters are low in dissolved solids, quite acidic, pH averaging 4.4. While these high-quality acid waters support indigenous fish and amphibian communities that are tolerant of the acidity of the waters, they are inhospitable to many non-indigenous plant and animal species (USFWS, SNE-NYB Coastal Program 1997). On the periphery of the Pine Barrens and in areas where water characteristics are altered by agriculture or development, higher levels of pH allow a greater number of fish species to survive (Hastings 1998). Freshwater and anadromous fish are listed in the table below. Saltwater fish, which will also occur in portions of the waters of Upper Township will be listed separately.



Table 25: New Jersey Freshwater Fishes (NJDEP, DFW 2005)

Common Name	Scientific Name	HP	Common Name	Scientific Name	HP
American Brook Lamprey	Lampetra appendix	N	Sea Lamprey	Petromyzon marinus	N
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	N	Blueback Herring	Alosa aestivalis	N
Shortnose Sturgeon	Acipenser brevirostrum	N	Hickory Shad	Alosa mediocris	N
Brook Trout	Salvelinus fontinalis	N	Alewife	Alosa pseudoharengus	N
Gizzard Shad	Dorosoma cepedianum	N	American Shad	Alosa sapidissima	N
Rainbow Smelt	Osmerus mordax	N	Bowfin	Amia calva	I
Redfin Pickerel	Esox americanus	N	Eastern Mudminnow	Umbra pygmaea	N
Chain Pickerel	Esox niger	N	Northern Pike	Esox lucius	I
Goldfish	Carassius auratus	E	Muskellunge	Esox masquinon	I
Quillback	Carpoides cyprinus	N	Common Carp	Cyprinus carpio	E
Eastern Silvery Minnow	Hybognathus regius	N	Cutlips Minnow	Exoglossum maxillingua	N
Comely Shiner	Notropis amoenus	N	Golden Shiner	Notemigonus crysoleucas	N
Bridle Shiner	Notropis bifrenatus	N	Satinfin Shiner	Cyprinella analostana	N
Common Shiner	Luxilis cornutus	N	Ironcolor Shiner	Notropis chalybaeus	N
Swallowtail Shiner	Notropis procne	N	Spottail Shiner	Notropis husdonius	N
Fathead Minnow	Pimephales promelas	I	Spotfin Shiner	Cyprinella spiloptera	N
Blacknose Dace	Rhinichthys atratulus	N	Bluntnose Minnow	Pimephales notatus	I
Creek Chub	Semotilus atromaculatus	N	Longnose Dace	Rhinichthys cataractae	N
Grass Carp	Ctenopharyngodon idella	E	Fallfish	Semotilus corporalis	N
Creek Chubsucker	Erimyzon oblongus	N	White Sucker	Catostomus commersoni	N
White Catfish	Ameiurus catus	N	Northern Hog Sucker	Hypentelium nigricans	N
Yellow Bullhead	Ameiurus natalis	N	Black Bullhead	Ameiurus mela s	I
Channel Catfish	Ictalurus punctatus	I	Brown Bullhead	Ameiurus nebulosus	N
Margined Madtom	Noturus insignis	N	Tadpole Madtom	Noturus gyrinus	N
Banded Killifish	Fundulus diaphanus	N	Pirate Perch	Aphredoderus sayanus	N
Eastern Mosquitofish	Gambusia holbrooki	N	Mummichog	Fundulus heteroclitus	N
Fourspine Stickleback	Apletes quadracus	N	Mosquitofish	Gambusia affinis	I
Ninespine Stickleback	Pungitius pungitius	N	Threespine Stickleback	Gasterosteus aculeatus	N
Striped Bass	Morone saxatilis	N	White Perch	Morone americana	N
Rock Bass	Ambloplites rupestris	I	Mud Sunfish	Acantharchus pomotis	N
Bluespotted Sunfish	Eleacanthus gloriosus	N	Blackbanded Sunfish	Eleacanthus chaetodon	N
Green Sunfish	Lepomis cyanellus	I	Banded Sunfish	Eleacanthus obesus	N
Bluegill	Lepomis macrochirus	I	Pumpkinseed	Lepomis gibbosus	N
Warmouth	Lepomis gulosus	I	Redbreasted Sunfish	Lepomis auritus	N
Largemouth Bass	Micropterus salmoides	I	Smallmouth Bass	Micropterus dolomieu	I
Black Crappie	Pomoxis nigromaculatus	I	White Crappie	Pomoxis alularis	I
Tessellated Darter	Etheostoma olmstedii	N	Swamp Darter	Etheostoma fusiforme	N
Shield Darter	Percina peltata	N	Yellow Perch	Perca flavescens	N
Slimy Sculpin	Cottus cognatus	N	Walleye	Sander vitreus	I
Hogchoker	Trinectes maculatus	N	Oriental Weatherfish	Misgurnus anguillicaudatus	E

HP - Historical Presence E - Exotic N - Native I - Introduced



The bays, estuaries and marine waters of New Jersey can be home to 28 marine mammals and 336 marine finfish at some point during the year. Ken Able, of Rutgers University has compiled extensive lists marine fish which can be found in New Jersey waters. The historical status of each species in terms of abundance season of occurrence is also indicated (NJDEP, DFW 2005).

Table 26: New Jersey Saltwater Fishes (NJDEP, DFW 2005)

COMMON NAME	SCIENTIFIC NAME	ST	COMMON NAME	SCIENTIFIC NAME	ST
Atlantic Hagfish	<i>Myxine glutinosa</i>	R	Clearnose Skate	<i>Raja eglanteria</i>	A
Sea Lamprey	<i>Petromyzon marinus</i>	C	Little Skate	<i>Raja erinacea</i>	A
Sand Tiger	<i>Odontaspis taurus</i>	A	Rosette Skate	<i>Raja garmani</i>	C
Bigeye Thresher Shark	<i>Alopias superciliosus</i>	O	Barndoor Skate	<i>Raja laevis</i>	C
Thresher Shark	<i>Alopias vulpinus</i>	R	Winter Skate	<i>Raja ocellata</i>	A
Basking Shark	<i>Cetorhinus maximus</i>	R	Thorny Skate	<i>Raja radiata</i>	O
White Shark	<i>Carcharodon carcharias</i>	R	Southern Stingray	<i>Dasyatis americana</i>	R
Shortfin Mako	<i>Isurus oxyrinchus</i>	R	Roughtail Stingray	<i>Dasyatis centroura</i>	C
Porbeagle	<i>Lamna nasus</i>	R	Atlantic Stingray	<i>Dasyatis sabina</i>	R
False Cat Shark	<i>Pseudotriakis microdon</i>	R	Bluntnose Stingray	<i>Dasyatis say</i>	O
Chain Dogfish	<i>Scylliorhinus retifer</i>	A	Spiny Butterfly Ray	<i>Gymnura altavela</i>	R
Silky Shark	<i>Carcharhinus falciformis</i>	R	Smooth Butterfly Ray	<i>Gymnura micrura</i>	
Bull Shark	<i>Carcharhinus leucas</i>	R	Spotted Eagle Ray	<i>Aetobatus narinari</i>	R
Blacktip Shark	<i>Carcharhinus limbatus</i>	R	Bullnose Ray	<i>Myliobatis freminvillei</i>	O
Dusky Shark	<i>Carcharhinus obscurus</i>	CS	Cownose Ray	<i>Rhinoptera bonasus</i>	OS
Sandbar Shark	<i>Carcharhinus plumbeus</i>	AS	Manta	<i>Manta birostris</i>	R
Tiger Shark	<i>Galeocerdo cuvier</i>	R	Devil Ray	<i>Mobula mobular</i>	R
Smooth Dogfish	<i>Mustelus canis</i>	A	Bonnethead	<i>Sphyrna tiburo</i>	R
Lemon Shark	<i>Negaprion brevirostris</i>	R	Smooth Hammerhead	<i>Sphyrna zygaena</i>	R
Blue Shark	<i>Prionace glauca</i>	C	Spiny Dogfish	<i>Squalus acanthias</i>	ASF
Atlantic Sharpnose Shark	<i>Rhizoprionodon terraenovae</i>	R	Atlantic Angel Shark	<i>Squatina dumeril</i>	CSF
Scalloped Hammerhead	<i>Sphyrna lewini</i>	R	Smalltooth Sawfish	<i>Pristis pectinata</i>	R
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	C	Atlantic Torpedo	<i>Torpedo nobiliana</i>	R
Atlantic Sturgeon	<i>Acipenser oxyrinchus</i>	R	Gafftopsail Catfish	<i>Bagre marinus</i>	R
Ladyfish	<i>Elops saurus</i>	R	Rainbow smelt	<i>Osmerus mordax</i>	T
Tarpon	<i>Megalops atlanticus</i>	R	Rainbow Trout	<i>Oncorhynchus mykiss</i>	R
Bonefish	<i>Albula vulpes</i>	R	Atlantic Salmon	<i>Salmo salar</i>	R
American Eel	<i>Anguilla rostrata</i>	A	Brown Trout	<i>Salmo trutta</i>	R
Green Moray	<i>Gymnothorax funebris</i>	R	Longtooth Anglemouth	<i>Gonostoma elongatum</i>	R
Spotted Moray	<i>Gymnothorax moringa</i>	R	Mullers Pearlsides	<i>Maurollicus muelleri</i>	R
Speckled Worm Eel	<i>Myrophis punctatus</i>	R	Oceanic Lightfish	<i>Vinciguerria nimbaria</i>	R
Margined Snake Eel	<i>Ophichthus cruentifer</i>	O	Shortnose Greeneye	<i>Chlorophthalmus agassizi</i>	C
Palespotted Eel	<i>Ophichthus ocellatus</i>	R	Inshore Lizardfish	<i>Synodus foetens</i>	O
Conger Eel	<i>Conger oceanicus</i>	C	Snakefish	<i>Trachinocephalus myops</i>	R
Blueback Herring	<i>Alosa aestivalis</i>	A	White Barracudina	<i>Notolepis rissoi</i>	R
Hickory Shad	<i>Alosa mediocris</i>	C	Duckbill Barracudina	<i>Paralepis atlantica</i>	R
Alewife	<i>Alosa pseudoharengus</i>	A	Sharpchin Barracudina	<i>Paralepis coregonoides</i>	R
American Shad	<i>Alosa sapidissima</i>	T	Glacier Lanternfish	<i>Benthosema glaciale</i>	R
Atlantic Menhaden	<i>Brevoortia tyrannus</i>	A	Smallfin Lanternfish	<i>Benthosema suborbitale</i>	R
Atlantic Herring	<i>Clupea harengus</i>	CW	Horned Lanternfish	<i>Ceratoscopelus maderensis</i>	C
Gizzard Shad	<i>Dorosoma cepedianum</i>	O	Warming's Lanternfish	<i>Ceratoscopelus warmingi</i>	R



Table 26: New Jersey Saltwater Fishes (continued)

Round Herring	<i>Etrumeus teres</i>	O	Longfin Lanternfish	<i>Diogenichthys atlanticus</i>	R
Scaled Sardine	<i>Harengula jaguana</i>	R	Benoit's Lanternfish	<i>Hygophum benoiti</i>	R
Atlantic Thread Herring	<i>Opisthonema oglinum</i>	O	Slender Lanternfish	<i>Hygophum reinhardti</i>	R
Spanish Sardine	<i>Sardinella aurita</i>	O	Winged Lanternfish	<i>Lampanyctus alatus</i>	R
Striped Anchovy	<i>Anchoa hepsetus</i>	C	Largescale Lanternfish	<i>Symbolophorus veranyi</i>	R
Bay Anchovy	<i>Anchoa mitchilli</i>	A	Antenna Codlet	<i>Bregmaceros atlanticus</i>	R
Silver Anchovy	<i>Engraulis eurystole</i>	O	Cusk	<i>Brosme brosme</i>	R
Fourbeard Rockling	<i>Enchelyopus cimbrius</i>	R?	Gag	<i>Mycteroperca microlepis</i>	R
Atlantic Cod	<i>Gadus morhua</i>	CWS	Glasseye snapper	<i>Priacanthus cruentatus</i>	R
Haddock	<i>Melanogrammus aeglefinus</i>	OW S	Blackline Tilefish	<i>Caulolatilus cyanops</i>	R
Offshore Hake	<i>Merluccius albidus</i>	C	Tilefish	<i>Lopholatilus chamaeleonticeps</i>	A
Silver Hake	<i>Merluccius bilinearis</i>	A	Bluefish	<i>Pomatomus saltatrix</i>	A
Atlantic Tomcod	<i>Microgadus tomcod</i>	C	Cobia	<i>Rachycentron canadum</i>	R
Pollock	<i>Pollachius virens</i>	C	Sharksucker	<i>Echeneis naucrates</i>	R
Red Hake	<i>Urophycis chuss</i>	A	Whitefin Sharksucker	<i>Echeneis neucratoides</i>	R
Carolina Hake	<i>Urophycis earlii</i>	R	Marlinsucker	<i>Remora osteochir</i>	R
Spotted Hake	<i>Urophycis regia</i>	C	Remora	<i>Remora remora</i>	R
White Hake	<i>Urophycis tenuis</i>	O	White Suckerfish	<i>Remorina albescens</i>	R
Fawn Cusk-eel	<i>Lepophidium profundorum</i>	A	African Pompano	<i>Alectis ciliaris</i>	R
Striped Cusk-eel	<i>Ophidion marginatum</i>	C	Yellow Jack	<i>Caranx bartholomaei</i>	R
Crested Cusk-eel	<i>Ophidion welschi</i>	R	Blue Runner	<i>Caranx crysos</i>	OSF
Oyster Toadfish	<i>Opsanus tau</i>	A	Crevalle Jack	<i>Caranx hippos</i>	CSF
Goosefish	<i>Lophius americanus</i>	C	Horse-eye Jack	<i>Caranx latus</i>	R
Striated Frogfish	<i>Antennarius striatus</i>	R	Bar Jack	<i>Caranx ruber</i>	O
Sargassumfish	<i>Histrio histrio</i>	R	Atlantic Bumper	<i>Chloroscombrus chrysurus</i>	R
Redeye Gaper	<i>Chaunax stigmaeus</i>	R	Round Scad	<i>Decapterus punctatus</i>	R
Clearwing Flyingfish	<i>Cypselurus comatus</i>	R	Pilotfish	<i>Naucrates ductor</i>	R
Bandwing Flyingfish	<i>Cypselurus exciliens</i>	R	Leatherjack	<i>Oligoplites saurus</i>	O
Spotfin Flyingfish	<i>Cypselurus furcatus</i>	R	Bigeye Scad	<i>Selar crumenophthalmus</i>	R
Atlantic Flyingfish	<i>Cypselurus melanurus</i>	R	Atlantic Moonfish	<i>Selene setapinnis</i>	OS
Flying Halfbeak	<i>Euleptorhampus velox</i>	R	Lookdown	<i>Selene vomer</i>	OS
Ballyhoo	<i>Hemiramphus brasiliensis</i>	R	Greater Amberjack	<i>Seriola dumerili</i>	R
Silverstripe Halfbeak	<i>Hyporhamphus unifasciatus</i>	O	Almaco Jack	<i>Seriola rivoliana</i>	R
Flat Needlefish	<i>Ablennes hians</i>	R	Banded Rudderfish	<i>Seriola zonata</i>	OS
Atlantic Needlefish	<i>Strongylura marina</i>	CS	Florida Pompano	<i>Trachinotus carolinus</i>	CS
Agujon	<i>Tylosurus acus</i>	R	Permit	<i>Trachinotus falcatus</i>	CS
Atlantic Saury	<i>Scomberesox saurus</i>	R	Palometa	<i>Trachinotus goodei</i>	CS
Sheepshead minnow	<i>Cyprinodon variegatus</i>	A	Rough Scad	<i>Trachurus lathami</i>	R
Marsh Killifish	<i>Fundulus confluentus</i>		Cottonmouth Jack	<i>Uraspis secunda</i>	R
Banded Killifish	<i>Fundulus diaphanous</i>	A	Dolphin	<i>Coryphaena hippurus</i>	CS
Mummichog	<i>Fundulus heteroclitus</i>	A	Atlantic pomfret	<i>Brama brama</i>	R
Spotfin Killifish	<i>Fundulus luciae</i>	C	Schoolmaster	<i>Lutjanus apodus</i>	R
Striped Killifish	<i>Fundulus majalis</i>	A	Red Snapper	<i>Lutjanus campechanus</i>	R
Rainwater Killifish	<i>Lucania parva</i>	C	Cubera Snapper	<i>Lutjanus cyanopterus</i>	R
Eastern Mosquitofish	<i>Gambusia holbrocki</i>	C	Gray snapper	<i>Lutjanus griseus</i>	OS
Rough Silverside	<i>Membras martinica</i>	C	Yellowtail snapper	<i>Ocyurus chrysurus</i>	R
Inland Silverside	<i>Menidia beryllina</i>	A	Vermillion snapper	<i>Rhomboplites aurorubens</i>	R
Atlantic Silverside	<i>Menidia menidia</i>	A	Tripletail	<i>Lobotes surinamensis</i>	
Deep Water Squirrelfish	<i>Holocentrus bullisi</i>	R	Irish pompano	<i>Diapterus auratus</i>	R



Table 26: New Jersey Saltwater Fishes (continued)					
Dusky Squirrelfish	<i>Holocentrus vexillarius</i>	R	Spotfin mojarra	<i>Eucinostomus argenteus</i>	R
Buckler Dory	<i>Zenopsis cochifera</i>	C	Silver jenny	<i>Eucinostomus gula</i>	R
Fourspine Stickleback	<i>Apeltes quadracus</i>	C	Tidewater mojarra	<i>Eucinostomus harengulus</i>	R
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	C	Flagfin mojarra	<i>Eucinostomus melanopterus</i>	R
Ninespine Stickleback	<i>Pungitius pungitius</i>	R	Pigfish	<i>Orthopristis chrysoptera</i>	R
Bluespotted Cornetfish	<i>Fistularia tabacaria</i>	R	Sheepshead	<i>Archosargus probatocephalus</i>	R
Longspine Snipefish	<i>Macrorhamphosus scolopax</i>	R	Sea bream	<i>Archosargus rhomboidalis</i>	R
Lined Seahorse	<i>Hippocampus erectus</i>	CSF	Spottail pinfish	<i>Diplodus holbrooki</i>	R
Opposum Pipefish	<i>Microphis brachyuros</i>	R	Pinfish	<i>Lagodon rhomboides</i>	R
Northern Pipefish	<i>Syngnathus fuscus</i>	A	Scup	<i>Stenotomus chrysops</i>	A
Chain Pipefish	<i>Syngnathus louisianae</i>	R	Silver perch	<i>Bairdiella chrysoura</i>	C
Sargassum Pipefish	<i>Syngnathus pelagicus</i>	R	Spotted seatrout	<i>Cynoscion nebulosus</i>	R
Flying Gurnard	<i>Dactylopterus volitans</i>	R	Weakfish	<i>Cynoscion regalis</i>	A
Blackbelly Rosefish	<i>Helicolenus dactylopterus</i>	A	Banded drum	<i>Larimus fasciatus</i>	R
Spinycheek Scorpionfish	<i>Neomerinthe hemingwayi</i>	R	Spot	<i>Leiostomus xanthurus</i>	C-A
Highfin Scorpionfish	<i>Pontinus rathbuni</i>	R	Southern kingfish	<i>Menticirrhus americanus</i>	O
Barbfish	<i>Scorpaena brasiliensis</i>	R	Horned Whiff	<i>Citharichthys cornutus</i>	R
Mushroom Scorpionfish	<i>Scorpaena inermis</i>	R	Angelfin Whiff	<i>Citharichthys gymnorhinus</i>	R
Smoothcheek Scorpionfish	<i>Scorpaena isthmensis</i>	R	Bay Whiff	<i>Citharichthys spilopterus</i>	R
Spotted Scorpionfish	<i>Scorpaena plumieri</i>	R	Smallmouth Flounder	<i>Etropus microstomus</i>	C
Acadian Redfish	<i>Sebastes fasciatus</i>	O	Gulf Flounder	<i>Paralichthys albigutta</i>	R
Armored Searobin	<i>Peristedion miniatum</i>	C	Summer Flounder	<i>Paralichthys dentatus</i>	A
Northern Searobin	<i>Prionotus carolinus</i>	A	Fourspot Flounder	<i>Paralichthys oblongus</i>	C
Striped Searobin	<i>Prionotus evolans</i>	A	Windowpane	<i>Scophthalmus aquosus</i>	C
Sea Raven	<i>Hemitripterus americanus</i>	C	Dusky Flounder	<i>Syacium papillosum</i>	R
Grubby	<i>Myoxocephalus aeneus</i>	C	Witch Flounder	<i>Glyptocephalus cynoglossus</i>	C
Longhorn Sculpin	<i>Myoxocephalus octodecemspinosus</i>	C	American Plaice	<i>Hippoglossoides platessoides</i>	R
Shorthorn Sculpin	<i>Myoxocephalus scorpius</i>	R	Atlantic Halibut	<i>Hippoglossus hippoglossus</i>	R
Alligatorfish	<i>Aspidophoroides monopterygius</i>	R	Winter Flounder	<i>Pleuronectes americanus</i>	A
Lumpfish	<i>Cyclopterus lumpus</i>	R	Yellowtail Flounder	<i>Pleuronectes ferrugineus</i>	C
Atlantic Seasnail	<i>Liparis atlanticus</i>	R	Hogchoker	<i>Trinectes maculatus</i>	C
Inquiline Seasnail	<i>Liparis inquilinus</i>	C	Blackcheek Tonguefish	<i>Symphurus plagiosa</i>	R
White Perch	<i>Morone americana</i>	A	Orange Filefish	<i>Aluterus schoepfi</i>	R
Striped Bass	<i>Morone saxatilis</i>	A	Gray Triggerfish	<i>Balistes capriscus</i>	R
Wreckfish	<i>Polyprius americanus</i>	R	Queen Triggerfish	<i>Balistes vetula</i>	R
Swallowtail Bass	<i>Anthias woodsi</i>	O	Ocean Triggerfish	<i>Canthidermis sufflamen</i>	O
Black Sea Bass	<i>Centropristis striata</i>	A	Fringed Filefish	<i>Monacanthus ciliatus</i>	R
Red Grouper	<i>Epinephelus morio</i>	R	Planehead Filefish	<i>Monacanthus hispidus</i>	R
Warsaw Grouper	<i>Epinephelus nigritus</i>	R	Scrawled Cowfish	<i>Lactophrys quadricornis</i>	R
Snowy Grouper	<i>Epinephelus niveatus</i>	R	Trunkfish	<i>Lactophrys trigonus</i>	R
Black Grouper	<i>Mycteroperca bonaci</i>	R	Smooth Trunkfish	<i>Lactophrys triqueter</i>	R
Northern kingfish	<i>Menticirrhus saxatilis</i>	C	Web Burrfish	<i>Chilomycterus antillarum</i>	R
Atlantic croaker	<i>Micropogonias undulatus</i>	C	Spotted Burrfish	<i>Chilomycterus atinga</i>	R
Black drum	<i>Pogonias cromis</i>	C	Striped Burrfish	<i>Chilomycterus schoepfi</i>	O
Red drum	<i>Sciaenops ocellatus</i>	O	Porcupinefish	<i>Diodon hystrix</i>	R



Table 26: New Jersey Saltwater Fishes (continued)

Red goatfish	<i>Mullus auratus</i>	R	Smooth Puffer	<i>Lagocephalus laevigatus</i>	OS
Spotted goatfish	<i>Pseudupeneus maculatus</i>	R	Northern Puffer	<i>Sphoeroides maculatus</i>	CS
Bermuda chub	<i>Kyphosus sectatrix</i>	R	Checkered Puffer	<i>Sphoeroides testudineus</i>	R
Atlantic spadefish	<i>Chaetodipterus faber</i>	R	Ocean Sunfish	<i>Mola mola</i>	O
Foureye butterflyfish	<i>Chaetodon capistratus</i>	R	Wahoo	<i>Acanthocybium solandri</i>	R
Spotfin butterflyfish	<i>Chaetodon ocellatus</i>	F	Frigate Mackerel	<i>Auxis thazard</i>	R
Banded butterflyfish	<i>Chaetodon striatus</i>	R	Little Tunny	<i>Euthynnus alletteratus</i>	CS
Gray angelfish	<i>Pomacanthus arcuatus</i>	R	Skipjack Tuna	<i>Katsuwonus pelamis</i>	R
Sergeant major	<i>Abudefduf saxatilis</i>	R	Blue Marlin	<i>Makaira nigricans</i>	R
Striped mullet	<i>Mugil cephalus</i>	A	White Marlin	<i>Tetrapterus albidus</i>	C
White mullet	<i>Mugil curema</i>	A	Black Ruff	<i>Centrolophus niger</i>	R
Great barracuda	<i>Sphyraena barracuda</i>	R	Black Fathead	<i>Cubiceps baxteri</i>	R
Northern sennet	<i>Sphyraena borealis</i>	C	Barrelfish	<i>Hyperoglyphe perciformis</i>	R
Atlantic threadfin	<i>Polydactylus octonemus</i>	R	Harvestfish	<i>Peprilus alepidotus</i>	O
Tautog	<i>Tautoga onitis</i>	A	Butterfish	<i>Peprilus triacanthus</i>	A
Cunner	<i>Tautoglabrus adspersus</i>	C	Freckled Driftfish	<i>Psenes cyanophrys</i>	R
Emerald parrotfish	<i>Nicholsina usta</i>	R	Bluefin Driftfish	<i>Psenes pellucidus</i>	R
Ocean pout	<i>Macrozoarces americanus</i>	C	Bigeye Squaretail	<i>Tetragonurus atlanticus</i>	R
Snakeblenny	<i>Lumpenus lumpretaeiformis</i>	R	Twospot Flounder or Spottail Flounder	<i>Bothus robbinsi</i>	R
Arctic shanny	<i>Stichaeus punctatus</i>	R	Gulf Stream Flounder	<i>Citharichthys arctifrons</i>	A
Radiated shanny	<i>Ulvaria subbifurcata</i>	R	Blue Tang	<i>Acanthurus coeruleus</i>	R
Rock gunnel	<i>Pholis gunnelus</i>	R	Oilfish	<i>Ruvettus pretiosus</i>	R
Atlantic wolffish	<i>Anarhichas lupus</i>	R	Atlantic Cutlassfish	<i>Trichiurus lepturus</i>	R
Northern stargazer	<i>Astroscopus guttatus</i>	O	Atlantic Bonito	<i>Sarda sarda</i>	O
Striped Blenny	<i>Chasmodes bosquianus</i>	O	Chub Mackerel	<i>Scomber japonicus</i>	R
Crested Blenny	<i>Hypoleurochilus germinatus</i>	R	Atlantic Mackerel	<i>Scomber scombrus</i>	A
Feather Blenny	<i>Hypsoblennius hentz</i>	O	King Mackerel	<i>Scomberomorus cavalla</i>	O
Seaweed Blenny	<i>Parablennius marmoratus</i>	R	Spanish Mackerel	<i>Scomberomorus maculatus</i>	O
American Sand Lance	<i>Ammodytes americanus</i>	A	Cero	<i>Scomberomorus regalis</i>	O
Northern Sand Lance	<i>Ammodytes dubius</i>	A	Albacore	<i>Thunnus alalunga</i>	C
Fat Sleeper	<i>Dormitator maculatus</i>	R	Yellowfin Tuna	<i>Thunnus albacares</i>	C
Darter Goby	<i>Gobionellus boleosoma</i>	R	Bigeye Tuna	<i>Thunnus obesus</i>	O
Highfin Goby	<i>Gobionellus oceanicus</i>	R	Bluefin Tuna	<i>Thunnus thynnus</i>	CS
Naked Goby	<i>Gobiosoma bosc</i>	A	Swordfish	<i>Xiphias gladius</i>	CS
Seaboard Goby	<i>Gobiosoma ginsburgi</i>	O	Sailfish	<i>Istiophorus platypterus</i>	R
Ocean Surgeon	<i>Acanthurus bahianus</i>	R			

A – Abundant AS - Abundant in summer ASF - Abundant in spring and fall F – Frequent R - Rare
T – Threatened C – Common C-A - Common-abundant CS - Common in summer
CSF - Common in summer and fall CW - Common in winter CWS - Common in winter and spring O – Occasional
OS - Occasional in summer OSF - Occasional in summer and fall
OWS - Occasional in winter and spring

4.2 Terrestrial Animals

The numerous terrestrial habitat types present were discussed in the Botanical Resources section. Coastal habitats include beaches and dunes. Inland habitats include oak-dominated and pine-dominated forests. Agriculture and other human activities create disturbed habitat type that are attractive to certain types of wildlife.



Dozens of species of native mammals are known to reside in the New Jersey Pinelands and Southern New Jersey. Four of the bats in the table below are only present during migration (USFWS, SNE-NYB Coastal Program 1997).

Table 27: New Jersey Mammals (NJDEP, DFW 2005b, Wolgast 1998)					
Common Name	Scientific Name	St	Common Name	Scientific Name	St
Opossum	<i>Didelphis marsupialis</i>	S	Eastern Cottontail	<i>Sylvilagus floridanus</i>	S
Masked Shrew	<i>Sorex cinereus</i>	S	Eastern Chipmunk	<i>Tamias striatus</i>	S
Short-tailed Shrew	<i>Blarina brevicauda</i>	S	Woodchuck	<i>Marmota monax</i>	S
Least Shrew	<i>Cryptotis parva</i>	U	Gray Squirrel	<i>Sciurus carolinensis</i>	S
Eastern Mole	<i>Scalopus aquaticus</i>	S	Red Squirrel	<i>Tamiasciurus hudsonicus</i>	S
Star-nosed Mole	<i>Condylura cristata</i>	U	Southern Flying Squirrel	<i>Glaucomys volans</i>	U
Little Brown Bat	<i>Myotis lucifugus</i>	S	Beaver	<i>Castor canadensis</i>	INC
Keen Myotis	<i>Myotis septentrionalis</i>	U	Marsh Rice Rat	<i>Oryzomys palustris</i>	S
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	U	White-footed Mouse	<i>Peromyscus leucopus</i>	S
Eastern Pipistrel	<i>Pipistrellus subflavus</i>	U	Red-backed Vole	<i>Clethrionomys gapperi</i>	S
Big Brown Bat	<i>Eptesicus fuscus</i>	S	Meadow Vole	<i>Microtus pennsylvanicus</i>	S
Red Bat	<i>Lasiurus borealis</i>	S	Pine Vole	<i>Microtus pinetorum</i>	S
Hoary Bat	<i>Lasiurus cinereus</i>	U	Muskrat	<i>Ondatra zibethicus</i>	S
Meadow Jumping Mouse	<i>Zapus hudsonius</i>	U	Southern Bog Lemming	<i>Synaptomys cooperi</i>	U
Red Fox	<i>Vulpes vulpes</i>	S	House mouse	<i>Mus musculus</i>	I
Black Bear	<i>Ursus americanus</i>	INC	Gray Fox	<i>Urocyon cinereoargenteus</i>	S
Long-tailed Weasel	<i>Mustela frenata</i>	S	Raccoon	<i>Procyon lotor</i>	S
Mink	<i>Mustela vison</i>	S	Striped Skunk	<i>Mephitis mephitis</i>	S
River Otter	<i>Lutra canadensis</i>	S	White-tailed Deer	<i>Odocoileus virginianus</i>	D
Coyote	<i>Canis latrans, var.</i>	INC			
St – Status E - Endangered D - Decreasing INC - Increasing S - Stable U – Undetermined I - Introduced P - Peripheral					

The diversity of terrestrial fauna in Upper Township is exemplified by the birds. Cape May County, New Jersey is renowned for its bird diversity. The County is a peninsula encompasses many habitat types. It is strategically located on East Coast migratory bird flyways. Famous ornithologists, such as Alexander Wilson, George Ord, William and Spencer Baird have worked in Cape May County. John James Audubon painted in the salt marshes of the Great Egg Harbor Estuary (USGS. 2006). The list of bird species below includes birds found in Cape May County, the waters of Delaware Bay, and offshore to a distance of 50 miles (USGS. 2006).

Table 28: Birds of Cape May County, New Jersey (USGS 2006)				
Common Name	Common Name	Common Name	Common Name	Common Name
Red-throated loon	Common Loon	Pied-billed Grebe	Horned Grebe	Common Barn Owl
Cory's Shearwater	Greater Shearwater	Sooty Shearwater	Audobon's Shearwater	Eastern Screech Owl
Wilson's Storm Petrel	American White Pelican	Brown Pelican	Northern Gannet	Short-eared Owl
Great Comorant	Doube-crested Comorant	American Bittern	Least Bittern	Great Horned Owl
Glossy Ibis	White Ibis	Wood Duck	Brant	Snowy Owl
Green-winged Teal	American Black Duck	Northern Pintail	Blue-winged Teal	Barred Owl
Northern Shoveler	Gadwall	Eurasian Widgeon	American Widgeon	Long-eared Owl
Canvasback	Redhead	Ring-necked Duck	Greater Scaup	Northern Saw-whet Owl
Lesser scaup	Common Eider	King Eider	Harlequin Duck	Common Nighthawk
Oldsquaw	Black Scoter	Surf Scoter	White-winged Scoter	Chuck-will's-widow
Common Goldeneye	Bufflehead	Hooded Merganser	Common Merganser	Whip-poor-will
Red-breasted Merganser	Ruddy Duck	Osprey	Swallow-tailed Kite	Horned Lark



Table 28: Birds of Cape May County, New Jersey (continued)

Common Name	Common Name	Common Name	Common Name	Common Name
Mississippi Kite	Bald Eagle	Ring-necked Pheasant	Ruffed Grouse	Purple Martin
Great Blue Heron	Snow Goose	Wild Turkey	Black Rail	Tree Swallow
Great Egret	Canada Goose	Clapper Rail	King Rail	Bank Swallow
Snowy Egret	Mallard	Virginia Rail	Sora	Brown Creeper
Little Blue Heron	Black Vulture	Purple Gallinule	Common Morhen	Carolina Chickadee
Tricolored Heron	Turkey Vulture	American Coot	Sandhill Crane	Eastern Bluebird
Cattle Egret	Northern Harrier	Greater Yellowlegs	Willet	Veery
Green Heron	Sharp-shinned Hawk	Lesser Yellowlegs	Spotted Sandpiper	Gray Catbird
Black-crowned Night Heron	Cooper's Hawk	Solitary Sandpiper	Upland Sandpiper	Ruby-throated Hummingbird
Yellow-crowned Night Heron	Northern Goshawk	Northern Bobwhite	Whimbrel	Red-headed Woodpecker
Tundra Swan	Red-shouldered Hawk	Marbled Godwit	Hudsonian Godwit	Red-bellied Woodpecker
Mute Swan	Broad-winged hawk	Ruddy Turnstone	Red Knot	Hairy Woodpecker
Black-bellied Plover	Swainson's Hawk	Sanderling	Semipalmated sandpiper	Rock Dove
American Golden-plover	Red-tailed Hawk	Western Sandpiper	Least Sandpiper	White-winged Dove
Semipalmated plover	Rough-legged Hawk	White-rumped Sandpiper	Pectoral Sandpiper	Mourning Dove
Piping Plover	American Kestrel	Baird's Sandpiper	Purple sandpiper	Eastern Wood Pewee
Killdeer	Merlin	Dunlin	Stilt Sandpiper	Acadian Flycatcher
American Oystercatcher	Peregrine Falcon	Buff-breasted Sandpiper	Ruff	Willow Flycatcher
Black-necked Stilt	Golden Eagle	Short-billed Dowitcher	Long-billed Dowitcher	Eastern Phoebe
American Avocet	Common Snipe	American Woodcock	Wilson's Phalarope	Western Kingbird
Red-necked Phalarope	Red Phalarope	Pomarine Jaeger	Parasitic Jaeger	Eastern Kingbird
Gull-billed Tern	Caspian Tern	Sandwich Tern	Royal Tern	No. Rough-winged Swallow
Roseate tern	Arctic Tern	Common Tern	Forster's Tern	Cliff Swallow
Least Tern	Black tern	Black skimmer	Dovekie	Golden-crowned Kinglet
Razorbill	Belted Kingfisher	Least Flycatcher	Chimney Swift	Ruby-crowned Kinglet
Laughing Gull	American Crow	Great Crested Flycatcher	Yellow-bellied Sapsucker	Blue-gray Gnatcatcher
Little Gull	Fish Crow	Scissor-tailed Flycatcher	Downy Woodpecker	Swainson's Thrush
Common Black-headed Gull	Blue Jay	Barn Swallow	Northern Flicker	Gray-cheeked Thrush
Bonaparte's Gull	White-breasted Nuthatch	Carolina Wren	Black-billed Cuckoo	Eastern Meadowlark
Ring-billed Gull	Tufted Titmouse	Winter Wren	Yellow-billed Cuckoo	Brewer's Blackbird
Herring Gull	Red-breasted Nuthatch	Sedge Wren	Olive-sided Flycatcher	Orchard Oriole
Iceland Gull	Bicknell's Thrush	Marsh Wren	Yellow-bellied Flycatcher	Baltimore Oriole
Lesser Black-backed Gull	American Robin	House Wren	Alder Flycatcher	Brown-headed Cowbird
Glaucous Gull	Brown Thrasher	Wood Thrush	Cedar Waxwing	Red Crossbill
Great Black-backed Gull	Loggerhead Shrike	American Pipit	White-eyed Vireo	Rusty Blackbird
Northern Mockingbird	Yellow Warbler	Hermit Thrush	Blue-headed Vireo	Common Grackle
Northern Shrike	Chestnut-sided Warbler	European Starling	Yellow-throated Vireo	Evening Grosbeak
Blue-winged Warbler	Magnolia Warbler	Yellow-throated Warbler	Warbling Vireo	American Goldfinch
Golden-winged Warbler	Cape May Warbler	Pine Warbler	Philadelphia Vireo	Purple Finch
Tennessee Warbler	Black-throated Blue Warbler	Prairie Warbler	Red-eyed Vireo	House Finch
Orange-crowned Warbler	Black-throated Green Warbler	Black-and-white Warbler	Palm Warbler	Lapland Longspur
Northern Parula	Blackburnian Warbler	Louisiana Waterthrush	Bay-breasted Warbler	Yellow-headed Blackbird
Nashville Warbler	Cerulean Warbler	Kentucky Warbler	American Redstart	White-throated Sparrow
Yellow-rumped Warbler	Ovenbird	Wilson's Warbler	Connecticut Warbler	Snow Bunting
Blackpoll Warbler	Northern Waterthrush	Scarlet Tanager	Mourning Warbler	Bobolink
Worm-eating Warbler	Hooded Warbler	Indigo Bunting	Canada Warbler	Red-winged Blackbird
Prothonotary Warbler	Summer Tanager	Chipping Sparrow	Northern Cardinal	Boat-tailed Grackle
Common Yellowthroat	Blue Grosbeak	Yellow-throated Warbler	Dickcissel	



Table 28: Birds of Cape May County, New Jersey (continued)

Common Name	Common Name	Common Name	Common Name	Common Name
Yellow-breasted Chat	Rose-breasted Grosbeak	Salt marsh Sharp-tailed Sparrow	Pine Warbler	Wilson's Warbler
Dickcissel	American Tree Sparrow	Nelson's Sharp-tailed Sparrow	Prairie Warbler	Connecticut Warbler
Eastern Towhee	Louisiana Waterthrush	Fox Sparrow	Black-and-white Warbler	Red-eyed Vireo
Chipping Sparrow	Scarlet Tanager	Song Sparrow	Kentucky Warbler	Palm Warbler
Clay-colored Sparrow	Indigo Bunting	Grasshopper Sparrow	Mourning Warbler	Bay-breasted Warbler
Savannah Sparrow	Lark Sparrow	Lincoln's Sparrow	Canada Warbler	American Redstart
Field Sparrow	Seaside Sparrow	Vesper Sparrow	Northern Cardinal	Swamp Sparrow
House Sparrow	White-crowned Sparrow	Dark-eyed Junco	Pine Siskin	Common Redpoll

Southern New Jersey is home to numerous herptile species (reptiles and amphibians). As is the case for plants and other terrestrial animals, one of the reasons for this diversity is that many species are at the limits of their ranges, particularly southern Coastal Plain species. Many amphibian species are unable to establish viable populations in undisturbed areas of the central Pinelands, probably due to the low pH of the surface waters. Waters on the fringes of the Pine Barrens can support more of these species. Coastal Plain Intermittent Ponds provide important breeding habitat for amphibians (USFWS, SNE-NYB Coastal Program 1997).

Table 29: Cape May County Reptiles (NJDEP, DFW 2001 NJDEP, DFW 2005)

Common Name	Scientific Name	St	Common Name	Scientific Name	St
Common Snapping Turtle	<i>Chelydra serpentina</i>	S	Common Musk Turtle	<i>Sternotherus odoratus</i>	S
Eastern Mud Turtle	<i>Kinostemon s. subrubrum</i>	U	Spotted Turtle	<i>Clemmys guttata</i>	SC
Bog Turtle	<i>Clemmys muhlenbergii</i>	E	Eastern Box Turtle	<i>Terrapene c. carolina</i>	SC
Red-eared Slider	<i>Malaclemys t. terrapin</i>	U	Eastern Painted Turtle	<i>Chrysemys p. picta</i>	U
Redbelly Turtle	<i>Pseudemys rubriventris</i>	U	Northern Brown (DeKay's) Snake	<i>Storeria d. dekayi</i>	S
Northern Water Snake	<i>Nerodia s. sipedon</i>	S	Eastern Garter Snake	<i>Thamnophis s. sirtalis</i>	S
Northern Redbelly Snake	<i>Storeria o. occipitomaculata</i>	S	Eastern Smooth Earth Snake	<i>Virginia v. valeriae</i>	U
Eastern Ribbon Snake	<i>Thamnophis sauritis sauritis</i>	S	Northern Ringneck Snake	<i>Diadophis punctatus edwardsi</i>	S
Eastern Hognose Snake	<i>Heterodon platyrhinos</i>	D	Southern Ringneck Snake	<i>Diadophis p. punctatus</i>	S
Eastern Worm Snake	<i>Carphophis a. amoenus</i>	U	Northern Black Racer	<i>Coluber constrictor constrictor</i>	U
Rough Green Snake	<i>Opheodrys vernalis</i>	S	Black Rat Snake	<i>Elaphe o. obsoleta</i>	U
Eastern King Snake	<i>Lampropeltis g. getula</i>		Northern Pine Snake	<i>Pituophis m. melanoleucus</i>	T
Scarlet King Snake	<i>Lampropeltis triangulum elapsoides</i>	SC	Coastal plain Milk Snake intergrade	<i>Lampropeltis t. triangulum X L. t. elapsoides elapsoides</i>	SC
Five-lined Skink	<i>Eumeces fasciatus</i>	U	Northern Fence Lizard	<i>Sceloporus undulates hyacinthus</i>	S

ST – Status E – Endangered T – Threatened D – Decreasing SC – Special Concern U – Undetermined S – Stable I – Introduced

Table 30: Cape May County Amphibians (NJDEP, DFW 2001 NJDEP, DFW 2005)

Common Name	Scientific Name	St	Common Name	Scientific Name	St
Marbled Salamander	<i>Ambystoma opacum</i>	SC	Eastern Tiger Salamander	<i>Ambystoma t. tigrinum</i>	E
Red-spotted Newt	<i>Notophthalmus v. viridescens</i>	D	Four-toed Salamander	<i>Hemidactylium scutatum</i>	D
Red-backed Salamander	<i>Plethodon c. cinereus</i>	S	Eastern Mud Salamander	<i>Pseudotriton m. montanus</i>	T
Northern Red Salamander	<i>Pseudotriton r. ruber</i>	D	Fowler's Toad	<i>Bufo woodhousii fowleri</i>	SC
Eastern Spadefoot Toad	<i>Scaphiopus h. holbrookii</i>	D	Northern Cricket Frog	<i>Acris c. crepitans</i>	U
Northern Gray Treefrog	<i>Hyla versicolor</i>	S	Northern Spring Peeper	<i>Hyla c. crucifer</i>	S
New Jersey Chorus Frog	<i>Pseudacris triseriata kalmi</i>	S	Bullfrog	<i>Rana catesbeiana</i>	S



Table 30: Cape May County Amphibians (NJDEP, DFW 2001 NJDEP, DFW 2005) (continued)

Common Name	Scientific Name	St	Common Name	Scientific Name	St
Carpenter Frog	<i>Rana virgatipes</i>	SC	Green Frog	<i>Rana clamitans melanota</i>	S
Wood Frog	<i>Rana sylvatica</i>	S	Southern Leopard Frog	<i>Rana spinocephala</i>	S
Pickerel Frog	<i>Rana palustris</i>	S			

ST – Status E – Endangered T – Threatened D – Decreasing SC – Special Concern U – Undetermined S – Stable I – Introduced

The incredible diversity observed in bird species also holds true for butterflies. Wright and Sutton (1999) have compiled the list below based on review of private and museum collections and the entomology literature.

Table 31: Butterflies of Cape May County, New Jersey (Wright & Sutton 1999)

Common Name	Common Name	Common Name	Common name
Pipevine Swallowtail	Banded Hairstreak	Aphrodite Fritillary	Appalachian Brown
Zebra Swallowtail	Striped Hairstreak	Regal Fritillary	Georgia Satyr
Black Swallowtail	Southern (No.) Hairstreak	Silver-Bordered Fritillary	Little Wood Satyr
E. Tiger Swallowtail	Brown Elfin	Meadow Fritillary	Common Wood Nymph
Spicebush Swallowtail	Frosted Elfin	Pearl Crescent	Monarch
Palamedes Swallowtail	Henry's Elfin	Baltimore	Silver-Spotted Skipper
Checkered White	Eastern Pine Elfin	Question Mark	Long-Tailed Skipper
Cabbage White	'Olive' Juniper Hairstreak	Eastern Comma	Hoary Edge
Falcate Orangetip	Hessel's Hairstreak	Gray Comma	Southern Cloudywing
Clouded Sulphur	White M Hairstreak	Compton Tortoiseshell	Northern Cloudywing
Orange Sulphur	Gray Hairstreak	Mourning Cloak	Hayhurst's Scallopwing
Cloudless Sulphur	Red-Banded Hairstreak	American Lady	Sleepy Duskywing
Little Yellow	Eastern Tailed Blue	Painted Lady	Juvenal's Duskywing
Sleepy Orange	'Northern' Spring Azure	Red Admiral	Horace's Duskywing
Harvester	Coastal Holly Azure	Common Buckeye	Zarucco Duskywing
American Copper	Summer Azure	Red-Spotted Purple	Wild Indigo Duskywing
Bronze Copper	American Snout	Viceroy	Common Checkered Skipper
Bog Copper	Gulf Fritillary	Hackberry Emperor	Common Sootywing
Great Purple Hairstreak	Variegated Fritillary	Tawny Emperor	Swarthy Skipper
Coral Hairstreak	Great Spangled Fritillary	Eyed Brown	Clouded Skipper
Least Skipper	European Skipper	Fiery Skipper	Leonard's Skipper
Cobweb Skipper	Peck's Skipper	Tawny-Edged Skipper	Crossline Skipper
Whirlabout	Northern Broken Dash	Little Glassywing	Sachem
Delaware Skipper	Rare Skipper	Mulberry Wing	Zabulon Skipper
Aaron's Skipper	Broad-Winged Skipper	Dion Skipper	Black Dash
Two-Spotted Skipper	Dun Skipper	Dusted Skipper	Common Roadside Skipper
Eufala Skipper	Brazilian Skipper	Salt Marsh Skipper	Ocola Skipper
Giant Swallowtail	Southern Dogface	Orange-Barred Sulphur	Edward's Hairstreak
Hoary Elfin	Golden-Banded Skipper	Confused Cloudywing	Dotted Skipper
Indian Skipper	Arogos Skipper	Hobomok Skipper	



4.2.3 Rare Species and Species of Special Concern

A search of State and Federal maps and databases to determine if records exist for occurrences of threatened and endangered wildlife species, rare plants or natural communities, or critical wildlife habitat on or in the immediate vicinity of the project site. Specifically, a search of the New Jersey Department of Environmental Protection Natural Heritage Program (NHP) Database was performed and the New Jersey Landscape Mapping Project was reviewed. Numerous threatened and endangered animals are known to occur within Upper Township. Foraging and nesting habitat for Bald Eagles, Least Tern, Black-crowned Night Heron and Yellow-crowned Night Heron are present in the NHP database. Rare vertebrates and invertebrates are listed below in separate tables.

Table 32: Rare Vertebrate Animals of Upper Township (Lord 2006)					
Common Name	Scientific Name	Status	Common Name	Scientific Name	Status
Barred Owl	<i>Strix varia</i>	T/T	Great Egret	<i>Casmerodius albus</i>	S/S
Bar-Winged Skimmer	<i>Libellula axilena</i>		Jefferson Salamander	<i>Ambystoma jeffersonianum</i>	SC
Black Rail	<i>Laterallus jamaicensis</i>	T/T	Least Tern	<i>Sterna antillarum</i>	E
Black Skimmer	<i>Rynchops niger</i>	E	Little Blue Heron	<i>Egretta caerulea</i>	S/S
Black-Crowned Night-Heron	<i>Nycticorax nycticorax</i>	T/S	No. Diamondback Terrapin	<i>Malaclemys terrapin terrapin</i>	SC
Black-Throated Green Warbler	<i>Dendroica virens</i>	SC	Northern Harrier	<i>Circus cyaneus</i>	E/U
Canada Warbler	<i>Wilsonia canadensis</i>	SC	Northern Parula	<i>Parula americana</i>	SC
Carpenter Frog	<i>Rana virgatipes</i>	SC	Northern Pine Snake	<i>Pituophis m. melanoleucus</i>	T
Cerulean Warbler	<i>Dendroica cerulea</i>	SC	Osprey	<i>Pandion haliaetus</i>	T/T
Common Tern	<i>Sterna hirundo</i>	D/S	Peregrine Falcon	<i>Falco peregrinus</i>	E
Cooper's Hawk	<i>Accipiter cooperii</i>	T/T	Pine Barrens Treefrog	<i>Hyla andersonii</i>	T
Cope's Gray Treefrog	<i>Hyla chrysoscelis</i>	E	Piping Plover	<i>Charadrius melodus</i>	E
Eastern Box Turtle	<i>Terrapene carolina</i>	SC	Red-Headed Woodpecker	<i>Melanerpes erythrocephalus</i>	T/T
Eastern Kingsnake	<i>Lampropeltis g. gelula</i>	U	Red-Shouldered Hawk	<i>Buteo lineatus</i>	E/T
Eastern Tiger Salamander	<i>Ambystoma t. tigrinum</i>	E	Sharp-Shinned Hawk	<i>Accipiter striatus</i>	SC
Five-Lined Skink	<i>Eumeces fasciatus</i>	U	Snowy Egret	<i>Egretta thula</i>	S/S
Forster's Tern	<i>Sterna forsteri</i>	INC/S	Southern Bog Lemming	<i>Synaptomys cooperi</i>	U
Fowler's Toad	<i>Bufo woodhousii fowleri</i>	SC	Spotted Turtle	<i>Clemmys guttata</i>	SC
Glossy Ibis	<i>Plegadis falcinellus</i>	D/S	Timber Rattlesnake	<i>Crotalus h. horridus</i>	E
Golden-Winged Warbler	<i>Vermivora chrysoptera</i>	SC	Treetop Emerald	<i>Somatochlora provocans</i>	
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	T/S	Tricolored Heron	<i>Egretta tricolor</i>	INC/S
Great Blue Heron	<i>Ardea Herodias</i>	S/S	Veery	<i>Catharus fhscenscens</i>	SC
Bald Eagle	<i>Haliaeetus leucocephalus</i>	E			
E – Endangered T – Threatened S – Stable SC – Special Concern					
E/T, T/T, T/S – Dual Status, letter before the slash is status of breeding population, letter after the slash is for the migratory population					

Of the rare terrestrial invertebrates that have been observed in Upper Township, the Frosted Elfin is officially listed as threatened. No endangered invertebrates were listed.



Table 33: Rare Terrestrial Invertebrates of Upper Township (Lord 2006)			
Common Name	Scientific Name	Common Name	Scientific Name
Frosted Elfin	<i>Callophrys irus</i>	Scarlet Bluet	<i>Enallagma pictum</i>
Pine Barrens Bluet	<i>Enallagma recurvatum</i>	Coastal Bog Metarranthis	<i>Metarranthis pilosaria</i>
A Geometrid Moth	<i>Metarranthis sp.1</i>	Precious Underwing	<i>Catocala pretiosa pretiosa</i>

4.3 Critical Habitats and Special Ecological Communities

4.3.1 Federal Habitat Complexes

The US Fish and Wildlife Service ("USFWS") has identified regionally significant habitats and species populations in the New York Bight Watershed. The USFWS recognizes the importance of delineating the larger habitat complexes that link local habitat patches and species populations, forming regional ecological assemblages. This landscape level perspective is critical to establishing uniform and effective management practices to replace site-by-site, uncoordinated practices that do not take into account real ecological complexity. For instance, species may utilize different habitat types at different life stages. Interbreeding between populations of a species promote genetic health. Habitat patches that lose species can be recolonized from populations in other patches, if connectivity is preserved. In identifying these habitat complexes the USFWS was particularly interested in locations of naturally occurring populations of federally and state-listed endangered and threatened species and candidates for listing, and those areas that contain significant concentrations of, or are otherwise important to critical life-history stages of, other indigenous species. The following use categories were prioritized:

- breeding, nesting, or spawning sites;
 - migration pathways and stopover areas, including areas of open space in urban areas;
 - roosting sites;
 - nursery areas;
 - staging areas;
 - dispersal corridors;
 - core concentration areas;
 - overwintering areas;
 - major feeding or foraging areas
- (USFWS, SNE-NYB Coastal Program 1997).

Upper Township lies at the confluence of three of the important habitat complexes identified by the USFWS. These are:

- Cape May Peninsula Habitat Complex (Complex #1)
- New Jersey Pinelands Habitat Complex (Complex #2)
- Great Egg Harbor Estuary Habitat Complex (Complex #3)

These habitat complexes are described briefly below.

Cape May Peninsula Habitat Complex (Complex #1)

The Cape May Peninsula habitat complex includes the entire Cape May Peninsula, encompassing marine, estuarine, wetland and upland habitats. Within this boundary all uplands, wetlands and open water are included in the habitat



complex, except for developed barrier island and inland sites. Within Upper Township the habitat complex includes the barrier beaches and back barrier lagoon system on the Atlantic side, coastal plain intermittent ponds, hardwood and Atlantic white cedar swamps, upland forests, and agricultural areas. Significant habitat for migratory land birds, raptors, migratory shorebirds, colonial nesting waterbirds, and regionally rare wetland and upland communities and plants. Also included are the nearshore waters of the New York Bight known to be important for marine mammals. The complex includes the Delaware Bayshore and near shore waters as well, but Upper Township does not include these areas (USFWS, SNE-NYB Coastal Program 1997).

New Jersey Pinelands Habitat Complex (Complex #2)

The westerly portion of Upper Township is contained within the NJ Pinelands Habitat Complex. The complex, extends from Lakehurst to Cape May, New Jersey. In Upper Township, the NJ Pinelands boundary is to the west of Cedar Swamp Creek. Habitat types include upland, aquatic, and wetland habitats occupying a contiguous area of over one million acres on the Atlantic Coastal Plain of southeastern New Jersey. The NJ Pinelands vegetation is of significance, since it is characterized by dry pine, oak, and heath communities in a humid, temperate, deciduous forest climate. These pine barren communities are maintained in this climate due to the prevalence of low-nutrient sandy soils and frequent fires that allow fire-adapted species and plants tolerant of low-nutrient conditions to invade and maintain ecological communities. Although there is little topographic relief, upland and lowland communities are very different from one another (USFWS, SNE-NYB Coastal Program 1997).

As the largest area of contiguous, undeveloped forest and wetland on the Atlantic Coastal Plain of the Mid-Atlantic region, the NJ Pinelands are not only regionally, but also globally significant. It is the largest pine barrens complex in the world and it supports globally rare upland and wetland communities and species found ranging from several glacial relict species to some northern and numerous southern species that reach their geographical Coastal Plain limits in the Pinelands. The NJ Pinelands are underlain by one of the largest aquifers in the country. The pristine headwaters and wetlands are home to many indigenous species. These clean waters support the productivity of the New Jersey backbarrier lagoon estuaries (USFWS, SNE-NYB Coastal Program 1997).

Great Egg Harbor Estuary Habitat Complex (Complex #3)

This habitat complex encompasses the entire Great Egg Harbor River and estuary from its headwater streams to its connection with the open marine waters of the New York Bight through Great Egg Harbor Inlet. Included are all riverine and estuarine wetlands and open water of the Great Egg Harbor River and its tributaries to the limit of tidal influence, the open water and islands of Great Egg Harbor Bay and Peck Bay, and adjacent saltmarsh habitat from the mouth of the river to the inlet, the inlet itself, and the sandy shoreline at the northern end of Ocean City barrier island. The Tuckahoe River is a tributary to the Great Egg Harbor estuary. It forms the northerly boundary of Upper Township. The drainage areas of tributaries to the Tuckahoe River include Cedar Swamp Creek, Hughes Creek, Flat Creek East, Flat Creek West, Jobs Creek, Banks Creek, Halfway Creek and Banks Run.

This estuary complex provides seasonal or year-round habitat for anadromous, estuarine, marine, and freshwater fish and shellfish, nesting and migratory waterbirds and raptors, migratory and wintering waterfowl, and rare brackish and freshwater tidal communities and plants. Also included in the habitat complex are several small, palustrine (nontidal) wetlands immediately adjacent to the estuary that contain exemplary rare natural communities and plant occurrences (USFWS, SNE-NYB Coastal Program 1997).

4.3.2 State of New Jersey Critical Habitat Mapping

The New Jersey Department of Environmental Protection's Division of Fish and Wildlife has developed maps identifying critical areas for threatened and endangered species based on land-use classifications and species



location. This effort was coordinated through a study known as the Landscape Project. The project focuses on large areas throughout the State that are ecologically similar in regard to plant and animal communities, referred to as Landscape Regions. Cape May County is situated within three Landscape Regions, the Atlantic Coast, Delaware Bay and the Pinelands Landscape Regions. The Atlantic Coast Region is identified as one of the most productive coastal habitats in the country. The low-lying marsh and beaches of the barrier island communities support some of the state's most important colonies of nesting birds. The Delaware Bay Landscape Region encompasses most of the County and features populations of bald eagles, gray tree frogs and over thirty other endangered species in its vast woodlands. The extensive salt-water marshes support a vital shorebird migration habitat. The Pinelands Landscape Region is a unique ecosystem that supports diverse reptile, amphibian and invertebrate populations. The extensive cedar swamps and wetlands systems support large populations of insects, birds and aquatic communities.

The Landscape Project delineates the State into five habitat classes; forest, grassland, forested wetland, emergent wetland and beaches. These classes are based on information extracted from the NJDEP's Land Use/Land Cover data. Habitat patches within these areas are classified by a ranking system based on the status of the species present in each. The prioritized ranking system is as follows:

- **Rank 5** is assigned to areas containing one or more occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species.
- **Rank 4** is assigned to areas containing one or more occurrences of at least one State endangered species.
- **Rank 3** is assigned to areas containing one or more occurrences of at least one State threatened species.
- **Rank 2** is assigned to areas containing one or more occurrences of at least one non-listed State priority species.
- **Rank 1** is assigned to areas that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species, but do not intersect with any confirmed occurrences of such species.

The largest portion of Upper Township's critical habitat is identified as the forested classification, most of which is recognized as containing one or more State endangered species (Rank 4), (see Figure 10). The NJDEP has also mapped Natural Heritage Priority Sites which include habitats for threatened and endangered species (see Figure 11). There are environments within the Pinelands Management Area that are prioritized as Rank 5 for Federal endangered and threatened species. The Petersburg section of the Township is forested containing State threatened species (Rank 3). There are small pockets of forested wetlands all of which are also located within the Pinelands Management Area (NJDEP, DFW 2006).

Rank 5 habitat mapped in Upper Township is associated with Bald Eagle Foraging Areas and Nest Buffers, since Bald Eagle is a Federally threatened and State endangered species. Rank 4 Habitat consists of Black-crowned Night Heron Foraging and Nesting habitat and Least Tern foraging habitat. Both of these species are State Endangered. Yellow-crowned Night Heron is a State Threatened species in New Jersey. Foraging Habitat for this species is present in Upper Township. Also mapped for the Landscape Project are Foraging and Nesting Habitat for Colonial Waterbirds and for Tern species other than Least Tern. These species are not threatened or endangered as Figure 10 shows. Large areas within Upper Township are mapped as habitat for threatened and endangered species. Much of this habitat occurs on publicly-owned land. Where it occurs on private land, special measures may be needed to preserve valuable wildlife habitat, while allowing necessary economic development and redevelopment in the Township.



4.3.3 NJ Natural Heritage Program Priority Sites

The NJDEP's Natural Heritage Program has identified sites within the State of New Jersey that exhibit exceptional natural diversity or consist of prime habitat for threatened and endangered plant species and ecological communities. These sites are called Natural Heritage Priority Sites. The Natural Heritage Program has mapped several of these ecological communities within Upper Township. Approximately 14,407 acres, or 33 percent of Upper Township is contained within mapped Natural Heritage Priority Sites (see Figure 11). The sites are named and described below.

Avalon-Stone Harbor Marsh Macrosite

Located behind a series of Atlantic coastal barrier islands, the Avalon-Stone Harbor Marsh Macrosite is dominated by tidal salt marshes interspersed with shallow back bays. A fringe of forested wetlands and mesic uplands are present on the western side. The site includes shore bird nesting areas and the surrounding salt marsh complex, as well as patches of forest on the mainland edge, which provide a place for migrating birds on the Atlantic flyway to rest and feed. The Garden State Parkway forms the westerly boundary, except where tidal creeks and forested areas extend to the west of the highway (NJDEP, NHP 2001a).

A concentration of state threatened bird species are documented from the salt marsh complex. A significant number of osprey nest in natural vegetation, mostly cedar trees within the site. The site is considered to have moderate biodiversity significance (USFWS, SNE-NYB Coastal Program 1997). Forested fringe areas may be important to migrating neotropical passerines (NJDEP, NHP 2001a). Only about 0.06 acres of the Macrosite is located within Upper Township.

Corson Inlet North Site

This site includes a State Park located on the southerly end of the Ocean City barrier island. Plant communities include coastal dune shrubland (bayberry variant), coastal dune grass and marine intertidal sand beach. These communities comprise the beach and dune habitat of rare birds, including a globally rare State Endangered bird, and good populations of two other State significant animals (NJDEP, NHP 2001b). The site is considered to have high biodiversity significance (USFWS, SNE-NYB Coastal Program 1997). Approximately 21 acres of this site are located within Upper Township.

Corson Inlet South and Whale Beach

The site consists of coastal barrier beach and dune habitat, which are documented habitat of significant bird species. Excellent populations of Piping Plover, Least Tern (USFWS, SNE-NYB Coastal Program 1997), and other State Endangered birds are present (NJDEP, NHP 2001c). The site is considered to have high biodiversity significance (USFWS, SNE-NYB Coastal Program 1997). Approximately 168 acres of this site are located within Upper Township.

Great Cedar Swamp Macrosite

This Macrosite is part of a forested greenbelt, which extends the length of the Cape May Peninsula. It is mostly contained within the Cape May County Refuge. The site is considered to possess high biodiversity significance (USFWS, SNE-NYB Coastal Program 1997). The core of the site is a large organic-soil wetland in the headwaters of both Dennis Creek and Cedar Swamp Creek comprised of extensive old growth Hardwood Swamp, Atlantic White Cedar Swamp, Mixed Hardwood-White Cedar Swamp, other forested wetlands, adjacent Mesic Coastal Plain Mixed Oak Forests and some Dry Oak-Pine Forest. Critical aquifer recharge zones within the watershed are included within the Macrosite. State imperiled animal and plants are present (NJDEP, NHP 2001d). Approximately 6,762 acres of this Macrosite are within the boundaries of Upper Township.



Middle Thorofare

This Priority Site includes tidal salt marsh habitat located west of Corson Inlet. A globally rare State endangered bird species is present (NJDEP, NHP 2001e). Approximately 34 acres of Middle Thorofare lie within the boundaries of Upper Township. The site is considered to have moderate biodiversity significance (USFWS, SNE-NYB Coastal Program 1997).

North of Middletown

This site contains fresh to brackish tidal marsh that provides habitat for bird species including a globally rare State endangered bird species (NJDEP, NHP 2001f). Approximately 130 acres of this site are within the boundaries of Upper Township.

Seaville Methodist Church Site

This site is located at the headwater of a small creek draining into Ludlam Bay. Wetlands with a federally threatened plant, critical upland buffers and additional upland buffers to the watershed divide are included within the boundaries (NJDEP, NHP 2001g). Approximately 183 acres of this site are within the boundaries of Upper Township.

Strathmere Bay Island

A small bay island located west of Strathmere, which provides nesting habitat for bird species including an excellent population of a State endangered species and a bird species of SC (NJDEP, NHP 2001h). Approximately 44 acres of this site are within the boundaries of Upper Township. The site possesses moderate biodiversity significance (USFWS, SNE-NYB Coastal Program 1997).

Tuckahoe Corbin Salt Marsh Macrosite

The macrosite consists of tidal saltmarsh (low marsh), tidal river shoreline and wooded marsh edge, which contains populations of several State endangered and threatened birds (NJDEP, NHP 2001i). Approximately 5,961 acres of this site are situated within the boundaries of Upper Township.

Woodbine Bogs

An abandoned cranberry bog in the Pinelands, Woodbine Bogs is characterized by contiguous wetland habitat for plant and animal species plus uplands that drain towards the wetlands. One globally imperiled plant, one globally rare plant, and one State imperiled animal are documented for the site (NJDEP, NHP 2001j). The site possesses very high biodiversity significance (USFWS, SNE-NYB Coastal Program 1997). Approximately 1,104 acres of this site are situated within the boundaries of Upper Township.

5.0 CULTURAL AND COMMUNITY RESOURCES

5.1 Archaeological Resources

One archaeological site is listed for Upper Township in the New Jersey's National and Historic Register of Historic places. This site is called the *B.L. England Prehistoric Site [Locus 1] (28-Cm-32) (ID#3061)*. The State Historic Preservation Office issued opinions on the site in 1991 and 1992 (NJDEP HPO 2006). While other archaeological sites are not officially listed for Upper Township, the potential exists for additional prehistoric and historic archaeological resources to exist. Since an important prehistoric site was found on a marsh island in the Cape May Refuge, the extensive marshes in Upper Township may yield further resources. It appears that Native Americans utilized the marshes and adjacent upland areas for 12,000 years without interruption (USFWS 2004).



5.2 Historic Resources

Prior to settlements resulting from early European voyages to the new world, populations of early peoples existed throughout North America. Early hunters and gatherers probably crossed from Asia into America by way of the land mass now submerged under the Bering Strait. Sophisticated technology reveals information about early settlements. Scientific studies support the existence of early population centers along the Mississippi River, the Delaware River and well into New Jersey.

Limited records of European interactions with earlier inhabitants of southern New Jersey do exist and can be used to gain some information. Many archeological artifacts support the existence of the earliest settlers.

It wasn't until 1524, that the first documented European visit by De Verazano was authenticated, when he dropped anchor at Sandy Hook. (The Historical Preservation Society of Upper Township NJ, Inc., 1989). Verified interactions, official records and family histories present an expanding picture of early development in Upper Township. The Historic List which is a culmination of the work of the Historical Preservation Society of Upper Township New Jersey, Inc. is the framework of the history. It is the personal stories and photographs found in their publications, "A History of Upper Township and Its Villages" and "The Upper Township Memories" which reveal the true history. Their website can be found at (<http://hpsout.tripod.com>).

The following list of Historic Properties represents information obtained from the Geographic Information Services (GIS) of Cape May County, New Jersey Office of Information Technology, Office of GIS and NJ Department of Community Affairs, Office of Smart Growth. The list identifies properties shown on Historic Properties Map (Figure 12) and represents one of the largest collections of documented historic sites in the State of New Jersey

Site No.	Block	Lot	Address	Description
0	558.00	21.00	3048 RT US 9 SO	Old Corson House (ca. 1800)
1	558.00	24.01	3038 RT US 9 SO	Hewitt (Somerset) House (ca. 1800)
2	559.00	27.00	3053 RT US 9 SO	Curlew Bay Club (ca. 1876)
3	567.00	25.00	1817 RT US 9 SO	Edgar Corson House (ca. 1860)
4	558.00	8.00	3108 RT US 9 SO	Ella Rubin House (ca. 1770)
5	842.00	2.00	104 S BAYVIEW DR	US Coast Guard Station #32 (ca. 1917) Boathouse
6	845.00	2.00	109 S COMMONWEALTH AVE	Strathmere Methodist Church (ca. 1922)
7	843.00	2.00	101 S BAYVIEW DR	US Coast Guard Station #32 (ca. 1917)
8	601.00	19.00	600 RT US 9 SO	Second Baptist Church (ca. 1790)
9	601.00	18.00	600 RT US 9 SO	Second Baptist Church (ca. 1790)
10	597.00	32.00	805 RT US 9 SO	Captain Corson House (ca. 1865)
11	16.00	5.00	292 MARSHALLVILLE RD	Captain Belford Smith House (ca. 1862)
12	653.02	12.00	4 RT US 9 NO	Trinity Methodist Church (ca. 1869)
13	479.00	108.00	912 RT US 9 NO	Henry Clay House, Inn, Fishing Club (ca. 1732)
14	687.00	27.00	731 RT US 9 NO	John Stites House (ca. 1851)
15	687.00	24.00	715 RT US 9 NO	Charles Ashmead Mansion (ca. 1845)
16	453.00	80.02	341 DENNS/PTSBB RD	Corson (ca. 1846)
17	453.00	78.00	371 DENNS/PTSBB RD	Corson-Wescott House (ca. 1799)
18	12.00	23.01	375 MARSHALLVILLE RD	J. Stille House (Burley) (ca. 1834)
19	348.00	36.00	2231 RT 50	First National Bank of Tuckahoe (ca. 1900)



Table 34: Historic Properties (continued)				
20	296.00	10.00	104 READING AVE	Ward Stille House (ca. 1875)
21	348.00	31.01	2261 RT 50	Dr. Randolph Marshall Pharmacy (ca. 1880)
22	664.00	1.01	315 RT US 9 NO	Beesleys Point (2nd) School (ca. 1889)
23	349.00	4.00	2170 RT 50	Old Presbyterian Church (Daughters of American Rev.) (ca. 1851)
24	723.00	34.00	205 RT US 9 NO	Maurice Corson House (ca. 1835)
25	723.00	33.01	129 RT US 9 NO	Aunt Mary Lake & Constantine Foster House
26	605.00	1.00	728 RT US 9 SO	Joseph Edwards House (ca. 1765)
27	616.00	8.00	828 RT US 9 SO	Godrey House
28	566.00	48.00	1530 RT US 9 SO	Jesse Somers Corson House
29	566.00	59.00	1624 RT US 9 SO	David Corson House
30	565.02	116.00	1836 RT US 9 SO	Amos Townsend house, served in Civil War
31	565.02	118.00	1850 RT US 9 SO	Caroline Corson Ross House
32	563.00	30.01	2010 RT US 9 SO	Dr. Drake built front section
33	561.00	25.00	2058 RT US 9 SO	Parmenas Corson House (ca. 1770)
34	553.00	13.00	2 RT 50	Corson's Tavern (ca 1750, 1825-1830)
35	558.00	30.01	3018 RT US 9 SO	Old Corson House (Daugherty) (ca. 1800)
36	558.00	12.00	3088 NJSH RT US 9 S	Seaville Friends Meeting House (ca. 1716, 1763)
37	558.00	9.00	3100 RT US 9 SO	Isaac Scull House (ca. 1720) & Seaville Meth. Church (ca. 1857)
38	559.00	16.00	3085 RT US 9 SO	Jesse Gandy House (ca. 1833)
39	668.00	23.00	415 NJSH RT US 9 NO	Quaker Meeting House (ca. 1840-50)
40	600.00	39.00	300 RT US 9 SO	Nicholas Godfrey, Jr. House (ca. 1720)
41	16.00	1.01	304 MARSHALLVILLE RD	Alvin Copsetta (ca. 1840)
42	348.00	88.00	1509 RT 50	Hess House (ca. 1790)
43	479.00	12.00	1303 TUCKAHOE RD	Henry Young General Store (ca. 1812)
44	415.00	2.00	1430 RT 50	Bailey House (ca. 1780)
45	479.00	98.00	712 RT US 9 NO	Townsend Stites House (ca. 1812)
46	479.00	94.02	624 RT US 9 NO	Isiah (Howard) Stites House (ca. 1742)
47	687.00	18.00	12 BEESLEYS PL	Thomas Beesley House (ca. 1803) State & National Register
48	663.00	1.00	316 RT US 9 NO	Garretson House (ca. 1695-1730)
49	661.00	79.00	236 RT US 9 NO	Young Plantation (Eli Burnell) House (ca. 1740)
50	727.00	0.00	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
51	727.00	11.00	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
52	727.00	21.00	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
53	727.00	12.00	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
54	727.00	22.00	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
55	727.00	13.00	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
56	727.00	23.01	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
57	727.00	14.01	29 NORWOOD RD	Dr. Jacob Willets House (ca. 1840)
58	650.00	10.00	114 STAGECOACH RD	Fendall Smith House (ca. 1750)
59	630.00	18.00	844 RT US 9 SO	Daily/Helen Schoonkoff House
60	630.00	24.00	844 RT US 9 SO	Daily/Helen Schoonkoff House
61	630.00	23.00	844 RT US 9 SO	Daily/Helen Schoonkoff House



Table 34: Historic Properties (continued)				
62	630.00	19.00	844 RT US 9 SO	Daily/Helen Schoonkoff House
63	630.00	20.00	844 RT US 9 SO	Daily/Helen Schoonkoff House
64	630.00	21.00	844 RT US 9 SO	Daily/Helen Schoonkoff House
65	630.00	22.00	844 RT US 9 SO	Daily/Helen Schoonkoff House
66	559.00	36.01	3023 RT US 9 SO	Godfrey House (Arthur Sutton House) (ca. 1865)
67	559.00	34.00	3035 RT US 9 SO	Dr. Leaming House (ca. 1800)
68	545.00	22.01	183 TYLER RD	Roger Test (Joseph Corson Jr.) House (ca. 1810)
69	545.00	20.00	177 TYLER RD	Henry Young (Joseph Corson III) House (ca. 1812)
70	574.00	10.00	1006 RT US 9 SO	Ambrose & Minni Corson House
71	574.00	15.00	1020 RT US 9 SO	Pedrick-Young House (ca. 1760-1785)
72	566.00	52.00	1542 RT US 9 SO	John Corson, Jr. House (ca. 1710)
73	565.03	85.00	1810 RT US 9 SO	Matthew Godfrey House (ca. 1806)
74	558.00	14.00	3080 RT US 9 SO	Thomas Gandy House (John Gandy) (ca. 1708)
75	558.00	10.00	3092 RT US 9 SO	Joseph & Sarah Townsend Corson House (ca. 1800)
76	559.00	12.00	3097 RT US 9 SO	Philip Godfrey (Reeves-Iszard) (ca. 1695) State & Nat. Register
77	558.00	4.00	3122 RT US 9 SO	Silvanus Townsend House (ca. 1750-60)
78	15.00	1.00	287 MARSHALLVILLE RD	Dr. Randolph Marshall House (ca. 1854)
79	12.00	30.00	331 MARSHALLVILLE RD	Randall Marshall House (ca. 1820)
80	477.01	13.00	121 S OLD TUCKAHOE RD	Van Gilder House (ca. 1773)
81	456.00	13.02	759 RT 50	William Boone House (ca. 1740)
82	455.00	34.00	350 DENNS/PTSBG RD	Petersburg Wesley Methodist Church (ca. 1853)
83	14.00	1.00	346 MARSHALLVILLE RD	Thomas Chew Marshall House (ca. 1818)
84	26.00	66.01	601 MILL RD	Joseph Falkenburg Mill Site (ca. 1760)
85	348.00	100.00	1901 TUCKAHOE RD	Capt. Allen Corson House (ca. 1817)
86	414.00	52.00	860 DENNS/PTSBG RD	Caldwell
87	587.00	1.00	859 RT US 9 SO	Friendship School (ca. 1831)
88	587.00	2.00	859 RT US 9 SO	Friendship School
89	587.00	3.00	859 RT US 9 SO	Friendship School
90	587.00	4.00	OCEAN CITY PARK	Friendship School
91	587.00	5.00	OCEAN CITY PARK	Friendship School
92	587.00	6.00	OCEAN CITY PARK	Friendship School
93	587.00	7.00	OCEAN CITY PARK	Friendship School
94	587.00	8.00	OCEAN CITY PARK	Friendship School
95	587.00	9.00	OCEAN CITY PARK	Friendship School
96	587.00	10.00	OCEAN CITY PARK	Friendship School
97	587.00	11.00	OCEAN CITY PARK	Friendship School
98	587.00	12.00	OCEAN CITY PARK	Friendship School
99	587.00	13.00	OCEAN CITY PARK	Friendship School
100	587.00	14.00	OCEAN CITY PARK	Friendship School
101	587.00	15.00	OCEAN CITY PARK	Friendship School
102	902.00	3.02	RAILROAD	Tuckahoe Train Station (ca. 1893) State & National Register
103	548.00	8.00	26 TYLER RD	John Wesley Gandy House (ca. 1815) State & National Register



The list of Historic Properties stands on its own merits. The sheer magnitude of the list provides insight into the efforts of many contributors. The Historical Preservation Society of Upper Township New Jersey, Inc. and community members have contributed enormous efforts to reach the accomplishment represented by this list of Historic Properties. Review of the historic list offers an overview of past events and ongoing efforts to maintain the remnants of the record of these events.

The Historical Preservation Society of Upper Township NJ, Inc. remains active and continues to meet regularly. Guidance to the Society for historic building acquisition is provided by Lewis Albrecht, Chairman, Architectural Guidance Committee who provided the list of historic properties in this NRI.

5.2.1 *Historical Trees*

Two large trees have been identified, measured and are pending official registration.

- The huge **Gandy Holly** (*Ilex opaca*), located on Nicholas Lane, has been promised perpetual care by the Historical Preservation Society in partnership with the Township Committee.
- The largest **Eastern Red Cedar** (*Juniperus virginiana*) is located on the property of the Seaville Methodist Church where a deed restriction insures that the tree will not be disturbed.

5.3 Public Lands/Open Space/Parks and Recreational Areas

5.3.1 *Open Space*

For the purpose of this inventory, we will define Open Space as undeveloped land which is permanently deed restricted. Much of Upper Township consists of publicly-owned land, which is either environmentally constrained or wildlife management areas. Large areas of land within the Township are owned and managed by State and Federal agencies for the protection of threatened and endangered species and wildlife habitats. Cape May County has established a trust fund to preserve open space and agricultural lands. The Trust is funded by a County property tax of 1 cent per 100 dollars of assessed valuation and currently generates approximately 1.3 million dollars a year. Since its inception, the program has preserved approximately 3,000 acres of open space and farmland (almost 5 square miles) in the County. As of May 2006, there were five (5) preserved farms encompassing approximately 77.1 acres in Upper Township.

The Open Space list that follows should be used as a supplement to the Open Space Map (Figure 13) to distinguish between State owned land, which is the majority of the acreage, preserved farms, and Township owned parcels. The Open Space Map (Figure 13) should be reviewed in conjunction with the Natural Heritage Priority Site Map (Figure 11), which outlines a specific category of State owned land. The Natural Heritage Priority Map includes State Parks and Forests, Wildlife Management Areas, and Natural Lands Trust preserves.

Table 35: Preserved Farmland in Upper Township				
BLOCK	LOT	IDENTIFIER	ACREAGE	CATEGORY
12.00	8.00	Cedar Villas	28.15	Preserved Farmland
0.00	0.00	Tuckahoe Nurseries (Mason)	1.41	Preserved Farmland
559.00	31.02, 33.00	Roth	23.96	Preserved Farmland
12.00	10.00, 11.00, 12.00, 13.00, 14.00	Sack	18.30	Preserved Farmland
723.00	37.00	Johnson	5.29	Preserved Farmland



A number of State and Federal-owned properties are present in Upper Township. These areas and their respective acreages are listed in the table below:

Table 36: State and Federal Lands in Upper Township	
IDENTIFIER	ACREAGE
Belleplain State Forest	5,354.62
Cape May Wetlands Wildlife Management Area	2,566.24
Corson's Inlet State Park	93.42
Tuckahoe Wildlife Management Area (MacNamara)	20.16
Mill Creek Marsh	11.46
Peaslee Wildlife Management Area	1,329.88
Tuckahoe	4,364.64
Waterfowl	391.46
Cape May National Wildlife Refuge (Great Cedar Swamp Division)	3,861.70

The following highlights key State and Federal lands in Upper Township.

Belleplain State Forest

Belleplain State Forest, located in both Cape May and Cumberland Counties, consists of over 13,000 acres of primarily forested land of which 5,355 acres are located in Upper Township. Situated on the outskirts of Pine Barren lands, where better soil conditions allow for a wider variety of trees and shrubs, including hickory, beech, and ash. The forest offers a dynamic matrix of lowland hardwood swamps, former agricultural areas in various stages of succession, stands of Atlantic white cedar and plantations of Norway spruce, Eastern white pine and Virginia pine, and marshes.

Belleplain was established in 1928 by the State for public recreation, timber production, wildlife management, and water conservation. Beginning in 1933, the Civilian Conservation Corps ("CCC") transformed the Meisle family's cranberry bog into a 26.2 acre reservoir that was first named Meisle Lake and later renamed Lake Nummy (in honor of the last Lenape Sachem, or Chief, to live in the county). Three separate CCC camps operated on the property and the men who served constructed the forest's nature center (formerly the main office) and the maintenance buildings, and created much of the present day road system, bridges, and dams. The CCC also improved vast tracts of fields and forest through release-thinnings, hand plantings, and other silvicultural techniques.

<http://members.aol.com/famjustin/Belleplain1.html>

Belleplain Forest is accessible by many motorized routes, multi-use trails, and the abandoned railroad bed of the former "Pennsylvania-Reading Seashore Line" which bisects the forest in an east-west orientation. This state forest offers two connecting self-guided nature trails around Lake Nummy - a 6.5 mile East Creek trail which links two recreation areas, and approximately 10 miles of additional marked paths. A bathing area at Lake Nummy is open Memorial Day weekend to Labor Day; a small boat dock is situated on the southern shore of Lake Nummy and a boat



ramp is on the western shore of East Creek Pond. Other amenities include picnic tables and barbeque grills; a 10 station fitness course; a wildlife observation platform; a staffed nature center (seasonal operation); a boat rental and food/novelty concession at Lake Nummy during the summer months; and a trailer dumping station for campers. In addition to Lake Nummy, East Creek Pond is a second body of water located completely within the park's boundaries. (<http://www.stateparks.com/belleplain.html>)

Corson's Inlet State Park

Corson's Inlet State Park was established in 1969 to protect ocean front land. The Park contains 341 acres of land in Upper Township and Ocean City, of which 223.6 acres lie within the Municipal boundary of Upper Township. The area's natural habitats are rich in the diversity of its wildlife with sand dunes, shoreline overwash, marine estuaries and upland areas in which hundreds of wildlife species live and breed. The park offers outstanding scenic beauty and endless opportunities for observing a multitude of migratory and residential wildlife species. Corson's Inlet is extremely popular for hiking, fishing, crabbing, boating and sunbathing.

(<http://www.state.nj.us/dep/parksandforests/parks/corsons.html>)

The Cape May Wetlands Wildlife Management Area

The Cape May Wetlands Wildlife Management Area, located in Cape May County, New Jersey, contains a total of 12,702 acres of which 2,566 acres are located in Upper Township. The majority of this site is bounded by Ocean Drive and the Garden State Parkway eastwest, Sea Isle City Boulevard in the south and Roosevelt Boulevard in the north. This coastal wetland area is almost all salt marsh, less than 100 acres is upland-field habitat. The site is covered with tidal salt marsh of cordgrass and salt hay and the main vegetation of upland edges such as red cedar, wild cherry, sweet gum, bayberry, poison ivy and high tide bush. The intercoastal waterway flows through the entire length of the site. The marshes are heavily utilized by waterfowl during the fall and winter months and numerous shore birds nest in the area. Saltwater fishing and crabbing are excellent in all the coastal bays and estuaries.

(<http://www.state.nj.us/dep/fqw/wmaland.htm>)

Peaslee Wildlife Management Area

Peaslee Wildlife Management Area is one of the largest wildlife management areas in the state. Peaslee has thousands of acres of upland pine-oak forests and lowland bogs. Its longest border is the upper part of the Tuckahoe River. Old cranberry bogs and a mill are in the early stages of succession, and offer excellent freshwater marsh habitats. Peaslee includes diverse habitats to explore: the wooded edge, pinelands, cedar bog, hardwood swamp, scrub oak forests, sweet ferns, grassy fields, and yellow-clover pasture.

(<http://www.nps.gov/neje/miqsites.html>)

Tuckahoe Wildlife Management Area (MacNamara)

Tuckahoe Wildlife Management Area (MacNamara), is located along the scenic Tuckahoe River as it winds its way to the Great Egg Harbor River and Bay through an expanse of salt marsh and tidal creeks. This area is excellent for bird watching. Six brackish water impoundments on the upland edges of the tract also provide good bird-watching opportunities. Located on the edge of the Pine Barrens, the woodlands bordering the salt marsh are a mixture of pine and oak trees. A hardwood swamp and small freshwater lake provide additional habitat for beaver, turtles, frogs, and fish. An 8-mile drive provides opportunities for exploring these dynamic habitats.

(<http://www.nps.gov/neje/miqsites.html>)

Cape May Wildlife Refuge

The Cape May National Wildlife Refuge was established in January 1989 when the U.S. Fish and Wildlife Service acquired the Refuge's first (90-acre) parcel from The Nature Conservancy in June of that year. Since then the Refuge has grown to more than 11,000 acres as the Service continues to buy land. Ultimately the Refuge will protect over



21,200 acres of precious wildlife habitat in New Jersey's Cape May Peninsula. Cape May National Wildlife Refuge's key location in the Atlantic Flyway makes it an important link in the vast nationwide network of National Wildlife Refuges administered by the U.S. Fish & Wildlife Service.

The Great Cedar Swamp Division is located in Upper and Dennis Townships near the towns of Woodbine and Dennisville. Currently over 3,800 acres are within Upper Township. This area has the largest contiguous forest on the refuge and is part of the Pinelands National Reserve and the Great Egg Harbor National Scenic and Recreational River. This division protects mostly hardwood swamp, salt marsh, and bog habitat along with some forested uplands and grassland areas. Unique viewing opportunities exist for Atlantic white cedar stands, a variety of warblers, including prothonotary and pine warblers, wood thrush, bald eagles, wintering short-eared, long-eared and northern saw-whet owls, and northern diamondback terrapin. The Great Cedar Swamp Division also supports large numbers of marsh and water birds, songbirds, raptors, reptiles, and amphibians. (<http://www.capemay.fws.gov>)

5.4 Aesthetic Resources

Both the natural and the built environment are components of the aesthetic resources available in Upper Township. Intact historical buildings, with their varied architectural styles together with historic gardens and trees, provide a human historical context. Perhaps more striking is the natural setting of Upper Township. Scenic resources are present at many scales. Long distance vistas encompass ocean, beaches and dunes or extensive saltmarsh and bay views. The rare plant and animal populations and rare ecosystems, such as intermittent ponds and fens provide for a smaller scale appreciation of natural beauty. These resources are valuable in their own right, but also have value because they are beautiful and provide a unique sense of place.

6.0 SUMMARY AND IMPORTANCE OF RESOURCES

This Environmental Resource Inventory has established that Upper Township possesses a rich heritage of natural and cultural resources. Upper Township possesses an abundance of natural resources covering large land areas. Many of these resources are significant, because of their pristine condition or their rarity. Certain resources are important on a regional and in some cases global level. Much land in the Township has been purchased for preservation. It is hoped that the recognition of the richness and importance of the natural resources encompassed by the Township will lead to a sense of stewardship. This inventory can inform stewardship efforts by guiding planning efforts, so that economic development can be attained without degrading the important natural resources.



7.0. REFERENCES

- Association of New Jersey Environmental Commissioners (ANJEC). No Date. *The Environmental Resource Inventory*. Mendham, NJ: 12 p.
- ANJEC. No Date. Open Space is a Good Investment, The Financial Argument for Open Space Preservation, A Resource Paper
- Breden, T. 1989. A Preliminary Natural Community Classification for New Jersey. In: EF Karlin (ed.). *New Jersey's Rare and Endangered Plants and Animals*. Institute for Environmental Studies. Ramapo College, Mahwah, NJ: 280 p.
- Cape May County Division of Market and Demographic Research. 2003. County Population and Labor Force Projections for New Jersey: 2000 to 2020. In: Cape May County Data Book, January 2003
- Collins, BR, & KH Anderson. 1994. *Plant Communities of New Jersey: A Study in Landscape Diversity*. Rutgers University Press. New Brunswick, NJ: 287 p.
- Dietrich, Paul E., Sr., P.E.: 2002 *Strathmere Beach Management Plan*, 12 p.
- Dorwart, JM. 1992. *The Making of an American Resort Community*. Rutgers University Press. New Brunswick, NJ: 339 p.
- Federal Emergency Management Agency (FEMA). 1977. Flood Insurance Rate Map, Community Panel Nos. 340159-0002-B through 340159-0008-B
- Federal Interagency Committee for Wetland Delineation. 1989. *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, and USDA Soil Conservation Service. Washington, DC Cooperative technical publication: 76 p. plus appendices
- Gessner, J., and E. Stiles. 2001. *Field Guide to Reptiles and Amphibians of New Jersey*. NJDEP Division of Fish and Wildlife, Endangered and Non-game Species Program. Trenton, NJ
- Great Egg Harbor River Management Planning Committee with Assistance from National Park Service. 1996. *Great Egg Harbor National Scenic and Recreational River and Its Tributaries*. Final Guidelines for Local River Management Plans.
- Herman, GC, RC Canace, SD Stanford, RS Pristas, PJ Sugarman, MA French, JL Hoffman, MS Serfes, WJ Mennel. 1998. *Aquifers of New Jersey*. New Jersey Geological Survey Open-file Map OFM 24
- The Historical Preservation Society of Upper Township, NJ. 1989. *A History of Upper Township and Its Villages*
- The Historical Preservation Society of Upper Township NJ, Inc., 2004. *Upper Township Memories, A Resident Survey of Historical Preservation* (2nd edition).
- Marley, ML. 1977. *Survey of Cape May County, New Jersey (revised 2002)*. Rutgers, the State University and Cape-Atlantic Soil Conservation District United States Department of Agriculture, Natural Resources Conservation Service. 49 pp.
- Lord, H. 2006. Natural Heritage Program Data Base Search. Correspondence dated August 2, 2006.
- National Park Service (Phila.) with Great Egg Harbor River Planning Committee. 2000. *Comprehensive Management Plan and Environmental Impact Statement*. for Great Egg Harbor National Scenic and Recreational River, Final.
- Natural Resources Conservation Service (NRCS). 2006. Web Soil Survey. (<http://websoilsurvey.nrcs.usda.gov/app/>)
- NJDEP, Division of Fish and Wildlife (DFW), Bureau of Freshwater Fisheries. 2000. *Locations of Anadromous American Shad and River Herring During Their Spawning Period in New Jersey Freshwaters Including Known Migratory Impediments and Fish Ladders*. Sicklerville, NJ
- NJDEP, DFW. 2005a. Freshwater Fish of New Jersey. (<http://www.nj.gov/dep/fgw/chkfish.htm>)
- NJDEP, DFW 2005b. Mammals of New Jersey. (<http://www.nj.gov/dep/fgw/chkmamls.htm>)
- NJDEP, DFW 2005c. Birds of New Jersey. (<http://www.nj.gov/dep/fgw/chkbirds.htm>)
- NJDEP, DFW 2005d. Reptiles of New Jersey. (<http://www.nj.gov/dep/fgw/chkrept.htm>)
- NJDEP, DFW 2005e. Amphibians of New Jersey. (<http://www.nj.gov/dep/fgw/chkamph.htm>)



- NJDEP Historic Preservation Office (HPO). 2006. *New Jersey and National Registers of Historic Places*. (Last Update: 7/20/2006). (http://www.state.nj.us/dep/hpo/1identify/lists/cape_may.pdf)
- NJDEP N.J.A.C. 7:1J, entitled Processing of Damage Claims Pursuant to the Spill Compensation and Control Act requires that information about ground water pollution be available to the public
- NJDEP Division of Watershed Management. 2006a. Watershed Information Web site. (<http://www.nj.gov/dep/watershedmgt/basicinfo.htm>)
- NJDEP Division of Watershed Management. 2005. New Jersey Stormwater Best Management Practices. (http://www.njstormwater.org/tier_A/bmp_manual.htm)
- NJDEP, Natural Heritage Program. 2001a. *Natural Heritage Priority Site – Avalon-Stone Harbor Marsh Macrosite (Description)*. (Site Code S.USNJHP1*53)
- NJDEP, Natural Heritage Program. 2001b. *Natural Heritage Priority Site – Corson Inlet North Site (Description)*. (Site Code S.USNJHP1*187)
- NJDEP, Natural Heritage Program. 2001c. *Natural Heritage Priority Site – Corson Inlet South and Whale Beach (Description)*. (Site Code S.USNJHP1*186)
- NJDEP, Natural Heritage Program. 2001d. *Natural Heritage Priority Site – Great Cedar Swamp Macrosite (Description)*. (Site Code S.USNJHP1*253)
- NJDEP, Natural Heritage Program. 2001e. *Natural Heritage Priority Site – Middle Thoroughfare (Description)*. (Site Code S.USNJHP1*366)
- NJDEP, Natural Heritage Program. 2001f. *Natural Heritage Priority Site – North of Middletown (Description)*. (Site Code S.USNJHP1*1313)
- NJDEP, Natural Heritage Program. 2001g. *Natural Heritage Priority Site – Seaville Methodist Church Site (Description)*. (Site Code S.USNJHP1*644)
- NJDEP, Natural Heritage Program. 2001h. *Natural Heritage Priority Site – Strathmere Bay Island (Description)*. (Site Code S.USNJHP1*525)
- NJDEP, Natural Heritage Program. 2001i. *Natural Heritage Priority Site – Tuckahoe Corbin Salt Marsh Macrosite (Description)*. (Site Code S.USNJHP1*73)
- NJDEP, Natural Heritage Program. 2001j. *Natural Heritage Priority Site – Woodbine Bogs (Description)*. (Site Code S.USNJHP1*598)
- NJDEP, Division of Fish & Wildlife, Endangered & Nongame Species Program. 2006. *New Jersey's Landscape Project, Version 2.0*.
- NJDEP. 2005. Surface Water Quality Standards (N. J. A. C. 7:9B). Trenton, NJ
- NJDEP and USGS. 2002. *Hydrogeologic Framework, Availability of Water Supplies, and Saltwater Intrusion, Cape May County, New Jersey*, Water-Resources Investigations Report 01-4246
- NJ Geological Survey (NJGS). 2006. Physiographic Provinces of New Jersey. Information Circular (<http://www.state.nj.us/dep/njgs/enviroed/infocirc/provinces.pdf>)
- NJ Geologic Survey. (Accessed 2006). Digital Geodata Series: DGS02-7 Physiographic Provinces of New Jersey
- NJGS. 2002. *A Method for Evaluation of Ground-Water-Recharge Areas in New Jersey, Report GSR-32*. Trenton, NJ
- Olsson, H. 1998. Vegetation: A Phytosocial Classification. In: (Forman, RTT (ed) *Pine Barrens Ecosystem and Landscape*. Rutgers
- Owens, JP, PJ Sugarman, NF Sohl, RA Parker, HF Houghton, RA Volkert, AA Drake, and RC Orndorff. 1998. Bedrock Geologic Map of Central and Southern New Jersey. USGS and NJGeological Survey Miscellaneous Investigations Series Map I-2540-B
- Robichaud, B. and M Buell. 1989. *Vegetation of New Jersey* Rutgers University Press, New Brunswick, NJ.
- Staples, John. 2006. United States Department of the Interior, Fish and Wildlife Service Threatened and Endangered Species Review For Upper Township, Cap May County, New Jersey. Correspondence Reference #06-SL-0155 dated August 29, 2006.



- Stevens, L. 1898. *History of Cape May County*
- Tedrow, J.C.F. 1986. *Soils of New Jersey*. Robert E. Krieger Publishing Company, Inc., Malabar, Florida
- Tiner, RW. 1985. *Wetlands of New Jersey*. US Fish and Wildlife Service, Region 5, Habitat Resources. Newton Corner, MA: 117p.
- U.S. Fish and Wildlife Service (USFWS), Southern New England-New York Bight Coastal Ecosystems Program. 1997. *Significant Habitats and Habitat Complexes of the New York Bight Watershed – Cape May- Complex #1*. Charleston, Rhode Island (http://training.fws.gov/library/pubs5/web_link/text/cmp_form.htm)
- USFWS, Southern New England-New York Bight Coastal Ecosystems Program. 1997. *Significant Habitats and Habitat Complexes of the New York Bight Watershed – New Jersey Pinelands - Complex #2*. Charleston, Rhode Island (http://training.fws.gov/library/pubs5/web_link/text/cmp_form.htm)
- USFWS, Southern New England-New York Bight Coastal Ecosystems Program. 1997. *Significant Habitats and Habitat Complexes of the New York Bight Watershed – Great Egg Harbor Estuary- Complex #3*. Charleston, Rhode Island (http://training.fws.gov/library/pubs5/web_link/text/cmp_form.htm)
- USFWS. 2004. *Cape May National Wildlife Refuge Comprehensive Conservation Plan*. (library.fws.gov/CCPs/capemay_final04.pdf)
- US Geological Survey (USGS). 1977a. Marmora 7.5 Minute Topographic Quadrangle. Viewed on Terraserver Web Site (<http://terraserver-usa.com/place.aspx?>)
- USGS. 1977b. Sea Isle City 7.5 Minute Topographic Quadrangle. Viewed on Terraserver Web Site (<http://terraserver-usa.com/place.aspx?>)
- USGS. 1977c. Tuckahoe 7.5 Minute Topographic Quadrangle. Viewed on Terraserver Web Site (<http://terraserver-usa.com/place.aspx?>)
- USGS. 1977d. Woodbine 7.5 Minute Topographic Quadrangle. Viewed on Terraserver Web Site (<http://terraserver-usa.com/place.aspx?>)
- USGS. 2005. *Major Aquifers in New Jersey*. (<http://nj.usgs.gov/gw/aquifer.html>)
- USGS. 2006. *Bird Checklists of the United States: Birds of Cape May County*. Northern Prairie Wildlife Research Center Online. Jamestown, ND: (<http://www.npwrc.usgs.gov/capemay.htm>)
- Whittaker, RH. 1998. Vegetational Relationships of the Pine Barrens. In: (Forman, RTT (ed) *Pine Barrens Ecosystem and Landscape*. Rutgers University Press. New Brunswick, NJ: 315-331)
- Wolgast, LJ. 1998. *Mammals of the New Jersey Pine Barrens*. In: (Forman, RTT (ed) *Pine Barrens Ecosystem and Landscape*. Rutgers University Press. New Brunswick, NJ: 315-331)
- Wright, D. and P Sutton. 1999. *Checklist of Butterflies of Cape May County, NJ*. Cape May Bird Observatory, Cape May Court House, NJ

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