ENVIRONMENTAL RESOURCE INVENTORY

FOR

UPPER DEERFIELD TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY

MAY 18, 2006

Prepared for:

Upper Deerfield Township
Environmental Commission

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TABLE OF CONTENTS

Section			Page #
1.0	INTRODUCTION		1
2.0	HISTORY		4
	2.1	Local History	4
	2.2	Historic Preservation	4
	2.3	Significant Trees	6
	2.4	Historic Roads	6
3.0	CLIMATOLOGY		7
4.0	GEOLOGY		8
	4.1	Physiography	8
	4.2	Stratigraphy	9
	4.3	Surficial Formations	9
	4.4	Aquifers and Recharge Areas	9
	4.5	Potable Water Supply	11
	4.6	Contamination	11
	4.7	Wellhead Protection	15
	4.8	Known Contaminated Sites	15
	4.9	EPA Superfund Sites	16
	4.10	Sole Source Aquifers	17
5.0	SOILS		17
	5.1	Soil Types	17
	5.2	Prime Farmland	20
	5.3	Hydric Soils	21
	5.4	Steep Slopes	23
	5.5	Soil Erosion and Sediment Control	23
6.0	WATER RESOURCES		24
	6.1	Drainage Basins and Major Surface Water Features	24
	6.2	Surface Water Quality Classification	27
	6.3	Surface Water Quality	28
		6.3.1 AMNET Monitoring	.28
		6.3.2 Federal Clean Water Act (Section 303d)	29
		6.3.3 Non-Point Source Pollution	30
		6.3.4 Point Source Pollution	31
	6.4	Surface Water Quality Protection	31
		6.4.1 Riparian Corridors	31
		6.4.2 Flood Hazard Area Control Act Rules	33
		6.4.3 Stormwater Management Rules	33
		6.4.4 Public Participation	.34
	6.5	Floodplains	34

TABLE OF CONTENTS – Continued **Page #**

7.0 WETLANDS 35
- **7.1 Definition and Identifying Factors 35**
- **7.2 Wetland Locations 36**
- **7.3 Wetland Resource Value Classification 36**
- **7.4 Wetland Communities 38**
  - **7.4.1 Palustrine Deciduous Forested Wetlands 39**
  - **7.4.2 Palustrine Scrub/Shrub Wetlands 39**
  - **7.4.3 Palustrine Emergent Wetlands 39**
  - **7.4.4 Palustrine Needle Leaved and Broad Leaved Wetlands 40**
  - **7.4.5 Modified Wetlands 40**
  - **7.4.6 Vernal Pools 40**
  - **7.4.7 Wetland Mitigation 42**
  - **7.4.8 EPA Priority Wetlands 42**
  - **7.4.9 Wetland Regulations 43**

8.0 AIR QUALITY 44

9.0 LAND USE 45

- **9.1 Land Use/Cover Types 45**

10.0 WILDLIFE 48
- **10.1 Fisheries 48**
- **10.2 Endangered and Threatened Species 49**
- **10.3 Endangered and Threatened Plant Species 53**
- **10.4 NJDEP Priority Site 55**
- **10.5 The Landscape Project 55**
- **10.6 Forest Fragmentation and Corridors 57**
- **10.7 Regulatory Protection for Endangered and Threatened Species 58**

11.0 SUMMARY 59

12.0 FIGURES 62-78
- **Figure 1 Location Map**
- **Figure 2 Geology**
- **Figure 3 Wellhead Protection Areas and Known Contaminated Sites**
- **Figure 4 USGS Topographic Map**
- **Figure 5 Soil Series**
- **Figure 6 Slopes**
- **Figure 7 Watersheds**
- **Figure 8 Surface Water Resources**
- **Figure 9 HUC-14 Subwatersheds**
- **Figure 10 Floodplains**

TABLE OF CONTENTS – Continued **Page #**

Figure 11 Wetlands
Figure 12 Forest and Grassland Habitat
Figure 13 Potential Vernal Habitat
Figure 14 Land Use/Land Cover
Figure 15 Bald Eagle Foraging Habitat
Figure 16 Forested and Emergent Wetland Habitat

13.0 REFERENCES..... 79

APPENDIX A: NJDEP NATURAL HERITAGE PROGRAM DATA AND U.S. FISH AND WILDLIFE SERVICE RESPONSE LETTER LIST OF SITES REGULATED BY NJDEP

APPENDIX B: PHOTOGRAPHS

LIST OF TABLES

Table 1 Contamination Susceptibility in Public Noncommunity Wells..... 13
Table 2 Upper Deerfield Township Known Contaminated Sites 16
Table 3 Soils Mapping Units and their Characteristics 19
Table 4 Upper Deerfield Township Watersheds/Subwatersheds..... 26
Table 5 Biological Condition of Streams in Upper Deerfield Township 29
Table 6 Impaired Waters Listed on the 303(d) List for Upper Deerfield Township... 29
Table 7 Recent NJPDES Permitted Facilities in Upper Deerfield Township..... 31
Table 8 Distribution of Wetland Communities in Upper Deerfield Township 38
Table 9 Distribution of Land Use/Land Cover Types 45
Table 10 Threatened and Endangered Wildlife..... 49
Table 11 Threatened and Endangered Plant Species 54

1.0 INTRODUCTION

The purpose of the Environmental Resource Inventory (ERI) for Upper Deerfield Township is to objectively identify and describe the natural resources, cultural conditions and environmental features within the Township. The ERI provides both visual depictions of natural resources, in the form of mapping information (Section 12, Figures), and text that describes these resources, their sensitivities and limitations for development and suggested measures for protection of sensitive resources. The text has been gathered from existing resources such as the Upper Deerfield Township Master Plan, and reports and studies provided by County, State and Federal Agencies and organizations.

Existing map sources provided the basis for establishing the location of natural resources presented in this ERI. Since the maps were not field verified, the resource mapping presented herein is intended for general planning purposes and should not substitute for site-specific surveys. The following map sources were used as the basis in establishing the extent of natural resources in Upper Deerfield Township:

Base Maps:

Monochromatic Bit-Mapped 7.5 Minute Topographic Images of New Jersey, Gregory C. Herman and Maryann C. Scott, N.J. Geological Survey Digital Geodata Series DGS99-1, May 27, 1999, derived from USGS 7.5 Minute Digital Raster Graphic (DRG) Topographic Series Bridgeton, Elmer, Shiloh and Alloway Quadrangles

NJDEP Municipality Boundaries for the State of New Jersey, NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS), Trenton, NJ, 2003.

New Jersey Geological Survey CD-Series CD 00-1Bedrock Geology (1:100,000-scale) and Topographic Base Maps (1:24,000- and 1:100,000-scales) of New Jersey June 30, 2000.

GIS Layers:

Soil Survey Geographic (SSURGO) database for Cumberland County, New Jersey, USDA, Natural Resources Conservation Service, Fort Worth, Texas, December 2004.

Physiographic Provinces of New Jersey, New Jersey Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS), Ronald S. Pristas (ed.), NJDEP/NJGS, Trenton, NJ, 2002.

NJDEP 11 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC11), Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS), Trenton, 2000.

NJDEP Water Bodies for New Jersey (1:24000), NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS), Trenton, NJ, 1998.

NJDEP Surface Water Quality Standards of New Jersey, New Jersey Department of Environmental Protection, Division of Landuse Management, Bureau of Freshwater & Biological Monitoring, Trenton, NJ, 2005.

NJDEP Known Contaminated Site List for New Jersey, 2004, Department of Environmental Protection (NJDEP), Division of Remediation Support, Site Remediation and Waste Management Program (SRWM)

NJDEP 14 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC14), Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS), Trenton, 2000.

Federal Emergency Management Agency Q3 Flood Data, Disc 18 - New Jersey, Puerto Rico, Virgin Islands, National Flood Insurance Program, September 1996.

NJDEP Emergent Wetland Critical Habitat, New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered Non-Game Species Program, vector digital data, NJ Division of Fish and Wildlife, Trenton, NJ, October 23, 2001.

NJDEP Forest Critical Habitat, New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered Non-Game Species Program, vector digital data, NJ Division of Fish and Wildlife, Trenton, NJ, October 23, 2001.

NJDEP Forested Wetland Critical Habitat, New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered Non-Game Species Program, vector digital data, NJ Division of Fish and Wildlife, Trenton, NJ, October 23, 2001.

NJDEP Grassland Critical Habitat, New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered Non-Game Species Program, vector digital data, NJ Division of Fish and Wildlife, Trenton, NJ, October 23, 2001.

NJDEP Wetlands of Cumberland County, New Jersey 1986, New Jersey Department of Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis, NJDEP, Trenton, November 1999.

NJDEP Linear Non-Tidal Wetlands of Cumberland County, New Jersey 1986, NJ Department of Environmental Protection (NJDEP), Office of Information Resource Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), NJDEP, Trenton, November 1998.

NJDEP Bald Eagle Foraging, New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP), Trenton, NJ, 2001.

Bureau of Geographic Information and Analysis (BGIA), Office of Information Resources Management (OIRM), New Jersey Department of Environmental Protection (NJDEP);20000114;

W12LU95.shp (Land Use/Land Cover and Impervious Surfaces for the Watershed Management Area 1 New Jersey, 1995/97).

Disclaimer: These (maps/publications/reports) were developed using New Jersey Department of Environmental Protection Geographic Information System digital data, however these secondary products have not been verified by NJDEP and is not state-authorized.

Upper Deerfield Township is a primarily rural municipality located within northern Cumberland County in southwestern New Jersey (Figure 1 of Section 12). Upper Deerfield Township borders Alloway Township and Upper Pittsgrove Townships to the northeast (Salem County); Deerfield Township to the east; Fairfield Township and Bridgeton City to the south; and Hopewell Township to the west. The Master Plan (1988) identifies Upper Deerfield Township as having a total area of approximately 31.8 square miles, or approximately 20,352 acres. Of this total area, approximately 1% of Upper Deerfield is classified as surface water. This total area differs slightly from the State data which calculates the area as approximately 31.2 square miles. The discrepancy may be due to subtle differences in calculating boundaries along the Cohansey River. Within this report, the data obtained from the State is calculated from the latter (31.2 square miles) number.

From 1980 to 1990, Cumberland County grew from a population of 132,866 to 138,053. Between 1990 and 2000, the County grew to a population of 146,438, at an annual growth rate of 0.6%. According to the US Census Bureau (2003), there are 7,679 people living in Upper Deerfield Township. This number increased from 7,556 in the 2000 Census and 6,927 in the 1990 Census. The 2000 census showed Upper Deerfield having the fourth largest population in Cumberland County with a rural population of approximately 3,003 and an urban population of 4,553 with an annual growth rate of .9%.

Although Cumberland County is one of New Jersey's slower growing counties and growth increases within the municipality have been slow over the last 20 years, the Upper Deerfield Township Planning Board Master Plan Reexamination Report (adopted September 8, 2003) states the concerns of increasing growth pressures within the Township associated with residential and commercial development. The use of environmental data through an ERI is important for executing environmentally and culturally responsible land use planning with regard to future population increase. The ERI is designed as a planning tool for identifying, protecting and preserving the Township's environmentally sensitive resources and maintaining its rural setting. In this context, the ERI helps Upper Deerfield fulfill Goal 1 stated in the Township's Municipal Master Plan (1988): *"The preservation of the Township's character and physical features, both natural and manmade, from which it (the community's character) is derived."*

It is important to consider that the ERI provides a base point for reviewing future activities. As conditions change, including land use, the quality and quantity environmental resources and local, State and Federal laws, the ERI must be reviewed and updated. This is necessary to accurately represent the progression of the municipality and to keep the document functioning as a legitimate tool for planning.

2.0 HISTORY

2.1 Local History

History of Upper Deerfield Township compiled from *"This Place Called Home,"* F. Alan Palmer, 1985.

In the late 1600's, colonists from Long Island and parts of New England, in search of a warmer climate and refuge from religious persecution, began to settle region now known as Cumberland County. Initially, the villages of Fairfield and Greenwich were developed along the Cohansey River. Deerfield Township, which originally contained Upper Deerfield, was created with the development of Cumberland County in 1748. During the colonial period, agriculture was limited to food crops for subsistence augmented by the clearing of forest for cordwood. Cordwood was shipped to Philadelphia for sale. The early farmers would simply exhaust the nutrients of the surface soil (formed by reduced forest matter) and regularly clear new areas for crops. Old fields were allowed to succeed into shrub areas or were utilized for livestock.

Increased use of fertilizers, the development of the iron plow and other advances in agriculture allowed for greater land production and the focus switched from subsistence farming to trade. The development of a railroad in Bridgeton City in 1860 led to an increase in agricultural trade with Philadelphia. Upper Deerfield split from Deerfield Township in 1922 and continues to retain its agricultural character, and the continuation of a farming tradition is considered a Township priority.

2.2 Historic Preservation

Historic Preservation is the identification, evaluation and protection of historic and archaeological resources. Historic properties are links to the past that provide a physical record of the events and people that shaped our history. Historic preservation includes saving historic properties, conserving natural landscapes and scenic views. In New Jersey the public commitment to implement historic preservation is defined by three distinct designation types: National Register of Historic Places, the New Jersey Register of Historic Places and designation by a municipality pursuant to the authority of the New Jersey Municipal Land Use Law. The National Historic Preservation Act of 1966 established the National Register of Historic Places as the official list of historic resources worthy of preservation. The NJ Register of Historic Places Act of 1970 established the New Jersey Register of Historic Places as the state's official list of historic places. The New Jersey Register is modeled after the National Register and uses the same criteria for establishing eligibility. Listing of a property in the New Jersey Register of Historic Places provides recognition of a property's historic importance and assures protective review of public projects that might adversely affect the character of the historic property. However, listing on the National or State Register only affects public undertakings and does not prevent a private property owner from altering or even demolishing a listed property. The most effective protection of historic resources is designation and regulation at the municipal level.

According to the Historic Preservation Office of NJ, two Upper Deerfield sites are currently

identified on the State Register and the National Register of historic places:

Deerfield Pike Tollgate House (ID #1052) 89 Old Deerfield Avenue NR- 75001131. The house was constructed in 1853 for the development of a new turnpike. A toll collector resided at the house and operated the tollgate and remained active through World War I. The house was demolished in 2001 because of its poor condition.

Deerfield Presbyterian Church (ID# 1053) Northwest Corner of Bridgeton to Deerfield Pike and Seeley Road, Seabrook NR – 80002481. Originally built in 1737 from local sandstone, the church replaced a log schoolhouse utilized as a place of worship since 1732. From 1737 to 1795, it was the only church in northeastern Cumberland County.

North Pearl Street (ID# 1028) (NJ Route 77) north of Irving Avenue to Carll's Corner was given consideration for the State Register. In Upper Deerfield, at least 15 sites had been considered for the Historic Register of Cumberland County.

Prehistoric Sites

Archaeological evidence indicates that the New Jersey Coastal Plains were occupied from Paleo-Indian times and that the vast majority of prehistoric sites are located within 300 feet of water.

In general, the Cohansey River and associated tributaries would have potential for prehistoric sites. Camp and village sites are often found on well drained areas on the north side of open water. Areas within 300 feet of surface water typically have the highest potential for prehistoric sites. Sites are also found in areas outside of 300 feet of water, particularly on drainage divides and upland areas, but these sites are much fewer in comparison with those near watercourses. Studies have also demonstrated that prehistoric sites are more apt to be situated in areas with well-drained soils, level topography, historic trails, and a decent vantage point. Evidence of the Delaware or Lenape Indians within New Jersey may be categorized as camp and village sites, shell heaps, cemeteries, rock shelters, quarries, caches and trails. Artifacts may include pottery fragments, fireplace stones, and stone chips/unfinished tools or other evidence of tool making are typically associated with campsites (Skinner and Schrabisch, 1913).

The nation of Lenni Lenape Indians associated with the Cohansey River drainage and Cumberland County were known as the Unalachtigo. It is estimated that approximately 600 Indians were living in the region during the time of settlement. Settlements were known to exist along the Cohansey near Greenwich and along the Maurice Rivers (Palmer et al, 1985). Skinner and Schrabrich (1913) identified clusters of well-established Unalachtigo sites along Cohansey near Bridgeton and determined this area to be their "headquarters." These prehistoric sites were identified along Harrow Brook, Beebe Run, Barrett's Run Cornwell Run, and Stone Bridge Run. In addition, the Unalachtigo utilized several major trails to travel from the Delaware River to the Atlantic Ocean, including the Cohansey Trail, which parallels the Delaware River from near Camden, passes through Cumberland County, and continues to the tip of Cape May (Palmer, et al, 1985).

Multiple prehistoric artifacts are documented within the vicinity of the Cohansey River Drainage in the recording books of the George Woodruff Collection at the Bridgeton Public Library.

Artifacts documented include arrowheads found at Carll's Corner, Tumbling Dam Park, and Sunset Lake, and quartz knives documented from Silver Lake. Settlement artifacts including pots and banner stone are documented from Piney Point and pots are documented from the Mary Elmer Lake region (Bergmann, 2005). Studies of the Cohansey River near Mary Elmer Lake in Hopewell have been conducted for archeological evidence.

There currently are two listed prehistoric sites in Upper Deerfield identified at the State Historic Preservation Office. These sites are located just southwest of where Cornwell Drive intersects the old central Railroad. The other documented site is just north of County Road 522 near the Bridgeton Border.

2.3 Significant Trees

In New Jersey, trees, particularly white oaks (*Quercus Alba*), were often used as trail markers for prehistoric and colonial pathways. The white oak's distinctive light bark aided travelers in identifying pathways at night. Often these large white oaks have a wide bole and crown, indicating that these trees have been growing in a cleared area for a considerable amount of time (sometimes several hundred years). In recent years, there has been interest in Upper Deerfield and other communities in identifying and preserving certain trees for their contribution to the community's culture and landscape.

In July of 2005, the Upper Deerfield Environmental Commission received an evaluation of a large white oak near the intersection of Burlington Road and the old Jersey Central Railway. The oak is of interest because of its large size and that it is in a location of historical significance. The oak is at diameter at breast height (dbh) of approximately 48 inches and its estimated age is between 200 and 250 years of age. The oak is located within the vicinity of the Cohansey Road and Burlington Road. Because of its historical significance (utilized as early as 1697) other oaks along the original path of Burlington Road within Upper Deerfield may be worthy of research or documentation (Bergmann, 2005).

2.4 Historic Roads

While historic road structures such as bridges and guardwalls have traditionally been identified as having historic value, active roads or remnant pathways with certain physical features in slope design and alignment are increasingly being recognized as historically significant. In addition, less tangible qualities such as a road's specific history or use as a thoroughfare in a larger historical context may also add to its importance (Soulliere, 1995). Some of Upper Deerfield's potentially significant roadways are identified below:

Currently referred to as Old Deerfield Pike, the "Old Stagecoach Road" has its origins in the 18th century during early settlement of the region. The road ran from Bridgeton through Upper Deerfield to the county line (ca 1768) (Cushing and Sheppard, 1883). In 1796 the road was straightened and relaid from Commerce Street to Loper's Run and was extended further northward in 1811. Portions of the original road, currently visible as a narrow road cut, can be viewed from Cornwell Road looking north past the Township's Lawnside Cemetery (Bergmann, 2005).

Buttonmill Road served as a vital way to get products from mills in the Township south to

Bridgeton City. Constructed in 1856, the road allowed travelers from the Silver Lake Mill to access Bridgeton without having to travel north or west to access existing roads. The Buttonmill "remnant" portion of this roadway in Upper Deerfield has historical significance due to the use of the "cut and fill" engineering characteristic of this time period noted as significant in Miriam Crum's Historic Roadway Study of New Jersey (Bergmann, 2005).

Cushing and Sheppard (1883) noted that prior to 1716 an east/west road crossed the Cohansey River at Tumbling Dam Pond (Sunset Lake). This crossing was utilized during high tide and is part of a road referred to as the "Old Cohansey Road." Although its origins are not fully known, the general consensus is that the Winchester and Western Railroad bed follows the Old Cohansey Road's path. Cohansey Road was used as a pathway for over 10,000 years by native peoples and later by early Swedish settlers.

The "Old Cohansey Road" continued east towards "Old Burlington Road." Old Burlington Road was constructed ca. 1697 by Fairfield settlers seeking a direct route to Burlington County. The road is identified in the New Jersey Historic Roadways Study as the Cape May-Burlington Road and connected the two counties via Bridgeton. The current Old Burlington Road starts at Indian Run Branch along Irving Avenue and heads in a northerly direction north to Carll's Corner (see Section 2.3, Significant Trees). An approximate quarter mile of the Old Burlington Road is discontinued from Route 56 to Route 77. The road then follows Route 77 north to Big Oak Road and eventually reaches the Cumberland County line (Bergmann, 2005).

3.0 CLIMATOLOGY

New Jersey experiences a significant variation in temperature between the summer and winter months and large daily and day-to-day fluctuations. In the winter, New Jersey's climate is influenced by the semi-permanent high-pressure that forms over Canada and the northern Great Plains. Strong surges of cold air borne on prevailing northwesterly winds drag cold polar air masses to the southeast over the eastern United States. Storm centers often accompany these cold polar masses of air. In spring, the high pressure over Canada weakens and a Bermuda high develops over the Atlantic Ocean. The clockwise flow around this high-pressure system results in prevailing winds from the south and southwest, carrying moist tropical and maritime air from the Gulf of Mexico and the Caribbean. In autumn, the Bermuda high weakens and retreats to the south. During this transition period, New Jersey often experiences mild and tranquil weather as weak high pressure moves slowly southeast from Canada. The winter circulation pattern slowly becomes reestablished by December, ushering in our winter weather.

In spite of New Jersey's small size (7,836 square miles), the Office of the State Climatologist identifies five distinct climate zones in the state: Northern; Central; Pine Barrens; Southwest; and Coastal. The region's geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns produce distinct variations in the daily weather between each of these zones. According to the NJ Climate Zone Map, Upper Deerfield is located primarily within the Pine Barrens Climate Zone with Southwest Climate Zone running close to the Township's southern border. The Pine Barrens Climate Zone's generally sandy soils allow for a quick release of solar radiation absorbed during the day. These soils tend to hold less moisture. As a result, the region

experiences lower minimum temperatures and drier conditions than nearby coastal areas. The drier conditions generally lead to an increased risk of forest fires within the region. The Southwest Climate Zone borders Upper Deerfield to the south and west from sea level to 100 feet is influenced by its proximity to the Delaware Bay. Soils tend to be less sandy in this region and as a result, this climate zone typically has the highest daily temperatures in the state.

Cumberland County generally experiences slightly milder winters and a higher annual mean temperature (54.4 degrees F; Millville 1971-2003) than in northern and central parts of New Jersey. The coldest temperatures are typically experienced during December through January with an average minimum daily January temperature of 24.4 degrees F (Millville, NJ) for the period. The hottest month of the year is July, with an average maximum daily high temperature of approximately 85.6 degrees F. Snow may typically fall from about late November to early April and snowfall averages approximately 14" annually. Rainfall is relatively evenly distributed throughout the growing season with slightly more rain falling in July and August. Measurable average annual precipitation is around 43.20" (Millville, NJ), slightly lower than most other areas within the State. Millville averaged 1,009 cooling degree-days annually. Cooling degree-days refers to the number of degrees that the temperature rises above 65 degrees F throughout the year. Cumberland and surrounding areas experience more degree cooling days than most areas in the state with the exception of large cities. This is indicative of the slightly warmer maximum temperatures experienced locally.

4.0 GEOLOGY

4.1 Physiography

Physiography is the relationship between a location and the underlying geology. New Jersey includes four major physiographic provinces, the Ridge and Valley, Highlands, Piedmont and the Atlantic Coastal Plain (Figure 2, Section 12). The Coastal Plain area is the most easterly and southerly area of New Jersey and constitutes about 60% of the total land area of the state. It belongs to a larger geologic province of the eastern United States that extends northward through Long Island to Cape Cod and southwestward along the coast into Mexico. The Coastal Plain province is separated into the Inner and Outer Coastal Plain. The Outer Coastal Plain occupies about 3,400 square miles, or 45% of the State. Upper Deerfield Township lies within the Outer Coastal Plain (see Section 12, Figure 2). The Inner Coastal Plain lies to the north and west of Upper Deerfield. The Coastal Plain is the youngest of the physiographic provinces, having been formed beginning about 140 million years before present day (MYBP). The Coastal Plain is almost entirely of Cretaceous (136-65 MYBP) and Tertiary (65-1.8 MYBP) ages. The Coastal Plain began to form as the continental deposits on older metamorphosed rocks subsided below sea level. Subsequently, marine and marginal marine materials and sediments were deposited. As a result, the Coastal Plain is composed of a sequence of unconsolidated highly permeable to relatively impermeable quartz gravel, sand, silt, glauconitic sand (greensand) and clay strata that dip and thicken southeastward, extending seaward onto the submerged continental shelf. During the Cretaceous and Tertiary periods the Atlantic Ocean alternately advanced and retreated across the landscape, retreating for the final time about 5 MYBP.

The soils of the Outer Coastal Plain are typically much sandier and have a lower proportion of clay than the soils of the Inner Coastal Plain. As a result, the soils of the Outer Coastal Plain are

typically less fertile than those of the Inner Coastal Plain as water flows through the soil and leeches out nutrients. The characteristic vegetation of the Pine Barrens is largely a result of the low fertility and droughty, sandy soils that predominate within the Outer Coastal Plain.

4.2 Stratigraphy

The sediments of various geologic strata that comprise the Coastal Plain physiographic province were laid down in a sequential process, one atop the next, as the ocean advanced and retreated over millions of years. Alternating layers of gravelly and sandy marine materials and continental, fluvial sediments and clays were deposited. The gravelly and sandy marine deposits contain substantial pore spaces while the silty and clay deposits create confining layers, or "aquiludes." The Coastal Plain beneath Upper Deerfield consists of 14 tilted layers of gravels, silts, sands and clays. The sandy layers are porous and often contain significant quantities of water. They are sandwiched between nonporous clays. The edges of the tilted layers are exposed at the surface where they form "outcrops." The downward tilted layers increase in thickness in a southeasterly direction, to as much as 6,000 feet thick at Cape May. The sediment deposits that form the Coastal Plain are underlain by crystalline metamorphic and igneous bedrock of Paleozoic and/or Precambrian Age. Due to the great depth at which bedrock occurs, it has no affect on the surficial geology or influence on uses of the land.

4.3 Surficial Formations

The Township of Upper Deerfield lies entirely within the Cohansey Formation (Tch), the uppermost Tertiary formation in the Coastal Plain (see Section 12, Figure 2). This is the same formation that underlies the majority of the New Jersey Pine Barrens. The Cohansey is underlain by the Kirkwood formation, which outcrops in western Salem County and in southern Cumberland. The Cohansey Sand resulted from the interaction of many depositional processes found in close proximity in a deltaic environment. It consists primarily of nearshore – marine deposits identified as a white or light colored, medium to coarse-grained stratified quartz sand containing some lenses of gravel. It also contains locally, clay laminae or lenses of light colored clay up to 25 feet thick. As a result of natural processes, the present soils of the Cohansey Sand show much variation in their mixtures of clays, silts, sands and gravels.

4.4 Aquifers and Recharge Areas

An aquifer is a saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients. More than 75% of the freshwater supply in the Coastal Plain is groundwater drawn from aquifers. The most common aquifers are those geologic formations that have relatively high hydraulic conductivity values, such as unconsolidated sands and gravels, permeable sedimentary rocks such as sandstone and limestone, and heavily fractured sedimentary, volcanic and crystalline rocks. The aquifers of the Coastal Plain consist primarily of unconsolidated sands and gravels.

The groundwater that comprises an aquifer is derived from that part of precipitation that does not run off the surface of the land to streams or return to the atmosphere through evaporation and transpiration. Factors which determine the amount of water that infiltrates to the groundwater aquifer include the porosity and permeability of the surficial material, the slope of the land, the amount and kind of natural and artificial cover, and the intensity and amount of precipitation. Cumberland County aquifers are recharged primarily by precipitation, which enters through

outcrops or via the overlying unconsolidated material. Some additional water may enter the aquifer from vertical leakage through adjacent semi-confining units or recharge where the hydraulic gradient is from a stream or lake to the aquifer.

There are two main types of aquifers – confined and unconfined. Confined aquifers are situated such that less permeable formations (called aquitards) are located above and below the aquifer, confining the groundwater in the aquifer. The aquifers nearest the ground surface are generally unconfined aquifers. The Cohansey Sand aquifer is considered an unconfined aquifer. An actively pumped well in an unconfined aquifer can draw down the surface water table in the vicinity of the well when pumped, affecting nearby surface water bodies (Freeze and Cherry, 1979).

Aquifers are generally equated to the name of the geologic formation in which they exist, but in actuality do not necessarily correspond to the defined boundary of the mapped geologic formation. Because the Cohansey and Kirkwood formations are hydraulically interconnected, the aquifer is referred to as the Kirkwood – Cohansey, although occasionally it is referred to as the Cohansey Sand. The Kirkwood - Cohansey aquifer is the primary source of groundwater for Upper Deerfield Township and Cumberland County. This aquifer ranges in thickness from approximately 30-180 feet. The Kirkwood Formation extends below the Cohansey extends to approximately 300 feet.

As discussed above, the Cohansey Formation is the principal formation that outcrops beneath Upper Deerfield Township. The groundwater aquifer associated with this formation is considered an unconfined aquifer and is capable of yielding groundwater for potable use.

Based upon its storage capacity, hydraulic conductivity and accessibility for direct recharge, the Kirkwood - Cohansey is considered the most important freshwater aquifer in the New Jersey Coastal Plain. The Kirkwood - Cohansey is a water-table aquifer although it may contain several distinct water-bearing layers. The capacity of the system is estimated at 17 trillion gallons, the largest of any underground aquifer in the United States. The hydrological and ecological impacts to the Kirkwood-Cohansey from water diversions has become a concern. In 2001, under the Gibson Bill (N.J.P.L. 2001 c.165) the Pinelands Commission was directed by the New Jersey Legislature to prepare a hydrological and ecological evaluation of the Kirkwood-Cohansey aquifer to determine potential impacts from present and future water supply demand. The Kirkwood-Cohansey Project was designed to measure the effect of groundwater diversions and the potential ecological impacts in the Aquifer, particularly in the Pinelands. The study is expected to be complete in 2009.

The Mount Laurel Sand and Wenonah Formation are Cretaceous formations consisting of quartz, mica, glauconite and shell material lying three layers below the Kirkwood Formation. This Aquifer was thought to have potential as a future supply of fresh water in northern Cumberland County where the waters in the aquifer contain less salt. It is currently not a major source of groundwater withdrawl in Cumberland County.

The Potomac-Raritan–Magothy (PRM) is a Cretaceous layer and the bottom layer, lying just above bedrock and approximately 4,100 feet thick. Although it is a major source of water for

southern New Jersey, the PRM aquifer is reported to be depleting at a significant level. The Kirkwood-Cohansey is considered a quality water alternative to this aquifer and Cumberland County does not use the PRM as a source of groundwater withdrawal (R. Brewer, 2005 Personal Communication). Water withdrawals from the Potomac-Raritan-Magothy, which has supplied Camden, Burlington and Gloucester Counties in New Jersey and portions of eastern Pennsylvania, have recently been limited by the NJDEP due to severe water level declines within this confined aquifer system.

Most of Camden, Burlington and Gloucester Counties were designated as Critical Water Supply Area #2 in 1986. Upon this designation, PRM usage was cut back by 22% and no new uses were allowed. Alternative water supplies have been developed (Navoy). PRM users in Camden, Burlington and Gloucester Counties must find substitute water supplies.

4.5 Potable Water Supply

Water from the Cohansey aquifer is generally slightly mineralized and soft. Iron, manganese, dissolved carbon dioxide and carbonic acid are commonly present, sometimes in objectionable quantities. Following iron and manganese removal and with pH adjustment, the water is of excellent quality.

In Upper Deerfield, public water is supplied by the Upper Deerfield Township Water Department. The Upper Deerfield Water Department draws from the Kirkwood-Cohansey Aquifer. The Upper Deerfield Water Department is a public community water system that draws from two wells. The Seabrook Water Corporation, a public community water system containing three wells previously drew from the Kirkwood-Cohansey aquifer and served Upper Deerfield. NJDEP determined that Seabrook's wells were had exceeded MCLs (Mean Contaminant Levels) for radionuclides for five years. In December of 2003, the NJDEP ordered Seabrook Water Corporation to turn off its wells and allow Upper Deerfield Water Department to supply the Seabrook customers via an interconnection (NJPBU, 2004). The wells are currently not in operation. Additional Information regarding the Seabrook Water Corporation may be obtained through the NJ Bureau of Public Utilities.

Upper Deerfield Township also contains seven noncommunity water systems consisting of seven wells. Information about these systems is summarized in section 4.6 below.

4.6 Contamination

The chemical quality of ground water is a primary concern where it is used for public and domestic supply. The chemical properties are determined by the chemical properties of the precipitation; mineralogy of the substrate through which the water moves; and the length of time the water is in contact with the substrate. The chemical content can be altered by the introduction of contaminants into the environment. Pollutants may enter the environment from point or non-point sources. Point sources are usually discrete sources where concentrations may be elevated, such as leaking pipes, underground storage tanks and accidental spills. Non-point sources are usually lower concentrations spread out over larger areas; such as fertilizers and pesticides applied in agricultural area; stormwater runoff from pavement and vehicle emissions that settle on the ground and infiltrate with precipitation. Public water systems are required to

provide treatment if any contaminants are detected at frequencies or contaminants above allowable levels.

The Kirkwood - Cohansey aquifer is vulnerable to contamination introduced at or near land surface because it consists of highly permeable unconsolidated sands and gravels. The chemical quality of the Cohansey is of concern because of increasing reliance on it for public and domestic water supply.

The State conducts a review of potential contamination sources near public drinking water systems and completes a source water assessment summary as part of their Federally mandated Source Water Assessment Program (SWAP). State information regarding Upper Deerfield's public water supply can be obtained at http://www.nj.gov/cgi-bin/dep/swap/swapdata.pl. SWAP provides information regarding the potential for contamination and **does not indicate that the town's drinking water is contaminated**. Through SWAP, supplies are evaluated for potential contamination of pathogens, nutrients including nitrogen and phosphorous, pesticides, volatile organic compounds (VOCs) typically found in solvents and in gasoline additives, natural and man made radioactive substances, radon, inorganic materials such as arsenic, asbestos and metals, and disinfection additives such as chlorine mixed with organic material. Susceptibility levels are listed as being "High", "Medium" or "Low".

Both Upper Deerfield Water Department wells were found to have a high potential for nutrient contamination and radioactive substances. Both wells were found to have medium potential for pesticides and radon. One of the wells was found to have medium potential for inorganic materials. All other categories were in the low potential.

As with Upper Deerfield Water Department, the Seabrook Water Corporation wells were found to have the highest potential for nutrients and radioactive materials. One well was found to have high potential for pathogen contamination. All three wells were also found to have medium potential for radon and disinfection byproducts. Two wells were found to have medium potential for pesticides and one was found to have medium potential for inorganics contamination. Table 1 summarizes the susceptibility of noncommunity water supply wells in Upper Deerfield.

Table 1

Contamination Susceptibility Public Noncommunity Wells in Upper Deerfield

	Pathogens			Nutrients			Pesticides			Volatile Organic Compounds			Inorganics			Radionuclides			Radon			**Disinfection** Byproduct Precursors		
Sources	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
Seabrook House		1			1			1				1			1	1				1			1	
Red Barn Deli			1		1			1		1					1	1				1			1	
Deerfield Christian Nursery	1				1			1				1			1	1				1			1	
Country Kids Learning		1			1			1				1		1		1				1			1	
On a Roll			1		1			1				1			1	1				1			1	
Franco's Place			1		1			1				1		1		1				1			1	
Skate 2000			1			1			1			1		1		1				1			1	
Total	1	2	4	0	6	1	0	6	1	1	0	6	0	3	4	7	0	0	0	7	0	0	7	0

It is important again to stress that this data reflects **potential** contamination and does not mean that the drinking water is contaminated. Levels of susceptibility are determined by looking at various factors impacting the wells including the hydrologic conductivity of the soil as well as percentages of organic matter and clay in the soils, the proximity of agricultural land uses, the proximity and amount of urban landscape or impervious surfaces, and the proximity of streams and wetlands. Nutrients and pesticide contamination, rated as medium potential for most of the noncommunity wells, typically result from non-point source pollution from agricultural runoff, golf courses or lawns. Pathogens such as *E.coli* results from human or animal waste entering a water system. Sources may include leaky septic systems, large waterfowl populations or runoff from livestock operations.

Trace quantities of minerals that contain uranium and thorium occur within the sands and gravels that comprise the Cohansey Sand formation. As a result, radium, a decay product of the radioactive minerals, may be a concern within the aquifer. This is reflected in the higher potential for radionuclide contamination in all of Upper Deerfield's water supply wells and the elevated levels of radionuclides found in the Seabrook Water Corporation wells. Aquifers within Coastal Plain have been found to be susceptible to radionuclide contamination due to the presence of naturally occurring radioactive decay elements in the soil, particularly radium, which can more easily absorb into groundwater as it comes in contact with soils or sand. Radium 226, 228 and 224 have all been detected in Coastal Plain aquifers, particularly the Kirkwood-Cohansey (NJDEP, 2005). The USGS (Szabo, 1990) has identified dissolved radium in

concentrations in excess of USEPA drinking water standards of 5 picocuries in about 30 percent of ground water samples from wells in the Kirkwood – Cohansey aquifer. Radium 226 and 228 are the most commonly found radiums in the Kirkwood-Cohansey aquifer (Graham and Cusick, 1998).

Preliminary water testing for radioactive elements involves measuring gross alpha activity. Alpha radiation is product of radioactive decay, a process by which elements emit radiation to reach a more stable form and is measured in units known as picocuries. Under current US Environmental Protection Agency Laws, the lifetime risk associated for consuming water with the maximum allowable contaminant level for gross alpha activity is 1 in 10,000, or one additional fatal cancer for every 10,000 people consuming two liters of water per day for seventy years. Municipal water systems are required to test for and treat water above the MCL. As previously mentioned, the current MCL for dissolved radium (226 and 228) is 5 pCi/L (picocuries per liter) (USEPA, 2001).

Due to the high sand concentration and other highly permeable materials that comprise the Kirkwood-Cohansey, chemicals may easily infiltrate the aquifer. It is therefore susceptible to contamination from point and non-point sources. In agricultural communities such as Upper Deerfield, contamination from nitrogen is often a concern. Residential development and golf courses may also contribute to excessive nitrogen through application of fertilizers for grass maintenance.

A study by the USGS (Stackelberg et al, 1997) in the "Glassboro Study Area," which includes Upper Deerfield, identified nitrates as the most commonly detected contaminant in recently recharged groundwater in the Cohansey Aquifer. Nitrate is a stable form of nitrogen found in oxygenated subsurface groundwater environments. Inputs from human sources are usually from domestic fertilizers (lawn and garden fertilizer), agricultural fertilizers, including animal waste, and effluent from leaking sewer lines, cesspools and septic tanks. Elevated nitrates are harmful to infants and farm animals and result in a condition termed methemoglobinemia, or "blue-baby syndrome." Elevated nitrates were most commonly found in agricultural areas. Areas classified as old urban and new urban had slightly elevated levels while undeveloped area had very low levels of nitrates in the subsurface environment. Pesticides and volatile organic compounds (VOC) were also frequently detected in recently recharged, shallow groundwater; however, their concentrations were typically low and rarely exceeded established drinking water standards.

"Glassboro Study Area" findings are consistent with recent NJDEP tests in Upper Deerfield. From September of 2002 to March 2003, NJDEP tested 19 private wells in Upper Deerfield for contaminates. Five of these wells were found to have unacceptable levels of nitrates. Mercury, VOCs and *E.coli* bacteria were also tested for and were found to meet acceptable standards in all 19 wells. Source: http://www.state.nj.us/dep/pwta/pwta_report.pdf

The presence of the various contaminants indicates that human activities have affected the quality of shallow groundwater within the Kirkwood – Cohansey aquifer. Another study (Murphy 1998) performed to evaluate nitrates in groundwater found that the highest levels were from shallow wells (less than 100 feet depth), within 50 feet of a septic tank, near land to which fertilizer had been applied or within ¼ mile of a agricultural field, sod farm or golf course.

4.7 Wellhead Protection

In order to protect New Jersey Groundwater Resources, the New Jersey Department of Environmental Protection (NJDEP) has identified Wellhead Protection Areas (WHPAs) for public community water supply wells. The WHPA is the area from which a well draws its water within a specified timeframe. Once delineated, the WHPA are typically considered priority areas to prevent and clean up groundwater contamination. NJDEP GIS mapping depicts a total of six public community water supply wells and five public non-community water supply wells in Upper Deerfield (Section 12, Figure 3). Wellhead protection areas throughout the state may be viewed at NJDEP's I-map at www.state.nj.us/dep/gis

WHPA's consist of three tiers, each based on the time of travel (TOT) to the well. The outer boundaries of these tiers will have the following times of travel:

Tier 1 = two years (730 days)
Tier 2 = five years (1,826 days)
Tier 3 = twelve years (4,383 days)

The portion of the zone of contribution designated as the WHPA is based upon the TOT of the groundwater to a pumping well. The TOTs are based on the need to assess the relative risk of contamination to the well, allowing priority to sources that pose an imminent threat. The Tier 1, 2 and 3 WHPAs for the water supply wells in Upper Deerfield are shown on Figure 3 of Section 12. This figure also provides the locations of Known Contaminated Sites (KCS) that are listed by the NJDEP. KCS located within the 2, 5 and 12 year WHPAs are included in Figure 3.

Land use planning should include an examination of the existing and proposed land uses in the wellhead protection areas. Certain land uses have a greater potential to contaminate groundwater than do others. Consideration should be given to monitoring or restricting certain types of land uses in wellhead protection areas.

4.8 Known Contaminated Sites

The NJDEP Site Remediation Program currently maintains a list of more than 12,000 New Jersey sites that are confirmed to be contaminated and are undergoing a remedial investigation or a cleanup or are awaiting assignment to a NJDEP case manager. According to the NJDEP, Upper Deerfield contains a total of six Known Contaminated Sites (Figure 3 in Section 12) as listed in the table below.

Table 2
Upper Deerfield Township Known Contaminated Sites

Site Name	Case Number	Site Address	Status as of 2005	Preferred ID
Hess Service Station	BSCM 008418	Carll's Corner	Active 11/30/94	008418
Seabrook Farms Incorporated SLF	BUST 9303274	Finley Rd.	Pending 4/9/93	93795
Upper Deerfield Twp. Municipal Building	BFO-S 9304141	Rt. 77	Pending 5/22/93	126587
Vineland Construction	BFO-S 931088	Burlington Rd.	Pending 10/28/93	64599
53 Sunset Lake Road	BFO-S 244567	53 Sunset Lake Road	Active 12/30/04	244567
Clement Pappas Company*	BUST 0045245	W. Parsonage Rd.	NFA 10/7/94	15639

*The Clement Pappas Company Site is a closed case with restrictions.

Source: http://www.state.nj.us/dep/srp/kcs-nj/

Known Contaminated Sites are sites where contamination of soil and/or groundwater is confirmed at levels greater than the applicable cleanup criteria or standard. Remedial activities, which may be as simple as soil removal and replacement, or which are very complex may be underway. The sites may be regulated under one or more State and/or Federal regulatory program. A site may be active, such as the Hess Service Station, or may be pending, such as Seabrook Farms, when the site has not yet been assigned to a specific remediation program. The NJDEP may be contacted for detailed information on the nature, extent and severity of contamination at a specific site. Currently over 150 sites in Upper Deerfield have been regulated by NJDEP. These sites include those that have been determined to not be contaminated or have completed remediation and have received letters from NJDEP determining that "No Further Action" (NFA) is needed. To review the full list of reviewed sites, visit the NJDEP dataminer site at http://datamine.state.nj.us/dep/DEP_OPRA/. The datamine site contains an archive of inspections, enforcement actions and violations, if any, on file for each of these sites. Sites that may not be closed may not have data available. The current list of sites inspected for Upper Deerfield (printed from the datamine website) is included in the Appendix A of the ERI.

4.9 EPA Superfund Sites

The Superfund Program, established through the US Environmental Protection Agency (EPA) in 1980, was created to locate, investigate and clean up the Nations' most contaminated sites. The Upper Deerfield Sanitary Landfill site is an inactive landfill covering 14 acres on a 23-acre plot on Husted Station Road. Originally a gravel pit from 1938-1960, the Township purchased the site in 1977 and it operated as a licensed municipal landfill receiving household waste until its closure in 1983. Nearby residents raised concerns regarding the contamination of well water. NJDEP installed three monitoring wells. Samples from these and nearby residential wells revealed mercury and volatile organic compounds (benzene, vinyl chloride, and trichloroethylene). In addition, low levels of contaminants were found in the site soil. In 1986,

the Township installed a public water supply well and distribution system to supply residents with potable water.

The development of an alternative potable water supply for nearby residents and significant decreases in soil contaminants led to an EPA ruling that the site at present did not impose a serious health threat. The Upper Deerfield Sanitary Landfill was deleted from the National Priorities List of Superfund Sites in 2000. Division of solid waste management is working to complete required solid waste closure regulations. Long term (30 year) monitoring of the site continues through the town under a USEPA Administrative Consent Order. The Township has put deed and zoning restrictions on the site. For more information on superfund sites, visit the EPA website at www.epa.gov/superfund

4.10 Sole-Source Aquifers

The Federal *Safe Drinking Water Act* contains provisions that allow for specific designation of areas that are dependent on ground water as their sole or principal drinking water source. The technical requirements for designation as a sole source aquifer are that (1) more than 50% of the drinking water for the aquifer service area is supplied by the aquifer system and (2) that there are no economically feasible alternative drinking water sources.

In the June 24, 1988 Federal Register, the Notice of Approval designating the *Coastal Plain Aquifer* was published, which states that it is "the sole or principal drinking water source for the area and which, if contaminated would create a significant hazard to public health." When an area is designated as a sole source aquifer, the Federal environmental review process will ensure that Federal agencies will not commit funds toward projects which may contaminate these designated ground water supplies.

5.0 SOILS

5.1 Soil Types

The Upper Deerfield Zoning and Development Code recognizes the Right to Farm Ordinance (Article VII, Section 22.1) on all areas designated as farms within the Township. The Township recognizes that the benefits of farming, including product production, aesthetics, cultural and open space, offset any nuisances caused by the practice. Some farms within the Township are under Farmland Preservation and Upper Deerfield's emphasis on farming underscores the importance to identify valuable soil types within the municipality and to take soil variety into account when determining land use and preservation value. Since 1989, the Cumberland County Agricultural Preservation Board, through the county's Farmland Preservation Program, has preserved over 80 easements representing 10,000 acres throughout Cumberland County. Increased funding in 2006 will allow for the permanent preservation of approximately 30 farms representing 3000 acres over the next two years. Additional information on farmland preservation and the selection process may be obtained through the county website at www.ccpa.net/cumberland.

Soils provide the basis for the potential land uses within the community. They determine the types of vegetation or crops that can be grown and influence the development activities and design of structures that can be constructed. Soils represent a non-renewable resource and must be appropriately managed. In addition to the cultural and aesthetic losses typically associated with the loss of farms to residential development, the loss of quality soil typically occurs. Residential and commercial development results in the conversion of soils from their historic agricultural or open space uses and into permanent non-use.

Soils are formed by forces of the environment acting on soil material deposited or accumulated by geologic processes. The characteristics of a soil at any give location are determined by the climate in which the soils material has accumulated and has existed since accumulation; the physical and mineralogical composition of the parent material; the relief or slope of the land which influences drainage, moisture content, aeration, susceptibility to erosion, and exposure to the sun and elements; the biological forces (plants and animals) acting upon the soil material; and the length of time the climate and biological forces have had to act on the soil.

The moderate amount of rainfall in the region generally leaches out the free carbonates and much of the bases in the soils. As a result the soils of Upper Deerfield and the surrounding area are sometimes acidic. The parent material consists of marine and fluvial deposited clays, silts, sands and gravels of the Cohansey Formation. Deposits of sand form low fertility soils with little water holding capacity. Soils formed from clays are difficult to cultivate. The majority of the soils consist of mixed sand, silt and clay and so will have varying characteristics, depending on the percentage of the various particles. Upper Deerfield's topography is mostly flat to gently sloping, which along with the high permeability results in little potential for erosion (Figure 4 in Section 12.0).

Many of the soils show evidence of leaching which occurs to soils that develop beneath a pine forest. The age of most of the surface soils in the County are estimated to be 10,000 to 12,000 years old, dating from the time when the last glaciers melted.

The Natural Resource Conservation Service (NRCS) has also prepared soil mapping (SSURGO) that is available from NJDEP GIS data. SSURGO is mapped throughout the State of New Jersey. Mapping was prepared on a detailed scale that provides individual soil mapping units for Cumberland County. The soil series map (Figure 5 in Section 12) is based on the mapping provided by the NRCS. Upper Deerfield includes a total of 36 individual soil mapping units, excluding sand pits and gravel pits. The 36 mapping units occur in 16 different soil series.

Table 3

Upper Deerfield Soil Mapping Units and their Characteristics

Name	Label	Acres	% of Total Soils	Soil Status	Drainage Class /Depth to Seasonal High Water Table/ Hydric
Atson Sand, 0 to 2% slopes, rarely flooded	AtsAr	.0653	0.00%		Poorly drained, 2 inches, H
Aura sandy loam, 2 to 6% slopes	AugB	28.8457	.15%	P	Well drained 6+ feet
Aura gravely sandy loam, 2 to5 % slopes	AuhB	1897.9154	9.51%	P	Well drained, 20 inches
Berryland and Mullica Soils, 0 to 2% slopes, occasionally flooded	BEXAS	172.5090	.86%	UI	Very poorly drained 0 inches H
Chicone silt loam, 0 to 1% slopes	ChsAt	11.3746	.06%		Poorly drained, 0 inches H
Chillum silt loam, 0 to2 % slopes	ChtA	1050.4099	5.26%	P	Well drained 72+ inches
Chillum silt loam, 2 to5 % slopes	ChtB	2199.5497	11.02%	P	Well drained 72 inches
Downer loamy sand, 0 to 5% slopes	DocB	323.9848	1.62%		Well drained 6+ feet
Downer loamy sand, 5 to 10 % slopes	DocC	1006.7937	5.05%		Well drained 6+ feet
Downer sandy loam, 0 to 2 % slopes	DoeA	137.577	.69%	P	Well drained 6+ feet
Downer sandy loam, 2 to 5% slopes	DoeB	383.4354	1.92%	P	Well drained 6+ feet
Downer-Urban land complex, 0 to 5% slopes	DouB	.9476	.00%		Well drained 6+ feet
Evesboro sand, 0 to5 % slopes	EveB	33.5410	.17%		Excessively drained 6+ feet
Evesboro sand, 5 to 10% slopes	EveC	119.1330	.60%		Excessively drained 6+ feet
Evesboro sand, 10 to15% slopes	EveD	32.1634	.16%		Excessively drained 72 inches
Fallsington sandy loam, 0 to2% slopes	FamA	151.1622	.76%	SI	Poorly drained, 2 inches H
Fort Mott loamy sand, 0 to 5% slopes	FodB	180.1589	.90%		Very deep, well drained 72 inches
Hammonton loamy sand, 0 to 5% slopes	HbmB	17.8345	.09%	SI	Very deep, moderately Well drained 18 inches
Hammonton sandy loam, 0 to 2 % slopes	HboA	22.6154	.11%	P	Moderately well drained, 18 inches
Manahawkin muck 0 to 2 % slopes	MakAt	762.7291	3.82%	UI	Very poorly drained, 0 inches, H
Matapeake silt loam, 0 to 2% slopes	MbrA	938.0354	4.70%	P	Well drained, 72 inches
Matapeake silt loam, 2 to 5% slopes	MbrB	1547.5573	7.76%	P	Well drained 72 inches

Table 3 (continued)

Name	Label	Acres	% of Total Soils	Soil Status	Drainage Class /Depth to Seasonal High Water Table/ Hydric
Matapeake silt loam, 5 to 10% slopes	MbrC	317.4059	1.59%	SI	Well drained 18 inches
Mattapex silt loam, 0 to 2% slopes	MbuA	440.1811	2.21%	P	Moderately well drained 18 inches
Mattapex silt loam, 2 to 5% slopes	MbuB	329.7631	1.65%	P	Moderately well drained 18 inches
Othello silt loam, 0to 2% slopes	OthA	33.8457	.17%	SI	Poorly drained 6 inches, H
Othello and Fallsington soils, 0 to2%	OTKA	7.9332	.04%	SI	Poorly drained 2 inches, H
Pits, sand and gravel	PHG	24.7056	.12%		
Sassafras sandy loam, 0 to 2% slopes	SacA	2816.7624	14.12%	P	Well drained 6+ feet
Sassafras sandy loam, 2 to 5% slopes	SacB	1449.2317	7.26%	P	Well drained 6+ feet
Sassafras sandy loam, 5 to 10% slopes	SacC	729.5159	3.66%	SI	Well drained 6+ feet
Sassafras gravelly sandy loam, 0 to 2% slopes	SadA	332.1135	1.66%	P	Well drained 72 inches
Sassafras gravelly sandy loam, 2 to 5% slopes	SadB	1715.1907	8.6%	P	Well drained 72 inches
Sassafras gravelly sandy loam, 5 to 10% slopes	SadC	435.8692	2.18 %	SI	Well drained 72 inches
Sassafras-Urban land complex, 0 to 5% slopes	SapB	.5797	.00%		Well drained 6+ feet
Water		127.8870	.64%		
Woodstown sandy loam, 0 to2 % slopes	WoeA	121.1802	.61%		Moderately well drained 18 inches
Woodstown sandy loam, 2 to5 % slopes	WoeB	50.7470	.25%		Moderately well drained 18 inches

- P – Prime Farmland
- SI – Soil of Statewide Importance
- UI – Soil of unique importance
- H – Hydric Soil

5.2 Prime Farmland

The NRCS has identified soils based on their agricultural significance, or Land Capability Classification. The best quality soils are termed “Prime Farmlands” which are followed by “Soils of Statewide Importance.” Prime Farmlands include all those soils in Land Capability Class I and selected soils from land Capability Class II. Prime Farmlands is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops and is also available for these uses. It has the soils quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when treated and managed according to acceptable farming methods. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding. Soils of Statewide Importance include those

soils in land capability Class II and III that do not meet the criteria as Prime Farmlands, but nonetheless support agricultural production, with some limitations. These soils may be suited to certain crops or require special conservation practices to maintain their productivity. The table identifies the soil-mapping units that are considered Prime Farmland or Soils of Statewide, or unique importance, drainage class, as well as depth to the seasonal high water table and depth to bedrock.

Areas of Prime Farmland and Soils of Statewide Significance occur throughout Upper Deerfield. The major soil series that represent these high quality agricultural soils are the Sassafras (7,479 acres) a common soil primarily throughout the southern half of the Township. Aura (1,898 acres)are found primarily in the eastern portion of the Township, Downer (sandy loams from 0-5% slopes – 521 acres) found primarily within the southwestern corner of the Township, Chillum (3,250 acres), found primarily in the northern third of the Township. Fallsington (151 acres) and Hammonton (41 acres) are also found within the Township. Prime Farmland soils occupy an estimated 76% or approximately 15,163 acres of Upper Deerfield Township. The soils that are identified as Prime Farmland and Soils of Statewide Significance represent areas that are most suitable for retention as agricultural lands. The preservation of high quality agricultural soils is generally considered vital to keeping an agricultural identity within a municipality or region.

5.3 Hydric Soils

Hydric soils are found in small amounts in Upper Deerfield and are primarily associated with the wetlands along creek corridors and surface waters (see Figure 5 in section 12). Hydric soils are the soils that typically characterize the soil substrate found in wetlands. They are soils that are poorly to very poorly drained and that have a water table at or near the ground surface during the growing season; or, are soils that are frequently ponded or flooded for a long duration or very long duration during the growing season. The major hydric soil series in Upper Deerfield are identified as Manahawkin muck (763 acres), Othello/Fallsington soils (193 acres), Berryland and Mullica (173 acres). These soils occupy about 5.7% or approximately 1,140 acres of Upper Deerfield Township.

Upper Deerfield's Major Soil Series are provided here with a brief description:

SASSAFRAS

Approximately 7,479 acres of soils in the Sassafras series are mapped in Upper Deerfield. The Sassafras Series consist of well-drained, extremely to strongly acidic soils that that are typically found in upland environments. Parent materials consist of sandy marine and old alluvial sediments. The Sassafras soil typically has a brownish surface layer 9 inches thick. Depth to the bedrock is greater than 60 inches. Organic matter is generally low with an average clay content of about 21%. These soils tend to have a fine-loamy texture. Associated vegetation is typically mixed upland hardwoods, with some pines. Agricultural uses are for general crops, truck crops, pastures and fruits. These soils generally have a Capability Class of II and III.

CHILLUM

Approximately 3,249 acres of soils in the Chillum series are mapped in Upper Deerfield. Chillum soils are typically found in dissected uplands. The Chillum Series consist of well-drained, extremely to strongly acidic soils that develop in eloian material underlain by loamy

marine sediments. These soils typically have a thin (1 inch) dark grayish brown silt loam layer. Followed by an 8 inch E horizon of brown silt loam. Depth to bedrock is greater than 60 inches. Permeability is moderate in the subsoil and slow to moderate in the underlying material. These soils tend to be loam, silt loam or silty clay loam to 40 inches. Wooded areas associated with Chillum are oak dominant mixed hardwoods, with some pine stands. Cultivated areas are used for corn, soybeans, small grains, pasture or hay. Some chillum soils are often used for urban development.

MATAPEAKE

Approximately 2,803 acres of soils in the Matapeake series are mapped in Upper Deerfield. The Matapeake series consist of well-drained, very deep soils that are extremely to strongly acidic. These soils are found in upland interfluves and side slopes. Parent materials are eolian sediments underlain by coarser fluvial and marine sediments. The surface A horizon tends to be a 5 inch grayish brown layer followed by an E horizon of a light yellowish brown to 11 inches. Depth to bedrock is greater than 72 inches. These soils have low organic mater content and are generally loam, silty loam or fine sandy loam. Oaks are the dominant vegetation associated with Matapeake soils. Almost all areas are cultivated and corn, soybeans and small grains are commonly grown.

AURA

Approximately 1,927 acres of soils in the Aura series are mapped in Upper Deerfield. Aura soils are found on hilltops and divides at higher elevations. The Aura Series consist of well-drained soils that developed in thick beds of sand and gravel. A typical Aura soil has a yellowish-brown surface layer about 17 inches thick. Below a depth of about 26 inches is a layer of firm sandy clay loam that restricts penetration of roots. The content of organic matter is usually moderate to low, natural fertility is moderate and the soils are acidic. Water holding capacity ranges from moderately low to moderate, depending on the texture of the surface soil. As these soils dry out, they tend to harden. The native vegetation is trees, mostly oaks, while idle fields will become covered with pines, if a seed source is present nearby. Associated with agricultural activity; crops are typically fruits or vegetables. Some of these soils have potential for erosion and drought.

DOWNER

A total of 1,852 acres of soils in the Downer series are mapped in Upper Deerfield Township. Downer soils are typically found on lower slopes in the landscape. They consist of nearly level, deep, well-drained soils that formed on deposits of sand and gravel that contain small amounts of silt and clay. A typical cultivated Downer soil has brownish-yellow loamy sand about 19 inches thick over a similar thickness of yellowish-brown sandy loam. In a natural condition, these soils have a water table that rises to within about 2 feet of the surface in the late fall through the early spring. The organic matter content is low to moderate, fertility is low, and the soils are acidic. Water holding capacity is low to moderately low. The natural vegetation is usually oak but may contain pine. Sassafras and pine usually colonize abandoned fields. Downer soils are suitable for most crops although high value crops will require irrigation. Wind erosion and sandblasting of crops are serious problems in places where Downer soils are cultivated or left bare. Capability Class units are II and III, with limitations due to the potential for erosion and drought.

5.4 Steep Slopes

Upper Deerfield's relatively flat to gently sloping topography is typical of the Outer Coastal Plain physiographic region. The highest elevation of around 145 feet above sea level is found near the northern end of the Township near Grier's Lane. Altitudes generally decrease to the west near the Cohansey River and south. The lowest elevations, under 40 feet, are found at the southern portion of the municipality near Sunset Lake (Section 12, Figure 6).

"Steep" slopes, or those slopes of 10% or greater, do exist at locations adjacent to the northern end of Sunset Lake. NJDEP mapping shows that much of the municipality has slopes ranging between 0-2% and 2-5%. A number of areas primarily west of NJ Route 77 in the Township have slopes between 5-10%. Small areas north of Cornwell Run and north of CR 705 contain areas with slopes in excess of 10%. Tributaries including the Foster, Parsonage and Cornwell Runs have slopes typically have slopes between 5 and 10% (Section 12, Figure 6).

In general, development of slopes is not recommended due to the increased risk of erosion, stormwater runoff and flooding potential. The additional runoff results in sedimentation of down slope surface waters, which damages habitat and has the potential to damage property. The sloping land increases the rate of runoff, which reduces the rate of groundwater infiltration. This is exacerbated when vegetation is unnecessarily stripped from the slope.

5.5 Soil Erosion and Sediment Control

The NJDEP Soil Erosion and Sediment Control Act (N.J.S.A. 4-24-42 et seq.), requires that a Soil Erosion and Sediment Control Plan be prepared for any clearing or disturbance of 5000 square feet or more. The plan must be prepared in accordance with the Standards for Soil Erosion and Sediment Control in N.J.A.C 2:90. Soil disturbance of one acre or more during construction also requires a New Jersey Pollutant Discharge Elimination System (NJPDES) permit, which is also obtained from the SCD. The SCD monitors compliance with the SESC plan during construction. Information about SCEC planning for projects and applying Best Management Practices (BMPs) for agricultural purposes can be obtained from the Cumberland County-Salem Conservation District at (856) 451 - 2422.

6.0 WATER RESOURCES

6.1 Drainage Basins and Major Surface Water Features

The Cohansey River is within the NJDEP "Watershed Management Area #17", referred to as the Delaware Bay Drainage area. The principal rivers within the Delaware Bay Drainage Area are the Maurice, Salem, and Cohansey. Upper Deerfield is situated primarily within the Cohansey and Maurice Drainages. The Cohansey River is approximately 30 miles long, beginning in Salem County north of Upper Deerfield and flowing south to the Delaware Bay. There are approximately 20 large impoundments directly along the river including three major lakes in Upper Deerfield: Sunset Lake, Seeley Lake, and Bostwick Lake. The relatively flat topography of the Cohansey Drainage area results in the numerous tributaries found throughout the western half of Upper Deerfield. The Cohansey and adjacent corridor habitats support both State and Federal endangered and threatened species such as the bald eagle. The Cohansey River becomes tidal south of Bridgeton. Surface waters associated with the Cohansey are listed as Freshwater non-trout FW-NT and freshwater non-trout with a saline interface FW2-NT/SE 1.

Although the Maurice River does not flow through Upper Deerfield, several tributaries of the river, including Muddy Run and Thundergust Brook, begin in Upper Deerfield. Headwaters of the Maurice River begin near Glassboro in Gloucester County. From Willow Grove Lake northeast of Upper Deerfield in Salem County, the river meanders in a southerly direction for approximately 50 miles, discharging directly to the Delaware Bay. As a result of its significant natural resources, the Maurice River is recognized as a "Wild and Scenic River" by the National Park Service. The watershed provides some of the most important habitat in New Jersey for bald eagle. Numerous threatened and endangered species find their homes along its banks, bluffs and riparian habitats. The globally endangered sensitive joint vetch is found within intertidal waters. The head of tide, which is the inland extent of the tidal influence, is located at Union Lake near Millville, where the river is dammed. The surface waters within the Maurice are currently listed as Freshwater non-trout with a saline interface FW2-NT/SE1 (see Section 12, Figure 8).

A watershed is classified as all the land that drains to a particular waterway. The extent of the watershed is defined by the topography, hills, slopes, ridges and divides. Large watersheds are comprised of smaller subwatersheds. These can be further subdivided into even smaller watersheds, much like the branches of a tree, all eventually leading to the main stem. Watersheds represent unique natural systems where soil, plants, and animals interact. The US Geological Survey has mapped and identified watersheds using a hierarchical numbering system. Each watershed or "hydrologic unit" is identified by a unique hydrologic unit code (HUC) consisting of up to 14 digits, for the smallest mapped watersheds. There are 921 HUC-14 subwatersheds in New Jersey, ranging in size from 0.1 to 42 square miles, with an average size of 8.5 square miles. There are 150 HUC -11 watersheds ranging in size from 0.1 to 143 square miles, with an average size of 51.9 square miles (see Section 12, Figures 7 and 9).

Four HUC-11 watersheds are identified in Upper Deerfield. These are identified as the Cohansey River (above Sunset Lake), Cohansey River (below Cornwell Run), Muddy Run, and Maurice River (Union Lake to Sherman Ave). Table 4 below provides the acreage of each of these watersheds and the subwatersheds that comprise the larger systems. The majority of Upper Deerfield is contained within Cohansey River HUC-11 watersheds. The Clark Branch, Stone

Bridge Run, Parsonage Run, Foster Run, Loper Run and Cornwell Run each drain to the Cohansey (above Sunset Lake) and drain approximately 60 % of Upper Deerfield. There are two small unnamed runs within Upper Deerfield that feed the Cohansey River, one that converges with the Cohansey near CR 540 and a second that that meets the Cohansey halfway between CR 540 and CR 689. Jackson Run and tributaries of the Indian Fields Branch drain into the Cohansey into the HUC-11 (below Cornwell Run) and drain about 14 % of Upper Deerfield.

Other HUC–11s in Upper Deerfield are associated with the Maurice River. These include the Muddy Run HUC-11, which consists of the headwaters of Muddy Run itself, Thorne Branch, Thundergust Brook, and an unnamed tributary that starts south of CR 540, west of Burlington Road, and flows east to Centerdon Lake. This HUC-11 drains approximately 18 % of Upper Deerfield.

Headwaters of the Lebanon Branch are found in Upper Deerfield as part of the Maurice River HUC–11 Watershed (Union Lake to Sherman Ave.). This HUC-11 covers approximately 8 % of Upper Deerfield Township. The locations of these features are illustrated on the Watersheds Map (Figure 7 in Section 12) and the Surface Water Resources maps (Figure 8 in Section 12).

Table 4

Upper Deerfield Township Watersheds/Subwatersheds

Watershed Name	*USGS Watershed HUC-11 Code*	*Surface Water Classification*	*HUC-14 Subwatershed Name*	*HUC-14 Subwatershed Ac.*	*USGS Subwatershed HUC-14 Code*
Cohansey River (above Sunset Lake)	02040206080	FW2 – NT C2	Cohansey River (above Beals Mill)	1,349.6	02040206080010
			Cohansey River (inc. Hands Pond to Beals Mill)	3,169.81	02040206080020
			Parsonage Run/Foster Run	3,720.10	0204020608030
			Cohansey River (inc. Beebe Run to Hands Pond)	560.35	02040206080040
			Cohansey River (inc. Cornwell Run –Beebe Run)	3,140.13	02040206080050
Cohansey River (below Cornwell Run)	02040206090	FW2 – NT C2	Indian Fields Branch/Jackson Run	2,186.79	02040206090020
			Cohansey River Rocaps Run to Cornwell Run	635.35	02040206090030
Maurice Rriver (Union Lake to Sherman Avenue)	02040206160	FW2 –NT C1/C2	Lebanon Branch Mill Creek	1,694.43	0204020616010
Muddy Run	02040206150	FW2–NT C1/C2	Indian Run (Muddy Run)	1,321.18	02040206150040
			Muddy Run (incl. Parvin Lake to Palatine Lake)	1,328.72	02040206150050
			Muddy Run (Landis Ave. to Parvin Lake)	934.85	02040206150060

Upper Deerfield contains of several major lakes, three of which are impoundments along the Cohansey River. Bostwick Lake is located at the northern most stretch of the Cohansey River where it merges with Clark Branch (a second branch parallels CR 730) in Upper Deerfield. Bostwick Lake is currently dry due to a rupture in the lake's dam and is expected to be repaired in the future. Seeley Lake is just below the convergence of Harrow Run and the Cohansey River. Sunset Lake is at near the southerly most portion of Upper Deerfield just below Cornwell Run. Another major impoundment is Silver Lake, located off of CR 704 along Loper Run, just east of the Cohansey River. These major surface waters comprise about 200 acres in Upper Deerfield.

6.2 Surface Water Quality Classification

In New Jersey, it is the policy of the State to restore, maintain, and enhance the chemical, physical, and biological integrity of its waters, to protect the public health, to safeguard aquatic biota, protect scenic and ecological values and to enhance the domestic, municipal, recreational, industrial, agricultural and other reasonable uses of the State's waters. Water quality is evaluated with respect to Surface Water Quality Standards (SWQS) and water quality concerns occur when SWQS are not met or are threatened. New Jersey's Surface Water Quality standards (NJAC 7:9B, et seq.) establish the water quality goals and policies underlying the management of the State's water quality.

All of the surface water bodies that are located in Upper Deerfield Township are classified as either freshwater non -trout (FW2-NT) or as freshwater non-trout with a saline interface (FW2-NT/SE1) The saline interface refers to most of the Cohansey River and its tributaries. The major impoundments along the Cohansey River are considered freshwater non-trout. Non-Trout waters are not associated with trout production or trout maintenance and are generally unsuitable for trout because of their physical, chemical, or biological attributes. In spite of this designation, the Division of Fish and Wildlife's Bureau of Freshwater Fisheries has stocked trout in the Cohansey River (NJBFWF, 2005). These waters are suitable for wide variety of warmwater fish species.

<u>The designated use for FW2-NT waters are identified as:</u>

- Maintenance, migration and propagation of the natural and established biota;
- Primary and secondary contact recreation;
- Industrial and agricultural water supply;
- Public potable water supply after conventional filtration, treatment and disinfection; and,
- Any other reasonable uses.

<u>The designated use for FW2-NT/SE1 waters are identified as:</u>

- Shellfish harvesting in accordance with NJAC7:12*
- Maintenance, migration and propagation of the natural and established biota;
- Primary and secondary contact recreation;
- Any other reasonable uses.

*Shellfish harvesting may not be applicable in all FW2-NT/SE 1 waters

Category 1 and 2 waters

In addition to the standard water quality classifications, waters are also classified as either Category 1 or Category 2 waters. Category 1 waters are those waters designated for additional protection due to their "color, clarity, scenic setting other aesthetic value, exceptional ecological significance, recreational significance, water supply significance or fisheries resources." All other waters are considered Category 2 waters. Under the NJ Stormwater Management Rules (N.J.A.C. 7:8) Category 1 waters are afforded a designated special waters resource protection area (SWRPA). The SWRPA areas are those areas within 300 feet of the top of each bank of C1 waters. In addition, the 300-foot width SWRPA is required adjacent to those waters that drain to C1 waters within the limits of the associated (HUC-14) subwatershed (see Figure 9 of Section 12). The SWRPA is intended as a buffer between development and these special waters in order to further protect water quality. The 300-foot width buffer is based on an NJDEP review of existing scientific literature. Existing development within the SWRPA is not regulated. Consequently, maintenance of existing features, such as tree pruning, cultivation and mowing are also not regulated. However, new construction or expansion of existing facilities that would disturb up to one acre of land or create one-quarter acre of new impervious surfaces is considered major development and would be regulated under the NJDEP Stormwater Management Rules (N.J.A.C. 7:8).

Portions of the Maurice River and tributaries outside of Upper Deerfield, including areas within the Union Lake Wildlife Management Area have been given a C1 classification. In addition, portions of Muddy Run and Thundergust Brook within state parks or WMAs have been given a C1 classification. In addition, Parvin Lake and Thundergust Lake are listed as C1. Although it contains considerable areas of Endangered and Threatened Species Habitat, the entire length of Cohansey River and tributaries are currently considered Category Two (C2) waters. However multiple environmental organizations have petitioned the NJDEP to consider giving the entire length of the Maurice and Cohansey Rivers a Category One (C1) classification based primarily on the presence of threatened and endangered species.

6.3 Surface Water Quality

The surface water quality for rivers and creeks of has been evaluated in Cumberland County using various methods; in particular, the NJDEP uses a protocol termed Ambient Biological Monitoring Network (AMNET) for rapidly assessing water quality. In addition, under the Federal Clean Water Act Section 303 (d), states are required to list the status of their streams. The 303(d) list is generated using the AMNET and other stream monitoring data such as that generated by the NJDEP Clean Lakes Program, NJDEP Shellfish Monitoring Program, Fish Tissue Monitoring and NJDEP/USGS chemical and physical water quality monitoring.

6.3.1 Ambient Biological Monitoring Network (AMNET)

In order to determine the health of the streams that comprise the watersheds, the NJDEP performs monitoring of benthic macroinvertebrate populations using the Environmental Protection Agencies Rapid Bioassessment Protocols – Level II procedure. Using this method, aquatic communities are examined for pollution tolerant and intolerant life forms and the results are used to compute a New Jersey Impairment Score and Biological Condition. Higher quality

sites tend to have a greater diversity of healthy non-deformed species. The program is termed the Ambient Biological Monitoring Network (AMNET). In New Jersey, over 800 locations are sampled on a five-year rotating schedule. Sampling stations near Upper Deerfield are included in the table below.

Biological impairment of streams may be caused by several major factors including non-point source pollution; point source pollution and a lack of stream corridor (riparian) buffers. Of 74 test sites in the WMA 17 (Delaware Bay tributaries), 19 are non-impaired, 49 are moderately impaired and 6 are severely impaired.

Table 5
Biological Condition of Streams in (or near) Upper Deerfield Township

Stream Name	Location	AMNET Station	Biological Condition	Location Notes
Cohansey	Beal Road	AN0709	Moderate	Alloway
Cohansey	CR 540	AN0710	Moderate	Upper Deerfield
Parsonage Run	Finley Road	AN0711	Severe	Upper Deerfield
Cohansey	Silver Lake Road	AN0712	Moderate	Upper Deerfield

6.3.2 Federal Clean Water Act Section 303 (d)

Under the Federal *Clean Water Act* Section 303(d), each State is required to list impaired waterbodies. New Jersey uses chemical and biological stream monitoring to determine these impaired waters. Waterbodies cannot be removed from the 303(d) list until the water quality standards are met. A review of the 303(d) listings finds that the following water bodies in or bordering Upper Deerfield are included:

Table 6
2004 Impaired Waters Listed on the 303(d) List for Upper Deerfield Township

Water	Station Name	Parameters Tested	Status
Cohansey River	@ Rt. 540	Aquatic Life	Not attaining
Cohansey River	@ Seeley	Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Silver, Thorium, Zinc	Insufficient Data
Cohansey River	@ Seeley	Fecal Colliform, Temperature, Dissolved Oxygen, Nitrate, dissolved Solids, Unionized Ammonia	Attaining
Cohansey River	@ Seeley	Phosphorus, pH, Lead	Not Attaining

(Table 6 continued)

Water	Station Name	Parameters Tested	Status
Cohansey River	@ Silver Lake Rd.	Aquatic Life	Not Attaining
Sunset Lake-17	Sunset Lake	Aquatic Life	Attaining
Sunset Lake-17	Sunset Lake Sunset Lake Bathing Beach	Nutrients, Sedimentation (Eutrophic) Fecal Coliform, Fish-Mercury	Not Attaining
Parsonage Run	@ Finley Rd.	Aquatic Life	Not Attaining

Source: http://www.state.nj.us/dep/wmm/sgwqt/wat/integratedlist/2004intlist1-5.xls

The water bodies listed on the 303(d) list in, or bordering Upper Deerfield fail to attain the water quality standards and to support all designated uses. The Cohansey River at Seeley is not attaining for phosphorus, pH, lead, and aquatic life. The station is monitored under NJDEP/USGS. Sunset Lake is also non-attaining for fecal coliform and fish-mercury. Sunset Lake is monitored under the NJDEP Clean Lakes Program, Cumberland County Health Department, NJDEP Freshwater Fisheries and Fish Tissue Monitoring. Sunset Lake was determined to have eutrophic conditions in 1998. Eutrophic lakes have excessive vegetative growth, which is due to high nitrates or phosphorus, likely from non-point source inputs, such as adjacent agricultural land uses. During summer months the vegetation dies and consumes oxygen as it decays. This often creates odors and can be harmful to the fish and aquatic organisms that inhabit the waterbody. Reduction of adjacent impervious surfaces and fertilizers, and improving the quality of vegetated buffers around surface water bodies may improve eutrophic conditions in waterbodies.

6.3.3 Non-Point Source Pollution

The major source of stream pollution in Upper Deerfield is the result of stormwater runoff and other non-point sources. These sources of pollution are somewhat difficult to identify since they do not discharge directly from a pipe, or a "point source." The major form of non-point source pollution is from stormwater that runs off of developed, impervious surfaces and from agricultural areas that are subject to erosion. Non-point source stormwater runoff affects the quantity and quality of the receiving waters. The increase in quantity causes downstream areas to peak faster and higher than under natural or predevelopment conditions. This results in downstream flooding and erosion problems. When water runs quickly over the land surface or is directed via a pipe to a stream, the opportunity for the water to infiltrate and recharge groundwater is lost. Groundwater supplies the stream base flow for many streams. Reduced stream base flows can negatively impact the hydrology of adjacent wetlands. The reduced base flow and increased peak flows cause streams to erode at a faster than normal rate which introduces excess sediment. The increased sedimentation fills channels and causes streams to broaden and become increasingly shallow. Sediment is the most common and easily recognized of the non-point source pollutants. Cropland erosion accounts for about 38% of the approximately 1.5 billion tons of sediment that reach the nations' waters each year. In addition

to increased runoff, developed areas also accumulate pollutants on the land surface from atmospheric deposition. These pollutants are mobilized and transported to streams during storm events. The most common pollutants associated with stormwater include solid waste/floatables; sediment; nutrients; pesticides; metals; road salts; petroleum hydrocarbons and pathogens. Stormwater that runs off of pavement or is stored in detention basins is also often heated, which raises the temperature of the receiving waters. The consequences of non-point source pollution result in significant stream and habitat degradation.

6.3.4 Point Source Pollution

Point source pollution comes from a defined "point" in the landscape such as an industrial or stormwater discharge pipe. Point source discharges to surface and ground water are regulated by the NJDEP under the New Jersey Pollution Discharge Elimination System (NJPDES). Much of this program was created under the Federal Clean Water Act (1972). To accomplish the goals of the program, permits are issued that limit the mass and or concentration of pollutants, which may be discharged into the ground or surface water. These types of permits often require monitoring and include maintenance and best management practices to ensure that they are functioning properly. The types of permitted facilities range from campgrounds, schools and shopping centers to large industrial and municipal wastewater facilities. Recent discharge permits issued in Upper Deerfield are listed in Table 7. Municipal locations and information regarding the NJDEP Active Permit List can be obtained at http://datamine.state.nj.us/dep/DEP_OPRA.

Table 7
Recent NJPDES Permitted Facilities within Upper Deerfield Township

NJPDES ID	Facility Name	Last Check	Type of Discharge
NJ0033006.001A	Seabrook Brothers& Sons	4/2/03	Surface water
NJ0062731.002A	Clement Pappas Co, Inc.	4/2/03	Surface water
NJ0062731.003A	Clement Pappas Co, Inc.	8/16/01	Surface water
NJ0062731.004A	Clement Pappas Co, Inc.	8/16/01	Surface water
NJ0062731.005A	Clement Pappas Co, Inc.	8/16/01	Surface water
NJ0087602.G01G	Seabrook Brothers & Sons	1/9/02	Ground water
NJ0087602.K01K	Seabrook Brothers &Sons	1/9/02	Ground water

6.4 Surface Water Quality Protection

6.4.1 Riparian Corridors

Riparian corridors are natural areas along river systems that typically connect larger patches of habitat and provide the stream or river with a buffer to disturbance. The riparian corridors in which streams and rivers are located serve many functions in protecting these sensitive resources. They are complex ecosystems that provide food and shade and are effective in removing excess nutrients and sediment from surface runoff and shallow groundwater. Streamside vegetation also buffers the impacts of some pesticides and provides dissolved and particulate organic food needed to maintain high biological productivity and diversity. Streamside forests improve water quality and biological diversity by filtering out sediments and suspended solids; transforming excess nitrogen and phosphorus; storing nutrients for extended periods; and provide energy to the stream in the form of dissolved carbon compounds and

particulate organic detritus (dead plant matter). This detritus forms the basis for the aquatic food chain. In New Jersey, deforestation associated with agriculture and urban and residential development has drastically reduced the extent of stream corridor protected by forest.

Because of the extreme importance of riparian corridors to the recruitment and movement of wildlife and the quality of surface water, efforts to protect and preserve stream corridors should be a priority for any land acquisition projects and when reviewing development proposals. The width of the preserved buffer along stream corridors can vary, depending on soil permeability and slopes. Areas with flatter slopes and with soils having a greater proportion of sand would not require a buffer as wide as areas with steeper slopes and soils containing less sand. Effective corridors should typically be 100 feet or wider (Welsch, 1991). A 300 foot width riparian corridor, or special water resource protection area, has recently been adopted by the NJDEP to protect all Category I (CI) waters in New Jersey (N.J.A.C. 7:8). In addition to providing water quality protection, a 300-foot width buffer will provide significantly greater benefits to aquatic biota and other wildlife than would a narrower corridor.

The NJDEP's Division of Fish and Wildlife's Draft Wildlife Action Plan (August 2005) identifies designated Conservation Zones, assesses the resources of that Zone, and develops conservation goals and actions to best protect wildlife. The report states that the Western Cumberland County Zone, which includes the Cohansey River and its associated wetland and grassland habitats, has the least amount of public land in the Delaware Bay Region (1.5 square miles). The Plan states the need to protect the riparian corridors of the Cohansey River. Among the stated conservation actions, is a plan to identify and map significant natural vegetative communities, particularly on public lands and lands that serve as wildlife corridors; and work with landowners, planners, and government organizations to acquire critical riparian habitats. This may be accomplished by direct purchase, easements, and enlisting private lands in preservation programs that limit human disturbance during certain periods of the year. To protect stream corridor buffers, Upper Deerfield may consider an ordinance can be enacted to limit the removal of vegetation, construction activities, soil disturbance, and the installation of impervious surfaces as well as limit the use of pesticides and other chemicals, including lawn fertilizers, within floodplains and in the vicinity of streams. Native vegetation can be planted within riparian corridors that have historically been agricultural land in an effort to enhance buffer effectiveness.

Restoration of stream buffers on agricultural lands is supported by various programs administered by the New Jersey Division of the USDA Natural Resource Conservation Service (NRCS). The NRCS provides technical assistance through various programs, primarily the Conservation Technical Assistance Program (CTA). The CTA typically results in the development of a Conservation Plan for a farm that directs the landowner to available programs, such as the Farm Bill Program. A number of Farm Bill programs provide for conservation practices such as the Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Wetland Reserve Program (WRP), Conservation Reserve Program (CRP), Farm and Ranch Land Protection Program (FRPP) and the Grassland Reserve Program (GRP). These programs offer cost sharing opportunities for implementing conservation practices. The CRP is especially applicable to riparian buffer conservation. This program

compensates farmland owners for the loss of land being converted to protect stream corridors and also provides funding to perform the actual restoration of the buffers.

6.4.2 Flood Hazard Area Control Act Rules

Under the NJDEP *Flood Hazard Area Control Act Rules* (N.J.A.C. 7:7), the NJDEP regulates development within the vicinity of stream corridors and within floodplains. However, under this regulation, the protection of vegetation only extends for a distance of 25 feet from the top of bank along non-trout production streams. Trout production streams are allowed a 50 foot buffer from the top or the bank, however these streams do not occur in Upper Deerfield. A corridor of this width may provide some limited stream corridor functions, such as shade and bank stabilization, but will provide little in the way of filtering sediment or pollutants or the uptake of nutrients. Further protection for these resources can be provided by enacting local ordinances that provide more stringent requirements than those enforced by NJDEP. The greater the width of the buffer, the more effective will be the functions provided for protection of the stream corridor.

6.4.3 Stormwater Management Rules

New Jersey has adopted two sets of rules that affect stormwater management in New Jersey. The first set of rules are the Phase II New Jersey Pollutant Discharge Elimination System (NJPDES) Stormwater Regulation Program Rule (N.J.A.C. 7:14A-1 *et seq.*). These rules address pollutants associated with existing stormwater runoff, as required under the Federal Clean Water Act. These rules govern the issuance of permits to certain public entities, including municipalities, which own or operate small municipal storm sewer systems (MS4s). The permit program establishes the Statewide Basic Requirements that must be implemented to reduce non-point source pollutant loads from these sources. The Statewide requirements include measures such as: The adoption of ordinances (litter control, pet waste, wildlife feeding, proper waste disposal, etc.,); the development of a municipal stormwater management plan and implementing ordinances; requiring certain maintenance activities (such as street sweeping and catch basin cleaning); implementing solids and floatables controls; locating discharge points and stenciling catch basins; and a public education component.

The second set of rules are the Stormwater Management Rules (N.J.A.C. 7:8-1 *et seq.*), which apply to stormwater systems associated with new (proposed) development. The design and performance standards established in these rules have replaced the stormwater management rules that apply to residential development under the Residential Site Improvement Standards (RSIS), and include residential subdivisions, site plan and building permit approvals. For non-residential development, the Stormwater Management Rules will not be applied at a local level until a municipal ordinance is passed adopting the standards. However, if the non-residential development requires one of the Land Use Regulation Program permits listed at N.J.A.C. 7:8-1.6(c), the new rules will be applied under that review.

The Stormwater Management Rules apply to new development that will ultimately result in the disturbance of one or more acres of land, or in an increase in impervious surface by one-quarter of an acre or more (*i.e.*, "major development").

6.4.4 Public Participation

It is important to educate the public on the value of protecting the town's stream corridors. This can be done by involving the public in projects such as a stream monitoring program, implementing stream cleanup projects, and riparian planting projects in order to improving the condition of the stream corridor. Stream walks can be organized to involve the citizens in observing the stream and floodplains, and also to identify any potential problem areas (*i.e.*, erosion, illegal dumping, unauthorized stormwater discharges, etc.). Schoolteachers, particularly those with backgrounds in botany, ecology or aquatic biology, could incorporate a water chemistry/stream biology section into their curriculum, and plan field trips to local parks where waterways can easily be observed.

6.5 Floodplains

Activities in floodplains are regulated by the NJDEP under the *NJ Flood Hazard Area Control Act* (N.J.S.A. 58:16A-50 et seq.).

A floodplain is defined in N.J.A.C. 7:13-1.1 et seq. as the area inundated by the regulatory flood including the watercourse that creates it. For regulatory purposes, the floodplain is calculated as the area inundated by the 100-year storm, plus 25% flow in order to account for the affects of future development in the watershed. The floodplain area includes both the floodway and flood fringe. The floodway is the channel and portions of the floodplain adjoining the channel, which are reasonably required to carry and discharge the regulatory flood. The floodway is subject to high velocity flows during flooding events. The flood fringe is the portion of the flood plain contiguous with the floodway. The flood fringe experiences flooding, but is inundated to a lesser degree than the floodway. Delineated floodplains have been established and officially adopted by the State of New Jersey. Flood profiles, mapping and corresponding computer models for delineated watercourses may be obtained from the NJDEP.

The Flood Insurance Program, administered by the US Flood Emergency Management Agency (FEMA) has also prepared mapping and classifies flood plain areas in a manner similar to the State of New Jersey. The mapping is determined by looking at various factors including topography, water volume, and fold capacity. Their mapping may be utilized if it can be demonstrated that the mapping reflects full development of the drainage area. The Floodplains Map provided as Figure 10 in Section 12 depicts the approximate extent of floodplains throughout Upper Deerfield Township. This mapping was derived from digital coverage provided by FEMA. The widest mapped FEMA floodplains in Upper Deerfield extend along the Cohansey River and its tributaries from Harrow Run to above Sunset Lake. Floodplains extend over 850 feet from the Cohansey River just south of Seeley Lake.

Because of the scale of the FEMA Q3 digital flood data, is not designed to make precise flood risk determinations, but rather is designed to be used as general guidance of the proximity of Special Flood Hazard Areas. Some areas within Upper Deerfield may be prone to flooding may not be identified on the FEMA mapping. Furthermore, FEMA recommends a 250 buffer be applied outside of the floodplain boundary line. Users should refer to official FEMA hardcopy maps if a site in question falls within a buffer. For more information on FEMA floodplain mapping visit the FEMA website at http://www.fema.gov/fhm/fq_q3.shtm.

Certain types of activities in floodplains must be authorized by a stream encroachment permit issued by NJDEP in accordance with the *NJ Flood Hazard Area Control Act* (FHACA) Rules. By regulating and limiting development in the flood hazard area, not only is the floodplain protected as a resource, but potential property loss is minimized as well. Filling and development of floodplains removes the capacity of the floodplain to provide flood storage benefits, which increases the likelihood of increased upstream and downstream flooding. Vegetated floodplains reduce the velocity of stormwater, thereby reducing erosion and increasing flood storage. Floodplains also provide habitat and travel corridors for wildlife.

The FHACA rules currently provide for stream buffers of 25 or 50 feet from the top of bank, depending on several factors. The 50 foot buffers are intended for waters that are designated as Trout Maintenance (FW2-TM) or Trout Production (TP); areas where acid-producing soils are present; and areas where endangered and threatened species are known to, or historically have been known to utilize habitat. Upper Deerfield's surface waters are non-trout and acid producing soils are not mapped and most likely do not occur within the Township. They are found to the west of Upper Deerfield in Salem County and along the Inner Coastal Plain geologic formations of central New Jersey. For any floodplains that may be associated with the habitat of threatened and endangered species within the Township, the NJDEP would impose a 50-foot buffer. Within this buffer area, NJDEP requires that vegetation not be disturbed unless it is demonstrated that there is no alternative when constructing a project. Any Major Development that requires a Stream Encroachment Permit is also subject to the Stormwater Management Rules at N.J.A.C. 7:8, which require a stream buffer, or Special Resource Protection Area, of 300 feet adjacent to Category 1 waters (see discussion in water resources).

Municipal Flood Hazard Area regulations are outlined in the Zoning and Development Codes for Upper Deerfield Chapter 98, Article VII, 98-19.

7.0 WETLANDS

7.1 Definition and Identifying Factors

The NJDEP regulates activities in wetlands and their adjacent transition areas under the *New Jersey Freshwater Wetlands Protection Act* (NJSA 13:9A-1 et seq.), which defines a wetland as:

> "An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation."

In other words, a wetland is an area with a specific hydrologic regime that supports the growth of plants adapted to living in saturated soil conditions. Wetlands serve many important functions. They minimize flooding by absorbing water during storm events and releasing it slowly over time. They improve water quality by filtering sediments and adsorbing nutrients and pollutants and reducing them to their elemental forms. Wetlands provide habitat for many species of wildlife including Federal and State-listed endangered and/or threatened species.

Many types of wetlands, particularly the boundaries of wetlands are not always readily identified through simple observation, as wetland vegetative communities and hydrological characteristics may be, at times, difficult to distinguish from upland features. In order to accurately define and delineate wetlands, a methodology was developed by the Federal Interagency Committee for Wetland Delineation (FICWD) and is presented in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (FICWD 1989). NJDEP has adopted this manual as the technical basis for identifying and delineating freshwater wetlands in New Jersey. The location and extent of wetlands is established using a three-parameter approach: 1) dominance of hydrophytic vegetation, 2) presence of hydric soils, and 3) evidence of long-term wetland hydrology.

7.2 Wetland Locations

The general distribution of freshwater wetlands in Upper Deerfield is depicted on the Wetlands Map (Figure 11 in Section 12.0). The mapped wetlands are based on photo interpretation of 1986 color infrared aerial photos which were integrated with other sources (hydric soils, USGS floodprone areas and 1906 atlas sheet geology) based on coincident features. The extent of wetlands as depicted are intended to be used as a general planning tool. **The specific location, extent and resource value classification of wetlands is subject to case-by-case detailed field delineations, surveys and analysis**. The presence, absence, extent and resource value classification of wetlands are subject to verification by the NJDEP Land Use Regulation Program through the Letter of Interpretation application process.

According to the NJDEP wetlands mapping, the Township's wetlands are often narrow and linear; and primarily follow the major stream corridors that traverse Upper Deerfield. The most expansive wetlands are associated with the Cohansey River corridor. Large wetland communities are also mapped along the Foster and Parsonage Runs. These areas generally correspond with "low development capability" defined in the Development Capability Map of the Upper Deerfield Master Plan, 1988. Wetlands are also found supported by the major hydric soils identified as Manahawkin (primarily along the Cohansey and along the Parsonage and Foster Runs), Berryland/Mullica (portions of the Cohansey and along the Loper and Cornwell Runs).

While the Township may not adopt ordinances specifically regulating activities in wetlands and wetland transition areas, the Township may adopt an ordinance requiring that an applicant for subdivision, site plan or building permit approval obtain a Letter of Interpretation (LOI) from NJDEP establishing the limit of wetlands and wetlands transition areas on a property.

7.3 Wetland Resource Value Classification

The Freshwater Wetlands Protection Act classifies wetlands according to resource value. Each wetland resource value classification has a corresponding transition area, or upland buffer, that must be maintained between the wetland and adjacent development to protect the integrity and viability of the wetland ecosystem. There are three different resource value classifications; exceptional, ordinary and intermediate; and as described below:

> *Exceptional resource value wetlands* are the highest quality wetlands and require a 150-foot standard transition area. Exceptional resource value wetlands are those

that drain to FW-1 waters, FW-2 trout production waters or their tributaries, or are present or documented habitat for threatened or endangered species.

Ordinary resource value wetlands are typically viewed as the lowest quality wetlands and do not require a standard transition area. Ordinary resource value wetlands do not exhibit the characteristics of exceptional resource value wetlands and include isolated wetlands that are surrounded by development by more than 50% and are less than 5,000 square feet in size. These wetlands include drainage ditches, swales, or detention basins.

Intermediate resource value wetlands include all freshwater wetlands not defined as exceptional or ordinary and require a 50-foot standard transition area.

NJDEP has the final authority to determine the resource value classification of wetlands. This is established when the NJDEP issues a "Letter of Interpretation" (LOI) for a site. A LOI is obtained by submitting an application to the NJDEP Land Use Regulation Program in accordance with the requirements found at N.J.A.C. 7:7A-3.

All of the surface waters within Upper Deerfield are classified as non-trout by NJDEP. However, as discussed in Section 10, threatened and endangered species are associated with the broad forested wetland corridors that follow the major surface waters in Upper Deerfield. As identified by the NJDEP Natural Heritage Program, species that may influence wetland resource value classifications include Barred owl (*Strix varia*), Cooper's Hawk (*Accipiter cooperii*). Some part of the habitat requirements of these species is associated with freshwater wetlands. It is important to remember that other species, including state-endangered the Pine Barrens treefrog *(Hyla andersoni*), that are not recorded in the Natural Heritage Database, occur in nearby communities and can be considered for surveying under some circumstances.

Two Federally-threatened species that impact wetland buffers exist within Upper Deerfield. Swamp pink (*Helonias bullata*) a Federally-threatened obligate wetland plant that is known to occur in several locations in Upper Deerfield. Federally-threatened Bald eagle (*Haliaeetus leucocephalus)* foraging and nesting areas are recorded in Upper Deerfield. The presence of Federally-listed species will also affect the resource value of wetlands with which it is associated. In fact, the US Fish and Wildlife Service, which has jurisdiction over this species under the *Endangered Species Act of 1973*, may impose a wetland buffer that exceeds 150 feet depending on circumstances. This is determined on a case-by-case basis. A brief description of the preferred habitat for these species is provided in Section 10. The NJ Landscape Project Mapping, which is another tool used to identify the potential presence of endangered or threatened species habitat, identifies most of the large wetland complexes associated with the Cohansey (primarily in the corridor between Seely and Sunset Lakes) as providing habitat for Federal and/or State-listed threatened or endangered species. Based on a review of NJDEP Natural Heritage information and the NJ Landscape Project Forest and Grassland Habitat mapping (Figure 12 in Section 12.0), it appears that that large portions of the wetlands in Upper Deerfield, particularly those in Cohansey corridor, would be likely to be classified as exceptional resource value wetlands and would have an associated 150-foot width wetland transition area (buffer). If endangered or threatened species and their associated habitat are found to be absent

from wetlands in Upper Deerfield, it is probable that they would be classified as intermediate resource value with an associated transition area of 50 feet. The resources value, or width of the transition area, is established by the NJDEP on a case-by-case basis when a Letter of Interpretation application is submitted for NJDEP review and verification.

7.4 Wetland Communities

Upper Deerfield includes a total of approximately 1,020 acres or 5.1 % of land that is currently mapped as wetland by the NJDEP (Figure 11 in Section 12). These wetlands are non – tidal (palustrine) wetland. The wetland communities are classified following a system identified by Cowardin (1979), which separates wetlands into one of five basic ecological systems: Marine, Estuarine, Riverine, Palustrine, and Lacustrine. Most of Upper Deerfield's wetlands are considered palustrine. A table providing the approximate percentage of the major types of palustrine wetlands is included below:

Table 8

Distribution of Wetland Communities in Upper Deerfield Township

Wetland Type	**Acreage**	**% of Total Wetland**
Modified (MOD)	70.795	6.94
Emergent (PEM)	119.963	11.70
Deciduous (PFO1)	622.221	61.01
Evergreen (PFO4)	115.9	11.36
Broad Leaved Evergreen (PFO3)	18.581	1.82
Scrub / Shrub (PSS)	72.425	7.10
Total	1019.88	100

Palustrine wetlands include all non-tidal wetlands dominated by trees, shrubs and persistent emergent vegetation. These wetlands are usually bordered by uplands and shoreward of lakes and river channels and typically include all wetlands termed marsh, bogs, swamps, and fens. Palustrine wetlands may include small shallow intermittent or permanent ponds, such as vernal pools.

Much of the wetland hydrology in Upper Deerfield is due to surface water runoff, in the form of sheet flow or flooding from adjacent open waters, or groundwater discharge to the surface. Water tables are usually highest in the late winter and into early spring. During this period water may pond or flood the wetlands for variable periods. In May or June, the water table usually begins to drop to its lowest levels, which occur in September or October. Fluctuations relate mainly to rainfall patterns, temperatures, and rates of evapotranspiration (the rate of water uptake from vegetation).

The major palustrine wetland type in Upper Deerfield is deciduous forested (PFO 1) wetland (over 60% of mapped wetlands). Palustrine scrub-shrub wetlands (PSS) make up about 7% of Upper Deerfield's wetlands. Palustrine emergent wetlands (PEM) and palustrine needle leaved evergreen (PFO4) each make up near 11% of Upper Deerfield's wetlands. A small portion of

wetlands are listed as PFO3. White cedar swamps usually form a monoculture with few co-dominant trees. The dense canopy precludes the establishment of a dense understory, so only scattered trees and shrubs and a limited herbaceous layer are found. A small percentage (just under 7%) of Upper Deerfield's wetlands are modified (MOD), primarily by agricultural activities. Although Atlantic white cedar forests are not mapped in Upper Deerfield, the trees have been documented within the Township and may represent a component of the municipality's forested wetlands (see Appendix B, Photographs).

7.4.1 Palustrine Deciduous Forested Wetlands

Deciduous forested wetlands are the most abundant type of wetland in New Jersey and in Upper Deerfield, and occupy the majority of the wetlands mapped in the municipality at approximately 622 acres. Forested wetlands help to filter and purify water, by absorbing and filtering pollutants and sediments. They also stabilize stream flows by temporarily storing floodwater and mitigating the effects of drought. Forested wetlands include vegetation that is greater than 6 meters tall and may have a variety of water regimes ranging from permanently inundated to intermittently flooded. In Upper Deerfield, the forested canopy will typically include red maple (*Acer rubrum*), black gum *(Nyssa sylvatica*), sweet gum (*Liquidambar styraciflua*) and sweetbay (*Magnolia virginiana*). Tulip poplar (*Liriodendron tulipifera*), American holly (*Ilex opaca*), sassafras (*Sassafras albidum*) and willow oak (*Quercus phellos*) may be found along the drier upland edges. Common understory plants will include highbush blueberry (*Vaccinium corymbosum*), southern arrowwood, (*Viburnum dentatum*), maleberry (*Lyonia ligustrina*), swamp azalea (*Rhododendron viscosum*) and sweet pepperbush (*Clethra alnifolia*).

Large populations of swamp pink (*Helonias bullata*), a federally-listed threatened plant exists in some of Upper Deerfield's forested wetlands associated with the Cohansey Drainage (see Section 10.3). It is typically found in the herbaceous layer of the deciduous forested wetlands. It is critically important to consider this species when evaluating impacts to forested wetlands/transition areas, particularly along the River as well as areas mapped as potential habitat.

7.4.2 Palustrine scrub shrub wetlands

In Upper Deerfield, about 72.425 acres are currently mapped as scrub-shrub wetland. Scrub shrub wetlands include vegetation that is less than 6 meters tall and includes true shrubs or young trees and may represent a stage of succession, such as may occur following logging. These wetlands include a variety of water regimes ranging from permanently inundated to intermittently flooded. The dominant plants are likely to be red maple saplings, Southern arrowwood and highbush blueberry with leatherleaf (*Chamaedaphne calyculata*), staggerbush (*Lyonia mariana*), and sweet pepperbush. Saplings of Atlantic white cedar (*Chamaecyparis thyoides*) and pitch pine (*Pinus rigida*) may also be present.

7.4.3 Palustrine Emergent Wetlands

Palustrine emergent wetlands are freshwater marshes dominated by persistent and non-persistent grasses, rushes sedges, forbs and other herbaceous or grass like plants. Common plants include cattails (*Typha* spp.), common reed (*Phragmites australis*), water willow (*Decodon verticillatus*), woolgrass (*Scirpus cyperinus*), rice cutgrass (*Leersia oryzoides*), burreeds (*Sparganium* spp.), arrow arum (*Peltandra virginica*), pickerelweed (*Pontederia cordata*), and purple loosestrife

(*Lythrum salicaria*) and a number of *Polygonum* species. Purple loosestrife is an invasive plant from Eurasia that commonly colonizes disturbed, emergent wetlands, river and stream banks, pond edges and ditches. Under favorable conditions, it can rapidly replace the native plant community with a dense, monotypic stand.

7.4.4 Palustrine Forested Needle leaved / Broad-leaved Evergreen Wetlands

There are about 116 acres of palustrine forested needle-leaved evergreen wetland in Upper Deerfield. Palustrine forested needle leaved evergreen wetlands are similar to forested deciduous wetlands except that the dominant species may be either pitch pine (pitch pine lowlands) or Atlantic white cedar (cedar swamps).

Pitch pine lowlands are among the "driest" wetlands in Southern New Jersey. Pitch pine lowlands usually represent the transitional areas between cedar swamps or hardwood swamps and the adjacent uplands. Pitch pine is dominant with red maple and black gum interspersed. Other scattered trees of sweet gum, Atlantic white cedar, gray birch (*Betula populifolia*), and American holly may also be found. Due to the relatively sparse canopy provided by pitch pine, the understory is usually dense and well developed.

A small amount (approx. 18 acres) of broad-leaved evergreen wetlands are mapped in Upper Deerfield. The dominant species in broad-leaved evergreen wetlands in the region would typically be dominated by American holly (*Illex opaca*). In northern parts of New Jersey, this species is typically associated with uplands. In the Outer Coastal Plain, it is more frequently found growing in wetland habitats.

7.4.5 Modified Wetlands

Just over 70 acres of modified wetlands are mapped in Upper Deerfield. The majority of those wetlands are modified through agricultural purposes. Modified wetlands are those wetlands that have been altered by human activities, typically for agriculture and are usually altered by ditching, diking or the installation of subsurface drainage. In southern New Jersey, wetlands may be linear ditches associated with agricultural fields or altered for blueberry and cranberry cultivation. Other important uses are for pasturage or crops such as corn, soybeans, hay, small grains, summer vegetables and sod. Modified wetland will often revert back to the natural hydrophytic plant community if the drainage features are abandoned. These areas can also be actively converted back to wetland with minimal effort, by plugging ditches and drains or removing dikes.

7.4.6 Vernal Pools

A map showing the vernal pools that have been identified in Upper Deerfield is included (Figure 13 of Section 12). As of the date of this report, a total of eight vernal pools have been mapped in Upper Deerfield. None of these mapped pools have been identified as including documented habitat for vernal pool species and are not certified by NJDEP Non Game and Endangered Species Program. Vernal pools identified as "not surveyed" are pools identified by aerial photography and no field investigation has been performed to confirm their status or existence on the ground. Vernal pools identified as "Yes/Vernal Pool" have been field investigated and have been found to have the physical features of a vernal pool; however, vernal pool species have not yet been identified. The remaining vernal pools will require field investigation at the appropriate

time of year to determine if they will qualify as "certified" vernal pools. Typically surveys for salamanders are done by looking for individuals or eggs or larvae in the pool between March and June. During warm, wet nights in the spring, frog surveys may be completed by listening for vocalizations around the wetland habitats.

Vernal pools are ephemeral wetlands that fill annually in the winter and early spring from precipitation runoff or rising groundwater tables. They may be located within a forested, scrub-shrub or emergent wetland. Most years they dry out during the summer and late fall, losing water through evapotranspiration or as the groundwater table drops. This wet/dry cycle and the low water oxygen levels prevent the establishment and breeding of fish, yet provides a unique temporary habitat for many species. The time of year that the pool fills and dries out will influence the community of animals that utilizes the pool. Numerous amphibians and invertebrates have evolved life cycles adapted to the exploitation of vernal pools. Some species are completely dependant on these pools (obligate species) while others may use vernal pools or other wetlands (facultative species) for their life activities. Vernal pools are also indispensable for biodiversity, with local populations often entirely dependent on a single pool. Vernal pools also provide an important source of water for a variety of other wildlife. Vernal pools are a unique wildlife resource that have long been ignored or overlooked. They have been filled, drained, and used as road drainage detention ponds. Adjacent areas have been cleared and groundwater wells have lowered water tables. Fertilizers and pesticides have degraded water quality in many vernal habitats.

The most optimal vernal habitats in the Township exist within the forested areas associated with the Cohansey River. Although not documented to occur in Upper Deerfield, certain obligate vernal pool species of interest including the Eastern tiger salamander (*Ambystoma tigrinum*), a State-listed endangered species, and the rare spadefoot toad (*Scaphiopus holbrookii*) and marbled salamanders (*Ambystoma opacum*) exist within Cumberland County. Other amphibians, including the State endangered Southern gray treefrog (*Hyla chrysoscelis*) and Pine Barrens treefrog (*Hyla andersoni*), and the rare southern leopard (*Rana sphenocephala*) and carpenter frog (*Rana virgatipes*) are all southern New Jersey species often associated with vernal pools. These species would be among the unique Coastal Plain species of interest that may be targeted in amphibian/vernal pool surveys within the Township.

Vernal pools are a very valuable natural resource, and although often isolated from adjacent wetlands, are worthy of protection, along with adjacent upland buffers. Amphibian inhabitants of vernal pools may utilize adjacent forested habitat of up to 1,000 feet or more from the breeding pool. For more information about Upper Deerfield's vernal pools, surveying for vernal pools, documenting pools and general habitat information, visit NJDEP/Rutgers vernal pool site at http://www.dbcrssa.rutgers.edu/ims/vernal/viewer.htm

Currently, under the NJDEP *Freshwater Wetlands Protection Act* rules (N.J.A.C. 7:7A), vernal pools and adjacent wetland transition areas are protected from disturbance by prohibition of issuance of most general permits for activities in these vernal habitats [N.J.A.C. 7:7A-4.3(b)16]. However, as of the date of this document, NJDEP General Permit #6 currently allows the filling of up to one acre of non-tributary or isolated wetlands, (which may be vernal pools) that do not provide documented habitat for State-listed threatened or endangered species. The NJDEP has

discretionary authority, however, to require an Individual Permit for a proposed disturbance to an isolated wetland that is a vernal pool.

7.4.7 Wetland Mitigation

Wetlands such as the modified agricultural wetlands mentioned in section 7.4.5 may be converted to their original state as part of a mitigation project. Wetland mitigation is required for certain projects that impact open waters and wetlands in New Jersey. Mitigation is the development, preservation, enhancement or restoration of wetland required (often by NJDEP) as compensation for wetlands impacted or lost during permitted activities such as road development. Mitigation may provide opportunities for landowners to sell wetlands that are otherwise not developable and have less economic value, or sell adjacent uplands they wish not to sell for development. The New Jersey Department of Transportation and other organizations are often required to purchase sites for mitigation. As mentioned in the Stream Corridors section of the ERI, the NRCS can direct farmers and other landowners to programs and organizations involved with wetland mitigation/restoration.

Wetland mitigation can be performed onsite or offsite or through land donations, monetary contributions, or through the purchase of wetland mitigation bank credits. A wetland mitigation bank is a pre-constructed wetland or an area of wetland/upland that has been preserved. The Willow Grove Lake Wetlands Mitigation Bank (WGLMB) is located in Salem County and Cumberland County, straddling Willow Grove Lake and the Maurice River. The WGLMB totals 1,073 acres and includes 600 acres of wetland and 473 acres of upland. The WGLMB is owned and operated by the Nature Conservancy. The WGLMB is included within the larger 1,811 acre Willow Grove Lake Preserve (WGLP), also operated by the Nature Conservancy. The Wetland Mitigation Council has assigned 40 wetland mitigation credits to the Willow Grove Bank. The service area of the mitigation bank includes Watershed Management Areas 1, 11, 17, 18, 19 and 20 (Delaware River Drainage Basin). For interest in purchasing mitigation credits at the bank, contact the Nature Conservancy at (908) 879-7262.

7.4.8 EPA Priority Wetlands

EPA Priority Wetlands are those wetlands that are designated as priority wetlands by the US Environmental Protection Agency. The list recognizes wetlands identified by Federal, State and private contributors to be considered to be the most important and vulnerable in the state. The designation of a wetland as a United States Environmental Protection Agency (USEPA) priority wetland precludes the use of certain General Permits pursuant to the NJ Freshwater Wetlands Protection Act Rules.

The eastern portion of Upper Deerfield is within the drainage basin of the Maurice River. The entire drainage basin of the Maurice River is considered to be EPA Priority. This river system has been so designated since “wetlands of this drainage are among the most pristine natural areas in New Jersey,” and it “supports major winter populations of the federally threatened bald eagle and provides historically suitable nesting habitat for this species,” and other “state-listed species present include osprey, red-shouldered hawk, Southern Gray and Pine Barrens treefrogs and barred owl.” Isolated wetlands of the Maurice River Basin that are not located in floodplains are not considered USEPA Priority.

7.4.9 Wetlands Regulations

Since July 1, 1988 the NJDEP Bureau of Freshwater Wetlands has regulated all disturbances in freshwater wetlands under the NJ Freshwater Wetlands Protection Act Rules (NJAC 7:7A et seq.). Since July 1, 1989, they have regulated "transition areas," lands adjacent to wetlands. As per the freshwater wetlands regulations, municipalities cannot adopt local wetlands ordinances.

In March 1994 the NJDEP assumed the administration of the federal 404 wetlands program for the majority of freshwater wetlands in the state. The US Army Corps of Engineers (USACE) retained jurisdiction over all tidal wetlands, certain interstate waters and wetlands and freshwater wetlands within 1,000 feet of tidal waters. The US Environmental Protection Agency, the National Marine Fisheries Service, and the US Fish and Wildlife Service retain some oversight over this program, such as reviewing permit applications for major discharges to wetlands and reviewing new Freshwater Wetlands Permits and other changes to the rules for consistency with the Federal 404 Program.

Between July 1, 1988 and July 1, 1989, only activities in wetlands and open waters themselves were regulated by NJDEP. Since July 1, 1989, transition areas adjacent to wetlands have also been regulated. Regulated activities in wetlands include draining, flooding, cutting of vegetation, excavation, filling, and erection of structures. Similar activities are regulated in wetland transition areas.

There are two types of permits than can be issued for wetlands disturbance 1) General Permits and 2) Individual Permits. A General Permit may also be issued for activities in wetland transition areas. General permits can be granted for certain minor activities in wetlands subject to certain conditions. There are General Permits for wetlands encroachments related to multiple activities including: utility lines; outfalls road crossings; disturbance of isolated wetlands; disturbance of ditches or swales; surveying; soils sampling; house additions; trails and boardwalks; docks and piers; dredging of ponds; fish and wildlife management activities; clean up of hazardous waste; etc. For outfalls and road crossings, no more than 1/4 acre can be disturbed. For isolated wetlands, ditches and swales, no more than 1 acre can be disturbed. Additions to residential dwellings existing prior to July 1, 1988, are limited to less than 750 SF of fill with no effect to adjacent wetlands. If wetlands filling cannot be avoided, proposed activities should be limited to those activities authorized under General Permit where at all possible.

Individual Permits are required for all other disturbances in wetlands not authorized under General Permits. These are very difficult to obtain. If the proposed activity is water dependent, and wetlands disturbance is minimized, a permit may be granted. For non-water dependent uses it must be proven that there is no other alternative location or design for the proposed project that would involve less or no wetlands disturbance. An alternative site to be considered can be on property owned by the applicant or on any property that could be obtained in the region. This requirement is very difficult to satisfy. Mitigation, or creation of wetlands from uplands, at a ratio of 2:1 would be a condition of an Individual Permit, but is not required for most General Permits.

Activities in wetland transition areas must be authorized under a Transition Area Waiver. Granting of a wetland permit is accompanied by a waiver to disturb the associated transition area. If activities are limited to within a transition area, they may be approved under a Transition Area Averaging Plan Waiver. Under such a plan the shape of a transition area may be adjusted as long as the total area of the standard transition area is not reduced and other minimum and maximum width requirements of the transition area are maintained. Selected activities within a transition area may be authorized under a Special Activities Waiver. These activities may include activities such as construction of road crossings or stormwater outfalls that would be authorized under a General Permit if they were conducted in wetlands. Where certain specific characteristics of slope and vegetative cover are present in the transition area and the development intensity is not high, a straight reduction of the transition area, without compensation, may be authorized under a waiver. Lastly, a Hardship Waiver may be granted under certain circumstances.

8.0 AIR QUALITY

Existing ambient air quality for the project site was obtained from the 2001 Air Quality Report, published by the NJDEP, Bureau of Air Monitoring. In New Jersey, there are continuous monitoring stations that monitor six specific air pollutants which are used as indicators of air quality and for which Ambient Air Quality Standards (AAQS) have been established. These pollutants are listed as carbon monoxide, nitrogen oxides, ozone, sulfur dioxide, smoke shade and fine particulates. In addition, a manual monitoring network has been established to measure inhalable particulates, ozone precursors, atmospheric deposition, lead and air toxics. Ambient air quality data are used as the baseline for evaluating the effect of the construction of new emission sources or of modifications to existing sources. New stationary sources of air contamination require permits from the NJDEP, Bureau of Air Quality, New Source Review.

Air Quality monitoring is not performed by the NJDEP directly in Upper Deerfield Township, however; it is performed in Millville, NJ. The Millvillle weather station is located near Millville Airport, approximately nine miles southeast of the border of Upper Deerfield and Bridgeton. Winds in the region are typically westerly or northwesterly in fall and winter months and frequently southerly during the summer months. Sulfur dioxide, ozone, and nitrogen oxides are monitored at the Millville Site. The results of the 2001 air monitoring for the three pollutants measured at Millville were compared to the National and State ambient air quality standards. Nitrogen oxides and sulfur dioxide did not violate the primary or secondary air quality standards during 2001. Ozone however, violated the standard (8 hrs w/ >0.08 ppm) on 14 days during 2001. Ground level ozone is a gas that forms when nitrogen oxides and volatile organic compounds (VOCs) react in the presence of sunlight and heat. Nitrogen oxides primarily come from vehicles and power plants and VOCs are emitted from chemical plants, factories and motor vehicles. Ozone season is during the summer and ozone formation occurs mainly during daytime. Repeated exposure to ozone results in damage to the lungs and aggravates many respiratory ailments. Children and asthmatics are especially prone to be affected by exposure to ozone.

The air monitoring data are also used to characterize the general air quality within nine distinct Air Quality Index Reporting Regions covering New Jersey. Descriptor ratings, ranging from "Good" to "Unhealthful," have been established to provide a general system of rating the regional air quality. Upper Deerfield is located within Area 9, which is the Delaware Bay Region. The Delaware Bay region was reported to have had 312 days rated "good;" 37 days rated as "moderate;" 12 days rated as "unhealthy for sensitive groups;" and 2 days rated as "unhealthy." There were no days rated as "very unhealthy" in the Delaware Bay region. Among the nine reporting regions, only the Southern Coastal region (Atlantic and Cape May counties) had more days rated as having "good" air quality. The Southern Delaware Valley Region, just north of the Delaware Region, had 111 days listed as moderate and 20 days listed as unhealthy for sensitive groups. This region is more likely impacted by the heavy urbanization of Philadelphia and its surrounding communities.

In general, the air quality in New Jersey has improved significantly since the passage of the Clean Air Act in 1970. New Jersey is now in compliance with all National Ambient Air Quality Standards (NAAQS), except for ozone. Based on a review of the Air Quality 2001 data, the air quality in Upper Deerfield is better than in most parts of New Jersey.

9.0 LAND USE

9.1 Land Use/Cover Types

Land use cover types according to NJDEP 1995-1997 digital GIS coverage are presented on the Land Use/Land Cover map (Figure 14 in Section 12). Cover types include Agricultural, Forest (deciduous, coniferous, and scrub shrub), Wetland, Open Water, Residential/Urban and Barren Land. The approximate acreages of these various cover types are summarized below:

Table 9
Distribution of Land Use/Land Cover Types

Land Cover Type	Acreage	% of Total
Agricultural	12,035.838	60.33
Barren Land	88.518	.44
Forest: Deciduous	2,772.056	13.89
Forest: Coniferous	222.513	1.12
Forest: Mixed Scrub / Shrub	722.362	3.62
Open Waters	1,14.911	.58
Residential/Urban	2,977.014	14.92
Wetlands	1,018.0957	5.10
Total*	19,951.307	100

*NJDEP identifies Upper Deerfield as being the 31.2 square miles (19951 acres) – discrepancies are generally due to subtle border calculation differences, often found along river boundaries such as the Cohansey River in Upper Deerfield.

Agricultural land is clearly Upper Deerfield's dominant land use at approximately 60%. Other significant tracts of land are predominantly forested upland (18.63%), and wetland (5.10 %). Residential and urban land uses occupy only about 15% of the land area. "Urban land" is a general term referring to those areas covered by impervious surfaces such as pavement or structures associated with development. Small residential/urban land uses are scattered throughout the Township along the major roads. However, most of the urban/residential land areas are concentrated in a central portion of the Township along NJ Route 77 and in the southwestern portion of the Township north of Bridgeton City.

Brief descriptions of Upper Deerfield's major forest cover types are provided below. Both deciduous and coniferous forests exist within Upper Deerfield (see Appendix B, Photographs). The description of the wetland communities is provided in Section 7.4 Wetland Communities. The deciduous forests of Upper Deerfield may often be oak-pine forest with a dominant deciduous canopy. The Pine forests may in fact be a pine-oak forest dominated by a coniferous canopy.

Deciduous Forest

Decidious forest is the most widespread upland forest community in Upper Deerfield, occupying approximately 2,272 acres, or about 75% of the Township's upland forest complex. Deciduous forests are found abutting the riparian corridors along the much of the Cohansey River and its tributary corridors within Upper Deerfield.

Within these deciduous forests, tree-form oaks typically dominate the canopy. Species include white oak (*Quercus alba*), black oak (*Quercus velutina*), post oak (*Quercus stellata*), chestnut oak (*Quercus prinus*), red oak *Quercus rubra*), and scarlet oak (*Quercus coccinea*). Post oak (*Quercus stellata*), blackjack oak (*Quercus marilandica*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*) and laurels (*Kalmia* spp.) are typical representative understory associates.

Other tree species found in southern New Jersey mixed oak forests include black gum (*Nyssa sylvatica*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), southern red oak (*Quercus falcata*), red maple (*Acer rubrum*), persimmon (*Diospyros virginiana*) and American beech (*Fagus grandifolia*) and Virginia pine (*Pinus virginana*). Teaberry (*Gaultheria procumbens*), bracken fern (*Pteridium aquilinum*), wintergreen (*Chimaphila maculata*), rattlesnake weed (*Heiracium venosum*) and Pennsylvania sedge (*Carex pennsylvania*) may be found in the groundcover layer. Common vines include greenbriers (*Smilax* spp.) and Japanese honeysuckle (*Lonicera japonica*).

Coniferous Forest

Coniferous forest in Upper Deerfield will typically have a mix of pines and oaks. This forest type is not as extensive as the oak or oak pine forest; it occupies approximately 222 acres or about 1.12% of the upland forest complex.

In the coniferous forest, pines are commonly mixed with oak species mentioned above and the composition changes at various locations. The incidence of canopy oaks becomes less

discernible as the pine-oak forest transitions to a wetland community and, likewise, more pronounced as the community transitions to a drier oak-pine forest.

Pitch pine (*Pinus rigida*) is typically the dominant canopy species. Some shortleaf pine (*Pinus echinata*) may be mixed with this species. These species are associated with the common oak canopy species including white oak, post oak, chestnut oak, black oak, and scarlet oak, depending upon the position in the landscape. Understory associates typically include pitch pine and oak canopy saplings, scrub oak, blackjack oak, black huckleberry, and lowbush blueberry. Tall huckleberry (*Gaylussacia frondosa*) and highbush blueberry (*Vaccinium corymbosum*) locally dominate the shrub layer at the wetter end of the gradient. Likewise, black huckleberry and lowbush blueberry tend to dominate the shrub layer in the drier areas. Teaberry and bracken fern are common groundcover associates throughout. Christmas Tree farms may also be mapped as "coniferous forest" under NJDEP Land Use Mapping.

Shrub Forest

Upland Shrub areas are often successional areas such as abandoned lots and old agricultural fields. If left undisturbed these areas will typically succeed from herbaceous dominance to a mixture of herbaceous and woody "pioneer" vegetation that includes a variety of shrubs and small trees that, if allowed to succeed, may be replaced by forest canopy trees. After 10-15 years, dominant successional herbs may include goldenrods (*Solidago* spp), broomsedge (*Andropogon virginicus*) among others. At this point shrubs including winged sumac (*Rhus copallina*), silky dogwood (*Cornus amomum*) become dominant. Other species including black cherry, red maple, sweetgum (*Liquidambar styraciflua*) and sassafras (*Sassafras albidum*) are the first trees to colonize these sites.

In some local successional areas in southern New Jersey, Virginia pine forest may become established. Virginia or "scrub" pine forests are common in parts of Cumberland County. The dominant species is Virginia pine and common associates include shortleaf pine, southern red oak, chestnut oak, black oak, post oak, American holly and sassafras. Black huckleberry, mountain laurel (*Kalmia latifolia*), lowbush blueberry and bayberry (*Myrica pennsylvanica*).

In summary, Upper Deerfield currently contains large quantities of open space (over 75% of the land cover) including large expanses of agricultural land intermixed with riparian habitats and forests. Most of the forested areas are primarily deciduous. However, smaller communities of shrub and coniferous dominated forest also exist within the Township. In addition, forested and emergent wetlands are found adjacent to surface waters throughout Upper Deerfield. All of these areas provide a complex of habitat for a wide range of wildlife. NJDEP is in the process of developing a State Planning Map that could be used as a guide by county and municipal planners for determining the location of environmentally sensitive areas. NJDEP, by analyzing existing resource mapping and data, designated specific locations worth preserving for their natural resource value. This mapping is distributed for informational purposes only and not used by the State as a regulatory guide.

10.0 WILDLIFE

10.1 Fisheries

River Herring (alewife, *Alosa pseudoharengus* and blueback herring, *Alosa aestivalis,*) are important species that have supported one of the oldest documented fisheries in North America. They are vital in marine ecosystem food webs providing food for larger and economically important predatory species such as striped bass. These species are anadromous, referring to their spawning migration upriver from the sea. Parts of the Cohansey River have previous confirmation of alewife, blueback herring, and gizzard shad (*Dorosoma cepedianum*) presence however the development of dams and other impoundments affects their ability to migrate and spawn successfully. Fish ladders, structures that allow fish to migrate around impoundments sometimes help these fish to successfully spawn. Along the Cohansey, a fish ladder was created near Sunset Lake Dam and is believed to be functioning (Chris Smith, 2005). Along the Maurice River, a fish ladder at Union Lake allows river herring to migrate upriver. Both of these species may be found in Muddy Run and within the Maurice River itself. The fish ladders increase the probability that these species are found within the waters of Upper Deerfield's drainages.

Nitrogen can contribute to nutrient overload, commonly referred to as eutrophication. As previously mentioned in the document, eutrophication causes an increase in algae and a decrease in dissolved oxygen in a water body. Sunset Lake has become increasingly eutrophic since the 1940's, which has reduced some of its recreational potential (NJDEP, 2003). Past surveys indicate a good diversity of fish, however individuals per species within the lake is considered low.

The NJDEP, Division of Fish and Wildlife, Bureau of Freshwater Fisheries has a program to stock lakes and streams to encourage recreational fishing. According to the NJDEP, Muddy Run was stocked with Rainbow and Brook Trout in 1986. However, water temperatures exceed those tolerated by trout and the trout were not expected to establish. Channel catfish were stocked in Sunset Lake five times between 1995 and 2003; tiger muskellunge were stocked in Sunset Lake in 1994 and 1995. Portions of the Cohansey River have been stocked with trout.

The fisheries of Upper Deerfield are typically warmwater species associated with freshwaters systems. Included here is a list of the 19 species that have been identified in Sunset Lake by NJDEP. These species include:

American eel	(*Anguilla rostrata*)
Pumpkinseed sunfish	*(Lepomis gibbosis*)
Redbereast sunfish	(*Lepomis auritus*)
Bluegill	(*Lepomis gibbosus*)
Largemouth bass	(*Micropterus salmoides*)
Black crappie	(*Pomoxis nirgrmaculatus*)
Golden shiner	(*Notemigonus crysoleucas*)
Common carp	(*Cyprinus carpio*)
Creek chub sucker	(*Erimyzon oblongus*)
White sucker	(*Catostomous commersoni*)
Banded killifish	(*Fundulus diaphanus*)

Gizzard shad (*Dorosoma cepedianum*)
Blueback herring (*Alosa aestivalis*)
Chain pickerel (*Esox niger*)
Brown bullhead (*Ictalursus mebulosus*)
Tadpole madtom (*Noturus gynnus*)
Swamp darter (*Etheostoma fusiformi*)
Yellow perch (*Perca flavescens*)
White perch (*Morone americana*)

10.2 Endangered and Threatened Wildlife Species

Endangered species are those whose prospects for survival in New Jersey (State-listed), or nationally (Federally-listed), are in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination. Assistance is needed to prevent future extinction. Threatened species are those that may become endangered in New Jersey (State-listed) or nationally (Federally-listed) if conditions surrounding them begin or continue to deteriorate. Animals that are considered "rare" may also be State listed as Special Concern. These animals are species that are typically not afforded state protections except under certain circumstances such as under the Coastal Area Facilities Review Act (CAFRA) or within New Jersey's Highlands Preservation Area.

The New Jersey Natural Heritage Program (NJNHP), NJ Landscape Project mapping and US Fish and Wildlife Service (USFWS) were consulted as part of the preparation of the ERI (Appendix A, Correspondence). The USFWS and the NJNHP have records of sightings of a variety of rare species in Upper Deerfield Township are listed in Table 10:

Table 10
State and Federally Threatened and Endangered Wildlife

Common Name	Scientific Name	State Status	Federal Status
Barred owl	*Strix varia*	Threatened	
Cooper's hawk	*Accipiter cooperii*	Threatened	
Bald eagle (foraging area and nest buffer)	*Haliaeetus leucocephalus*	Endangered	Threatened
Savannah sparrow	*Passerculus sandwichensis*	Threatened	
Eastern box turtle	*Terrapine carolina*	Special concern	
Fowler's toad	*Bufo woodhousii fowleri*	Special concern	

A brief description of each of the species is provided:

Barred Owl
The barred owl requires large tracts of undisturbed forest dominated by mature and old growth stands and high canopy cover (Bosakowski et al. 1987, Bosakowski 1989). Large tree habitat is necessary to provide large old cavity trees for nest sites as well as open flyway space below the

canopy for hunting (Devereux and Mosher 1984). Analysis of land use in the Pequannock Watershed (Passaic and Sussex Counties) in 984-foot radius circles around owl locations revealed total forest cover averaged 86.7% if deciduous, coniferous, and mixed stands are combined (Bosakowski 1990). Analysis of computer-generated land use data (Landsat) in northern New Jersey revealed highly significant over-utilization of forested blocks compared to other land use types (Bosakowski 1994). Bosakowski et al. (1987) noted that wetlands were used significantly more by barred owls than by other sympatric nesting owls. This tendency was again noted by a different study in the Pequannock Watershed (Bosakowski and Smith 1997) where barred owl sites were significantly ($p < 0.10$) closer to wetlands (mean = 646 feet) than unoccupied habitats (mean = 1,213 feet). The reason for a preference for wetlands seems to be two-fold. The first reason appears to be related to wetland prey, which often account for a significant portion of the barred owl's diet (Bosakowski and Smith 1992). The second reason is that large wetland complexes are often undeveloped and represent the last remaining refuges for forest species as sprawl engulfs the remaining uplands.

The barred owl is a large owl that resides in forests and demonstrates long-term site fidelity in areas which remained undisturbed (Bent 1938, Bosakowski et al. 1987). Most nests are in large side cavities of hollow trees where a large branch has fallen off and created a hole. However, they sometimes nest in old hawk nests, broken-topped snags, or tree crotches of large old trees (Bent 1938). Barred owl territories are very large (mean = 676 acres) and encompass the entire home range (Nicholls and Fuller, 1987). Owl sites were located a considerable distance (mean = 2,204 feet) from houses and other buildings (Bosakowski and Smith 1997) showing a significant avoidance of human disturbance and habitat alteration.

In Upper Deerfield, the Landscape Project Mapping has identified critical habitat for barred owl within the large wetland/upland forest complexes associated with the Cohansey River. Other forested areas associated with the southern half of the Township including Cornwell, Loper, Foster and Parsonage Runs may have potential barred owl breeding habitat. Barred owls have been documented nesting in the vicinity of Sunset Lake. However, as with the Cooper's hawk, any substantial forests in the Township particularly those associated with wetlands may be suitable. Forests associated with the Muddy Run on the eastern boundary of the Township, may be suitable habitat for barred owls. This species is highly vocal and can be surveyed for in the spring using call-back techniques.

Cooper's Hawk

Cooper's hawks nest in submature and mature forest stands in extensively forested situations. In the northern part of New Jersey, basal area of 21 nest stands (135 square feet per acre) was significantly higher than available forest (random sites) showing that young forest was avoided for nesting (Bosakowski et al., 1992a). In that study, it was also noted that canopy cover (mean = 88.9%) at nest sites was significantly greater than at available forest (mean = 82.5%), suggesting that a dense canopy was selected for nesting. If available, Cooper's hawks seem to prefer coniferous or mixed forest, and nesting occurred infrequently (10.5%) in pure deciduous stands in the Pequannock Watershed. Bosakowski *et al*. (1992) found that nest sites contained higher levels of coniferous trees (34.6%) than available habitat (8%), thus showing a significant over utilization of conifers. Nests in conifers occurred in groves of white pine, hemlock, Scotch pine, and Norway spruce. On a landscape basis, nest sites were significantly closer to forest

edge and wetlands, which were probably important habitats for hunting. Nest sites tended to be at a lower slope location than random sites. Analysis of 12 nest sites in the Pequannock Watershed indicated that forest cover (73 to 99%) dominated the land use within 984 feet of the nest and very little suburban habitat was evident (0 to 6.7%), with the nearest house at a distance of 360 feet (Bosakowski et al. 1993). In southern New Jersey, Cooper's hawks typically utilize large forested wetlands dominated by black gum (*Nyssa sylvatica)* and red maple (*Acer rubrum*). As increases the breeding population combined with increased forest fragmentation has resulted in more Cooper's hawks breeding in less typical habitats such as smaller woodlots (Beans and Niles, 2003).

Seasonal home range size for an adult radio-tagged male was very large (1,936 acres) and daily home range averaged 570 acres (Murphy *et al*., 1988). Active nests are generally well spaced, but, in prime habitat, can be spaced as close as 0.74 miles apart (Bosakowski et al. 1992a). Nests are typically placed high (mean 67.3% of tree height) in live tall trees, and conifers are generally preferred if available (Bosakowski et al., 1992a). Similarly, Bent (1937) noted that 58.3% of nests in Massachusetts were in white pine. The hawks construct a platform stick nest, which is typically slightly larger than a crow nest.

Within Upper Deerfield, the Landscape Project Mapping has identified critical habitat for Cooper's hawk within the forests associated with the Cohansey River from CR 724 to Sunset Lake. This species would also be expected to use the same habitat as barred owl, which would include the majority of the large upland and wetland forests that are found throughout the Township.

Bald Eagle

Bald eagles build their nests in large trees (coniferous or deciduous) along forest edges, in woodlots or in forest near large bodies of water, where the species forages (Heintzelman, 1970; NJDEP, 1995). Nest stands were a minimum of 20 acres in Virginia (Cline 1993). In the Chesapeake Bay area, nest trees averaged 75 feet in height and 24.8 inches in diameter (Andrew and Mosher, 1982). Large bodies of water such as rivers, lakes, and estuaries are favored over smaller ones (NJDEP, 1994).

Despite recent population increases, evidence of eggshell thinning, infertility, and chick mortality from contaminant exposure is still a persistent threat to the recovery efforts of the bald eagle (Paturzo *et al.*, 1998). Environmental contaminants such as DDT (and its analogs), PCBs, and heavy metals such as mercury, cadmium, and arsenic can be bioaccumulated through the food web. In addition, Gerrard and Bortolotti (1988) speculated that overfishing by sportsman could reduce nesting densities of bald eagles that nest on large lakes. Logging of nest and roost site stands threatens to eliminate nest and roost trees, which are often very limited in the landscape. Increasing suburban sprawl and disturbance from various types of human activity also threaten bald eagles, which are generally very sensitive to human disturbance.

Landscape mapping identifies three distinct locations along the Cohansey in Upper Deerfield as Bald Eagle foraging habitat (figure 15, Section 12). These locations are associated with Bostwick, Seeley and Sunset Lakes. In addition to the wetlands, habitat patches of upland forest and grassland (agricultural area) west of NJ Route 77 from CR 540 to the southern border of the

municipality are listed as Rank 5. These areas may be associated with nest buffer habitat. Nest buffers are protected areas determined by USFWS and NJDEP. Suitable habitat includes certain sized forests and wetlands within an approximate 1.6 km radius of the nest. Wet farm fields and other modified wetlands are sometimes included in this buffer (see Section 12, Figure 15).

According to the USFWS, an active bald eagle nest is located within Upper Deerfield Township. For the species protection, exact locations are not provided. The USFWS recommends a 150-foot buffer be established along forested wetlands and uplands to protect foraging and roosting sites. The Service also recommends a seasonal restriction on project activities between December 15 and July 31st for activities beyond the 150-foot buffer. For additional information and for waivers of seasonal restrictions, contact the NJDEP Endangered and Nongame Species Program at (609) 628 –2103.

Savannah Sparrow
This sparrow is found in open habitats and marshlands. The savannah sparrow will occupy and nest in large open agricultural areas and pastures, particularly those that are grassy and containing wet meadows where they forage on insects and seeds. Nests occur on the ground, are cup-shaped and constructed of woven grasses.

Though listed in New Jersey, it is considered stable globally and is most likely expanded its range due to human changes in land use. In Upper Deerfield, open agricultural areas including those that are somewhat wet would be the most likely areas to support this species.

Eastern box turtle
Box turtles are considered the most terrestrial of New Jersey's turtle species. They are typically found in a variety of forests and open areas such as meadows. They may also be found in old fields, emergent and shrub wetlands and along riparian corridors. Box turtles are omnivores, feeding on berries, mushrooms, worms, insects and other invertebrates and occasionally carrion. These turtles are still fairly common, but have significantly declined throughout New Jersey due to loss of habitat and habitat fragmentation, automobile kills, and diseases introduced from the pet trade. As a result of these declines, they are State listed as a Special Concern species. They are extremely long lived (150 years) and nonbreeding adults may persist for a number of years as a released animal or as part of a relict population in urbanized areas.

Box turtles would most likely be found in much of Upper Deerfield's forested habitats. They may also be observed in agricultural areas, crossing roads, in yards and other areas considered atypical habitat. Properly installed silt fencing used around construction sites, particularly those adjacent to forested habitat, may reduce the probability of low mobility species such as box turtles from being injured during projects.

Fowler's Toad
The Fowler's toad prefers much drier conditions than its relative the American Toad (*Bufo americanus*). It prefers dry rocky or sandy habitats and is therefore the dominant toad species in the pine and dry oak forests of the Pine Barrens and southern New Jersey. The Fowler's toad is often active on rainy nights and sunny days from March through September. Despite its preference for drier sandy areas, it still breeds in aquatic environments including wet ditches and

shallow portions of lakes and ponds. It will also utilize vernal pools and should be considered during surveys of these habitats.

While rare in northern regions of the state, the species is quite common in the southern part of its range in the state and would most likely be fairly common in Upper Deerfield and may be found over much of the forested, agricultural and residential portions of the Township.

In summary, Upper Deerfield is home to several threatened and endangered birds. The forested corridors of the Cohansey and some of its main tributaries within Upper Deerfield are particularly important habitat areas for the Cooper's hawk and barred owl. Open bodies of water along the Cohansey provide suitable foraging habitat for the bald eagle and the species is nesting within the Township. Habitat for potentially rare amphibians such as the Pine Barrens treefrog or the Southern gray treefrog may exist within the Township and vernal pool/amphibian surveys may be advisable when considering various projects. While these species are not within the Natural Heritage data for the town, only onsite habitat evaluations and presence absence surveys could determine their presence or absence. In addition to the forested tracts and wetlands of the Township, large agricultural tracts of Upper Deerfield may be suitable for a variety of grassland birds including nesting habitat for the savannah sparrow. The composition of these agricultural areas including the amount of wet areas and the type agricultural practices would determine the extent of their quality as potential habitat for grassland species.

While regulatory issues typically focus on threatened and endangered species, it is also important to consider the diversity of rare and non-listed wildlife potentially supported by town's natural communities. Upper Deerfield's sizable forested areas contain a variety of important breeding forest interior dwelling and neo-tropical migrants including various warblers, thrushes and vireos. Turtles including the red-bellied turtle (*Psudemys rubriventris*), spotted turtle (*Clemmys guttata* -State Listed Special Concern) Eastern mud turtle (*Kinosternon subrubrum*) and musk turtle (*Sternotherus odoratus*) and many others may potentially be found in the surface waters of Upper Deerfield. Garter snakes (*Thamnophus sirtalus*), black racers (*Coluber constrictor),* black rat snakes (*Elaphe obsoleta*) rough greensnakes (*Opheodrys aestivus*) and ringneck snakes (*Diadophis punctatus punctatus*) are among the approximately 15 non-listed snake species that have or potentially have populations within Upper Deerfield. In addition, numerous poorly documented butterfly, dragonfly and other insect/invertebrate species vital to healthy ecosystems exist within these upland and wetland communities. Often the presence and diversity of these non-listed species is a significant indicator of overall habitat quality. Furthermore, a number of these species, while not listed, appear to be becoming increasingly uncommon throughout the State.

10.3 Endangered and Threatened Plant Species

Upper Deerfield has four historical records of rare or State-listed plants; and two recent and one historic record of one Federally-listed plant species. Table 11 identifies the rare plant species documented within the Township. Some additional species have been recorded in the vicinity of Upper Deerfield (see Appendix A, Correspondence).

Table 11
State and Federally Threatened and Endangered Plants

Common Name	Scientific Name	State Status	Federal Status	Most Recent Record
Barratt's sedge	*Carex barrattii*	Endangered		05/1935
Swamp pink	*Helonias bullata*	Endangered	Threatened	11/2001
Small yellow pond lily	*Nuphar microphyllum*	Endangered		09/1937
Pale beaked-rush	*Rychospora pallida*			07/1935
Dwarf Azalea	*Rhotodendron atlanticum*	Endangered		06/1935

Swamp pink
Swamp pink is an Federal listed obligate wetland plant found in a variety of palustrine forested and-scrub shrub wetlands; including forested wetlands bordering meandering streamlets; headwater wetlands, sphagnous Atlantic white cedar swamps and spring seepage areas. Specific hydrologic requirements limit its occurrence to wetland that are perennially saturated but not inundated by floodwaters. The water table must be at or near the surface and fluctuate only slightly. The substrate is mucky and the forested canopy is variable. It is characterized by a bright pink flower that blooms in early spring. It has a stocky hollow stem, 1 to 3' tall and a rosette of smooth, evergreen, basal leaves. Population sizes may vary from a few to several thousand plants.

The range of this plant as been reduced drastically worldwide and occurs primarily along the Atlantic Coastal Plain from New Jersey to Virginia, and in small bog habitats in the Southern Appalachians. This species is very susceptible to environmental perturbations, especially changes in the water table and canopy cover. Sedimentation from off-site construction projects may impact habitat; as may flooding and erosion. Because of the sensitivity of this species to groundwater and surface water disturbances, projects upstream or outside the wetland habitat that may change onsite water volume or quality may impact populations and precautions may need to be taken to avoid impacts. USFWS typically require minimal 300foot buffers on wetlands containing Swamp Pink. Buffers may extend over 600 feet and are determined on a case-by-case basis. According to the USFWS, there are documented occurrences of Swamp Pink within 1.5 miles of most of the Cohansey River in Upper Deerfield. Large populations are documented within the Township and occur within the forested areas near Sunset Lake. For additional information on swamp pink contact the US Fish and Wildlife Service (see Correspondence).

The following plants are rare wetland plants with occurrences dating back approximately 70 years. Populations of these plants would generally be limited to high quality or unique wetland habitats:

Barratt's sedge
Barratt's sedge is found in acidic open wetlands habitats (ph less than 5). They were traditionally associated with pine/oak barrens, bogs and swamps, but most populations are now found in pine barrens wetlands. Associate plants include red maple, sweet pepperbush, highbush blueberry, tussock sedge and sphagnum mosses and others. It is found in portions of the Northeast and small sections of the Southern Appalachians. Barratt's sedge is however uncommon and/or declining throughout much of its range. New Jersey populations are among the most stable due to the protections associated with the Pinelands.

Dwarf azalea
This *Rhododendron* species prefers bogs, riverbanks and other wetlands. Its flowers are large and white or pinkish. Found along the Atlantic Coastal plain, it is listed as endangered in New Jersey and Pennsylvania.

Small yellow pond-lily
This wetland species is found along riverbanks and other open water habitats. It is a floating leaved plant usually standing in shallow waters less than three feet. It has small heart shaped deeply notched leaves. The small yellow flowers are on a stalk that may sticks up out of the water. It is listed as endangered in several Northeastern states.

Pale beaked-rush
This plant inhabits acidic wetlands including peaty swales and abandoned cranberry bogs. The species is found primarily along the Mid-Atlantic Coastal Plain. Knieskern's beaked rush *(Rhynchopsora knieskernii)*, a Federally listed plant, is an associate species of the pale beaked rush. The plant is State Listed in Maryland.

10.4 NJDEP Priority Site

The NJDEP Office of Natural Land Management (ONLM) has identified critically important areas to conserve New Jersey's ecological heritage. Some of the best sites have been identified and mapped as Natural Heritage Priority Sites. While no Natural Heritage Priority Sites exist in Upper Deerfield, they do exist in neighboring communities including at Parvin Lake in Pittsgrove. The Parvin Lake Priority Site includes much of Parvin State Park, extending from Parvin Lake to Centerton Lake and including much of the surrounding forest. It also extends into neighboring Deerfield Township, along a tributary of Muddy Run. The Bluebird Branch and Town Swamp Branch of the Mill Creek and surrounding forested uplands are also listed as Natural Heritage Priority Sites. These sites are listed as such due to globally rare, threatened or endangered plant species.

10.5 The Landscape Project

In 1994, the NJ Division of Fish, Game and Wildlife's Endangered and Nongame Species Program (ENSP) adopted a landscape level approach to rare species protection called the Landscape Project. The Landscape Project has been designed to provide peer reviewed, scientifically sound information that is easily accessible and can be integrated with planning, protection and land management programs at every level of government – State, county and

municipal, as well as nongovernmental organizations and private landowners. The ENSP has developed landscape maps that identify critical rare species habitats based on land use classifications, documented rare species locations and habitat models linked to each of the rare, threatened or endangered species. The habitat patches are then assigned a Rank of 1 through 5, based on the status of the species present as follows:

Rank 5: Presence of one or more Federally - listed threatened or endangered species.
Rank 4: Presence of one or more State - listed endangered species.
Rank 3: Presence of one or more State - listed threatened species.
Rank 2: Presence of one or more occurrence of non-listed State priority species.
Rank 1: Habitat patches with minimum habitat specific suitability size requirements for threatened or endangered or priority species, but do not intersect with any confirmed occurrence.

These maps and overlays provide a basis for proactive planning, such as the development of local habitat ordinances, zoning to protect critical habitat, management guidelines for rare species protection on public and private lands and prioritizing land acquisition projects. By combining critical area maps with other GIS layers such as roads, development and publicly-owned lands, important areas in need of protection can be easily identified. Incorporation of this information early in the planning process results in less conflict, less time wasted, and less money spent attempting to resolve endangered and threatened species issues.

The highest priority rank will be the one that appears on the Landscape Project Maps, meaning that a higher ranked area could include additional species that would otherwise be mapped under a lower rank category.

Much of Upper Deerfield contains some level of potentially suitable habitat, including vast "grassland" habitat, referring to the agricultural areas' potential for breeding savannah sparrows and other grassland birds. The NJDEP Forest and Grassland Habitat Landscape Project mapping (Section 12, Figure 12) has identified significant areas of Rank 5 forest and grassland habitat in the Cohansey drainage west of NJ Route 77. The Rank 5 forest and grassland indicates nest buffer habitat for the federally threatened bald eagle. Areas mapped as Rank 3 forest along the Cohansey and its tributaries, and a portion of the Muddy Run identifies critical habitat for the NJ State Listed threatened barred owl and Cooper's hawk. The Rank 3 grassland is primarily mapped between CR 553 and NJ Route 77, and in agricultural areas south of NJ Route 56. This ranked habitat identifies the areas where the NJ State listed endangered savannah sparrow has been confirmed. Rank 2 grassland and forest habitat also identifies Eastern box turtle and/or Fowler's toad populations.

Most of wetlands associated with Upper Deerfield's streams potentially contain suitable habitat for species listed in the Natural Heritage Database. The Forested and Emergent Wetland Habitat Landscape Map (Figure 16 in Section 12) also identifies critical habitat for species associated with NJDEP mapped forested and emergent wetlands. The mapping identifies significant areas of Rank 5 forested wetland habitat associated with the Cohansey River and adjacent tributary corridors. This area and the portion of Rank 5 critical emergent wetland habitat near the confluence of Foster and Parsonage Runs are bald eagle buffers. Rank 3 forested wetland along

the Cohansey, Cornwell Run and Muddy Run identify areas that include critical habitat for the barred owl and Cooper's hawk; both listed as State threatened.

State Development and Redevelopment Plan Mapping

NJDEP Department of Community Affairs Office of Smart Growth has prepared Preliminary State Plan Mapping as part of the New Jersey State Plan. The purpose of the state plan stated as follows:

Coordinate planning activities and establish Statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic preservation, public facilities and services, and intergovernmental coordination (N.J.S.A. 52:18A-200(f)).

The Preliminary Plan Mapping was designed for review by county and municipal planners and will be refined as more accurate data is obtained. The mapping was prepared using a variety of background GIS files including Landscape Project mapping, Wetlands, Beaches, Open Water, Dedicated Open Space, 1995 Urban Lands, Natural Heritage Priority Sites, Critical Hydrologic Units, Groundwater Recharge, NJ Department of Agriculture Preserved Land, NJ Department of Agriculture Priority Lands including Prime Soils and Wastewater Management Plans and data from the Department of Transportation's Statewide Transportation Improvement Program. The NJDEP Preliminary Mapping (October, 2005) identifies Environmentally Sensitive Areas within Upper Deerfield Township.

For more information on the State Preliminary Plan for Cumberland County and specifically Upper Deerfield, visit the NJDEP Office of Smart Growth website at: www.state.nj.us/dca/osg/resources/maps/prelimmapsinfo.shtml

10.6 Forest Fragmentation and Corridors

Fragmentation of forested areas by means of development isolates stands from the main forest complex, increasing the amount of edge habitat and decreasing the amount of forest interior habitat. Negative effects of forest habitat fragmentation are well documented for breeding birds (Robinson, 1988; Robinson and Wilcove, 1994; Herkert, 1994; Robinson *et al.*, 1995). Large tracts of contiguous forested areas are necessary to support breeding populations of migratory songbirds (Robbins *et al.*, 1989; Robinson *et al*,. 1997) as well as forest dwelling raptors (Thiollay, 1988; Bosakowski *et al.*, 1992; Bosakowski, 1994; Bosakowski and Speiser, 1994). Most forest interior species will only nest within a forest "core" that is at least 90 meters (295 feet) from the nearest forest edge. In addition the forest core must be a minimum of about 10 hectares (25 acres) in size (Dawson et al. 1993). Fragmented forests are characterized by high levels of edge-related nest predation, brood parasitism, or both and prove undesirable for many area sensitive species. In addition, forest fragmentation facilitates the spread of exotic and invasive species, both vegetative and mammalian, that can dramatically change the habitat structure of the forest. Demographic data suggest that populations of many forest-breeding species in severely fragmented landscapes may be "sinks" that produce too few young to

compensate for adult mortality. Rates of parasitism and predation are so much lower in large forested landscapes that they may act as "sources" that produce a surplus of young that are able to colonize small tracts in fragmented landscapes (Robinson et al., 1997). Immigration and recolonization are critical for long-term regional survival of local populations, particularly for imperiled species. The loss of habitat is the primary reason for the decline in species and affects plants, mammals, birds, reptiles, amphibians, fish and invertebrates.

Habitat corridors are linear landscape elements that provide wildlife the ability to move between habitat patches. The best corridors are those that are the widest possible and those that connect the largest patches of habitat. Forest interior and neotropical migrant birds, although able to disperse effectively, have been found to have a higher probability of using wider corridors (Keller et al 1993). Hodges and Krementz (1996) recommend that the minimum corridor width be no less than 100 meters (330 feet) in width. This will provide adequate width for forest interior dwellers. Most imperiled species are habitat specialists, meaning that they only survive within a specific type of habitat. In addition, they only occur in limited numbers, so it is critical that areas of suitable habitat are connected via adequate corridors. This allows individuals to migrate between habitats and interbreed with subpopulations. This concept is particularly important for many small mammals, reptiles, amphibians and some invertebrates. Many of these creatures can be entirely prohibited from dispersing if impeded by barriers such as roads or unsuitable habitat. Corridors between natural communities help to mitigate the impacts of habitat fragmentation and species isolation. Corridors allow species with limited dispersal capabilities an effective means to disperse.

Substantial Forest corridors exist along portions of the Cohansey in Upper Deerfield (see Section 12, Figure 14). The forest corridor between Seely and Sunset Lakes is varies in width from around 2000 feet to sections of approximately 100 or more feet. Other significant forest corridors exist along the major tributaries feeding the Cohansey and in the southernmost portions of the Township. These largest swaths of corridor habitat in the Township provide for significant forest "interior" habitat and also provide a useful corridor for wildlife dispersal. Narrower forested stream corridors frequently connect Upper Deerfield's larger tracts of forest within Upper Deerfield. The narrow corridors are extremely important to maintaining wildlife recruitment and diversity in Upper Deerfield's forests. Forest fragmentation and connectivity should always be considered during development review. Projects should be designed to limit forest fragmentation and/or the destruction of forest core area.

10.7 Regulatory Protection for Endangered and Threatened Species

The US Fish and Wildlife Service (USFWS) protects Federally listed endangered and threatened wildlife and plant species and their habitat under the 1973 *Endangered Species Act*. Under Section 7 of this Act Federal agencies are required to consult with the USFWS to ensure that the actions they authorize, fund, or carry out will not jeopardize listed species. In the event that proposed actions are determined to jeopardize a listed species, the USFWS must offer reasonable alternatives that will meet the goals of the proposed action without jeopardizing the listed species.

Under Section 9 of the Act, private landowners are prohibited from the "take" of endangered or threatened species. It is unlawful to endanger the livelihood of a listed species and this provision is extended to the habitat required by the species for its survival. Section 10 of the Act provides for the preparation of Habitat Conservation Plans. This provision is made to protect the rights of private landowners to develop or use their land even though they have endangered species on their property. These landowners can receive an “incidental take permit” provided they develop a Habitat Conservation Plan that provides for the conservation of the species.

The State of New Jersey has its own Endangered Species Act, the *Endangered and Nongame Species Conservation Act* (N.J.S.A. 23:2A-13 *et seq*), which resulted in the listing of State endangered animal species (N.J.A.C. 7:25-4:13) and a Nongame Species list, including threatened species (N.J.A.C. 7:25 4.179(a)). As part of this act, all New Jersey animals appearing on the federal list are also included on this state list.

Until recently, the "take" provision of this Act has not been interpreted to protect habitat for endangered or threatened species. The NJDEP is in the process of preparing rules that would provide for the protection of habitat for endangered and threatened species, although these rules have not yet been formally proposed or adopted.

Endangered plants in New Jersey have been identified in accordance with the *Endangered Plant Species List Act* (N.J.S.A. 13:1B-15.151 et seq.). State listed endangered and threatened wildlife species that are dependent upon wetlands can have increased protection to their wetland habitat under the *Freshwater Wetlands Protection Act* Rules. Federally listed plant species are also afforded protection under this Act. A freshwater wetland that is habitat for an endangered or threatened species is considered exceptional resource value (N.J.A.C. 7:7A-2.4(b)2.) and is given a standard transition area width of 150 feet (2.4(d)).

The *NJ Flood Hazard Area Control Act Rules* provide for protection of state listed endangered and threatened animal and plant species that inhabit the floodplain. Upper Deerfield may consider providing additional protections to endangered and threatened species and their habitat through adoption of a local ordinance.

11.0 SUMMARY

Upper Deerfield contains a variety of unique natural and cultural resources. The Township’s ERI is designed as a general tool to help identify and define these resources and well as provide guidance when determining how to best protect them. As previously mentioned, the ERI is a document that should be updated as the Township develops over time. Field surveys to augment findings and creating specific ordinances, plans or policies to protect identified resources should be considered. Listed below are some potential actions and measures that could be taken to identify and efficiently protect resources in Upper Deerfield Township:

Open Space Seek ordinances or policies that further protect open space and create an open space plan. A properly developed open space plan will help guide growth, more efficiently protect natural resources and help to maintain quality of life within the community. The plan

should include goals and actions, an inventory and mapping of existing open space and the variety of resources each area provides. In addition, the plain should identify properties as having open space and recreation potential, and provide public needs analysis and public input. The Green Acres Program (www.nj.gov/dep/greenacres) provides funding and guidance on preparing open space and recreation plans.

Wildlife/Threatened and Endangered Species Surveys NHP database and Landscape Project data are accomplished primarily through remote sensing. Field surveys of the potential critical habitats of Upper Deerfield can be performed. Field surveys would refine data collected through the State databases and other sources included in the Environmental Resource Inventory. Activities may include general habitat determinations to verify state landscape rankings and presence /absence surveys.

Ecological assessment of forest areas may include call-back surveys for barred owls or Cooper's hawks, particularly in larger forest patches and corridors along the Cohansey and major tributaries where these species have not yet been documented. Determining the presence or absence of additional listed bird species including migratory bird species may aid in evaluating the ecological value of a particular habitat. "Grassland habitats" are mapped throughout Upper Deerfield's agricultural areas. These habitats can be field evaluated for grassland bird species. Often the type of agricultural activity (e.g. row crops vs. pasture) will determine if a given agricultural area is suitable for grassland birds. Savannah sparrow, grasshopper sparrow, upland sandpiper and bobolink are among the State listed birds that utilize specific grassland habitats in southern New Jersey.

Reptile and amphibian inventories with a particular focus on vernal pool investigations may be useful in determining the extent of critical habitat within the Township. Although not listed in Upper Deerfield, endangered frog species such as Pine Barrens treefrog and southern gray treefrogs are located within vicinity of the municipality. Presence /absence surveys and habitat evaluations for these species may be considered. Common obligate vernal pool breeders, such as spotted salamanders, marbled salamanders and wood frogs, should be among the species targeted in vernal pool evaluations. Determining the presence or absence of amphibian species is useful in determining the level of impacts and overall ecological diversity of a given site.

Upper Deerfield has historic records of several endangered plant species. Surveys to determine the diversity of plant species within the Township, particularly in wetlands, will aid in determining the health and ecological value of a habitat. An extensive survey to determine the extent of the Federally-listed swamp pink within Upper Deerfield may be useful in ensuring its protection. Although volunteers may be able to participate in some activities, it is important that sensitive threatened and endangered species data be collected by a professional biologist/botanist in accordance with State and/or Federal standards.

Flood Hazard Areas Some areas not listed in existing FEMA floodplain map for Upper Deerfield have been reported to have significant flooding. These include tributaries south of Harrow Brook and Cornwell Run (Bergmann, 2005). Municipal Flood Hazard Area regulations are outlined in the Zoning and Development Codes for Upper Deerfield Chapter 98, Article VII, 98-19. Flood hazard areas may be better identified and protected.

Stream Corridors/Riparian Buffers Many of the critical habitats identified in the ERI are associated with the Cohansey River and its major tributaries in Upper Deerfield. Upper Deerfield may consider adopting a stream corridor ordinance that identifies and clearly defines Township floodplains and stream corridors, and protects the corridors with a focus on protecting water quality (some municipalities utilize buffers 100 feet beyond the 100-year floodplain). The stream corridor may be extended if critical habitats, floodplains or wetlands are found to be adjacent to the corridor. Managing stream buffers must include efforts to create and/or maintain buffers with native stream bank vegetation that does not require maintenance. As with forest patch and corridor protection, stream corridor protection is essential in protecting habitat for wildlife migration and recruitment.

Historic/Archaeological Preservation Upper Deerfield contains a variety of historic roads, structures and potential archaeological sites. Historic and archaeological resources are typically best protected at the municipal level. As mentioned in the ERI, areas within 300 feet of the Cohansey River or its major tributaries have the higher potential for containing archaeological remains. Some municipalities have adopted Historic Preservation Plans to help with the process of protecting these resources. The general approach is to locate and determine the significance of historic sites and districts, set standards for determining historic worthiness, and to review how master plan elements may impact historical/archaeological resources.

Forests Upper Deerfield is home to significant woodland species including the threatened Cooper's hawk and the barred owl. Preserving significant forest buffers will not only protect these species, but will provide significant protection to a variety of species including neotropical migrant birds (see Section 10.6). Some municipalities adopt a woodlands protection plan and an ordinance with specific language for protecting woodland habitats and/or significant trees. Woodland protection plans and ordinances should focus on preserving contiguous patches of habitat, preventing fragmentation and reconnecting woodland patches via corridor preservation.