MIDDLE DELAWARE RIVER CONSERVATION PLAN

Prepared For:

Bridgeton Township
Durham Township
City of Easton
Forks Township
New Hope Borough
Nockamixon Township
Plumstead Township
Riegelsville Borough
Solebury Township
Tinicum Township
Upper Makefield Township
Williams Township

Funded by:

Pennsylvania Department of Conservation and Natural Resources

Prepared by:

HERITAGE CONSERVANCY

March 2004

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I. A Case for the Protection of the Middle Delaware River

Introduction and Purpose

The Middle Delaware River Conservation Plan (MDRCP) represents the culmination of a multi-year joint planning effort involving state, county, and local municipal organizations and residents for the 48.4 mile segment of the Delaware River extending from Forks Township, Northampton County to Upper Makefield Township in Bucks County. The purpose of a river conservation plan is to provide a comprehensive inter-municipal approach to improving, conserving, and making better use of the river's resources and surrounding land in this particular river segment.

The Pennsylvania Rivers Conservation Program has been developed to conserve and enhance river resources through preparation and accomplishment of locally initiated plans. The program provides technical and financial assistance to municipalities and river support groups to carry out planning, implementation, acquisition, and development activities. This river conservation plan includes an inventory of significant natural, recreational and cultural resources, the identification of key goals and objectives for conservation, and describes conservation and land management measures with specific implementation actions. This project is funded in part by a grant from the Community Conservation Partnership Program, made possible by the Keystone Recreation, Park and Conservation Fund Act of 1993. The program is administered by the Bureau of Recreation and Conservation, Pennsylvania Department of Conservation and Natural Resources (DCNR).

The four steps in developing the plan included:

- Coordination of initial public involvement
- Collection and analysis of resource data
- Preparation and distribution of draft river conservation plan
- Preparation of final river conservation plan

Upon completion of the MDRCP and subsequent approvals by the participating municipalities and the DCNR, this river segment would be listed on the Pennsylvania Rivers Conservation Registry.

The Pennsylvania Rivers Conservation Registry promotes river conservation and recognizes rivers or river segments in communities who have completed river conservation plans. The registry is also an avenue to endorse local initiatives by binding them together in a statewide recognition program. In order for a river to be placed on the registry, it must have an approved plan and local municipal support. Registry status must be achieved to qualify for implementation, development or acquisition grants.

Once listed on the rivers registry, the municipalities within the Middle Delaware River Study Area would then become eligible for DCNR funding under the Community Conservation Partnership Program (C2P2), Rivers Conservation Program for certain acquisition and development projects on a 50-50 cost sharing basis.

Study Area Description

The MDRCP Study Area boundary is shown on **Map 1 (Study Area)** and encompasses 12 municipalities across two counties along the southeastern boundary of Northampton County and the easternmost boundary of Bucks County. **Table I-1** shows that all or a portion of the following municipalities are within the study area: Forks Township, the city of Easton, Williams Township, Riegelsville Borough, Durham Township, Nockamixon Township, Bridgeton Township, Tinicum Township, Plumstead Township, Solebury Township, New Hope Borough, and Upper Makefield Township. The study area is approximately 105 square miles or 67,279 acres in size. The river segment in the study area is 48.4 (river) miles in length.

Table I-1 Distribution of Municipal Acreage - Middle Delaware River Study Area

Name	Acreage within Study Area	Percent of Total Study Area	Percent of Municipality in Study Area
Forks Township	2,102	3.1%	26.7%
City of Easton	735	1.1%	24.7%
Williams Township	8,146	12.1%	68.5%
Riegelsville Borough	695	1.0%	99.4%
Durham Township	2,301	3.4%	38.6%
Bridgeton Township	4,019	6.0%	92.2%
Nockamixon Township	5,346	7.9%	37.4%
Tinicum Township	7,263	10.8%	36.9%
Plumstead Township	1,674	2.5%	9.6%
Solebury Township	14,342	21.3%	83.0%
New Hope Borough	897	1.3%	100.0%
Upper Makefield Township	13,888	20.6%	99.8%
Other Municipalities*	5,871	8.7%	
Total	67,279	100.0%	

***Includes portions of Springfield, Buckingham, Wrightstown, Newtown, & Lower Makefield Townships**

The study area generally follows the prominent ridgeline on the west bank of the river, encompassing all direct drainages to the Delaware River, not previously or currently under study. The study area includes the following named tributaries: Frys Run (a.k.a. Frya Run), Rodges Run, Gallows Run, Wild Cat Hollow Run, Falls Creek, High Falls Creek, Mine Spring Creek, Swamp Creek, Smithtown Creek, Hickory Creek, Cuttalossa Creek, Primrose Creek, Rabbit Run, Aquetong Creek, Dark Hollow Run, Pidcock Creek, Jericho Creek, Houghs Creek, and Dyers Creek. A more detailed study is currently underway for Gallows Run. (**See Map 1**)

Map 1 Study Area
11 x 17 map

Major transportation routes within the study area include Pennsylvania (PA) Route 32 (River Road) and PA Route 611 (Easton Road) which provide north and south access through the study area. Major east/west routes include U.S. Route 202 (Lower York Road), PA Route 263 (Upper York Road), PA Route 532 (Washington Crossing Road) and PA Route 232 (Windy Bush Road). These state routes are supplemented by various local roadways, which provide access from southeastern Pennsylvania and the Lehigh Valley. Many of these routes provide access across the Delaware River into New Jersey including: PA Route 532 in Upper Makefield Township, U.S. Route 202 in New Hope Borough, and PA Route 263 in Solebury Township. River crossings are also found in Uhlerstown, Tinicum Township, Riegelsville Borough, and in the city of Easton.

Planning History

This particular study area was selected to complete coverage of the Delaware River Watershed included as part of the Lower Delaware National Wild and Scenic River System. Separate river conservation plans have been completed, or are nearing completion for the following adjacent waterways within the Delaware River Watershed: Cooks Creek, Paunacussing Creek, Tinicum Creek, and Tohickon Creek in Bucks County, and Bushkill Creek and the Lehigh River in Northampton County.[1]

The river conservation planning process within the Delaware River Watershed was an outgrowth of the Lower Delaware River Management Plan[2] prepared in conjunction with the Lower Delaware National Wild and Scenic River Study Report [3]. It is important to differentiate between the scope of a river conservation plan and that of a National Wild and Scenic Rivers study. A National Wild and Scenic River study is a congressionally authorized study to determine the suitability of a river segment to be added to the National Wild and Scenic Rivers System. The National Wild and Scenic River System was established by the 1968 Wild and Scenic Rivers Act (P.L. 90-542, as amended). The Act states that: *certain selected rivers of the Nation…shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations*.

The Lower Delaware River Wild and Scenic River Study was authorized by Congress in 1992. Its study area includes the river segment on both sides of the Delaware between the Delaware Water Gap in Upper Mt. Bethel, Northampton County PA and Upper Makefield Township in Bucks County PA, a distance of 65.6 miles. This segment of the Lower Delaware was added to the National Wild and Scenic River System in 2000.

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[1] For further information on completed studies see: Cooks Creek Watershed Conservation Plan (Durham Township Environmental Advisory Council and MJ Environmental Associates, Ltd. 2001), The Lower Tohickon Creek Watershed Conservation Plan (Tinicum Conservancy, and Princeton Hydro, LLC , 2002), Tinicum Watershed Conservation Plan (Tinicum Creek Watershed Association, Tinicum Township, and Princeton Hydro, 2000). Other watershed studies are in progress.

[2] Lower Delaware River Wild and Scenic River Study Task Force with assistance from the National Park Serve, Northeast Field Area, Lower Delaware River Management Plan, (Philadelphia, 1997)

[3] National Park Service, Lower Delaware National Wild & Scenic River Study Report Northeast Region (Philadelphia, 1999).

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In comparison, the Middle Delaware River Conservation Plan is prepared under a state authorized program, which focuses on a smaller segment of the Lower Delaware Scenic and Recreational River and is limited to the Pennsylvania side of the Delaware River. This planning effort is not intended to be duplicative; but rather builds upon and incorporates information from the previous studies and focus on the development of conservation goals and specific management options to further protect the Study Area's resources. This project builds upon the efforts of other river conservation plans in the Delaware River Watershed such as, the Neshaminy Creek Watershed Conservation Plan, in 1997, the Lower Delaware River Conservation Plan in 1999, the Tinicum Creek Watershed Conservation Plan (WCP) in 2000, the Cooks Creek WCP in 2001, and the Lower Tohickon Creek WCP in 2003.

In addition to the Lower Delaware River Management Plan, there are other regional planning documents under development, which share common river resource protection goals with this plan. These include the Regional Open Space Priorities Report (GreenSpace Alliance of Southeastern Pennsylvania, 2004), and the Delaware River Basin Commission's Delaware River Basin Water Resources Plan (Public Review Draft, Jan. 2004).

Summary of the Middle Delaware River Resources

The natural resources of this segment of the river and its watershed are significant. The river supports a diversity of fish populations, which has increased with the improvement of the water quality over the years. Land resources include an extremely diverse topography and dramatic changes in geology. A variety of vegetation results from the differences in elevation, climate, physiography, geology, hydrology and land use. These features provide habitat for many species of wildlife, some of which are rare, threatened or endangered. Another important feature of the Middle Delaware River Study Area is the farming activities that are spread throughout the area and the abundance of important farmland soils.

The historic resources of this stretch of the Delaware are significant. The long time line of historic periods and events include numerous Native American archeological sites from the Lenni-Lenape Indians who lived along the Delaware River for thousands of years prior to European settlement. The Middle Delaware River area was prominent during the colonial period, American Revolutionary times, the Industrial Revolution and the subsequent periods of urbanization and suburbanization. Important historical events include the first public reading of the Declaration of Independence in Easton on July 8, 1776 and, farther down the river, the crossing of George Washington's army on Christmas Eve, 1776 that commenced the battle of Trenton. Buildings, structures and place names of historic significance are evident throughout the study area.

The cultural resources of the Middle Delaware River are significant. This area has been a center for art, theater, music and literature for decades. The numerous historic properties

and historic districts located along the river such as Point Pleasant, Lumberville, Uhlerstown and Dolington are examples of the area's historical and cultural heritage.

Recreational resources related to the land and the river, are also widespread. Park and recreational facilities of the state, county and municipal governments are located throughout the area. Annual shad festivals held in Lambertville NJ and Easton PA and the Forks of the Delaware River Shad Fishing Tournament are examples of how recreation and natural resources are interconnected. Private recreational attractions include floating down the river in inner tubes and camping. Easton, New Hope and Washington Crossing are major tourist destinations. The Delaware and Lehigh Canal National Heritage Corridor and the canal towpath provided great recreational and cultural opportunities for visitors and residents. The river presents many options for water related activities, such as fishing, swimming, boating and bird watching.

The Middle Delaware River Study Area contains a wide range of resources. As with any asset, these resources must be preserved, maintained, nurtured and enhanced. There are both regulatory and non-regulatory methods that the federal, state and local governments may employ to protect these resources. Non-profit groups and land trust organizations also contribute to preservation efforts. Most importantly, decisions made by property owners will determine what the long-term qualities of the natural and built environments shall be.

II. Resource Inventory

Land Use and Demographic Profile

Land Cover and Zoning Patterns

Information gathered from the United States Geological Survey (USGS) and Pennsylvania Department of Environmental Protection (PA DEP) Land Cover Data from 1992 reveals patterns of low density to medium density residential intermixed with woodland/forests, agricultural, open space and limited commercial and industrial uses. As shown in Map 2 (Existing Land Cover), the less intensive land uses are prevalent in the townships, while more intensive uses such as medium to high density housing, commercial and industrial uses are mainly found within the city of Easton and the boroughs of Riegelsville and New Hope. The natural areas along the Middle Delaware River are interrupted only by towns that developed during the canal era or the earlier, log rafting period. Today, the area primarily includes small rural communities. Most of the river corridor is privately owned and is characterized by woodland areas, low-density residential, and agricultural uses. In 1992, over 60 percent (60.2% or 40,356 acres) of the Middle Delaware River Study Area was considered woodlands/forest. Agricultural lands comprise the second largest land cover category, representing about 31% of the total Study Area. Table II- 1 provides a breakdown of the land cover data within the Study Area. Updated land cover data is expected to be available through the Pennsylvania Spatial Data Access (PASDA) in late summer or early fall of 2003 from USGS. Due to development in the study area since 1992, land cover percentages are expected to change. Most likely the data will show reductions in the percentage of agricultural and farmland coverages and increases in low-density housing. This information, if available, will be provided in the final draft document.

Table II - 1 Land Cover Statistics for Study Area

Land Cover Type	Acres	% Study Area
Woodland/Forest	40,356.2	60.2%
Pasture/Hay	16,810.8	25.1%
Row Crop	3,766.0	5.6%
Open Water	2,492.9	3.7%
Low Intensity Residential	1,736.4	2.6%
Wetland	1,056.8	1.6%
Commercial/Transportation	375.7	0.6%
Quarries/Strip Mines/Gravel Pit	323.3	0.5%
High Intensity Residential	78.3	0.1%
Transitional	43.6	0.1%

Source: Pennsylvania Spatial Data Access based on United States Geological Survey Land Cover data.

Map 2 Existing Land Cover

1 – 11 x 17 map

Map 3 (Generalized Zoning) illustrates zoning patterns across the study area municipalities based on digital information provided by the Bucks County Planning Commission and Lehigh Valley Planning Commission. The Bucks County information is based on 1995 data updated to 2003, while the data from Lehigh Valley Planning Commission is from 2000. To provide consistency, the color-coding of the zoning categories has been adjusted to reflect similarities in zoning designations within each community and across the county lines.

In general, the major zoning designation within the study area townships (with the exception of Forks, Plumstead and Bridgeton Townships) is low-density residential (less than two dwelling units per acre). The majority of zoning within Plumstead and Bridgton Townships within the study area is for low-to-medium density housing (one to two dwelling units per acre). Forks Township includes a mix of suburban residential and light industrial and office business uses. Zoning in the more developed boroughs and cities, such as Riegelsville, Easton and New Hope, is more diverse and includes medium and high density residential, intermixed with commercial/retail, industrial and office uses.

It is important to note that the zoning designations shown on Map 3 reflects general categories and that the information may be dated. A municipality's current adopted zoning map should always be consulted to verify current and specific zoning designations on a parcel-by-parcel basis.

A review of the study area's zoning and land development ordinances revealed that many communities have varying degrees of natural resource protection tools. The majority of study area municipalities have floodplain, steep slope, and storm water management and water quality controls in place. Many have additional regulations for wetland and riparian buffer protection. Appendix A contains tables, which summarize the types of regulations currently in place within the study area communities. The data for Bucks County municipalities was compiled by the Bucks County Planning Commission and updated in 2003. The data for the Northampton County municipalities was compiled based on a review of the most recent zoning and subdivision ordinances available for Forks and Williams Township and the City of Easton.

Population and Housing Trends

Each of the communities within the Middle Delaware River Study Area is unique and may have specific demographic characteristics, which distinguish it from the others. However, it is also important to understand and recognize collective patterns and trends in population and housing unit growth, age distribution, and household characteristics. It is equally important to identify future growth trends by examining population projections for the region as well. Population forecasts provide reasonable, but qualified, projections of future levels.

Demographic information summarized in this document is drawn from the U. S. Census Bureau data from both 1990 and 2000. For comparison purposes, State and County data are also provided. There is an important spatial consideration to be kept in mind when

reviewing the following information. The data was obtained and is summarized on the municipal level. Therefore, the information regarding population and housing identify conditions and trends in the whole geographic areas of the municipalities, rather than being specific to the portions within the study area boundary. As shown in most of the maps in this report, the study area incorporates varying portions of the affected municipalities. For example, most of Bridgeton, Solebury and Upper Makefield Townships are included in the study area with smaller portions of Durham, Forks, Plumstead and Tinicum Townships.

Population Growth and Characteristics

As listed in **Table II-2**, the population of the municipalities within the study area grew by 12,231 residents between 1990 and 2000. Only the city of Easton and Riegelsville Borough lost population over the same time period. As shown in **Figure A**, several municipalities experienced growth rates well above the Bucks County growth rate of ten percent and the Northampton County rate of eight percent. These include Forks, Plumstead, Solebury, and Upper Makefield Townships and New Hope Borough. Collectively, the municipalities have increased population by over 18 percent since 1990.

Table II-2 Population Change in Study Area 1990-2000

Area	U.S. Census Population		Numeric Change	Percent Change
	1990	2000	1990-00	1990-00
Pennsylvania	11,881,643	12,281,054	399,411	3.4%
Bucks County	541,174	597,635	56,461	10.4%
Northampton County	247,105	267,066	19,961	8.1%
Planning Area Municipalities	**66,812**	**79,043**	**12,231**	**18.3%**
Bridgeton Township	1,378	1,408	30	2.2%
Durham Township	1,209	1,313	104	8.6%
Easton City	26,276	26,263	-13	0.0%
Forks Township	5,923	8,419	2,496	42.1%
New Hope Borough	1,400	2,252	852	60.9%
Nockamixon Township	3,329	3,517	188	5.6%
Plumstead Township	6,289	11,409	5,120	81.4%
Riegelsville Borough	912	863	-49	-5.4%
Solebury Township	5,998	7,743	1,745	29.1%
Tinicum Township	4,167	4,206	39	0.9%
Upper Makefield Township	5,949	7,180	1,231	20.7%
Williams Township	3,982	4,470	488	12.3%

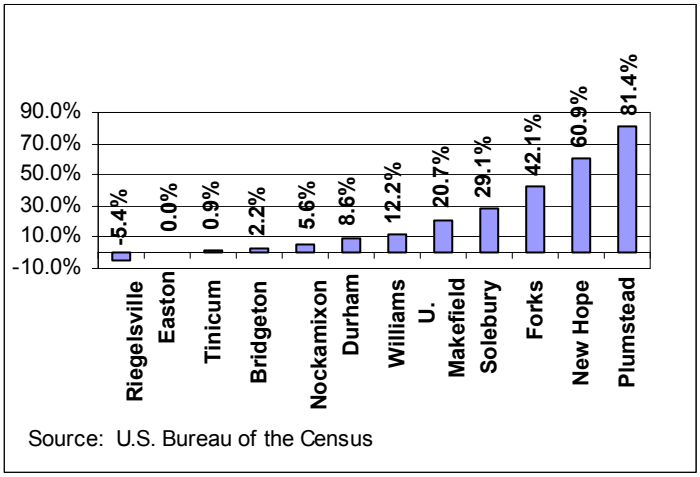
Sources: US Bureau of the Census, Census 2000. Bucks County Planning Commission, Municipal Directory. 2001. Lehigh Valley Planning Commission. Municipal Profiles. July 2001

As indicated by the data, population change varied substantially throughout the corridor, indicating that some municipal population growth rates have stabilized, while others are growing rapidly.

Map 3 Generalized Zoning

3 11 x 17 maps

Figure A Percent Change In Population 1990-2000



Source: U.S. Bureau of the Census

Population density is a measure of the number of residents per square mile and is calculated by dividing the total population by the total land area of the municipality. As would be expected, the city of Easton, and the two boroughs of New Hope and Riegelsville are much more densely populated than the townships. Again, it is important to keep in mind that the density numbers are for the entire municipality, not specifically the area within the study area. For example, most of Plumstead Township's growth took place along the Route 611 corridor, which is not located within the study area. Table II-3 summarizes the various population densities of the study area municipalities, the counties and state.

Table II-3 Population Density

Area	Land Area In Sq. Miles*	2000 Census Total Population	Population Density Per Sq. Mile
Pennsylvania	44,816.61	12,281,054	274
Bucks County	607.38	597,635	984
Northampton County	373.8	267,066	715
Planning Area Municipalities	**179.77**	**79,043**	**440**
Bridgeton Township	6.47	1,408	218
Durham Township	9.21	1,313	143
Easton City, Northampton	4.26	26,263	6,165
Forks Township, Northampton	12.06	8,419	698
New Hope Borough	1.27	2,252	1,773
Nockamixon Township	22.19	3,517	158
Plumstead Township	27.16	11,409	420
Riegelsville Borough	0.99	863	872
Solebury Township	26.64	7,743	291
Tinicum Township	30.2	4,206	139
Upper Makefield Township	20.93	7,180	343
Williams Township Northampton	18.39	4,470	243

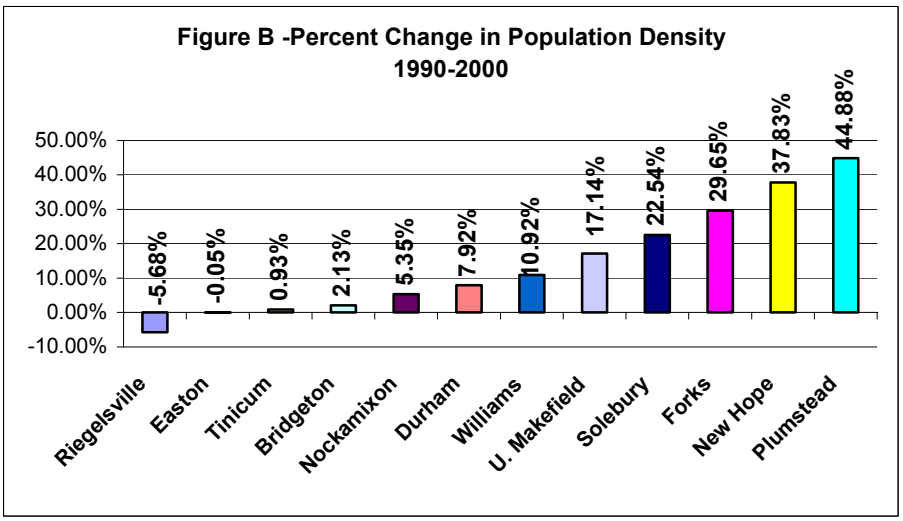
*Note: Land area excludes water area for density calculation

Sources: U.S. Census Bureau, Census 2000, Bucks County Planning Commission, Municipal Directory, 2001, and Lehigh Valley Planning Commission, Municipal Profiles, July 2001.

As a whole, the average density of these municipalities is below each of the county averages, indicating that the townships have more rural development patterns.

Another indicator of overall growth trends is the change in population density over time. Population density in 2000 was compared with 1990 figures and the results are illustrated in Figure B. This data typically correlates with other demographic changes such as population and housing growth. Thus, the townships of Forks, Plumstead, and Solebury, and the borough of New Hope all experienced double-digit increase in population density.

Figure B Percent Change in Population Density 1990-2000



Age and Household Characteristics

The 2000 census provided detailed information on various age characteristics of the people who lived in study area. The age distribution of the population is an important indicator for communities because of the potential impact on the provision of public services and facilities. For example, communities with a high percentage of young children are often faced with the need to raise funds for expanded educational and recreational facilities. The young adult age cohort (18-44) is the group most engaged in new household formation and purchasing homes. Thus, communities showing a high percentage within this age cohort tend to be growing. These concepts are summarized in the following two tables. The first, Table II-4, summarizes the percent of the population below 18 years and over 65 years. The second, Table II-5, summarizes the percent of total households with individuals below 18 and those over 65 years.

Table II-4 Age Characteristics in Study Area 2000			
Area	2000 Census	Percent of Population	
	Median Age	Under 18 Years	65 Years and Over
Pennsylvania	38.0	23.8	15.6
Bucks County	37.7	25.7	12.4
Northampton County	38.5	23.3	15.7
Planning Area Municipalities	**39.8**	**23.5**	**11.8**
Bridgeton Township	41.1	22.4	13.0
Durham Township	40.8	23.9	11.9
Easton City, Northampton	32.0	23.3	11.9
Forks Township, Northampton	38.6	27.6	12.7
New Hope Borough	41.2	15.5	11.3
Nockamixon Township	39.7	23.5	9.6
Plumstead Township	34.4	30.9	6.5
Riegelsville Borough	40.0	21.3	15.5
Solebury Township	44.1	22.0	11.6
Tinicum Township	42.2	21.0	13.9
Upper Makefield Township	42.4	26.7	10.2
Williams Township. Northampton	40.7	24.2	13.0

Source: U.S. Census Bureau, Census 2000

As summarized in **Tables II-4 and 5,** the municipalities within the study area exhibit percentages of population under 18 similar to the state and county averages. The percentage of elderly tends to be somewhat lower when compared to the state and county numbers. Those with a higher than average percentage of persons under 18 tend to be the communities which are experiencing more growth such as Plumstead, Forks and Upper Makefield. This becomes even more obvious when reviewing the household information shown in **Table II-5.** This table also lists the average household size and average family size for the study area municipalities, counties and state. Families are people living together who are related by blood, marriage or adoption. Households (HH) include families plus single person living units and unrelated people living together.

The change in household size from 1990 to 2000 was also examined. For the most part, household sizes in the study area municipalities have decreased, reflecting not only regional and statewide trends, but a national trend as well.

Table II-5 Selected Household Characteristics in Study Area				
Area	**% of HH with individuals under 18**	**% of HH with individuals over 65**	**Average HH Size - 2000**	**Average Family Size 2000**
Pennsylvania	32.6	27.8	2.48	3.04
Bucks County	37.7	23.3	2.69	3.17
Northampton County	33.6	28.0	2.53	3.02
Planning Area Municipalities	**33.8**	**21.7**	**2.56**	**3.02**
Bridgeton Township	31.7	24.2	2.52	2.97
Durham Township	36.1	23.5	2.71	3.07
Easton City	34.0	22.9	2.46	3.10
Forks Twp	42.0	23.8	2.76	3.13
New Hope Borough	18.4	17.1	1.94	2.74
Nockamixon Township	34.0	18.5	2.63	3.04
Plumstead Township	46.7	13.1	2.89	3.26
Riegelsville Borough	29.1	26.7	2.28	2.77
Solebury Township	31.4	20.1	2.52	2.94
Tinicum Township	28.5	24.9	2.49	2.94
U. Makefield Township	39.1	19.9	2.86	3.13
Williams Township	34.2	25.3	2.70	3.10

Source: U.S. Bureau of the Census, Census 1990, 2000.

Housing Unit Growth and Vacancy Characteristics

Table II-6 summarizes the housing unit changes in both number and percentage over the past decade. This data shows that over 5,000 new units were either constructed or formed (splitting a single unit into several units) in the past decade. These numbers correspond to the population growth figures and highlight the communities where new construction or formation has been most significant.

Table II-6 Housing Unit Change 1990 to 2000				
Area	**Number of Housing Units**		**Numeric Change**	**Percent Change**
	1990	**2000**	**1990 to 2000**	**1990 to 2000**
Bucks County	199,934	225,498	25,564	12.8%
Northampton County	95,345	106,710	11,365	11.9%
Planning Area Municipalities	**26,332**	**31,386**	**5,054**	**19.2%**
Bridgeton Township	573	612	39	6.8%
Durham Township	485	525	40	8.2%
Easton City	10,309	10,545	236	2.3%
Forks Twp	2,259	3,159	900	39.8%
New Hope Borough	1,007	1,251	244	24.2%
Nockamixon Township	1,260	1,411	151	12.0%
Plumstead Township	2,295	4,103	1,808	78.8%
Riegelsville Borough	404	403	-1	-0.2%
Solebury Township	2,503	3,207	704	28.1%
Tinicum Township	1,709	1,834	125	7.3%
U. Makefield Township	2,024	2,598	574	28.4%
Williams Township	1,504	1,738	234	15.6%

Source: U.S. Bureau of the Census, Census 1990, 2000.

The number of total housing units and the occupied housing units, are listed in Table II-7. Vacant housing units would include seasonal, recreational and occasional uses, as well as those for sale or rent at the time the census is taken.

Table II-7 Housing Occupancy

Area	Total Units		2000 Occupancy		Percent of Total Units	
	1990	2000	Vacant	Occupied	Vacant	Occupied
Pennsylvania	4,938,140	5,249,750	472,747	4,777,003	9.0%	91.0%
Bucks County	199,934	225,498	6,773	218,725	3.0%	97.0%
Northampton County	95,345	106,710	5,169	101,541	4.8%	95.2%
Planning Area Municipalities	**26,332**	**31,386**	**2,054**	**29,332**	**6.5%**	**93.5%**
Bridgeton Township	573	612	53	559	8.7%	91.3%
Durham Township	485	525	40	485	7.6%	92.4%
Easton City	10,309	10,545	1,001	9,544	9.5%	90.5%
Forks Twp	2,259	3,159	124	3,035	3.9%	96.1%
New Hope Borough	1,007	1,251	91	1,160	7.3%	92.7%
Nockamixon Township	1,260	1,411	74	1,337	5.2%	94.8%
Plumstead Township	2,295	4,103	165	3,938	4.0%	96.0%
Riegelsville Borough	404	403	25	378	6.2%	93.8%
Solebury Township	2,503	3,207	154	3,053	4.8%	95.2%
Tinicum Township	1,709	1,834	160	1,674	8.7%	91.3%
U. Makefield Township	2,024	2,598	86	2,512	3.3%	96.7%
Williams Township	1,504	1,738	81	1,657	4.7%	95.3%

Source: U.S. Census Bureau, Census 1990 and 2000.

Typically, housing vacancy rates between three percent and five percent indicate a strong housing market for both sellers and buyers. It is important to note that the data contained in the above table is from the 2000 census and does not reflect the current economic conditions characterized by very low mortgage interest rates (i.e. there may be a more rapid turnover of housing units for sale in 2003, than there were in 2000, which could affect housing vacancy rates). In general, municipalities in 2000 showed slightly higher-than-average vacancy rates, especially when compared to the countywide averages.

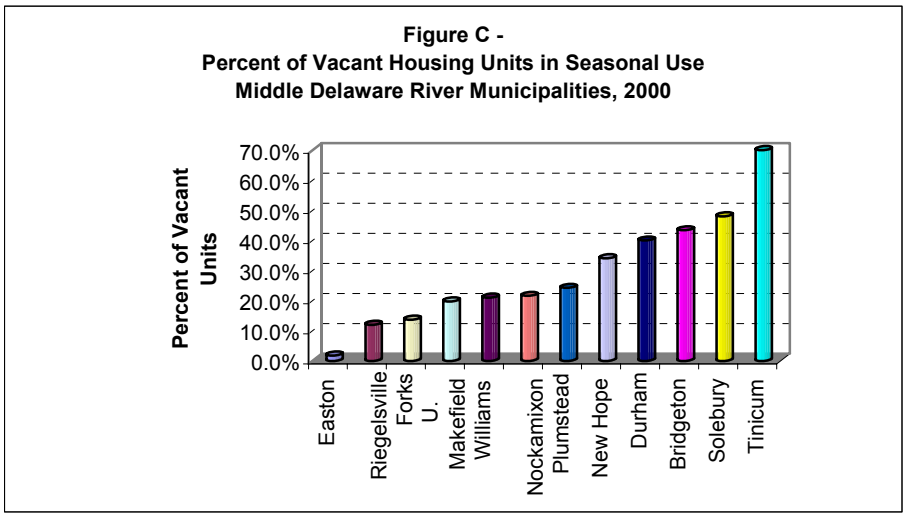
Above average vacancy rates may be partially attributed to vacation or seasonal homes, which are commonly found in areas with unique natural resources or river frontage and access. Thus, vacancy characteristics were further examined to see if this is true of the Middle Delaware River Study Area.

Table II-8 Housing Vacancy Characteristics 2000					
Area	**Total Housing Units, 2000**	**Number Of Vacant Units**	**Number Of Vacant Units In Seasonal Use**	**% Of Total Housing In Seasonal Use**	**% Of Vacant Units In Seasonal Use**
Pennsylvania	5,249,750	472,747	148,230	2.8%	31.4%
Bucks County	225,498	6,773	898	0.4%	13.3%
Northampton County	106,710	5,169	495	0.5%	9.6%
Study Area Municipalities	**31,386**	**2,054**	**384**	**1.2%**	**18.7%**
Bridgeton	612	53	23	3.8%	43.4%
Durham	525	40	16	3.0%	40.0%
Easton	10,545	1,001	18	0.2%	1.8%
Forks	3,159	124	17	0.5%	13.7%
New Hope	1,251	91	31	2.5%	34.1%
Nockamixon	1,411	74	16	1.1%	21.6%
Plumstead	4,103	165	40	1.0%	24.2%
Riegelsville	403	25	3	0.7%	12.0%
Solebury	3,207	154	74	2.3%	48.1%
Tinicum	1,834	160	112	6.1%	70.0%
Upper Makefield	2,598	86	17	0.7%	19.8%
Williams	1,738	81	17	1.0%	21.0%

Source: U.S. Bureau of the Census, Census 2000.

As summarized in Table II-8 and further illustrated in Figure C, a number of the study area municipalities have a high percentage of vacant housing units categorized as seasonal or recreational use properties. This is particularly evident in Bridgeton, Solebury and Tinicum Townships. Collectively, there are a higher percentage of seasonal units in the study area when compared to the two counties.

Figure C Percent of Vacant Housing Units In Seasonal Use



Source: U.S. Bureau of the Census, Census 2000.

Population Projections for the Planning Area

Population forecasts are not predictions. Population forecasts should be viewed as reasonable estimates of what levels of population growth might take place based on the assumptions and methods used by the agencies that prepare the forecasts. Certainly factors such as national, regional and local economic conditions will affect population trends. Other social factors, market considerations and infrastructure availability will influence growth. Political and legal matters always have direct affects on location, amount and timing of growth and development.

Table II-9 summarizes the population projections for the study area municipalities and the two counties. For the Bucks County municipalities, population forecasts were provided by the Delaware Valley Regional Planning Commission. The Lehigh Valley Planning Commission offered the projections for the Northampton County municipalities. These agencies have provided forecasts based on two 10-year periods that provide some guidance to 2020.

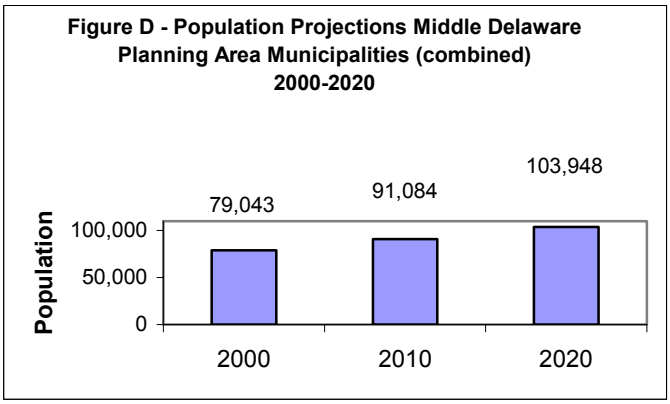
Table II-9 Population Projections for the Study Area

Area	Current Population	Projections*		Numeric Change			% Change		
	2000	2010	2020	2000-10	2010-20	2000-20	2000-10	2010-20	2000-20
Bucks County	597,635	662,400	719,610	64,765	57,210	121,975	10.8%	8.6%	20.4%
Northampton County	267,066	290,919	316,052	23,853	25,133	48,986	8.9%	8.6%	18.3%
Study Area Municipalities	**79,043**	**91,084**	**103,948**	**12,041**	**12,864**	**24,905**	**15.2%**	**14.1%**	**31.5%**
Bridgeton Township	1,408	1,470	1,500	62	30	92	4.4%	2.0%	6.5%
Durham Township	1,313	1,440	1,540	127	100	227	9.7%	6.9%	17.3%
Easton City	26,263	26,272	26,282	9	10	19	0.0%	0.0%	0.1%
Forks Township	8,419	10,543	13,477	2,124	2,934	5,058	25.2%	27.8%	60.1%
New Hope Borough	2,252	2,320	2,330	68	10	78	3.0%	0.4%	3.5%
Nockamixon Township	3,517	3,770	3,950	253	180	433	7.2%	4.8%	12.3%
Plumstead Township	11,409	14,280	16,310	2,871	2,030	4,901	25.2%	14.2%	43.0%
Riegelsville Borough	863	860	810	-3	-50	-53	-0.3%	-5.8%	-6.1%
Solebury Township	7,743	9,660	11,980	1,917	2,320	4,237	24.8%	24.0%	54.7%
Tinicum Township	4,206	5,580	6,110	1,374	530	1,904	32.7%	9.5%	45.3%
Upper Makefield	7,180	9,530	13,350	2,350	3,820	6,170	32.7%	40.1%	85.9%
Williams Township	4,470	5,359	6,309	889	950	1,839	19.9%	17.7%	41.1%

***Sources: Delaware Valley Regional Planning Commission, Population and Employment Forecasts, 2000-2025. No. 73, March, 2002. Lehigh Valley Planning Commission, 2000 Population Projections, November 2002.**

Based on the projections provided by the regional planning agencies, the overall population of the communities within the Middle Delaware River Study Area is expected to increase by 31.5 percent or 24,905 people by 2020. This increase is illustrated in Figure D. Population increases are projected to be most significant in the townships of Forks, Solebury and Upper Makefield.

Figure D Population Projection



Source: Delaware Valley Regional Planning Commission, Lehigh Valley Planning Commission

Major Employers

Due to the relatively rural nature of the project area, major sources of employment opportunities are primarily located in areas outside of the study area. There are retail and commercial centers located in Easton and in New Hope Borough. However, as indicated by the land use map only 3.4% of the planning area is considered developed and only 0.1% designated as high density. Industrial and commercial areas (0.6%) are primarily located along major corridors such as Route 611 (Easton Road) and Route 32 (River Road) and Route 202 (Washington Crossing Road) near New Hope Borough, a major tourist destination. These areas primarily contain retail facilities or tourism-related facilities.

The major employers in the region are related to healthcare and governmental facilities. In Bucks County, the regional healthcare and governmental facilities are located in or near the county seat of Doylestown. Other major employers are located in the southern or lower portions of the county near the City of Philadelphia. These include the Estee Lauder Company, St. Mary's Medical Center and Lower Bucks Hospital.[4] The largest employers in Northampton County such as Lehigh Valley Hospital, St. Luke's Hospital are located in the Allentown-Bethlehem region, west of the planning area.. Several large manufactures such as Binney and Smith (crayons), Victaulic Company of America (Pipe fittings), and Georgia Pacific-Dixie Cup Division are located in the northwestern section of Forks Township. The City of Easton also includes several colleges and Easton Hospital as well as the Northampton County Government Center. [5]

The population growth trends within the Middle Delaware River Study Area are consistent with and impacted by regional economic activity. From a regional

[4] Bucks County Economic Development Corporation, Largest Non-Governmental Employers in Bucks County. www.bcedc.com

[5] Lehigh Valley Economic Development Corporation, "Estimated Local Employment @ Largest Lehigh Valley Employers – 1/08/04. www.lehighvalley.org. and Lehigh Valley Profile and Trends (2002 Edition) Lehigh Valley Planning Commission, May 2002.

perspective, the City of Philadelphia is experiencing employment loss while the surrounding counties are experiencing employment growth. According to data from the DVRPC, the absolute number of employees has risen in Bucks County over the past 30 years (DVRPC, 2003). (132% increase over 1970). During the same period the number of workers increased by 11% in Northampton County. In both counties the number of workers employed has shifted from manufacturing to service and retail trade sectors.[6]

U.S. Census Data from 2000 indicates the majority of workers in the Middle Delaware River Study Area municipalities work within their state of residence. On average, nearly 77% of the communities within Bucks County and 70% of those in Northampton County work within Pennsylvania. Communities such as Riegelsville and New Hope Boroughs had the highest percent of out-of-state workers (presumably New Jersey or New York). In addition, the data suggests that workers who work in Pennsylvania work in their county of residence.[7]

Conclusions

The Middle Delaware River Study Area includes communities experiencing varying rates of population and housing change. The older, more developed boroughs, and the city of Easton are primarily built-out, have shown the least amount of growth over the past decade and are predicted to remain at or near their 2000 populations in the future. When viewed collectively, the study area municipalities have been exhibiting moderate growth, but still retain low population densities representative of suburban and rural areas. The area is expected to continue growth well into the future with some municipalities experiencing more rapid increases than others. The increasing demand for residential development in the Middle Delaware River communities may place additional stress on the river's natural and cultural resources such as it's prime farmland soils and forested areas However, most of the Middle Delaware River Communities have adopted strong resource protection ordinances and much of the land within the study area possesses physical constraints (i.e. geology, soils, topography) that limit the intensity and type of use permitted.

The demographic trends found in the U.S. Census data for this area are similar to those found regionally, including decreasing household sizes and increases in median age. Municipalities showing more rapid population and housing unit growth tended to have a larger percentage of households with individuals under the age of 18, which may have other implications regarding public services and facilities. Growth trends are also consistent with employment growth figures for the two counties, indicating that population and employment growth tend to be related. Job and population growth has continued to increase in the suburban counties while employment and population have declined in the City of Philadelphia,

[6] Delaware Valley Regional Planning Commission, "Regional Economic Information System Employment, 1970-2000", Regional Data Bulletin No. 74, October 2002.

[7] U.S. Census Bureau, "Place of Work for Workers 16 years and over-State and County Level". Census 2000 Summary File 3 (SF 3).

A number of the study area municipalities showed higher than average vacancy rates when compared to the county rates. A general evaluation of vacancy characteristics revealed that there tends to be a higher percentage of units characterized as seasonal or recreational use properties in the study area when compared to the two counties. This suggests that the area is popular both for year-round and seasonal residents.

Land Resources

Physiographic Region and Geology

The geology of the study area is extremely varied and directly affects land use and environmental conditions. For example, geology plays an important role in determining an area's potential for development, agricultural productivity and recreational opportunities. This is illustrated in the Middle Delaware River Study Area by the sections underlain by carbonate rock (limestone and dolomite), which tend to produce highly productive agricultural lands. Geologic data also aids in locating sources of quality groundwater as well as defining areas where groundwater can be stored and re-used. Geologic factors such as rock type, spacing, faults, joints and solution channels affect groundwater movement and availability.

Landforms of similar characteristics and underlying geology are classified into physiographic provinces and sections. Physiographic provinces are geographic areas that have marked structural difference in landforms from other provinces. Each province usually has distinctive climate, vegetation, soils, water and mineral resources. The boundaries between provinces are usually distinct, which reflect the underlying structures or configuration of the underlying rock such as lineations (linear patterns), faults, fractures and folds. Physiographic sections are areas within the provinces and have uniform geologic structures that are different from other sections within the province.[8]

As shown on **Map 4 (Physiographic Provinces),** the study area falls within three physiographic provinces. These are the Ridge and Valley Province, the New England Province, and the Piedmont Province. Two sections of note are the Reading Prong (located within the New England Province) and the Triassic Lowlands (located within the Piedmont Province). The Monroe Border Fault, also known as the Triassic Border Fault separates the Reading Prong from the Piedmont Province. The fault is considered nationally significant because it illustrates an episode of folding and thrusting in which Precambrian rocks were thrust northward over lower Paleozoic deposits.

"As the Delaware passes the mouth of the Lehigh River at Easton, PA, it enters the rolling landscape of the Piedmont Region. Below Easton, the ancient pre-Cambrian and Cambrian Formations are found, where the river has ground its way across four miles of granite, gneiss and quartz at Riegelsville Borough, PA. To geologists, this area is known as the "Reading Prong". At this point, the next great formations, the Triassic Lowlands begin. These formations include hard Brunswick and Lockatong shales where dinosaur fossils still lie deep under foot. This is a much younger land, whose granites, shales, limestones and sandstones date from the Triassic Period, some 225 million years ago. The river becomes broader and shallower below Easton, widening to 500 feet at Frenchtown, NJ, and is dotted with islands that are built of materials brought to the valley by glaciers of the Pleistocene Epoch, between 11,000

[8] Bucks County Planning Commission, Delaware River Corridor Study, (Doylestown, PA). G-6, G-7.

and 500,000 years ago. Most river islands are covered with a dense network of trees and vines.

The Triassic shales once lay thousands of feet above present ground levels, and in some places the molten mantle of the earth pushed up into the old lake-beds and cooled, leaving diabase. The hard diabase forced the river to curve at the great, dark three hundred foot cliffs above Upper Black Eddy. Diabase intrusions created stone sills and dikes, which impede underground water flows, are very hard to dig in, and have left deposits of "trap-rock" with commercial value. These deposits are mined and crushed into gravels."[9]

There are 15 geologic formations within these areas of the corridor. The general characteristics of these various formations are summarized in Table II-10 and shown on Map 5 (Geology).

The geologic history of this corridor has produced a number of special geologic sites such as the Monroe Border Fault (described earlier), Nockamixon Cliffs, Ringing Rocks, High Falls and Falls Creek Ravine, Bowman's Hill and Jericho Mountain. The Pennsylvania Geological Survey has designated two of these sites as Outstanding Scenic Geologic Features of Pennsylvania: Ringing Rocks in Bridgeton Township, and Nockamixon Cliffs in Nockamixon Township. In addition, the U.S. Department of the Interior has designated the Monroe Border Fault in Durham Township as a National Natural Landmark. Many of these unique geologic sites (i.e. Nockamixon Cliffs, Monroe Border Fault, Ringing Rocks) are also noted as priority natural areas in the county natural area inventories.[10] These natural geologic features are further described in the Natural Areas section of this report.

Carbonate Geology

The Middle Delaware Corridor contains portions of two major carbonate geologic formations located in Durham Valley (traversing both Springfield and Durham Townships and Riegelsville Borough) and in the Buckingham Valley including parts of Buckingham and Solebury Townships. These carbonate formations are comprised mainly of limestone and dolomite rock, which is especially susceptible to sinkholes due to its solubility. The porous nature of these areas also makes them abundant sources of groundwater. However, this porosity transmits groundwater very rapidly, and makes these areas susceptible to widespread groundwater contamination. The carbonate belts are illustrated on Map 5 and are comprised of the Allentown (Cal), Epler (Oe), and Leithsville (Clv) Formations, and Beekmantown Group (Ob).

Due to the limitations of carbonate geology, development in these areas requires extensive investigation for pollution prevention systems and foundation supports. Durham, Buckingham and Solebury Townships all regulate development within carbonate areas.

[9] Lower Delaware River Wild and Scenic River Study Task Force and National Park Service, Lower Delaware River Management Plan, (Philadelphia, PA, 1997), 6.

[10] See Rhodes, Ann F. and Timothy A. Block, 1999. Natural Areas Inventory of Bucks County, Pennsylvania.

Map 4 Physiographic Provinces

1 – 81/2 x 11 map

Map 5 Geology

3 – 11 x 17 maps

Table II-10 Middle Delaware River Geologic Formations

Formation	General Description	Topography	Drainage	Groundwater Yield
Allentown Formation (Cal)	Medium-gray dolomite and impure limestone; maximum thickness is about 2000 feet. Alternating dark to light gray banded, medium bedded high magnesium limestone.	Undulating valley of low relief; natural slopes are gentle and stable	Good subsurface drainage, little surface drainage.	Median yields range from 60 to 210 gal/min; many wells capable of yielding 1,000 gal/min. or more. Aquifer can be easily contaminated, turbidity is a common water quality problem.
Beekmantown Group (Ob)	A massive fine-grained, dolomitic limestone ranging in color from blue to light gray. Locally the rock can be shaly, laminated or conglomerate. Maximum thickness is about 2,300 feet.	Flat to rolling valleys of low relief; gentle and stable natural slopes.	Good subsurface drainage; minor surface drainage.	High yields from fractures and solution cavities; median yield is 50 gal/min., in southeastern Pa.; industrial and public supplies are available in most areas.
Brunswick Formation (Trb)	Sedimentary rock of the Triassic Lowlands that is a weak, bright red, argillaceous shale that readily crumbles into ragged fragments. This formation is a fair source of groundwater in this region due to bedrock intrusions.	Undulating hills of low relief; natural slopes are moderately steep and stable.	Good surface drainage.	Average domestic yield in region is 12-15 gal/min; highest yields are obtained from wells ranging in depth from 200 to 550 feet; wells less than 2,000 feet apart generally show some interference; lithology is an important factor in well yields; sandstone and conglomerate show highest yields.
Diabase (Trd)	A dark colored, holocrystaline igneous rock intrusion. Diabase is the poorest aquifer in the corridor.	Undulating hills of medium relief; natural slopes are moderately steep and stable; dikes form ridges.	Fair surface drainage.	Median yield is 5 gal/min; water levels show strong seasonal influence.
Epler Formation (Oe)	Interbedded limestone and dolomite underlying the Ontolaunee Formation. Member of the Beekmantown Group.	Rolling valleys of low relief; gentle and stable natural slopes.	Good subsurface drainage; sinkholes and caves are characteristic.	In the Lancaster Valley, Epler is a fair source for public supply and industrial use with well yields averaging over 25 gal/min.
Franklin Marble (fm)	Coarsely crystalline marble with scattered graphite flakes.	Dissected upland; gentle relief and stable slopes.	Good surface drainage; solution openings and subsurface drainage occur.	Yields of more than 100 gal/min. are common; water is hard.
Granitic Gneiss (gn)	Light gray, buff or brown lenticular granitic rock of metamorphic origins	Hills of medium to high relief; natural slopes are steep and stable.	Good surface drainage.	Median yield is less than 20 gal/min. yields of 35 gal/min or more may be obtainable from wells properly sited and developed; wells should be at least 100 feet deep, but probably not over 200 feet for maximum yield.

Formation	General Description	Topography	Drainage	Groundwater Yield
Hardyston Formation (Cha)	Light gray quartzite; weathers yellow brown: porous and limonitic in many places.	Rough mountains of medium to high relief; natural slopes are steep and stable.	Good surface drainage.	Median yield of 20 gal/min; water yielding fractures are seldom found below 200 feet; water is usually soft and of good quality; iron may be a problem.
Horneblende Gneiss (hg)	Dark green to black, igneous rock. This formation intrudes into granitic gneiss formation in Upper Bucks and Northampton County. This formation provides medium water yields.	Undulating hills of medium relief; natural slopes are moderately steep and stable.	Good surface drainage.	Median yield of reported wells is 10 gal/min; yields of 35 gal/min or more may be obtained from wells properly sited and developed.
Leithsville Formation (Clv)	A Cambrian age limestone characterized as gray dolomite with many sandy and cherty layers and buff shale beds. This formation overlays the Hardyston Formation and is succeeded by Allentown and Limeport Limestone.	Undulating valley of low to medium relief; natural slopes are gentle to moderately steep and stable.	Good surface drainage; little subsurface drainage.	Median yield is 100 gal/min; large yields may be obtained from solution openings; aquifer can be easily contaminated; turbidity is a common water-quality problem; water is relatively hard.
Lockatong Formation (Trl)	Formation is comprised of hard dark carbonaceous shale, black and purple argillite, red shale and thin limestone layer. This formation is not considered a reliable aquifer for high water yields.	Rolling hills of medium relief, natural slopes are moderately steep and stable.	Good surface drainage.	Average yield is 35 gal/min; lithology is an important factor in well yield.
Quartz Fanglomerate (Trfq)	Rough banding of coarse grained Quartz pebbles at base of Stockton Formation.	Moderately dissected semicircular hills having a scallop-like edge leading away from the base of South Mountain.	Good surface drainage.	Median well yield is 11 gal/min for non-domestic wells; maximum well yield of greater than 195 gal/min has been reported; generally of satisfactory quality for most purposes.
Rickenbach Formation (Ori)	Fine to coarse grained dolomite overlaying the Stonehenge Formation and underlying the interbedded Epler Formation.	Flat to rolling valleys of low relief; gentle and stable natural slopes.	Good subsurface drainage; minor surface drainage.	Yields greater than 100 gal/min are common; industrial and public supplies of groundwater are available.
Stockton Formation (Trs, Trsc)	Interbedded and repeated layers of coarse conglomerate, sandstone and argillaceous shale of the Triassic lowland formation. Groundwater in the Stockton formation is plentiful and high quality.	Undulating valleys of low relief; natural slopes are stable.	Good surface drainage	Average yield is 130 gal/min from arkosic sandstone and 20 gal/min from shale; good quality.
Trenton Gravel (Qt)	Unconsolidated floodplain deposits found along the Delaware River. Gray to pale-reddish brown, very gravelly sand interbedded cross-bedded sand and clay-silt layers.	Low-lying gravels at about 20 feet above sea level; occurs in Delaware River valley.	Good surface drainage.	Generally a good aquifer; yields may be in excess of 1,000 gal/min.

Source: Geyer, A. R and J. P. Wilshusen., *Engineering Characteristics of the Rocks of Pennsylvania, PA Geological Survey, 2nd Ed., Rev. 1982.*

Topography

The topography of a region basically describes the lay of the land. It is the configuration of a surface in relation to man-made and natural features. Topography is typically described in terms of differences in elevation and slope. As shown on **Map 6 (Topography)** the topography of the Middle Delaware River Study Area is characterized by its underlying physiographic provinces. Within the Northampton County portion of the study area are high hills, narrow valleys and mature streams characteristic of the Reading Prong section of the New England Province. Two of the more prominent hills of the Reading Prong are Elephant Rock and Hexenkopf Hill both located in Williams Township. The latter area marks the highest point in the Middle Delaware River Study Area and reaches an elevation of 1,017 feet above sea level. The majority of the Middle Delaware River Study Area's topography is characterized by the undulating valleys and hills of the Triassic Lowland section of the Piedmont Province. Natural slopes may be gentle, moderately steep, or steep, but stable. As illustrated on **Map 6**, this section's rolling terrain lies between altitudes of about 100 feet to 600 feet above sea level. Ridge tops, illustrated locally in Springfield/Durham Townships (Chestnut Hill, Buckwampum Mountain), and in Nockamixon Township (state game lands), can rise to 800 feet.

Steep Slopes

Development on moderate slopes in the range of 8 to 15 percent or greater accelerates erosion by removing or disturbing the established groundcover and topsoil. Slopes of 15 to 25 percent are considered steep and disturbed areas will yield heavy sediment loads, while very steep slopes over 25 percent produce heavy erosion and sediment loading when disturbed. Great care should be taken in disturbing areas within these steep slopes. Most municipalities within the study area have restrictive ordinances to protect these natural features. Removal of the vegetation destroys the groundcover, which absorbs rainwater, anchors soil and buffers or dissipates the impact of rainfall on topsoil. Without established vegetative cover, steep slopes yield greater volumes and more rapid rates of storm water runoff. This increased run-off contributes to more frequent and severe localized flooding in adjacent stream valleys during heavy rains and spring thaw. Erosion produces sediment that pollutes surface water. Over time, accumulated sediments narrow stream channels and fill ponds. This process restricts the capacity of waterways to handle flood flows and increases the incidence and severity of flooding.

Woodlands/Forests

Trees and wooded areas are a beneficial land resource within the Middle Delaware River Study Area. A woodland is typically defined as a tree area greater than one-quarter acre, but less than two acres where the largest trees measure at least 6 inches in diameter at 4.5 feet from the ground. Forests are areas greater than or equal to two acres, where trees provide leaf coverage to shade an understory, protect wildlife, and where an accumulation of organic matter covers the ground.[11]

[11] Bucks County Planning Commission, Natural Resources Plan; (Doylestown, 1999), 7.

Because of historic agricultural use, most tillable land was cleared and plowed under. Where the land was not suitable for cultivation because it was excessively wet, rocky, or steep, the forests were harvested from time-to-time, but not cleared.

According to 1992 land cover information obtained from the United States Geological Survey, over 60 percent (60.2% or 40,356 acres) of the Middle Delaware River Study Area was considered woodlands/forest, (See Map 2). Updated land cover data may be made available in the fall of 2003. These percentages will most likely decline, given the amount of single-family residential development that has occurred in the study area. However, the percentage of woodland/forest cover is still expected to be significant in relation to other land coverages categories. Thus, the protection of these natural areas will remain an important issue in the Middle Delaware River Study Area.

Today, most of the forested areas are still located in areas that were never suitable for farming. Within the study area, forest covers the mountains and hills in the area and extends in linear patterns along fields, ridges and streambeds. In all these areas, the forest provides numerous important functions in natural cycles and processes. It provides shelter for wildlife, plays an important role in the oxygen, carbon and nitrogen cycles, and most significantly, reduces erosion and sedimentation in the area's streams. The vegetative cover softens the impact of falling rain, facilitates groundwater recharge and reduces the volume and rate of runoff. Woodlands also play a role in filtering air pollutants and in moderating microclimates. For example, wooded stream corridors help filter out upland pollutants in storm water runoff. Woodlands moderate environmental conditions, support wildlife and provide recreational opportunities. Finally, trees provide an important scenic element in the landscape.

Of equal concern are the impacts that site preparation and construction practices have on woodlands. Although a required area to be protected may be shown on a development plan, damage from machinery, grade changes affecting root stability and aeration, soil compaction from temporary roads and materials stockpiling result in the loss of woodlands in a few years.

In addition to protection of existing woodlands, consideration should be given to landscaping for future generations and the planting of trees in environmentally sensitive areas. A mix of native plants is preferred to planting single type vegetation or widespread use of berms as buffering methods, although certain incompatible land uses may benefit from the immediate effect of berms in buffer improvements.

Soils

Soils are an integral and vital part of our environment. Soils provide us with food, support structures and transportation systems, help filter pollutants, and are part of the earth's hydrologic cycle. Soil properties include texture, structure, depth, color and density. These properties are a result of the underlying rock type, climate, vegetation, topography and weathering.

Map 6 Topography

1 – 11 ½ x 17 map

The differences in soil properties determine different management techniques, and exhibit different suitability characteristics when used for agriculture, forestry, sewage disposal, development and other purposes. Soil suitability is used to determine the types and intensity of land development and are often a basis for building standards found in zoning and subdivision and land development ordinances.

Within the Middle Delaware River Study Area, soils in the Triassic Lowland Section of the Piedmont are generally silt loams, well drained, and located on sloping land. There are exceptions to this rule, such as the Abbottstown and Doylestown associations, which are poorly drained and located on level land.[12] The Washington association soils, found primarily in Forks Township, are nearly level to sloping, deep and well-drained soils underlain by thin glacial till over cavernous limestone.[13] These soils are particularly well suited for agriculture. The Conestoga and Hollinger associations, located in Williams Township are gently sloping to steep, deep, well-drained soils underlain by granite, schist, gneiss and quartzite. This area includes Stouts Valley and most valley soils are classified as prime farmland. [14]

As a resource, soils are an important part of the ecosystem of the Middle Delaware River Study Area. Improper management of soils can result in erosion and sedimentation, decreased crop yields, nutrient loading of water bodies and decreased water quantity and quality.

The Natural Resource Conservation Service (NRCS) is administered by the U.S. Department of Agriculture and provides information on hydrologic soil groups within the United States. Soils are classified into four categories (A, B, C, and D) based upon rates of infiltration. The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. The hydrologic soil group also indicates the transmission rate-the rate at which water moves within the soil. This rate is controlled by the soil profile. "A" soils have a higher sand content and rapid infiltration, while "D" soils have a higher clay content and allow for very slow infiltration. These groups and their associated infiltration transmission rates are summarized in Table II-11.

Table II-11 Hydrologic Soil Type Definitions

Type	USDA Soil Texture	Infiltration Transmission Rate (in/hr)
A	Sand, loamy sand, sandy loam	> 0.30
B	Silty loam, loam	0.15 – 0.30
C	Sandy clay loam	0.05 - 0.15
D	Clay	0.00 – 0.05

Source: NRCS, National Engineering Handbook, Part 630, Hydrology

[12] The Agronomy Guide 2003, Part 1 Section 1, Soil Management.
[13] United States Department of Agriculture, Soil Conservation Service. Soil Survey of Northampton County Pennsylvania. 1974.
[14] Ibid

Table II-12 shows that the Middle Delaware River Study Area is composed primarily of hydrologic soil groups B and C soils. The hydrologic soil groups are important in determining areas of aquifer recharge and in calculating an area's potential storm water runoff rate.

Table II-12 Hydrologic Soil Groups

Soils - Hydro Group	Area (ac)	% Total
A	118	0.18%
B	27,184	40.40%
C	25,662	38.14%
D	5,743	8.54%
N/A	8,572	12.74%
	67,279	100.0%

Source: Heritage Conservancy

Floodplain and Hydric Soils

Floodplain and hydric soils show characteristics of both land and aquatic environments. Due to their unique properties, areas within the land/water interface such as floodplains and wetlands are particularly susceptible to adverse environmental impacts. Floodplain soil, for example, is rich in nutrients and easily supports plant growth. This provides an environment that typically supports many different species of plants, animals and birds. Vegetation within floodplains can help reduce the velocity of storm water and lowers erosive capacity. Floodplains also trap sediments which helps improve water quality following rainfall events. Floodplain soils within the Middle Delaware River Study Area are shown in Map 7 (Hydrography).

As shown on Map 7, floodplain soils are those areas adjoining drainage areas and water bodies, which are subject to flooding. These are delineated as alluvial soils, local alluvium, flood prone soils or soils subject to flooding in the Soil Surveys of Northampton, Bucks and Philadelphia Counties. Since smaller streams and watercourses were not studied under the National Flood Insurance Program (NFIP), floodplain soils are good alternative indicators of floodplains in these areas.

Hydric soils usually indicate the existence of a wetland area. A hydric soil is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of wetlands vegetation. Hydric soils of the Middle Delaware River Study Area are also shown on Map 7.

Map 7 Hydrography

1 – 11 ½ x 17 Map

Agricultural Soils

The National Resource Conservation Service provides a classification system for the identification of agricultural soils. These soils have been determined to be potentially the most productive for a wide range of field crops, with the least risk of damage when properly managed. These classifications include: prime farmland soils, statewide important soils, locally important soils and unique farmland soils. In both Bucks County and Northampton County, Prime Farmland soils are found within Capability Class I and II soils, whereas farmland of statewide importance are found within soil capability Class II and III.

As noted earlier, prime agricultural soils are abundant in the Middle Delaware River Study Area. Prime agricultural soils and agricultural soils of statewide importance within the Middle Delaware River Study Area are shown on **Map 8 (Important Farmland Soils)**. These soils are typically found in the stream valleys and within the lands underlain by limestone such as those within the Durham Carbonate Valley and the Buckingham Carbonate Valley as described previously and shown on **Map 5**.

Prime agricultural land is generally more productive than other land under the same management practices. Ironically, prime soils are not only ideal for farmland but, they are also the most easily and least costly soils to develop. Agricultural soils are typically located adjacent to the river, but above the floodplain, with ideal riverside views or locations. The primary crops within the study area include corn, numerous hay crops, small grains, soybeans and truck crops.

The number of farms and the amount of acreage devoted to agriculture have been declining. The most productive lands, Capability Classes I, II, and III soils, are being developed most rapidly. The conservation of agricultural activity in those areas which are actively farmed and which contain concentrations of high quality agricultural soils is highly encouraged. Many of the Middle Delaware River Study Area municipalities participate in agricultural preservation programs as described later in this document.

Soils Suitable for Wastewater Treatment and Disposal

Another classification of soils important to the Middle Delaware River Study Area includes those suitable for on-site wastewater treatment and disposal systems. According to 1990 data, over 70 percent of the homes in the Middle Delaware River Study Area use individual on-lot systems as the primary means of wastewater disposal. The same percent of homes rely on wells to supply drinking water. Traditional on-lot disposal systems utilize a septic tank to collect wastewater, provide primary treatment, and separate solids. The liquid effluent is then released from the septic tank into a series of underground lines (drainfield). The lines then distribute the wastewater into the soils. The soils act as a filter to remove suspended solids and bacteria before it returns to the groundwater. It is important to identify underlying soil conditions to minimize or eliminate possible water pollution.

The importance of designing on-site sewage systems based on soil characteristics is critical, because of the potential for groundwater contamination. As noted earlier, many residents of the Middle Delaware River Study Area rely on groundwater wells as a primary source of drinking water. The conservation of groundwater resources through proper sewage facilities planning was one of the primary objectives identified by the MDRCP PAC.

Soil is the foundation of conventional on-site wastewater treatment. Soils conditions are one of the most important elements in site evaluation and system design. The general properties of soils help to determine their suitability on on-lot disposal and land disposal through their ability to purify wastewater effluent. The main characteristics that are used to determine on-site suitability are: soil permeability, depth to bedrock and depth to water table. For example, in soils with rapid permeability, filtration of solids and oxidation of the organic materials does not occur and the result is contamination of the receiving water body. As shown on Map 9 (Suitability for On-Lot Septic Absorption Fields), a large proportion of the study area soils may exhibit properties, which limit the use of conventional on-lot disposal systems. This suggests that communities should monitor existing systems and educate residents on the benefits of regular inspection and maintenance of their individual systems. In areas undergoing new development, alternative methods of wastewater treatment and disposal should be investigated and encouraged to best meet the restrictions of underlying soils characteristics. Alternative dispersal methods might include drip irrigation, sand mounds or evapotranspiration trench.

Map 8 Prime Farmland Soils

3 – 11 ½ x 17 maps

Map 9 Suitability for On-Lot Septic Absorption Fields

3 – 11 ½ x 17 maps

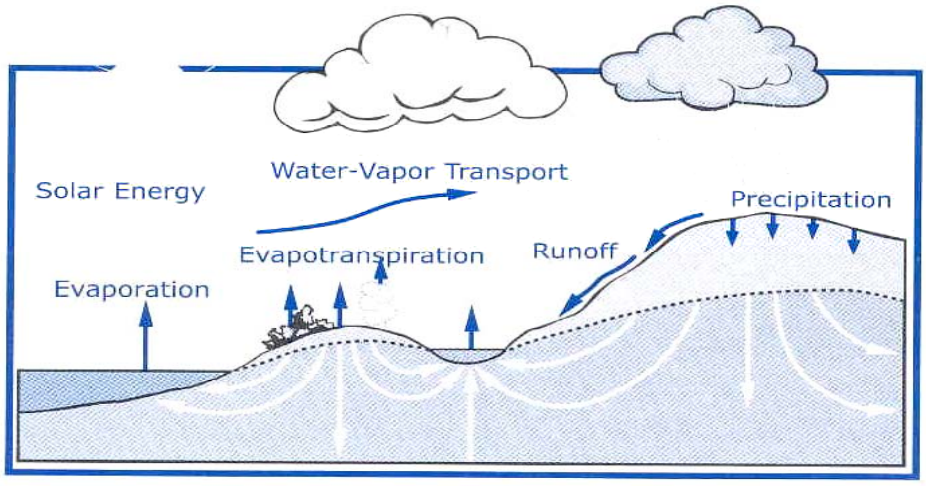
Water Resources

Summary of Water Cycle

The water or hydrologic cycle best describes the way in which water is circulated from the atmosphere to the land and to the sea. This cycle, illustrated in **Figure E,** is continuous. Water moves upward into the atmosphere through a process called evapotranspiration. Evapotranspiration is a combination of evaporation from land and water and transpiration from the leaves of plants. Water falls back to the land and water surfaces via precipitation, rain or snow. Precipitation can return water directly to a water body, or it may fall on pavement, rocks, soil, etc. This water travels downhill as runoff until it reaches a stream, lake or other water body. Water may also fall on permeable surfaces such as sand or some soils and then infiltrate via gravity into subsurface areas known as vadose zones (unsaturated zones) and eventually deeper into saturated zones. The saturated zone is the groundwater portion of the water cycle. The water table marks the top of the saturated zone. Groundwater travels below ground and resurfaces at streams, lakes, wetlands or oceans. If rocks or soil hold and transmit groundwater, they are called aquifers.

The water cycle is dynamic. Surface water moves along surfaces via streamflow and runoff. Groundwater also moves along hills and valleys that often mimic the overlying surface topography. Similar to surface water, ground water generally flows downhill, although, its movement is much slower. The water table is also dynamic, rising and falling based on the amount of infiltration and withdrawals from drinking wells.

Figure E The Hydrologic Cycle



Source: Miller, Patricia and A. Jantrania. Managing our Watersheds, A Systems Approach to Maintaining Water Quality, Small Flows Quarterly, Fall 2000, page 18.

Slope, permeability and rainfall intensity help determine both the speed of movement and the balance between infiltration and runoff.

Major Tributaries

There are numerous streams and named tributaries to the Delaware River and/or Delaware Canal within the Middle Delaware River Study Area. Pennsylvania sets forth water quality standards in 25 Pa. Code Chapter 93 for surface waters of the Commonwealth. These standards are important indicators of the biological health of the waterway as well as its recreational potential and aquatic life diversity. The standards are based upon water uses, which are to be protected and considered by the PA DEP in its regulation of discharges such as those from wastewater treatment plants or industry. Table II-13 below lists the streams and named tributaries present in the Middle Delaware River Study Area and their associated protected uses.

Table II-13 Characteristics of Named Streams and Tributaries in Study Area

Name of Stream or Tributary	Location	Chapter 93 Designation	Drainage Area (Sq. Miles)	Stream Length in Miles
Frys Run (a.k.a. Frya Run)	Williams Township	High Quality Waters	6.1	6.9
Rodges Run	Durham Township	Trout Stocked Fishery	*	1.35
Gallows Run	Nockamixon Township	Cold Water Fishery (CWF)	8.72	5.1
Wild Cat Hollow Run (a.k.a. Narrows Run)	Bridgeton Township	Trout Stocked Fishery	*	0.85
Falls Creek	Bridgeton Township	Trout Stocked Fishery	*	1.41
High Falls Creek	Bridgeton Township	Trout Stocked Fishery	*	2.70
Mine Spring Creek	Bridgeton Township	Trout Stocked Fishery	*	0.40
Swamp Creek	Tinicum Township	Trout Stocked Fishery	*	2.85
Smithtown Creek	Tinicum Township	Trout Stocked Fishery	1.38	2.75
Hickory Creek	Plumstead Township	Trout Stocked Fishery	1.5	1.02
Cuttaloosa Creek	Solebury Township	High Quality Waters, CWF	3.32	2.65
Primrose Creek	Solebury Township	Trout Stocked Fishery	3.52	2.84
Rabbit Run	Solebury Township	Trout Stocked Fishery	0.42	0.98
Aquetong Creek	Solebury Township	High Quality Waters, CWF	8.01	2.58
Dark Hollow Run	Solebury Township& New Hope Borough	Trout Stocked Fishery	0.71	1.5
Pidcock Creek	Solebury & Buckingham Townships	Warm Water Fishery	12.7	6.59
Jericho Creek	Upper Makefield & Wrightstown Townships	Warm Water Fishery	9.63	6.06
Houghs Creek	Upper Makefield	Warm Water Fishery	5.19	4.58
Dyers Creek	Upper & Lower Makefield Townships	Warm Water Fishery	1.2	1.14

Sources: Bucks County Planning Commission, 1982. Delaware River Corridor Study. Heritage Conservancy, and 25 Pa. Code Chapter 93.

*** Area undetermined – Note that some unnamed tributaries are not listed on this table.**

The Trout Stocking designation (TSF) requires maintenance of conditions suitable for stocked trout from February 15 to July 31 and maintenance and propagation of fish species and flora and fauna indigenous to warm water habitats. The Warm Water Fishes (WWF) designation requires maintenance and propagation of fishes and flora and fauna indigenous to warm water habitats. The Cold Water Fishes (CWF) designation requires maintenance and/or propagation of fish species and flora and fauna indigenous to cold water habitats. In addition to these protected use

designations, Chapter 93 includes two special protection designations: High Quality (HQ) waters and Exceptional Value (EV) waters. Surface water must meet strict conditions to qualify as a HQ water. These include specific chemical and biological conditions. To qualify as an EV water, a surface water must meet the conditions set forth for HQ designations plus additional requirements for recreational and wildlife significance. There are no EV waters in the Middle Delaware River Study Area; however, there are three waterways located adjacent to the Middle Delaware River Study Area with an EV designation: Bushkill Creek in Northampton County, and Cooks Creek and Tinicum Creek in Bucks County. In addition to the three EV waters, the adjacent Paunacussing Creek is designated as a HQ stream. These adjacent creeks have undergone separate river conservation plans and are not included in the MDRCP study area.

Within the study area, Aquetong and Cuttalossa Creeks and Frys Run have been designated as HQ waters. The Smithtown Creek Watershed Association petitioned the PA DEP to designate Smithtown Creek as an EV water. The Tohickon Creek watershed, also adjacent to the study area (and studied in a separate river conservation plan), is being considered for EV designation. The PA DEP recently revised its anti-degradation regulations, including the standards necessary for EV designation. The re-designations of Smithtown Creek and Tohickon Creek to EV are still pending.

Watercourses and Floodplains

Floodplains are areas that adjoin watercourses and are commonly defined as the area subject to the 100-year recurrence interval flood. These areas are shown on **Map 7.** Floodplains consist of two primary components: Floodway and flood fringe. A floodway is the portion of the 100-year floodplain that serves as a flood channel to pass deep, fast moving waters. It includes both the watercourse channel and the adjacent land area which must be reserved to carry the base flood without cumulatively increasing the 100-year flood elevation more than one foot. The flood fringe is the portion of the floodplain outside of the floodway, which contains the shallow, slower moving floodwater. Floodplains were identified in the studies associated with the National Flood Insurance Program (NFIP).

Floodplains serve as ideal areas for managed aesthetic and recreational activities. The natural flat, lush characteristics of floodplains as well as their waterfront view, make them ideal areas for outdoor recreational activities. Floodplain areas, especially along the Delaware River, often contain other resources such as historic heritage and archaeological sites.

As described earlier in this document floodplain (alluvial) soils are important in areas where the NFIP has not identified and calculated the floodway and flood fringe areas. In these unmapped areas, the floodplain soils indicate where flooding had occurred in the past. Unless a hydrological study is undertaken to prove that flooding has not

occurred in recent times, these floodplain soils should be considered part of the floodplain and regulated as a floodway.

The natural function of watercourses and floodplains is to accommodate floodwater. The natural vegetation supported by moist floodplains helps trap sediment from upland surface runoff, stabilizes stream banks for erosion control, and provides shelter for wildlife and proper stream conditions for aquatic life.

These floodplain limitations do not preclude all development. Agricultural uses, private and public recreation uses (e.g. golf courses, ball fields, golf driving ranges, picnic grounds, wildlife and nature preserves, swimming areas, passive open space, hunting and fishing areas, hiking trails) and uses incidental to residential structures (e.g. lawns, gardens, play areas) are permitted.

Due to their unique characteristics, ecological significance and susceptibility for adverse impacts, development within floodplains is regulated at the local, state and Federal levels. Regulations seek to minimize damage to life and property for existing development, control future development, and protect water quality. Regulatory agencies include the Federal Emergency Management Agency (FEMA), and the PA DEP.

There are also numerous state legislative programs directly or indirectly related to floodplain development and protection including the 1978 Storm Water Management Act (Act 167), the 1978 Dam Safety and Encroachment Act (Act 325), and the 1978 Pennsylvania Floodplain Management Act (Act 166) and its amendments of 1986, and 1989. Floodplains are also under local protection in many municipalities through the establishment of floodplain districts or zones. Each municipality within the study area restricts development within identified floodplain and flood fringe areas, and on floodplain soils.

In 1978, the Pennsylvania Floodplain Management Act (Act 166 of 1978) was enacted. This required local governments to exclude hospitals, nursing homes, jails, new or substantially expanded mobile home parks and subdivisions, and storage of specified hazardous material from floodplain areas. This act also required municipalities with flood prone areas to participate in the NFIP.

Wetlands

Wetlands are undrained, saturated soils which support wetland vegetation, where the water table is at or near the surface, or where shallow water covers the area due to permanent or seasonal inundation of surface or groundwater. Wetlands are typically defined by three characteristics: hydrology, soils and vegetation. The protection of wetlands is important for several reasons. Wetlands play a key role in maintaining and improving water quality by filtering out sediments and transforming nutrients such as nitrogen and phosphorus. They can also perform flood control and storm water

management functions by trapping and storing water during storms and floods, thereby reducing hazards to life and property. Finally, wetlands are important habitats. Many threatened or endangered plants and animals depend on wetland areas for survival.

Map 7 shows the locations of wetlands within the Middle Delaware River Study Area as listed in the National Wetlands Inventory (NWI). The NWI is a general reference only. More detailed field delineations must be performed to adequately survey and define the type of wetland system such as, riverine, palustrine, or lacustrine, and its ecological value. As indicated previously, the presence of hydric soils is another indicator of a wetland area, as well as the presence of specific wetland plant species. A trained wetland delineator will check for these conditions to help determine if the area meets the criteria for wetland designation.

The federal and state permitting process for disturbances within wetlands is regulatory, rather than protective. If the proper information is provided and the permit conditions satisfied, the permit is issued. Thus, the municipality's role becomes more important in terms of protecting these resources.

At the local level, wetland areas can be protected through the use of wetland protection ordinances and wetland buffer zone ordinances. Most municipalities within the study area prohibit development in wetland areas. However, protection measures are only effective if the wetland areas are properly identified through a wetland delineation as described above. Municipalities should require that applicants delineate wetlands on their property prior to development or provide evidence that no wetlands exist. In addition to wetlands, many municipalities in the study area regulate the intensity of development in wetland buffer areas. Local wetland buffer ordinances are very important, because the protection of wetland buffers is not mandated at the state level. The Bucks County Planning Commission recommends a buffer zone to extend 100 feet from the wetland boundary or to the limit of the delineated hydric soils whichever is less. Within this area, 80% of the buffer area must be protected from development.

Vernal Ponds or Pools are temporary ponds that fill up with water in the spring as a result of snowmelt, spring rains and/or elevated groundwater tables and then dry-up at other times of the year. Due to seasonal flooding, vernal pools can be important wildlife habitats for unique biological communities that include fairy shrimp, aquatic insects, turtles, frogs, toads and salamanders. The temporary characteristic of vernal pools makes them vulnerable, because they are easily overlooked and easily destroyed. Vernal pools are considered valuable as wildlife habitat because of the wide range of species that depend on them. For example, vernal pools provide a much safer breeding ground for amphibians than permanent waters, because there are no fish to eat the eggs and larvae. As with wetland areas, there are particular criteria for identifying these areas as important wildlife habitat. Municipalities may consider adding vernal pools to the list of resources, which must be identified prior to development activity so that they can be properly protected.

Lakes and Ponds

Lakes and ponds provide habitat for aquatic life as well as water sources for wildlife. These landscape features are scenic amenities and have aesthetic value. There are two notable lakes highlighted in the Bucks County Natural Areas Inventory (Rhodes, 1999) present in the Middle Delaware River Study Area. These are Aquetong Lake/Ingham Spring and Burrell's Lake both located in Solebury Township.

The Aquetong Lake/Ingham Spring site consists of a limestone spring and a 15-acre artificial lake below the spring. The lake is an important wintering site for birds. Ingham Spring is the largest spring in Bucks County and is also identified as an outstanding geological feature of Pennsylvania. This site is classified as a Priority 2 site in the Natural Areas Inventory meaning that it is of county-wide significance due to its overall quality and the diversity and importance of the resources its contains.

Burrell's Lake is a six-acre lake formed by a dam on Aquetong Creek. It is characterized by abundant waterfowl and its slopes include deciduous forest and diverse spring herbaceous flora. These two areas are highlighted on Map 10 (Natural Areas and Parkland).

Although popular as landscape features, man-made lakes and ponds may become problematic if not properly designed or maintained. These problems include eutrophication (the process by which a body of water becomes either naturally or by pollution rich in dissolved nutrients (as phosphates) and often shallow with a seasonal deficiency in dissolved oxygen), increased water temperature and attractiveness to geese. This latter problem has been the focus of much debate. Geese are attracted to well-mown lawns, particularly those adjacent to water bodies. These types of areas provide a safe environment for the birds. However, many locations are being overrun by geese and their associated droppings.

Riparian Buffer Areas

Riparian buffers are the areas of vegetation that grow along stream banks. Riparian buffers serve as natural filters of storm water and help to stabilize stream banks and reduce erosion.

The plant material helps hold the soils in place and removes sediment, nutrients and pollutants before they reach the water. The velocity of storm water is reduced and some groundwater recharge takes place in the riparian zone. Shade from the trees cools the water, which increases oxygen in the water and supports aquatic life. The vegetation provides wildlife habitat. Riparian buffers vary in width depending on their intended function, slope, width of the floodplain, presence of wetlands and other factors.

Many Middle Delaware River Study Area municipalities have adopted riparian buffer ordinances specifying minimum widths for buffers in areas surrounding stream

corridors. The widths vary from 25 feet to 75 feet and specify certain restrictions within these zones. In some cases, riparian buffers apply to wetland areas as well.

The Heritage Conservancy completed a riparian buffer assessment for this section of the Delaware River Watershed in late 2003 based on aerial photographs taken in 2000. For the purposes of this study a forested buffer is defined as an area of trees that is fifty feet wide with at least fifty percent canopy cover. It should be noted that only forested buffers were indicated in this study and that meadow or wetland buffers were not included in the analysis. Appendix B, shows the results of the Riparian Buffer Assessment for the study area.

In some cases, streams lacked buffers on only one side, while others lacked buffers on both sides. A review of the mapping for the Middle Delaware River Study Area revealed numerous tributaries lacking forested buffers on one or both sides. These included: Frys Run, Gallows Run, Swamp Creek, Primrose Creek, Aquetong Creek, Pidcock Creek, Jericho Creek, Houghs Creek and Dyers Creek.

On-site investigations should be utilized to determine the exact stream corridor situation and for possible candidate sites for restoration or planting programs.

Water Quality

The water quality of the Delaware River and its tributaries has undergone major changes throughout its long history. Prior to the European settlements in the seventeenth century, water quality was presumed to be pristine. As populations grew, the quality of the river declined until the end of World War II, when pollution in the Delaware River Basin was at its maximum.[15] In order to control water pollution, the Interstate Commission on the Delaware River Basin was established by the four Delaware River Basin states (New York, New Jersey, Pennsylvania and Delaware) in 1936. In 1961, the Delaware River Basin Commission (DRBC) was created and undertook additional efforts to control pollution by reducing industrial discharges and other point sources.

Water pollution control in the Delaware River is the joint responsibility of the federal government (U.S. Environmental Protection Agency), the environmental protection departments of the four basin states, and the DRBC. These agencies conduct monitoring, regulatory, planning and other water quality management functions. Water quality within the study area has been the focus of several recent DRBC studies and is generally considered good. The studies include the 1999 Lower Delaware Monitoring Program, and the 2002 305(b) Water Quality Assessment Report, which was revised in April 2003. In addition, the DRBC has just completed a draft Delaware River Basin Water Resources Plan to provide a unified framework for addressing and

[15] National Park Service, Lower Delaware National Wild & Scenic River Study Report Northeast Region (Philadelphia, 1999), 16.

redressing new and historic water resource issues and problems in the Delaware River Basin.[16]

The Lower Delaware Monitoring Program presented the findings of the 1999 water-quality survey of the Delaware and its tributaries between the Delaware Water Gap and Trenton, NJ, a reach of approximately 77 miles. This area includes the entire Middle Delaware River Study Area. The purposes of the survey were to:

- Assess the water quality throughout the lower non-tidal reach of the Delaware River, and continue to develop a baseline water quality database.
- Compare bacterial data to results of the DRBC 1987 bacterial survey
- Provide a scientific basis for management plans that will maintain and enhance, where practicable, existing water quality. [17]

This pilot study led to the establishment of a fixed monitoring network for the year 2000, for the purpose of defining existing water quality over a five-year period. The network was established because little data existed to characterize water quality in this reach.

Figure F
DRBC Main Stem Water Quality Zones

The DRBC's 2002 305(b) Water Quality Assessment Report provides an assessment of the Delaware River's support of various uses during 2000 and 2001 that are protected by the DRBC's water quality regulations or by the federal Clean Water Act of 1972. These uses are:

- ✓ Maintenance of aquatic life
- ✓ Providing a raw water source for human consumption
- ✓ Swimming and recreation
- ✓ Fish consumption
- ✓ Shellfish consumption[18]

The assessment primarily involves comparing levels of key water quality indicators (pH, for example) with DRBC stream quality objectives listed in the water quality regulations. Because DRBC's water quality regulations define "zones" in the Delaware River to which the stream quality objectives are applied, the 305(b) report assesses water quality based upon those zones.[19] As

[16] Delaware River Basin Commission, Delaware River Basin Water Resources Plan - Public Review Draft (Trenton, 2004). 1.

[17] Delaware River Basin Commission, The Lower Delaware Monitoring Program 1999 Survey of the Lower Non-tidal Delaware River and Pilot Study for a Long-Term Water-Quality Monitoring Network, 2.

[18] Delaware River Basin Commission, 2002 305(b) Water Quality Assessment Report, September 2002 (Revised April 2003), 1.

[19] See full report at http://www.state.nj.us/drbc/305b02.htm

shown in Figure E, the Middle Delaware River Study Area falls partially within Zone 1D and fully within Zone 1E.

Consistent with the U.S. Environmental Protection Agency's (EPA) Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates (September 1997), assessed water bodies are categorized into one of four use support levels:

- Fully supporting the use;
- Fully supporting the use, but the use is threatened;
- Partially supporting the use; and
- Not supporting the use [20]

The uses supported for the two assessment zones, which include the Middle Delaware River Study Area are summarized in the **Table II-14** below.

Table II-14 Overview of Use Support from 2002 305(b) Assessment

Assessment Unit	Aquatic Life	Drinking Water	Recreation	Fish Consumption [b]
1 D	Not Supported [a]	Fully Supported	Fully Supported	Partially Supported
1 E	Fully/Partially Supported [c]	Fully Supported	Fully Supported	Partially Supported

[a] due to total dissolved solids
[b] based upon a compilation of state fish consumption advisories
[c] due to high PH at Trenton

As shown on Table II-14, fish consumption was partially supported in these two zones due to the presence of Mercury in Zone 1D and Mercury, PCB's, Dioxins, and Pesticides in Zone 1E. The report notes that the possible sources of these contaminants are point and non-point sources and air deposition. Aquatic life use is not supported in Zone 1D due to total dissolved solids resulting from non-point sources. In Zone 1E, the partially supported use for Aquatic life was caused by a high pH level, possibly resulting from excessive plant growth during warm, low flow periods. It should be noted that the high pH level was recorded in the two-mile reach of Zone 1E, upstream of a continuous water quality monitoring station at Trenton, NJ.

The PA DEP is required by the Federal Clean Water Act to list stream segments in the state that are not meeting their designated use. This list is commonly referred to as the 303(d) list. According to the PA DEP's Watershed Restoration Action Strategy (WRAS), a small, unnamed tributary to Houghs Creek in Upper Makefield Township is considered impaired, based on the 2001 assessment results. This is the only stream within the Study Area to be included in the 303(d) list for 2001. All other assessed streams and tributaries within the study area attained water quality standards.[21]

[21] PA DEP Watershed Restoration Action Strategy (WRAS), Subbasin 02E. Pidcock Creek, Mill Creek and other small tributaries to the Delaware River Bucks County PA.

Point Source Pollution

Point sources of water pollution are specific discharges that are traceable to distinct sources (pipe, ditch, container, well, etc.), such as from wastewater treatment plants or industry. Point sources are required to be permitted under National Pollutant Discharge Elimination System program or NPDES and meet varying degrees of treatment, based on point of discharge. The degree of treatment is determined by the water quality standards, assigned by PA DEP of the receiving body of water. Table II-15 lists the permitted point source discharges in the Middle Delaware River Study Area as identified by a review of EPA, NPDES permit information.

Table II-15 NPDES Permitted Discharges within Study Area							
Facility Name	**Municipality**	**County**	**Permit Issue Date**	**Permit Expired Date**	**Type of Facility**	**Permitted Flow in MGD***	**Receiving Waters**
Henry Anderson	New Hope	Bucks	5-Nov-98	5-Nov-03	Private Sewage System	0.0005	Rabbit Run
Bucks County Sewer and Water Authority	Nockamixon	Bucks	7-Nov-95	7-Nov-00	Former Landfill (Hidden Valley)	Not Available	Unnamed Trib. to Gallows Run
Rico Carish	Easton	Northampton	15-Nov-01	14-Nov-06	Private Sewage System	0.0004	Delaware River
Easton Area Joint Sewer Authority - Sewage Treatment Plant	Easton	Northampton	30-Oct-01	30-Jun-06	Major Public Sewage System	10.0	Delaware River
City of Easton - Water Treatment Plant	Easton	Northampton	4-Jun-01	3-Jun-06	Public Water Supply	0.0014	Delaware River
Lucy Green and Mark Sfirri	New Hope	Bucks	14-Mar-01	14-Mar-06	Private Sewage Facility	0.0004	Pidcock Creek
Thomas Martin	Bridgeton	Bucks	1-Feb-99	1-Feb-04	Private Sewage Facility	0.0005	Unnamed Trib. to Penn. Canal
Palisades High School	Nockamixon	Bucks	18-Jul-00	18-Jul-05	High School	0.0215	Unnamed Trib. to Gallows Run

Source: US EPA Envirofacts Warehouse, Water Discharge Permit Information (PCS Database, updated December 31, 2002.)

*MGD = Million Gallons Per Day, (0.0004 = 400 gallons per day)

Non-point Source Pollution

Non-point source pollution does not come from a distinct discharge source, but results from contaminants that are carried to watercourses in storm water runoff. These contaminants include oil and salts from roads and parking lots, pesticides and herbicides from lawns and crop fields, and seepage from soil-based wastewater disposal systems. Erosion is also a large contributor to non-point source pollution. As storm water travels over land, it removes soil particles from the ground. These soil particles end up in streams and surface water bodies. This build–up of sediments may interrupt stream flow, decrease light penetration, clog fish gills and cover hatcheries. In addition, sediment often carries excess nutrients and pollutants associated with the soils.

The regulation of non-point source pollution has been a major topic of concern and regulatory programs have gradually shifted from point source to non-point source control as a way to address water quality on a watershed basis. One of the more effective ways to mitigate the problems of non-point source pollution is thorough the careful preparation of local ordinances which require storm water management and protection of stream buffers and other environmentally sensitive areas. Most of the Middle Delaware River municipalities have enacted storm water management ordinances either through participation in the state's Act 167 storm water management planning program or individually through zoning and subdivision requirements. Some communities have undertaken specific studies to assess the impacts of non-point pollution in specific sub-watersheds. One example, detailed below, is the recent study prepared for two watersheds in Tinicum Township.

Tinicum Township Non-Point Pollutant Loading Project

In June 2000, Tinicum Township undertook a detailed study to develop estimates of non-point source (NPS) pollutant loading for the Swamp Creek and Smithtown Creek Tributaries to the Delaware Canal.[22] The study was funded through the National Park Service's Lower Delaware National Wild and Scenic River Study Municipal Incentive Grant, administered by the Heritage Conservancy. It was determined that within Tinicum Township, Swamp Creek, Erwinna Creek, Dark Hollow Creek, and Smithtown Creek drain directly to the Delaware Canal. Pollutant and land use data was collected for both the Swamp Creek subwatershed (Swamp Creek and Erwinna Creek) and the Smithtown Creek subwatershed. Pollutants of primary concern included the nutrients of nitrogen (TN), phosphorus (TP) and suspended solids (TSS).

The purpose of the study was to quantify the current NPS pollutant loads entering the Delaware Canal through streams located within the Lower Delaware River watershed in order to establish pollutant threshold limits. Pollutant loads were quantified assuming various development density scenarios in the two subwatersheds. These loads were then used to determine watershed-based NPS pollutant limits. Tinicum Township was particularly interested in limiting the amount of sediment and NPS pollution reaching the historic canal from tributaries within its municipal boundaries.

The limits could then provide a basis for ordinances designed to protect the water quality of the streams as well as the canal. These requirements would incorporate the use of structural and non-structural best management practices in proposed development projects.

Since completion of the study in 2000, Tinicum Township adopted or revised its comprehensive storm water management ordinance and water development ordinance to incorporate recommendations from this study. The Swamp Creek watershed has been the focus of several restoration activities including removal of invasive vegetation. In addition, funding has been requested from the Pennsylvania Growing Greener program for streambank restoration activities.

Storm Water Management Planning

In accordance with the Pennsylvania Storm Water Management Act of 1978 (Act 167), all counties within the commonwealth are required to prepare storm water management plans for each watershed within their boundaries. Watershed areas for storm water management are delineated by PA DEP based on hydrologic characteristics. As listed in Table II-16 below, the Middle Delaware River Study Area includes portions of four-storm water planning watersheds delineated by the PA DEP.

[22] Tinicum Township and Princeton Hydro, LLC. The Tinicum Township Non-Point Pollutant Loading Project, June 2000.

Table II-16 Storm Water Management Plans in Study Area. Prepared Under Act 167		
Description	**Municipalities in Study Area**	**Date Adopted**
Martins/Jacoby Creeks and Delaware River Sub-basin 1- Northampton County	Forks Township	February 1996
Delaware River Sub-basin 2 and Lehigh River Sub-basin 5 (Fry's Run Study Area) Northampton County	Williams Township Easton City	Oct – 99 Feb –01
Delaware River North (Bucks County)	Riegelsville, Durham, Nockamixon, Bridgeton, and Tinicum Townships	Updated February 2002
Delaware River South (Bucks County)	Plumstead and Solebury Townships, New Hope Borough, and Upper Makefield Township.	Plan being Prepared

Each storm water management plan includes different techniques to help manage both the quantity and quality of storm water generated within the watershed. Each of the Act 167 plans includes a storm water model ordinance, which includes technical standards and criteria based on watershed hydrologic modeling. Each municipality within the watershed is required to adopt the provisions of the model ordinance within six months following the plan's approval by the PA DEP.

Both the Delaware River North and the Delaware River South Plans include mandatory groundwater recharge and water quality controls[23]. In previously adopted plans, there were no provisions for groundwater recharge and water quality detention was only for the retention of the first flush storm. Revised plans now include an increase in the water quality volume to be managed, and a mandatory volume of runoff that must be recharged. These plans encourage, support and direct that Best Management Practices or BMPs be used to manage storm water runoff. The water quality volume must be treated with the use of a BMP. The plan describes methods to select the appropriate BMP based on the control objectives and conditions of a particular site.

The Lehigh Valley Planning Commission is currently preparing a model storm water management ordinance applicable to each of the 62 municipalities in Northampton and Lehigh Counties. The ordinance will be similar to the PA DEP's MS4 model ordinance (for NPDES, Phase II) and will also require infiltration and/or the use of recommended water quality BMPs in all storm water management plans.

Water Supply

Surface Water Resources

[23] For more information see, Bucks County Planning Commission and Pennoni Associates, Inc. Delaware River (North) Watershed Act 167 Stormwater Management Plan, Bucks County Pennsylvania, February 28, 2002. DEP ME#96427 File No. SWMP 089-09.

The Delaware River is also a major source of surface water supply for the city of Easton and its surrounding municipalities. Both the city of Easton through its Bureau of Water and the Easton Suburban Water Company provide water service to about 25,700 customers within the city and to the townships of Palmer, Forks, Bethlehem, Williams, and Lower Nazareth and the boroughs of Wilson, West Easton and Glendon. The city of Easton obtains its water from the Delaware River and has an average production of 6.8 million gallons per day (MGD). The water treatment plant has a permitted capacity of 12 MGD. The Easton Suburban Water Authority purchases all of its water from the city and serves an average demand of 4.9 MGD.

Another major withdrawal area within the Middle Delaware River Study Area is at Point Pleasant. Both Philadelphia Electric Company (PECO) and Forest Park Water utilize water drawn from the Delaware for potable water supply and electric power generation. According to 1991 DRBC figures, nearly 70 percent of the water withdrawn from the Delaware River Basin (including parts of New York, New Jersey, Delaware and PA) was for power generation purposes.[24]

Groundwater Resources

Groundwater is stored in the openings, pores and cracks in rock formations. The greater the degree of porosity, the greater the water bearing capacity. Sand and gravel areas, which are most porous, store the most water. The Stockton sandstone and the carbonate (limestone) formations also store large quantities of water. The diabase and Lockatong formations are fairly nonporous and have low water bearing ability. The predominant geologic formations of the Middle Delaware River Study Area include the Brunswick (47.7%), Lockatong (10.3%), Allentown (8.6%), Diabase (8.3 %) and Stockton (8.1%) Formations. Within the upper Bucks County municipalities, the Stockton Formation appears to be a good source of groundwater for both commercial and domestic wells. The Brunswick Formation, on the other hand is typically a fair to good source of water for commercial wells, which can be sited in the most favorable areas, but only a fair source for domestic wells, which are located by proximity to a specific property.

The Allentown Formation is a carbonate formation, which generally provides good storage for groundwater. However, pollution potential in carbonate rocks can be higher. In the very porous carbonate areas, contaminated water spreads quickly and broadly throughout the solution channels in the bedrock. In most other formations, polluted water cannot travel as readily through the bedrock, but stays trapped in the rock for extended periods of time. Lockatong and Diabase formations are generally poor storage areas for groundwater.[25]

The planning, monitoring and permitting of groundwater and surface water withdrawals is regulated by the DRBC. The DRBC covers the entire Delaware River

[24] Delaware Estuary Program. Comprehensive Conservation and Management Plan for the Delaware Estuary, (September 1996)., 28.

[25] Ronald Sloto and Curtis Schreffler, 1994. Hydrogeology and Ground-Water Quality of Northern Bucks County, Pennsylvania, U.S. Geological Survey Water-Resources Investigation Report 94-4109.

Basin and partners with New York State, New Jersey, Pennsylvania and Delaware to regulate water withdrawals.

In 1981, the DRBC established a special regulatory program setting forth groundwater-protected areas in Montgomery, Bucks, Chester, Berks and Lehigh counties. IN the Middle Delaware River Study Area, Plumstead and Buckingham Townships are in DRBC groundwater protected areas. If anyone proposes to drill a well or group of wells with a yield greater than 10,000 gallons per day over any 30-day period, they must first apply for approval and permits from DRBC. All permit requests must be accompanied by detailed hydrologic reports. The goal of this program was to manage new and existing withdrawals from aquifers to ensure that total usage does not exceed the rate of groundwater recharge during normal and dry periods.

The major source of water supply in the Middle Delaware River communities is through groundwater accessed via individual wells. Thus, the management and protection of groundwater resources is a prime issue within the study area communities and has been addressed in a variety of studies.

In 1988, a number of Upper Bucks County residents began meeting to discuss ways to protect aquifers and streams from pollution and depletion. This led to the creation of the Groundwater Management Committee. The committee included eleven member municipalities: Bridgeton, Buckingham, Durham, Nockamixon, Plumstead, Solebury, Springfield, Tinicum, and Wrightstown Townships and New Hope and Riegelsville Boroughs.

In 1989, the committee proposed that a comprehensive groundwater study be completed to investigate water quantity and quality of the aquifers in central and upper Bucks County. The United States Geological Survey (USGS) was hired to conduct a three-year technical study. The main purposes of the study were to assess the availability and quality of groundwater in the region. This included providing information, which could be used to delineate major areas of recharge and to obtain information on the hydrologic budget. Groundwater data included descriptions of 1,357 wells and water levels for 28 observation wells measured during 1990-93. Surface water data included chemical analyses of water samples collected from Beaver Creek, Cooks Creek, Geddes Run, Little Tinicum Creek, Paunacussing Creek, Pidcock Creek, Rapp Creek, Smithtown Creek and Tinicum Creek. (Pidcock and Smithtown Creeks are part of the Middle Delaware Study Area).[26] The USGS study concluded that the groundwater system is interconnected through most of the study area. The exception to this is a portion of the northern reach where a localized water table was found not to be well connected to the regional groundwater system. Two superfund sites lie within this confined localized water table making the spread of contamination less likely, (see description in paragraphs below). [27]

[26] Schreffler, Curtis L. et al . Hydrologic Data for Northern Bucks County,, U.S. Geological Survey Open-file Report 94-381 (Lemoyne, Pennsylvania 1994), 1.

[27] Information from, http://www.delawareriverkeeper.org/factsheets/bucks_groundwater.html

Following the USGS study the Groundwater Management Committee prepared a position paper in 1994. The report indicated that based on the survey of ground-water quality completed by the USGS, the area has minimal new incidences of contamination. This implies that the historic and current land uses have not significantly degraded the quality of the water in the groundwater system.[28]

However, concern was expressed over two superfund sites (Echo Revere in Nockamixon and Boarhead Farms in Bridgeton), both of which resulted in groundwater contamination. According to the report, however, the sites are on a localized water-table aquifer, not hydraulically well connected to the regional groundwater system, so that the contamination is less likely to spread.[29] The Revere site is located within the Tinicum Creek Watershed area.

The Boarhead Farms site is located along Lonely Cottage Drive in Bridgeton Township. It occupies approximately 120 acres, half of which are wooded and non-wooded wetlands. The other half of the site includes open field areas, four manmade ponds, wooded uplands, a farmhouse office and stable.

Boarhead Corporation purchased the site in 1969 and remains the current legal owner. Throughout the 1970s, chemicals were found to be improperly stored and disposed of at the site. EPA placed the site on the National Priorities List (NPL) in March 1989. There have been four removal actions, which took place in 1992 and 1993.

A Record of Decision (ROD) was completed in 1998. EPA selected an alternative consisting of a number of components to provide remediation of the site. These are:

- Soil aeration and treatment of volatile organic compounds (VOC) hot spots
- Excavation and offsite disposal of buried drums
- Groundwater extraction, metals precipitation and air stripping
- Installation of additional monitoring wells, institutional controls and monitoring,
- Residential water treatment
- Phytoremediation

As of 2003, the process of remediation at this site is continuous and ongoing. Additional information regarding the site can be found at EPA's Superfund Website: www.epa.gov/superfund/sites/rodsites/0300963.htm

In July of 2003, a paper was presented by Dr. Ameleto Pucci Jr. Director of the Bucks County Health Department's Bureau of Environmental Health, which addressed water availability in diabase regions located within the Southeastern Pennsylvania Ground

[28] Ground-water Management Committee, Municipal Ground-Water Resources Management Northern Bucks County: Position Paper (Tinicum Township, PA, 1994), 16.
[29] Ibid.

Water Management Area (SEPGWMA). As described earlier, a small portion of the Middle Delaware River Study Area lies within this protected area. The paper opines that the existing model for groundwater management developed by the DRBC is based upon the assumption that Diabase Intrusions, which are extensive in the northern portions of the SEPGWPA in northern Bucks County, have the same hydrogeologic properties as the surrounding Locatong and Brunswick Formations.[30] Under this assumption, water availability may be overestimated for this specific region of northern Bucks County, when compared to calculations based on a modified version of the model which accounts for differing base flow properties of diabase. The paper suggests that the existing model should be examined and perhaps modified, if appropriate, to account for the differences in the water-bearing properties of the underlying geologic formations.

Community Water and Sewage Facilities

Although most of the higher density municipalities such as Easton, Riegelsville and New Hope rely on public supplies, over 70 percent of the housing units in the Middle Delaware communities rely on individual wells. In addition, over 70 percent of the housing units rely on on-site septic systems for sewage disposal. A breakdown, based on 1990 census data is provided in Table II-17. It should be noted that residents replying to the census question may have interpreted privately owned – community systems such as package treatment facilities as public sewers. Therefore, the percent of housing units on public sewers as detailed may be lower than the percentage shown in Table II-17.

Table II-17 Water and Sewer Facilities in the Study Area

Area	Percent of Housing Units on Public Water	Percent of Housing Units on Wells	Percent of Housing Units on Public Sewer	Percent of Housing Units with On-site systems
Planning Area Municipalities	**29.3%**	**70.8%**	**27.9%**	**72.1%**
Bridgeton Township	0.0%	100.0%	1.4%	98.6%
Durham Township	1.2%	98.8%	0.6%	99.4%
Easton City	100.0%	0.0%	98.6%	1.4%
Forks Twp 1	77.3%	22.7%	79.2%	20.8%
New Hope Borough	48.0%	52.0%	93.4%	6.6%
Nockamixon Township	3.4%	96.6%	2.7%	97.3%
Plumstead Township	6.8%	93.2%	28.0%	72.0%
Riegelsville Borough	96.8%	3.2%	10.6%	89.4%
Solebury Township	8.4%	91.6%	11.9%	88.1%
Tinicum Township 2	2.8%	97.2%	2.6%	97.4%
U. Makefield Township	1.5%	98.5%	2.4%	97.6%
Williams Township	4.8%	95.2%	3.0%	97.0%

Sources: U. S. Bureau of the Census, Census 1990 as summarized in the Bucks County Continuum, Bucks County Planning Commission. January 1994.
1) Based on information contained in the Water Supply and Sewage Facilities Plan Supplement (Lehigh Valley Planning Commission, 2000), the portion of Forks Township within the Middle Delaware Planning Area continues to be primarily served by individual on-lot systems and wells.
2) Presently, Tinicum has no public water or sewer systems, data may reflect private community systems.

[30] Pucci, Ameleto A. Jr., Water Availability in Diabase Regions of a Water Management Area, Peer-reviewed Conference Paper Preprint to be presented at the American Water Resources Association 2003 International Congress on Watershed Management for Water Supply Systems. New York City, NY. June 30-July 2, 2003. Pg. 3.

Biological Resources

Significant Wildlife and Natural Areas

According to the Bucks County Natural Resources Plan, there have been more recorded occurrences of rare wildlife in Bucks County than in any other county in Pennsylvania.[31] In addition to the river, the plan identifies two county significant wildlife areas in the Middle Delaware River Study Area. These are Nockamixon Cliffs and Bowman's Hill Wildflower Preserve. Both of these resources are described further in this document.

The Natural Areas Inventories (NAI) for both Northampton and Bucks Counties were reviewed to identify special natural areas of concern. Each inventory prioritizes sites based on their ecological values and importance. Although all sites listed in the inventories contain natural resources worthy of protection, they are prioritized based on individual characteristics. Those areas classified as Priority 1 sites, for example, are sites of state and countywide significance based on the uniqueness or exceptionally high quality of the natural features they encompass.[32] A listing of Aquatic and Terrestrial Wildlife Species in the Middle Delaware River Study Area can be found in **Appendix C** of this plan.

There are approximately ten island groups within the Middle Delaware River Study Area. They vary in size from small gravel mounds to forested habitats of over 100 acres. Due to limited access and seasonal flooding, the islands remain relatively natural. The islands provide critical stopovers for migrating birds and the shallow waters around them are important nurseries and feeding grounds for a variety of fish. The forested islands proved a rich environment for nesting waterfowl, herons and songbirds.[33] Areas of special significance (highest priority) are further described below.

Braided Channel Islands - Tinicum Township

This group of islands lies between Erwinna and Point Pleasant. They are a remnant of the glacial era representing outwash deposits and channels that formed as the glaciers to the north were melting. On the Pennsylvania side, the formation includes Fishing, Resolution, Walls, and Marshall's Islands and the Prahls Island Group. In addition to their geological significance, several of these islands have populations of the state rare Yellow Lamp Mussel *(Lampsilis cariosa*) and potential habitat for the Cobblestone Tiger Beetle.[34]

Nockamixon Cliffs

The Nockamixon Cliffs are a two-mile long stretch of Brunswick shale cliffs rising 250-300 feet above the Delaware River. The cool, north facing cliffs, which are kept moist year round by numerous streams and seeps, provide habitat for an arctic-alpine plant

[31] Bucks County Planning Commission, Bucks County Natural Resource Plan, 1999, 47.
[32] Rhodes, Ann F. and Timothy A. Block, Natural Areas Inventory of Bucks County, Pennsylvania. 1999, 12.
[33] National Park Service 1999, 33.
[34] Ibid, 21.

community rare to both Pennsylvania and the continental United States. This plant community includes the Pennsylvania-Endangered roseroot sedum (*Sedum rosea)* and the Pennsylvania-Rare white heath aster (*Aster ericoides*). According to the NAI, the site is regarded as one of the most important botanical sites in southeastern Pennsylvania.[35] Endangered species such as the peregrine falcon and osprey as well as over 90 other bird species have been known to roost there.[36] The NAI also notes that Nockamixon Cliffs was identified as a potential Natural Ecological Landmark and is also considered an outstanding scenic geologic feature.[37]

Rapp Creek (Upper Portion)

This site is primarily located within State Game Lands Number 56, and partially located in the Middle Delaware River Study Area. It includes an extensive continuous forested area containing Red oak, Sugar maple, Bottomland oak, and Red maple. Several populations of PA-Threatened Scarlet Indian Paintbrush (*Castilleja coccinea)* are known in the area. Other notable features are the PA-Endangered Eared false foxglove (*Tomanthera anuiculata*), and Pineland pimpernel (*Samolus parviflorus*). More information about this specific site can be found in the Tinicum Creek Watershed Conservation Plan.[38]

[35] Rhodes et al, 1999, 29.
[36] Bucks County Planning Commission, 2000.
[37] Rhodes et al, 1999, 29.
[38] See Tinicum Watershed Conservation Plan (Tinicum Creek Watershed Association, Tinicum Township and Princeton Hydro, 2000.)

The numerous NAI sites within the Middle Delaware River Study Area are summarized in **Tables II-18 and II-19**, one for each county. The areas are shown on **Map 10 (Natural Areas, Parks and Preserved Land).**

Table II-18 Middle Delaware River NAI Sites - Northampton County

Natural Areas	Municipality	Features	County Rank (State Significant)	Locally Significant
Getters Island	Easton	Stretch of river supports two animal species of concern.	4	na
Hexenkopf Slopes	Williams	Area is a broad southeast facing forested slope. Summit includes large rock outcrop formation known as Hexenkopf Rock. Includes several seeps and at least one vernal pool. Trees include: tulip poplar (Liriodendron turlipifera), sweet birch (Betula lenta), oaks (Quercus spp.) and hickories (Carya spp.) Shrubs include: Witch-hazel (Hamamelis virginiana) and spicebush (Lindera benzoin). Upland areas known as nesting sites for both black vultures (Coragyps atratus) and turkey vultures (Cathartes aura).	na	Medium
Hexenkopf Wetlands	Williams	Series of wetlands and seepy forests along unnamed tributary to Frys Run. Pa Endangered animal has been observed. Forest cover dominated by shrubs, sedges (Carex spp.), and sweetflag (Acorus calumus)	4	na
Mariton slopes	Williams	Area is a series of forested slopes and shaded escarpments above river. Good habitat for fern species and spring wildflowers. Valuable as migratory habitat for bird species using river corridor. red oak (Quercus rubra), chestnut oak (Quercus prinus), sweet birch (Betula lenta), red maple (Acer rubrum) and hemlock (Tsuga Canadensis).	na	High
Mariton Uplands Mariton Wildlife Sanctuary *	Williams	Site includes forest of varying ages and several large meadows. Supports fair to poor quality of PA-threatened plant species. Site part of 198- acre Mariton Wildlife Sanctuary and is contiguous to the Mariton Slopes.	5	na
Old Sow Island	Williams	Supports good quality population of PA-Rare plant species. Vegetation includes sycamore (Platanus occidentalis), ash (Fraxinus spp.), sandbar willow (Salix spp.), sneezeweed (Helenium autumnale) and frost grape (Vitis riparia).	4	na
Raubs Island	Williams	Supports good quality population of a PA-Rare plant species. Good habitat for osprey and heron.	5	na
Raubsville Lock 22-23	Williams	This stretch of Delaware supports an animal species of special concern. Site within Delaware Canal State Park.	5	na
Whippoorwill Island	Williams	PA Rare plant species and bird species such as Osprey (Pandion haliaetus) and herons. Vegetation includes sycamore (Platanus occidentalis), ash (Fraxinus spp.), sandbar willow (Salix spp.), sneezeweed (Helenium autumnale), frost grape (Vitis riparia), big bluestem (Andropogon gerardii) and poison ivy (Toxicodendron radicans).	4	na

Source: Nature Conservancy, 1999. A Natural Areas Inventory of Lehigh and Northampton Counties, Pennsylvania. * Denotes critical habit, as identified by the Nature Conservancy and the State of Pennsylvania – as referenced in the Lower Delaware National Wild and Scenic River Report (National Park Service, 1999. pg 30) na= not applicable, site may only be county-ranked or locally significant, not both.

Table II-19 Middle Delaware River NAI Sites - Bucks County			
Name	**Municipality**	**Notable Features**	**Priority**
Braided Channel Islands*	Tinicum Township	see text	1
Nockamixon Cliffs*	Nockamixon Township	see text	1
Rapp Creek (Upper Section	Nockamixon and Bridgeton Townships	see text	1
Aquetong Lake & Ingham Spring	Solebury Township	see text – (Water Resources)	2
Ringing Rocks County Park	Bridgeton Township	Site includes highest waterfall in County; High Falls, Wildcat Ravine, and Ringing Rocks diabase boulder field. Forested stream valley. Outstanding geologic feature of PA. Potential National Natural Geological Landmark. Red oak and Rich hemlock mixed -hardwood forests.	2
Buckwampum Hill	Springfield and Durham Townships	Site includes 320 acres of forested slopes and hilltop on the boundary between Springfield and Durham Townships. Headwaters streams of Gallows Run and Cooks Creek originate in seeps and wetlands on the slopes of the hill. Fifty-eight species of bird recorded by Bucks County Audubon Society, including 7 rare breeders. Red oak – mixed hardwood forest, Red maple – blackgum palustrine forest.	3
Chestnut Hill	Durham Township	Site consists of extensive wooded slopes and is adjacent to Monroe Border Fault. Sixty-three bird species have been identified by Bucks County Audubon society including 10 rare breeders. Red oak – mixed hardwood forest.	3
Bowman's Hill & Pidcock Creek	U. Makefield and Solebury Townships (Continuation of diabase ridge that forms Jericho Mountain)	Site includes wildflower preserve and stone observation tower. Important Bird Area with 59 recorded species, including 11 rare breeders. Potential geological natural landmark. Spring coralroot (*Corallarhiza wisteriana*), Sycamore floodplain forest, Rich hemlock mesic hardwood forest and Red oak mixed hardwood forest.	3
Burrell's Lake	Solebury Township	Six-acre lake formed by a dam on Aquetong Creek. Rich deciduous forest. Diverse spring herbaceous flora. Tulip tree-beech-maple forest.	3
Cuttalossa Creek Valley	Solebury Township	Small watershed provides habitat for 59 bird species, including 8 rare breeders.	3
Delaware Canal State Park. Ellisia site	Upper Makefield Township (1 mile SE of Brownsburg)	State rare plant [Water-pod (*Ellisia nyctelea*)] exists along canal towpath . Sycamore-river birch-box-eder floodplain forest.	3
Fieldstone Farm – wooded slopes along Delaware River and Paunacussing Creek.	Plumstead and Solebury Townships	Farm occupies a 500-acre upland site that includes forested slopes along the Paunacussing Creek and Delaware River just above Lumberville. Rich hemlock – mesic hardwood forest, Tulip tree – beech - maple forest and Red Oak – mixed hardwood forest.	3
Hal Clark Park	Solebury Township	Site on shore of Delaware River and includes riparian forest, successional old fields, & forested wetlands. PA Threatened shrub - hop-tree *(Ptelea trifoliata)*. Sugar maple, Sycamore, Red maple & River birch present.	3
Hendrick Island*	Solebury Township (Just north of Center Bridge)	112-acre island is part of Delaware Canal State Park. Includes riparian Sugar maple forest and diverse older trees. Formerly farmed. Important Native American archeological site. Largest Butternut tree in PA.	3
Indian Rock Ravine	Bridgeton and Nockamixon Townships	Steep ravine with exposed red shale cliffs of Brunswick Formation. Good diversity of woody & herbaceous species. Rich hemlock, Red oak.	3
Jericho Mountain	Upper Makefield Township	Diabase ridge with forested slopes, frequent springs & seeps. Includes man-made ponds. Good diversity of trees, shrubs and herbaceous species. Also 60 species of birds recorded, including 10 rare breeders.	3

Table II-19 Middle Delaware River NAI Sites - Bucks County			
Name	**Municipality**	**Notable Features**	**Priority**
Lynn Island	Nockamixon, Durham	This 11-acre island is part of Delaware Canal State Park Natural Area. Includes mature riparian forest. River birch, Tulip tree, Sycamore, abbreviated clubtail dragonfly & Ohio spiderwort *(Tradescantia ohiensis)*	3
Monroe Border Fault	Durham (Runs from River at Monroe west to where Rt. 212 crosses county line.)	National Natural Landmark. Also known as Triassic Border Fault. Geologic boundary between Reading Prong (north) and Piedmont physiographic province (south). Formed 250 million years ago when the block to the south dropped to form a deep valley.	3
Scudders Falls Island*	Lower and Upper Makefield. (Extends for about one mile upstream from the Scudder Falls Bridge)	This site includes islands and alluvial riverbanks. Islands are forested, with mature trees and rare shrub (common hop-tree *(Ptelea trifoliata)*. Backwater channels contain emergent wetland vegetation. Excellent habitat for riparian birds. Silver maple, water-willow, River birch bar community.	3
Timber Knolls Wetlands	Upper Makefield Township (West side of Taylorsville Road, north of Woodhill Road)	Extensive swamp forest, emergent wetlands & pond. Important habitat for birds and amphibians. Red maple - mixed shrub palustrine woodland.	3
David R. Johnson Natural Area	Solebury Township (Along River Road 0.75 miles northwest of Center Bridge)	DCNR Bureau of Forestry Natural Area. Wooded stream valley along Laurel Run. Rich hemlock, Red oak	4
Falls of the Delaware	Upper Makefield Township	A band of wooded swamp, emergent wetlands, early successional forest, and disturbed woods. Important part of green corridor along river and canal. Provides habitat for variety of birds. Black willow scrub/shrub wetland, Netted chain fern *(Woodwardia aceolata)*	4
Kintnersville-Gallows Run floodplain	Nockamixon Township (lower section between Rte. 611 & Delaware Canal)	Extensive floodplain wetlands and backwaters. Bluejoint - reed canary grass emergent wetland, Tussock sedge marsh, floodplain forest.	4
Murdoch Way Phlox site	Nockamixon Township (Located 0.9 miles west of the Nockamixon Cliffs)	Old fields under power lines with small population of Downy phlox (*Phlox pilosa)*	4
Washington Crossing - Marazzo Tract along Delaware Canal	Upper Makefield Township (South of Rte. 532)	25 acres of very disturbed forest along canal. Small streamlet & a wetland area adjacent to the south end of the canal. Adjacent Redbelly turtle habitat. Black willow scrub/shrub wetland.	4

Source: Rhodes, Ann F. And Timothy A. Block, 1999. Natural Areas Inventory of Bucks County, Pennsylvania.
*** Denotes a critical habitat as identified by the Nature Conservancy and State of Pennsylvania as referenced in the Lower Delaware National Wild & Scenic River Report (National Park Service, 1999. Pg. 30)**

Vegetation/Critical Habitat

The Middle Delaware River Study Area includes a variety of vegetation resulting from differences in elevation, climate, land use, physiography and geology. The majority of the study area is located in the Triassic Lowland Section of the Piedmont Physiographic Province. In this area, only stream valleys, steep slopes, poorly drained areas and scattered woodlots remain forested. The Lower Delaware River National Wild and Scenic Study reported a number of major tree species along the river corridor. These include: black, gray, river and yellow birch; red and sugar maple; red oak; white ash; large-toothed and trembling aspen; tulip tree; beech; black locust; walnut, and black cherry; sycamore; and hemlock. Shrubs include willow, spirea, silky dogwood and

alder. Woody species above the floodplain include spicebush, blueberry, huckleberry rhododendron, mountain maple, staghorn sumac, sweet fern and witch hazel. Vegetation along the river corridor provides valuable habitat for birds and other animals and shade for fish in the river.[39] **Appendix C** includes a listing of vegetation in the study area.

Some areas within the Middle Delaware River Study Area contain special vegetation features including rare plant species, unique or unusual floral habitats or outstanding individual species. These resources, if identified, are noted in the **Natural Areas Tables II-18 and II-19**. Nockamixon Cliffs for example, support special flora found at no other site in the area. Roseroot, an arctic-alpine herb, grows on the shelves and crevices near the tops of these cliffs and is in the southern most part of its habitat. The National Wild and Scenic Report also identified several "critical habitats" present within the Middle Delaware River Study Area. According to the report, these areas were identified by the Nature Conservancy in cooperation with the State of Pennsylvania and meet the outstandingly remarkable resource criteria:

- Frys Run (a.k.a. Frya Run)
- Hendrick Island
- Mariton Wildlife Sanctuary
- Marshall Island (Part of Braided Channel Island Group)
- Nockamixon Cliffs
- Scudders Falls Islands

Open Space/Preserved Land

Open space preservation is a basic tool for preserving the outstanding resources in the Middle Delaware River Study Area. Maintaining natural open space is critical to water quality. Wooded and forested areas provide shade for streams, cooling it to increase the water's ability to contain oxygen. Open space preservation protects vital habitat areas for rare and endangered plant and animal species. Preserving open space near historic properties helps them maintain their contextual value. The study area's numerous scenic vistas and recreational sites also benefit from preservation activities. As noted in the Lower Delaware Wild and Scenic River Report, *Any loss of open space in the corridor would significantly reduce the scenic character and recreational opportunities that made the river corridor eligible for National Wild and Scenic designation.* [40]

Agricultural resources are also an important component of open space. Properly managed agriculture lands preserve many natural and cultural values such as rural character, prime farmland soils, and scenic landscapes. The Middle Delaware River

[39] National Park Service. Lower Delaware National Wild & Scenic River Study Report (Northeast Region: Philadelphia 1999), 28

[40] National Park Service. Lower Delaware National Wild & Scenic River Study Report (Northeast Region: Philadelphia 1999), 40

Study Area contains numerous agricultural lands as well as important agricultural soils. Many of these areas are protected through land use ordinances and others are preserved through public and private acquisitions, easement and preservation programs.

Table II-20 summarizes the amount of acreage under preservation in the Middle Delaware River Study Area, including state and county parkland, state game lands, county or municipal preserved areas, lands under private preservation, and preserved agriculture land. Lands privately protected represent the highest percentage of preserved land in the study area. Approximately 7,957 acres or 11.8 percent of the study area lands are privately preserved. The location of these protected lands are shown on Map 10.

Map 10 Natural Areas, Parks and Preserved Lands

3 – 11 ½ x 17 maps

Table II-20 Middle Delaware River Preserved/Public Lands			
Category	**Acres Preserved in Study Area**	**Percent of Preserved Land**	**Percent of Study Area**
State Park	171.57	1.06%	0.26%
County Park	402.43	2.49%	0.60%
Public Owned or Preserved	767.00	4.74%	1.14%
Preserved Agriculture Lands	2,420.84	14.96%	3.60%
State Game Lands	4,467.52	27.60%	6.64%
Private Preservation	7,956.55	49.16%	11.83%
Total	16,185.07	100.00%	24.06%

Source: Heritage Conservancy, 2003

Cultural Resources

Recreation and Parkland

National Parks and Heritage Corridors

The Middle Delaware River Study Area lies within the Lower Delaware National Wild and Scenic River system and includes the Delaware and Lehigh National Heritage Corridor and State Heritage Park. As stated in the Lower Delaware National Wild and Scenic River Study Report, "*The Lower Delaware River flows through the very heart of the birthplace of our great nation. Every bend in the river speaks to us of history, of beauty, of opportunity – of life itself.*"[41]

The 65.6 mile long Lower Delaware River was designated as a National Scenic and Recreational River on November 1, 2000. It includes the entire reach of the Delaware River from The Delaware Water Gap to Washington Crossing. *"In proposing a river for designation, a recommendation is also made regarding the river's proposed classification. The classification - wild, scenic, or recreational - is based solely on the intensity of human presence along the river corridor…A river's classification is principally used to guide future actions by federal agencies on projects affecting federally owned lands".* [42] Approximately 25 miles of the river are classified as scenic and the remaining 40 miles are classified as recreational.

The Lower Delaware River was afforded this national designation because of its free-flowing condition and because it possesses at least one outstandingly remarkable resource value. The resource value must be directly related to, or dependent upon, the river. According to the National Park Service Study, the Lower Delaware River valley contains habitats that do not exist elsewhere in the region. The river is an important component of the Atlantic Flyway, one of four major waterfowl routes in North America. Additionally, the river is one of the most significant historic corridors in the nation, with crucial infrastructure still intact. One of these resources is the Delaware

[41] National Park Service, Lower Delaware National Wild & Scenic River Study Report; Northeast region (Philadelphia, 1999), 1.

[42] Ibid, page 4.

Canal, a key component of the Delaware and Lehigh (D & L) Navigational Canal National Heritage Corridor. The D & L Canal is a National Historic Landmark and its towpath is a designated National Recreation Trail. It is the only remaining continuously intact remnant of the 19th century towpath canal era.

State and County Parks

Both the state and counties have numerous parks within the study area as illustrated on **Map 10** and summarized in **Table II-21**. The Delaware Canal State Park is a major tourist attraction with an estimated one million visitors annually.[43] A major portion of the 60-mile Delaware Canal State Park, extending from the city of Easton in Northampton County to Bristol Borough in Bucks County, is within the Middle Delaware River Study Area.

The canal is an important resource to the region and state and is continuously being improved through state funding. In 1997, the state revealed a five-year, $7.65 million plan for the park designed to create recreational opportunities; eliminate or reduce the current rate of canal deterioration; enhance the local economy through tourism; and begin a systematic program for restoring the historic canal. In January 2003, the Pennsylvania Department of Conservation and Natural Resources (DCNR) purchased a 150-acre sand and gravel quarry to be protected as open space as part of the Delaware Canal State Park. The property, located along River Road has a 3,200-foot boundary along the State Park and about 4,600 feet of frontage along the Delaware River. It is adjacent to the Uhlerstown National Historic District and within the Delaware River floodplain. This new addition to the state park system was recently renamed the "Giving Pond". Water has been allowed to return to the existing 95-acre depression, creating a shallow lake with exposed islands and subsurface islands. Additional plans at the site include public parking for access to hiking trails, fishing, hunting, and canoeing and construction of an environmental education and information center for visitors. A recent article about the site, published in the Philadelphia Inquirer is included in **Appendix D.**

Washington Crossing State Historic Park is a 500-acre park located in two sections along the Delaware River. The northern section, or Thompson's Mill Section is located about six miles south of New Hope Borough along PA Route 32. This 190-acre portion of the State Park includes the 100-acre Bowman's Hill Wildflower Preserve as well as the restored Thomson-Neely House and Grist Mill. Approximately three miles south along Route 32 is the McConkey's Ferry Section of the park. The park includes the area where George Washington made his famous 1776 Christmas Day river crossing to attack the British forces in Trenton, NJ. As many as 10,000 spectators return annually to witness the re-enactment of the crossing.[44] This section also includes several 19th century sites such as the 1817 Mahlon K. Taylor House, the 1828 Taylorsville Store and the Hibb's House, c. 1823.

[43] Willis M. Rivinus The Complete Guide to the Delaware and Lehigh National Heritage Corridor (Lehigh River Foundation, 1994), 36.

[44] Ibid, page 37.

Table II-21 Regional Park and Recreation Sites - Middle Delaware River Study Area			
Name	**Municipality**	**Acreage**	**Special Features**
Northampton County Parks			
Frost Hollow Overlook	Forks	2.5 acres	County natural area and passive park. Provides access point to Delaware Canal State Park.
Wy-Hit-Tuk Park & Boat Launch	Williams	23.1 acres	Community Park, picnic area and playground. Activity node and access point along Delaware Canal State Park.
Fry's Run Park & Boat Launch	Williams	5.8 acres	County natural area and passive park. Provides access point to Delaware Canal State Park.
Bucks County Parks			
Tinicum County Park & Boat Launch	Tinicum	126.6 acres	Includes Historic Ervin-Stover House
Prahls Island Group	Tinicum	88.4 acres	Part of Braided Channel Island group. Priority 1 site in NAI. See Text.
Ringing Rocks County Park	Bridgeton	65.2 acres	PA Outstanding scenic geologic feature. Priority 2 site in NAI.
Hal H. Clark County Park	Solebury	27.5 acres	Priority 3 site in NAI, includes riparian forest, forested wetlands and successional old fields.
Riverfront and Boat Launch Areas			
Upper Black Eddy Boat Launch	Bridgeton	0.5	Owned by PA Fish and Boat Commission
Riegelsville	Riegelsville	0.5	Owned by PA Fish and Boat Commission
State and Federal Parkland			
Washington Crossing State Park (Thompson's Mill Section)	Solebury & Upper Makefield Township	190	Section includes Bowman's Tower, Thompson-Neely House and Grist Mill.
Bowman's Hill Wildflower Preserve	Solebury & Upper Makefield Township	100	Located within Thompson's Mill Section of Washington Crossing Park. Priority 3 site in NAI.
Washington Crossing State Park (McConkey's Ferry Section)	Upper Makefield Township (3 miles south of northern section).	300	Includes site where Washington crossed the Delaware - National Historic Landmark. Durham Boat House, McConkey's Ferry Inn, Taylor House, Taylorsville Store, Hibb's House.
Delaware and Lehigh Canal NHC, State Heritage Park. Delaware Canal State Park	Corridor	60 miles	Delaware Canal Reach extends from Easton to Bristol.
Lower Delaware River National Scenic and Recreational River	Delaware Water Gap to Washington Crossing	25.4 Miles - Scenic Recreational - 40.2 miles	Designated as part of the National Wild and Scenic Rivers System on November 1, 2000.

Sources: BCPC, Bucks County Natural Resource Plan 1999 and LVPC, Inventory Of Parks and Other Outdoor Recreation Sites In Lehigh and Northampton Counties, 2002

Historic Resources

The Native American tribes of the Lenni-Lenape nations were the original inhabitants of the land within the study area. The word Lenape (or Lena´pe) means "original human". The Lenapes have a 10,000 year documented history in their homeland and are the indigenous people of the Delaware and lower Hudson valleys from western Connecticut and New York City through New Jersey, eastern Pennsylvania, Delaware and northeastern Maryland. The English named the Lenape Sacred River "Delaware" (after Lord de La Warr) and called the Lenapes, "Delawares". Lenapes speak dialects of

the great Algonquin language and are considered the Grandfather people of almost two-thirds of the Indians of North America.[45]

The first European groups to arrive in the region were William Penn and the English Quakers in the 17th century. Shortly after the Quaker's arrival, other Dutch, Swedish and English immigrants also began setting up self-sufficient manor farms and small market villages. Prior to the European settlements, the Lenape hunted and fished along the Delaware River and its tributaries. Sites that represent Native Americans are primarily archeological, and many village and hunting campsites are known. Some major roads along or traversing the river corridor (both within the study area and beyond), follow routes of Native American Trails, and many place names (towns, rivers, streams, etc…) were taken from the language of the original inhabitants.[46]

By the end of the 18th Century European Settlers had dramatically changed the environment. Forests were cut, sawmills were constructed and land was cleared for farming. Due to the region's agricultural resources, most to the area remained unaffected by the 19th Century industrial growth, except for the use of canals as a transportation route and the establishment of small industrial centers such as New Hope along the Delaware River.

The Delaware River and Delaware Canal were two major transportation routes where early villages were established. Taverns and Inns served the needs of the river boatmen. After the Delaware Canal opened in 1833, more taverns and villages appeared along the canal route.[47] Although most villages were established due to their proximity to major transportation routes, some were established elsewhere. Common locations were the areas near streams, which powered grist and saw mills. Thus, there are nearly two-dozen 18th and 19th century villages and river towns within the Middle Delaware River Study Area. One of the largest of the towns is New Hope Borough. New Hope began as a ferry stop on the river and grew into a small industrial center. By the mid 20th century, New Hope had become a popular resort town including a playhouse that premiered new plays bound for Broadway. In addition, it became a home for many New York and Philadelphia artists. New Hope continues to draw one million visitors annually with its various shops, boutiques and playhouse.[48]

Many of the villages and towns include districts that are listed on or eligible for the National Register of Historic Places. In addition to New Hope and Easton's historic districts, the following villages' historic districts are listed on the National Register:

- Point Pleasant – Plumstead and Tinicum Townships
- Aquetong, Centre Bridge, Lumberville and Phillips Mill – Solebury Township
- Uhlerstown – Tinicum Township

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[45] Drawn from, Who are the Lena'pes? by M. Katu'ha Gamble in The First Americans, (April, 1993).

[46] U.S. Department of the Interior, National Park Service. Lower Delaware River National Wild and Scenic River Study, Draft Eligibility and Classification Report, October 1994. Pg 20.

[47] Bucks County Planning Commission, The Villages of Bucks County: A Guidebook, (Doylestown, PA: BCPC, 1987). 3.

[48] Willis M. Rivinus, The Complete Guide to the Delaware and Lehigh National Heritage Corridor (Lehigh River Foundation, 1994), 36.

- Brownsburg, and Dolington – Upper Makefield Township

The villages of this area, as well as throughout Bucks County, represent an important part of the county's culture and heritage. The preservation of these historic villages has become more important as continued population and housing growth impact village land use patterns. Bucks County has published a detailed village-planning handbook[49], which provides guidance to both municipal officials and village residents on appropriate land use policies and regulations. The handbook offers technical guidance on issues such as conversions and adaptive reuse, maintenance of village properties, sewage and water facilities and financing improvements.

The Middle Delaware's historic resources are very much intertwined with its recreational areas, as evident by the popularity of the Delaware Canal State Park, and Washington Crossing State Park. In addition to these historic landmarks, there are numerous individual properties and districts listed on, or determined eligible for the National Register of Historic Places. **Table II-22** lists these resources, including the dates on which they were either listed or determined eligible for the National Register. The table was developed from information provided by the Pennsylvania Historical and Museum Commission. The locations of these resources within the Middle Delaware Study Area are shown on **Map 11 (Historic Resources).** The map location numbers are keyed to **Table II-22**.

Scenic Resources

The Middle Delaware River Study Area provides year-round scenic opportunities. Visitors to the area can view the river from the cliffs and bluffs, or access the river via riverfront parks and boat launch areas. Travelers via automobiles are able to view the river and canal as well as pass through historic riverfront towns. River Road from Kintnersville to Morrisville (PA Route 611 and PA Route 32) is designated a Pennsylvania Scenic Road. Bird watching, hiking, boating and other eco-tourism opportunities are plentiful along the Delaware River. The area is located along the Atlantic Flyway, one of four major waterfowl migratory routes in the United States. Bald Eagles use the river's shoreline and islands for winter habitat and the state endangered osprey are making a comeback along the river, due to a reintroduction program. There are multiple boat launch areas and riverfront parks, which allow access to the river for boating and scenic views. There are also numerous kayaking/canoe clubs. The Delaware Canal State Park has a trail system designated as a National Recreational Trail.

[49] Bucks County Planning Commission, Village Planning Handbook, (Doylestown, PA: BCPC, 1989).

Map 11 Historic Resources

3 – 11 ½ x 17 maps

Table II-22 Middle Delaware River Study Area Historic Resources						
Properties Listed on, or Eligible for the National Register of Historic Places						
Map ID*	**Municipality**	**County**	**Property Name**	**Property Address**	**Date Listed**	**Date Determined Eligible**
1	Easton City	Northampton	Easton House	167-169 Northampton Street	12/3/1980	
2	Easton City	Northampton	Heller, William Jacob House	501 Mixsell Street	4/20/1982	
3	Easton City	Northampton	Simon, Herman House	41 N. Third Street	6/27/1980	
4	Williams Township	Northampton	Bridge in Williams Township	Local Route 48007 Over Fry's Run	6/22/1988	
5	Williams Township	Northampton	Coffeetown Grist Mill	Corner of Coffeetown and Kressman Roads.	11/16/1977	
6	Easton City	Northampton	Easton Historic District	Includes numerous properties. Small portion located in study area.	5/6/1983	
7	Riegelsville Borough	Bucks	Riegelsville Academy	615 Easton Road		7/18/1986
8	Tinicum Township	Bucks	Erwinna Covered Bridge	Local Route 09098 in Erwinna	12/1/1980	
9	Tinicum Township	Bucks	Stover, Isaac House	River Road	4/26/1990	3/8/1989
10	Tinicum Township	Bucks	Stover Mill	E. Side of River Road (Rte. 32)	10/18/1979	
11	New Hope Borough	Bucks	Ely, Joshua House	Rittenhouse Circle	3/6/1985	
12	Solebury Township	Bucks	Beaumont, A.J. House	Route 202		6/28/1999
13	Solebury Township	Bucks	Deer Park Auditorium	Lower Mountain Road		10/17/1980
14	Upper Makefield Township	Bucks	Chapman, John House	Eagle Road, off Rte. 232.	1/24/1974	
15	Upper Makefield Township	Bucks	Eagle Tavern/Woodhill Store	Woodhill and Eagle Roads.	4/20/1978	
16	Upper Makefield Township	Bucks	Taylor-Gwinner House	Taylorsville Road, (East of Local Route 09140)		6/16/1977

Table II-22 Middle Delaware River Study Area Historic Resources						
Properties Listed on, or Eligible for the National Register of Historic Places						
Map ID*	**Municipality**	**County**	**Property Name**	**Property Address**	**Date Listed**	**Date Determined Eligible**
17	Upper Makefield Township	Bucks	Taylor, David Barton House	1849 Wrightstown Road		11/19/1987
18	Tinicum Township	Bucks	Uhlerstown Covered Bridge	T421 in Uhlerstown	12/1/1980	
19	Tinicum Township	Bucks	Williams, John Farm	Headquarters Road		3/17/1994
20	Riegelsville Borough	Bucks	Reigel, Benjamin, House	29 Delaware Road	1/6/1987	6/19/1986
21	Nockamixon Township	Bucks	Kintnersville Historic District			10/3/1994
22	Tinicum Township	Bucks	Uhlerstown Historic District	Delaware R., Jugtown Hill Road	5/26/1994	1/29/1992
23	Tinicum Township	Bucks	Riverside Farm	River Road	4/21/1988	11/12/1986
24	Plumstead Township	Bucks	Point Pleasant Historic District	River Road & Point Pleasant Pike	10/5/1989	
25	Solebury Township	Bucks	Paxon, Isaiah Farm	River Road	8/23/1984	
26	Solebury Township	Bucks	Cuttalossa Historic District	Along Cuttalossa Road from River Road		4/22/1982
27	Solebury Township	Bucks	Center Bridge Historic District	River Road between Laurel & Ely Roads	3/26/1985	4/22/1982
28	Solebury Township	Bucks	Phillips Mill Historic District	Rte. 32 between Limeport & Chapel	6/30/1983	4/22/1982
29	Solebury Township	Bucks	Solebury Historic District	Old Upper York Road Phillips Mill		4/22/1986
30	Solebury Township	Bucks	Honey Hollow Watershed	2.5 Mi. S. of the Delaware River	4/7/1969	
31	New Hope Borough	Bucks	Rhoads Homestead	104 W. Bridge Street	8/8/1996	7/12/1983
32	New Hope Borough	Bucks	Cintra	181 W. Bridge Street	3/6/1985	
33	New Hope Borough	Bucks	Springdale Historic District	Old York, Stoney Hill, S. Sugan Road	3/6/1985	

Table II-22 Middle Delaware River Study Area Historic Resources						
Properties Listed on, or Eligible for the National Register of Historic Places						
Map ID*	**Municipality**	**County**	**Property Name**	**Property Address**	**Date Listed**	**Date Determined Eligible**
34	New Hope Borough	Bucks	Kitchen, William House	332 S. Sugan Road	3/6/1985	
35	Upper Makefield Township	Bucks	Smith, Oliver Hampton Homestead	River road (N.E. of Brownsburg)	1/30/1978	
36	Upper Makefield Township	Bucks	Washington Crossing	Washington Crossing State Park	10/15/1966	
37	Upper Makefield Township	Bucks	Keith House - Washington's Headquarters	Pineville Road, S. of Pineville	11/14/1978	
38	Upper Makefield Township	Bucks	Hayhurst Farm	Eagle Road, NE of Wrightstown	2/12/1974	
39	Upper Makefield Township	Bucks	Burroughs, John Homestead	Wrightstown-Taylorsville Road	3/5/1984	
40	Upper Makefield Township	Bucks	Makefield Meeting (Makefield Monthly Me	Mt. Eyre and Dolington Road	1/18/1974	
41	Solebury Township	Bucks	Van Sant Covered Bridge	T392 West of Washington Crossing State Park	12/1/1980	
42	Tinicum Township	Bucks	Frenchtown Bridge (Frenchtown H.D., NJ-P		5/19/1994	
43	Tinicum Township	Bucks	Bridge in Tinicum Township	LR920, Danboro/Mt. Pleasant Road	6/22/1988	
44	Solebury Township	Bucks	Upper Aquetong Valley Historic District	Aquetong, Meetinghouse, Creamery, Sugan Rd.	7/30/1987	9/2/1986
45	New Hope Borough	Bucks	New Hope Village Historic District	Ferry, Bridge, Mechanic, Main, Cory	3/6/1985	
46	Upper Makefield Township	Bucks	Brownsburg Village Historic District	Jct. of River and Brownsburg Roads	5/26/1994	5/5/1980
47	Upper Makefield Township	Bucks	Dolington Village Historic District	Jct. Of Rte. 532 & Mt. Eyre Road	5/26/1994	
48	Tinicum Township	Bucks	Erwinna Historic District	Erwinna Village, River HQ Road, GE		2/1/1994
49	Solebury Township	Bucks	Lumberville Historic District	River Road	8/9/1984	4/22/1982

*See **Map 11** for location of these resources. Source: Pennsylvania Historical and Museum Commission, 2003.

Natural Resource Protection

Rationale for Protection

The natural features of the landscape contribute to the quality of life in the study area. Farmland, woodlands, steep slopes, stream valleys and gently rolling open spaces are some of the resources that are both visually attractive and have important functions in the ecology of the region and human health. If these features are to remain and function as part of the natural systems, protection of specific natural features must be considered in land use decisions. Development practices that include concern for natural limitations of the land often save money for the builder and the community. For example, development that preserves floodplains and wetlands protects property and avoids the loss of life. Proper grading in steep slope areas and the protection of natural forest cover helps avoid soil erosion and sedimentation in drainage systems. It is increasingly expensive to repair washed-out roadways and to install or enlarge storm water control facilities. These and similar costs can be minimized if development is permitted and takes place within the natural limitations of the land. The impacts of improper development may extend well beyond the property that is used or developed.

There are certain natural features of the landscape that warrant concern and protection. Development or clearing in certain natural areas, such as floodplains or carbonate areas, will result in hazards to life and property. The best ways to protect these features and avoid environmental hazards is avoid any alterations and limit encroachment in the most sensitive areas. For example, regulations, which prohibit or restrict development in floodplains could result in less property damage and lessen the chance of injury or loss of life during severe storm events. The following is a brief explanation of the basis for the protection of natural features.

Resource Protection and the Pennsylvania Municipalities Planning Code

Limiting development encroachment, regrading or intrusion into sensitive areas helps protect certain natural features. Municipal ordinances may establish maximum, quantifiable encroachment standards based on the capacity of the natural feature to withstand the effects of clearing and grading. The intensity and location of developed uses and site alterations are limited by these standards which reflect the suitability of the land to accommodate disruption without negative impacts on the site and areas beyond its boundaries.

Constitutional and Statutory Precedent

The basis for the protection of natural features is found in the commonwealth's constitution, in judicial decisions, and in the MPC. In 1968, the constitution was amended by a vote of the people of Pennsylvania to state in Article I, Section 27:

> The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and aesthetic values of the environment. Pennsylvania's public natural resources are common property of all people, including generations yet to come.

As would be expected, the courts have had to evaluate how this constitutional provision would be applied and who would assume the role of protector of these rights of the people. The Commonwealth Court has stated that, although various state departments have certain responsibilities, the local governments of the commonwealth have been delegated authority for land use planning and preservation of open space and natural features under the MPC. The constitutional mandate must rely on various statutes of the Commonwealth for implementation. The state laws specify responsibility for different aspects of natural resource protection. The court has also stated that, in exercising this responsibility, municipalities must permit reasonable development of property as well as managing the public natural resources. The court emphasized that controlled development, rather than no development, should be the focus and is the responsibility of local governments.

The Pennsylvania legislature, through the MPC, has charged the local governing bodies with the responsibility for protecting the citizens' health, safety and welfare through comprehensive planning and land use regulations. Over the years, particularly in the 1978 and 1988 amendments, increased emphasis has been given to the protection of natural resources. The MPC includes the following provisions:

Section 301(a)(2). A municipal comprehensive plan shall include a land use plan for the preservation of floodplains and other areas of special hazard.

Section 503(2)(v). A subdivision and land development ordinance may include provisions for insuring that land which is subject to flooding, subsidence, or underground fires either shall be safe for the proposed use or that these areas shall be set aside for uses that do not endanger life or property.

Section 603(b)(5). Zoning ordinances may be designed to preserve the natural, scenic and historic values in the environment and to preserve forests, wetlands, aquifers and floodplains.

Section 603(b)(7). A zoning ordinance may contain provisions to promote and preserve environmentally sensitive areas.

Section 605(2)(ii), (iii), and (vii). Under the zoning ordinance, all uses of the same nature must be treated in a uniform manner within any one zoning district, except that special provisions may be made for areas identified as natural or artificial bodies of water, places of relatively steep slope or grade, areas of hazardous geological or topographic features, floodplain areas, agricultural areas and other places having special character or use affecting or affected by their surroundings.

Section 606. The zoning ordinance shall include or reference a statement of community development objectives relating to the need for protecting natural resources.

Section 609.1(c)(2) and (3) and Section 916.1(c)(5)(iii) and (iv). In evaluating a substantive challenge to the constitutionality of a zoning ordinance by a land owner,

the governing body or the zoning hearing board shall determine the suitability of the site for the intensity of use proposed by the site's soils, slopes, woodlands, wetlands, floodplains, aquifers, natural resources, and other features. It shall also evaluate the impact of the proposed use on the site's soils, slopes, woodlands, wetlands, floodplains, natural resources and natural features, the degree to which these are protected or destroyed, the tolerance of the resources to development, and any adverse environmental impact.
Other sections of the MPC address agricultural resources.

Section 301.(a)(2). A comprehensive plan shall include a plan for land use which may include provisions for the amount, intensity, character and timing of land use proposed for the preservation of prime agricultural lands, flood plains and other areas of special hazards and other similar uses.

Section 603.(b)(5). A zoning ordinance may permit, prohibit, regulate, restrict and determine the protection and preservation of agricultural land and activities.

Section 603.(c)(7). A zoning ordinance may contain provisions to promote and preserve prime agricultural land.

Section 603.(g)(1). Zoning ordinances shall protect prime agricultural land and may promote the establishment of agricultural security areas.

Section 603.(h). Zoning ordinances shall encourage the continuity, development and viability of agricultural operations.

Section 604.(1). The provisions of a zoning ordinance shall be designed to promote, protect and facilitate agricultural use.

Section 604.(3). The provisions of a zoning ordinance shall be designed to preserve prime agriculture and farmland considering topography, soil type and classification, and present use.

Section 605.(2)(vii). Within a zoning district, all provisions shall be uniform for each class of uses or structures, except that additional classifications may be made within any district along or near agricultural areas.

Section 606. A zoning ordinance should include a statement of community development objectives including the need for preserving agricultural land.

Section 609.1.(c)(5). Related to landowner curative amendments. If the challenge has merit, the Governing Body shall consider the impacts of the proposal on the preservation of agriculture and other land uses that are essential to public health and welfare.

Section 916.1.(c)(5)(v). Relates to substantive challenges. If the challenge has merit, the Zoning Hearing Board shall consider the impacts of the proposal on the preservation of agriculture and other land uses that are essential to public health and welfare.

Recommended Protection Standards

As described previously, the best way to preserve and protect areas of sensitive natural features is to limit encroachment in these areas. The limitations are based on the resource's tolerance to intrusion. The standards listed below should be considered by municipalities as a minimum to protect and preserve natural areas. Specific technical standards and criteria should be based on local conditions and municipalities are permitted and encouraged to go beyond minimum standards, if it is desired and warranted to adequately protect their significant resources.

1. Floodplains: Except for necessary roads and utilities, floodplains should not be filled, regraded or built upon except for necessary road and utility crossings, bridges, and water related structures such as docks, piers and marinas. Protection: 100 percent.

2. Floodplain (Alluvial) Soils: Where a floodplain has not been delineated for the Federal Flood Insurance Study and these soils exist, these soils will serve as the delineated floodplain. Except for necessary roads and utilities, floodplain soils shall not be regraded, filled or built upon. In the event that the landowner provides a study to delineate a floodplain with floodway and flood fringe areas, that study may be accepted to replace the floodplain soils delineation. A study provided by the landowner must be reviewed and found to be adequate by the municipal engineer, the Federal Emergency Management Agency, and the Pennsylvania Department of Community and Economic Development, and the study must be approved by the Governing Body. Protection: 100 percent.

3. Watercourses: Except for necessary roads and utilities, watercourses shall not be filled, diverted, piped or built upon. Protection: 100 percent.

4. Wetlands: Except for necessary roads and utilities, wetlands shall not be filled, drained or built upon. Protection: 100 percent.

5. Riparian Buffers: Except for regulated activities by the Commonwealth or the municipality for road and utility crossings, farm vehicle and livestock purposes, and recreational trails, riparian buffer areas shall not be cleared, regraded or built upon. Protection: 100 percent.

6. Lakes and Ponds: Lakes and ponds shall not be filled, drained or built upon. Protection: 100 percent.

7. Steep Slopes: Regrading or development in steep slope areas shall depend on the severity of the slope. Regrading or development in 15 to 25 percent slope

areas shall be limited to 15-25 percent. In steep slope areas of 25 percent or steeper, not more than 15 percent shall be developed or regraded. Protection: 15 to 25 percent slope = 75-85 percent protected. 25 percent or steeper slopes = 85 percent protected.

8. Woodlands: Cutting, clearing, regrading, or development in wooded areas will depend on the nature of the area and the intended development pattern as addressed in a municipality's comprehensive plan and zoning ordinance. Intrusion and development should be limited to 15 percent in rural area zoning districts. In other areas, intrusion and development should be limited to 50 percent. Protection: Rural Districts – 85 percent. Other Districts – 50 percent. As noted previously, a municipal tree protection ordinance should protect the area under the drip line (outer edges of the tree canopy) from regrading and compaction.

9. Prime Agricultural Soils: In areas where prime agricultural soils would be protected, intrusion and development shall be limited to 20 percent of the Class I soils, 25 percent of the Class II soils and 30 percent of the Class III soils. In addition, location criteria for the areas to be kept open will require the open space on adjoining properties will be placed side by side. Protection: Class I soils – 80 percent. Class II soils – 75 percent. Class III – 70 percent.

This plan supports those municipalities that have enacted ordinance provisions that provide at least the above minimum recommended levels of protection. As described in the study's goals and objectives and recommended in the Management Options Table in the following chapter, municipalities within the Middle Delaware River Study Area should review their current ordinances with respect to the many resources within the Middle Delaware River Study Area and consider, investigate, or discuss adoption of additional protective standards.

III. Management Options and Action Plan

Overview of the Public Participation Process

Public Participation Process and Meetings

In order to identify issues and concerns and to develop goals and objectives for this river conservation plan, a number of public outreach events and planning advisory committee meetings were conducted. The project began with two initial public meetings. On April 25, 2001, the first was conducted in Plumstead Township, Bucks County and the second was held the next evening in the city of Easton in Northampton Township. The purpose of these meetings was to explain the river conservation planning process and to gather information and opinions concerning threats and opportunities within the Study Area.

A Middle Delaware River Planning Advisory Committee was appointed from the municipalities, conservation organizations, the two counties and the business community. The advisory committee was intended to represent the broad range of interests within the study area.

On June 1, 2001, members of the Planning Advisory Committee traveled the length of the corridor by van and cars to observe and discuss important features, landscapes and other related matters. The group stopped at seven key locations to hear briefings by local experts on several issues identified in the first public meetings.

In 2002, draft goals and objectives were prepared based on the matters raised at the two initial meetings and the committee's tour of the corridor. On June 10, 2002, the committee met to discuss the draft goals and objectives and substantial number of objectives were added based on the member's knowledge of the area and experience in their communities. Revised drafts were circulated among the members and priorities established. These goals and objectives provided guidance for the consultant's work through 2002 and into 2003 on the plan preparation.

On July 16, 2003, a draft of the plan, including a set of management options, was presented and discussed with the committee to refine the identified management options. Committee comments were discussed and incorporated to prepare a draft plan to be used for public comment and review by the corridor's municipalities.

A public meeting was held on October 28, 2003 to present the draft Middle Delaware River Conservation Plan. The meeting was held at the Plumstead Township Municipal Building located on 5186 Stump Road, Plumsteadville, PA. The purpose of the meeting was to present the report's major findings and to receive public comment on the draft plan. The meeting was held during the thirty-day public comment period, which began on October 13th 2003. Over a dozen press-releases were distributed to media representatives in both Bucks and Northampton Counties to publicize the meeting. Prior to the start of the public review process, Copies of the full draft and executive summary were distributed to all members of the Middle Delaware River Planning Advisory

Committee and copies of the executive summary were distributed to each of the municipalities represented in the study area. Copies of the full draft report were provided to both the Bucks County and Lehigh Valley Planning Commission for public access. Electronic files of the full draft plan, executive summary and maps were posted on the conservancy's website, prior to the beginning of the public comment period.

Several comment letters, phone calls and e-mails were received by the conservancy on the draft plan. These comments, along with comments made at the public meeting were incorporated into the final draft of this plan.

Selection of Goals and Priority Objectives

The Planning Advisory Committee undertook an extensive goals preparation process to identify critical matters that might be addressed through the planning process and the funding opportunities that would follow. The goals preparation process was designed to ensure that a wide variety of issues (i.e., environmental, economic, infrastructure, community form, and regulatory options) were addressed. On June 10, 2002, the Planning Advisory Committee met in work sessions to develop a detailed listing of goals and objectives. These goals and objectives would provide direction for the preparation of the river conservation plan and list, comprehensively, projects and efforts that might be undertaken to achieve the purposes stated in the plan.

The following list describes the ten goals as identified by the Planning Advisory Committee along with a list of objectives to achieve each goal statement. The list of goals and objectives developed by the Planning Advisory Committee was extensive, which reflects the diversity and breadth of the members' interests as well as the size, shape and diversity of the study area. Using a ballot process, the Planning Advisory Committee identified the objective under each of the ten stated goals that was thought to have the highest priority for implementation. The committee was asked to vote on the top objectives based on three criteria:

- Importance. A project or activity that would maintain or enhance the quality of life within the corridor.
- Ability to Implement. A project or activity that has the practical possibility of being achieved.
- Time Frame. A project or activity that could either be completed in the five-year period or, for activities that would be on-going (such as the evaluation of environmental impact for development proposals), that the mechanisms or procedures would be established within that five-year period for their continued use.

These top priority objectives are highlighted in bold below along with other objectives that the committee identified as important. It should be understood that if a funding opportunity arose, if any issue became critical, or if a municipality, organization or other group would assume the initiative to implement an activity or a project not

identified as a top priority, that opportunity and effort would be supported, encouraged and, hopefully, pursued.

Implementation of the various objectives would likely involve a number of organizations, levels of government and individuals. A list of primary and supporting partners who might participate in efforts to achieve the goals and objectives is provided later in this section.

Goal 1: Natural Resources – Protect the people's right to clean air, pure water, and other natural resources of the environment, and to guarantee a quality environment to the present and future residents and visitors of the corridor.

Objectives:

1. Require the conservation of groundwater and surface water resources through proper sewage facilities planning, water resources planning, effective erosion control measures, storm water management techniques that recharge groundwater resources, enforcement of natural resource protection standards and sound development standards, and promotion of high quality site design.

2. Protect specific natural features of the landscape through municipal plans and land use ordinances.

3. Investigate guidelines related to the carrying capacities of critical natural resources.

4. Require the evaluation of environmental impacts for major development or zoning proposals.

5. Develop standard assessment criteria, organize the watershed groups and undertake visual assessments along all watercourses within the area.

6. Work with state and county agencies to require proper collection, transmission, treatment and disposal of wastewater.

7. Preserve woodlands and provide connecting corridors where they do not exist.

8. Identify and promote land use practices to reduce flood impacts downstream. Acquire flood-prone properties that could be put to beneficial community uses.

Goal 2: Agricultural Resources – Ensure that farmland remains an integral part of the landscape within the corridor.

Objectives:

1. Incorporate zoning techniques that protect agricultural soils and provide options to the landowners.

2. Encourage municipalities to recognize farmland resources and actively farmed areas in municipal planning.

3. Encourage participation in the Agricultural Security Districts and support landowners who are members of these districts.

4. Encourage farmland protection through the purchase of agricultural easements in areas recommended for farmland preservation.

Goal 3: Historical and Cultural Resources – Ensure the preservation of the corridor's historic and cultural resources by accommodating future growth in a manner that recognizes, protects and incorporates structures and sites of historic, architectural, archeological and cultural significance.

Objectives:

1. Promote the unique culture of towns and villages that are oriented to the river and the canal. Preserve the character and scale of the towns and villages through community planning and regulatory measures.

2. Promote the historic and current resources of the arts community and encourage growth of diverse artistic activities through community and private events.

3. Protect the historic buildings, sites and landscapes through community planning, incentives and regulations, and the pursuit of supportive funding.

4. Preserve and enhance villages through the use of planning guidelines developed by the Bucks County Planning Commission and others, and enact ordinance standards that implement those techniques.

5. Identify and map view sheds and scenic vistas and protect them through planning and regulatory measures such as conservation based development, cluster housing, transfer of development rights and the purchase of conservation easements.

6. Preserve and maintain the diversity of the corridor's historic resources, which include buildings, sites, views and vistas, tree stands, hedgerows, bridges, water bodies, rural roads, and Native American sites.

7. Reconstruct a pedestrian bridge on the foundations of the Point Pleasant-Byram Bridge.

8. Identify and protect Native American sites and trails.

9. Support the reconstruction of pedestrian bridges and the viaduct over the Tohickon Creek so that it is passable by boats.

Goal 4: Wildlife Resources Goal – Protect the wildlife that inhabits and uses the Delaware River and the land along the river and its tributaries.

Objectives:

1. Identify critical wildlife habitats and corridors. Enact measures for their protection.

2. Protect the aquatic habitats of local fish populations and encourage the opportunities for fishing, a part of the local heritage.

3. Permanently preserve sites identified in the Natural Area Inventories of Bucks and Northampton counties.

4. Encourage municipalities to enact riparian buffer standards.

5. Restore and preserve riparian buffers to provide wildlife habitat.

6. Promote the use of native plant species and work to eliminate invasive species.

7. Attempt to address the sensitive issues related to the significant growth in the populations of deer, Canada geese and other problematic wildlife species.

Goal 5: Recreational Resources Goal – Foster the provision of active and passive recreation opportunities for the use and enjoyment of current and future residents and visitors of the corridor.

Objectives:

1. Ensure that recreational areas and facilities are compatible with the protection of natural resources. Develop guidelines that identify the carrying capacity of the landscape.

2. Assess the needs for recreation facilities and programs. Undertake this evaluation on a municipal basis. Pursue grant funding for this assessment. Identify major recreation facilities or attractions beyond the geographic boundaries of the study area.

3. Undertake and implement greenway and trail planning.

4. Encourage municipalities to prepare and implement park and recreation plans.

5. Encourage cooperation among the municipalities to avoid unnecessary duplication of recreational facilities and programs. Promote a broad and comprehensive view of these facilities to include meeting places and libraries.

6. Include open space, recreation and bikeway provisions in municipal land development ordinances. During the development review process, encourage or require developers to incorporate trails and open space linkages.

7. Identify and pursue funding to enhance and protect the Delaware Canal State Park.

8. Identify and provide river access points in suitable locations.

9. Identify ways to reduce or eliminate the impact of motorized vehicles, including jet skis and four-wheel vehicles, on the river, wildlife, natural environment, area residents and on other recreation users. Prohibit off-road vehicles in creeks.

10. Foster tourism at locations (such as Bowman's Hill Wildflower Preserve, Washington Crossing State Park and the county parks) that are equipped to handle sizeable numbers of visitors. Discourage heavy use of locations that lack parking and other infrastructure to accommodate many users.

11. Oppose any proposal for riverboat gambling within this section of the Delaware River.

Goal 6: Sustainable Economic Development – Encourage economic activities that are based on the unique natural, historic, cultural, and recreational resources of the corridor, and ensure that these activities remain compatible with and enhance the resources.

Objectives:

1. Through municipal ordinances, avoid the development of incompatible office, industrial and "big-box" commercial uses in the rural areas and the villages of the corridor. In the more urban communities, encourage the development or redevelopment of nonresidential uses that support the economies and residents of these centers.

2. Seek to provide and to maintain roadways, bridges and other improvements that are compatible with the protection of the natural, historic and cultural resources.

3. Encourage the reuse and redevelopment of brownfields for appropriate, nonpolluting uses and activities.

4. Support agriculture as a sustainable business.

5. Investigate the establishment of a "Corridor Market Towns Initiative" which blends conservation and development efforts to sustain local economies and focuses on the heritage and cultural resources of the corridor's towns, villages and city.

Goal 7: Education and Conservation Participation – Promote and enhance the understanding of the historic, cultural, economic, and natural resources of the corridor.

Objectives:

1. Identify target audiences for educational efforts to achieve the plan's priority goals and objectives.
2. Work with the school districts to coordinate, in partnership with nonprofit organizations, curricula on the river's resources.

3. Identify or provide access to the river for school groups.

4. Provide information, such as overlay maps and information sheets, for the use of key decision makers.

5. Hold VIP tours for corporate officers, municipal officials, legislators and others to stress the importance of the corridor's historic, cultural, economic and natural resources.

6. Promote a "sense of place" among the corridor's residents that stresses the unique characteristics and qualities of their home environment.

7. Promote pride in the Delaware River's wild and scenic designation.

8. Institute an "Adopt a Stretch" clean-up program for sections along the river and other watercourses in the area.

9. Work with PENNDOT to phase-out the roadside spraying practices.

10. Distribute (if necessary, prepare) information on the elimination of invasive plant species.

11. Distribute (if necessary, prepare) information on practices that will help deal with negative impacts of wildlife (e.g. discontinuance of deer feeding).

12. Distribute (if necessary, prepare) information on proper disposal of solid waste.

Goal 8: Water Quality/Water Quantity – Maintain and enhance the water quality of the river and its tributaries.

Objectives:

1. Ensure all municipalities to protect wetlands, wetland margins and groundwater recharge areas through their ordinances.

2. Encourage all water quality and quantity planning efforts to be undertaken on a regional, watershed basis.

3. Restore and preserve riparian buffers.

4. Use the Delaware River Source Water Assessment for the identification of water quality deficits when that study is completed.

5. Provide maintenance and problem solving information to property owners related to on-site septic systems.

6. Develop plans to address existing storm water management problems that have been identified within the area.

7. Under recent amendments to the PA MPC, develop regulations for logging and forestry activities, including storm water and water quality standards and procedures.

8. Review the impervious surface provisions of the municipal ordinances and provide recommendations for revisions where warranted.

9. Work to develop Total Maximum Daily Load (TMDL) standards.

10. Seek funding for existing and new water quality monitoring systems.

11. Promote education on point and non-point sources of pollution. Sponsor training sessions on stream protection techniques.

12. Organize river clean-up events.

13. Identify and expedite the clean-up of polluted sites located within the corridor.

14. Research, distribute and implement model ordinances on techniques for the protection of water quality and quantities.

15. Share information among watershed groups within the corridor. Sponsor a watershed forum that will facilitate the discussion of common objectives and sharing of techniques.

Goal 9: Land Management – Ensure that land use planning and regulation by local governments and the land use practices of the property owners maintain and enhance the unique natural, historic, cultural, aesthetic and recreational resources of corridor.

Objectives:

1. Evaluate alternatives to low density, sprawl forms of residential development. Research, distribute and implement model ordinances for consideration by the municipalities.

2. Encourage multi-municipal planning among the municipalities. Investigate funding and other incentives.

3. Sponsor training sessions on bioregional approaches to conservation.

4. Sponsor training sessions on the use of conservation easements for open space protection.

5. Prepare a summary of planning and zoning techniques, including Bucks County Planning Commission's Performance Zoning and Tinicum Township's Overlay Zoning, as a source of information for municipal officials.

Goal 10: Implementation Resources – Establish a structure, mechanism or information system for continued cooperation and secure funding for projects and programs to maintain and enhance the unique natural, historic, cultural, and recreational resources of corridor.

Objectives:

1. Identify leadership and establish a structure or information system to facilitate the implementation of the river conservation plan.

2. Provide copies of the river conservation management plan to each municipality and the legislators whose districts encompass the corridor along with a summary of funding needs.

3. Promote public support for conservation funding.

4. Sponsor public information sessions on municipal funding initiatives for open space and watershed initiatives.

5. Build the capacity (volunteers, staff, resources, etc.) to implement the river conservation plan.

6. Focus on the top priorities among all the goals and objectives included in this plan and seek to implement them within the designated time frames.

7. One year after the adoption and approval of the river conservation plan, hold a meeting of the advisory committee and other interested parties to evaluate progress on the implementation projects. After five years, meet to evaluate progress on the priority projects and activities.

The following section focuses on the priority objectives to achieve the primary goals of the conservation plan as set forth by the Planning Advisory Committee as listed above.

Regional Implementation

Once the river conservation plan is approved, the municipalities and other partners will be responsible for prioritizing and implementing projects. An important outcome of this river conservation planning process may be the formation of partnerships among the municipal environmental advisory councils (EACs) and other members of the Planning Advisory Committee.

One of the final requirements of the planning process is to have municipalities endorse the plan and commit to implementing the recommendations. The last official responsibility of the Advisory Committee Group is to see that the plan is presented to the municipal governing body and request endorsement of the plan and its recommendations.
Heritage Conservancy will prepare and forward the necessary documentation to PA DCNR and assure that requirements are met to have the plan placed on the PA State Rivers Conservation Registry. The GIS data developed for this plan will be provided to the Pennsylvania Spatial Data Access website.

In order to continue the work of the plan and improve inter-municipal communication, it is proposed that the local environmental leaders continue to meet on a formal basis to discuss implementation strategies, watershed issues and guide regional projects recommended in the plan. Strong cooperation and communication is needed among municipalities within the Middle Delaware River Study Area as well as within the study area's of adjacent river conservation plan watersheds to raise awareness of projects affecting adjoining communities and to share information regarding upcoming funding opportunities. This regional information sharing will assist in implementation efforts related to this river conservation plan and also build local support for new partnerships to form in the community.

Partner Organizations

Many local, state and federal organizations can provide financial, regulatory and technical assistance to municipalities working on recommended river conservation projects. These organizations offer a variety of technical support services, review procedures, provide, or assist in developing educational materials, and provide sources of funding for specific activities. Some of the many partner organizations are listed on the following pages. Major partners also include the Middle Delaware River Study Area municipal officials and their numerous boards and commissions as well as the volunteer watershed and river organizations and sporting clubs in the region.

Bowman's Hill Wildflower Preserve

Bowman's Hill Wildflower Preserve (BHWP) showcases an extraordinary diversity of plants native to Pennsylvania and the Delaware Valley region. The Preserve focuses exclusively on native plants, in distinction from botanical gardens that may include natives in their collections. BHWP actively uses its 100-acre site as a resource to display and interpret a collection of nearly 1000 Pennsylvania native plant species growing in naturalistic settings. http://www.bhwp.org/index.php

Bucks County Audubon Society (BCAS)

Bucks County Audubon Society is a private, non-profit organization whose mission is to foster awareness, understanding and a sense of stewardship of the environment through education. BCAS operates the Honey Hollow Environmental Education Center, which hosts the annual Bucks County Envirothon and provides environmental education programs to some 10,000 students and teachers each year. They also have a native plant nursery. http://www.bcas.org/

Bucks County Conservation District (BCD)

The Bucks Conservation District is a unit of state government and was authorized and formed by the Bucks County Board of Commissioners in 1961 under the provisions of the Conservation District Law, Act 217 of 1945, as amended. The mission of the Bucks Conservation District is to provide for the wise use, management and development of the county's soil, water and related natural resources. This is accomplished with the cooperation of both public agencies and private groups and individuals, especially landowners. The major priority at BCD is the control of soil erosion and the resulting sedimentation. The district oversees the implementation of erosion and sediment control plans on new development including reviews and compliance inspections. http://www.bucksconservation.org/

Bucks County Department of Parks and Recreation (BCDPR)

The Bucks County Department of Parks and Recreation is the county agency, which provides for the development, management and operation of the recreational needs of county citizens. Programs of the BCDPR include: coordinating with municipalities and non-profit organizations in providing facilities for special needs; providing resource-based programs including nature centers, hiking, boating, fishing, camping and environmental education; providing for active recreation, including athletic events,

concerts, festivals, and other leisure activities; and providing programs and activities related to the environment and natural sciences.
http://www.buckscounty.org/departments/parks-recreation/

Bucks County Planning Commission (BCPC)
The planning commission provides functional and comprehensive planning to Bucks County and its 54 municipalities. Programs of the commission include sewage and storm water management, solid waste management, parks and open space, natural resources and housing planning, development of zoning, subdivision and land development ordinances and regulations. Commission staff provides consultation on planning and plan implementation. Under the Pennsylvania Municipalities Planning Code, the commission reviews and offers recommendations on all subdivisions, land developments, zoning change requests and other proposals submitted to the county's municipalities. The commission also manages an extensive resource library.
http://www.buckscounty.org/departments/planning/index.html

Delaware River Basin Commission
The Delaware River Basin Commission was formed in 1961 by the signatory parties to the Delaware River Basin Compact (Delaware, New Jersey, New York, Pennsylvania, and the United States) to share the responsibility of managing the water resources of the Basin. Since its formation, the Commission has provided leadership in restoring the Delaware River and protecting water quality, resolving interstate water disputes without costly litigation, allocating and conserving water, managing river flow and providing numerous other services to the signatory parties. Commission programs include water quality protection, water supply allocation, regulatory review (permitting), water conservation initiatives, watershed planning, drought management, flood control and recreation. http://www.state.nj.us/drbc/

Delaware River Greenway Partnership, Inc.
The mission of the Delaware River Greenway is to promote the public and private stewardship of a regional greenway as a continuous corridor of natural, historic, scenic and recreational resources along the Delaware River and its tributaries, and to recognize the integrity of the Delaware River system through a public/private partnership.

Delaware Riverkeeper Network
The Delaware Riverkeeper Network is a nonprofit, membership organization that has worked since 1988 to strengthen citizen protection of the Delaware River and its tributary watersheds. An affiliate of the American Littoral Society, a national conservation group, Riverkeeper works throughout the Delaware's entire 13,000 square mile watershed, which includes portions of NY, NJ, PA and DE. Programs include a watershed wide advocacy; taking a stance on regional and local issues that threaten water quality; a tributary task force initiative designed to organize and strengthen local communities working to protect local streams; restoration projects organizing volunteers to restore eroded stream banks using bio-engineering techniques; a volunteer monitoring program with sites along the entire length of the River; pollution hotlines; an enforcement program; and student intern opportunities. http://www.delawareriverkeeper.org/

Delaware Valley Regional Planning Commission
DVRPC is a regional planning agency, which works to foster regional cooperation in the nine-county, two state area surrounding Philadelphia. DVRPC provides services to member governments and others through planning analysis, data collection and mapping services. Aerial photographs, maps and a variety of publications are available to the public and private sector. http://www.dvrpc.org/

Friends of the Delaware Canal
The Friends of the Delaware Canal is an independent, non-profit organization working to restore, preserve and improve the Delaware Canal and its surroundings. Our primary goals are to ensure that the Canal is fully-watered and the towpath trail is continuous. The Friends embrace this mission in order to sustain a unique link to our heritage, care for and protect beautiful open space, and provide recreational opportunities for current and future generations. Our goals are accomplished through advocacy, community volunteerism and educational and recreational programs. *http://www.fodc.org/*

Heritage Conservancy and other Land Trust Organizations
The Heritage Conservancy along with the many other local-based and regional land trust organizations promote open space conservation, natural resource protection, historic preservation, wildlife habitat restoration and biodiversity through land use planning and design, adaptive reuse of historic structures, identification of key natural resources, and innovative land conservation and historic preservation strategies. Many land trust organizations provide technical assistance to municipalities and individual landowners through grants and fee-for-service. *Land trusts located or working within Bucks and Northampton Counties include: Bedminster Land Conservancy, Brandywine Conservancy, Cooks Creek Conservancy, Heritage Conservancy, Natural Lands Trust, Tinicum Conservancy and Wildlands Conservancy. All are members of the Pennsylvania Land Trust Association, which provides conservation resources for land trusts and the public. http:// www.conserveland.org*

Lehigh Valley Planning Commission (LVPC)

The Lehigh Valley Planning Commission provides planning services to the to the counties and 62 municipalities of the Lehigh Valley region, which includes both Lehigh and Northampton Counties. The commission maintains a professional staff that is able to provide a wide variety of planning services to municipalities in the region. The LVPC publishes numerous informational, analytical and policy-oriented planning reports on topics such as demographics, land use planning, recreation/natural features and the environment. Many of the publications can be found on the commission's website at http://www.lvpc.org.

Lower Delaware River Management Committee (LDRMC)

The Lower Delaware River Management Committee was created as a result of a memorandum of understanding signed as a result of the National Wild and Scenic River designation and to implement the Lower Delaware River Management Plan dated August 1997. The Committee is advisory and provides a forum for discussing and resolving issues of the river related interests, provides advice to river managing entities; and promotes and facilitates implementation of the management plan. The committee is represented by municipal entities, Pennsylvania and New Jersey Departments of Environmental Protection, National Park Service, Delaware River Greenways, the Delaware River Basin Commission, conservation organizations, and interested public.

National Park Service

The National Park Service (NPS) preserves the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. The National Park Service supports conservation goals through seed money, recognition programs and technical assistance to communities that seek its help.

NPS helps communities establish new trail systems, and restore degraded rivers in urbanized areas. It also assists communities with protecting historic and cultural places important to them. This assistance often results in better protection for related national park lands. http://www.nps.gov

Northampton County Conservation District

The Northampton County Conservation District serves a range of agricultural and urban interests and participates in a wide variety of resource programs. These programs include Erosion and Sedimentation Pollution Control, Agricultural Soil and Water Conservation Programs, Pennsylvania Ag in the Classroom Teacher Programs and Backyard Conservation programs for urban areas. The NCCD also works closely with the USDA agencies in the county to promote soils and water conservation and economic development on local farms. For more information see the NCCD website at http://northampton.pacd.org.

Penn State Cooperative Extension Service (PSCES)

Cooperative Extension is an informal educational partnership with county, state and federal governments. Penn State University Extension extends its campus to communities through county offices staffed by university professionals. Through this system, the latest research and technical information of the university is accessible to county residents. Priority issues focus on the economic, social and environmental progress of families and communities. Cooperative Extension accomplishes education through short courses, seminars, meetings, newsletters, publications, personal consultation and mass media. http://www.extension.psu.edu/

Pennsylvania Department of Community and Economic Development – Governor's Center for Local Government Services (DCED)
The center oversees a number of financial aid programs including the Floodplain Land Use Assistance Program, the Land Use Planning and Technical Assistance Program, the Local Government Capital Project Loan Program, and the Shared Municipal Services Program. http://www.inventpa.com

Pennsylvania Department of Conservation and Natural Resources (DCNR)
A priority goal of the DCNR is to develop and sustain partnerships with communities, non-profits and other organizations for recreation and conservation projects and purposes. The Department's Bureau of Recreation and Conservation is responsible for fostering, facilitating and nurturing the great majority of these partnerships through technical assistance and grant funding from the Community Conservation Partnerships Program (C2P2).

The Community Conservation Partnerships Program provides state and federal grant dollars to help fund community recreation, land trusts, rails-to-trails, rivers conservation and Pennsylvania recreational trails projects. These components are combined into a yearly application cycle and a single application format and process reducing paperwork for the applicant.

The Community Conservation Partnerships Program Grant manual and many related materials are available on the web at www.dcnr.state.pa.us/grants.

Pennsylvania Department of Environmental Protection (PA DEP)
PA DEP administers a wide array of grant and loan programs including the Growing Greener Grant Program, the Act 167 Storm Water Management Planning Program, the Act 537 Sewage Facilities Planning Grant Program and Environmental Education Grant Program. In addition, DEP provides grants for municipal recycling programs and brownfields redevelopment. PA DEP also provides technical support staff to assist in local projects. More information regarding DEP's grant programs may be found on the Department's website at www.dep.state.pa.us.

Pennsylvania Environmental Council (PEC)
Since it's founding in 1970, PEC has played an active role in environmental policy discussions and decision-making in Harrisburg, in both the regulatory and legislative

arenas. PEC is involved with a variety of land-use projects, including brownfields remediation, open space preservation, smart growth, and transit-oriented development. PEC has also been active in developing innovative projects that address land use, watershed protection and other issues. Some of these approaches involve new technology, others implement new ways to use familiar tools.

The Center for Rural Pennsylvania (CRP)
The Center for Rural Pennsylvania was created by the Pennsylvania General Assembly to assure rural and small communities have access to the problem solving tools they need and a supportive state government that aids their efforts. The center provides funds to identify and report ways to build the long-term viability of rural Pennsylvania by:

Awarding grants for applied research and model projects
Maintaining and disseminating information on rural trends and conditions
Publishing research and project results
Sponsoring local, state and national forums on rural issues

The center's website http://www.ruralpa.org/ provides additional information and key links.

United States Department of Agriculture, Natural Resource Conservation Service (NRCS)
The Natural Resources Conservation Service is the federal public service agency that helps individuals, groups, organizations, and city, town, county, and state governments to protect and promote the wise use of land and water resources. Programs of the NRCS include soil and water conservation, natural resource and soil surveys, community resource protection and management, and agricultural conservation programs. NRCS can provide on-site consulting assistance to land users with soil and water problems. http://www.nrcs.usda.gov/

Management Options Table

On the following pages, the list of goals and objectives has been expanded to identify general tasks, primary partners, supporting partners and projected implementation timing. The table identifies the roles each partner can play in planning and implementing conservation actions. Implementation timing has been generally determined based on the complexity and funding requirements of the recommended actions. As with any planning effort, the actual timing of a proposed action can be affected by other variables such as state or national economic policies, political will, and unrelated projects requiring limited municipal resources.

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
1. Natural Resource Goal - Conservation of Groundwater Resources				
Sewage Facilities Planning	Review and Update Act 537 plans for consistency with local land use planning decisions and natural resource protection goals. Emphasize techniques that provide groundwater recharge. Encourage land application as an alternative to stream discharge.	Municipalities – review individual plans and update if necessary DEP: technical assistance, funding through 537 process. BCHD: Technical Assistance	PSCES: technical assistance for on-lot septic users BCPC/LVPC: technical assistance, sample ordinances for on-lot maintenance and repair.	1-2 years
	Work with state and county agencies to require proper collection, transmission, treatment and disposal of wastewater. Provide on-lot disposal system (OLDS) education to residents. Establish OLDS maintenance ordinances.	Municipalities/Authorities – review current systems to identify concerns Update OLDS education materials, adopt OLDS maintenance ordinances. BCHD/SEO – identify problem areas and determine remediation actions. Watershed Groups – education and outreach.	PSCES: technical assistance for on-site treatment system users DEP – technical assistance	1-2 years
Water Resources Planning	Protect headwaters areas and subwatersheds. Conduct source water assessments. Evaluate areas appropriate for recharge techniques.	Municipalities/EACs – organization and Planning. DCNR/DEP: technical assistance, funding Watershed Groups – volunteer efforts, public education	BCPC/LVPC – technical assistance DRBC – technical assistance Consultants – planning studies, technical assistance	2-5 years
Erosion and Sedimentation Control	Establish recommended BMPs to meet at least minimum criteria or better for effective soil erosion and sediment control	Municipalities – support adoption of required BMPs CCD – determine most effective BMPs, technical assistance	Watershed groups – provide innovative ideas and strategic sites needing attention Scout troops – volunteers School groups – volunteers	1-2 Years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Enforce erosion and sedimentation plans during new construction	Municipalities – clearly document new construction activities CCD – plan review, provide on-site inspections, enforcement	DRG – technical assistance DRK – technical assistance	Ongoing
	Adopt mandatory controls in municipal ordinances.	Municipalities – adopt strict controls for new construction HC – technical assistance	BCPC/LVPC – technical assistance DRG – technical assistance	2-5 Years
Storm water Management	Update infiltration/water quality requirements for new development. Work closely with BCPC and LVPC on Act 167 updates.	Municipalities – adopt strict controls through local ordinances to achieve greater management DEP - technical assistance BCPC/LVPC - planning/technical assistance	HC – design Engineers – design, technical assistance Landscape architects – design, technical assistance Homebuilders association	2-5 Years
	Implement incentive program for volunteer homeowner BMP implementation to encourage recharge.	Municipalities – seek funding to implement a cost-share program Watershed groups – promote program and educate	DEP/DCNR – funding Private landowners – implement program DRG – technical assistance DRK – technical assistance	Ongoing
	Retrofit existing BMPs in existing developments, explore infiltration and filtering practices	NRCS - design/technical assistance CCD - technical assistance Homeowners associations – implement strategies through incentive program Private landowners – implement strategies through incentive program	Engineers – design, technical assistance Landscape architects – design, technical assistance	5-10 Years
2. Agricultural Resource Protection				
Protect Agricultural Soils	Review existing agricultural zoning ordinances to enhance protection of important farmland soils based on recommendations of this plan.	Municipalities – review current ordinances HC – technical assistance BCPC – technical assistance	DCNR – funding Consultants – technical assistance CRP – technical assistance NRCS – soils mapping information	1-2 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Update or adopt zoning techniques to protect agricultural soils as recommended in this plan. (Class I soils: 80%, Class II soils: 75%, Class III soils: 70%)	Municipalities – review current ordinances NRCS – Soil mapping assistance HC – technical assistance	DCNR - funding BCPC/LVPC – model ordinances Consultants – technical assistance CRP – technical assistance PSCES – technical assistance	2-5 years
Encourage farmland protection.	Sponsor local tax initiatives to raise money for purchase of agricultural easements in all municipalities.	Municipalities/landowners – identify areas, public education County– technical assistance, land owner outreach Local conservancies and land trust Organizations – technical assistance	BCPC/LVPC – technical assistance CRP – technical assistance	ongoing
	Purchase agricultural easements in areas recommended for agricultural preservation.	Municipalities/landowners – identify areas, public education HC – technical assistance	BCPC/LVPC – technical assistance CRP – technical assistance	Ongoing
Support agriculture as sustainable business	Recognize farmland resources and areas of farm activities in municipal planning.	Municipalities – initiate studies	CRP – technical assistance DCNR – funding	1-3 years
Community supported agriculture	Develop "Buy local" programs.	PSCES – technical assistance Local farmers – product	CRP – technical assistance BCPC/LVPC –technical assistance Local conservancies, land trusts – technical assistance, funding opportunities.	1-3 years
3. Protection of Historical and Cultural Resources				
Historic /Archaeological Resource Preservation	Promote river towns and villages through planning and regulatory measures	Municipalities/historic commission – initiate studies	PHMC/HC –technical assistance and funding Cultural resource consultants – technical assistance FDC, LDRMC – regional promotion, planning	2-5 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Identify and protect Native American sites of significance (trails, encampments, ritualistic sites, and villages within study area.)	Municipalities/historic commissions – initiate studies	PHMC/HC –technical assistance and funding Resource Consultants – archaeological	2-5 years
	Adopt (or update) historic preservation or historic district ordinances.	Municipalities/planning commission HC – technical assistance	BCPC/LVPC – model ordinances	2-5 years
	Support nomination of historic structures and districts	Municipalities – pass resolutions supporting nominations Non-profit organizations – prepare nominations HC – technical assistance	Private landowners – support local efforts Historic societies – provide local knowledge	Ongoing
	Promote historic areas through tourism initiatives	PA Tourism and Promotion Chamber of commerce – provide local funding and promotion County tourism promotion – regional distribution	Municipalities – promote resources Historic societies – provide local knowledge FDC, LDRMC – regional promotion	1-2 Years
	Link trails of BHWP to those of the Delaware Canal to promote New Hope area as destination site for natural, and cultural resource aspects of region.	BHWP/D&L/PHMC and municipalities – initiate planning studies, coordination, funding. Local Chamber of commerce – provide local funding and promotion. County tourism promotion – regional distribution		2-5 years
	Promote adaptive reuse of historic structures	Municipalities –flexibility in zoning and plan reviews Historic societies – promote preservation of structures Non-profit organizations – develop reuse alternatives	HC – technical assistance	2-5 Years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Reconstruct a pedestrian bridge on the foundations of the Point Pleasant-Byram NJ Bridge for possible trail link.	Tinicum and Plumstead Townships – seek and raise funding, select consultant Historic consultant – design	PHMC, DCNR – Technical assistance and funding.	2-5 years
	Establish Historic Architectural Review Boards (HARBs) where absent.	Municipalities – appoint review boards HC – technical assistance	BC – technical assistance	1-2 years
	Perform historic site surveys	Historic societies – provide local knowledge	HC – technical assistance Non-profit organizations – provide regional expertise	1-2 years
Preserve Scenic Views	Protect view sheds and corridors through planning and regulatory measures. Conduct viewshed assessments. Consider purchase of easements to protect views.	Municipalities/EACs – identify potential view sheds. Seek and raise funding for easement purchase. HC/land trusts – technical assistance, property-owner outreach/purchase and easement negotiation.	DCNR – funding Consultants – planning and technical assistance	2-5 years
4. Protection of Wildlife Resources				
Identify critical habitats and corridors	Review county priority sites and identify or update other areas. Provide species diversity assessments.	Municipalities/EAC – initiate planning studies Watershed groups - volunteer assessments, sponsor studies Ecologists – technical expertise HC/BHWP – technical Assistance	DCNR – funding	1-2 years
Protect Natural Areas	Enact measures to protect and preserve identified natural areas and habitats. Amend natural resource protection ordinances in accordance with recommended protection standards of this plan, where absent.	Municipalities – adopt/strengthen natural resource protection ordinances and standards. Seek or raise funding to purchase property or easements for protection Land trust organizations – assist in purchase/easement negotiations HC – technical assistance	DCNR – funding Counties – cost sharing Consultants – technical assistance	2-5 years

Table III-1 Management Options

Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Protect native plant communities throughout the study area. Projects may include repair and upgrade of Pidcock Creek Gates at BHWP.	BHWP – planning, sponsor study. BCPC/LVPC – technical assistance	DCNR – funding Consultants –technical assistance	1-2 years
Enforce Natural Resource Protection Standards	Review municipal ordinances and enforcement records with respect to landscape recommendations and use of native species. Develop model native plant list and offer to municipalities to reduce use of non-native species.	Municipalities/EAC/planning commissions – planning and organization BCPC/LVPC – technical assistance HC/BHWP – technical assistance	Consultants – develop or update ordinances. DCNR – funding	2-5 years
5. Protection of Recreational Resources				
Greenway/Trail Enhancement and Development	Upgrade and enhance existing trails and greenways throughout Middle Delaware Study Area.	Municipalities, EAC's – identification, planning, local support BHWP – planning	FDC, DRG, - planning, technical assistance, coordination BCPC/LVPC – technical assistance DCNR, NPS –funding	2-5 years
	Conduct trail feasibility studies including trail linking Pt. Pleasant, Lake Nockamixon, North Branch Neshaminy Creek through Landis Park, Peace Valley Park and Lake Galena. Investigate feasibility of trail from Pt. Pleasant to Byrum NJ. across timber frame foot bridge.	Municipalities, EAC's, Park and Recreation Commissions – identification, planning, local support Land Trusts: technical assistance, coordination, land acquisition assistance.	FDC, DRG, - planning, technical assistance, coordination BCPC/LVPC – technical assistance DCNR, NPS –funding	2-5 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Develop municipal greenway/trail plans compatible with natural resource protection goals. Coordinate with regional planning efforts.	Municipalities – initiate local studies and planning HC/conservancies – planning, technical assistance Landscape architects – planning, technical assistance DRG – planning, liaison to regional efforts	DCNR – funding NPS – technical assistance DRG, FDC, LDRMC – coordination, planning, data BCPC, LVPC, DVRPC – planning and coordination, technical assistance	1-2 years
	Develop regional trail network links.	County planning – initiate regional trail planning Non-profit organizations – provide vision for future trail connections NPS – planning, technical assistance DRG – planning, visioning	Local Residents LDRMC – regional outreach FDC/DRG – planning, technical assistance	5-10 years
	Implement trail projects	Municipalities – plan and organize construction HC – design, planning, land owner outreach DRG – planning, liaison to regional efforts	NPS – design, planning, funding BCDPR/LVPC – design, planning DCNR – funding Scout troops – volunteers School groups – volunteers	2-5 years
Recreation Development Compatible with natural resource protection	Develop 150-acre Giving Pond (Tinicum Quarry Site): • Improve public access to river and D&L trail • Construct environmental education and information center for visitors • Develop natural resource inventory	Local Municipalities – initiate planning process, seek funding DCNR/DEP – funding Delaware Canal State Park – technical assistance, planning Watershed Associations – volunteers, planning, outreach events.	Ecologists –inventory of site Consultants – design, construction BCPC – technical assistance	2-5 years

Table III-1 Management Options

Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Identify and pursue funding to enhance and protect the Delaware Canal State Park.	Local Municipalities – initiate planning process, seek funding DCNR/DEP – funding Delaware Canal State Park – technical assistance, planning Watershed Associations – volunteers, planning, outreach events.	BCPC/LVPC – technical assistance	2-5 years
	Investigate feasibility for development of environmental education centers along canal, river and tributaries in study area such as InghamSpring Site .	Local Municipalities –initiate planning process, seek funding Watershed Associations – technical assistance, outreach, planning BCPC, BCDPR – technical assistance	DCNR/DEP – technical assistance, funding Consultants – design and planning	2-5 years
	Support development of new active and passive recreation facilities within study area including Brownsburg Park in Upper Makefield Township.	Local Municipalities – initiate planning process, seek funding BCPC, LVPC – planning, technical assistance County Park Departments – planning, design and construction	DCNR – technical assistance, funding Consultants – design and planning	2-5 years
	Include open space, recreation and bikeway provisions in municipal land use ordinances.	Municipalities – revise ordinances HC – technical assistance	DCNR – funding BCPC/LVPC – model ordinance, technical assistance	1-2 years
River Access	Support river access studies	Municipalities – participate in regional planning effort NPS – technical assistance BCPC/LVPC – funding, planning, technical assistance Recreation interest groups – provide local knowledge DRG – regional planning, support and promotion	Private enterprise – provide public access where feasible DEP/DCNR – funding D&L Canal Commission, planning Delaware Canal State Park - planning FDC, LDRMC, DRG, DRK – planning PAF&BC – funding, technical assistance	1-2 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Assure coordination of river access facility construction with adjacent municipalities, County Dept. of Parks and Recreation, and state parks.	Municipalities – planning, acquisition and construction County parks departments – acquisition and construction State parks and PA FBC – coordination and planning	BC/LVDPR – technical assistance PAF&BC – technical assistance DCNR – funding Consultants – planning, design, technical assistance. FDC/LDRMC –coordination, planning	2-5 years
	Provide and support additional public river access sites and facilities, including the Delaware River Experience at Keller's Landing	Municipalities – acquisition and construction County parks – acquisition and construction Private landowners – allow access easements	BC/LVDPR – planning Consultants – design DCNR – funding PAF&BC – funding, design and construction	5-10 years
6. Sustainable Economic Development				
Avoid incompatible non-residential uses in rural or village areas	Revise ordinances to avoid incompatible office, industrial, and commercial uses.	Municipalities – initiate planning studies BCPC/LVPC – planning, technical assistance	DCNR – funding	2-5 years
	Participate in D& L Corridor Commission's economic initiatives and programs.	Municipalities – investigate feasibility	DCED & DCNR– planning – technical assistance & funding D&L Corridor Commission – technical assistance HC, PA Downtown Center – technical assistance	2-5 years
Brownfields Development and Redevelopment	Identify candidate sites for Brownfields redevelopment.	Municipalities – identify possible sites County Redevelopment Authorities – technical assistance, funding County Economic Development Agencies – technical assistance, funding.	PA DCED – funding, technical assistance PA DEP – technical assistance, funding PEC – technical assistance	2-5 years
	Develop plans to reuse or redevelop existing industrial sites and infrastructure for appropriate nonpolluting uses and activities.	Private enterprise – design and implement reuse plans County Redevelopment Authorities – technical assistance, funding County Economic Development	BCPC/LVPC – technical assistance Consultants – technical assistance DEP – funding DCED – technical assistance, funding	2-5 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
		Agencies – technical assistance, funding.	PEC –technical assistance	
7. Conservation Education				
Education of Public	Raise public awareness and develop education materials on BMPs and watershed conservation targeting homeowners, property managers and public works employees	Municipalities/EACs – design and implement program Watershed groups/BHWP – promote program, distribute materials, provide local expertise Non-profit organizations – design program materials	NRCS – materials CCD – materials, technical assistance HC – technical assistance DRK, FDC, DRG – technical assistance PSCES – technical assistance	Ongoing
	Organize lecture series addressing watershed conservation strategies. Establish speaker's bureau to provide local and national expertise.	Municipalities/EACs – host Watershed groups –local experts Non-profit organizations – solicit regional experts HC, BHWP – Host lecture series and provide lecture coordination Continue Land Ethics Symposium	DRK, FDR, DRG – technical assistance	Ongoing
Education of youth	Work with local schools to include watershed conservation in the curriculum.	Municipalities/EACs – raise local awareness BCAS – curriculum Watershed groups – provide local knowledge	School Districts -curriculum Scouts School groups DEP/DCNR – funding	Ongoing
	Develop a children's environmental camp at BHWP to serve as an outdoor laboratory to study native species and their contribution for sound ecological landscaping and watershed protection.	BHWP – initiate study, design program materials Municipalities/EAC's – raise local awareness Watershed groups – promotion	School Districts – assist in curriculum HC and other conservation organizations – technical assistance DEP/DCNR – funding	2-5 years
	Support existing education programs such as the Delaware River Experience at	Watershed groups, local citizens – raise awareness	School Districts – assist in curriculum HC and other conservation	2-5 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Keller's Landing.		organizations – technical assistance DEP/DCNR – funding	
	Develop curriculum for school teachers that promotes the value of native species as an effective way to protect and preserve Middle Delaware River and its waterways. Target economically disadvantaged schools that might not have opportunity for on-site training.	Watershed groups –provide local expertise, volunteers School Districts – Planning, curriculum development BCAS, BHWP – curriculum development, volunteers, study sites.	NRCS/CCD – materials, technical assistance HC and other conservation organizations –technical assistance. DEP/DCNR –funding	2-5 years
	Institute an "Adopt a Stretch" program for sections along the river, and tributaries.	Watershed groups – provide local expertise	FDC, DRK – materials, technical assistance Scouts School groups	Ongoing
8. Protect Water Quality				
Non-Point Source Pollution	Educate local citizenry about impacts of non-point source pollution	Watershed groups – promote program, distribute information NRCS – materials CCD – provide expertise DRK and DRG with DRBC – non-point source pollution monitoring	CCD – materials, expertise PEC – expertise PSCES – technical assistance DEP - funding	1-2 years
	Undertake NPS assessment studies	Watershed groups – provide local knowledge Municipalities – adopt recommended strategies Consultants – technical assistance	CCD - technical assistance DEP – funding NRCS - technical assistance HC – technical assistance DRBC/DRK/DRG – technical assistance	2-5 years
	Implement model NPS projects	Municipalities/EACs – coordinate projects Watershed groups – provide local knowledge and projects Local conservancies/land trusts – plan	CCD- technical assistance NRCS - technical assistance Homeowners associations – implement projects Private landowners – implement	2-5 years

Table III-1 Management Options

Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
		and design demonstration projects Consultants – design, technical assistance	projects Private enterprise – implement projects	
Stream Corridor Improvement/Restoration	Initiate/review stream bank assessment studies. Verify with on-site "truthing"/site inspections.	Municipalities/EACs – planning and organization of areas HC – Provide county riparian buffer assessment information Watershed groups – planning, organization of volunteers, local knowledge	DCNR/DEP – technical assistance, funding	1-2 years
	Continue on-going stream restoration programs such as in Swamp Creek Watershed and Gallows Run..	HC – Provide county riparian buffer assessment information, assist in obtaining funding. Watershed groups/conservancies – planning, organization of volunteers	DCNR/DEP – technical assistance, funding DRK – Technical Assistance	ongoing
	Plant riparian buffers using native plantings where needed. Possible sites include (but not limited to) tributaries along Frys Run, Gallows Run, Primrose Creek, Pidcock Creek and Houghs and Creek	Municipalities/EACs – planning and organization Watershed groups – planning, organization and volunteers DEP/DCNR – funding, technical assistance DRG – planning and organization	NRCS - technical assistance BHWP - native plant selection and materials, technical assistance PEC - planning, coordination, education Scout troops – volunteers School groups – volunteers DEP, PA Stream Re-leaf – technical assistance	1-2 years
	Protect existing riparian buffers at 100% level as recommended in this plan.	Municipalities – adopt or update local riparian buffer ordinances, plan greenways Non-profit organizations – negotiate purchase or easement of properties Homeowners associations – donate easements, manage riparian areas on common land Private landowners – manage riparian areas, donate easements	HC/local conservancies – protection strategies County - land management DCNR – funding DRG – protection strategies	2-5 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
	Educate adjacent property owners on managing stream corridor areas	Municipalities/EACs – initiate volunteer programs NRCS – programs, materials, public awareness Watershed groups – administer programs	PSCES –materials DCNR – funding HC/local conservancies – expertise	Ongoing
*9. **Land Management***				
Zoning Ordinances	Review existing natural resource protection ordinances based on recommendations of this plan.	Municipalities – solicit reviews of current ordinances HC - technical assistance BCPC/LVPC - technical assistance	DCNR – funding Consultants – technical assistance	1-2 years
	Update applicable ordinances to implement watershed conservation to incorporate recommendations of this plan for floodplain and floodplain soils, watercourses, wetlands, riparian buffers, lakes and ponds, steep slopes, woodlands and prime agricultural soils, where absent.	Municipalities – draft and adopt new ordinances HC, BCPC/LVPC – technical assistance	BCPC/LVPC – model ordinances Consultants - technical assistance DCNR – funding	2-5 years
Development Plan Reviews	Promote inter-municipal reviews of development plans affecting adjacent and/or downstream communities	Municipalities – respond to regional issues Consultants – planning	State Government - incentive program Watershed groups – raise awareness of regional issues	5-10 years
Land/Resource Protection Strategies	Work with local non-profit organizations to assess benefits of various protection strategies	Municipalities – review available strategies Private enterprise – funding, implement protection measures Non-profit organizations – negotiate protection measures DRG – support and promote actions	HC – technical assistance BC - cost-sharing DCNR – funding	1-2 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
Open Space Preservation	Utilize county open space preservation program funds and/or raise local money for open space preservation/land acquisition to protect critical resource areas and promote watershed conservation	Municipalities – develop plans, purchase property or easements for protection Non-profit organizations – assist in purchase/easement negotiations. HC – technical assistance	County - cost-sharing DCNR - funding	1-2 years
	Implement municipal open space plans	Municipalities – prepare plan and follow recommendations HC – technical assistance	County - cost-sharing	2-5 years
Flood Control	Study impacts of flooding on local waterways	Municipalities – initiate local study Watershed groups – provide local knowledge and expertise of conditions DRK – provide planning and expertise	NRCS – technical assistance USGS – data BCPC/LVPC – technical assistance DRBC – technical assistance Consultants – planning, technical assistance DRG – coordination	2-5 years
Land Development	Provide incentives to encourage "Green" techniques in new developments (e.g. low-impact development, sustainable practices, smart growth principles, conservation subdivision)	Municipalities – adopt, and offer innovative zoning options for design Consultants - planning and design, technical assistance Land Trusts- provide technical assistance with “conservation by design” planning techniques	State government – funding and cost-sharing Economic development councils Chambers of Commerce National and regional conservation organizations –technical assistance, sample ordinances	2-5 years
10. Implementation of Plan Goals and Objectives				
Facilitate Regional Implementation	Establish an organizational or information system to discuss regional concerns and address inter-municipal communication and to disseminate information.	Municipalities - delegate representative to regional review committee Consultants – planning HC – technical assistance DRG – planning, coordination	State government - incentive program DRBC – technical assistance for watershed planning LDRMC – liaison to regional efforts EACs, watershed groups	2-5 years

Table III-1 Management Options				
Issues and Concerns	*Conservation Actions*	*Primary Partners*	*Supporting Partners*	*Projected Implementation*
Disseminate Information	Distribute copies of MDRCP plan to all municipalities. Make study available via electronic media.	HC – prepare summary of findings, hard and electronic copies.	EAC, watershed groups – outreach and education DRG, LDRMC – regional outreach	Upon approval of final plan
	Sponsor public information sessions on funding open space/watershed projects.	Municipalities – host sessions HC – assist in funding source identification		Ongoing
	Update zoning and planning regulations for municipalities on both sides of the river and perform outreach program to support the municipalities.	Municipalities LDRMC – Coordinate outreach effort	BCPC, LVPC – technical assistance	2-5 years
Abbreviations: BCAS – Bucks County Audubon Society, CCD – County Conservation Districts (both Bucks and Northampton), BCDPR – Bucks County Dept. of Parks and Recreation, BCPC – Bucks County Planning Commission, BCHD – Bucks County Health Department, BHWP – Bowman's Hill Wildflower Preserve, CRP – Center for Rural Pennsylvania, DCED – Pennsylvania Department of Community and Economic Development, DEP – Pennsylvania Department of Environmental Protection, DCNR-Pennsylvania Department of Conservation and Natural Resources, DRBC – Delaware River Basin Commission, DRG – Delaware River Greenway, DRK – Delaware River Keeper Network, DVRPC – Delaware Valley Regional Planning Commission, FDC – Friends of the Delaware Canal, HC - Heritage Conservancy, LDRMC – Lower Delaware River Management Committee, LVPC - Lehigh Valley Planning Commission, NPS – National Park Service, NRCS – Natural Resources Conservation Service, PAF&BC – Pennsylvania Fish and Boat Commission, PEC – Pennsylvania Environmental Council, PSCES – Penn State Cooperative Extension Services, USGS – U.S. Geological Service, US EPA – U.S. Environmental Protection Agency				

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List of Acronyms

ACT 166	Pennsylvania Floodplain Management Act
ACT 167	Pennsylvania Storm Water Management Act
ACT 537	Pennsylvania Sewage Facilities Planning Act
BCPC	Bucks County Planning Commission
BMP	Best Management Practices
CMTI	Corridor Market Towns Initiative
CWF	Cold Water Fishery (Chapter 93 water quality designation)
DCED	Department of Community and Economic Development (PA)
DCNR	Department of Conservation and Natural Resources (PA)
DEP	Department of Environmental Protection (PA)
DRBC	Delaware River Basin Commission
DVRPC	Delaware Valley Regional Planning Commission
EPA	United States Environmental Protection Agency
EV	Exceptional Value (watersheds or waters)
HQ	High Quality (watersheds or waters)
LVPC	Lehigh Valley Planning Commission
MPC	Municipalities Planning Code (PA)
NAI	Natural Areas Inventory
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List (Superfund Program)
NPS	Non-Point Source (Pollution)
ROD	Record of Decision (Superfund Program)
TSF	Trout Stocked Fishery (Chapter 93 water quality designation)
VOC	Volatile Organic Compounds
WWF	Warm Water Fishery (Chapter 93 water quality designation)

Appendix A

Natural Resource Regulations for
Middle Delaware River Communities

Appendix B

Riparian Buffer Status Map

Appendix C

Terrestrial and Aquatic Wildlife Species

Appendix D

Giving Pond Newspaper Article