Introduction

This project was financed in part through a grant from the Community Conservation Partnerships Program, Rivers Conservation Program, under the administration of the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation, with additional funding through a grant from the William Penn Foundation.

The plan was undertaken by Berks County Conservancy with the partnership of a student team from Pennsylvania State University through a Student Technical Experience in Problem Solving (STEPS) agreement. The project involved a four-step planning process of 1) determining initial interest and meeting with public and steering committee (advisory council) 2) collecting and analyzing resource data, 3) preparing a draft river conservation plan with public input, and 4) preparing a final plan. The plan includes the assessment of the Maiden Creek watershed, and recommendations of projects determined through research and public input that would improve the quality of the Maiden Creek Watershed. The goal of this plan is to serve as a guide for municipalities, conservation groups and citizens interested in pursuing future implementation projects in the Maiden Creek watershed. The plan will identify areas in need of restoration or protection, and a priority list in order of need.

Table of Contents

Introduction ……..……..2
List of Tables ……..……..4
List of Figures ……..……..4

Watershed Characteristics
Location and Size ……..……..5
Topography and Physiographic Provinces ……5
Stream Order ……7
Corridor ……7
Land Use ……7
Zoning ……9
Social/Economic Profile ……10
Transportation ……12
Outstanding or Unique Features ……12
Population ……12

Land Resources
Geology ……14
Soil Characteristics ……14
Limitations/Suitability ……15
Ownership ……15
Hazard Areas ……16

Water Resources
Protecting Water Resources ……17
Wetlands ……18
Floodplains ……19
Ponds and Dams ……20
Water Quality Assessment ……20
Monitoring ……20
Point Sources ……23
Non-Point Sources ……24
Groundwater Quality ……25
Well Head Protection Areas ……26
Precipitation ……29
Public/Private Water Supplies ……29

Biological Resources
Wildlife ……31
Vegetation ……34
Areas of Local Ecological Significance ……35

Cultural Resources
Archaeological/Historical ……36
Headwaters of the Ontelaunee ……36
Iron Region of the Moselem ……37
Recreation ……38
Issues, Goals and Management Options
Summary of Goals ……47
Sample of Potential Projects ……47

Appendix
Riparian Forest Buffer Assessment ……61

Bibliography ……65

List of Tables

1. Subwatersheds ……6
2. Stream Order and Classification ……6
3. Proposed Development ……9
4. Population Density ……13
5. Population by Municipality ……13
6. NPDES Permits ……24
7. Groundwater Vulnerability Risk Categories ……28
8. Public Water Suppliers ……30
9. PA Natural Diversity Index (PNDI) species ……32
10. Reptiles and Amphibians ……33
11. Fish ……34
12. List of Private and Public Parks by Municipality ……39
13. Recognized Historic Sites ……41
14. Riparian Buffer Assessment (length and percentages) ……63

List of Figures

1. Maiden Creek Watershed Location
2. Maiden Creek Municipalities
3. Maiden Creek Physiographic Provinces
4. Maiden Creek Subwatersheds
5. Maiden Creek Protected Use Streams
6. Maiden Creek Land Cover
7. Maiden Creek Bedrock Types
8. Non-Irrigated Soil Capacity Class
9. Maiden Creek Gamelands
10. Maiden Creek Floodplains, Hydric, and Wetlands
11. Pollution Sensitivity Indices Through Macroinvertebrate Sampling

WATERSHED AREA CHARACTERISTICS

Location and Size

The Maiden Creek watershed is in the southeast portion of Pennsylvania, lying within the upper Schuylkill River Basin in northeastern Berks County and extreme western Lehigh County (Figure 1). Small portions of eastern Schuylkill County lie within the watershed at the ridgeline of Blue Mountain and in State Gamelands. Nineteen townships and five boroughs, or parts thereof, lie within the watershed. The boroughs of Kutztown, Fleetwood, Lenhartsville and Lyons along with Greenwich, Maidencreek and Richmond townships lie entirely within the watershed. Nearly all of Albany, Lynn, and Maxatawny townships are within the watershed as well (Figure 2). The Maiden Creek Watershed covers approximately 216-square miles with more than 100 miles of perennial streams including Maiden Creek and ten named tributaries.

Topography and Physiographic Provinces

Three different sections of two different physiographic provinces comprise the watershed to produce a variety of landforms and soils within a relatively small area. The southern slope of Blue Mountain is in the Appalachian Mountain section of the Ridge and Valley Province. The southern boundary of the watershed, including the north face of Irish Mountain and Sand Hill, lies within the Reading Prong Section of the New England Province. Between these two mountains is the Great Valley Section of the Ridge and Valley Province. This section comprises 93 % of the watershed by area and includes Shochary Ridge in the northeastern quadrant of the watershed (Figure 3). Elevations range from approximately 1675' above sea level along Blue Mountain to 260' at the mouth of Maiden Creek. For the purposes of this study, the watershed was divided into 13 subbasins, one for each of the ten major named tributaries and three for the main stem of Maiden/Ontelaunee Creek (see Table 1 and Figure 4). Breaking the stream into smaller sections enables issues that relate to that particular tributary to be examined more thoroughly, thus focusing attention on the most important issues for the various areas of the watershed. The subwatersheds range in size from 36.65 sq. mi. (Ontelaunee Creek) to 3.63 sq. mi. (Peters Creek).

In Pennsylvania, streams or stream reaches are classified under water quality standards regulated by the Pennsylvania Department of Environmental Protection (Figure 5). There are five protected use designations awarded to streams that support the maintenance and propagation of fish species and suitable habitat for flora and fauna. The two highest designations, High Quality (HQ) and Exceptional Value (EV) mandate special water quality protection, as they embody outstanding ecological resources that are required to be maintained at existing quality.
The Maiden Creek and its tributaries have achieved high rankings for water quality. Peters Creek and the source waters of the

Subwatershed	Stream Length (miles)	Area in Square Miles	Location (township)
Ontelaunee Creek	12.5	37.46	Lynn, Albany
Kistler Creek	6.7	10.01	Lynn, Albany
Pine Creek	6	18.25	Albany
Stony Run	6.2	9.16	Albany
Upper Maiden Creek	19.1	30.83	Lynn, Albany
Furnace Creek	6.1	3.71	Albany, Windsor, Greenwich
Mill Creek	8.2	23.48	Upper Bern, Tilden
Sacony Creek	17.4	33.01	Richmond, Greenwich, Maxatawny
Moselem Creek	4.1	13.85	Richmond
Bailey Creek	3.3	2.97	Perry, Maidencreek
Peters Creek	1.9	3.79	Maidencreek
Lower Maiden Creek		12.14	Maidencreek, Ontelaunee
Willow Creek	9.7	22.17	Ontelaunee
Total	**102.9**	**220.83**	

Table 1 Subwatersheds

Stream Name	Section	Stream Order	Classification
Ontelaunee Creek	*Source to Pine Creek*	3	CWF
Pine Creek			
	Source to farthest downstream crossing of T803	4	HQ-CWF
	Farthest downstream crossing of T803 to mouth	4	CWF
Kistler Creek		4	TSF
Stony Run		4	TSF
Upper Maiden Creek		3	TSF
Furnace Creek		4	TSF
Mill Creek		4	TSF
Saucony Creek			
	Source to SR1029 Bridge In Rockland Township	4	EV
	SR 1029 Bridge In Rockland Township to SR 1029 Bridge in Kutztown	4	CWF
	SR 1029 Bridge in Kutztown to mouth	4	TSF
Moselem Creek		4	HQ-CWF
Bailey Creek		4	WWF
Peters Creek		4	EV
Lower Maiden Creek			
Willow Creek			

Table 2: Stream Order and Classification

Saucony Creek are classified Exceptional Value (EV), the highest designation, reserved for the most pristine waters in the state. The upper portion of Pine Creek and Bailey Creek are listed as High Quality – Cold Water Fisheries (HQ-CWF). Ontelaunee Creek and the lower section of Pine Creek are rated Cold Water Fisheries (CWF), which support trout and native flora and fauna in a cold-water habitat. Upper Maiden Creek and a majority of it's tributaries are rated Trout Stocked Fishery (TSF), supporting the maintenance of stocked trout from February 15 to July 31 and the propagation of fish species and flora and fauna that are indigenous to a Warm Water Fisheries.

Stream Order

Stream order corresponds with the size of the stream (Table 2). Small tributaries are fifth order streams. Two fifth order streams join to form a fourth order stream. A third order stream is formed when two fourth order streams come together, and a second order stream is fed by at least two third order streams. The Maiden Creek is a third order stream, while its named tributaries are fourth order streams.

Corridor

The stream corridor includes the stream and adjacent land, approximately one mile along either side of the stream. Stream characteristics and water quality are greatly dependent upon the natural features of this land, as well as the modifications that have occurred over time.

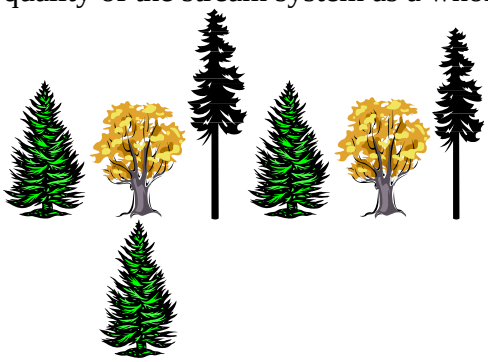
Land Use

Land uses in a watershed directly affect the quality and quantity of both surface and groundwater. Uses such as agriculture, timber harvesting, and urban or suburban development can impact water quantity by changing runoff amounts, timing and infiltration rates. These uses can also change water quality by contributing sediment and nutrients to runoff and groundwater. An analysis of land use can determine potential sources of pollution and water quantity problems, such as flooding or water supply availability (Figure 6).
The Environmental Resources Research Institute (ERRI) at Penn State University supplied land use data for the Maiden Creek watershed. Categories of land use include water (surface water area), high and low intensity development (urban/suburban), hay/pasture, row crops, commercial, forest (deciduous, coniferous and mixed), wetlands (woody and emergent), quarry areas and transitional vegetation (bare soil, no cover crop).

Approximately 58% of the Maiden Creek watershed land is used for agricultural purposes, both crops and pastures. The most fertile land for agriculture is in the Great Valley section of the watershed. The southern portion of the Great Valley contains limestone-based soils that are well suited to agriculture. The impact upon water quality varies with the intensity of the use. Intensive livestock grazing or animal feedlots can overburden the stream with

nutrients, while intensive cultivation can increase erosion and sedimentation.

Forest is the next largest land use type, covering 39% of the watershed, with deciduous, coniferous or mixed forest present. A substantial amount of wooded land is distributed rather evenly throughout the watershed in small fragmented farm woodlots, riparian corridors and steep slopes. Forested habitat enhances the water quality of the stream system as a whole.



Developed land consists of small villages and boroughs in the watershed. These land areas and other impervious areas such as quarries and major roads and highways make up approximately 2% of the watershed.

Land development continues to occur in the Maiden Creek watershed in the form of suburban and ex-urban development. Increases in commercial and residential land uses can put additional stresses on water quality and quantity. Here again, there can be serious water-related problems associated with earth moving activities and increased impervious surfaces. Both increase runoff-carrying sediments, nutrients, and chemicals that degrade water quality. In areas where natural buffering cannot handle these impacts, non point source pollution is the result. To sustain water quality in streams in these areas, best management practices (BMPs) are designed to alleviate those conditions that pollute the stream.

The most extensive suburban development in the Maiden Creek watershed has occurred in Maiden Creek Township although other municipalities have plans for increased development (Table 3). Greenwich Township is proposing the most growth in the near future with 342 acres of land to be developed. Maxatawny Township has an additional 238 acres proposed for development. Richmond, Windsor and Albany Townships each have over 100 acres of land proposed for development. Although the Maiden Creek watershed is faced with the likely possibility of continued growth, both the Berks County Planning Commission and the Lehigh Valley Planning Commission are attempting to direct growth to areas of existing infrastructure such as the US 222 corridor and the two I - 78 interchanges.

Both the Berks County Planning Commission and the Lehigh Valley Planning Commission strive to guide land use in the Maiden Creek watershed through

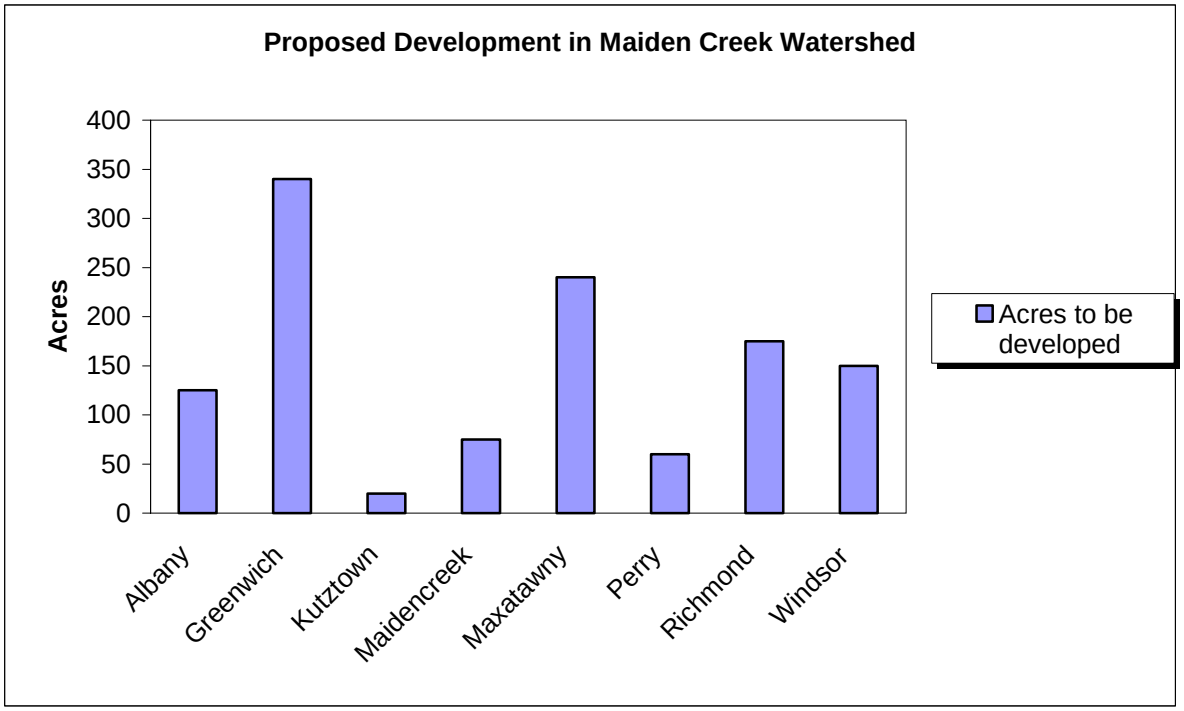


Table 3: Proposed Development in Maiden Creek Watershed

comprehensive planning. However, most decisions affecting land use are made at the municipal government level. Municipalities can control land use with zoning ordinances, subdivision ordinances and land development ordinances, stormwater management ordinances, and floodplain and wellhead protection regulations.

Zoning

Zoning ordinances designate allowable land uses by creating zoning districts. Typically a zoning ordinance has a range of districts such as high to low density residential districts, as well as agricultural, commercial, industrial, institutional and conservation districts.

As part of this study, an inventory of each municipality's ordinances in the Maiden Creek watershed was completed. Most municipalities in the area do in fact implement some type of land use control.

One method being used for the preservation of farm acreage is the purchase of agricultural conservation easements. Berks County Conservancy/Berks County Agricultural Land Preservation Board and Wildlands Conservancy/ Lehigh County Agricultural Land Preservation Board purchase these easements. Conservation easements can ensure the existence of agriculture on suitable land in perpetuity.

The Agricultural Security Areas Program (ASA) is another program that assists farmers in protecting and conserving their land. Farmers who enlist with ASA are able to sell agricultural conservation easements on their land. They are also eligible for state funds that can financially assist them in implementing resource conservation practices. However, it is important to note that those farmers enrolled in ASA can still choose to subdivide their land if they wish. ASA properties are located throughout the Maiden Creek watershed, with a large concentration of enrolled farms found in the fertile Great Valley and in the areas surrounding Kempton in Albany Township.

Another tool being used to preserve farmland (as well as limit suburban growth) is the Agricultural Zoning Incentive

Program (AZIP). The Berks County Planning Commission is working with municipalities to implement this program in local land use planning. Under this program, planning commissions receive funding to revise ordinances to include effective agricultural zoning. In return, the participating municipalities are required to implement what the county deems to be effective agricultural zoning. The agricultural zoning system often used is "sliding scale zoning."

Sliding scale zoning limits the amount of parcels that a farmer can subdivide from the original tract. For example, if the original tract size is 120-150 acres, 7 residential units can be built. If the original tract is 15-30 acres, only 3 units can be built. Though AZIP does not set a maximum lot size, it does recommend to participating municipalities that maximum lot sizes are no larger than the amount of space needed for an on-lot septic system. This zoning system encourages the continuance of agriculture while severely limiting the possibility of denser suburban development (Berks County Planning Commission, personal communication). As of January 2000, five of the twelve Berks County townships have adopted effective agricultural zoning.

None of the township zoning ordinances have sewer and septic requirements above and beyond the typical zoning ordinance. The ordinances require public sewage system hook-ups where feasible. Septic systems must be used otherwise and must be constructed and inspected before use as required by the PA Department of Environmental Protection. There were no septic tank density restrictions found, besides common lot size requirements for the allowance of on site sewage disposal. There also were no allowances found for the use of alternative sewage disposal methods. Maxatawny Township indicated a program requirement requiring routine maintenance of septic systems. These regulations are contained in a separate ordinance and require that septic tanks be pumped every three years.

Impervious cover limitations were common to the municipalities' zoning ordinances. The limitations are often determined by lot coverage (building size) or by lot coverage and paved area. The limitations on impervious cover defined only by lot coverage is an insufficient way to set limits on impervious cover because paved areas are not included. Maiden Creek and Longswamp both have limited total impervious surface for each zoning district.

Social / Economic Profile

This fertile area was originally settled first by the Swedish, then the Quakers, German Amish, French Huguenots, Mennonites, and the English. Settlement started at the beginning of the eighteenth century when pioneers migrated toward the fertile ground of the Schuylkill River.

The presence of limestone soil brought people to this area. Settlement started at the beginning of the eighteenth century when pioneers migrated toward the fertile ground of the Schuylkill River. This area was also a convenient location because it was easy and affordable to communicate with Philadelphia. The Schuylkill River was another important resource because it was navigable by flat-bottomed boats to carry mainly agriculture products to Philadelphia markets. The Union Canal was built which extended from Middletown on the Susquehanna to Reading on the Schuylkill. Reading was now directly linked to Philadelphia.

The nineteenth and early twentieth century was an era of industry. Steam locomotives were in use by the mid-1830's, which was very beneficial for growth. Railroad lines first extended southeastward to Philadelphia, and in 1842, the railroad system extended from Pottsville to the anthracite coal regions. The railroad eventually connected from Reading to Harrisburg and Allentown.

Eventually railroads became less desirable for commerce and transportation. The automobile revolutionized living habits in Berks County, with roads being the major use of transportation. By the early 1950's, Berks County became a highly populated county, and suburban sprawl began to increase between Reading and Philadelphia. By 1980, there were more than 3000 miles of public roads within the Berks County.

Agriculture is the predominant land use in the Maiden Creek watershed. Farming in the Maiden Creek watershed includes both crop and livestock production. Other types of important agriculture in the watershed include mushroom farming and orchards.

Agriculture is important economically in both Berks and Lehigh Counties. Berks County ranked 4th and Lehigh County ranked 18th in the state for total cash receipts in 1995. Berks County ranks in the top 15 counties in Pennsylvania for the production of cattle, horses, sheep, swine, poultry and bees. The county also ranks among the top 15 in the state for the production of corn, hay, wheat, oats, barley, soybean, rye, vegetables, apples, peaches, and strawberries.

Although agriculture is the predominant land use in the Maiden Creek watershed, there are other points of interests that are a benefit to the community's economy. One area of interest is the Kutztown Fairgrounds. The Fairgrounds was first established by the Agricultural and Horticultural Society and is now currently operated by the Kutztown Fair Association. It is home to the internationally known Kutztown Pennsylvania German Festival. This festival is a showcase of the Pennsylvania German culture, displaying demonstrations on farming, weaving, candle making, and its traditional Pennsylvania Dutch food.

Richmond Township provides an assortment of golf courses and is the home of Crystal Cave. Berkleigh Country club has been a host for the pro golf's LPGA (Ladies Pro Golf Association) Betsy King Classic since 1996.

Saucony is not only the name of the creek in the Maiden Creek watershed, but also refers to a popular running shoe. The Saucony Shoe Company originated in Kutztown during 1947. Although the manufacturing has since been sent to plants in foreign lands, Saucony was one of the running shoe companies to make their shoes in the United States.

Kutztown University also provides economic benefits to the Maiden Creek watershed. The university now spreads over 325 acres, serving about 8,200 students, and employs approximately 330 full-time faculty members. Many local stores are positioned along Main Street near the campus, providing various goods to the student population.

Transportation

Several major routes important to the transportation of people and goods intersect the Maiden Creek watershed. These routes are of both local and regional importance. Interstate 78/US 22 is a major highway connecting the watershed to points east and west such as Allentown and Harrisburg. Likewise, US 222 serves as an important link between Reading and Allentown and has seen major residential and commercial development.

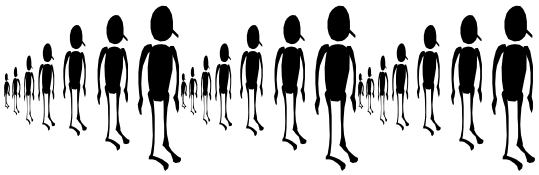
Route 143, which runs north and south through the Maiden Creek watershed, is an important route for agricultural goods. This route is the major connection between rural agricultural land in the northern reaches of the watershed and I - 78 and US 222, the major east-west routes crossing through the watershed.

Outstanding or Unique Features

The 2,100-mile Appalachian Trail, running from Maine to Georgia, parallels the northern border of the watershed in Albany, Greenwich, and Windsor townships. This is a nationally significant recreational resource that attracts thousands of users each year. The trail follows the crest of Blue Mountain from the north and dips down into both the Pine and Furnace Creek subbasins before exiting the watershed to the west. Several side trails provide access to Hawk Mountain Sanctuary, Blue Rocks and the Pinnacle, three regionally important recreational features.

Population

Table 4 shows population 1990 population density per square mile. 1990 and 2000 population data for municipalities wholly or partially within the watershed are shown in Table 5. Maidencreek Township experienced the highest change in population with an increase of 93%. Rockland, Muhlenberg, Ruscombmanor and Maidencreek townships showed the largest increases during this period.



Municipality	Population Density 2000 (# of persons per sq.mile)
Albany Township	41.3
Alsace Township	304.9
Fleetwood Borough	4,018
Greenwich Township	109.9
Kutztown Borough	3,166.90
Lenhartsville Borough	1,730
Longswamp Township	240.7
Lyons Borough	1,260
Maidencreek Township	442.8
Maxatawny Township	231
Muhlenberg Township	1,393.60
Ontelaunee Township	128.1
Perry Township	135.3
Richmond Township	148.3
Rockland Township	232.4
Ruscombmanor Township	255.1
Topton Borough	2,782.90
Windsor Township	105.8

Table 4: Population Projections

Municipality	1990 Population	2000 Population	Percent Change
Berks County			
Albany	1,547	1547	7.3
Alsace	3,459	3,689	6.64
District	1,211	1,449	19.6
Fleetwood	3,478	4,018	15.5
Greenwich	2,977	3,386	13.7
Kutztown	4,704	5,067	7.7
Lenhartsville	195	173	-12.7
Longswamp	5,387	5,608	4.1
Lyons	499	504	1.0
Maidencreek	3,397	6,553	92.9
Maxatawny	5,724	5,982	4.5
Muhlenberg	12,636	16,305	29
Ontelaunee	1,359	1,217	11.6
Perry	2,516	2,517	0.03
Richmond	3,439	3,500	1.7
Rockland	2,675	3,765	40.7
Ruscombmanor	3,129	3,776	20.6
Topton	1,987	1,948	-2.0
Windsor	2,101	2,392	13.8

Table 5: Population by Municipality in Watershed

WATERSHED AREA CHARACTERISTICS

Location and Size

The Maiden Creek watershed is in the southeast portion of Pennsylvania, lying within the upper Schuylkill River Basin in northeastern Berks County and extreme western Lehigh County (Figure 1). Small portions of eastern Schuylkill County lie within the watershed at the ridgeline of Blue Mountain and in State Gamelands. Nineteen townships and five boroughs, or parts thereof, lie within the watershed. The boroughs of Kutztown, Fleetwood, Lenhartsville and Lyons along with Greenwich, Maidencreek and Richmond townships lie entirely within the watershed. Nearly all of Albany, Lynn, and Maxatawny townships are within the watershed as well (Figure 2). The Maiden Creek Watershed covers approximately 216-square miles with more than 100 miles of perennial streams including Maiden Creek and ten named tributaries.

Topography and Physiographic Provinces

Three different sections of two different physiographic provinces comprise the watershed to produce a variety of landforms and soils within a relatively small area. The southern slope of Blue Mountain is in the Appalachian Mountain section of the Ridge and Valley Province. The southern boundary of the watershed, including the north face of Irish Mountain and Sand Hill, lies within the Reading Prong Section of the New England Province. Between these two mountains is the Great Valley Section of the Ridge and Valley Province. This section comprises 93 % of the watershed by area and includes Shochary Ridge in the northeastern quadrant of the watershed (Figure 3). Elevations range from approximately 1675’ above sea level along Blue Mountain to 260’ at the mouth of Maiden Creek. For the purposes of this study, the watershed was divided into 13 subbasins, one for each of the ten major named tributaries and three for the main stem of Maiden/Ontelaunee Creek (see Table 1 and Figure 4). Breaking the stream into smaller sections enables issues that relate to that particular tributary to be examined more thoroughly, thus focusing attention on the most important issues for the various areas of the watershed. The subwatersheds range in size from 36.65 sq. mi. (Ontelaunee Creek) to 3.63 sq. mi. (Peters Creek).

In Pennsylvania, streams or stream reaches are classified under water quality standards regulated by the Pennsylvania Department of Environmental Protection (Figure 5). There are five protected use designations awarded to streams that support the maintenance and propagation of fish species and suitable habitat for flora and fauna. The two highest designations, High Quality (HQ) and Exceptional Value (EV) mandate special water quality protection, as they embody outstanding ecological resources that are required to be maintained at existing quality.
The Maiden Creek and its tributaries have achieved high rankings for water quality. Peters Creek and the source waters of the

Subwatershed	Stream Length (miles)	Area in Square Miles	Location (township)
Ontelaunee Creek	12.5	37.46	Lynn, Albany
Kistler Creek	6.7	10.01	Lynn, Albany
Pine Creek	6	18.25	Albany
Stony Run	6.2	9.16	Albany
Upper Maiden Creek	19.1	30.83	Lynn, Albany
Furnace Creek	6.1	3.71	Albany, Windsor, Greenwich
Mill Creek	8.2	23.48	Upper Bern, Tilden
Sacony Creek	17.4	33.01	Richmond, Greenwich, Maxatawny
Moselem Creek	4.1	13.85	Richmond
Bailey Creek	3.3	2.97	Perry, Maidencreek
Peters Creek	1.9	3.79	Maidencreek
Lower Maiden Creek		12.14	Maidencreek, Ontelaunee
Willow Creek	9.7	22.17	Ontelaunee
Total	**102.9**	**220.83**	

Table 1 Subwatersheds

Stream Name	Section	Stream Order	Classification
Ontelaunee Creek	*Source to Pine Creek*	3	CWF
Pine Creek			
	Source to farthest downstream crossing of T803	4	HQ-CWF
	Farthest downstream crossing of T803 to mouth	4	CWF
Kistler Creek		4	TSF
Stony Run		4	TSF
Upper Maiden Creek		3	TSF
Furnace Creek		4	TSF
Mill Creek		4	TSF
Saucony Creek			
	Source to SR1029 Bridge In Rockland Township	4	EV
	SR 1029 Bridge In Rockland Township to SR 1029 Bridge in Kutztown	4	CWF
	SR 1029 Bridge in Kutztown to mouth	4	TSF
Moselem Creek		4	HQ-CWF
Bailey Creek		4	WWF
Peters Creek		4	EV
Lower Maiden Creek			
Willow Creek			

Table 2: Stream Order and Classification

Saucony Creek are classified Exceptional Value (EV), the highest designation, reserved for the most pristine waters in the state. The upper portion of Pine Creek and Bailey Creek are listed as High Quality – Cold Water Fisheries (HQ-CWF). Ontelaunee Creek and the lower section of Pine Creek are rated Cold Water Fisheries (CWF), which support trout and native flora and fauna in a cold-water habitat. Upper Maiden Creek and a majority of it's tributaries are rated Trout Stocked Fishery (TSF), supporting the maintenance of stocked trout from February 15 to July 31 and the propagation of fish species and flora and fauna that are indigenous to a Warm Water Fisheries.

Stream Order

Stream order corresponds with the size of the stream (Table 2). Small tributaries are fifth order streams. Two fifth order streams join to form a fourth order stream. A third order stream is formed when two fourth order streams come together, and a second order stream is fed by at least two third order streams. The Maiden Creek is a third order stream, while its named tributaries are fourth order streams.

Corridor

The stream corridor includes the stream and adjacent land, approximately one mile along either side of the stream. Stream characteristics and water quality are greatly dependent upon the natural features of this land, as well as the modifications that have occurred over time.

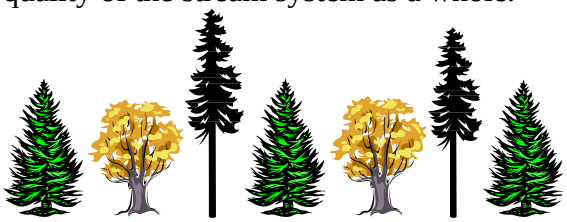
Land Use

Land uses in a watershed directly affect the quality and quantity of both surface and groundwater. Uses such as agriculture, timber harvesting, and urban or suburban development can impact water quantity by changing runoff amounts, timing and infiltration rates. These uses can also change water quality by contributing sediment and nutrients to runoff and groundwater. An analysis of land use can determine potential sources of pollution and water quantity problems, such as flooding or water supply availability (Figure 6).
The Environmental Resources Research Institute (ERRI) at Penn State University supplied land use data for the Maiden Creek watershed. Categories of land use include water (surface water area), high and low intensity development (urban/suburban), hay/pasture, row crops, commercial, forest (deciduous, coniferous and mixed), wetlands (woody and emergent), quarry areas and transitional vegetation (bare soil, no cover crop).

Approximately 58% of the Maiden Creek watershed land is used for agricultural purposes, both crops and pastures. The most fertile land for agriculture is in the Great Valley section of the watershed. The southern portion of the Great Valley contains limestone-based soils that are well suited to agriculture. The impact upon water quality varies with the intensity of the use. Intensive livestock grazing or animal feedlots can overburden the stream with

nutrients, while intensive cultivation can increase erosion and sedimentation.

Forest is the next largest land use type, covering 39% of the watershed, with deciduous, coniferous or mixed forest present. A substantial amount of wooded land is distributed rather evenly throughout the watershed in small fragmented farm woodlots, riparian corridors and steep slopes. Forested habitat enhances the water quality of the stream system as a whole.



Developed land consists of small villages and boroughs in the watershed. These land areas and other impervious areas such as quarries and major roads and highways make up approximately 2% of the watershed.

Land development continues to occur in the Maiden Creek watershed in the form of suburban and ex-urban development. Increases in commercial and residential land uses can put additional stresses on water quality and quantity. Here again, there can be serious water-related problems associated with earth moving activities and increased impervious surfaces. Both increase runoff-carrying sediments, nutrients, and chemicals that degrade water quality. In areas where natural buffering cannot handle these impacts, non point source pollution is the result. To sustain water quality in streams in these areas, best management practices (BMPs) are designed to alleviate those conditions that pollute the stream.

The most extensive suburban development in the Maiden Creek watershed has occurred in Maiden Creek Township although other municipalities have plans for increased development (Table 3). Greenwich Township is proposing the most growth in the near future with 342 acres of land to be developed. Maxatawny Township has an additional 238 acres proposed for development. Richmond, Windsor and Albany Townships each have over 100 acres of land proposed for development. Although the Maiden Creek watershed is faced with the likely possibility of continued growth, both the Berks County Planning Commission and the Lehigh Valley Planning Commission are attempting to direct growth to areas of existing infrastructure such as the US 222 corridor and the two I - 78 interchanges.

Both the Berks County Planning Commission and the Lehigh Valley Planning Commission strive to guide land use in the Maiden Creek watershed through

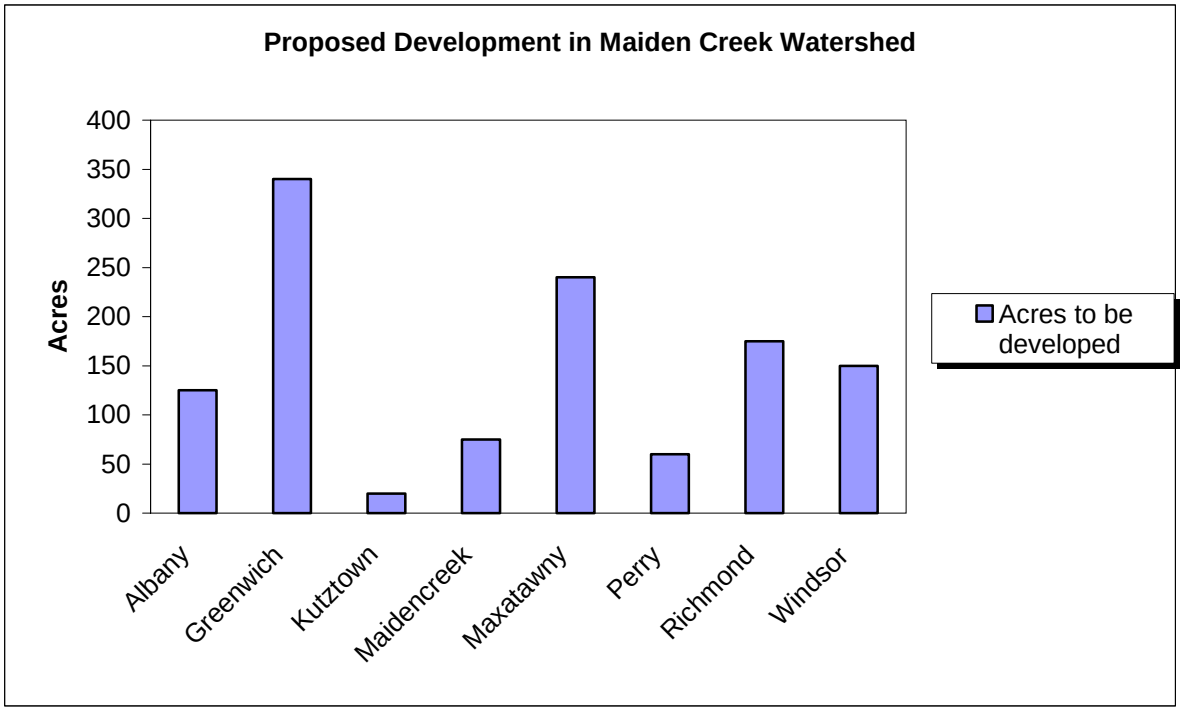


Table 3: Proposed Development in Maiden Creek Watershed

comprehensive planning. However, most decisions affecting land use are made at the municipal government level. Municipalities can control land use with zoning ordinances, subdivision ordinances and land development ordinances, stormwater management ordinances, and floodplain and wellhead protection regulations.

Zoning

Zoning ordinances designate allowable land uses by creating zoning districts. Typically a zoning ordinance has a range of districts such as high to low density residential districts, as well as agricultural, commercial, industrial, institutional and conservation districts.

As part of this study, an inventory of each municipality's ordinances in the Maiden Creek watershed was completed. Most municipalities in the area do in fact implement some type of land use control.

One method being used for the preservation of farm acreage is the purchase of agricultural conservation easements. Berks County Conservancy/Berks County Agricultural Land Preservation Board and Wildlands Conservancy/ Lehigh County Agricultural Land Preservation Board purchase these easements. Conservation easements can ensure the existence of agriculture on suitable land in perpetuity.

The Agricultural Security Areas Program (ASA) is another program that assists farmers in protecting and conserving their land. Farmers who enlist with ASA are able to sell agricultural conservation easements on their land. They are also eligible for state funds that can financially assist them in implementing resource conservation practices. However, it is important to note that those farmers enrolled in ASA can still choose to subdivide their land if they wish. ASA properties are located throughout the Maiden Creek watershed, with a large concentration of enrolled farms found in the fertile Great Valley and in the areas surrounding Kempton in Albany Township.

Another tool being used to preserve farmland (as well as limit suburban growth) is the Agricultural Zoning Incentive

Program (AZIP). The Berks County Planning Commission is working with municipalities to implement this program in local land use planning. Under this program, planning commissions receive funding to revise ordinances to include effective agricultural zoning. In return, the participating municipalities are required to implement what the county deems to be effective agricultural zoning. The agricultural zoning system often used is "sliding scale zoning."

Sliding scale zoning limits the amount of parcels that a farmer can subdivide from the original tract. For example, if the original tract size is 120-150 acres, 7 residential units can be built. If the original tract is 15-30 acres, only 3 units can be built. Though AZIP does not set a maximum lot size, it does recommend to participating municipalities that maximum lot sizes are no larger than the amount of space needed for an on-lot septic system. This zoning system encourages the continuance of agriculture while severely limiting the possibility of denser suburban development (Berks County Planning Commission, personal communication). As of January 2000, five of the twelve Berks County townships have adopted effective agricultural zoning.

None of the township zoning ordinances have sewer and septic requirements above and beyond the typical zoning ordinance. The ordinances require public sewage system hook-ups where feasible. Septic systems must be used otherwise and must be constructed and inspected before use as required by the PA Department of Environmental Protection. There were no septic tank density restrictions found, besides common lot size requirements for the allowance of on site sewage disposal. There also were no allowances found for the use of alternative sewage disposal methods. Maxatawny Township indicated a program requirement requiring routine maintenance of septic systems. These regulations are contained in a separate ordinance and require that septic tanks be pumped every three years.

Impervious cover limitations were common to the municipalities' zoning ordinances. The limitations are often determined by lot coverage (building size) or by lot coverage and paved area. The limitations on impervious cover defined only by lot coverage is an insufficient way to set limits on impervious cover because paved areas are not included. Maiden Creek and Longswamp both have limited total impervious surface for each zoning district.

Social / Economic Profile

This fertile area was originally settled first by the Swedish, then the Quakers, German Amish, French Huguenots, Mennonites, and the English. Settlement started at the beginning of the eighteenth century when pioneers migrated toward the fertile ground of the Schuylkill River.

The presence of limestone soil brought people to this area. Settlement started at the beginning of the eighteenth century when pioneers migrated toward the fertile ground of the Schuylkill River. This area was also a convenient location because it was easy and affordable to communicate with Philadelphia. The Schuylkill River was another important resource because it was navigable by flat-bottomed boats to carry mainly agriculture products to Philadelphia markets. The Union Canal was built which extended from Middletown on the Susquehanna to Reading on the Schuylkill. Reading was now directly linked to Philadelphia.

The nineteenth and early twentieth century was an era of industry. Steam locomotives were in use by the mid-1830's, which was very beneficial for growth. Railroad lines first extended southeastward to Philadelphia, and in 1842, the railroad system extended from Pottsville to the anthracite coal regions. The railroad eventually connected from Reading to Harrisburg and Allentown.

Eventually railroads became less desirable for commerce and transportation. The automobile revolutionized living habits in Berks County, with roads being the major use of transportation. By the early 1950's, Berks County became a highly populated county, and suburban sprawl began to increase between Reading and Philadelphia. By 1980, there were more than 3000 miles of public roads within the Berks County.

Agriculture is the predominant land use in the Maiden Creek watershed. Farming in the Maiden Creek watershed includes both crop and livestock production. Other types of important agriculture in the watershed include mushroom farming and orchards.

Agriculture is important economically in both Berks and Lehigh Counties. Berks County ranked 4th and Lehigh County ranked 18th in the state for total cash receipts in 1995. Berks County ranks in the top 15 counties in Pennsylvania for the production of cattle, horses, sheep, swine, poultry and bees. The county also ranks among the top 15 in the state for the production of corn, hay, wheat, oats, barley, soybean, rye, vegetables, apples, peaches, and strawberries.

Although agriculture is the predominant land use in the Maiden Creek watershed, there are other points of interests that are a benefit to the community's economy. One area of interest is the Kutztown Fairgrounds. The Fairgrounds was first established by the Agricultural and Horticultural Society and is now currently operated by the Kutztown Fair Association. It is home to the internationally known Kutztown Pennsylvania German Festival. This festival is a showcase of the Pennsylvania German culture, displaying demonstrations on farming, weaving, candle making, and its traditional Pennsylvania Dutch food.

Richmond Township provides an assortment of golf courses and is the home of Crystal Cave. Berkleigh Country club has been a host for the pro golf's LPGA (Ladies Pro Golf Association) Betsy King Classic since 1996.

Saucony is not only the name of the creek in the Maiden Creek watershed, but also refers to a popular running shoe. The Saucony Shoe Company originated in Kutztown during 1947. Although the manufacturing has since been sent to plants in foreign lands, Saucony was one of the running shoe companies to make their shoes in the United States.

Kutztown University also provides economic benefits to the Maiden Creek watershed. The university now spreads over 325 acres, serving about 8,200 students, and employs approximately 330 full-time faculty members. Many local stores are positioned along Main Street near the campus, providing various goods to the student population.

Transportation

Several major routes important to the transportation of people and goods intersect the Maiden Creek watershed. These routes are of both local and regional importance. Interstate 78/US 22 is a major highway connecting the watershed to points east and west such as Allentown and Harrisburg. Likewise, US 222 serves as an important link between Reading and Allentown and has seen major residential and commercial development.

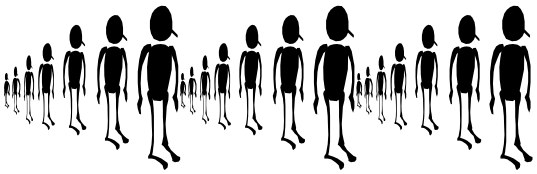
Route 143, which runs north and south through the Maiden Creek watershed, is an important route for agricultural goods. This route is the major connection between rural agricultural land in the northern reaches of the watershed and I - 78 and US 222, the major east-west routes crossing through the watershed.

Outstanding or Unique Features

The 2,100-mile Appalachian Trail, running from Maine to Georgia, parallels the northern border of the watershed in Albany, Greenwich, and Windsor townships. This is a nationally significant recreational resource that attracts thousands of users each year. The trail follows the crest of Blue Mountain from the north and dips down into both the Pine and Furnace Creek subbasins before exiting the watershed to the west. Several side trails provide access to Hawk Mountain Sanctuary, Blue Rocks and the Pinnacle, three regionally important recreational features.

Population

Table 4 shows population 1990 population density per square mile. 1990 and 2000 population data for municipalities wholly or partially within the watershed are shown in Table 5. Maidencreek Township experienced the highest change in population with an increase of 93%. Rockland, Muhlenberg, Ruscombmanor and Maidencreek townships showed the largest increases during this period.



Error! Not a valid link.

Table 4: Population Projections

Municipality	1990 Population	2000 Population	Percent Change
Berks County			
Albany	1,547	1547	7.3
Alsace	3,459	3,689	6.64
District	1,211	1,449	19.6
Fleetwood	3,478	4,018	15.5
Greenwich	2,977	3,386	13.7
Kutztown	4,704	5,067	7.7
Lenhartsville	195	173	-12.7
Longswamp	5,387	5,608	4.1
Lyons	499	504	1.0
Maidencreek	3,397	6,553	92.9
Maxatawny	5,724	5,982	4.5
Muhlenberg	12,636	16,305	29
Ontelaunee	1,359	1,217	11.6
Perry	2,516	2,517	0.03
Richmond	3,439	3,500	1.7
Rockland	2,675	3,765	40.7
Ruscombmanor	3,129	3,776	20.6
Topton	1,987	1,948	-2.0
Windsor	2,101	2,392	13.8

Table 5: Population by Municipality in Watershed

LAND RESOURCES

Geology

Geology and landform vary greatly among the separate subbasins of the watershed because of varying bedrock types (Figure 7). From north to south, the geology of the watershed transitions from a sandstone and sandstone/shale ridge (Blue Mountain) to smaller shale/sandstone hills in the northern two-thirds of the Great Valley. The headwaters of Stony Run, Ontelaunee, Pine, Kistler, Furnace and Mill Creeks originate in these sandstone/shale areas, with the uppermost reaches of Furnace Creek originating entirely in sandstone-underlain areas. Bedrock composed mostly of shale underlies the subbasin of Bailey Creek.

The Sacony Creek subwatershed has the most diverse geology, with its headwaters originating in areas underlain by gneiss and quartzite. The creek then flows through areas with limestone and dolomite bedrock before entering an area of shale bedrock where it empties into the main stem. The Mill Creek drainage accounts for 43% of the Sacony Creek subwatershed, and its headwaters originate in areas of shale/sandstone bedrock. As a result, Sacony Creek and its tributaries flow across all types of bedrock occurring within the watershed. Willow Creek has similar diversity with quartzite, gneiss, limestone and dolomite within its subbasin. Moselem Creek originates from springs, emerging from limestone and dolomite formations and then crossing into shale bedrock at its confluence with the Maiden Creek main stem. Peters Creek is also a limestone spring-fed stream, which empties directly into Lake Ontelaunee.

Soil Characteristics

With the varied geology of the watershed comes a diverse soil composition as well. Six soil associations occur within the boundaries of Maiden Creek drainage (Figure 8). The Hazleton-Dekalb-Buchanan Association is composed of soils derived from residuum or colluvium above sandstone and sandstone/shale or quartzite. There are two bands of this association in the watershed, one on the south face of Blue Mountain and one on the north face of the Reading Prong. The Berks-Weikert-Beddington association formed over shale and sandstone and is the most common soil association, accounting for 35% of the watershed. Ryder-Clarksburg-Berks soils originate from residuum of shaly limestone; from colluvium of limestone, shale and sandstone; or residuum of shale. Two small areas of this association occupy parts of Sacony, Mill, Moselem, and Baileys Creeks.

Soils of the Hagerstown-Duffield-Clarksburg association are derived from limestone bedrock. A band of these soils runs through the Great Valley in the Sacony, Moselem, Peters and Willow Creek subbasins. The soils of the Chester Glenelg-Manor association are derived from micaceous schist. This association is found north of the Reading Prong on the floor of the Great Valley, running through the Willow, Moselem and Sacony Creek subbasins.

The contrasting geology and soils have implications for the water budget of each subbasin. Generally, areas underlain by sandstone and shale or quartzite and gneiss have greater surface runoff than areas over limestone and dolomite. Limestone-derived soils tend to have higher infiltration rates

than shale or sandstone-derived soils. In addition, the karst topography of the limestone-derived soils includes closed depressions, which tend to allow precipitation to infiltrate the soils more easily. Related to this higher infiltration rate of the soils is an increase in groundwater vulnerability. As more precipitation infiltrates and recharges the groundwater, rather than flow across the surface of the ground into a stream, pollutants at the surface, such as nitrates and pesticides can be carried into the groundwater. The presence of sinkholes in areas of karst geology increases the vulnerability of groundwater because they create direct conduits for surface water to flow into the underlying water table.

Limitations / Suitability

Soils are arranged by capability class to show their general suitability for most types of farming. Soils in Capability Class I are the best for farming, i.e., they have the least limitations, the widest range for use and suffer the least damage when used. Soils in Class VIII have the most limitations, have lower yields, and suffer the most damage when used.

Distribution of capability classes within the watershed is varied. There are few soils in Class I. Class II soils are more common and are largely distributed in the lower third of the Great Valley, as well as in some of the smaller stream valleys in the northern part of the watershed.

Protection of higher capability class soils is important for preservation of agriculture in the area. As costs rise and make individually owned farms less viable, it will be more important to preserve these prime farmland soils to maintain the agricultural productivity and heritage of the region.

Ownership

Public ownership is limited to State Gamelands 106 and 217 along Blue Mountain and Gameland 182 along Sacony Creek downstream from Kutztown, as well as a small tract of Weiser State Forest (Figure 9). Of these three units, some 500 acres are within the Maiden Creek basin. There are no federal or state parks within the watershed. Numerous smaller parcels of public lands including schools, municipal parks and miscellaneous municipal properties exist in the watershed.

Baseball field along Furnace Creek

Private parcels include large farms and woodlots, commercial/industrial properties and smaller residential lots.

Hazard Areas

A closed landfill near Christmans Lake outside Lenhartsville is a Superfund site where pollution was discovered in the early 1970s. There are no active landfills in the Maiden Creek watershed.

Mining is not widespread in the area, but two limestone quarries operate in the southern part of the watershed in the Great Valley. Allentown Cement operates a facility near Lake Ontelaunee and Peters Creek, and Eastern Industries has an open pit southeast of Kutztown in the Saucony Creek subwatershed. The quarry and hot mix asphalt plants serve Berks and western Lehigh Counties. The companies' asphalt and concrete plants must follow requirements such as acquiring operating permits for air quality, maintaining storage tanks that fuel the equipment, and water quality in the case that they would need to remove water from their operations.

Sinkholes occur in carbonate rock formations (limestone and dolomite) and are common in portions of the Great Valley. Certain geologic formations are more susceptible to sinkhole formation due to varying physical characteristics of the bedrock.

WATER RESOURCES

Protecting Water Resources

Achieving and maintaining high quality water resources is a goal and a challenge for state, county and local governments and for landowners and residents throughout the commonwealth. Pennsylvania has over 83,000 miles of streams, more stream miles than any other state except Alaska. Over the years, development and agriculture have removed natural forest canopies that once covered and protected thousands of stream miles. In the past decades, sprawling residential growth has accelerated in Southeast Pennsylvania. There is a very strong economic and moral incentive to address water quality issues on a watershed basis. It makes economic sense to prevent degradation rather than remediate pollution, to plan protection strategies rather than to react to problems, and to work across municipal boundaries to protect irreplaceable water resources. The health of our ecosystem, and our own quality of life, will be the beneficiaries.

To assist with this challenge, Pennsylvania has implemented statewide watershed activities including the proper classification and protection of Pennsylvania's waters. State water quality standards, mandated by the Clean Water Act, are regulated and set by the Pennsylvania Department of Environmental Protection with approval from the Environmental Protection Agency. These standards are specified in Chapter 93 of the Pennsylvania Code. As part of Chapter 93, stream reaches for protected uses are designated based upon specific water quality and biological conditions. There are five protected use designations for the stream reaches within Maiden Creek watershed. They are defined as follows:

TSF: Trout Stocking Fishery – Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna that are indigenous to a warm water habitat.

WWF: Warm Water Fishery – Maintenance and/or propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.

CWF: Cold Water Fishery – Maintenance and/or propagation of fish species, including the family Salmonidae and additional flora and fauna, which are indigenous to a cold-water habitat.

HQ: High Quality Waters – A stream or watershed that has excellent quality waters and environmental or other features that require special water quality protection.

EV: Exceptional Value Waters – A stream or watershed that constitutes an outstanding national, State, regional, or local resource, such as waters of national, State, or county parks or forests, or waters which are used as a source of unfiltered potable water supply, or waters of wildlife refuge or State game lands, or waters which have been characterized by the Fish Commission as "Wilderness Trout Streams," and other waters of substantial recreational or ecological significance

The classifications **HQ** and **EV** are special protection waters, required to be maintained at their existing quality. Local government ordinances should incorporate good design

techniques and buffer zones for the continued protection of the areas in these designated watersheds. Limiting erosion and sedimentation on construction sites and maintaining as much natural vegetation on the site as possible are two basic things that can be done. Maintaining buffers along stream and creek banks and reducing the amount of impervious surfaces are additional items that can be incorporated into local ordinance regulations.

Table 2 and Figure 5, in Project Area Characteristics, both depict the protected use designations within the Maiden Creek watershed. The upper Sacony Creek basin and all of Peters Creek have been designated as Exceptional Value (EV) streams. Additionally, the upper Pine Creek basin and all of Moselem Creek are considered High Quality Cold Water Fisheries (HQ-CWF). The remaining streams within the watershed are primarily Cold Water Fisheries (CWF) and Trout Stocked Fisheries (TSF), while the lower portion of the watershed is considered to be a Warm Water Fishery (WWF), including Lake Ontelaunee and downstream sections.

Wetlands

Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions, including swamps, marshes, bogs and similar areas. Most wetlands are recognized by the growth of characteristic plants, occurrence of standing water, and the existence of moist soils. These soils usually have high organic content.

Wetlands have a variety of functions and uses. They can be extremely rich areas for plant growth and animal habitat, often serving as breeding places for many organisms. Wetlands also act as natural filters in removing pollutants such as bacteria and sediment from the water. Organisms living in the wetland consume the pollutants trapped by plants. The soils in a wetland are often acidic. This allows a wetland to receive acidic infiltrations and remain relatively unaffected.

Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology. Wetland hydrology creates permanent or periodic inundation, or soil saturation to the surface, at least seasonally. The presence of water for a week or more during the growing season typically creates anaerobic conditions in the soil, which affect the types of plants that can grow and the types of soils that develop.

Wetland types of plants include palustrine, lacustrine, and riverine habitats. Of the palustrine wetlands, open-water habitats are the most numerous, followed by emergent marshes, forests and scrub-shrub environments. Forests are more prevalent than open water marshes, however.

A significant palustrine emergent wetland is Sacony Marsh, southeast of Kutztown. Sacony Marsh covers an area of 20 acres containing several significant populations of rare or endangered plants. Lacustrine habitats include Lake Ontelaunee, Leaser Lake, Hamburg reservoir and a small reservoir west of the main stem above Lake Ontelaunee. The one riverine wetland habitat in the watershed is in the Upper Maiden Creek drainage along the main stem. It runs along the west bank of the stream from Zettlemeyer's Bridge south to the village of Dreibelbis.

Accordingly wetlands should be preserved and maintained not only for their role in improving water quality, but also as key areas to sustain biodiversity and protect rare and endangered species.

Floodplains

A floodplain is the land that lies adjacent to a river or stream that is periodically flooded by overflow. It acts as a natural barrier to prevent flooding of surrounded developed areas. This land is usually flat and contains alluvial soils that may be wet a portion of the year. It often supports wetlands vegetation that can serve as excellent areas for habitat and biodiversity. The floodplain areas vary with the topography and size of stream, increasing with stream order and drainage area.

Figure 10 shows the locations of mapped 100-year floodplains in the Maiden Creek Watershed. These 100-year floodplains have at least a 1-percent chance of flooding in any given year. Such events are typically associated with tropical systems that move inland from the Gulf of Mexico or the Atlantic. More common high water events are rain on snow situations in winter, when melting snowpack and rainfall combine to produce a flood. This happened most recently in January 1996.

Communities that participate in the National Flood Insurance Program (NFIP) are required to adopt and enforce floodplain ordinances. Property owners in participating communities are able to purchase flood insurance. All municipalities in the watershed maintain regular status in the NFIP at this time. This allows continued development within the floodplain, assuming that all regulations for development are stringently followed.

Most of the mapped 100-year floodplains lie along the larger streams in the watershed, with the width of the floodplain increasing with stream order and drainage area. Topography affects the width of the floodplains as well. The main stem in Upper Maiden Creek has a narrower floodplain because steep slopes restrict it on one or both sides for much of its length. Conversely, Ontelaunee and Sacony Creeks have wider floodplains because of the low-lying areas along these stream corridors.

Areas where potential problems exist due to development include the Borough of Kutztown and Maxatawny Township along

Sacony Creek. The floodplain serves as a natural buffer area along the creek through much of its length. This greatly aids in protecting the stream banks and absorbing the impacts of runoff and nutrient loading. Therefore, a floodplain is best left in natural open space.

Ponds and Dams

Open-water lakes and ponds do not occur naturally in the watershed since glaciation during the last ice ages did not extend to Berks or Lehigh Counties. Rather, concrete or earthen dams are used to impound any lakes occurring in the watershed.

The two largest lakes in the watershed are Lake Ontelaunee near the mouth of Maiden Creek and Leaser Lake in Lynn Township on a tributary of Ontelaunee Creek. Lake Ontelaunee covers approximately 1100 acres, and Leaser Lake covers approximately 110 acres. Two smaller reservoirs include Hamburg and Christmans Lake. Numerous smaller ponds are scattered about the drainage basin. Some of these are groundwater-fed while others are impoundments of small streams.

Water Quality Assessment

The 1998 305(b) Report of Water Quality Assessment was issued by the Pennsylvania Department of Environmental Protection and lists all the assessed streams in the state. The report also lists those streams that they plan to assess and the sources/causes of impairment for assessed streams. Lake Ontelaunee is the only assessed water body in the watershed and was determined to be eutrophic. Lake Ontelaunee is listed in the 1998 303(d) list of impaired streams. Sources of impairments are agricultural/urban runoff, storm sewers, on-site wastewater, and municipal wastewater discharges. The causes of impairments are nutrient loads and suspended solids.

Monitoring

Maiden Creek Watershed Association is currently performing water quality monitoring along Maiden Creek. The association is made up of citizens whose goal is to promote awareness of the Maiden Creek watershed being a valuable natural resource through community education and water quality monitoring.

DEP evaluated waters within the Maiden Creek watershed in March of 1996 at 42 sites on named and unnamed tributaries. The evaluation included a one-time sample of chemical parameters and a biosurvey and stream habitat assessment using EPA rapid assessment protocols. A water quality network (WQN) station is located at the mouth of Maiden Creek to monitor sediment and various chemical parameters, but is no longer operational.

MCWA has recently started monitoring surface water in Maiden Creek watershed. Past water quality sampling efforts have indicated elevated nitrates, phosphorous, fecal coliform bacteria, and sediments as potential concerns.

Nitrogen as nitrate is a human health concern when it is present in drinking water supplies (surface or ground). The specific

health concern with nitrate-nitrogen is methemoglobinemia or "blue baby syndrome." To reduce the probability of such problems EPA has set a maximum contaminant level (MCL) in drinking water for nitrate-nitrogen at 10 mg/l. Nitrates were elevated (>5mg/l) in the following locations:

- Christmans Lake (5.3 mg/l)
- Moselem Ck, several locations (6.1, 10, 7.0, 10mg/l)
- Peters Creek (8.6, 8.5 mg/l)
- Unnamed Tributary to Maiden Creek on (8.5 mg/l)
- Unnamed Tributary to reservoir below upper Campbell's facility (6.7 mg/l)
- Sacony Creek at Christmans Road (7.0 mg/l)

Nitrate levels in the watershed may have been elevated due to agricultural activities and to a lesser extent human waste disposal, but levels were not exceptionally high in most of the surface water measurements. However, Peters and Moselem Creeks were two exceptions with nitrate concentrations at or near 10 mg/l. Phosphorus is primarily a concern for surface waters because it can accelerate the formation of algal blooms and eutrophication of lakes. There are many sources where phosphorous can be found. Some of these include soil, wastewater treatment plants, fertilizer, runoff from animal manure storing areas, and commercial cleaning preparations. Most phosphorus is transported by sediment because it typically attaches to soil particles that move with erosion and surface flow. Because phosphorus is not known to be a health hazard, no surface water quality standard has been established. However, the US EPA is presently considering the implementation of such standards.

Algal blooms fueled by phosphorus are a priority concern for Lake Ontelaunee. Sampling was conducted in March, June, and July of 1998. Samples with greater than 0.1 mg/l of phosphorus included:

- Kutztown POTW: .16 mg/l
- Campbell's facility: .49 mg/l
- Mouth of Sacony Creek: .68 mg/l
- Virginville Gutter Discharge: .32 mg/l
- Furnace Creek Pipe: 1.5 mg/l
- Lynn POTW: 5.2 mg/l

High suspended-sediment loads can cause problems for aquatic life, and water treatment processes pollutants such as phosphorus are deposited along with the sediments in water supply reservoirs. Sedimentation and phosphorus loading has been identified as a concern for Lake Ontelaunee in previous studies.

In 1992, roughly 25% of Lake Ontelaunee's volume had been lost to sedimentation since construction in the 1930's. Sources of sediment include soil erosion from agricultural runoff, urban stormwater and other land-use activities. Erosion from streambanks is also a sediment source.

Fecal contamination is a potential threat to human health in the watershed but not as a result of consumption in drinking water. Criteria for fecal coliform in surface water are defined in the water quality standards as follows:

- 200 counts per 100 ml for recreation during the swimming season (May 1-September 30)
- 1,000 count per 100 ml during the remainder of the year

Potential sources include point source discharges from sewage treatment plants, malfunctioning or inadequate septic systems, and runoff from

agricultural lands, particularly pasture lands of livestock. If the pollution is of human origin, this may indicate inadequate wastewater treatment systems. If animal waste is the likely source, improved livestock waste management such as excluding cattle from streams may be a solution.

A screening level of sampling was conducted to locate areas of potential fecal contamination. The sampling found contamination of greater than 10,000 colonies per 100 ml in the stormwater outfall locations in or immediately downstream from Virginville and Lenhartsville. These unsewered areas have historically been areas of concern of fecal contamination to Maiden Creek. A sample collected in a stormwater pipe system at Furnace Creek's mouth also had an extremely high fecal coliform concentration. Concentrations greater than 1,000 colonies in 100 ml occurred on at least one sampling date for the following streams:

- Unnamed tributary to Maiden Creek near Onyx Cave
- Kistler Creek at Kistler Valley Road
- Saucony Creek, just upstream of its mouth
- Tributary formed by outflow from Christmans Lake at Route143
- Pine Creek at Route 143
- School Creek at Route 143

The underlined locations had counts in excess of 10,000 colonies per 100 ml samples were collected in relatively dry weather, which indicate direct contamination of the flows sampled. Human origins were noted as almost certainly the source for the majority of the contaminated samples collected in stormwater pipes.

The Save Our Streams Macroinvertebrate Protocol was used to evaluate macroinvertebrate data collected by the DEP for their Special Protection Report. Under this protocol, a biotic index value is calculated as follows:

1 X number of taxa (most tolerant species)

+

2 X number of taxa (moderately sensitive species)

+

3 X number of taxa (most sensitive species)

Biotic Index Value (BIV)

Stream walkers in the Maiden Creek Watershed (concerned citizens from Berks County) collected additional information on macroinvertebrates. A biological study was conducted to determine the ability of the Maiden Creek (and its tributaries) to support aquatic macroinvertebrate life. A habitat evaluation was conducted and macroinvertebrate samples were counted and rated for pollution sensitivity and diversity.

Furnace Creek

Figure 11 shows the pollution sensitivity indices developed as part of the stream walker survey. The streams shown in blue are those stations ranked as being "excellent," while those shown in yellow are rated "good", and those shown in red are

"fair" or "poor" streams. Peters Creek, an Exceptional Value stream, is an anomaly as it has extremely high biotic value because of a few species, however the lack of diversity results in a low ranking. On the other hand Christmans Creek is a highly impacted stream with an expected low ranking due to occurrence of pollution sensitive species

Point Sources

According to the National Pollutant Discharge Elimination System (NPDES) established as part of the Clean Water Act, the US EPA issues permits that allow discharges of regulated amounts of cooled effluent into water bodies. The EPA regulates and monitors the amounts of effluent discharged by permit holders. The NPDES permit holder is responsible for maintaining and updating the permit on a regular basis. Table 6 shows the list of NPDES permitted discharges within the Maiden Creek watershed.

Other point sources of pollution that are not major contributors, but are additional potential point sources include industrial and commercial users of toxic materials, and automobile-related commercial facilities. Automobile-related commercial facilities could be any gas station, or repair shop that uses toxic materials or sprays water to clean potential pollutants off of automobiles. These establishments also store fuel in subsurface tanks, which have the potential to pollute water resources through leaking or accidental spills.

Information from the stream walker files identified a number of potential pollution

Site Name	Permit #	Discharge Into
Berks County		
McConway & Torley Kutztown Steel Foundry	1209	Sacony Creek
East Penn Lyons Smelter and Battery Plant	48021	Sacony Creek
Harakel and Schenwar Residence	4382	Maiden Creek
Schuylkill Valley High School	48453	Maiden Creek
Reed Residence	2610	Mill Creek
Hamburg Boro Water System	4384	Furnace Creek
Kief Industries Excelsior Brass Manufacturing	48439	Willow Creek
Fleetwood Borough Sewage Treatment Plant	48410	Willow Creek
Golden Oaks CC	3965	Furnace Creek
Maidencreek Twp. Sewage Treatment Plant	48826	Willow Creek
Kutztown Sewage Treatment Plant	48425	Sacony Creek
Lyons Borough Sewage Treatment Plant	4373	Sacony Creek
Vlasic Foods Farm B Mushroom Farm	3048	Peters Creek
Eaken Textile Chemical Manufacturing	3307	Willow Creek
Giorgio Foods Mushroom Processing Plant	48033	Willow Creek
Allentown Cement Evansville Cement Plant Qy	4769	Maiden Creek
Reading Water System	48449	Maiden Creek
Lehigh County		
Blue Rock Mountain Spring Water (Ind. Waste)	12343	UNT Ontelaunee Creek
Lynn Twp. Sewer Authority	70254	Ontelaunee Creek
Paul Borman, Single Residence STP	62901	UNT Ontelaunee Creek

Table 6: NPDES Permits in Maiden Creek Watershed

sources throughout the watershed such as: unknown wastewater discharges from residential areas, drain pipes from unknown sources, cattle with free access to streams, trash dumps, abandoned cars, industrial operations (e.g., paint stripping facilities), mushroom growing operations, tire dumps, and waste products from commercial businesses.

Non-Point Sources

Pollution caused by erosion and runoff from farms, businesses and residential properties are non-point sources of stream degradation. Pollutants can be nutrients, such as nitrogen and phosphorus that are used in fertilizers used on farms, lawns and golf courses. Nutrients can also come from manure and human wastes. Nutrient management practices can reduce these causes of pollution that produce excessive plant growth in streams and ponds.

The greatest non-point pollutant in the Maiden Creek watershed is sediment, small particles of soils or other insoluble materials washed into the stream after rain and storm incidents. Every significant rainfall induces runoff and erosion that results in muddy stream conditions in the Maiden Creek. Large storms and downpours that produce flooding can result in serious damage to the stream banks and streambeds. Although heavy rains cannot be prevented, stormwater controls can minimize the amount of

sediment that enters the stream under normal conditions. Best management practices (BMPs) on farms, erosion and sedimentation controls at all earth moving sites, detention basins in residential developments, use of streamside buffers of natural vegetation, and enactment and implementation of stormwater management ordinances are measures that address sediment loading in streams.

Groundwater Quality

The groundwater quality within the Maiden Creek watershed is determined by two major factors. The first factor that influences the quality of groundwater is the underlying geologic formations that contact the water in pores and fractures. The Maiden Creek watershed is dominated by sedimentary rock formations and only in its extreme southern part does it contain only a few metamorphic rock types. In the northern two-thirds of the watershed, the geology is primarily sandstone and shale. Sandstone is fairly resistant to weathering and therefore does not tend to contribute large amounts of dissolved minerals to groundwater. Siliceous minerals are usually the major component. Shale tends to contribute compounds with iron, manganese, and sulfur to groundwater. The southern third of the watershed is composed mostly of limestone and dolomite, a small portion of which also has some diabase and granitic gneiss (metamorphic rocks). Limestone and dolomite rocks are rich in calcium and magnesium and are also easily dissolved by water. As a result, groundwater from these sources is called "hard water" because it tends to be rich in these minerals.

While the geology tends to determine the expected quality of groundwater from a given source, more often than not, the quality of groundwater is determined by the human activities in the surrounding region. In the Maiden Creek watershed, agricultural, residential, and industrial land uses are most responsible for groundwater contamination.

High nitrate concentrations are also prevalent in carbonate formations. Infiltration and overland runoff carrying nitrate from various sources may enter aquifers directly through solution cavities, sinkholes, and fractures. Nitrate at concentrations greater than 10 mg/L in drinking water may be toxic to children under three months of age by causing methmoglobinemia – a reduction of oxygen supply in the blood. Fertilizers, barnyard wastes, and wastewater from on-site disposal systems or leaky sewers are potential causes of increased nitrate loads. Measures to correct such problem areas are implementation of land use practices that minimize infiltration.

The majority of the Maiden Creek watershed (58%) is used for agriculture. Agricultural land uses are a concern because of the different types of chemicals that are applied to the land for crop production. Furthermore, concentrated animal operations (CAOs) and mushroom farms are also of concern because of their use and disposal of agricultural wastes.

In the Maiden Creek watershed, the primary pollutant of concern with respect to groundwater is nitrate. Nitrate is a component in fertilizers for crops and tends to leach into groundwater upon contact with infiltrating precipitation. It can also enter groundwater via septic systems.

Currently, nitrate-nitrogen concentrations within the watershed are quite variable. The Pennsylvania Department of Environmental Protection (DEP), which operates an Ambient and Fixed Station Network (FSN)

of monitoring wells across the state, currently monitors 27 different chemical analytes including nitrate-nitrogen. The EPA maximum contaminant level (MCL) for nitrate-nitrogen concentrations in drinking water is 10 mg/l. Only three wells tested greater than 10 mg/l for nitrate-nitrogen concentrations. While the majority of wells remained below 5 mg/l in concentration, it is important to consider when these wells were sampled (e.g. time of year). This is because nitrate-nitrogen concentrations in groundwater can vary greatly due to changes in water levels and changes in land use (e.g. growing season vs. non-growing season for cropland). The specific sampling information was unavailable for the DEP Ambient and FSN Monitoring report. Thus, continued monitoring for nitrate-nitrogen must be done at different times of year to discover variations in these wells.

While nitrate-nitrogen is a watershed-wide concern because of the large use of land for agricultural and residential development (e.g. cropland, animal wastes, and septic systems), there are other concerns within the watershed for groundwater quality. Industrial uses and accidental discharges of toxic materials to groundwater occur frequently and threaten groundwater quality in more specific localized regions within the watershed. Furthermore, incidences of soil contamination by closed landfills (e.g. Christman Landfill near Lenhartsville) and open dumps also threaten groundwater quality with hosts of hazardous chemicals that leach into groundwater reservoirs.

There are various industries within the Maiden Creek watershed, all of which can contribute to groundwater contamination. Industries that must store, transport, and dispose of wastes run the risk of allowing these wastes to be accidentally spilled and transported to groundwater. Wastewater from such operations typically contains various forms of organic chemicals and heavy metals, which can be extremely detrimental if consumed or used by humans. Additional concerns also exist for leaking underground storage tanks at gasoline stations throughout the watershed. Leakage of gasoline and its chemical constituents into groundwater (specifically benzene, toluene, ethylbenzene, and xylene (BTEX)), has been a problem for many years and can be costly to remediate. Recently, an issue has arisen with respect to the usage of methyl tertiary butyl ether (MTBE) as an oxidant in gasoline. This organic compound burns cleaner and promotes better air quality when used in gasoline. However, when MTBE leaks into groundwater, its extreme solubility in water allows it to travel very quickly through aquifers (sometimes miles in a day) and it has proven to be a very difficult chemical to remove. Therefore it is important to monitor drinking water wells for this contaminant, especially ones that are adjacent to developed areas with underground storage of gasoline.

Well Head Protection Areas

Several municipalities in the Maiden Creek watershed have recognized the potential impacts of groundwater contamination and have combined efforts to participate in wellhead protection programs. Wellhead protection is required by the Safe Drinking Water Act (SDWA) and is a program that is designed to protect source water areas from man-induced contaminants. Wellhead protection areas (WHPA) are delineated into three distinct zones:

- **Zone I:** 100 to 400 foot radius surrounding the well. Depends on the aquifer characteristics.

- **Zone II:** Zone of Contribution to the well based on a 10-year time of travel of water to the well. This zone is based on pumping and recharge rates of the well using hydrogeologic models.
- **Zone III:** The "Upland Area of Runoff Contribution" influenced by topography and based on the drainage basin.

The municipalities within the Maiden Creek watershed that have developed WHPAs are Kutztown, Topton, and Lyons municipal water authorities and Maxatawny Township.

The primary purpose of wellhead protection is to restrict land uses within delineated zones of contribution that threaten groundwater quality. The types of land uses that pose risks to groundwater are summarized in Table 7. Within Zone I, all "high risk" land uses are prohibited. Within Zones II and III, special exceptions can be given for some types of "high" and "medium risk" facilities.

An inventory of the major potential sources of groundwater pollution within the WHPAs has identified many potential point, nonpoint, and transportation related sources in the area, including:

- **Point Sources**: small industries that generated 100-1000 kg of hazardous waste per month, underground storage tanks (USTs), road salt storage areas, graveyards, open dumps, junkyards, quarries, and abandoned waste disposal sites.
- **Nonpoint sources**: agricultural operations and on-lot disposal of wastewater.

Low Risk

1. Land Surrounding a well or reservoir, owned by a municipality.
2. Permanent open space dedicated to passive recreation.
3. Federal, state, municipal, private parks and forests.
4. Woodlands managed for forest products.
5. Permanent open space dedicated to active recreation.
6. Field Crops: Pasture, hay, grains, vegetables.
7. Low Density Residential: Lots larger than 2 acres.
8. Churches, municipal offices.

Medium Risk

1. Agricultural Production: Dairy, livestock, poultry, nurseries, orchards, berries.
2. Golf course, quarries.
3. Medium Density Residential: Lots from ½ to 1 acre.
4. Institutional Uses: Schools, hospitals, nursing homes, prisons, garages, salt storage, sewage, treatment facilities.
5. High Density Housing: Lots smaller than ½ acre.
6. Commercial Uses: Limited hazardous material storage.

High Risk

1. Retail Commercial: Gasoline, farm equipment, automotive, sales and service, dry cleaners, photo processors, medical arts, furniture strippers, machine shops, radiator repair, printers, fuel oil distributors.
2. Industrial: All forms of manufacturing and processing, research facilities.
3. Underground storage of chemicals, petroleum.
4. Waste Disposal: Pits, ponds, lagoons, injection, wells used for waste disposal, bulky waste and domestic garbage landfills, hazardous waste treatment, storage and disposal sites.

Table 7: Groundwater Vulnerability Risk Categories

- **Transportation Routes**: US 222, East Branch Conrail railroad, secondary roads and rail lines leading to industrial and agricultural areas.

Potential future sources of contamination as identified in the report are those areas that remain undeveloped. Pressure to convert these areas into commercial or residential developments presents a significant risk to groundwater resources within the WHPAs.

Precipitation

The National Oceanic and Atmospheric Administration (NOAA) website provides downloadable precipitation data for both the Reading and Allentown weather monitoring stations. The Reading station's period of record was from 1948 to 1997 (though in 1973 the station moved 4 degrees NNW). The Allentown weather monitoring station collected data from 1948 to 1996. The average annual mean for precipitation recorded at Reading was 42.8 inches per year. The lowest annual precipitation total was 27.74 inches in 1997. The highest annual precipitation total was 56.85 inches in 1963. The average annual mean for precipitation recorded at Allentown is 44.49 inches per year. The highest annual precipitation total was 67.69 inches in 1952. The lowest annual precipitation total was 29.82 inches in 1980. The National Oceanic and Atmospheric Administration data collected for 1997 indicate that mean annual precipitation for the Lake Ontelaunee watershed was approximately 37.1 inches (8.8 inches below normal).

Public / Private Water Supplies

There are numerous public water supply services within the watershed. The Reading Water Authority (RWA) supplies water to the largest number of people in the county, and also provides the largest volume of water in the county. Approximately 123,000 people, most of which live in the city of Reading, are served by the Reading Water Authority. Ontelaunee, Muhlenberg, and Bern Township Water Authorities own and maintain their own water systems, but are supplied with water from the Reading Water Authority. The RWA is also connected with a number of other townships in the event that they may need water.

There are only three major surface water suppliers in the watershed. The remainder of the watershed uses water from smaller public and/or private water wells. While the majority of the population within the watershed is serviced by groundwater withdrawals, the largest withdrawals in the watershed are still from surface water. Table 8 lists the major water suppliers in the watershed as well as the estimated number of people that are served by each. On an annual basis, 902 million gallons per year of water are withdrawn from groundwater aquifers whereas 4.6 billion gallons per year of water are taken from surface water sources. Over 97 percent of the surface water withdrawals are taken from Lake Ontelaunee for drinking water supplies to the City of Reading.

System Name	**Location**	**Population Served**
Armstrong's Mobile Home Park	Blandon	29
Berkleigh Heights Mobile Home Park	Fleetwood	75
Bern Twp. Municipal Authority	Reading	350
Fleetwood Borough Water System	Fleetwood	3500
Green Acres Mobile Home Park	Kutztown	47
Hamburg Municipal Water and Sewer Authority	Hamburg	4500
Highland Estates Mobile Home Park	NA	600
Kutztown Borough Water Authority	Kutztown	9100
Lyons Borough	Lyon Station	490
Maidencreek Twp Water Authority	Blandon	4550
Maxatawny Twp Municipal Authority	Kutztown	300
Ontelaunee Twp Municipal Authority	Leesport	175
Reading Area Water Authority	Reading	86648*
Retirement Village Mobile Home Park	Kutztown	70
Sittlers Mobile Home Park	Kutztown	89
Valley View Mobile Home Park	Blandon	77

Services provided primarily for people not living within Maiden Creek watershed.

Table 8: Public Water Suppliers

BIOLOGICAL RESOURCES

Blue Mountain is the most extensive relatively contiguous area of natural habitat in the watershed and is a major corridor for the movement of biota in eastern Pennsylvania. The mountain may be the wildest area remaining in southeastern Pennsylvania having extensive forests, and numerous steep gradient streams, rock outcrops, and boulder fields such as the River of Rocks in the Pine Creek subwatershed. Blue Mountain has long been recognized as one of the major East Coast flyways for migrating raptors. The world-famous Hawk Mountain Sanctuary is situated in the northwest corner of Maiden Creek watershed. However, for much of the watershed, forest fragmentation is problematic for wildlife movement and survival.

Wildlife

Blue Mountain provides important habitat for large mammal species including white-tailed deer, black bear, bobcat, fox, raccoon, and probably coyote as well as numerous small mammals including the threatened Allegheny woodrat. The forested uplands of Blue Mountain provide habitat for resident birds such as eastern wild turkey, ruffed grouse, and several species of hawks and owls. The mountain provides habitat for many nesting resident and Neotropical species and is an important songbird migration corridor. The lower slopes of Blue Mountain contain spring seeps, vernal pools, and riparian sites which support a rich assemblage of plants, animals, birds, reptiles and amphibians, and insects associated with these mesic sites. Leaser Lake Woods, a relatively diverse mature second growth forest, is a good example of this habitat type. Protection of the ecological integrity of Blue Mountain is vital to preserving biological diversity in the Maiden Creek watershed.

Throughout the watershed, small farm woodlots, forested riparian corridors and steep slopes, old fields, and other areas not in active agricultural production, or residential, commercial, or industrial uses, function as biological refugia. Lake Ontelaunee and the surrounding conifer plantations constitute a substantial habitat for biological resources. Sacony Marsh is the most significant wetland habitat in the watershed and is the location of several plant species identified in the Pennsylvania Natural Diversity Index (PNDI) species of special concern listing. Table 9 represents The Pennsylvania Biological Survey detailed classifications giving the current status of species found in the Maiden Creek watershed that are considered to be endangered or threatened.

Many of the listed species are associated with wetland habitats or other specialized niches, which is indicative of the past degradation of those biologically rich environments. Diverse fish populations and many reptiles and amphibians (Table 10) are also dependent on healthy water environments. At least thirty-seven fish species were documented by the DEP Special Protection Report to occur in the Maiden Creek watershed with both warmwater and coldwater species represented (Table 11). Macroinvertebrate data indicated that most streams would be classified as good to excellent using pollution sensitivity and diversity indices of aquatic invertebrates.

Scientific Name	Common Name	Recommended PBS Status
Plants		
Aster ericoides	White heath aster	Condition Undetermined
Aster radula	Rough-leaved aster	PA Threatened
Carya laciniosa	Big shellbark hickory	Tentatively Undetermined
Dryopteris celsa	Log fern	PA Endangered
Dryopteris clintoniana	Clinton's wood fern	PA Threatened
Eleocharis intermedia	Matted spike-rush	PA Threatened
Helianthemum bicknellii	Bicknell's hoary rockrose	PA Endangered
Helianthemum propinoum	Low rockrose	Tentatively Undetermined
Juniperus communis	Common juniper	Tentatively Undetermined
Lonicera hirsuta	Hairy honeysuckle	PA Endangered
Poa paludigena	Bog bluegrass	PA Threatened
Polygonum amphibium	Water smartweed	Tentatively Undetermined
Pycanthemum torrei	Torey's mountain-mint	PA Endangered
Salix myricoides	Broad-leaved willow	PA Endangered
Solidago rigida	Hard-leaved goldenrod	PA Endangered
Birds		
Asio otus	Long-eared owl	Condition Undetermined
Bartramia longicauda	Upland sandpiper	PA Threatened
Circus cyaneus	Northern harrier	
Cistothorus palustris	Marsh wren	Candidate
Cistothorus platensis	Sedge wren	PA Threatened
Ixobrychus exilis	Least bittern	PA Endangered
Nycticorax nycticorax	Black-crowned night-heron	Candidate
Protonotaria citrea	Prothonotary warbler	Candidate Rare
Rallus elegans	King rail	PA Endangered
Tyto alba	Barn-owl	Candidate
Mammals		
Neotoma magister	Allegheny woodrat	PA Threatened
Reptiles/amphibians		
Clemys muhlenbergii	Bog turtle	PA Endangered
Crotalus horridus	Timber rattlesnake	Candidate
Pseudemys rubriventris	Redbelly turtle	Candidate

Table 9: List of PNDI (Pa Natural Diversity Index) species in the Maiden Creek Watershed

Scientific Name	Common Name
Snakes	
Agkistrodon contortrix	Northern Copperhead
Coluber constrictor	Northern Black Racer
Crotalus horridus	Timber Rattlesnake
Diadophis punctatus	Northern Ringneck Snake
Elephe obsolteta	Black Rat Snake
Heterodon platirhinos	Eastern Hognose Snake
Lampropeltis triangulum	Eastern Milk Snake
Nerodia sipedon	Northern Water Snake
Storeria occipitomaculata	Redbelly Snake
Thamnophis sauritus	Eastern Ribbon Snake
Thamnophis sirtalis	Eastern Garter Snake
Storeria dekayi	Northern Brown Snake
Salamanders	
Ambystoma maculatum	Spotted Salamander
Ambystoma opacum	Marbled Salamander
Desmognathus fuscus	Spotted Dusky Salamander
Eurycea bislineata	Northern Two-lined Salamander
Eurycea longicauda	Longtail Salamander
Gyrinophilus porphyriticus	Spring Salamander
Notophthalmus viridescens	Red-spotted Newt
Plethodon cinereus	Redback Salamander
Plethodon glutinosus	Slimy Salamander
Pseudotriton ruber	Northern Red Salamander
Frogs and Toads	
Bufo americanus	American Toad
Pseudacris crucifer	Spring Peeper
Rana catesbeiana	Bull Frog
Rana clamitans	Green Frog
Rana palustris	Pickerel Frog
Rana pipiens	Northern Leopard Frog
Rana sylvatica	Wood Frog
Turtles	
Chelydra serpentina	Snapping Turtle
Chrysemys picta	Midland Painted Turtle
Sternotherus carinatus	Common Musk Turtle
Terrapene carolina	Eastern Box Turtle
Skinks	
Eumeces fasciatus	Five-lined Skink

Table 10: Reptiles and Amphibians in the Maiden Creek Watershed

American Eel	Common Shiner	Rainbow Trout
Banded Killifish	Creek Chub	Redbreast Sunfish
Black Crappie	Creek Chubsucker	Redfin Pickerel
Blacknose Dace	Cutlips Minnow	Rockbass
Bluegill	Gallfish	Satinfin Shiner
Bluntnose Minnow	Golden Shiner	Smallmouth Bass
Brook Trout	Green Sunfish	Spotfin Shiner
Brown Bullhead	Greenside Darter	Spottail Shiner
Brown Trout	Largemouth Bass	Swallowtail Shiner
Channel Catfish	Longnose Dace	Tesselated Darter
Comely Shiner	Margined Madtom	Walleye
Common Carp	Pumpkinseed	White Sucker
		Yellow Perch

Table 11: Fish list for the Maiden Creek Watershed

The National Audubon Society is currently conducting an inventory and assessment of the Kittantinny Ridge that includes the Blue Mountain area. It identifies issues, concerns, and opportunities to conserve the ridge. The study will include recommendations for future conservation, development, and other land use management.

Vegetation

The different combinations of geology, soils, topographic aspect and human disturbance result in varying vegetation patterns throughout the watershed with deciduous forests dominating the natural landscape. Isolated stands of coniferous forest occur with hemlock and white pine being the dominant species. Major changes of forest species composition occur with varying soil moisture holding capacities. On ridgetops, more xeric species occur, whereas in the colluvial soils at the foot of a slope, more mesic species dominate.

Topographic aspect affects available soil moisture as well, with north-facing slopes containing more mesic populations and south facing slopes more xeric populations. This is evident because coniferous stands only occur in three main areas in the watershed:

- The north face of Irish Mountain in the Willow Creek subwatershed.
- The north side of Shochary Ridge in the Ontelaunee Creek subwatershed.
- The north side of Blue Mountain, north of the Pinnacle in the Pine Creek subwatershed.

Isolated stands of conifers occur in the Sacony subwatershed as well in low-lying

mesic soils. The conifer stands near Lake Ontelaunee are largely non-native and were planted by the Reading Water Authority for erosion control purposes.

Emerging patterns show that Pine and Furnace Creeks are the most heavily forested, with 63% and 74% forest cover respectively. Annual herbaceous cover is the leading category for Bailey, Mill, Moselem, Peters and Saucony subwatersheds. This cover type is almost exclusively associated with row crops on agricultural land, as there are no native annual herbaceous cover types in this area. Forest is the leading cover type in all the remaining subbasins, though not as dominant as in the Pine and Furnace Creek basins. Because these two streams have the slopes of Blue Mountain within their drainage basins, this dominance of forest cover is to be expected.

Areas of Local Ecological Significance

Blue Mountain
Blue Mountain is a large continuous area of natural habitat that includes forest with streams, seeps, springs, vernal pools, rock outcrops, and boulder fields. This area is a major flyway for migrating raptors.

Leaser Lake Woods (Lynn Twp.)
This is a relatively diverse second growth forest. The site is jointly owned by Lehigh County and the PA Fish and Boat Commission and supports streams, seeps, lakeshore, forest, and boulder fields.

Bears Rocks (Lynn Twp.)
During a survey of this site in 1991, evidence of a PA-Threatened animal species was discovered. However, the evidence was not fresh, indicating that the species had been living in the past but may not have occupied the site at the time of the survey.

Saucony Creek Marsh (Kutztown Quadrangle)
This relatively large marsh has three plants species of special concern. It is an excellent site for natural history and environmental education classes

Cultural Resources

Archaeological/Historical

The territory encompassing the Maiden Creek watershed was transferred from the native Lenni Lenape to the heirs of William Penn in 1732. At that time, English Quakers bought large tracts of land in what became Maidencreek and Ontelaunee Townships and German immigrants settled the northern reaches of the watershed. The topography, settlement patterns and economic history of the watershed can be readily divided into three sections: the headwaters of the Ontelaunee, the Maidencreek/Moselem corridor and the Quaker quadrant.

Headwaters of the Ontelaunee

Lynn & Weissenberg Townships, Lehigh County and Albany Township, Berks County

Some of the earliest settlers to this region were immigrants from the Germanic Palatinate region that came as indentured servants to Schoharie, New York. Dissatisfied with the treatment they received from the British, these immigrants floated down the Susquehanna and then migrated east along the Tulpehocken and Swatara Creeks. Other Swiss and Palatinate immigrants came by way of the Oley Valley and Goshenhoppen in Montgomery County. Prior to 1752, when Berks and Northampton Counties were created, this area was known as *Allemaengel"* or *"all wants"* in German, which indicated a country wanting in fertile soils. These townships are still populated by descendents of these early settlers—Kistler, Dietrich, Fetterholf, Berks, and Trexler.

Gristmills and iron forges were established streamside to supplement the agriculture-based economy. At Mosserville, John Much in 1746 first warranted a mill and tannery. Other mills were established along the creek at Saegersville (later renamed New Tripoli), Lynnport, and Steinsville. The Union Forge and Furnace on Pine Creek (later known as the Brobst Forge) operated a small charcoal furnace and two forges before 1780. The slopes of the Blue Mountain were timbered to provide charcoal for this enterprise, more than to create additional cropland in an area that provided only subsistence farming until the later half of the nineteenth century. The only remaining log-constructed gristmill in Berks County still stands along the Pine Creek. Small villages grew up around the Ontelaunee (as the creek is known in Lehigh County) and its major tributaries of School, Kistler and Pine Creeks and Stony Valley Run.

In 1777, Frederick Leaser, was delivering applejack to Philadelphia from his Lynn Township farm when his wagon was commandeered to transport the Liberty Bell to safety.

Schneider Schoolhouse, Lynn Township

Leaser took the new county's symbol of freedom to Allentown, where it was kept

safe during the British occupation of Philadelphia.

In 1874, the Schuylkill and Lehigh Railroad Company completed a rail line along the Maiden Creek from Tuckerton at the Schuylkill River to Slatington in Lehigh County. The railroad contributed to major changes in the local economy and the agrarian landscape. New towns sprung up at railroad depots. Potatoes became a major cash crop with more than 10,000 train cars of potatoes shipped each year in the early twentieth century from the depots along the Maiden Creek. The "Centennial Quarry" at the foot of the Blue Mountain near Steinsville expanded operations when the railroad made transporting the heavy loads of slate more economically feasible. New Tripoli became a fashionable resort destination. The villages of Lynnport, Trexler, Kempton and Wannamaker Station expanded and prospered. The period from 1874 until the stock market crash in 1929 was the heyday of economic development for the *Allemaengel.* So many historic resources including farmsteads, train depots, gristmills and commercial buildings remain from this period that the entire area may qualify as a traditional cultural landscape suitable for listing in the National Register of Historic Places. Local historical societies are collecting information and artifacts to disseminate, interpret and display local history.

Interior of Schneider Schoolhouse

Iron Region of the Moselem

Richmond, Perry, Maxatawny, and Longswamp Townships Berks County

Beginning in 1732, when the territory was opened for settlement, immigrants from the Palantine region of Germany traveled west along the Manatawny Creek and over the Oley Hills to the Moselem Valley. By 1740, they had established six townships in the fertile limestone valley. The Merkel, Rothermel, Greenawald, Dunkle, Kutz, Hottenstein, Mertz and Schaeffer families were predominant landowners in this region. In 1753, the Maiden-Creek Road was laid out from the village Berkley near the Schuylkill River to Easton in what was then Northampton County.

The Germans proved to be skilled builders evidenced by an exceptional evolution of barn construction. The Switzer-style barn of their homeland was adapted and refined from 1780 through 1810 to what became known as the standard Pennsylvania barn--recognized by the second-story extended forebay that provided protection to the stalls on the lower level. Very few examples of pure Germanic early homesteads remain, but German craftsmanship is evident in several limestone homes built in the Anglo-Germanic Renaissance style that developed in the early Republic years from 1780-1812.

Iron ore was discovered in the region with one of the earliest and most prominent being the Moselem Forge established in 1750. By the mid-1800s there were more than one hundred iron mines across the region yielding large quantities of hematite ore. Gristmills, workers houses and company mansions are all that remain of the large iron complex that once dominated the landscape along the Moselem Creek. Other major iron furnaces in operation from the time of the

Revolution to the end of the Civil War period include the Sally Ann, Windsor, Maiden Creek, Topton and Kutztown Furnaces.

In 1857, the East Penn Railroad was erected from Temple in a northwesterly direction through the agricultural landscape to connect iron mines with the large foundry established there. The villages of Blandon, Walnuttown, Bowers, Lyons and Topton or Mertztown check the 1876 Atlas were established along this rail line. In 1874, the Schuylkill and Lehigh Railroad followed the Maiden Creek where it served the Moselem Furnace and fostered the development of Virginville as both a resort community and a trans-shipment point for the area's produce and livestock. The integrity of railroad-era buildings in Virginville has resulted in it recognition as a Historic District listed in the National Register of Historic Places. Other important resources along the rail line include the Dreibelbis Station and the Merkle Gristmill.

Table 13 on Pages 41 – 46 lists all of the recognized historic sites in the watershed by name and township.

Recreation

The Berks County Open Space and Recreation plan lists Maiden Creek as one of the high priority natural areas and stream corridors. Acquisition and preservation of important natural areas and stream corridors is recommended throughout the County. The Plan also recommends a system of interconnecting greenways along these areas, which could provide a link to other recreational facilities and be used for hiking, biking, nature study, and other activities. Opportunities for greenways can exist through the utilization of abandoned rail lines. One opportunity listed in the Plan would involve a five county cooperative effort, which would create a trail/park system to run the entire length of the Schuylkill River from Pottsville to Philadelphia.

Maiden Creek watershed is fortunate to have over 100 various recreational facilities. They include a mixture of municipal land and parks, golf courses, rod and gun clubs, campgrounds offering camping, hiking and swimming. State gamelands make up the northern reaches of the watershed. The Appalachian Trail, running from Maine to Georgia, follows the crest of Blue Mountain from the north and dips down into both the Pine and Furnace Creek subbasins before exiting the watershed to the west. Several side trails provide access to Hawk Mountain Sanctuary, Blue Rocks, and the Pinnacle, three regionally important recreational features.

Table 12 on Pages 39 – 40 gives a listing of public and private recreational facilities in each municipality.

Public Parks
Private Parks

Longswamp Township	**Muhlenberg Township**
Longswamp Municipal Park	*Bernhardt's Dam*
Hunsicker Picnic Grove	*Cherokee Ranch Playground*
Mertztown Rod & Gun	*Desilting Basin*
Topton Fish & Game	*Eisenbrown Tot Lot*
St. Paul Lutheran Church Playground	*Francis Street Pocket Park*
Doe Mountain	*Recreation Building*
Rulabah Stables	*South Temple Pocket Park*
Oreville Kart Track	*Felix Dam Linear Park*
	Stoudt's Ferry Bridge Playground
Maidencreek Township	*Pioneer Grove/Kelly's Lock*
Portion of Lake Ontelaunee	Schell's Drive-in
Blandon Fire Co. Playground	Muhlenberg Twp. Athletic Assoc.
Maidencreek Twp. Municipal Building	Muhlenberg Swim Assoc.
Maier's Grove	Laurel Run Swim Club
Shady Glen Picnic Grove	Schuylkill Marina
Rich Maiden Golf Course	The Boating Center
Pleasant Hill Golf Course	Laurel Lanes, Inc.
Park Plaza Mini-Golf	Fantasy Roller Rink
Blandon Rod & Gun Club	Timberline Inc. Skating Center
Rte. 222 Flying Club	Bingo World
	Met-Ed Fitness Trail
Richmond Township	
Crystal Cave	**Ontelaunee Township**
Berkleigh Country Club	*Lake Ontelaunee*
Moselem Springs	*Municipal Land*
Fleetwood Fish & Game	Blue Falls Grove
Walnttown Fish & Game	Leesport Gun Club
Gorilla Golf	Schellhammer Race Track
Deka Softball Field	Family Grand Prix
Sacony Park Campsites	
Conservancy Land	**Albany Township**
Kutztown Beach Club	Hawk Mountain Sanctuary
	Pinnacle
Rockland Township	Lehigh Valley Astronomical Society
Emphense Garden	Blue Rocks
Jim Moore Park	Appalachian Trail
Rockland Rod & Gun	Kempton Park Association
	PA Dutch Farm Museum
District Township	WK & S Stream Railroad
Garden Park	
Blue Spring Riding Club	
Conservancy Land	

Ruscombmanor Township	**Greenwich Township**
Reuben Strause Park	Pine Hill Campground
Ruscombmanor Municipal Ballfield	Blue Rocks Campground
Pricetown Rifle Association	Camp Ed-Mar, Boy Scout Camp
Evergreen Country Club	Robin Hill Retreat Camp
Hobby Horse Ranch	Kutztown Rod & Gun Club
	Dutchmill Campground
Fleetwood Borough	Conservancy Land
Borough Park	Appalachian Trail
Fleetwood Park & Pool	
Little League Field	**Perry Township**
YMCA	*Perry Township Recreation Area*
	Perry Township Golf Course
Kutztown Borough	Winchester Shooting Club
Community Park	Shoemakersville Swim Association
Kutztown Pool	Conservancy Land
Mini-Park	
Kutztown Fairgrounds	**Lenhartsville**
KATO's Field	PA Dutch Folklife Museum
Lyons Borough	**Windsor Township**
Lyons Municipal Park	*Hamburg Reservoir Campsite*
	Appalachian Trail
Topton	Blue Mountain Camp
Municipal Park	Christman Lake
	Edenberg Recreation Park, Inc.
Alsace Township	Lenhartsville Fish & Game
Township Park	
Gasser Golf Course	**Maxatawny Township**
Oley Valley Fish & Game	Bower's Park Grove Assoc.
Conservancy Land	Sittler's Golf Center

Table 12: List of Public and Private Parks by Municipality in Berks County

Table 13: Recognized Historic Sites in Watershed

HISTNAME	REGISTER	MUNICIP
Jeremiah Starr House	PHMC	Ontelaunee
Parvin Homestead	PHMC	Ontelaunee
City Water Works	PHMC	Ontelaunee
Davies' House	NR	Ontelaunee
Berkley Inn	PHMC	Ontelaunee
Dunkel House	PHMC	Ontelaunee
Robert Schmehl Property	NR Eligible	Ontelaunee
Dunkel Farm	PHMC	Ontelaunee
Dunkle Homestead	PHMC	Ontelaunee
Slegel, Carl Property	BC	Fleetwood
Fretz, Paul Property	BC	Fleetwood
Schlegel Pioneer House	PHMC	Fleetwood
Sholl Home	PHMC	Fleetwood
Ernst, Paul Property	PHMC	Fleetwood
Schaeffer, Janet Property	PHMC	Fleetwood
Hunsicker, John Property	PHMC	Fleetwood
Kutztown Historic District	PHMC	Kutztown
Kutztown Bridge	PHMC	Kutztown
Kutztown 1892 Public School Buil	NR	Kutztown
Deisher, H.K. Knitting Mill	NR	Kutztown
Folk Farm	PHMC	Longswamp
Rohrbach Farm	PHMC	Longswamp
Henningsville Hotel & Village	PHMC	Longswamp
101 S. Main Street	PHMC	Lyons
Abel, Dave & Kristie Property	PHMC	Lyons
Bertlett, J. Store	PHMC	Lyons
Reppert, Allan Property	PHMC	Lyons
Barto, Amos Hotel	PHMC	Lyons
Molltown	PHMC	Maidencreek
Orthodox Friend's Meeting House	BC	Maidencreek
Maidencreek Friend's Meeting Hou	BC	Maidencreek
Lightfoot-Meredith House	BC	Maidencreek
Penrose Farm	PHMC	Maidencreek
Evensville Road House	PHMC	Maidencreek
Reeser Farm	PHMC	Maidencreek
Stoudt Farm	PHMC	Maidencreek
Rothermel Farm	BC	Maidencreek
Route 222 House	PHMC	Maidencreek
Hlalfway House (Maidencreek Vill	PHMC	Maidencreek
Kauffman House	PHMC	Maidencreek
Rothermel Homestead	PHMC	Maidencreek
Kerby Homestead	PHMC	Maidencreek
Kerby Farm	PHMC	Maidencreek
Kauffman Farm	PHMC	Maidencreek

Kauffman, Johannes Homestead	PHMC	Maidencreek
Guldin Mill	NR	Maidencreek
Guldin Store	PHMC	Maidencreek
Evangelical Lutheran & Reformed	PHMC	Maidencreek
Bland's Town (Blandon)	PHMC	Maidencreek
544 Main Street House	PHMC	Maidencreek
Kindt's Corner Historic District	PHMC	Maidencreek
Golden Eagle Hotel	PHMC	Maxatawny
Seigfried Mill	PHMC	Maxatawny
Mill Creek Creamery	PHMC	Maxatawny
Levan Mill House	PHMC	Maxatawny
Wiser Farm	PHMC	Maxatawny
Grim Farm	PHMC	Maxatawny
Grim Homestead	BC	Maxatawny
Kemp's Motel	PHMC	Maxatawny
Kroningersville	PHMC	Maxatawny
Levan's Old Mill	PHMC	Maxatawny
Hottenstein Farm	PHMC	Maxatawny
Hottenstein Mansion	NR	Maxatawny
Hottenstein Farm	PHMC	Maxatawny
Zimmerman House	PHMC	Maxatawny
Weisport	PHMC	Maxatawny
Siegfried Farm	PHMC	Maxatawny
Siegfried's Dale Farm	NR	Maxatawny
Siegfried's Dale Farm	NR	Maxatawny
Siegfried's Dale Farm	NR	Maxatawny
Siegfried's School	NR	Maxatawny
Schofer (Village of)	PHMC	Maxatawny
Siegfried's Church	PHMC	Maxatawny
Deisher Homestead	PHMC	Maxatawny
Sauder Farm	PHMC	Maxatawny
Kemp, Daniel Farm	PHMC	Lyons
Bowers Station - Bowers Road Sec	PHMC	Maxatawny
Bowers, Jonas House	PHMC	Maxatawny
Bowers Station - Old Bowers Road	PHMC	Maxatawny
Bowers Tavern	PHMC	Maxatawny
Christ (DeLongs) Reformed Church	PHMC	Maxatawny
Sharadin Homestead	PHMC	Maxatawny
Sharadin Farm	PHMC	Maxatawny
Seibert-DeLong House	PHMC	Maxatawny
Stein's School House	PHMC	Richmond
Moselem Village	PHMC	Richmond
Moselem Furnance Mansion	BC	Richmond
Moselem Farms Mill	NR BC	Richmond
Dreibelbis, Jacob Farm	NR	Richmond
Crystal Cave	PHMC	Richmond
Moselem Church	PHMC	Richmond

Moselem School	PHMC	Richmond
Merkel Mill Complex	PHMC	Richmond
Sell, John Farm	PHMC	Richmond
Becker's St. Peter Church	PHMC	Richmond
St. Peter's United Church of Chr	PHMC	Richmond
Billig Farm	PHMC	Richmond
Heffner, Lee Jr. Property	PHMC	Richmond
Moselem Springs Inn	PHMC	Richmond
Leibelsperger Farm	PHMC	Richmond
Moselem Springs Farm	PHMC	Richmond
Schaeffer, William Farm	PHMC	Richmond
Kiefer Farm	PHMC	Richmond
Hoch Farms	PHMC	Richmond
Schlegel, Christian Farm	NR	Richmond
Schlegel Grist Mill	BC	Richmond
Heffner Log Cabin	PHMC	Richmond
Virginville Historic District	PHMC	Richmond
Mansion House	PHMC	Richmond
Dreibelbis Hotel	PHMC	Richmond
Walnuttown	PHMC	Richmond
Delong Farm	PHMC	Rockland
Deoliveria, Anthony Mickey Prope	PHMC	Rockland
Niess, Nicholas Property	PHMC	Rockland
Grim's Mill	PHMC	Rockland
Dent, Dr. C.P. Property	PHMC	Rockland
Sally Ann Furnace Complex	PHMC	Rockland
Guinther Farm	PHMC	Rockland
Burkholder, Norman Property	PHMC	Rockland
Hertzog School	PHMC	Rockland
Meldrum, Alex Property	PHMC	Rockland
Burkholder, S.R. Property	PHMC	Rockland
Klein, H. Property	PHMC	Ruscombmanor
Edgewood Mills	PHMC	Ruscombmanor
Mill, Jacob Farm	PHMC	Ruscombmanor
Rothermel Farm	PHMC	Ruscombmanor
Price, Jacob Homestead	PHMC	Ruscombmanor
Eby, Irwin Property	PHMC	Ruscombmanor
Pyle, C. Eugene & Phyllis Proper	PHMC	Ruscombmanor
Keller Farm	PHMC	Ruscombmanor
Pricetown (Village of)	PHMC	Ruscombmanor
Pricetown Hotel	PHMC	Ruscombmanor
St. John's Union Church	PHMC	Ruscombmanor
Union Church	PHMC	Ruscombmanor
Yoder Pottery	PHMC	Ruscombmanor
Weber, Dr. Farm	PHMC	Ruscombmanor
Zucco, Doug Property	PHMC	Ruscombmanor
Miller Snyder Farm	PHMC	Albany

Levan Farm	PHMC	Albany
Bailey Road	PHMC	Albany
Quaker City	PHMC	Albany
Hagenbuck Homestead	PHMC	Albany
Schaumbachs Tavern	PHMC	Albany
Donohue Cabin	PHMC	Albany
Bolichs Meeting House & School	PHMC	Albany
New Bethel Union Church & School	PHMC	Albany
Albany Store / Albany Hotel	PHMC	Albany
Pitcairn Property	PHMC	Albany
Stone Arch Bridge	PHMC	Albany
Greenawalt Distillery	PHMC	Albany
Village of Trexler	NR	Albany
Amos Trexler House	NR	Albany
Trexler Hotel	NR	Albany
Trexler, Albert E. Property	NR	Albany
Trexler Hotel	NR	Albany
Waidelich, Paul Property	NR	Albany
Philadelphia & Reading Railroad	PHMC	Albany
Dennis Cichelli Property	PHMC	Albany
William Stump Farm	PHMC	Albany
Village of Kempton	PHMC	Albany
Bachmans Implements	PHMC	Albany
Kempton House Hotel	PHMC	Albany
Dietrichs Mill	PHMC	Albany
Wirt Bond Horse Shoeing	PHMC	Albany
Red Church / Allemaengel Church	PHMC	Albany
Wessnersville	PHMC	Albany
Wessnersville School	PHMC	Albany
Wessnersville Hotel	PHMC	Albany
Wessnersville PO & Store	PHMC	Albany
Trexler Bridge	PHMC	Albany
Berk Log House	NR	Albany
Dietrich Mill	PHMC	Albany
Moser Tannery Site	PHMC	Albany
Dietrich Farm	PHMC	Albany
Levan Farm / Mountain PO	PHMC	Albany
Jarrett Property	PHMC	Greenwich
Lenhart Farm	PHMC	Greenwich
Ensminger Farm	PHMC	Greenwich
Friedens UCC Church	PHMC	Greenwich
Merkel Grist Mill	PHMC	Greenwich
Kermit Heeps Property	PHMC	Greenwich
Dreibelbis Station	PHMC	Greenwich
Steins Tavern	PHMC	Greenwich
Adam Stein Farm	PHMC	Greenwich
Peter Dunkel Homestead	PHMC	Greenwich

Dunkels Church	PHMC	Greenwich
John Merkel Homestead	PHMC	Greenwich
Sundays School	PHMC	Greenwich
Berks County Railroad Tunnel	PHMC	Greenwich
Heffner Farm	PHMC	Greenwich
Heffner Hotel	PHMC	Greenwich
Ziegler Property	PHMC	Greenwich
Schleimer Property	PHMC	Greenwich
Sunday Log Cabin	PHMC	Greenwich
Spohn-Dietrich Homestead	PHMC	Greenwich
Kunkel Property	PHMC	Greenwich
Stein Mill	PHMC	Greenwich
Kutz Homestead	PHMC	Greenwich
Shofers Mill	PHMC	Greenwich
Kutz Mill	PHMC	Greenwich
Quellmaltz Property	PHMC	Greenwich
Kohler Farm	PHMC	Greenwich
Samuel Schmidt Farm	PHMC	Greenwich
Lenhartsville Borough	PHMC	Lenhartsville
Lenhartsville - Old Route 22	PHMC	Lenhartsville
Lenhartsville - Penn Street Sect	PHMC	Lenhartsville
Pennsylvania Dutch Folk Culture	PHMC	Lenhartsville
Lenhartsville School / Lodge	PHMC	Lenhartsville
Penn Street Bridge	PHMC	Lenhartsville
Barnscapes of Perry	PHMC	Perry
Addam Farm	PHMC	Perry
Leiby Blue Stone Quarry	PHMC	Perry
Jacob Leiby Homestead	PHMC	Perry
DeTurk Farm	PHMC	Perry
Dreibelbis Farm	PHMC	Perry
Dreibelbis Hotel	PHMC	Perry
Fraunfelder Farm	PHMC	Windsor
Strausser Farm	PHMC	Windsor
Strausser- Adam Farm	PHMC	Windsor
Brobst Grist Mill	NR	Albany
Fort Everett	PHMC	Lynn
Sweitz Road & 863	PHMC	Lynn
Billig's House	PHMC	Lynn
Village of Lynnport	PHMC	Lynn
Rt 143	PHMC	Lynn
Village of Wanamaker	PHMC	Lynn
New Tripoli Fire C	PHMC	Lynn
Schneider School	PHMC	Lynn
New Tripoli Hotel	PHMC	Lynn
Schohary Road Farmst	PHMC	Lynn
Steinsville	PHMC	Lyn
Sweitz Road and 863	PHMC	Lynn

Lynnville	PHMC	Lynn
Elmer Snyder farm	PHMC	Lynn
frederick leaser far	PHMC	Lynn
Moser Mill Complex	PHMC	Lynn
LN 002	PHMC	Lynn
Mosser Farm Complex	PHMC	Lynn
Former store and PO	PHMC	Lynn
Mosser Mill complex	PHMC	Lynn
LN 006	PHMC	Lynn
LN 007	PHMC	Lynn
Farmstead	PHMC	Lynn
Cider House	PHMC	Lynn
Ebenezer Church U.C.	PHMC	Lynn
Allemengel & Gun C	PHMC	Lynn
Hentzelman Home	PHMC	Lynn
Allemengel Road	PHMC	Lynn
Ulrich's Mill and Ho	PHMC	Lynn
Spring Valley Farm	PHMC	Lynn
Allemengel Road	PHMC	Lynn
Ontelanee Mt. Farm	PHMC	Lynn
Scholler Road	PHMC	Lynn
Early log house	PHMC	Lynn
Schoolhouse	PHMC	Lynn
Farm	PHMC	Lynn
Allemengel Road	PHMC	Lynn
Billig's Mill	PHMC	Lynn
Allemengel Road	PHMC	Lynn
Farmhouse	PHMC	Lynn
Allemengel Road	PHMC	Lynn
Rt 143	PHMC	Lynn
Rt 143	PHMC	Lynn
Jacob's Union Church	PHMC	Lynn
Baer House	PHMC	Lynn
Levan's Coal Siding	PHMC	Lynn
barn	PHMC	Lynn
General Store	PHMC	Lynn
Wanamaker Hotel	PHMC	Lynn
Wanamaker Depot	PHMC	Lynn
Schoolhouse	PHMC	Lynn
Mende Home	PHMC	Lynn
Daniel Kistler Farm	PHMC	Lynn
Edward Majarian Home	PHMC	Lynn

Issues, Goals and Management Options

Summary of Goals:

- Reduce nutrient, sediment and pathogen delivery to Lake Ontelaunee and the tributaries of Maiden Creek.
- Reduce threats to groundwater supplies from nitrogen, pathogens, and other contaminants.
- Maintain and enhance groundwater availability for drinking supply and maintenance of stream baseflows.
- Preserve, enhance, and restore aquatic and terrestrial habitat and diversity.
- Protect rural land and water resources from potential impacts of future development.
- Encourage stewardship of natural and cultural resources.

A Sample of Potential Projects

- Form a community-based organization dedicated specifically to Maiden Creek to foster watershed awareness (Accomplished).

- Assist landowners in implementing Best Management Practices (BMP's) in problem areas in Maiden Creek Watershed where livestock have access to the stream channel.

- In cooperation with the Berks and Lehigh County Conservation Districts, the agricultural extension offices, and current nutrient planning efforts, continue to improve both the planning and implementation efforts of the control of waste from Concentrated Animal Operations (CAO's) in the watershed.

- Work with Trout Unlimited to restore or enhance riparian buffers, giving priority to the areas in need of reduction in nutrient and sediment loading to Lake Ontelaunee.

- Restore or enhance riparian buffers in vulnerable areas, such as Bailey and Moselem Creeks and areas where adjacent land use is agriculture or development.

- Expand current groundwater monitoring activities especially in areas that represent a diversity of land uses such as agriculture, commercial/residential, and industrial for groundwater quality conditions.

- Partner with municipal water suppliers to promote enhancement of existing municipal water conservation plans and encourage conservative use of water supplies.

- Upgrade streams within Maiden Creek watershed to EV & HQ status.

- Purchase easements to ensure the existence of agriculture on suitable land.

- Work with municipalities and Berks County Planning Commission to implement agricultural zoning and to incorporate protection of water resources in municipalities' zoning ordinances purpose statement.

- Partner with organizations and agencies to conduct public educational workshops on watershed issues and topics.

- Encourage townships to develop projects to increase and/or improve recreational facilities and greenways in the Maiden Creek watershed.

- Work with current and future golf course owners and/or operators to encourage adoption of golf course design and BMPs.

- Implement and monitor erosion and sedimentation control plans on all sites involving earth-moving activities.

- Monitor groundwater levels in existing municipal and private wells, especially during periods of peak use and during dry periods when groundwater levels are most at risk of being affected.

- Develop a prioritized list of Maiden Creek watershed municipalities to contact and provide education and information to encourage the development or amendment of ordinances to protect the resources of the watershed.

- Increase levels of funding sources for habitat management of PNDI sites in the watershed.

The planning process involved review of existing reports and information, field observations, steering committee discussions, communication with various agency personnel, personal interviews with local residents and organization representatives, a public issues forum, and a planning workshop.

A public issues forum was held on March 14, 2000 in Berks County to identify and discuss issues and concerns of the public. Concerned citizens and steering committee members (representatives from the watershed) were present. Priority concerns of the participants included water pollution, habitat fragmentation, urban growth, and watershed education and awareness. A planning workshop was conducted on March 31, 2000 at Penn State University to discuss alternative management strategies to address priority issues and goals identified by the student team. The workshop involved local and state representatives from the Maiden Creek/Lake Ontelaunee Steering Committee, the student team members, and Penn State faculty.

Goals and management options are presented for the following issues:

- Impairment of surface waters from suspended solids, nutrients, and pathogens
- Threats to groundwater supplies from nitrates, pathogens and other contaminants
- Future impact of groundwater withdrawals on baseflow to streams and drinking water availability
- Degradation of aquatic and terrestrial habitat
- Impacts of development on agricultural land, rural character, open space and environmentally sensitive areas

Issue: Impairment of surface waters from suspended solids, nutrients, and pathogens

Sediment: Excess sediment in stream flow has degraded fish and macroinvertebrate habitat in streams and has contributed to eutrophication of Lake Ontelaunee. Suspended solids including sediment have been identified as a cause of water quality impairment in Lake Ontelaunee by the DEP. In 1992, the storage capacity of the lake had decreased 25% since its construction in the 1930s. Sources of sediment include erosion from rural and urban areas, such as cropland, construction sites and streambanks. Sediment also carries other pollutants, i.e., phosphorus, which is a related concern in this watershed.

View to Lake Ontelaunee

Phosphorous: Excess nutrients in running and standing waters cause algal blooms. Algal blooms block sunlight in the water killing vascular plants in deeper waters. When they die, algae create biological oxygen demand, depriving macroinvertebrates and fish of needed dissolved oxygen. Excess algae growth also creates increased water filtration needs and causes taste and odor problems in drinking water supplies. In freshwater systems phosphorous is typically the limiting nutrient, which is also the case in Lake Ontelaunee. Elevated levels of total Phosphorus were detected in the watershed in the F.X. Browne and Cadmus studies.

Nitrogen/Nitrates: Excess nitrogen and nitrates in streams and groundwater create health hazards to humans and livestock alike. Methemoglobinemia can occur in human infants when nitrate levels exceed 10mg/L in drinking water supplies. Excess nitrates cause algal blooms in estuarine environments, where nitrogen replaces phosphorous as the limiting nutrient. This impacts submerged grass beds, which are vital habitat for various fisheries in the Delaware Bay. Excess nitrogen also encourages the growth of invasive, exotic species in both terrestrial and aquatic environments.

Previous assessment studies of the Lake Ontelaunee watershed have detected elevated nitrate (> 5 mg/L) levels on some tributaries. Nitrogen can be supplied from non-point sources such as runoff from urban areas and agricultural lands, on-lot septic systems, and point sources such as wastewater treatment facilities.

Pathogens: Contamination of surface waters by pathogens can present health problems for humans, livestock and aquatic organisms. Water quality standards for fecal coliform bacteria limit water-contact activities to waters with no more than 200 colonies per 100 ml during the swimming season. Samples collected in Cadmus and the DEP Special Protection studies found some elevated levels in Maiden Creek and several of its tributaries.

Goal: Reduce nutrient, sediment and pathogen delivery to Lake Ontelaunee and the tributaries of Maiden Creek.

Management Options:

1. Conduct additional investigations in subwatersheds with high estimated sediment and nutrient loadings to further identify problem areas and target enhanced implementation of best management practices to address nonpoint source pollution in identified areas.

Estimates of pollutant loadings from various assessments indicate the Stony Run, Bailey, Mill, Moselem, Sacony, Peters, and Upper Maiden Creek subwatersheds have relatively high loading rates of nutrients and sediment. Most of these tributaries also empty directly (or nearly directly) into Lake Ontelaunee; thus their contributions can significantly affect water quality in the lake. Moselem, Peters and Sacony Creeks also contain High Quality or Exceptional Value waters. Sacony Creek (including Mill Creek) subwatershed is a priority watershed based on high estimated loading rates of phosphorous and sediment and because of its large watershed area, it contributes the largest amount of nutrients and sediment to Lake Ontelaunee.

2. Restore or enhance riparian forested buffers and give priority to restoration projects based on the potential for reduction in nutrient and sediment loading to Lake Ontelaunee and protection of special protection waters.

A screening level assessment of riparian forest buffers in selected subwatersheds shows numerous stream segments in potential need of restoration or enhancement practices (Appendix I). More detailed site assessments should be conducted and specific restoration projects developed. Projects should focus on contiguous areas to more effectively treat specific drainages. Establishment of multi-zone buffers (trees and grasses) should be used where feasible. A riparian management plan specifically for the Reading Water Authority land surrounding Lake Ontelaunee should also be developed and implemented.

3. Innovative funding arrangements should be explored and developed to acquire riparian conservation easements that incorporate best management provisions on priority sites.

4. Identify and prioritize problem areas where livestock have access to the stream channel and assist landowners in implementing Best Management Practices (BMPs) in these areas. BMPs for livestock-producers include:

- Streambank fencing
- Stabilized livestock crossings
- Alternative watering facilities
- Stabilization and/or restoration of damaged streambanks through bioengineering techniques

Prioritization for BMP implementation could consider the following criteria:

- Stability of and/or damage to stream banks
- Priority of stream, based on estimated nutrient and sediment loadings
- Number of livestock with access to stream
- Presence of and/or condition of riparian buffer zone
- Other site specific criteria

5. Provide resources to expedite development and implementation of additional farm conservation plans and nutrient management plans. Incorporate wetland and riparian area protection, restoration and enhancement in plans where applicable.

Examples of conservation practices included in these plans are:

- Conservation tillage (minimum or zero tillage)
- Terraces
- Grassed waterways
- Field or strip contour plowing
- Streambank fencing
- Less erosive crop rotations
- Winter cover crops

“Resources” include financial and technical assistance that would allow farmers to develop and implement these plans. A funded demonstration farm could help educate farmers about the economic and environmental benefits of such plans. A P.L. 566 Planning Project through the Natural Resource Conservation Service (NRCS) should be pursued.

6. Develop and implement improved waste management facilities for Concentrated Animal Operations (CAOs) where needed.

In cooperation with the Berks and Lehigh County Conservation Districts the agricultural extension offices and current nutrient management planning efforts, continue to improve the control of waste from CAOs in the watershed. Efforts in the Tulpehocken watershed have begun to install new facilities at various farms to help them decrease their impact on adjacent surface waters. These efforts could be duplicated in the Maiden Creek watershed with similar success.

7. Encourage development of a resource recovery business for excess agricultural wastes.

With a surplus of nutrients coming into the watershed via fertilizers for crops and feed for livestock, some sustainable method of exporting excess nutrients out of the watershed needs to be created. Excess nutrients in the form of organic animal wastes are currently spread on fields to fertilize crops. As nutrient management plans and stricter regulations for manure/compost spreading create a need to dispose of greater amounts of excess materials, a surplus will exist. It could thus become economically feasible for an industry to collect and compost this excess manure and package it for sale at the retail level. Berks County Conservancy could encourage such an industry to develop, thus creating a "market" for excess nutrients. An example of such a company exists in Lancaster County.

8. Implement and monitor erosion and sedimentation control plans on all sites involving earth-moving activities.

Stormwater permits and erosion and sedimentation plans are required for construction sites disturbing five acres or more of land. This process is administered through the conservation district offices and the Pennsylvania Department of Environmental Protection (DEP). Sites disturbing less than five acres can be regulated through the individual municipalities. Citizen groups have the opportunity to be extra sets of "eyes" for the conservation districts and local authorities to assist in monitoring construction activity. Monitoring should occur during precipitation events to best determine if erosion control measures are preventing sediment from leaving the site. Signage with the conservation district office and DEP Reading Regional Office phone numbers should be required at the entrance to all sites, directing the public to report sediment problems to these offices.

9. Work with current and future golf course owners and/or operators to encourage adoption of golf course design and BMPs through the International Audubon Society Cooperative Sanctuary Program.

With several golf courses already operating and demand likely to spawn new courses in the watershed, BMPs for these highly intense land uses need to be put in place. Golf courses use relatively large amounts of fertilizers and pesticides and thus present a potential contamination to surface and groundwater supplies. By their very nature golf courses (fairways, greens, etc.) are incompatible with forested riparian corridors. With comprehensive zoning, ecologically appropriate site design and implementation of BMPs, the effects of

these large areas of turfgrass could be mitigated somewhat. Use available land use control mechanisms to limit future golf courses to non-riparian upland locations.

10. Work with the conservation district and agricultural extension offices to implement mushroom farm BMPs for production and processing facilities in the watershed.

With Berks County being a significant production center for mushrooms, this industry has the potential to significantly affect water quality in Maiden Creek. BMPs for these agricultural facilities are specialized and should be addressed separately from general agricultural BMPs. Production, storage and disposal of mushroom compost need to be regulated through nutrient management plans and conservation plans. Wastewater from the washing of the mushrooms at the processing plant and the mushroom houses themselves can contain large amounts of nutrients and contaminants.

11. Identify un-permitted point source discharges and areas of malfunctioning septic systems and implement appropriate control measures through management and regulatory programs.

Municipal Act 537 Plans should be updated to address sewage problems and implement necessary improvements. Areas of malfunctioning septic systems should be addressed through repair and maintenance programs or installation/expansion of public sewer systems. Where residences have "wildcat" (unauthorized) connections of their sanitary sewer lines to the storm drain system, owners may not have the resources to correct the problem. Commercial operations may be better able to correct unauthorized discharges. In either case, assistance or regulatory actions (where needed) should be taken to alleviate the problems.

12. Institute reporting of Total P and Total N levels for all NPDES permits.

Currently, ammonia nitrogen is reported but total nitrogen and total phosphorous in discharges are not reported to DEP. Efforts in the Chesapeake Bay Watershed have succeeded in adding phosphorous to the list of reported values in all permitted discharges. Lake Ontelaunee is an impaired water body and indicated as a high priority for TMDL assessment by DEP. Both municipal wastewater and commercial dischargers could further treat effluent to reduce phosphorous levels, if needed to meet TMDL requirements when established. Also, consider the applicability of other approaches such as point source trading by industrial dischargers.

13. Development of a water quality monitoring program has been established by the Maiden Creek Watershed Association (MCWA) with support from PADEP's Citizen Volunteer Monitoring Program.

Volunteers from the MCWA have established a monitoring program over the past year. Each volunteer has been trained and samples have been periodically tested by a laboratory for quality control, to ensure validity of the data.

14. Restore or enhance riparian buffers in vulnerable areas, such as Bailey and Moselem Creeks, and locations where adjacent land use is agriculture or development.

Potential Lead Organizations:

- Maiden Creek Watershed Assoc.
- County Conservation Districts
- Municipal Governments

- DEP Regional Office

Potential Funding Sources:

- Growing Greener Grant Program (DEP Watershed Protection Grants)
- DCNR Rivers Conservation Implementation Grants
- NRCS PL-566 Grants
- DEP Nonpoint Management Program
- Educational Mini-Projects Program
- EPA Environmental Education Grants
- USDA FSA Conservation Reserve Enhancement Program
- USDA NRCS Environmental Quality Incentives Program (EQIP)
- USDA NRCS Watershed Surveys and Planning Program
- Harrisburg Foundation
- Charles A. and Anne Morrow Lindburgh Foundation
- Fish American Foundation
- Dirt and Gravel Road Maintenance
- Environmental Quality Incentives Program
- EPA Section 319 Nonpoint Source Implementation Grants
- USDA Farm Bill Provisions
- PA Game Commission Pasture Stream Bank Fencing Program
- DEP Act 537 Planning Grants

Issue: **Threats to groundwater supplies from nitrates, pathogens, and other contaminants**

Groundwater supplies in the Maiden Creek watershed have been contaminated in the past as a result of varying land use patterns, the most important of which are agricultural, residential, and commercial/industrial development. With expansion of these land uses projected to increase, the threat of groundwater contamination also increases. Elevated levels of nitrates and pathogenic organisms have been noted in samples taken from various well locations throughout the watershed. The origin of the contaminants could be from agriculture (fertilizer, agricultural waste disposal, etc.), residences (septic systems, unsewered communities) and/or golf courses (fertilizer use). Furthermore, contamination from commerce/industry (e.g. heavy metals and organics) as well as leaking underground storage tanks (e.g. BTEX compounds and MTBE) also has been noted.

Goal: Reduce threats to groundwater supplies from nitrogen, pathogens, and other contaminants.

Management Options:

1. Implement Source Water Protection plans for all public water supplies derived from groundwater within the Maiden Creek watershed. Establish wellhead protection areas around all municipal drinking water supplies as a means for controlling land uses and transportation activities that have a high potential to pollute groundwater.

2. Conduct further hydrogeologic investigations in vulnerable groundwater areas such as sinkholes and important recharge and discharge areas. These areas should include, but not be limited to, previously or currently contaminated sites and/or areas that are projected to face future development pressures. Application for grants can be obtained from the Pennsylvania Department of Environmental Protection, United States Geological Survey, and/or Delaware River Basin Commission. A consultant firm could be hired to perform the investigation. This type of work would logically integrate with the preparation of Source Water Protection plans (see above).

3. Perform a study of nitrates and pathogens in private wells similar to the one performed in 1985 by the Berks County Cooperative Extension.

4. Expand current groundwater monitoring activities for groundwater quality conditions. This should include monitoring at least twice per year using deep wells (existing wells are recommended) and piezometers for water quality parameters of concern (e.g. nitrates, pathogens, heavy metals, organics, etc.). Specific areas within the watershed should be targeted for monitoring that represent a diversity of land uses (e.g. agriculture, commercial/residential, industrial, etc).

Potential Lead Organizations:

- Municipal Water Suppliers
- DEP Regional Office

Potential Funding Sources:

- Growing Greener Grant Program (Pennvest Drinking Water Protection Grants)
- DEP Nonpoint Source Management Program
- State Water Resources Research Institute Program (USGS)
- Drinking Water State Revolving Fund through EPA and SDWA
- Clean Water Act, Section 319 Grant Program
- Safe Drinking Water Act (Source Water Protection Program)
- The League of Women Voters of Pennsylvania Citizen Education Fund (LWVPA-CEF)
- PA DEP Pennsylvania State Revolving Loan Fund

Issue: Future impact of groundwater withdrawals on baseflow to streams and drinking water availability

The groundwater resources in the Maiden Creek watershed are very valuable for use by the public for drinking water supplies, as well as use by industry and agriculture in their production processes. Moreover, several large companies bottle and transport groundwater to areas outside of the watershed for commercial profit. Groundwater is not just important for its use by humans, but it is also valuable because of its hydrological connection to surface water in streams, lakes, ponds, and wetlands. During periods of low flow (baseflow), groundwater inputs typically account for the majority of flow in streams. This raises concerns regarding intense withdrawals of groundwater, especially during extended periods of drought, because baseflow in streams can be reduced to the point at which aquatic and terrestrial ecosystems are adversely impacted. Within Maiden Creek watershed, the Delaware River Basin Commission (DRBC) monitors and regulates groundwater use by public water suppliers and industry. However, use by private well owners is not monitored. Anticipated growth in the watershed, including residential, commercial, and industrial development, will place increased pressures on groundwater uses.

Goal: Maintain and enhance groundwater availability for drinking water supply and maintenance of stream baseflows.

Management Options:

1. Promote enhancement of existing municipal water conservation plans. To encourage conservative use of water supplies, municipal water suppliers should update or consider the adoption of:

- Leakage/loss control programs
- Water metering accuracy
- Pricing methods that discourage water waste
- Educational programs targeted at schools/universities

In addition, municipal water authorities have the power to influence local water use

regulations that can be used to encourage water conservation by requiring:

- Water saving plumbing fixtures and fittings in all homes and buildings
- Minimal use of water during peak use summer periods (e.g. lawn/garden watering, car washing, etc.)

2. Update supply and demand projections for all major water users in the Maiden Creek watershed. This should be considered in making future planning decisions regarding development and land use.

3. Monitor baseflow of tributaries proximal to regions of intense groundwater use (e.g. large industries and groundwater bottling companies). If tributaries appear to be adversely impacted (e.g. dry for long periods when normally would have water flowing), enforcement and/or new management alternatives may be necessary (regulations by the Pennsylvania Department of Environmental Protection and/or Delaware River Basin Commission).

4. Monitor groundwater levels in existing municipal and private wells, especially during periods of peak use and during dry periods when groundwater levels are most at risk of being adversely affected.

Potential Lead Organizations:

- Municipal Water Suppliers
- DEP Regional Office

Potential Funding Sources:

- State Water Resources Research Institute Program (USGS)
- Delaware River Basin Commission

Issue: Degradation of aquatic and terrestrial habitat.

As a consequence of historic land use patterns and contemporary land use activities, the general quality of aquatic ecosystems in terms of species diversity and abundance, water quality, and physical habitat structure has been degraded over time. Similarly, habitat for terrestrial organisms has been greatly reduced in area, complexity, biodiversity, and continuity. Land development pressure in the future may be expected to further impact natural systems and the availability of suitable habitat to sustain native biota. Biological assessment information including vegetative cover mapping, riparian buffer analysis, and the Pennsylvania GAP Analysis Project offer useful tools to develop proactive initiatives targeted to protect and enhance identified critical habitats.

Goal: Preserve, enhance, and restore aquatic and terrestrial habitat and diversity.

Management Options:

1. Establish a prioritized list of important high value habitats in need of protection and enhancement programs. Focus initially on primary areas and subwatersheds identified as having highest quality habitats including, but not limited to:

- Blue Mountain forested uplands

- Lake Ontelaunee shoreline, uplands, and contiguous riparian corridors
- Peters Creek subwatershed
- Sacony Marsh
- Sacony Creek-Exceptional Value segment
- Pine Creek subwatershed
- PA GAP "Leading Landscapes" of high value unprotected habitats such as:

  -The main stem riparian corridor up stream from Lake Ontelaunee to the Lehigh County headwaters.
  -Uplands at the base of Blue Mountain contiguous to the main stem riparian corridor
  -Stony Run subwatershed

2. Identify and implement opportunities to repair, enlarge, and ultimately connect protected high quality riparian habitats. Candidate sites would include:

- Existing Berks County Conservancy easements
- Corridor near Lyons between Sacony Marsh and the Exceptional Value headwaters
- Floodplains upstream and downstream of Game Lands #182 along Sacony Creek
- Upland habitats that may serve as genetic "sinks" and biological refuge

3. Utilize existing programs and grant sources such as the Berks County Conservancy and county agricultural easement programs to protect priority sites.

4. Explore and develop funding arrangements to leverage habitat protection and acquisition. A potential scenario might involve partnerships among the Reading Water Authority, Berks Conservancy, and PA Game Commission to commit local matching funds leveraging Keystone Grant or Rivers Conservation implementation funds to acquire riparian lands for dual habitat enhancement and streambank erosion control/sedimentation reduction objectives. The Agricultural Zoning Incentives Program (AZIP) may offer similar opportunities.

5. Explore full range of private land stewardship strategies, from handshake agreements to fee simple purchase.

6. Partner with organizations and agencies to conduct public educational workshops on watershed issues and topics.

7. Upgrade streams in Maiden Creek watershed to EV & HQ status.

Potential Lead Organizations:

- Berks County Conservancy
- Wildlands Conservancy (Lehigh County)
- County Planning Agencies

Potential Funding Sources:

- The Leo Model Foundation, Inc.
- The William Penn Foundation
- EPA Environmental Education Grants
- Charles A. and Anne Morrow Lindburgh Foundation
- Coldwater Heritage Partnership
- Wildlife Habitat Incentives Program
- US Fish and Wildlife Service, Partners for Wildlife Program
- USDA Wetland Preserve Program
- USDA Forest Incentive Program

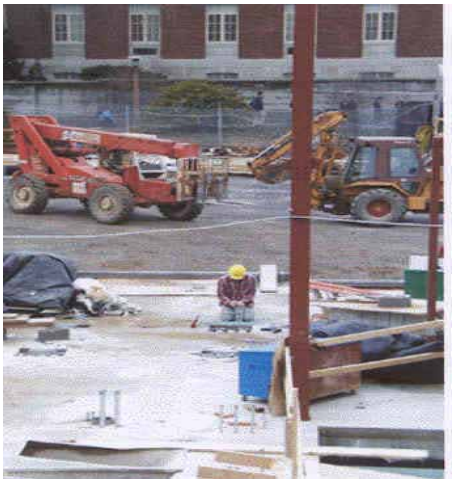
- US Department of Interior Fish and Wildlife Service Partners for Wildlife Program
- PA DCNR Keystone Fund
- Ducks Unlimited MARSH Program for Waterfowl Protection
- Land Trusts

Issue: Impacts of development on agricultural land, rural character, open space and environmentally sensitive areas

Continuing urban and suburban development in the Maiden Creek watershed is resulting in challenges and potential problems for water quality and quantity. These challenges and potential problems include:

- Addition of more impervious surface area
- Loss of open space
- Loss of agricultural land and rural character
- Increases in the demand for drinking water and wastewater treatment from both public and private sources
- Increases in erosion and sediment delivery to streams from construction sites
- Increases in the delivery of pollutants to surface and groundwater from urban land uses

Conventional and status quo development will undoubtedly create more stresses on the Maiden Creek watershed and Lake Ontelaunee. Lack of consistency in municipal land use planning and land use controls can hamper coordinated efforts to protect natural resources.



Areas projected for further development include New Tripoli in Lynn Township, the US 222 corridor east and west of Kutztown, the PA 61 corridor, the Krumsville and Lenhartsville exits of I-78 and Maidencreek Township. Maidencreek Township has experienced the most significant growth in the Maiden Creek watershed over the last two decades. One result of this type of development has been a significant loss of agricultural lands. Berks County Planning Commission cites a 5% loss of farmland for Berks County between 1982-87 (BCPC, 1991).

Goal: Protect rural land and water resources from potential impacts of future development.

Management Options:

1. Conduct a more detailed inventory of critical land use patterns and trends as they may affect water resource protection areas (e.g. riparian buffers, floodplains, wetlands, and groundwater recharge areas) within the watershed through multi-municipal planning.

2. Use multi-municipal watershed based planning and cooperation between both Berks and Lehigh counties and municipal governments to standardize and strengthen

land use controls for the protection of sensitive areas such as steep slopes, wooded lands, riparian buffer zones, wetlands, floodplains and well heads (ground water zones of influence) in order to protect water resources from future development.

3. Use data on sensitive areas in county comprehensive plans and other more detailed sources as a basis for improving municipal comprehensive plans, zoning, and subdivision ordinances for the protection of these sensitive areas.

4. Encourage development on properties with existing public water and sewer service. Promote infill and redevelopment of existing urban areas.

5. Work with municipalities to limit infrastructure extensions for new development, especially when proposed extensions enter or are adjacent to sensitive areas and prime agricultural soils.

6. Expand the use of the Agricultural Zoning Incentive Program (AZIP) and effective agricultural zoning with cooperation between county and municipal governments throughout the watershed to protect valuable agricultural lands and maintain rural character.

7. Identify priority areas for the conservation of agricultural land, open space, and sensitive areas that are not already protected by municipal zoning ordinances. The purpose of this would be to concentrate the efforts of conservation easement purchase programs such as the Agricultural Security Areas (ASA) program and the Agriculture Conservation Easement (ACE) program administered by the Berks County Agricultural Land Preservation Board and the Lehigh County Agricultural Land Preservation Board, the Berks County Conservancy's agricultural easement programs, and other Berks and Lehigh County conservation easement programs.

8. Expand Act 167 stormwater management planning (completed for Sacony and Mill Creek subwatersheds) to the whole Maiden Creek watershed.

9. Require stormwater management ordinances to include water quality enhancement before release to surface and ground water (e.g. through the use of constructed wetlands, grease and oil separators, etc.) and infiltration incentives and/or requirements (e.g. through the use of grassed swales and check dams, infiltration trenches, surface flow spreaders, pervious paving, etc).

10. Encourage municipalities to adopt local ordinances that reduce the amount of total impervious surface area in developing subwatersheds through the use of conservation development (such as cluster development), narrower road widths, smaller minimum parking lot requirements, and other sustainable development practices.

11. Update Act 537 plans for municipalities and implement needed improvements. Encourage all municipalities in the watershed to adopt a sewage management program for public and private sewage treatment facilities that requires routine inspection and maintenance of properly functioning systems and replacement of failing systems.

12. Identify priority areas for the inspection and maintenance of private septic systems, including areas of high septic tank densities on or near groundwater recharge areas or near other areas with high vulnerability to ground and surface water pollution.

13. Explore, and where applicable, utilize new and alternative methods of wastewater treatment such as constructed wetlands, composting toilets, etc. through local ordinance allowances and pilot projects.

14. Provide educational opportunities, publications, workshops, training courses, etc. for the development community about sustainable development practices. Cover the potential problems created by development in agricultural areas, sensitive areas and priority open space areas.

Potential Lead Organizations:

- County Planning Agencies
- Municipal Governments

Potential Funding Sources:

- Growing Greener Grant Program (DCNR Open Space and Recreation Grants)
- Growing Greener Grant Program (Pennvest Grants)
- Growing Greener Grant Program (PDA County Farmland Preservation Grants)
- Growing Greener Grant Program (DEP Watershed Protection Grants)

Issue: Need for additional recreation facilities within the watershed

1. Encourage townships to develop projects to increase and/or improve recreational facilities and greenways in the watershed.

Potential Lead Organizations:

- County Planning Agencies
- Municipal Governments

Potential Funding Sources:

- Growing Greener Grant Program (DCNR Open Space and Recreation Grants)
- Growing Greener Grant Program

Issue: Form a community-based organization dedicated specifically to Maiden Creek to foster watershed awareness (Accomplished)

Maiden Creek Watershed Association
One of the goals that has already been accomplished during the building of the conservation plan is organizing a community-based organization dedicated specifically to Maiden Creek to foster watershed awareness. This has been accomplished through the Maiden Creek Watershed Association. Their meeting date is the fourth Wednesday of every month at the Virginville Grange at 7:00pm. It is open to anyone with an interest in improving the watershed and preserving its natural resources. Their goals and accomplishments are the following:

· Measure watershed quality and set goals for improvement.
· Maximize involvement and participation in the Maiden Creek Watershed Association actions.
· Develop and maintain an informational web page.
· Posting stream signs.
· Education through exhibits and publications.
· Increase public awareness of watershed issues through educational workshops and seminars.
· Stream clean-ups.
· Stream restoration projects.
· Lobby on public issues that effect water quality.

Maiden Creek Watershed Association is currently monitoring areas along the Maiden Creek.

Appendix I

Riparian Forest Buffer Assessment

The purpose of this assessment is to identify areas in need of riparian buffer enhancement or restoration and to examine the continuity of the forested riparian buffer in selected subwatersheds of the Maiden Creek watershed. Subwatersheds were selected based on land use characteristics, estimated non-point source pollution loading, and designated uses for surface water quality standards.

The Importance of Riparian Forest Buffers

Riparian buffers are an important part of the landscape for many reasons. Riparian buffers provide many benefits to streams, water quality, wildlife and humans. Human activities such as residential, commercial and industrial development and agricultural uses have fragmented, degraded and even eliminated forested riparian buffers along many stream and river segments.

The condition of the riparian zones strongly influences the environment of the stream and stream channel. The existence and condition of a vegetated riparian buffer will affect water temperature and light exposure, stream channel morphology and both aquatic and terrestrial habitat. Riparian buffers also influence pollutant loading to surface waters, flood events and the recreational and aesthetic value of streams. The following is a brief description of the primary ways riparian buffers function to protect watershed health.

Riparian buffers provide shade to stream causing cooler and more stable water temperatures. Cooler water temperature improves the availability of dissolved oxygen (DO) in water. Available DO is extremely important to the quality of aquatic habitat and wildlife. Riparian buffers also improve aquatic and terrestrial habitats because they provide food, cover and travel corridors for countless species of wildlife. Vegetation in riparian buffers also helps to maintain healthy stream morphology. Trees and understory, with their roots, stems, leaves, and leaf litter, help to control erosion, maintain streambank stability and mitigate the effects of peak flows. The vegetation can also remove nutrients from soil, water and slow surface flows to encourage the removal of suspended solids and phosphorous. Another benefit of riparian buffers is their contribution to landscape aesthetics and recreation. The vegetation can provide a buffer between agricultural or developed land and the stream, creating peaceful and pleasant places to enjoy many types of recreation.

The dense vegetation, undisturbed soils and healthy microbial activity of an undisturbed native riparian forest are the ideal condition for riparian buffers. This undisturbed condition would undoubtedly provide the most effective protection of water resources. However, these conditions are rare and other types of vegetated riparian buffers provide many functions that will produce protection for water resources as well as wildlife habitat and aesthetic and recreational benefits. A minimum width of fifty feet of vegetation has been shown to provide a wide range of benefits associated with vegetated riparian buffers.

The Riparian Buffer Assessment Framework

Riparian buffers offer the potential to maintain and improve water quality entering the main stem of Maiden Creek and Lake Ontelaunee. The selection of priority subwatersheds for further riparian buffer assessment was conducted by examining land use information, nutrient and sediment loading estimates an existing riparian buffer condition. For comparative purposes, it was also deemed useful to choose a subwatershed that appeared to have good water quality, less intensive land uses in the subwatershed or stream corridors and apparent existence of large amounts of riparian forest buffers.

The subwatersheds chosen for the riparian buffer assessment were Sacony, Bailey, Moselem and Pine Creeks. The first three were chosen for their relatively high estimated pollutant loading rates for nitrogen, phosphorous and total suspended solids, percent of land use in agricultural or developed uses including barren land and proximity to Lake Ontelaunee. Pine Creek was chosen because of its relatively low pollutant loading estimates. Pine Creek also contrasted with the other three streams with respect to land use characteristics and was chosen for comparative purposes. All land use information is estimated from digital land use coverage derived form satellite imagery.

Sacony Creek Subwatershed

It was identified that Sacony Creek was a major contributor of total suspended solids, phosphorous and to a lesser extent nitrogen to Lake Ontelaunee. Additional analysis also found Sacony Creek to be among the highest contribution subwatersheds for total suspended solids, phosphorous and nitrogen (Mill Creek, a tributary of Sacony Creek, was not included in this analysis). Land use in the Sacony Creek subwatershed is estimated at 59% agricultural land and the highest values for the thirteen subwatersheds. The Sacony Creek subwatershed is expected to see further development in areas that have been undergoing the most development pressure in the Maiden Creek watershed, including the US 222 corridor and the Krumsville area. Land use within an 800-foot stream corridor is estimated at 40% agricultural land and 3.5% barren and developed land, the fourth highest value for developed land among the thirteen subwatersheds. Some headwaters of Sacony Creek are designated Exceptional Value and important Cold Water Fishery streams by the Department of Environmental Protection. Lower portions of the stream are designated Trout Stock Fisheries.

Bailey Creek Subwatershed

Bailey Creek is a significantly smaller subwatershed, however it drains directly into Lake Ontelaunee. Bailey Creek's estimated nitrogen load is the highest among all thirteen subwatersheds. It also has the highest estimated phosphorous and total suspended solid loading rates. Agricultural land use in the Bailey Creek subwatershed amounts to 65% of the watershed while developed land use adds an additional 1% of intensive land use. In the 800-foot stream

corridor, 54% of the land is used for agriculture, the largest amount of the thirteen corridors, and developed land use amounts to 1%.

Moselem Creek Subwatershed

Moselem Creek has the second (to Bailey Creek) highest estimated loading rates for nitrogen, phosphorous and total suspended solids. Land use in the Moselem Creek subwatershed consists of 63% agriculture and 2% barren and developed land. The stream corridor contains 52% agricultural land and 2.5% developed land. In addition to agricultural and developed land, Moselem Creek subwatershed and its stream corridor contains two golf courses and mushroom farms. These relatively unique land uses are additional potential sources of non-point source pollution that could be mitigated with riparian buffers. Another reason for the selection of Moselem Creek is that the entire stream has been designated a High Quality Cold Water Fishery by the DEP.

Pine Creek Subwatershed

The Pine Creek subwatershed was assessed for comparative purposes because the loading estimates and land use characteristics contrasted to those of the other three selected subwatersheds. Though these characteristics suggest that Pine Creek might be in less need of riparian buffer restoration or enhancement, it may be the subwatershed that would benefit most from riparian buffer protection/preservation efforts.

Watershed	Forested buffer on both sides of stream Percent Length (m)	No forested buffer Percent Length (m)	No forested buffer/adjacent crop or developed land use Percent Length (m)	Avg segment length (no forested buffer) Length (m)
Saucony	66% 40808	24% 14886	19% 11684	363
Bailey	29% 2096	71% 5193	71% 5193	649
Moselem	25% 2855	75% 8456	69% 7854	1409
Pine	60%	29%	16%	291

Table 14: Riparian Buffer Assessment (Lengths and Percentages)

Pine Creek loading estimates were the lowest among all thirteen subwatersheds for nitrogen, phosphorous and total suspended solids. Land use in the subwatershed consisted of 21% agriculture and less than 1% barren and developed land. The stream corridor land use consisted of 34% agriculture and less than 1% barren developed land. Land use in this subwatershed

presents a less significant threat to water quality than in most other subwatersheds. Significant portions of Pine Creek stream miles have been designated as High Quality Cold Water Fisheries.

Though Saucony Creek has relatively high estimated pollutant loading rates, the riparian buffer condition percentages are comparable to those of Pine Creek's, which had much lower pollutant loading estimates. However, Saucony Creek has a significantly larger total length of stream with no forested buffer and adjacent crop production or developed land uses. Bailey and Moselem Creeks have the highest percentages of stream length with no forested buffer and highest percentages of stream length with no forested buffer and adjacent crop production or developed land uses.

The assessment shows a significant amount of stream length in potential need of forest buffer restoration or enhancement in the watersheds assessed. The stream segments with no riparian buffer and developed or crop production land uses should receive priority for additional assessment because those areas have the highest potential for non-point source pollution loading directly to stream.

Bibliography

Berks County Cooperative Extension, 2000. *Land Preservation Statistics.* Berks County, Pennsylvania.

Berks County Planning Commission. *Agricultural Zoning Incentive Program (AZIP).* Reading, Pennsylvania.

Berks County Planning Commission. 1991. *Natural Areas Inventory of Berks County.* Pennsylvania Science Office of the Nature Conservancy, Middletown, Pennsylvania.

Berks County Planning Commission. May 1999. *Berks County Data Book.* Reading, Pennsylvania.

Berks County Planning Commission. January 1999. *Berks County Open Space and Recreation Plan.* Reading, Pennsylvania.

Berks County Planning Commission. December 1991. *Berks County Comprehensive Plan Revision.* Reading, Pennsylvania.

Berks County Planning Commission and R.K.R. Hess Assoc. Inc. 1997. *ACT 167 of Watershed Stormwater Management Plan for Sacony Creek Watershed, Berks County.* Berks County Commissioners, Reading, Pennsylvania.

Cadmus (The Cadmus Group). 1998. *Watershed Assessment for ht eONtelaunee Watershed, Reading, Pennsylvania.* Waltham, Massachusetts.

Carlin, R.F. 1996. "Early responses of stream communities to riparian restoration in agricultural watersheds, Eastern USA." *Proc. Of Headwaters: Water Resources and Soil Conservation.* April 1998. Merano, Italy.

DEP (Pennsylvania Department of Environmental Protection). 1998. *Report of Water Quality Assesment.*

DEP (Pennsylvania Department of Environmental Protection). August 1998. The Pennsylvania Code, Chapter 93., Commonwealth of Pennsylvania, Bureau of Watershed Conservation, Harrisburg, PA.

DEP (Pennsylvania Department of Environmental Protection). 1996. *Special Protection Report for the Maiden Creek Watershed.*

DRBC (Delaware Rivers Basin Commission). 2000. *1996 Water Use Data*. Unpublished.

Evans, B.M. and M.C. Anderson. 1996 *DRASTIC Scores for Groundwater Vulnerability to Pollution in Pennsylvania.* The Penn State University, University Park, PA.

F.X. Browne. April 1994. *Diagnositc-feasibility Study of Lake Ontelaunee,* Lansdale, PA.

GAP (The Pennsylvania GAP Analysis Project). 1999. The Penn State University, Dr. Wayne Myers, and Joseph Bishop. University Park, PA.

Geyer, A.R. and J. P. Wilshusen. 1982. *Engineering characteristics of the Rocks of Pennsylvania.* Pennsylvania Geologic Survey.

Joint Planning Commission. April 1993. *Comprehensive Plan for Lehigh and Northampton Counties, Pennsylvania.*

Kochanov, W.E. 1993. "A real analysis of karst data from the Great Valley of Pennsylvania." In Beck, B.F., ed. *Applied Karst Geology, Multidisciplinary Conference on Sinkholes and the Engineering and Environmental impacts of Karst, 4th, Panama City Florida.* 1993 Proceedings, Rotterdam, A.A. Balkema, pp. 37-41.

Lehigh Valley Planning Commission. April 1999. *Lehigh and Northampton Counties Natural Areas Inventory Summary.* Pennsylvania Science Office of the Nature Conservancy. Middletown, PA.

Nizeyimana, E., B.M. Evans, M.C. Anderson, W.W. Peterson, D. DeWalle, W. Sharpe, and B. Swistock. 1997. *Quantification of Non-point source loads within Pennsylvania Watersheds.* Environmental Resource Research Institute, The Penn State University.

PNDI (Pennsylvania Natural Diversity Inventory). November 1999. Maiden Creek Watershed. Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry.

USGS (United States Geologic Survey). 1999

STORET (Storage and Retrieval of US Waterways and Parametric Data). 1996. Environmental Protection Agency. *Earthinfo-CD2.* EarthInfo, Inc. Boulder, Colorado.

Spots, Stevens, McCoy and Acer Engineers and Consultants. 1993.

Wohl, N.E. and R. F. Carline. 1996. "Relations among riparian grazing, sediment loads, macroinvertebrates, and fishes in three central Pennsylvania streams." *Can. J. Fish Aquat Sci.* 53:260-266.

Websites:

DEP (Pennsylvania Department of Environmental Protection).
www.dep.state.pa.us

FEMA (Federal Emergency Management Agency).
www.fema.gov/fema/csb.htm

WEEU The Voice of Berks and Beyond
http://www.weeu.com/salutes-kutztown.asp

NOAA (National Oceanic Atmospheric Administration). NCDC (National Climate Data Center.
www.ncdc.NOAA.gov/ol/climatedataa.htmw

PASS (Pennsylvania Agricultural Statistics Service) Berks and Lehigh County.
http://nass.usda.gov/pa/cntymap/

PASDA (Pennsylvania State Data Access).
www.pasda.psu.edu/

USGS (United States Geologic Survey).
www.usgs.gov

EPA (Environmental Protection Agency).
www.epa.gov