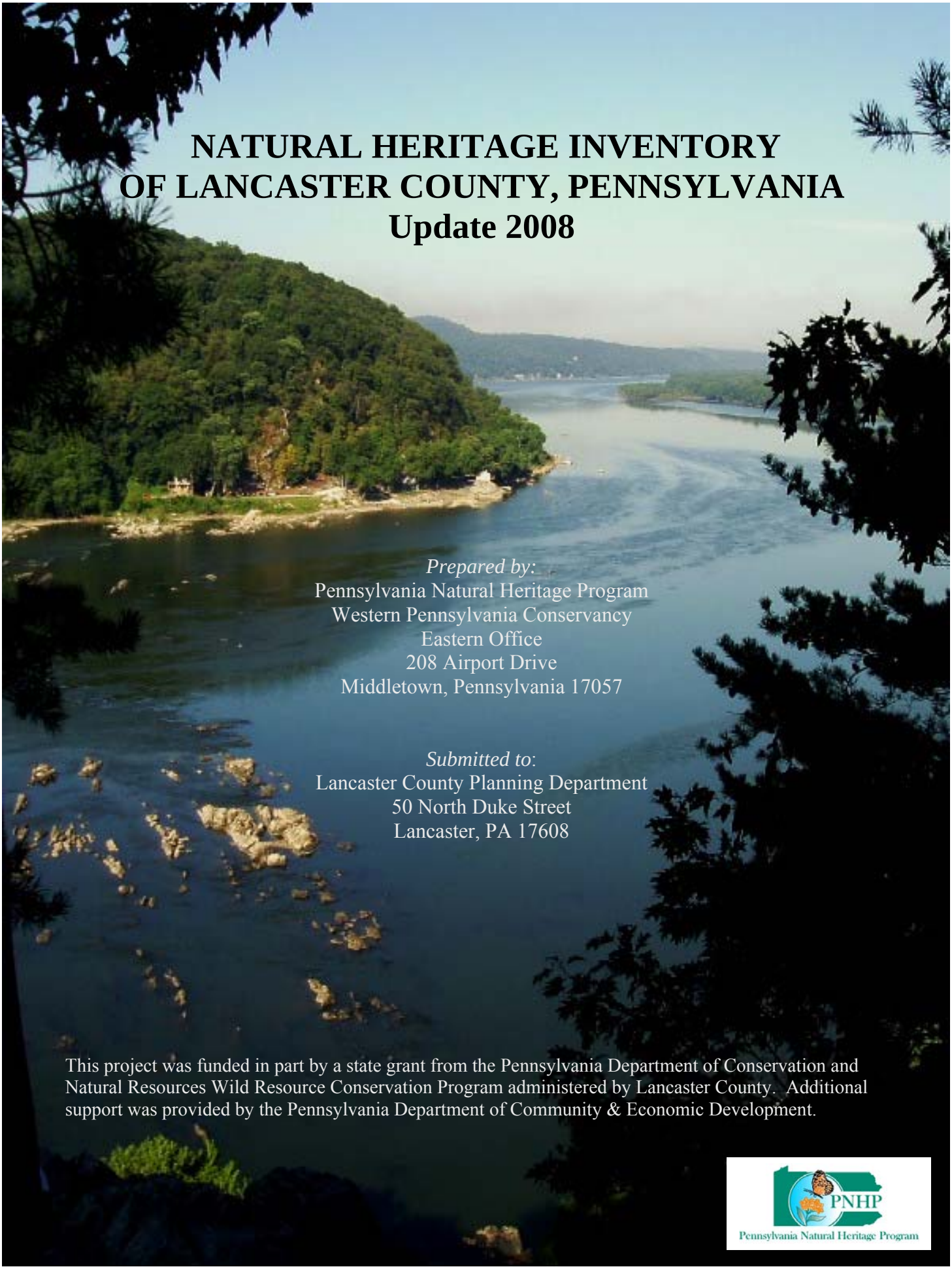

NATURAL HERITAGE INVENTORY OF LANCASTER COUNTY, PENNSYLVANIA
Update 2008

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This project was funded in part by a state grant from the Pennsylvania Department of Conservation and Natural Resources Wild Resource Conservation Program administered by Lancaster County. Additional support was provided by the Pennsylvania Department of Community & Economic Development.

PNHP
Pennsylvania Natural Heritage Program

Natural Heritage Inventory of Lancaster County, Pennsylvania Update 2008

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PREFACE

The Lancaster County Natural Heritage Inventory Update is a document compiled and written by the Pennsylvania Natural Heritage Program (PNHP) of the Western Pennsylvania Conservancy (WPC). It builds on the original Natural Areas Inventory of Lancaster County completed in 1990 by the Pennsylvania Science Office of The Nature Conservancy. This document contains information on the locations of rare, threatened, and endangered species and of the highest quality natural areas in the county; it is not an inventory of all open space. It is intended as a conservation tool and should in no way be treated or used as a field guide. Accompanying each site description are general management recommendations that would help to ensure the protection and continued existence of these natural communities, rare plants, and animals. The recommendations are based on the biological needs of these elements (communities and species). The recommendations are strictly those of the PNHP and do not necessarily reflect the policies of the state or the policies of the county or townships for which the report was prepared.

Managed areas such as state, county and township lands as well as those of the Lancaster County Conservancy, the major utility companies and railroads along the Susquehanna River are also provided on the maps based on information obtained from the Lancaster County GIS Department. This information is useful in determining where gaps occur in the protection of land with ecologically significant habitats, natural communities, and rare species. The mapped boundaries are approximate and our list of managed areas may be incomplete, as new sites are always being added.

Implementation of the recommendations is up to the discretion of the landowners. However, cooperative efforts to protect the highest quality natural features through the development of site-specific management plans are greatly encouraged. Landowners working on the management of, or site plans for specific areas described in this document are encouraged to contact the PNHP for further information.

The results presented in this report represent a snapshot in time, highlighting the sensitive natural areas within Lancaster County. The sites in the Lancaster County Natural Heritage Inventory have been identified to help guide wise land use and county planning. The Lancaster County Natural Heritage Inventory is a planning tool, but is *not* meant to be used as a substitute for environmental review, since information is constantly being updated as natural resources are both destroyed and discovered. Planning Commissions and applicants for building permits should conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the PNHP website, at http://www.naturalheritage.state.pa.us/. If conflicts are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources. If additional information on species of special concern becomes available during environmental review, the review may be reconsidered by the jurisdictional agency.

ACKNOWLEDGEMENTS

This project was funded in part by a state grant from the Pennsylvania Department of Conservation and Natural Resources Wild Resource Conservation Program administered by Lancaster County. Additional support was provided by the Pennsylvania Department of Community & Economic Development. Thanks to everyone who provided financial and administrative support for the inventory. Without your help, this study would not have been possible.

The species information utilized in the inventory came from many sources as well as our own field surveys. We wish to acknowledge all of those who carried out botanical and zoological survey work over the years. Without their contributions, this report would have been far less complete.

The report benefited from the help of local naturalists and conservationists who gave generously of their time. Thanks to all the help and support given by:

Tim Draude, botanist and local naturalist
Steve Johnson for Lepidopteron surveys and identification
Larry Coble Jr., for mussel surveys and other natural history information
Dr. Larry Klotz, for botanical surveys
Dr. Carol Loeffler, pilot for aerial surveys
Mike Bertram, Serpentine Habitat Restoration Coordinator
Muhlenberg Botanical Society

The Lancaster County GIS Department provided a huge quantity of very useful data layers and support for mapping the county. The thoroughness of this report is largely a result of the voluminous data sets available from the County GIS Department.

Thanks to the many other private citizens who contacted our office with information on natural areas.

Many thanks to everyone who participated in the Lancaster County Green Infrastructure Steering Committee. In particular, appreciation for guidance and input on the report go to Mike Domin & Scott Standish of the Lancaster County Planning Commission; David Rouse – WRT, Tim Staub – RETTEW Associates, Ralph Goodno - Lancaster County Conservancy, Sally Just and Diane Kripas of DCNR.

Copies of this document may be obtained from:

Lancaster County Planning Commission
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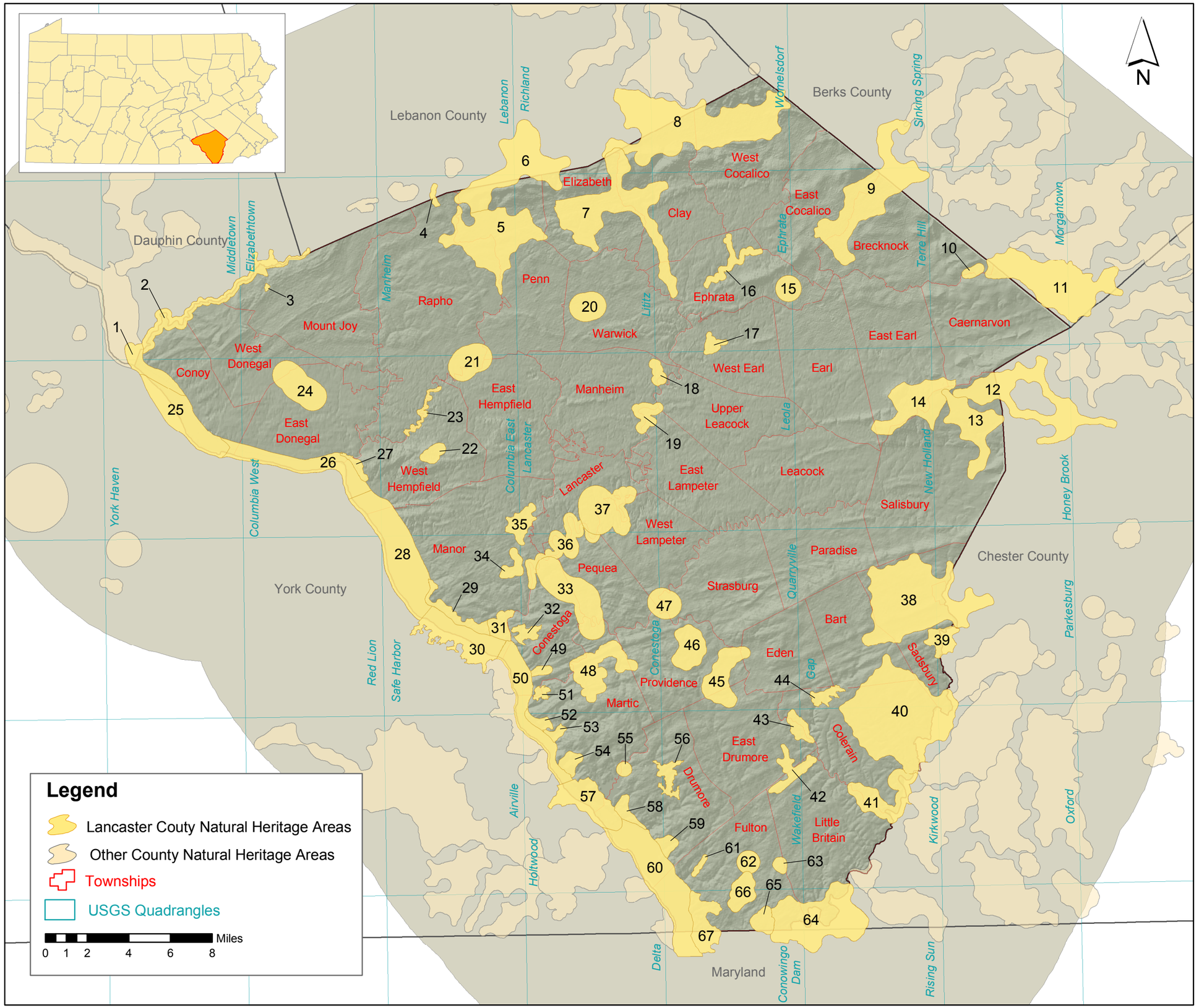
This document is also available in electronic format from:
Pennsylvania Natural Heritage Program website: www.naturalheritage.state.pa.us
Western Pennsylvania Conservancy website at: www.paconserve.org

This reference may be cited as:
Natural Heritage Inventory of Lancaster County - Update 2008. Pennsylvania Natural Heritage Program. 2008. Western Pennsylvania Conservancy. Middletown, PA.



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Lancaster County
Natural Heritage Inventory
Update 2008

Pennsylvania Natural Heritage Program

Index map #	Natural Heritage Area Name	Significance	Page #
1	Conowago Falls	High	*Pg 215*
2	Conowago Creek	High	*Pg 207*
3	Helt's Woods	Notable	*Pg 307*
4	Chiques Creek Headwaters	High	*Pg 171*
5	Chiques Creek	Exceptional	*Pg 177*
6	Penryn Park, Walnut Run	Exceptional	*Pg 405*
7	Lower Middle Creek, Segloch Run Woods	Exceptional	*Pg 355*
8	Middle Creek Wildlife Management Area	Exceptional	*Pg 371*
9	Little Muddy Creek	High	*Pg 349*
10	State Game Lands #52	Notable	*Pg 477*
11	Conestoga River Headwaters	High	*Pg 197*
12	West Branch Brandywine Creek	High	*Pg 513*
13	Pequea Creek Headwaters	High	*Pg 411*
14	Welsh Mountains	High	*Pg 507*
15	Hahnstown	Notable	*Pg 295*
16	Ephrata Community Hospital	Notable	*Pg 259*
17	Brownstown	Notable	*Pg 153*
18	Lititz Run @ Conestoga River	High	*Pg 333*
19	Holland Heights	Notable	*Pg 311*
20	Lititz Spring	Notable	*Pg 339*
21	Indian Springs	Notable	*Pg 317*
22	Ironville Mud Pond	Notable	*Pg 321*
23	Chiques Creek Bluff	Notable	*Pg 165*
24	Donegal Springs	Notable	*Pg 243*
25	Brunner (Lows) Island	Exceptional	*Pg 157*
26	Accomac, Marietta, Wrightsville Rivershore	High	*Pg 125*
27	Chickies Rock Park	High	*Pg 183*
28	Conejohela Flats	Exceptional	*Pg 189*
29	Frys Run Slopes	High	*Pg 269*
30	Apollo Park	Notable	*Pg 133*
31	Safe Harbor Woods	High	*Pg 453*
32	Safe Harbor East Woods	Notable	*Pg 447*
33	Silver Mine Park	High	*Pg465*
34	Owl Bridge, Stehman Church Woods	Notable	*Pg 401*
35	Little Conestoga Creek	High	*Pg 343*
36	Conestoga River	High	*Pg201*
37	Danville Pike Cave, Williamson Park, Kiwanis Park Woods	High	*Pg 237*
38	East Branch Octoraro Headwaters	High	*Pg 247*
39	Steelville Hollow	Notable	*Pg 481*
40	East Branch Octoraro Creek, Bull Run	High	*Pg 253*
41	Octoraro Reservoir	Notable	*Pg 395*
42	Fulton View Woods	Notable	*Pg 275*
43	Stewart Run Woods	High	*Pg 485*
44	Conner's Mill Woods	High	*Pg 223*
45	Gleissners Swamp	Notable	*Pg 279*
46	Smithville Swamp	High	*Pg 471*
47	Refton Cave	High	*Pg 435*
48	Trout Run Ravine, Red Hill Hollow, Camp Snyder Woods	High	*Pg 489*
49	Shenk's Ferry Wildflower Preserve	High	*Pg 459*
50	Blair, Duncan, Urey, Weise Islands	High	*Pg 145*
51	Pequea Creek Woods	High	*Pg 417*
52	Reed Run, House Rock Slope, Wind Cave Outcrop	High	*Pg 427*
53	Tucquan Glen	High	*Pg 495*
54	Kelly's Run, Tobe Run	High	*Pg 325*
55	Muddy Run Reservoir	Notable	*Pg 383*
56	Fishing Creek @ Scalpy Hollow Road	Exceptional	*Pg 263*
57	Conowingo Islands	Exceptional	*Pg 229*
58	Midway Station. Wissler Ravine	High	*Pg 377*
59	Benton Ravine	High	*Pg 139*
60	Lower Susquehanna River	Notable	*Pg 363*
61	Peters Creek	Notable	*Pg 423*
62	Wakefield	Notable	*Pg 503*
63	Oakryn Barren	Local	*Pg 393*
64	Goat Hill Serpentine Community	Exceptional	*Pg 287*
65	Rock Springs Serpentine Community	Exceptional	*Pg 441*
66	New Texas Serpentine Community	Exceptional	*Pg 387*
67	Haines Glen	High	*Pg 299*

Pennsylvania Natural Heritage Program

Lancaster County Natural Heritage Inventory, Update 2008

A County Natural Heritage Inventory (CNHI) is designed to identify and map areas that support species of concern, exemplary natural communities, and broad expanses of intact natural ecosystems that support important components of Pennsylvania's native biodiversity. In addition, this project has mapped and described natural connections between and among these rare species habitats as a means to help prevent their isolation from the natural landscape.

While the habitats of species of concern is a primary focus of this project, many other ecological factors were weighed when defining the "Green Infrastructure" of Lancaster County and the surrounding area. These include: steep slopes; intact forests; interior forests; native habitat quality; wetlands, streams and rivers; riparian buffer width and quality; and bedrock geology.

These natural attributes, or the "green infrastructure" of the area was compared to the built landscape, or "gray infrastructure" to highlight those areas that are most in need of conservation action. In order to connect these "hubs" to the surrounding landscape, a series of "greenways" were identified as potential migratory pathways to help facilitate animal and plant movement in a rapidly changing environment.

The restoration of streamside vegetation, or riparian buffers, may have the most significant effect on improving habitat connections while simultaneously improving water quality passing through the county to the Susquehanna River and the Chesapeake Bay.

Conservation Value Summary:

While all of the natural habitats within the county contribute to the overall health of the County's ecological systems, the highest priority natural habitats and the potential connections between them become evident by combining the landscape features discussed above.

The map on the right indicates the potential natural value of all areas within the county and the surrounding area. Darker colors indicate a higher relative ecological value that lighter colors. The highest priority natural areas include the State Line Serpentine Barrens habitats, Conowingo Islands, the Welsh Mountains, the Furnace Hills and the headwaters of Chiques Creek, Middle Creek and Cocalico Creek. The primary connecting features within the county are the contiguous forested areas and the network of streams and rivers in the county.

Many streams will require restoration of the riparian buffer area to fully function as habitat and migratory corridors within the county.

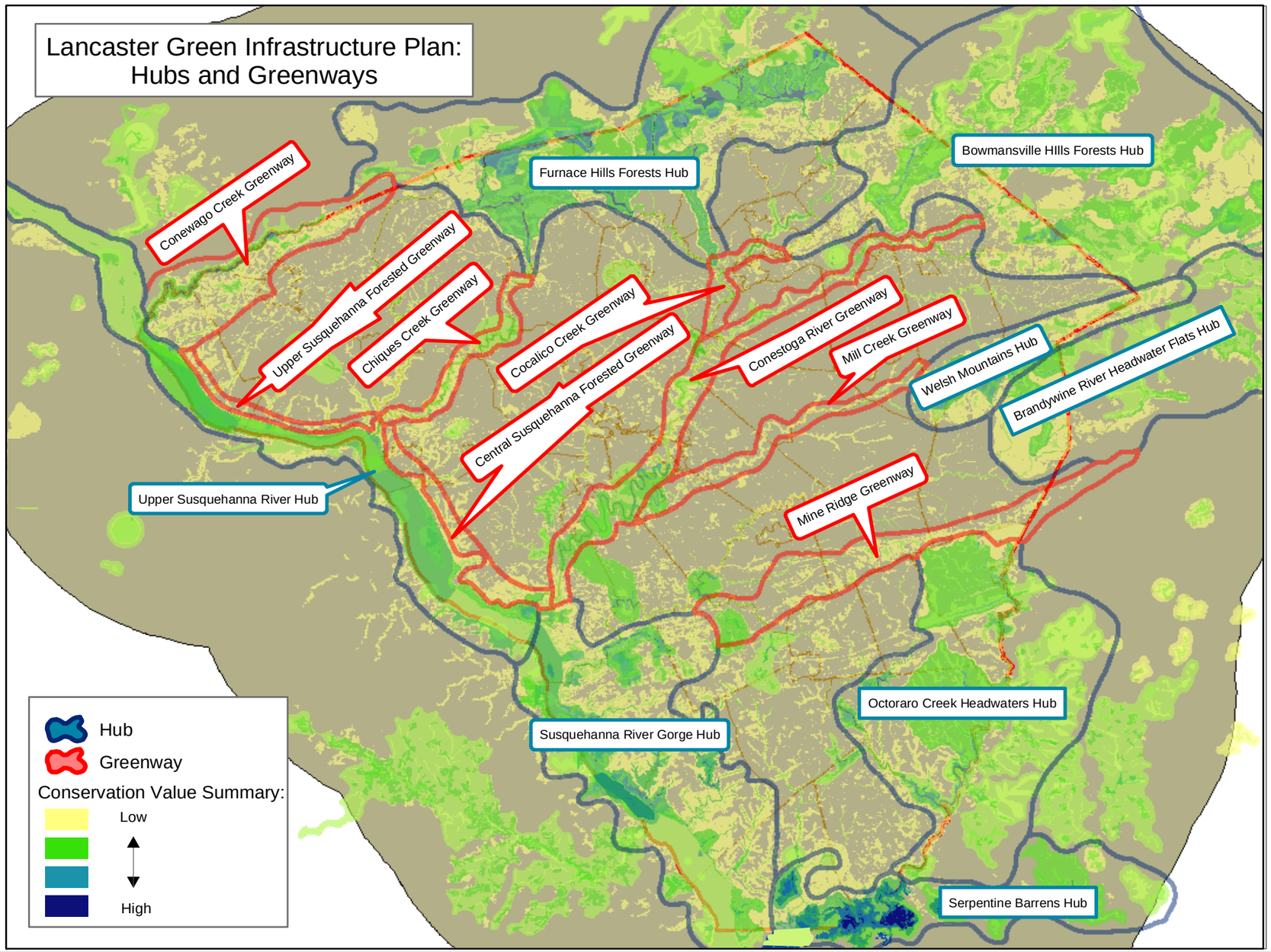
Hubs and Greenways:

In addition to those areas containing species of concern, the analysis of the combined landscape features helped to determine the most evident habitat linkages as well as the most likely potential linkages. These habitat linkages are necessary to help keep natural habitats from becoming isolated islands in a sea of human modified landscape. Portions of the County containing groupings of Natural Heritage Areas and other high quality natural habitats were grouped into broadly defined regions for incorporation into the Lancaster County Green Infrastructure Plan.

Definitions:

Hubs are the large natural landscapes of the county that contain concentrations of high quality habitats and Natural Heritage Areas. These areas currently provide habitat and regional migratory potential for most of the County's native plants and animals and are the primary components of the County's natural environments.

Greenways are those areas identified as contributing to the local migratory potential within the County that help to bridge the gaps between the Hubs. These areas were chosen because of existing fragments of linking habitats such as smaller patches of forest, woodlots, and stream corridors. In most cases, these corridors are in need of restoration to improve their utility as habitats and migratory potential.



Site Index (Natural Heritage Areas listed by name, alphabetically)

Index map #	Natural Heritage Area Name	Significance	Municipality(ies)	*USGS quadrangle*	Page #
26	Accomac, Marietta, Wrightsville Rivershore	High	Conoy Twp. East Donegal Twp. West Hempfield Twp.	*Columbia West, York Haven*	*Pg 125*
30	Apollo Park	Notable	Manor Twp. & York Co.	*Safe Harbor*	*Pg 133*
59	Benton Ravine	High	Drumore Twp.	*Holtwood, Wakefield*	*Pg 139*
50	Blair, Duncan, Urey, Weise Islands	High	Conestoga Twp. Manor Twp. Martic Twp. & York Co.	*Airville, Conestoga, Holtwood, Safe harbor*	*Pg 145*
17	Brownstown	Notable	West Earl Twp.	*Ephrata*	*Pg 153*
25	Brunner (Lows) Island	Exceptional	Conoy Twp. East Donegal Twp. & York Co.	*York Haven*	*Pg 157*
27	Chickies Rock Park	High	East Donegal Twp. West Hempfield Twp.	*Columbia West*	*Pg 183*
5	Chiques Creek	Exceptional	Manheim Boro Penn Twp. Rapho Twp.	*Lititz* *Manheim*	*Pg 177*
23	Chiques Creek Bluff	Notable	Rapho Twp. West Hempfield Twp.	*Columbia East*	*Pg 165*
4	Chiques Creek Headwaters	High	Rapho Twp. & Dauphin Co.	*Manheim*	*Pg 171*
28	Conejohela Flats	Exceptional	Manor Twp. West Hempfield Twp.	*Columbia East* *Columbia West* *Red Lion* *Safe Harbor*	*Pg 189*
36	Conestoga River	High	Lancaster Twp. Pequea Twp.	*Conestoga*	*Pg201*
11	Conestoga River Headwaters	High	Caernarvon Twp. & Berks County	*Elverson* *Morgantown*	*Pg 197*
44	Conner's Mill Woods	High	Colerain Twp.	*Gap*	*Pg 223*
2	Conowago Creek	High	Conoy Twp. & Dauphin Co.	*Middletown*	*Pg 207*
1	Conowago Falls	High	Conoy Twp. & Dauphin & York Cos.	*Middletown* *York Haven*	*Pg* 215
57	Conowingo Islands	Exceptional	Drumore Twp. Martic Twp. & York Co.	*Holtwood*	*Pg 229*
37	Danville Pike Cave, Williamson Park, Kiwanis Park Woods	High	Lancaster City Lancaster Twp. West Lampeter Twp.	*Lancaster*	*Pg 237*
24	Donegal Springs	Notable	East Donegal Twp. West Donegal Twp.	*Columbia West*	*Pg 243*

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Index map #	**Natural Heritage Area Name**	**Significance**	**Municipality(ies)**	***USGS quadrangle***	*Pg*
38	East Branch Octoraro Creek	High	Bart Twp. Colerain Twp. & Chester Co.	*Gap* *Kirkwood* *Oxford*	*Pg 247*
40	East Branch Octoraro Headwaters	High	Bart Twp. Sadsbury Twp. Christiana Boro & Chester County:	*Gap* *Parkesburg*	*Pg 253*
16	Ephrata Community Hospital	Notable	Ephrata Twp. Ephrata Boro	*Ephrata*	*Pg 259*
56	Fishing Creek @ Scalpy Hollow Road	Exceptional	Drumore Twp.	*Holtwood* *Wakefield*	*Pg 263*
29	Frys Run Slopes	High	Manor Twp.	*Safe Harbor*	*Pg 269*
42	Fulton View Woods	Notable	Little Britain Twp.	*Wakefield*	*Pg 275*
45	Gleissners Swamp	Notable	East Drumore Twp. Eden Twp. Providence Twp.	*Quarryville*	*Pg 279*
64	Goat Hill Serpentine Barren	Exceptional	Fulton Twp. Little Britain Twp. & Chester Co. & Maryland	*Conowingo Dam* *Kirkwood* *Rising Sun*	*Pg 287*
15	Hahnstown	Notable	Ephrata Twp.	*Ephrata* *Terre Hill*	*Pg 295*
67	Haines Glen	High	Fulton Twp. & Maryland	*Conowingo Dam*	*Pg 299*
3	Helt's Woods	Notable	Mount Joy Twp.	*Elizabethtown*	*Pg 307*
19	Holland Heights	Notable	East Lampeter Twp. Manheim Twp. Upper Leacock Twp.	*Lancaster* *Leola*	*Pg 311*
21	Indian Springs	Notable	East Hempfield Twp. Penn Twp. Rapho Twp.	*Columbia East* *Manheim*	*Pg 317*
22	Ironville Mud Pond	Notable	West Hempfield Twp.	*Columbia East*	*Pg 321*
54	Kelly's Run, Tobe Run	High	Martic Twp.	*Holtwood*	*Pg 325*
18	Lititz Run @ Conestoga River	High	Manheim Twp. Upper Leacock Twp.	*Lancaster* *Leola*	*Pg 333*
20	Lititz Spring	Notable	Lititz Boro Warwick Twp.	*Lititz*	*Pg 339*
35	Little Conestoga Creek	High	Manor Twp.	*Columbia East* *Conestoga* *Lancaster* *Safe Harbor*	*Pg 343*
9	Little Muddy Creek	High	Brecknock Twp. East Cocalico Twp. & Berks Co.	*Terre Hill* *Sinking Spring*	*Pg 349*

Site Index

Index map #	**Natural Heritage Area Name**	**Significance**	**Municipality(ies)**	***USGS quadrangle***	*Pg*
7	Lower Middle Creek, Segloch Run Woods	Exceptional	Clay Twp. Elizabeth Twp.	*Lititz* *Richland*	*Pg 355*
60	Lower Susquehanna River	Notable	Drumore Twp. Fulton Twp. & York Co. & Maryland	*Conowingo Dam* *Delta* *Holtwood* *Wakefield*	*Pg 363*
8	Middle Creek Wildlife Management Area	Exceptional	Clay Twp. & Lebanon Co.	*Richland* *Womelsdorf*	*Pg 371*
58	Midway Station. Wissler Ravine	High	Drumore Twp.	*Holtwood*	*Pg 377*
55	Muddy Run Reservoir	Notable	Martic Twp. Drumore Twp.	*Holtwood*	*Pg 383*
66	New Texas Serpentine Barren	Exceptional	East Earl Twp. Salisbury twp.	*New Holland*	*Pg 387*
63	Oakryn Barren	Local	Fulton Twp. Little Britain Twp.	*Wakefield*	*Pg 393*
41	Octoraro Reservoir	Notable	Colerain Twp. Little Britain Twp.	*Kirkwood*	*Pg 395*
34	Owl Bridge, Stehman Church Woods	Notable	Manor Twp.	*Conestoga.* *Safe Harbor*	*Pg 401*
6	Penryn Park, Walnut Run	Exceptional	Elizabeth Twp. Penn Twp. & Lebanon Co.	*Lebanon* *Lititz* *Manheim*	*Pg 405*
13	Pequea Creek Headwaters	High	Salisbury Twp.	*Honeybrook*	*Pg 411*
51	Pequea Creek Woods	High	Conestoga Twp. Martic Twp.	*Conestoga*	*Pg 417*
61	Peters Creek	Notable	Fulton Twp.	*Wakefield*	*Pg 423*
52	Reed Run, House Rock Slope, Wind Cave Outcrop	High	Martic Twp.	*Conestoga* *Holtwood*	*Pg 427*
47	Refton Cave	High	Pequea Twp. Providence Twp. Strasburg Twp. West Lampeter Twp.	*Conestoga* *Quarryville*	*Pg 435*
65	Rock Springs Serpentine Barren	Exceptional	Fulton Twp.	*Conowingo Dam*	*Pg 441*
32	Safe Harbor East Woods	Notable	Conestoga Twp.	*Conestoga* *Safe Harbor*	*Pg 447*
31	Safe Harbor Woods	High	Manor Twp.	*Safe Harbor*	*Pg 453*
49	Shenk's Ferry Wildflower Preserve	High	Conestoga Twp.	*Conestoga*	*Pg 459*
33	Silver Mine Park	High	Martic Twp. Pequea Twp.	*Conestoga*	*Pg465*

Index map #	**Natural Heritage Area Name**	**Significance**	**Municipality(ies)**	***USGS quadrangle***	*Pg*
46	Smithville Swamp	High	Providence Twp.	*Quarryville*	*Pg 471*
10	State Game Lands #52	Notable	Brecknock Twp. Caernarvon Twp.	*Morgantown*	*Pg 477*
39	Steelville Hollow	Notable	Sadsbury Twp. & Chester Co.	*Gap* *Parkesburg*	*Pg 481*
43	Stewart Run Woods	High	Colerain Twp. East Drumore Twp.	*Kirkwod* *Wakefield*	*Pg 485*
48	Trout Run Ravine, Red Hill Hollow, Camp Snyder Woods	High	Conestoga Twp. Martic Twp. Providence Twp.	*Conestoga*	*Pg 489*
53	Tucquan Glen	High	Martic Twp.	*Holtwood*	*Pg 495*
62	Wakefield	Notable	Fulton Twp.	*Wakefield*	*Pg 503*
14	Welsh Mountains	High	East Earl Twp.	*New Holland*	*Pg 507*
12	West Branch Brandywine Creek	High	Caernarvon Twp. Salisbury Twp. & Chester Co.	*Honey Brook*	*Pg 513*

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EXECUTIVE SUMMARY

Introduction

Our natural environment is key to human health and sustenance. A healthy environment provides clean air and water; supports fish, game, and agriculture; and furnishes renewable sources of raw materials for countless aspects of our livelihoods and economy.

An ecosystem is "the complex of interconnected living organisms inhabiting a particular area or unit of space, together with their environment and all their interrelationships and relationships with the environment" (Ostroumov 2002). All the parts of an ecosystem are interconnected—the survival of any species or the continuation of a given natural process depends upon the system as a whole, and in turn, these species and processes contribute to maintaining the system. An important consideration in assessing ecosystem health is the concept of biodiversity. Biodiversity can be defined as the full variety of life that occurs in a given place, and is measured at several scales: genetic diversity, species, natural communities, and landscapes. One of the first steps in ensuring protection of our natural environment is to recognize environmentally sensitive or ecologically important areas and to provide information regarding their vulnerability to various land use activities.

A County Natural Heritage Inventory (NHI) is designed to identify and map areas that support species of concern (those considered rare, threatened or endangered at state or federal level), exemplary natural communities, and broad expanses of intact natural ecosystems that support important components of Pennsylvania's native species biodiversity. In addition, this project has mapped and described natural connections between and among these species of concern habitats as a means to help prevent their isolation from the natural landscape. The intended purpose of this report is to provide information to municipal, county, and state governments, local conservation organizations, private individuals, and business interests so that they may plan development with the preservation of an ecologically healthy landscape for future generations in mind. This report is intended to be a component of the larger Lancaster County Green Infrastructure Plan which will in turn be a component of the Lancaster County Comprehensive Plan.

In order to determine the long-term needs of the priority landscapes of the county and their connections to the landscape, we conducted this assessment in four phases:

1) Reviewed and updated the status of species and natural communities of concern.
2) Provided site-specific recommendations for the conservation of biodiversity within and between high priority landscapes.
3) Evaluated the condition of large contiguous forest blocks and all watercourses in the county for their utility as components of Green Infrastructure.
4) Conducted a landscape-level analysis to determine the role of individual natural areas within the larger ecological picture of southeastern Pennsylvania and to identify the natural connections between them.

Conservation Planning:

The priority natural habitats identified in this report were designated and ranked with regard to their ecological significance to provide the information necessary to plan for the conservation of biodiversity at the species, community, and ecosystem levels. The Natural Heritage Areas are mapped to include both the immediate habitat and surrounding lands important in the support of these special elements as well as the natural corridors that connect them. For more information on specific recommendations for an area, refer to the text for that Natural Heritage Area.

Methods

Sixty of Pennsylvania's sixty-seven counties have completed Natural Heritage Inventories to date. The original Lancaster County NHI, (originally called Natural Areas Inventory or NAI), was the first County Inventory completed in Pennsylvania and proceeded in a manner that was a template for all subsequent County Inventories. This update is intended to build on the information generated in the first inventory and to provide Lancaster County with additional knowledge useful for the conservation of its unique natural heritage.

A significant emphasis of this report is on identifying the connections between the high quality habitats of Lancaster to those outside of the county, to provide a regional ecological framework for the Lancaster County Green Infrastructure Plan. With this in mind, our analysis begins as a ten-mile boundary around Lancaster County, to better understand the landscape scale connections within the region. Many mapping features were incorporated into the analysis

to help identify and define the high priority natural habitats of Lancaster County.

Information Gathering

Since most of the remaining natural landscape of Lancaster County has been well documented over the past 20 years, identification of new areas for species of concern in the county was not a priority for this project. A review of the Pennsylvania Natural Heritage Program (PNHP) database determined where locations for special concern species and important natural communities were known to exist in Lancaster County. Since the original Lancaster County NHI (NAI) was completed, many professional and recreational naturalists, including those from our own office, have visited and revisited many of the county's most significant natural areas. The data generated from these visits has accumulated over the years in the PHNP database. Field forms submitted from these visits were reviewed to determine if updates to the information was necessary or desirable.

Knowledgeable individuals were consulted concerning the occurrence of rare plants, animals and unique natural communities in the county. Voluminous GIS data sets were provided by the county for our analysis. Recent aerial photos, Geological maps, United States Geologic Survey (USGS) topographical maps, National Wetlands Inventory maps, United States Department of Agriculture (USDA) soil surveys and many other published materials were also used to identify and characterize areas of potential ecological significance.

Field Work

A limited number of ground surveys were conducted to collect detailed information on the status of the species and communities present at a location, the threats it faces, management needs, and what size of an area should be protected to preserve the unique habitat. Inventory Ecologists concentrated on the areas with the most interesting, unique, diverse and suitable habitat for species of concern and exemplary natural communities. The flora, fauna, level of disturbance and local threats were among the most important data recorded for each site. Sites were not ground surveyed in cases where permission from private property owners to visit a site was not granted or when enough information was available from other sources.

Data Analysis

Data obtained during the field season was combined with prior existing data and summarized. All locations with species or communities of statewide concern, as well as exceptional examples of more common natural communities were mapped and described.

The boundaries defining each species of concern core habitat were based on physical and ecological factors, and specifications for species protection developed by PNHP biologists based on scientific literature review. The sites were then assigned a significance rank based on size, condition, rarity of the unique feature, and quality of the surrounding landscape. Spatial data on the elements of concern were then compiled in a geographic information system (GIS) and combined with other available GIS layers for landscape analysis.

Landscape Analysis:

Many mapping elements went into determining and defining the network of natural habitats within Lancaster County. The primary elements include:

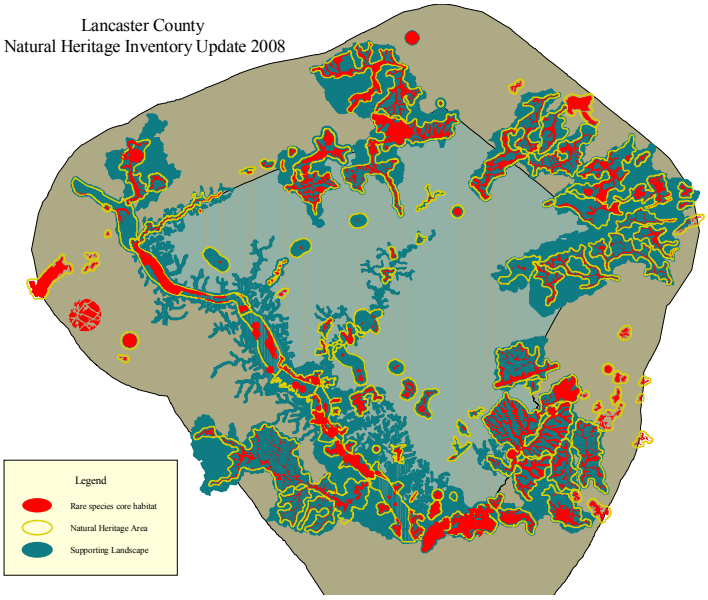
- Natural Heritage Areas
- Forest Blocks
- Interior Forests
- Natural Communities
- Riparian Corridors
- Floodplains (100 & 500-year)
- Steep Slopes (>25%)
- Important Bird Areas
- Important Mammal Areas

Natural Heritage Areas: Natural Heritage Areas are habitats that contain plant or animal species considered rare, threatened or endangered at state or federal levels. Natural Heritage Areas can also be delineated around high quality natural communities, which are those considered to be uncommon in the state, or among the best of their type within the state.

Sixty-seven Natural Heritage Areas are recognized in Lancaster County for this NHI Update. The distribution of Natural Heritage Areas across the county is shown on the site index map. Documented are 129 species of concern including 72 plants, 9 birds, 4 reptiles, 4 freshwater mussels, 3 cave invertebrates, 10 butterflies, 28 moths, and one dragonfly. Many of these species

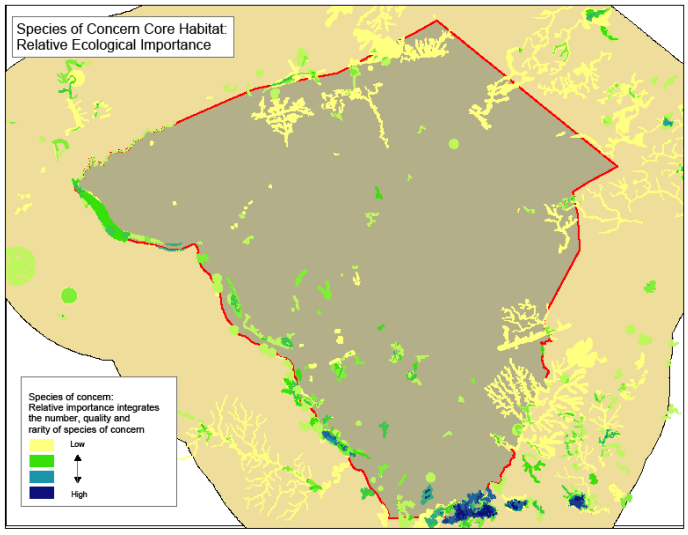
have multiple population occurrences in the county. See Appendix VIII for a complete list of species of concern.

In addition, 60 other Natural Heritage Areas were delineated in adjacent counties within 10 miles surrounding Lancaster County. Only those Natural Heritage Areas that are entirely or partially within Lancaster County are described in this report. Significance ranks of Natural Heritage Areas (exceptional, high, notable and local) in order of their contribution to the protection of the biological diversity and ecological integrity of the region are given in **Table 1**: Lancaster County Natural Heritage Areas Summary (page 21).

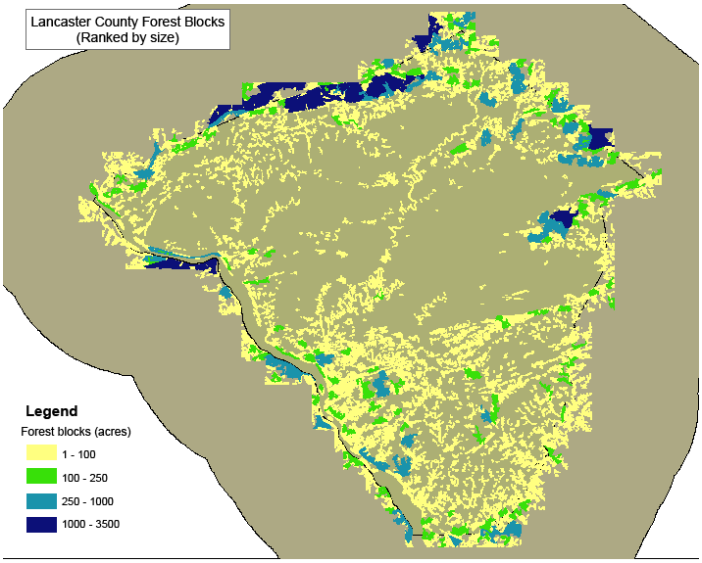


Definitions:

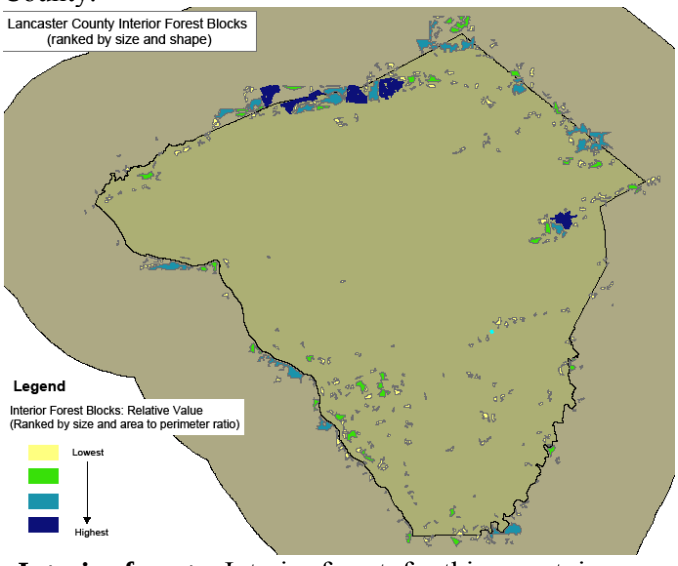
- "Natural Heritage Area" is a convenient label for species of concern core habitats that occur singly or in overlapping or adjacent habitats. This designation is used primarily as a frame for discussion of the various natural features that occur within a particular area. The Natural Heritage Area is further delineated into two regions based on its susceptibility to habitat disturbance:
  - "Species of Concern Core Habitat" delineates the actual and adjacent similar habitat of individual species of concern (plants and/or animals considered rare, threatened or endangered at state or federal levels) exemplary natural communities, or exceptional native diversity. This level of mapping delineates essential habitat that cannot absorb significant levels of habitat-disturbing activity without substantial impact to the elements of concern.
  - "Supporting Natural Landscape" includes areas necessary to maintain vital ecological processes or secondary habitat that could be impacted by certain types of habitat-disturbing activities. Consult the individual Natural Heritage Area descriptions to get specific management recommendations for each location. Much of the Supporting Landscape overlaps between the various Natural Heritage Areas creating a rather continuous and integrated area that should be considered the framework of the County's Greenways Infrastructure. Many of the Supporting Landscape areas were derived from the upstream watersheds adjacent to the species of concern core habitat. Activities that occur within the upstream portions of the watershed can have a significant impact on the Natural Heritage Area Core Habitat.



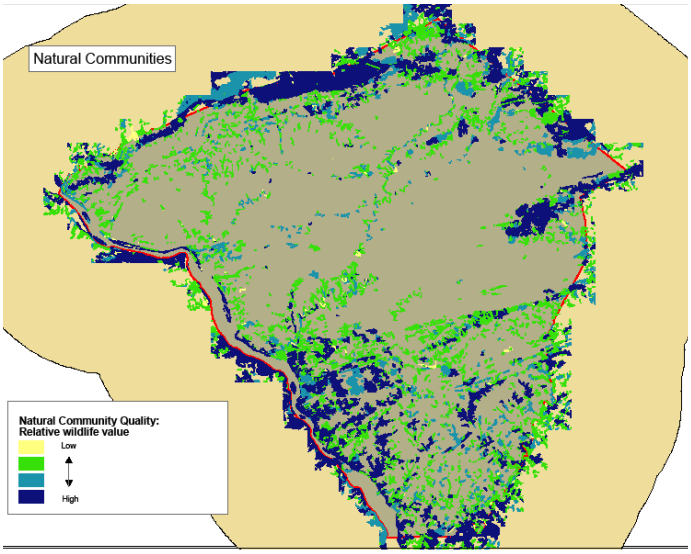
Species of Concern Core Habitat; Relative Ecological Importance: All of the species of concern core habitats are highly important for the species of concern they harbor, but ranking them based on number of species of concern and the degree of rareness helps to illustrate the relative importance of each area in relation to one another. This map integrates the number, quality and rarity of the species of concern in each area. Darker shading on the map represents areas where more species of concern 'stack up' and represent concentrations of species of concern into "hotspots". **This analysis clearly portrays the State Line Serpentine Barrens and the Conowingo Islands as the most significant areas for species of concern in the county. This is due to the high numbers of species of concern documented at these locations as well as the relative degree of state and global rarity of each species.**



Forest Blocks / Natural Habitats: Through the conservation of large forested blocks / natural habitats, the necessary environmental conditions for whole suites of species both common and rare are preserved. The largest contiguous forest blocks / natural habitats of the county were identified and ranked according to size, with the assumption that bigger is better. These forest blocks and their adjacent natural habitats should be considered the backbone of wildlife habitat in the county. Conservation efforts in the county should concentrate on maintaining these large forest blocks by avoiding further fragmentation with additional roads, development, and utility rights-of-way. The largest forest blocks are concentrated among the Furnace Hills along Lancaster's northern border with Lebanon County and the Welsh Mountains in the east-central part of the county along the border with Chester County.



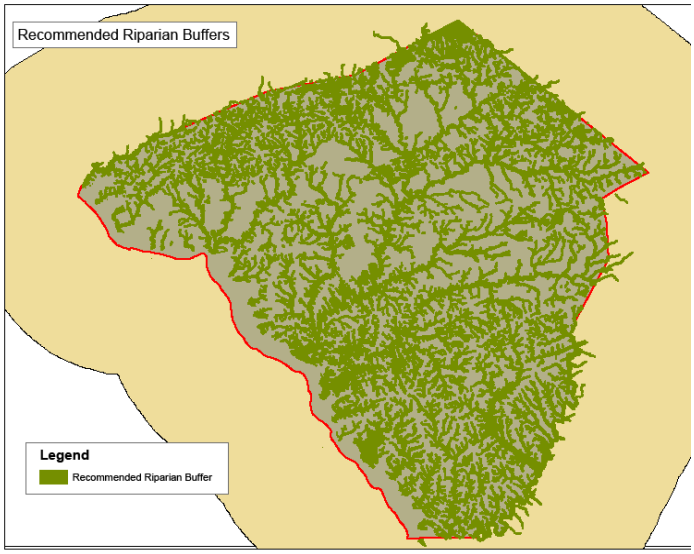
Interior forests: Interior forest, for this report, is defined as forest at least 100 meters in from the edge of any human-created opening such as a field, road, railway line or utility rights-of-way. Interior forest is an important habitat type for many species of plants and animals. The area between the forest edge and 100 meters into the forest is considered highly influenced by edge effects, such as increased levels of light, temperature, wind and dryness which create much different habitat conditions from those found in interior forest. Interior forest patches were ranked according to size with larger patches considered relatively more valuable than smaller patches. Interior forest patches smaller than five acres were dropped from the analysis as likely too small to be suitable habitat for forest interior species. As with the Forest Block analysis, the results reveal that the largest blocks in the county are concentrated among the Furnace Hills, Bowmansville Hills, Welsh Mountains, and a small area in Texter Mountain in the north part of the county.



Natural Communities: The natural habitats of Lancaster County are not a uniform expanse of shrubs, trees and other plants, but instead contain species that reflect the environmental conditions found in that general location such as wetness, slope, sunlight, and bedrock geology. When plant distributions are examined at a finer level, patterns of characteristic plant associations can be determined. A natural community is defined as a group of organisms occurring in a particular area based on the environmental conditions found there. The natural communities for this project were delineated from the inspection of aerial photographs taken in 2005 and followed up by selective targeted ground-truthing. All of the primary areas of natural vegetation and any significant portions of potential corridors have been classified based on "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999). All areas were given a

quality rank based on the degree of naturalness of the vegetation community present.

Natural communities were ranked by assigning a 3 (highest rank) to a habitat identified as a "natural community type" as in "Terrestrial & Palustrine Plant Communities of Pennsylvania" by Jean Fike, published by PA DCNR in 1999. These were regarded as essentially 'natural' communities with little evidence of invasion by introduced species. Those habitat types identified as a natural community with a negative influence, such as "weedy" or "grazed", were given a rank of 2. At the low end of the scale, ranked 1, were those habitats considered in an early stage of succession, recovering from recent past disturbances such as farming or repeated timber harvest. These forests are typically highly invaded by introduced plants and are consequently a low quality natural community. Highly modified landscapes such as those dominated by agriculture or urban areas were not considered in this analysis.

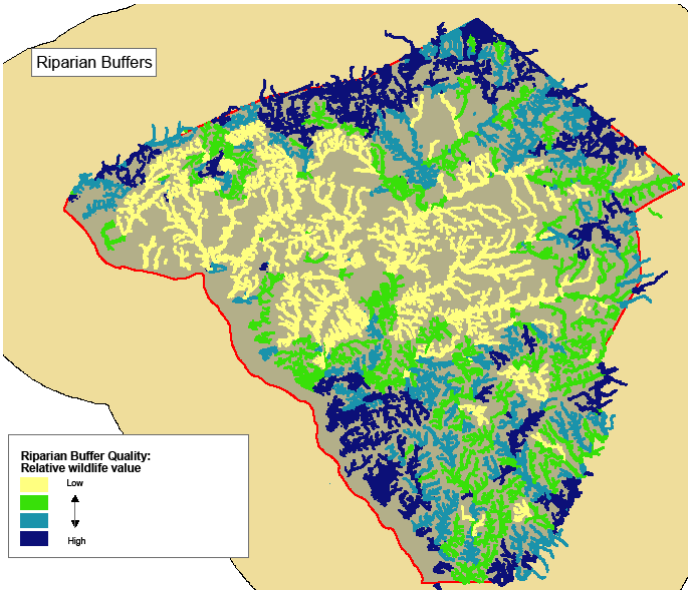


Riparian Corridors: Riparian areas are lands directly adjacent to streams, creeks, and rivers. Land adjacent to waterways and wetlands has an immediate influence on the quality of the water and the habitat it supports. Protect, enhance and restore riparian buffers to help improve water quality while also providing habitat and migratory corridors for many animals and plants through all parts of the county.

o Riparian Buffer Width: The scientific literature varies with regard to recommended riparian buffer widths. From a strictly water quality standpoint, native forested buffers of 35-100 feet are thought to be sufficient for water quality maintenance. These narrow buffers will help provide shade for temperature control, filter pollutants from runoff and provide coarse woody debris into the system, which is necessary for aquatic organisms. Based on studies of variously-sized riparian buffers, a general width of 100 meters (328 feet) from creek bank is recommended to maintain the water quality of the stream or wetland as well as to support many of the species of wildlife found in these sites. This results in a uniform buffer that is easy to apply.

The approach that was used to calculate the recommended riparian buffer width in Lancaster County was based on several site-specific topographic variables. The recommended riparian buffer extends upland 100 meters from the edge of the 100-year floodplain, but is modified by topographic variables specific to all areas. One of the primary interests in calculating a riparian buffer width is to provide enough area for stormwater runoff to slow and be filtered or be absorbed into the groundwater before it reaches a stream. Since an impervious surface like a road or parking lot does not allow stormwater to be slowed or filtered into the groundwater, these were not counted towards the 100 meter buffer width calculation. Similarly, since steep slopes (those over 25%) do not significantly allow water to slow or be filtered into the ground water, these were not considered as contributing to the 100 meter buffer width. Slopes of smaller degrees also lessen the ability of the runoff to be filtered or absorbed based on the amount of slope. For our calculation, two feet of buffer were added for each 1% of slope in lands adjacent to the stream.

This resulted in an undulating riparian buffer that incorporates floodplains, steep slopes, adjacent wetlands, and impervious surfaces into the calculation. As the size of a buffer increases, the effectiveness of that buffer to improve water quality, flow, and wildlife habitat increases.



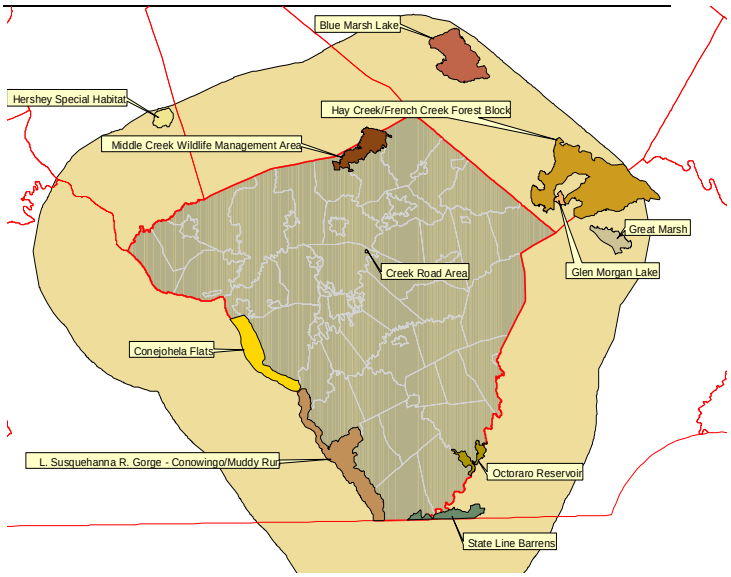
Riparian Buffer Quality: Each riparian buffer segment in the county, excluding the mainstem of the Susquehanna River, was analyzed using eight variables and ranked according to their potential cumulative effect on water quality. These variables include:

A. Percent of riparian buffer in agriculture
B. Percent of riparian buffer in urbanization
C. Percent of riparian buffer undeveloped (combined forested area, wetlands, etc.)
D. Percent of total upstream watershed agriculture
E. Percent total upstream watershed urbanization
F. Percent total upstream watershed undeveloped (combined forested area, wetlands, etc.)
G. Number of upstream road crossings
H. Number of upstream point sources of pollution

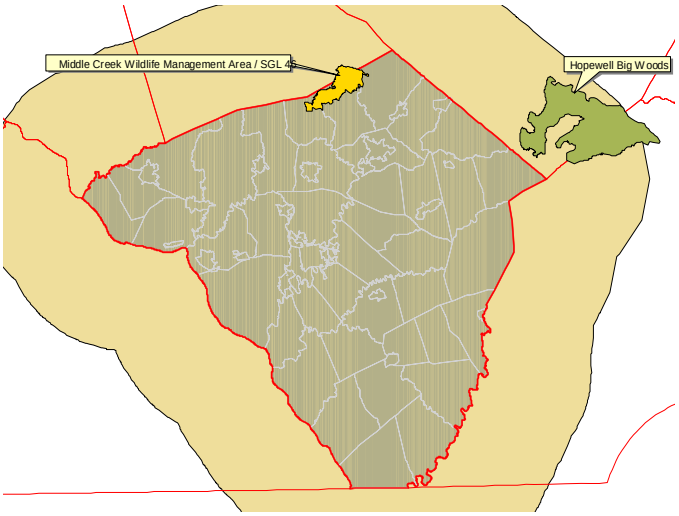
The cumulative scores were then sorted from best to lowest quality and represent four categories of potential conservation status:

1. Highest Restoration Priority (lowest potential quality)
2. Secondary Restoration Priority (second-lowest potential quality)
3. Secondary Conservation Priority (second-best potential quality)
4. Highest Conservation Priority (best potential quality)

Water and habitat quality is referred to as "potential" because these categories are based on GIS-derived data, which is subject to error. These categories should guide planning efforts and aid in the decision-making process, but should not be substituted for on-site stream assessments. This analysis helps to highlight those riparian areas that meet a goal for 100-meter vegetated buffers and should be considered priorities for preservation. This also highlights those that are furthest from meeting the 100-meter riparian buffer goal and should be considered priorities for restoration. However, another way to consider this analysis is to focus on those that fall in the middle of the spectrum. Those that are in the second-best potential quality would take much less effort and expense to raise them to the highest level of quality. Similarly, those that are in the second lowest quality category could be in danger of falling into the lowest quality category if they do not receive prompt restoration action.



Important Bird Areas: In an effort to conserve the Commonwealth's avifauna, the Pennsylvania Chapter of the National Audubon Society, along with the Pennsylvania Ornithological Technical Committee of the Pennsylvania Biological Survey, has identified 81 areas within the state that are considered to be a part of a global network of places recognized for their outstanding value to bird conservation. Termed Important Bird Areas, or IBAs, six of these areas occur within Lancaster County:



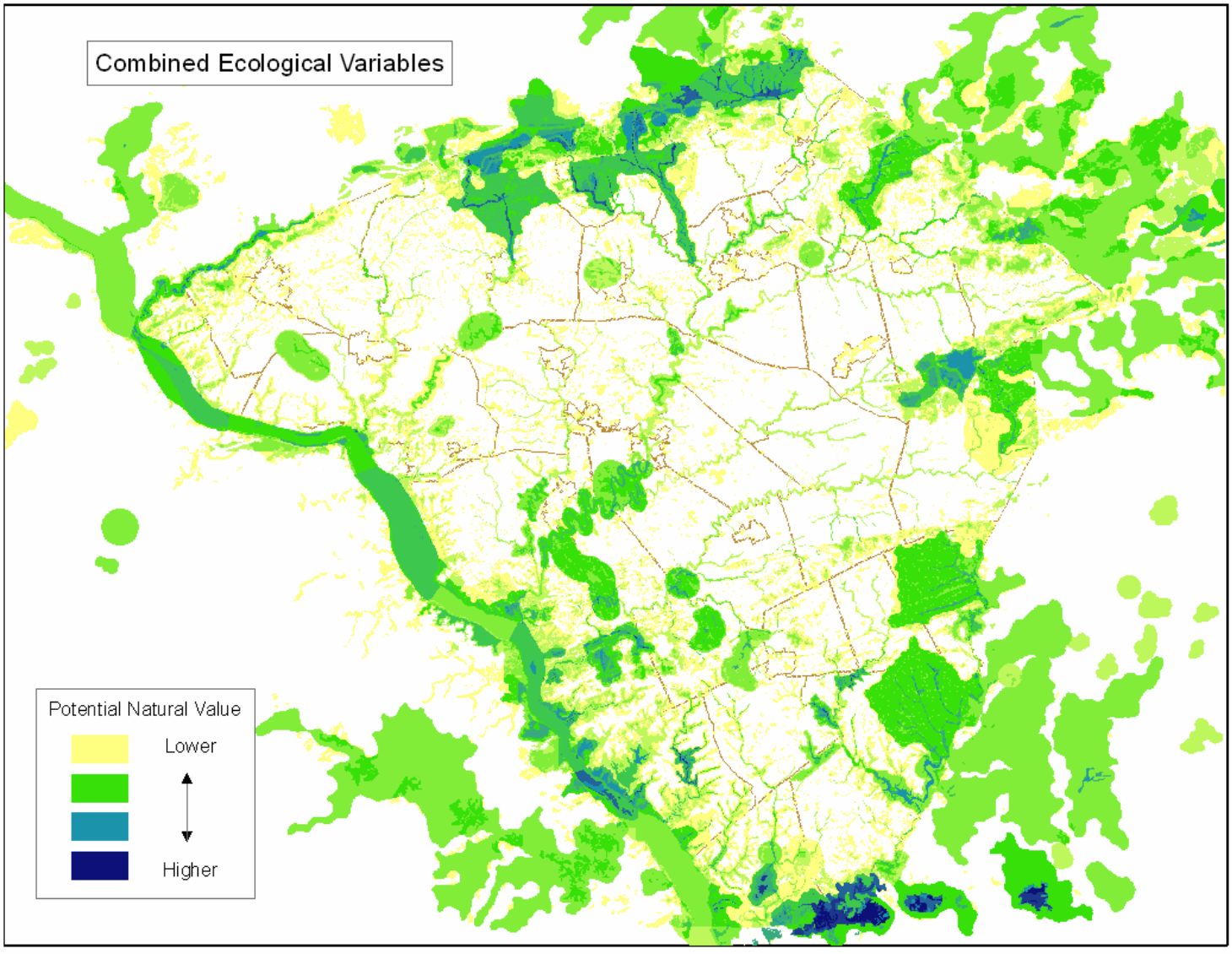
Important Mammal Areas: The Important Mammal Areas Project (IMAP) is being carried out by a broad based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Precedence is given to sites with species of concern but the project is also interested in habitats that have high mammalian diversity or those that offer exceptional educational value. Nominated sites are reviewed by IMAP personnel and local scientists, with final site selection managed by the Mammal Technical Committee of the Pennsylvania Biological Survey. The primary concern of the project is to help ensure the future of Pennsylvania's wild mammals, both game and non-game species.

Landscape Analysis Results:

While all of the natural habitats within the county contribute to the overall health of the County's ecological systems, the highest priority natural habitats and the potential connections between them become evident by combining the landscape features discussed above.

The map below indicates the potential natural value of all areas within the county and the surrounding area. Darker colors indicate a higher relative ecological value that lighter colors. The highest priority natural areas include the State Line Serpentine Barrens habitats, Conowingo Islands, the Welsh Mountains, the Furnace Hills and the headwaters of Chiques Creek, Middle Creek and Cocalico Creek.

The primary connecting features within the county are the contiguous forested areas and the network of streams and rivers in the county. Many streams will require restoration of the riparian buffer area to fully function as habitat and migratory corridors within the county.

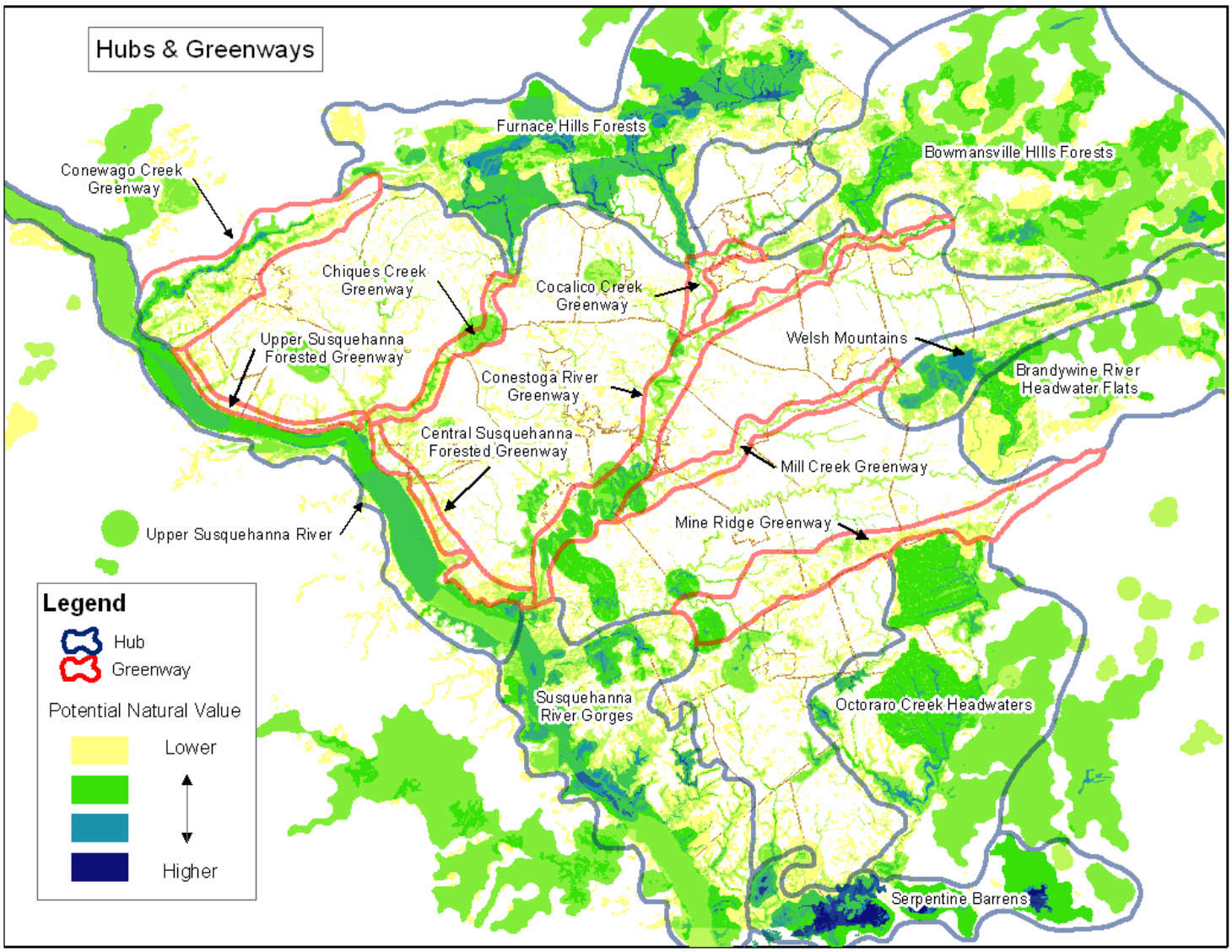


Hubs and Greenways:

In addition to those areas containing species of concern, the analysis of the combined landscape features helped to determine the most evident habitat linkages as well as the most likely potential linkages. These habitat linkages are necessary to help keep natural habitats from becoming isolated islands in a sea of human modified landscape. Portions of the County containing groupings of Natural Heritage Areas and other high quality natural habitats were grouped into broadly defined regions for incorporation into the Lancaster County Green Infrastructure Plan.

Definitions:

- o Hubs are the large natural landscapes of the county that contain concentrations of high quality habitats and Natural Heritage Areas. These areas currently provide habitat and regional migratory potential for most of the County's native plants and animals and are the primary components of the County's natural environments.
- o Greenways are those areas identified as contributing to the local migratory potential within the County that help to bridge the gaps between the Hubs. These areas were chosen because of existing fragments of linking habitats such as smaller patches of forest, woodlots, and stream corridors. In most cases, these corridors are in need of restoration to improve their utility as habitats and migratory potential.



Lancaster County Hubs and Greenways Descriptions

HUBS (Listed alphabetically):

The **Bowmansville Hills Forests Hub** includes the forested hills and rich stream valleys that straddle the Lancaster / Berks county border and contains numerous interior forest blocks. Creeks originating in the forested landscape feed the Conestoga River and Cocalico Creek in Lancaster County as well as the Schuylkill River in Berks County. The floodplains and associated wetlands of the many streams meandering through the area provide important habitat for numerous native plant and animal species including several species of concern in ten Natural Heritage Areas, many of which are shared with or occur completely within Berks County. The streams emanating from the forested landscape are of high quality, but become quickly degraded as they progress though the agricultural / urban landscape. Preservation of high quality creeks and restoration of floodplain and wetland habitats on all lower quality creeks within these watersheds should be a priority activity within this hub. In addition, preserve the connectivity of natural habitats, especially unbroken forests and riparian corridors, to help provide essential habitat and potential migratory pathways for native plants and animals.

The **Brandywine River Headwater Flats Hub** is primarily in Chester County, but encompasses similar habitat in Lancaster County. The streams draining south from the Welsh Mountains meander across the relatively flat valley of the Pequea Creek watershed. The agriculturally dominated landscape also contains considerable forested habitats, primarily in Chester County. The forests and other natural environments provide essential habitat for many native plants and animals as well as a potential migratory pathway connecting the Bowmansville Hills Forests though the Welsh Mountains to the Octoraro Creek Headwaters. The meandering stream floodplains also provide essential habitat for several species of concern in six Natural Heritage Areas stretching into Chester County. Restoration of floodplain and wetland habitats on all creeks should be a priority activity within this hub.

The **Conewago Creek Greenway** includes the section of the creek between the PA Turnpike and the creek's confluence with the Susquehanna River. The creek and its vegetated banks and uplands provide habitat for a variety of native plants and animals including several species of concern in two Natural Heritage Areas. The greenway contains numerous patches of natural habitat including several blocks of interior forest forming a "stepping stone" connection between the forested expanses of the Furnace Hills and the Susquehanna River. Most of the forested habitat of this greenway occurs on top of a linear bedrock outcrop of diabase, a hard rock of volcanic origin. The thin soils over the diabase bedrock prevented easy conversion to agricultural uses; so much of the area has remained forested. The floodplain of the Conewago Creek contains fewer expanses of natural habitat and should be considered a priority for restoration to improve the habitat for resident species and as a potential migratory pathway. The linear greenway provided though a restoration of the habitat would also supply a suitable linear public park, serving municipalities along the Lancaster / Dauphin / Lebanon County border.

The **Furnace Hills Forests Hub** includes the expanse of forest between Lancaster and Lebanon Counties referred to as the Furnace Hills. This area contains the largest expanse of forested habitats including the most significant interior forest blocks remaining in Lancaster County. Composed primarily of State Game Lands, the continually forested area provides substantial habitat and migratory potential for a wide variety of native plants and animals including a number of species of concern in ten Natural Heritage Areas. The nearly uninterrupted natural habitats provide a link to similar habitats in Lebanon and Berks Counties. In portions of the forest, the lack of understory recruitment of native trees and shrubs and a visible browse line suggests that action needs to be taken to reduce the deer herd. This in turn could decrease herbivory pressure on the understory and help improve future forest composition. Invasive species of shrubs and trees dominate the understory in other locations indicating a need for silvicultural restoration to improve future forest stands. Included in this hub are the headwaters of Chiques Creek, Cocalico Creek and Middle Creek, which provide essential habitat for common native species as well as several species of concern. The streams within the forested habitats of the Furnace Hills represent a large

concentration of the highest quality streams in the county. Once the creeks leave the forest and enter the agricultural / urban landscape, the water quality decreases with each mile before reaching the Susquehanna River. Restoration of floodplain and wetland habitats on all creeks within these watersheds should be a priority activity within the southern portion of this hub.

The **Octoraro Creek Headwaters Hub** encompasses the boundary between Lancaster and Chester Counties. The many branches of the creek, in places, meander across wide floodplains that have been used for pasture and hay crops. Portions of the floodplain have become revegetated in characteristic floodplain plant communities, primarily on the Chester County side of the creek, while the Lancaster county side remains mostly in active agricultural production. Floodplains with native vegetation provide habitat for a wide variety of plants and animals as well as a potential natural migratory pathway between Chester County through the Welsh Mountains and south to Maryland. Restoration of floodplain and wetland habitats on all creeks within these watersheds should be a priority activity within this hub. A revegetated floodplain and its adjacent reforested uplands could be compatible with a carefully sited recreational trail. Any future park design plans should place primary emphasis on promoting a viable floodplain natural community rather than on providing recreational opportunities though active park facilities and infrastructure.

The **Serpentine Barrens Hub** contains a mixture of agricultural lands and rural residences with scattered woodlots and includes outcrops of serpentine bedrock. The serpentine habitats of southern Lancaster and Chester Counties and into Maryland are among the most globally important habitats in Pennsylvania. The bedrock substrate underlying the serpentine habitat is a geologic rarity itself. When it is exposed at the surface of the ground, it typically harbors a suite of plants and associated insects uncommon for the region. Frequently, there are also species that are endemic to these habitats and grow nowhere else. The serpentine barrens habitats contain a very high concentration of plant and insect species of concern in ten Natural Heritage Areas stretching into Chester County and Maryland. The serpentine habitats are part of a series of terrestrial habitat “islands” stretching into Maryland that should be thought of as a single system. These serpentine habitats occur in isolated patches as the bedrock material, serpentinite, is exposed at the surface of the ground in a scattered fashion much like an archipelago chain of islands.

Active stewardship of these habitats is necessary, contrary to a hands-off management approach typical to other types of natural areas. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type. The plants that characterize these habitats are adapted to the dry, nutrient poor soils and periodic fire events. A priority for the security of these globally rare habitats should be to establish protection for the core habitats as well as to provide for the landscape context in which natural process can be maintained.

A long range goal for these isolated habitats is to recognize them as a single system and plan for their ecological needs. The area between and around these habitats should be maintained to provide the necessary buffer to allow prescribed burns to sustain the open habitat once the bulk of the woody species have been removed. Natural corridors between the barrens will help keep the genetic flow between the isolated populations of species in circulation. These systems may be best maintained in an agricultural or rural setting. Residential development near or between these barrens should be strongly discouraged.

The **Susquehanna River Gorge Hub** includes the Susquehanna River between the Conestoga River at Safe Harbor and the Maryland border. The steep, hilly topography along the southern half of the Susquehanna River in Lancaster County has made most of it unsuitable for conversion to agricultural uses. Consequently, the area has retained much of its natural character in contrast to the rest of the county. This hub contains 16 Natural Heritage Areas with numerous species of concern and also provides a wide corridor of natural habitats that is a vital link in the regional migratory pathway. Although most of the area was repeatedly logged in the past, the steep, narrow gorges draining into the Susquehanna River give us a view of what Lancaster County may have looked like before its conversion to agricultural uses. Many of the cool, moist ravines provide habitat for an impressive suite of spring wildflowers. For this reason,

Shenk's Ferry and other ravines are popular spring tourist destinations, drawing crowds of people during the peak spring blooming season. Numerous species of concern also occur within the forested habitats of the ravines. The streams flowing though the forested ravines of this area are considered to have some of the best riparian buffers in the county for protection of water quality.

In addition to the forested ravines, the river, its floodplain and associated islands provide ample habitat for a wide array of native plants and animals. The deep water area associated with Holtwood dam is a popular recreational boating area. The Susquehanna River below Holtwood Dam is one of Pennsylvania's most unusual and picturesque riverine landscapes. The water level of the river fluctuates widely due to seasonal flooding and dry spells, alternately inundating and exposing numerous islands in the river. Deposits of soil have filled cracks, crevices and depressions in the exposed bedrock, to provide a distinctive habitat for many species of plants uncommon to Pennsylvania. Recently improved fish ladders on the three major dams on the Susquehanna River have helped to alleviate formerly impassable barriers to migratory fishes that travel between fresh and salt water habitats. While the passages have improved the migratory pathway for fishes that live in salt water and migrate to freshwater habitats to spawn, the American eel, which lives in fresh water but breeds in the ocean, has not been helped by the current fish ladder designs. The American eel may be an important link in the lifecycle of several native freshwater mussels, so an improvement in eel migratory routes may help improve freshwater mussel populations as well.

The **Upper Susquehanna River Hub** includes the section of the Susquehanna River between Lancaster County's border with Dauphin County at Conewago Creek down to the Conestoga River at Safe Harbor Dam. Sections of the river are popular recreational boating destinations due to the predictably deep water created by the York Haven and Safe Harbor dams. This area also contains many significant riverine habitats, including eight Natural Heritage Areas, and functions as an important natural migration corridor for many birds and fish. Most of the existing natural habitat is within the river or its floodplain and associated islands. These habitats support a wide variety of native plants and animals including several species of concern associated with the river habitats. The Susquehanna River is subject to extreme seasonal water level fluctuations, from raging floodwaters to a mere trickle during drought events. This natural disturbance of flooding and drying along with seasonal ice scour helps produce the unique habitats associated with the river. The natural disturbance cycle also creates conditions favorable for the establishment of invasive species of plants, which frequently dominate the shoreline of the river.

Recently improved fish ladders on the three major dams on the Susquehanna River have helped to alleviate formerly impassable barriers to migratory fishes that travel between fresh and salt water habitats. While the passages have improved the migratory pathway for fishes that live in salt water and migrate to freshwater habitats to spawn, the American eel, which lives in fresh water but breeds in the ocean, has not been helped by the current fish ladder designs. The American eel may be an important link in the lifecycle of several native freshwater mussels, so an improvement in eel migratory routes may help improve freshwater mussel populations as well.

The hilly topography referred to as the **Welsh Mountains Hub** is dominated by large continuously forested areas with several significant interior forest blocks. The large forested blocks of this hub should be considered one of the primary natural habitats of the county. The forested landscape provides essential habitat and migratory potential for a wide variety of native plants and animals including several species of concern in one Natural Heritage Area. It provides both a habitat refuge for local native species as well as a large enough habitat to be considered part of a regional corridor connecting with similar habitats in Chester and Berks Counties. Most of this hub is maintained as relatively undisturbed forest; however, several roads and numerous residences fragment the canopy. This hub includes Lancaster County Money Rocks Park. Additional lands are controlled by the New Holland Borough Authority and maintained as watershed protection for the New Holland Reservoir. This land should be retained by the borough and maintained in its current use as forested land for watershed protection. Other streams draining from the Welsh Mountains lead to the Conestoga River, Mill Creek and Pequea Creek

GREENWAYS (Listed alphabetically):

The **Chiques Creek Greenway** follows Chiques Creek from Manheim Borough to the Susquehanna River. This potential Greenway currently has only fragments of natural habitat along the creek, its floodplain and associated uplands. The many branches and tributaries of Chiques Creek originate in the Furnace Hills, where they are considered among the best quality streams in the county. Once the creek leaves the forest and enters the agricultural / urban landscape, the water quality decreases with each mile before Chiques Creek empties into the Susquehanna River. Restoration of floodplain, wetland and upland forest habitats should be a priority activity along the entire length of Chiques Creek. The restored habitat would help provide suitable habitat for plants and animals, improve the water quality of Chiques Creek and help connect the Furnace Hills with the Susquehanna River though a landscape dominated by agriculture and urban uses. The linear greenway provided though a restoration of the habitat could also supply a suitable linear public park, serving municipalities along the length of Chiques Creek. Any future park design plans should place primary emphasis on promoting a viable floodplain natural community rather than on providing recreational opportunities though active park facilities and infrastructure.

The **Cocalico Creek Greenway** is a potential connection between the Furnace Hills Forests Hub, the Bowmansville Hills Forests Hub, to the Conestoga River and eventually the Susquehanna River. This potential greenway makes use of existing undeveloped and less developed land around Ephrata Borough and the surrounding suburban development as well as the Cocalico Creek floodplain. Additional potential linkages could incorporate other sections of Cocalico Creek and its floodplain. This potential Greenway currently has only fragments of natural habitat along the creek, its floodplain and associated uplands. The restored habitat would help provide suitable habitat for plants and animals, improve the water quality of Cocalico Creek and help provide a local migratory pathway though a landscape dominated by agriculture and urban uses. The linear greenway provided though a restoration of the habitat could also supply a suitable linear public park, serving communities around Ephrata Borough. Any future park design plans should place primary emphasis on promoting a viable floodplain natural community rather than on providing recreational opportunities though active park facilities and infrastructure.

The **Conestoga River Greenway** is a potential greenway corridor that contains numerous fragments of natural habitat scattered from its headwaters to its confluence with the Susquehanna River. The Conestoga River makes many bends and curves and has forested uplands where the creek is flanked by steep slopes. Wide floodplains occur intermittently along the length of the river. Upstream and downstream of Lancaster City, the habitat is primarily dominated by agriculture and rural residential development and newer suburban developments. The river passes though southern Lancaster City, creating a potential dead end for any migrating animals using this river as a migratory pathway. With a combination of preservation of the fragments remaining and restoration of floodplain, wetland and upland forest habitats, the river could become a significant habitat connector through the county to the Susquehanna River. Restoration of floodplain, wetland and upland forest habitats should be a priority activity along the entire length of the Conestoga River and its tributaries. The restored habitat would help provide suitable habitat for plants and animals, improve the water quality of the Conestoga River and help provide a local migratory pathway though a landscape dominated by agriculture and urban uses. The linear greenway provided though a restoration of the habitat could also enhance and expand the current linear public park, serving communities along the length of the Conestoga River. Any future park design plans should place primary emphasis on promoting a viable floodplain natural community rather than on providing recreational opportunities though active park facilities and infrastructure.

Mill Creek Greenway like the other potential greenways, currently has only scattered fragments of natural habitats to provide a connection between the Welsh Mountains and the Susquehanna River. Mill Creek flows though a landscape dominated by agriculture and rural residences and suburban developments. With a combination of preservation of the fragments remaining and restoration of floodplain, wetland and upland forest habitats, Mill Creek could become a significant habitat connector through the county to the Susquehanna River. Restoration of floodplain, wetland and upland forest

habitats should be a priority activity along the entire length of Mill Creek and its tributaries. The restored habitat would help provide suitable habitat for plants and animals, improve the water quality of Mill Creek and help provide a local migratory pathway though a landscape dominated by agriculture and urban uses. The linear greenway provided though a restoration of the habitat could also supply a suitable linear public park, serving municipalities along the length of Mill Creek. Any future park design plans should place primary emphasis on promoting a viable floodplain natural community, with secondary emphasis on providing recreational opportunities though active park facilities and infrastructure.

Mine Ridge Greenway does not follow a creek or river like the other potential greenways, but instead follows a significant string of upland forested habitats along a ridgeline of undulating hills on top of quartzite bedrock. The hilly topography and thin soils over hard bedrock are the likely factors to have kept the land out of agricultural production. Despite several significant interruptions, particularly in the vicinity of Route 222, the forested ridgeline makes a natural migratory pathway between the Lancaster / Chester county line and the Susquehanna River. Restoration of natural habitats along the floodplains of Big Beaver Creek and Little Beaver Creek may help provide the missing connection. With a combination of preservation of the connected forested ridgeline and restoration of floodplain and wetland habitats, Mine Ridge could become a significant habitat connector through the county to the Susquehanna River. The restored habitat would help provide suitable habitat for plants and animals and help provide a local migratory pathway though a landscape dominated by agriculture and urban uses.

The associated **Upper Susquehanna Forested Greenway and Central Susquehanna Forested Greenway** are the terrestrial (upland) corridors associated with the river corridor. These two greenways currently have minimal natural habitat, the landscape having been converted to agricultural, urban and suburban uses over the past several centuries. While the Susquehanna River provides an excellent migration corridor for those plants and animals that can use the aquatic habitat, the agricultural and urbanized landscape on the Lancaster side of the river contains minimal natural habitat and leaves little opportunity for land-based migration. This greenway is currently limited to the frequently very narrow area between the river bank and the railroad tracks. An expansion of the upland natural habitat along the entire length of the Susquehanna River between the Conewago Creek and the Conestoga River should be considered a restoration priority to help improve a vital link in this important regional migratory pathway. The expanded natural vegetation greenway would also provide a suitable linear public park, connecting municipalities along the river.

Table 1:

Lancaster County Natural Heritage Areas Summary

The areas of significance for the protection of biological diversity in Lancaster County categorized alphabetically within four significance ranks. More in-depth information on each area including detailed descriptions and management recommendations, where appropriate, can be found in the text of the report listed alphabetically by site name.

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Exceptional Significance		
Index Map #25	**Brunner (Lows) Island** Lancaster County: Conoy Township York County: Hellam, East Manchester & Newberry Twps, & York Haven Boro *(York Haven Quad)*	Location: This Natural Heritage Area includes the section of the Susquehanna River south of the borough of York Haven to the railroad bridge crossing the river at the mouth of Codorus Creek. Brunner Island is the site of a PPL owned coal-fired electric generating plant. A public hiking trail is along the remnants of the Pennsylvania Canal. Ecological considerations: Several large islands occur in this section of the river including Haldeman, Ely and Pole Islands. The majority of these islands retain most of their natural conditions. This portion of the river also contains an extensive region of bedrock outcrop, referred to as Haldeman Riffles, which is dramatically revealed during times of seasonally low water. These shallow water habitats and the adjacent forested shoreline support eight animal species of concern and two plant species of concern. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and York Counties. High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat in this section of the river. Establish at least 100 meter buffer of woody vegetation along the river shore and all segments of tributary streams to help protect the water quality of the river by reducing erosion, sedimentation, and pollution. Consider establishing a 300 meter wide strip of native vegetation as a terrestrial habitat corridor along both shores of the river to improve the quality of the Susquehanna River regional migratory corridor.	Pg. 157
Index Map #5	**Chiques Creek** Manheim Boro, Penn & Rapho Twps. *(Lititz & Manheim Quads)*	Location: This large Natural Heritage Area covers portions of several sub-watersheds including Shearers Creek, Boyer's Run and the section of Chiques Creek Watershed between the Pennsylvania Turnpike and Manheim Borough. Ecological considerations: The relatively flat topography of the region allows water to pool in low lying areas, creating wetlands of varying types. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production. The remaining wetland fragments should be considered the backbone for a restoration of this habitat type in the Chiques Creek watershed. The species of concern inhabiting these shallow wetlands require specific plant communities with a matrix of open canopied habitats. Primary conservation goals: Maintain and restore this Natural Heritage Area as a floodplain wetland complex composed of multiple types of open and closed canopy wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area by reestablishing the matrix of open canopied wetland complexes. Once the open habitat within the historic floodplain has been restored, light grazing could be an effective tool to maintaining the habitat for all wet meadow species.	Pg. 177

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Exceptional Significance		
Index Map #28	**Conejohela Flats** Lancaster County: Manor & West Hempfield Twps, & Columbia & Washington Boroughs York County: Chanceford, Hellam, Lower Windsor Twps, & Wrightsville Borough, *(Columbia East, Columbia West, Red Lion & Safe Harbor Quads)*	Location: This Natural Heritage Area describes the section of the Susquehanna River and the adjacent banks between the Columbia – Wrightsville Bridge to Turkey Hill, south of Washington Borough. The water level of this section of the river is impacted by Safe Harbor Dam, which forms Lake Clarke, a popular area for recreational boating. Ecological considerations: Conejohela Flats is a combination of small brushy islands and mud flats located in the Susquehanna River just west of Washington Borough. This area has been designated an Important Bird Area by the Pennsylvania Audubon Society primarily because the mud flats provide an important habitat and migratory stopover for shore birds that is found in few other locations in Pennsylvania. Six animal and two plant species of concern have been documented in the habitats of the river and adjacent uplands. These habitats also help provide a vital link in the Susquehanna River regional migratory corridor. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and York Counties. Protect and expand the natural vegetation along both shores of the river floodplain and adjacent upland. Consider establishment of a 300-meter wide strip of native vegetation as a terrestrial habitat corridor along the eastern shore of the river where development hasn't already eliminated this possibility. Encourage agricultural areas along the banks of the river and its adjacent bluffs to retreat from the river's edge and to revert to a forested landscape. Establish a 100-meter buffer of woody vegetation along all segments of tributary streams to help protect the water quality of the river by reducing erosion, sedimentation, and pollution. The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics.	Pg. 189
Index Map #57	**Conowingo Islands** Lancaster County: Drumore & Martic Twps. York County: Lower Chanceford Twp. *(Holtwood Quad)*	Location: This Natural Heritage Area includes the section of the Susquehanna River immediately below Holtwood Dam Ecological considerations: This area should be considered one of Lancaster County's top preservation priorities. Seasonally fluctuating river levels alternately flood, scour and expose the bedrock boulders below the Holtwood dam to create one of Pennsylvania's most unusual and picturesque riverine landscapes. The unusual environment also provides suitable habitat for seventeen plant species of concern and three animal species of concern. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and York Counties. Almost all of the core habitat is currently owned by the PPL Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the assumption that the current land use and ownership will remain for the foreseeable future. Continue protection of this landscape as an important ecological resource. If the utility companies choose to divest themselves of portions of this landscape, it should be considered a high priority for conservation acquisition. Avoid building, replacing or expanding dams. Improve fish passage over the three major dams for the American eel.	Pg. 229

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Exceptional Significance		
Index Map #56	**Fishing Creek @ Scalpy Hollow Road** Drumore Twp. *(Holtwood & Wakefield Quads)*	Location: This Natural Heritage Area is in the very center of Drumore Township. Ecological considerations: Glade spurge is a plant species of concern that has a relatively small global range. Fewer than 10 populations, most of them with only a few individuals, are currently known from Pennsylvania. At this location, glade spurge is growing in the moist seepages and along damp road banks. *Inappropriate road maintenance activities could easily eliminate portions of this population.* The large forested areas adjacent to this Natural Heritage Area help provide a habitat linkage to the Susquehanna River. Primary conservation goals: Coordinate road maintenance activities between land stewards of the Lancaster County Conservancy and Drumore Township road maintenance crews to provide adequate protection considerations for this species. The viability of the known populations of glade spurge and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. Logging of the adjacent slopes is a potential concern. This species may be impacted by excessive browsing by deer in some locations. Deer exclosure fencing may be necessary to protect this species occurrence.	Pg. 263
Index Map #64	**Goat Hill Serpentine Community** Lancaster County: Fulton & Little Britain Twps. Chester County: West Nottingham Twp. Maryland: Cecil County *(Conowingo Dam, Kirkwood & Rising Sun Quads)*	Location: This area occurs at the Lancaster / Chester County boundary along the Octoraro Creek and the Maryland State line. Ecological considerations: This area contains approximately 450 acres of globally rare serpentine habitat in a mosaic of the characteristic serpentine barrens plant communities. Goat Hill is currently known to support 19 plant species of concern and 36 animal species of concern, most of which are butterflies & moths that feed on the plants present. The serpentine community itself is considered globally imperiled due to the limited occurrences of this habitat type around the world. Primary conservation goals: Most of the core species of concern habitat occurs on protected lands in Chester County. Additional potential habitat occurs adjacent to the Octoraro Creek in Lancaster County. Active stewardship of these habitats is necessary. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type. Habitat restoration activities should strive to establish a mosaic of habitat types to accommodate the variety of organisms and their diverse habitat preferences.	Pg. 287
Index Map #7	**Lower Middle Creek, Segloch Run Woods** Clay, Ephrata & Elizabeth Twp. *(Ephrata, Lititz & Richland Quads)*	Location: This Natural Heritage Area includes most of the Middle Creek watershed between the PA Turnpike and where Middle Creek meets Cocalico Creek. The western edge of this area includes Speedwell Forge Lake County Park, while the northern portion is part of State Game Lands #46. Ecological considerations: This Natural Heritage Area is made up of large expanses of agricultural fields interspersed with a mosaic of woodlots along Middle Creek, Hammer Creek, Segloch Run and their tributaries. Two plant species of concern and eight animal species of concern (mostly butterflies) are known to occur within these wetland and floodplain habitats. The floodplains and wetlands along all streams and tributaries within this Natural Heritage Area should be considered existing or potential core habitat for species of concern. Primary conservation goals: Maintain and restore this Natural Heritage Area as a wetland complex, composed of multiple types of open and closed canopy wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area by reestablishing the matrix of open canopied wetland complexes. Once the open habitat within the historic floodplain has been restored, light grazing could be an effective tool to maintaining the habitat for all wet meadow species.	Pg. 355

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Exceptional Significance		
Index Map #8	**Middle Creek Wildlife Management Area** Lancaster County: Clay & West Cocalico Twps. Lebanon County: Heidelberg & Mill Creek Twps. *(Richland & Womelsdorf Quads)*	Location: This large Natural Heritage Area includes the northern portions of Clay and West Cocalico Townships and extends into Lebanon County and slightly into Berks County. Ecological considerations: This area contains a wide diversity of habitat types, in an agriculture dominated landscape containing important wetland habitats. Middle Creek Wildlife Management Area makes up a significant part of this Natural Heritage Area, which is part of the Furnace Hills Forests Hub. Six sensitive species of concern have been documented from different parts of this area. Primary conservation goals: Maintain this area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland habitats.	Pg. 371
Index Map #66	**New Texas Serpentine Community** Fulton Twp. *(Conowingo Dam & Wakefield Quads)*	Location: This Natural Heritage Area occurs between Wakefield Borough and the Pennsylvania / Maryland border. Conowingo Creek passes though this area. Ecological considerations: The serpentine habitats of southern Lancaster County are among the most globally important habitats in Pennsylvania. This area contains approximately 200 acres of globally rare serpentine habitat in a good mosaic of the characteristic serpentine barrens plant communities. Eleven plant species of concern and seven animal species of concern have been documented in this habitat. Active stewardship of these habitats is necessary to prevent succession to more common woodland types. Primary conservation goals: Consider this habitat the top priority for preservation of species of concern habitat in Lancaster County. A combination of fee simple acquisition, conservation easements, transfer of development rights and tax incentives could be employed towards this goal. Consider this area to be a part of the larger State Line Serpentine Barrens habitat and provide for the long term maintenance of this disturbance dependent system. In the absence of naturally occurring fire, active stewardship is necessary to maintain the open aspect of the habitat. Focus vegetation removal efforts on coniferous trees on hilltops. Eventually, prescribed burning should be employed to help maintain herbaceous openings. Link regional serpentine habitats through wide habitat corridors. Keep the surrounding landscape in an agricultural setting to avoid potential conflict between restoration activities and suburban development.	Pg. 387
Index Map #6	**Penryn Park, Walnut Run** Lancaster County: Elizabeth, Penn & Rapho Twps. Lebanon County: Cornwall Boro, Heidelberg & South Lebanon Twps. *(Lebanon, Lititz, Manheim & Richland Quads)*	Location: This large Natural Heritage Area includes portions of State Game Lands #156 and the YMCA Camp Shand or Penryn Park at the Lancaster / Lebanon county boundary. The Horseshoe Trail also passes though this area. Ecological considerations: The landscape is mostly forested, but the vegetation clearing done on the utility rights-of-way has helped to provide the habitat conditions favorable for several species of concern. Overall, eight species of concern are known from this area. Primary conservation goals: Maintain the open habitats along the utility rights-of-way. This wet opening helps to provide the habitat requirements of several of the species of concern known from this location. Otherwise, preserve the intact forest canopy. This site is part of one of the most contiguous tracts of forest in the county and forested land extends well beyond the Natural Heritage Area. Establishing permanent protection and maintaining connectivity to adjacent forested land is important to provide an extensive interior forest habitat corridor linking to habitats out of the county.	Pg. 405

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Exceptional Significance		
Index Map #65	**Rock Springs Serpentine Community** Fulton Twp. & Cecil County, Maryland *(Conowingo Dam Quad)*	Location: This Natural Heritage Area occurs adjacent to Route 222 at the Pennsylvania / Maryland border. Ecological considerations: The serpentine habitats of southern Lancaster County are among the most globally important habitats in Pennsylvania. Six plant species of concern and eight animal species of concern have been documented in this habitat. This area had been severely overgrown, the canopy closure threatening to eliminate the suitable habitat for the serpentine adapted species. Recent restoration activities have removed the tree canopy to expose the soil and bedrock substrate. Active stewardship of these habitats is necessary to prevent succession to more common woodland types. Primary conservation goals: Consider the serpentine habitats the top priority for preservation of species of concern in Lancaster County. Since most of the suitable core habitat is owned by the Lancaster County Conservancy, proper restoration activities is the most immediate goal. Acquire adjacent habitat to expand and buffer the existing serpentine habitat. Consider this area to be a single part of the State Line Serpentine Barrens habitat and provide for the long term maintenance of this disturbance dependent system. In the absence of naturally occurring fire, active stewardship is necessary to maintain the open aspect of the habitat. Eventual prescribed burning should be employed to help maintain herbaceous openings. Link regional serpentine habitats through wide habitat corridors. Keep the surrounding landscape in an agricultural setting to avoid potential conflict between restoration activities and suburban development. A large pile of used tires abuts the serpentine habitat and should be removed before prescribed fires are employed.	Pg. 441
	High Significance		
Index Map #26	**Accomac, Marietta, Wrightsville Rivershore** Lancaster County: Conoy, East Donegal, West Hempfield Twps, & Marietta Boro York County: Hellam Twp, Wrightsville Boro *(Columbia West & York Haven Quads)*	Location: This site includes the section of the Susquehanna River between the railroad bridge at the Conoy / East Donegal Township line to the Columbia / Wrightsville Bridge. Most of the species of concern core habitat occurs within the shallow mudflats and flood prone banks of the river, but also includes a small wooded ravine on the western shore. Ecological considerations: Seven plant species of concern and two animal species of concern are known to occur within this stretch of the river. The shallow mudflats exposed during periods of low river level provide habitat for wading birds that feed on aquatic plants and animals. The mudflats also provide an important migratory stopping place for these and other birds that use the Susquehanna River as a migratory pathway. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and York Counties. Preserve the natural hydrologic conditions of the river. Protect and expand the natural vegetation along the eastern shore of the river floodplain and adjacent upland to preserve and improve its utility as a regional migratory corridor. Consider establishing a 300-meter wide strip of native vegetation as a terrestrial habitat corridor along the eastern shore of the river where current development hasn't already prevented this option.	Pg. 125

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #59	**Benton Ravine** Drumore Township *(Holtwood & Wakefield Quads)*	Location: This Natural Heritage Area includes a forested ravine along the Susquehanna River in southern Drumore Township. The area has been designated a National Natural Landmark. Ecological considerations: Benton Ravine, also known as Ferncliff Wildflower & Wildlife Preserve, is a forested, steep-sided narrow valley with a cascading stream, large rock exposures, and a rich spring wildflower display. The deeper portion of the ravine is dominated by a hemlock-tuliptree-birch forest of high enough quality (for its type) to be considered an exceptional natural community. In addition, one plant species of concern is known to occur within the area. The landscape drops off abruptly towards the Susquehanna River, forming a ridgeline of steep bluffs overlooking the river. The forested landscape provides an essential link in the Susquehanna River regional migratory corridor. Primary conservation goals: Safeguard the expanse and quality of the native forest canopy within the rare species core habitat. The forested landscape also helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge for a multitude of other forest dependent species. Most of the critical rare species habitat is owned by the Lancaster County Conservancy and likely will not be vulnerable to land use changes or logging activities. Prevent the conversion of the surrounding agricultural lands to residential or industrial development. Establish wide, forested buffers along streams and creeks where they are lacking and preserve and enhance them where they are present.	Pg. 139
Index Map #59	**Blair, Duncan, Urey, Weise Islands** Lancaster County: Conestoga, Manor & Martic Townships York County: Chanceford & Lower Chanceford Townships *(Airville, Conestoga, Holtwood & Safe Harbor Quads)*	Location: This includes the portion of the Susquehanna River between Safe Harbor Dam and Holtwood Dam and contains a large impounded area of the river referred to as Lake Aldred. Ecological considerations: There are several islands and bedrock outcrops within the river that provide habitat for four plant and three animal species of concern. The surrounding uplands on both sides of the river are primarily forested and provide an essential terrestrial link in the Susquehanna River regional migratory corridor. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and York Counties. Most of the priority core habitat within Conowingo Islands is owned by the Exelon and PPL utility producing companies and is presently considered to be of secondary concern for conversion to incompatible uses based on the current management regime. Discourage the establishment of seasonal cottages and year-round residences along the river shoreline and river islands. Improve fish passage over the three major dams for the American eel.	Pg. 145

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #27	**Chickies Rock Park** East Donegal & West Hempfield Twps, & Columbia Boro *(Columbia West Quad)*	Location: Chickies Rock County Park is located along the Susquehanna River between Marietta and Columbia Boroughs. Ecological considerations: This popular public park includes sheer cliff faces as well as bottomland habitats along Chickies Creek at its confluence with the Susquehanna River. The parkland is mostly forested and provides necessary habitat for a number of native species due to its variety of habitat types including two plant species of concern. The plant community covering portions of the sheer rock face of Chickies Rock is considered a "Little bluestem-Pennsylvania sedge opening". These openings typically occur on dry, acidic sites where woody invasion is prevented or slowed by thin soil, droughty conditions, frequent fire or other natural disturbances. This large natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Since this Natural Heritage Area is almost entirely within the County Park System, proper stewardship of the natural resources present is the top priority. Conserve the intact forest canopy and a healthy native shrub layer. Prohibit logging on the slopes facing the Susquehanna River. Allow the forest of Chickies Rock Park to approach old growth conditions. Control invasive species of plants.	Pg. 183
Index Map #4	**Chiques Creek Headwaters** Lancaster County: Rapho Twp. Lebanon County: West Cornwall Twp. *(Manheim Quad)*	Location: Chiques Creek begins in the springs and seeps of Governor Dick Park in Lebanon County before flowing into Lancaster County north of the Pennsylvania Turnpike. Ecological considerations: This large expanse of forest provides important interior forest habitat and acts a part of a regional migratory corridor across the top of Lancaster County. Though logged repeatedly in the past, the forest is maturing and has an interesting mix of trees, shrubs and wildflowers associated with slightly calcareous diabase bedrock including one plant species of concern. Primary conservation goals: Pursue conservation easements, transfer of development rights and fee simple acquisition on larger parcels along Chiques Creek. Allow the forest to achieve and maintain old-growth conditions. The hunting policy of Governor Dick Park should be amended to allow deer hunting on the property to protect the future forest composition.	Pg. 171
Index Map #36	**Conestoga River** Conestoga, Lancaster, Manor & Pequea Twps, & Millersville Boro *(Conestoga & Lancaster Quads)*	Location: This Natural Heritage Area is located along the winding bends of the Conestoga River between Lancaster City and Millersville Borough. Ecological considerations: The Conestoga River makes a series of tight bends south of Lancaster City, on its way to the Susquehanna River. Two species of concern were documented along this stretch of the Conestoga River. The core habitat for these sensitive species of concern is both the river and the adjacent upland forest. These species may utilize slightly different locations up and down this stretch of the river every year. These species of concern require abundant food source in the river and its tributaries as well as breeding areas in the adjacent upland forest. Primary conservation goals: The overall objective for this area should be to restore and establish a wide forested/vegetated riparian corridor along this stretch of the Conestoga River and its tributaries. Encourage agricultural areas along the banks of the river to retreat from the river's edge and to revert to a forested or wetland landscape as is suitable to the topography and hydrology. The forested floodplain along this stretch of the Conestoga could be an appropriate location for a linear municipal park serving Lancaster City and Millersville Borough. Emphasis should be on promoting a viable floodplain natural community rather than on active park facilities and infrastructure.	Pg. 201

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #11	**Conestoga River Headwaters** Lancaster County: Caernarvon Twp. Berks County: Caernarvon Twp. *(Elverson & Morgantown Quads)*	Location: Most of this Natural Heritage Area occurs in Berks County, with only a small portion occurring in Brecknock and Caernarvon Townships in Lancaster County. Ecological considerations: This landscape contains a diversity of habitats within a landscape formerly dominated by agriculture. Wetlands along the Conestoga River and its tributaries provide habitat for wetland species of plants and animals. The forested habitats and stream corridors help connect to locations outside of the county. Primary conservation goals: Restore a series of slow moving marsh systems along this portion of the Conestoga River and its tributaries. Habitat modification by beavers could help to improve the integrity of this habitat. Preserve the integrity of large forested areas by avoiding additional fragmenting features such as roads, development and utility infrastructure.	Pg. 197
Index Map #1	**Conewago Falls** Lancaster County: Conoy & Londonderry Twps. Dauphin County: Newberry Twp. York County: York Haven Boro *(Middletown & York Haven Quads)*	Location: This Natural Heritage Area encompasses the section of the Susquehanna River from the Safe Harbor Dam down river to Bainbridge. Ecological considerations: Seasonally fluctuating river levels alternately flood, scour and expose the bedrock boulders providing suitable habitat for four plant species of concern adapted to these conditions. The floodplain forest north of Bainbridge includes wetland habitats. Three freshwater mussel species of concern and three other animal species of concern have been documented within this stretch of river and its floodplain habitats. Primary conservation goals: Coordinate the protection of this landscape between Lancaster, Dauphin and York Counties. Protect and expand the native vegetation along both shores of the river floodplain and adjacent upland. Establish at least a 100 meter buffer of woody native vegetation along the river shore and a 100 foot buffer along all segments of tributary streams to help protect the water quality of the river. Consider expansion of a 300-meter wide strip of native vegetation as a terrestrial habitat corridor along both shores of the river where development hasn't already eliminated this possibility. Future development projects and subdivisions should be discouraged within the floodplain of the river, its tributaries, or wooded habitats. A wooded public walking trail is maintained by Conoy Township along the old canal towpath. The habitats of the river shoreline and floodplain would be compatible for an expanded passive recreation park system.	Pg. 215
Index Map #44	**Conner's Mill Woods** Colerain Township *(Gap Quad)*	Location: Conners Mill Woods is a steep, wooded ravine surrounding Bowery Run near its confluence with the West Branch of the Octoraro Creek. Ecological considerations: The site contributes to a large, relatively un-fragmented tract of forested land along the West Branch of the Octoraro Creek and its tributaries that help form the backbone of a natural corridor to the Octoraro Reservoir. A few rock outcrops in the area contain Bradley's spleenwort, a plant species of concern. All of the currently known populations of this plant in PA occur in a few scattered sites in Lancaster County. Since all of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large responsibility for its continued existence in the state. Primary conservation goals: The outcrops and surrounding woods should be left in their current condition. Removal of the forested canopy around the rock outcrops could alter the microhabitat conditions that the fern prefers; therefore, logging operations should not occur along the steep slopes facing Bowery Run and the West Branch of the Octoraro Creek. Permanent protection of these lands, particularly in the core habitat, through conservation easements or acquisition should be a priority. Emphasis should be placed on preserving this site's intact forest canopy, which provides important habitat requirements for Bradley's spleenwort. The wooded landscape is compatible with passive recreation such as fishing, hunting and hiking, but more intensive recreational opportunities are not recommended for the core or supporting landscape for this area.	Pg. 223

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #37	**Danville Pike Cave, Williamson Park, Kiwanis Park Woods** Lancaster, Pequea & West Lampeter Twps. & Lancaster City *(Lancaster Quad)*	Location: Most of this Natural Heritage Area occurs within Lancaster County Central Park and the adjacent Buchmiller County Park. Ecological considerations: Two plant species of concern occur in specialized habitats within the park boundaries. In addition, two cave invertebrate species of concern were documented at a roadside spring opening. These species are presumably more prevalent in the connected subterranean habitat Primary conservation goals: A long term objective for the area should be to restore the forested/vegetated floodplain of the Conestoga River, Mill Creek and the adjacent slopes and uplands to include all the area within the 100-meter riparian buffer. Restoration of the riparian buffer will help connect habitats along the length of the Conestoga River to provide an intra-county corridor to the Susquehanna River. An additional objective should be to protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-dwelling species of concern present at this location.	Pg. 237
Index Map #38	**East Branch Octoraro Creek** Lancaster County: Colerain Twp. Chester County: Lower Oxford & Upper Oxford Twps. *(Kirkwood Quad)*	Location: The East Branch Octoraro Creek forms the boundary between Lancaster and Chester Counties. Ecological considerations: The relatively flat topography of the region allows water to pool in low lying areas, creating wetlands of varying types. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production. The remaining wetland fragments should be considered the backbone for a restoration of this habitat type in the Octoraro watershed. The three species of concern inhabiting these shallow wetlands require specific plant communities within a matrix of open canopied habitats. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and Chester Counties. Long term goal for this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before it was drained for agricultural production. Maintain this floodplain as a wetland complex, composed of multiple types of wetlands with both open and closed canopies. Habitat modification by beavers could help to improve the integrity of this area by reestablishing the matrix of open canopied wetland complexes.	Pg. 247
Index Map #38	**East Branch Octoraro Headwaters** Lancaster County: Bart & Sadsbury Townships, Christiana Borough Chester County: West Fallowfield & West Sadsbury Townships, Atglen Borough *(Gap & Parkesburg Quads)*	Location: This Natural Heritage Area includes most of the northern half of Sadsbury Township, and extends into Chester County. Ecological considerations: The floodplains of Pine Creek and Valley Creek combine at this site to form a rich bottomland wet meadow habitat dominated by grasses and grass-like plants. One animal and one plant species of concern are known to occur within these wetland and floodplain habitats. The floodplains and wetlands along all streams and tributaries within this Natural Heritage Area should be considered existing or potential core habitat for species of concern. Primary conservation goals: Maintain and restore this Natural Heritage Area as a wetland complex, composed of multiple types of open and closed canopy wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area by reestablishing the matrix of open canopied wetland complexes. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.	Pg. 247

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #29	**Frys Run Slopes** Manor Township *(Safe Harbor Quad)*	Location: This Natural Heritage Area includes the forested slopes along the Susquehanna River between Turkey Hill and the Little Conestoga River. Ecological considerations: Two species of concern have been documented within this area. This large natural landscape also functions as an important terrestrial component of the Susquehanna River regional habitat corridor. Primary conservation goals: Provide for the long-term protection of the core habitat through conservation easements and fee-simple acquisition. Create "no spray" zones along the most sensitive areas of the railroad rights-of-way to avoid unintentional destruction of the species of concern or their habitats. Prevent fragmentation and incursions into the forested landscape. The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics. Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.	Pg. 269
Index Map #67	**Haines Glen** Lancaster County: Fulton Twp. (Extends into Maryland) *(Conowingo Dam Quad)*	Location: This section of the Susquehanna River is roughly seven miles long, running from the railroad bridge just north of the Conoy / East Donegal Township line to the Columbia / Wrightsville Bridge, and includes riverside portions of the Borough of Marietta. Ecological considerations: The hilly upland features remain forested in this otherwise agricultural landscape. Steep forested bluffs drop down to the Susquehanna River, exposing west-facing bedrock outcrops along the railroad tracks paralleling the shoreline. This area supports four plant species of concern and one animal species of concern. The riverside forested habitat also provides an essential link in the Susquehanna River regional migratory corridor. Primary conservation goals: Prevent fragmentation and incursions into the forested landscape. The forest cover should be allowed to achieve and maintain old-growth characteristics. Create "no spray" zones along the most sensitive areas of the railroad rights-of-way to avoid unintentional destruction of the species of concern or their habitats. Develop a restoration plan for the small serpentine influenced habitat.	Pg. 299
Index Map #54	**Kelly's Run, Tobe Run** Martic Twp. *(Holtwood Quad)*	Location: The habitat is exceptionally scenic and hosts a portion of the popular Conestoga Trail. Ecological considerations: Scenic Kelly Run tumbles past impressive rock outcrops and scattered boulders though this steep-sided forested ravine on its way to the Susquehanna River. Four plant species of concern are currently known from this Natural Heritage Area. The deeper portion of the ravine is dominated by a hemlock-tuliptree-birch forest of high enough quality (for its type) to be considered an exceptional natural community. This large natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Prevent fragmentation of the forested landscape. Suppress the establishment and spread of invasive species of plants. The forest cover should be allowed to achieve and maintain old-growth characteristics. Most of this habitat is currently protected as a nature sanctuary by PPL and the Lancaster County Conservancy. If PPL chooses to divest itself of this property, it should be considered a high priority for conservation acquisition.	Pg. 325

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #18	**Lititz Run @ Conestoga River** Manheim & Upper Leacock Twps. *(Lancaster & Leola Quads)*	Location: Lititz Run joins the Conestoga River after passing underneath several busy roads including Route 222, north of Lancaster City. Ecological considerations: Small patches of woods occur sporadically along the banks of both Lititz Run and the Conestoga River here. Two different animal species of concern were documented at the confluence of these two creeks in the 1980's and 1990's, but have not been documented since. Both of these sensitive species of concern live and breed in the forested habitat along waterways and feed primarily on aquatic organisms in smaller streams and rivers. The core habitat for these sensitive species of concern is both the creek and the adjacent upland forest. Primary conservation goals: The riparian streamside forests need to be restored all along Lititz Run, the Conestoga River and its tributaries. Prevent the conversion of agricultural or natural lands adjacent to Lititz Run, the Conestoga River or its tributaries to residential or industrial development. Protect and expand the natural vegetation along the creek floodplain and adjacent upland.	Pg. 333
Index Map #35	**Little Conestoga Creek** Manor Twp. *(Columbia East, Conestoga, Lancaster & Safe Harbor Quads)*	Location: This Natural Heritage Area occurs along the Little Conestoga River west of the Borough of Millersville. Ecological considerations: The Little Conestoga River flows though a landscape dominated by urban and suburban development. Even so, much of the creek though this Natural Heritage Area retains a wide forested buffer. An animal species of concern lives and breed in the forested habitat along this waterway and feeds primarily on aquatic organisms in smaller streams and rivers. The core habitat for this species of concern is both the creek and the adjacent upland forest. Primary conservation goals: Conserve / restore the mature floodplain forests and the associated upland buffer forests along both shores of the Little Conestoga Creek and its tributaries.	Pg. 343
Index Map #9	**Little Muddy Creek** Lancaster County: Adamstown Boro, Brecknock & East Cocalico Twps. Berks County: Brecknock & Spring Twps. *(Sinking Spring & Terre Hill Quads)*	Location: This Natural Heritage Area spans the boundary between Brecknock and East Cocalico Townships in Lancaster County and also extends into Chester County. Ecological considerations: Wetland fragments within this landscape should be considered the backbone for a restoration of this habitat type in the Little Muddy Creek watershed. Primary conservation goals: Reestablish the slow moving marsh systems that once dominated this area. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. Reconnect habitats on either side of the PA Turnpike and Route 222 by reconfiguring stream culverts and bridges to allow for more successful animal migration.	Pg. 349
Index Map #58	**Midway Station, Wissler Ravine** Drumore Twp. *(Holtwood Quad)*	Location: This Natural Heritage Area occurs just south of Muddy Run Reservoir along the Susquehanna River and includes Susquehannock State Park. Ecological considerations: Four plant species of concern occur along the wooded ravines, steep forested slopes and exposed rock outcrops facing the Susquehanna River. The hilly topography has discouraged past conversion to other uses such as agriculture. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Preserve the forested connections along the Susquehanna River ravines. The rock outcrops along the railroad should be established as "no spray" zones and vegetation management conducted with the knowledge of rare plants in the immediate vicinity. The forest cover should be allowed to achieve old-growth characteristics.	Pg. 377

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #13	**Pequea Creek Headwaters** Salisbury Twp. *(Honeybrook Quad)*	Location: The tributaries that flow south from the Welsh Mountains enter the agriculturally dominated landscape of Pequea Creek valley. Ecological considerations: The species of concern inhabiting these wetland habitats requires specific plant communities with a mix of open canopied habitats. Carefully targeted woody vegetation removal may be necessary to maintain wetland openings preferred by this species. Primary conservation goals: Reestablish the slow moving marsh systems that once dominated this area. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes.	Pg. 411
Index Map #51	**Pequea Creek Woods** Conestoga & Martic Twps. *(Conestoga Quad)*	Location: This section of the creek is the boundary between Conestoga Township to the northwest and Martic Township to the southeast. Ecological considerations: Pequea Creek, at its confluence with the Susquehanna River, is hemmed in by steep forested slopes that rise approximately 300 feet from the stream banks to the hill summit. This site is mostly forested and hilly, with several patches of interior forest that contain three plant species of concern. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Conserve the current forest cover and improve or expand the amount of forest cover in non-forested areas. Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way. The forest cover should be allowed to achieve old-growth characteristics.	Pg. 417
Index Map #52	**Reed Run, House Rock Slope, Wind Cave Outcrop** Martic Twp. *(Conestoga & Holtwood Quads)*	Location: This Natural Heritage Area occurs along the Susquehanna River south of Pequea Borough. Ecological considerations: This area is composed of a variety of habitats including the steep, forested slopes overlooking the Susquehanna River, the river's floodplain and banks, and the richly vegetated Reeds Run ravine. Numerous bedrock outcroppings are exposed along the steep slope from the hill crests to the river. The Conestoga Trail parallels the river shoreline, traversing the slopes past House Rock, which provides a spectacular view of the Susquehanna River. Five plant species of concern and one animal species of concern have been documented in these habitats. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Safeguard the quality and expanse of the forested landscape. Prevent fragmentation of the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve old-growth characteristics.	Pg. 427
Index Map #47	**Refton Cave** Pequea, Providence, Strasburg & West Lampeter Twps. *(Conestoga & Quarryville Quads)*	Location: This Natural Heritage Area occurs along the Pequea Creek near the town of Refton. Ecological considerations: Refton Cave is a limestone solutional cave with large underground pools of water. The cave is home to several invertebrate cave species of concern, one of which, Refton cave planarian, is currently considered globally imperiled due to the very few known populations of this species in the world. Primary conservation goals: Protect and improve the quality of the groundwater by restoring the forested/vegetated floodplain of the Pequea Creek, Little Beaver Creek and the adjacent slopes and uplands to include all the area within 100-meters from the upper edge of the floodplain. Water quality improvement will benefit the local human communities as well as the habitat of the cave-dwelling species of concern present at this location. Implement an Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect ground water resources.	Pg. 435

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #31	**Safe Harbor Woods** Conoy, East Donegal, West Hempfield Twps, & Marietta Borough (Columbia West & York Haven Quads)	Location: This wooded habitat on the west side of the mouth of the Conestoga River contains steep-sided, narrow ravines that feed into the Conestoga River. Ecological considerations: The habitat is rich, and supports a diverse spring wildflower community. Exposed bedrock outcrops jut out from the scenic ridgeline and slopes along the river. Three plant and one animal species of concern have been documented within this wooded landscape. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Safeguard the quality and expanse of the forested landscape, especially as it extends into the supporting landscape between the branches of Witmer Run. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve and maintain old-growth characteristics.	Pg. 453
Index Map #49	**Shenk's Ferry Wildflower Preserve** Conestoga Township *(Conestoga Quad)*	Location: Shenk's Ferry is a wooded ravine along the Susquehanna River north of Pequea Borough. Ecological considerations: The lower slopes of this wooded ravine support a very rich and diverse herbaceous layer. This area is a popular destination for spring wildflower viewing. Among the rich diversity of spring wildflowers present, two plant species of concern have been documented from this location. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Provide for the long-term protection of the core habitat. The Shenks Ferry Wildflower Preserve is currently owned by PPL. If PPL chooses to divest itself of the property, it should be considered a high priority for conservation acquisition. Adjacent forested properties should be acquired or provided with conservation easements to help expand and provide a buffer to this habitat. Remove invasive species of plants. Reduce the size of the deer herd. Allow the forest to return to near old-growth conditions	Pg. 459
Index Map #33	**Silver Mine Park** Conestoga, Martic & Pequea Twps *(Conestoga Quad)*	Location: This area roughly parallels the Conestoga / Pequea Township boundary between the Conestoga River and Pequea Creek with Silver Mine Township Park occurring along Pequea Creek. Ecological considerations: This Natural Heritage Area is dominated by an agricultural landscape over limestone bedrock. Two cave invertebrate species of concern and a sensitive species of concern have been documented at two locations associated with underground passages. In addition, a sensitive species of concern uses the fields, pastures and wood edges of the agricultural landscape as its primary habitat. Primary conservation goals: Implement a Karst Hazard / Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect ground water resources. Restore the forested/vegetated floodplain of the Conestoga River, Pequea Creek and all their tributaries.	Pg. 465
Index Map #46	**Smithville Swamp** Providence Township *(Quarryville Quad)*	Location: This Natural Heritage Area consists of various patchy woodlots in an agriculture and residential dominated landscape. Ecological considerations: An interesting forested and open wetland within this area contains an unusual mix of plants more typically associated with the coastal plain of Delaware & New Jersey including five plant species of concern. Primary conservation goals: The primary goal should be to acquire the patch of wet woods described as a "Red maple-magnolia coastal plain palustrine forest" and the surrounding "Red maple terrestrial forest" as a dedicated nature preserve. Secondarily, other woodlots in the Natural Heritage Area should be considered potential species of concern habitat and connected to form a network of suitable habitat. Restore a forested buffer around the wetland habitat to help protect the sensitive wetland habitat from further encroachment	Pg. 471

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #43	**Stewart Run Woods** Colerain & East Drumore Twps. *(Wakefield & Kirkwood Quads)*	Location: Stewart Run flows through this wooded stream valley on its way to the West Branch of the Octoraro Creek. County owned Theodore A. Parker III Natural Area constitutes a large portion of the core habitat at this site. Ecological considerations: The steep ravine slopes in this valley contain a number of bedrock outcrops that provide habitat for lobed spleenwort, a small fern that grows on dry shaded cliffs and rock outcrops. Primary conservation goals: Much of Stewart Run Woods is interior forest and a primary conservation goal for this site is the maintenance of an intact forest canopy throughout the site. Permanently protect and maintain connectivity to adjacent forested land through acquisition or conservation easement. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species.	Pg. 485
Index Map #48	**Trout Run Ravine, Red Hill Hollow, Camp Snyder Woods** Conestoga, Martic & Providence Twps. *(Conestoga Quad)*	Location: This area contains Martic Township Park and Lancaster County Conservancy's Haver-Trout Run Nature Preserve. Ecological considerations: This hilly, forested tributary to Pequea Creek contains impressive rock outcrops, small wetlands and several significant blocks of interior forest. The variety of forest dominated natural communities provides suitable habitats for a large diversity of common native plants and animals as well as for six plant species of concern and two butterfly species of concern. Primary conservation goals: Provide for the long-term protection of the core habitat through conservation easements and fee-simple acquisition. Expand the protection of the habitat as a nature sanctuary by Lancaster County Conservancy and/or as an expansion of Martic Township Park. Any future park expansion should emphasize preserving viable natural communities rather than on active park facilities and infrastructure.	Pg. 489
Index Map #53	**Tucquan Glen** Martic Township *(Holtwood Quad)*	Location: This Natural Heritage Area is a wooded ravine that occurs along the Susquehanna River between Pequea Borough and Muddy Run Reservoir. Ecological considerations: This area contains a narrow, scenically outstanding, forested ravine that ends at the Susquehanna River, which supports a lush, diverse, relatively undisturbed herbaceous undergrowth. Along with a good diversity of native species the site also contains six plant species of concern. The hemlock-tuliptree-birch forest present within the ravine is a high-quality example of this forest community type. The age of the trees suggest nearly old growth conditions. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Prevent fragmentation of the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to maintain old-growth characteristics. The hemlock component of the forest is in jeopardy due to the infestation of hemlock woolly adelgid and would benefit from timely introduction of verified biological control agents for the pest. Much of the vulnerable habitat is already under the protection of the Lancaster County Conservancy. Conservation easements should be sought for adjacent forested and agricultural properties to help provide terrestrial connectivity along the Susquehanna River.	Pg. 495

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	High Significance		
Index Map #12	**West Branch Brandywine Creek** Lancaster County: Salisbury Township Chester County: Honey Brook Twp. *(Honey Brook & Wagontown Quads)*	Location: This Natural Heritage Area is primarily in Chester County, but includes a portion of the West Branch Brandywine Creek watershed near Route 322 in Salisbury Township. Ecological considerations: Most of the historic wetlands of this watershed were drained or dammed to create fields or farm ponds for agricultural production. The remaining wetland fragments should be considered the backbone for a restoration of this habitat type in the watershed. Four species of concern are currently known from these habitats. The species of concern inhabiting these shallow wetlands require specific plant communities within a matrix of open canopied habitats. Primary conservation goals: Maintain and restore this Natural Heritage Area as a floodplain wetland complex composed of multiple types of open and closed canopy wetlands. Provide for riparian connections between and among wetland habitats. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area by reestablishing the matrix of open canopied wetland complexes. Once the open habitat within the historic floodplain has been restored, light grazing could be an effective tool to maintaining the habitat for all wet meadow species.	Pg. 513
	Notable Significance		
Index Map #30	**Apollo Park** Lancaster County: Manor Twp. York County: Chanceford Twp. *(Safe Harbor Quad)*	Location: Though primarily in York County, this area includes the section of the Susquehanna River between Turkey Hill and the Safe Harbor Dam and the adjacent forested slopes in York County Ecological considerations: One plant and one animal species of concern are currently known to occur along this section of the river. In addition, the forested slopes on the western shore of the river contain relatively large blocks of interior forest. The river and adjacent forested and other natural habitats help provide a vital link in the Susquehanna River regional migratory corridor. Primary conservation goals: Coordinate the protection of this landscape between Lancaster and York Counties. Protect the natural vegetation along the shore of the river floodplain and the integrity of the large interior forest within the adjacent uplands by avoiding additional fragmenting features such as roads, residences and utility rights-of-ways.	Pg. 133
Index Map #17	**Brownstown** West Earl Township *(Ephrata &Leola Quads)*	Location: There is a strong curve in the Conestoga River just east of Brownstown where the floodplain widens and a small portion of the natural floodplain forest along the river remains intact. Ecological considerations: The small patch of forest here supports a breeding population of an animal species of concern that lives and breeds in the forested habitat adjacent to waterways and feeds primarily on aquatic organisms in smaller streams and rivers. This species is apparently not sensitive to human activity as it has been found in urban and suburban settings as long as the appropriate habitat is available. Primary conservation goals: Strict enforcement of zoning regulations to prohibit building activity within the 100-year floodplain of the Conestoga River would help protect the habitat of this species of concern. The forested floodplain along this stretch of the Conestoga may be an appropriate location for a municipal park serving Brownstown and West Earl Township. Emphasis should be on promoting a viable floodplain natural community rather than on active park facilities and infrastructure.	Pg. 153

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Notable Significance		
Index Map #23	**Chiques Creek Bluff** Rapho & West Hempfield Twps. *(Columbia East Quad)*	Location: Chickies Creek forms a series of tight loops as is passes along the border between Rapho and West Hempfield Townships. Ecological considerations: There are nearly vertical, north-facing limestone outcrops in several of these bends. One of these steep outcrops supports a population of jeweled shooting star, a plant species of concern. Primary conservation goals: Restore the forested canopy 100 feet from the top of the cliff to help provide cool, moist microclimate conditions necessary for the jeweled shooting star. Remove invasive species of plants that threaten the jeweled shooting star population. Very little natural habitat occurs in the vicinity of this section of Chiques Creek. Restoration of wide forested riparian corridors along Chiques Creek and all tributaries should be a priority for this section of the Chiques Creek watershed to help improve water quality and provide habitat and local migratory potential for many native animal and plant species.	Pg. 165
Index Map #2	**Conewago Creek** Lancaster County: Conoy, Mount Joy, & West Donegal Twps. Dauphin County: Londonderry Twp. *(Middletown & Elizabethtown Quads)*	Location: This Natural Heritage Area is designated along Conewago Creek between the Pennsylvania Turnpike to the Creek's confluence with the Susquehanna River. Ecological considerations: Large patches of forest in the area coincide with thin soils over diabase bedrock, which discouraged agricultural activities. Regard the Conewago Creek and the adjacent large forest patches of the diabase bedrock region as a single unit that combine to form a link in a regional migration corridor between the Furnace Hills and the Susquehanna River. Two freshwater mussel species of concern have been documented for the creek. Primary conservation goals: This area should be considered one of Lancaster County's top restoration priorities. Coordinate the protection and restoration of this landscape between Lancaster and Dauphin Counties. Conewago Creek should be considered potentially one of the primary forested riparian corridors in the County. The creek and surrounding natural habitats, with some careful restoration, can facilitate animal migration in an east-west direction, connecting the Furnace Hills forested corridor to the Susquehanna River. A wide forested, naturally vegetated corridor along both shores of the creek would be compatible with a linear park or trail system. The Conewago Recreational Trail already serves as the trail, but the area would benefit from the restoration of floodplain forests and marshes on both sides of the creek. This link is in danger of erasure due to infill from suburban sprawl. Prevent the conversion of agricultural or natural lands adjacent to Conewago Creek or its tributaries to residential or industrial development.	Pg. 207
Index Map #24	**Donegal Springs** East Donegal & West Donegal Twps *(Columbia West Quad)*	Location: Donegal Springs occurs on Donegal Presbyterian Church property west of Mount Joy Borough. Ecological considerations: A small cave-dwelling species of concern has been documented among the leaf litter where the spring empties into the pool. Primary conservation goals: The focus of conservation efforts for this species, and the underground cave habitat as a whole, is the protection of the quality of the groundwater. Consider implementing an Aquifer Protection Overlay Zone to help protect groundwater resources. Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution by buffered with native vegetation to help slow the flow of water before it enters the sinkhole. Avoid contamination of the groundwater by preventing agricultural, residential, industrial and roadway runoff from entering the system.	Pg. 243

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Notable Significance		
Index Map #16	**Ephrata Community Hospital** Ephrata Boro & Ephrata Twp. *(Ephrata Quad)*	Location: Indian Run joins Cocalico Creek at Ephrata Borough where small portions of the natural floodplain forest remain intact. Ecological considerations: The small patch of forest here supports a breeding population of a sensitive species of concern. The adjacent landscape is dominated by the Ephrata Borough and the neighboring suburbs. The core habitat for these sensitive species of concern is both the creek and the adjacent upland forest. This sensitive species of concern requires abundant food source in the river and breeding areas in the adjacent upland forest. Primary conservation goals: Improve the water quality of Cocalico Creek by protecting and expanding the natural forest/vegetation buffer along the creek, its floodplain and all its tributaries.	Pg. 259
Index Map #42	**Fulton View Woods** East Drumore & Little Britain Twps. *(Wakefield Quad)*	Location: This Natural Heritage Area occurs along the boundary between East Drumore and Little Britain Townships. Ecological considerations: The connected forested blocks represent an existing link in a habitat corridor supporting the Octoraro Creek watershed. American holly, a plant species of concern has also been documented in this forested habitat. Primary conservation goals: Maintain an intact forest canopy, which provides key habitat for American holly, helps to protect water quality of local streams and serves as a migratory corridor to the West Branch Octoraro Creek for many forest dependent species.	Pg. 275
Index Map #45	**Gleissners Swamp** Eden, East Drumore & Providence Twps. *(Quarryville Quad)*	Location: Ecological considerations: Gleissners Swamp is an isolated, streamside red maple-magnolia coastal plain palustrine forest that has largely been destroyed due to past conversions to agricultural activities and by recently expanded grazing. Though severely degraded, this relatively diverse community is ecologically significant as it represents an uncommon community in this part of the state that is more frequently found in coastal New Jersey and Delaware. It currently supports five plant species of concern, though historically, seven additional species of concern were documented from this location. Primary conservation goals: The overall objective for this area should be to restore and establish a wide forested/vegetated corridor between these isolated wetlands and Big Beaver Creek. The existing fragmented patches of habitat may be able to serve as the backbone of future habitat restoration efforts for this ecologically significant area. The wetland habitats at this location are too delicate to withstand recreational pressure and are not suitable for public use and instead should be preserved as a dedicated nature sanctuary.	Pg. 279
Index Map #15	**Hahnstown** Ephrata Township *(Ephrata & Terre Hill Quads)*	Location: This Natural Heritage Area occurs in Ephrata Township south of Route 222. Ecological considerations: This agriculture dominated area contains several small tributaries to the Conestoga River, but offers little natural habitat. In spite of the intensively cultivated landscape, the remnants of streamside vegetation have attracted a sensitive species of concern. Primary conservation goals: Restoration of wide forested riparian corridors along the Conestoga River and all its tributaries should be a priority for this watershed.	Pg. 295
Index Map #3	**Helt's Woods** Elizabethtown Boro & Mount Joy Twp. *(Elizabethtown Quad)*	Location: This small Natural Heritage Area occurs at the Elizabethtown exit ramp from Route 283. Ecological considerations: A small patch of a plant species of concern occurs in this fragmented patch of forest. There is more potential habitat for this plant in the large forested area on the eastern side of Route 283. Primary conservation goals: Consider this small patch of woods a part of the larger habitat corridor of the diabase bedrock area and the adjacent Conewago Creek.	Pg. 307

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Notable Significance		
Index Map #19	**Holland Heights** East Lampeter, Manheim & Upper Leacock Twps. *(Lancaster & Leola Quads)*	Location: This Natural Heritage Area occurs along the floodplain and adjacent riparian corridor of the Conestoga River north of the Borough of Eden. Ecological considerations: The Conestoga River though this area has a wide, well defined, naturally vegetated floodplain, while the surrounding uplands are nearly filled with suburban development. A sensitive species of concern has been documented along this section of the river. Primary conservation goals: Restoration of vegetated stream buffers along the Conestoga River and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conestoga River, Susquehanna River and the Chesapeake Bay.	Pg. 311
Index Map #21	**Indian Springs** East Hempfield, Penn & Rapho Twps *(Columbia East & Manheim Quads)*	Location: These spring openings occur near Chiques Creek south of Manheim Borough. Ecological considerations: A cave species of concern has been documented from two small springs in this intensively agricultural setting. The focus of conservation efforts for this species, and the subterranean habitat as a whole, is the protection of the groundwater quality. Primary conservation goals: Avoid contamination of the groundwater by preventing agricultural, residential and roadway runoff from entering the system. Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution by buffering with trees & native vegetation to help slow and filter the flow of water before it enters the sinkhole. Consider implementing an Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect groundwater resources.	Pg. 317
Index Map #22	**Ironville Mud Pond** West Hempfield Twp. *(Columbia East Quad)*	Location: A former quarry site north of Mountville contains three bodies of water resulting from past quarrying activity: Mud Lake, Grubb Lake and Purple Lake. Ecological considerations: A plant species of concern occurs on disturbed soils along the edge of the quarry pit. The surrounding woodlot is densely infested with invasive species and weed native plants. Primary conservation goals: Pursue acquisition of the other quarry pits and the remainder of the adjacent woodlot as an expansion of the Grubb Lake Public Park. No special management should be necessary for the plant species of concern as long as the current habitat conditions persist. The adjacent woodlot would benefit from the removal of low quality vegetation and invasive species of plants.	Pg. 321
Index Map #20	**Lititz Spring** Lititz Boro & Warwick Twp. *(Lititz Quad)*	Location: Lititz Spring is on private land owned and operated by the Lititz Moravian Congregation and maintained as a public park in the borough of Lititz. Ecological considerations: A cave species of concern has been documented from the spring. The focus of conservation efforts for this species, and the subterranean habitat as a whole, is the protection of the groundwater quality. Primary conservation goals: Avoid contamination of the groundwater by preventing agricultural, residential and roadway runoff from entering the system. Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution by buffering with trees & native vegetation to help slow and filter the flow of water before it enters the sinkhole. Consider implementing an Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect groundwater resources.	Pg. 339

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Notable Significance		
Index Map #60	**Lower Susquehanna River** Lancaster County: Drumore & Fulton Twps. York County: Peach Bottom Twp. Maryland: Cecil & Harford Counties *(Conowingo Dam, Delta, Holtwood & Wakefield Quads)*	Location: This Natural Heritage Area includes the section of the Susquehanna River south of the Conowingo Islands below the Holtwood Dam to the Pennsylvania / Maryland border. Ecological considerations: The flat water area backed up by the construction of Conowingo Dam in Maryland provides an important habitat to fish feeding birds. Mount Johnson Island also hosts one known plant species of concern. Primary conservation goals: Pursue conservation easements, transfer of development rights and fee simple acquisition on properties along the river shoreline, the adjacent slopes and forested plateaus to help conserve the effectiveness of the Susquehanna River natural corridor. Preserve and expand the native vegetation along the river corridor to include land within 300-meters of the river's floodplain and within 100-meters of all tributaries to the river.	Pg. 363
Index Map #55	**Muddy Run Reservoir** Drumore & Martic Twps. *(Holtwood Quad)*	Location: Muddy Run Reservoir was created by damming the Muddy Run Valley for power generation. It occurs south of Route 372 at the Susquehanna River. Ecological considerations: The man-made lake provides habitat for a nesting pair of Ospreys, which utilize aquatic habitats for food gathering and upland habitats or prominent features as nesting areas. The forested edge of the lake as well as the large body of water are both important habitat components for this species Primary conservation goals: Leave standing snags around the edge of the reservoir to increase nesting opportunities for Ospreys. Expand the forested buffer surrounding Muddy Run Reservoir to increase the water quality of the reservoir and improve habitat opportunities for other wildlife. Replace conifer plantations with native trees and shrubs to mimic quality natural communities in adjacent areas of similar topographic position.	Pg. 383
Index Map #41	**Octoraro Reservoir** Lancaster County: Colerain & Little Britain Twps, Chester County: Lower Oxford Twp. *(Kirkwood Quad)*	Location: Octoraro Reservoir is on the boundary between Lancaster and Chester Counties at the confluence of the east and west branches of Octoraro Creek. Ecological considerations: The Octoraro Reservoir occupies former agricultural and natural lands that were flooded to provide for a municipal water supply. Much of the surrounding area is owned by the Chester Municipal Water Authority. Two species of plants associated with open habitats and a sensitive species of concern can be found in this area. Primary conservation goals: A riparian buffer along all floodplains of all tributaries in the watershed should be restored to native herbaceous plants, shrubs and trees to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals.	Pg. 395
Index Map #34	**Owl Bridge, Stehman Church Woods** Manor Twp. *(Conestoga & Safe Harbor Quads)*	Location: This area southwest of Millersville includes the confluence of the Little Conestoga Creek and the West Branch of the Little Conestoga Creek and the associated upstream habitats. Ecological considerations: Floodplain and limestone outcrop habitats along both creeks provide the necessary habitat for two plant species of concern. In addition, the natural habitats along the creeks help to provide a link in a local migratory corridor connecting the Little Conestoga Creek to the Susquehanna River. Primary conservation goals: The long term goal for the area should be to conserve/restore the mature floodplain forests and the associated upland buffer forests along the Little Conestoga Creek, the West Branch of the Little Conestoga Creek and their tributaries. The habitats at this location are well on their way towards a functioning riparian buffer, and with additional attention could become a model for other restoration activities.	Pg. 401

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Notable Significance		
Index Map #61	**Peters Creek** Fulton Twp. *(Wakefield Quad)*	Location: Peters Creek flows through a partially wooded, partially agricultural landscape in western Fulton Township before emptying into the Susquehanna River. Ecological considerations: Wet meadows within the floodplain of the creek provide the necessary habitat for elephant's foot, a plant species of concern. Primary conservation goals: Protect natural habitats along the creek floodplain through land acquisition, conservation easements, and riparian restoration initiatives.	Pg. 423
Index Map #32	**Safe Harbor East Woods** Conestoga Twp. *(Conestoga & Safe Harbor Quads)*	Location: This Natural Heritage Area occurs on the south side of the Conestoga River where it empties into the Susquehanna River. Ecological considerations: The area is dominated by a hardwood forest with a rich herbaceous layer along the steep slopes of several unnamed streams and includes two large interior forest patches. A single plant species of concern has been documented here. Approximately half of the Natural Heritage Area is owned by Safe Harbor Power Company. Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Primary conservation goals: Provide for the long-term protection of the core habitat. Consider fee-simple acquisition, or conservation easement options with the largest property owners of the core habitat outside of the Safe Harbor Water Power Corporation property holdings. Allow the forest to return to near old-growth conditions. Reduce the size of the deer herd.	Pg. 447
Index Map #10	**State Game Lands #52** Brecknock & Caernarvon Twps. *(Morgantown Quad)*	Location: This Natural Heritage Area occurs between the PA Turnpike and the Lancaster/Berks County line the in northeastern part of the county. Ecological considerations: This is a small portion of a larger forest on diabase bedrock that contains a small population of a plant species of concern. The adjacent forested landscape includes relatively large patches of interior forest that connect to the larger forested landscape of northern Lancaster County and western Berks County. Much of the forest understory is dominated by invasive species of shrubs. Primary conservation goals: Preserve and improve the quality and expanse of the intact forested landscape. Establish habitat connections between the north and south sides of the PA Turnpike through the construction of green underpasses, overpasses and culverts.	Pg. 477
Index Map #39	**Steelville Hollow** Lancaster County: Sadsbury Twp. Chester County: West Fallowfield Twp. *(Gap & Parkesburg Quads)*	Location: This Natural Heritage Area occurs along the West Branch Octoraro Creek at the Lancaster / Chester County boundary. Ecological considerations: Steep wooded hillsides border the East Branch of the Octoraro Creek at this site and create a deep stream valley. These slopes provide important habitat for two plant species of concern. The viability of existing populations of these plants, and their rock outcrop habitat may be enhanced by maintaining a surrounding buffer of forest. Primary conservation goals: Permanent protection of the forest habitat, particularly in the core habitat, through conservation easements or acquisition should be a priority. Management should focus on limiting disturbance, maintaining an intact forest canopy and expanding forest coverage.	Pg. 481

Index Map #	Natural Heritage Area Name Municipalities *(USGS quadrangles)*	Description	Page #
	Notable Significance		
Index Map #62	**Wakefield** Fulton Twp. *(Wakefield Quad)*	Location: This Natural Heritage Area occurs along the Conowingo Creek just south of Wakefield Borough. Ecological considerations: The Conowingo Creek in this Natural Heritage Area passes though a landscape dominated by agricultural activities. Small patches of forest occur along its banks. In places, the floodplain widens into wet meadow habitats. The core habitat for this sensitive species of concern is both the wider streams in the area and the adjacent forest patches. Primary conservation goals: Implement the conservation / restoration of a wide strip of native vegetation as a terrestrial habitat corridor along the creek floodplain and all its tributaries. Prevent the conversion of agricultural or natural lands adjacent to Conowingo Creek, or its tributaries to residential or industrial development. Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well as building activities.	Pg. 503
Index Map #14	**Welsh Mountains** East Earl Township Salisbury Township *(Honeybrook & New Holland Quads)*	Location: This Natural Heritage Area includes the adjacent large blocks of interior forest referred to as the Welsh Mountains that surround the watershed for New Holland Reservoir. Ecological considerations: Several streams originate in the area and flow through a predominantly dry-oak heath forest on their way to the reservoir. The large forested blocks at this site should be considered one of the primary natural corridors of the county. This area also supports three plant species of concern. Primary conservation goals: Prevent fragmentation of the forested landscape. Management of lands should focus on maintaining the large intact forest canopy. Two of the plant species of concern prefer open habitats. Active management - such as fire, mowing, or invasive species removal - is often required to maintain the proper successional stage at sites where it grows.	Pg. 507
	Local Significance		
Index Map #63	**Oakryn Barren** Fulton & Little Britain Twps. *(Wakefield Quad)*	Location: This Natural Heritage Area occurs along the Little Conowingo Creek east of Wakefield Borough at the Fulton / Little Britain Township border. Ecological considerations: This area currently contains no known species of concern, but has the potential for restoration of serpentine barrens habitats. The bedrock geology is serpentine and the thin coniferous woods resemble similar habitats prior to restoration activities. Primary conservation goals: Conduct surveys of the area for potential serpentine habitat restoration. Connect this habitat to similar habitat at New Texas along the serpentine bedrock geology and Little Conowingo Creek.	Pg. 393

Conservation Recommendations

The following are general recommendations for protecting the biological diversity of Lancaster County.

1. Incorporate Lancaster County NHI information into planning efforts at the county, municipal and regional level. Consider the NHI information as the backbone for future Greenways planning efforts within this area.
2. Create or expand funding opportunities to support planning, acquisition and stewardship of natural areas.
3. Encourage conservation initiatives for natural areas on private land.
4. Prepare management plans that address species of concern and natural communities.
5. Provide for low-impact buffers around natural areas.
6. Protect and improve conditions of streams, rivers and other bodies of water.
7. Reduce fragmentation of surrounding landscape.
8. Encourage local grassroots organizations (watershed groups, Environmental Action Committees, etc.) to work for the protection and maintenance of natural areas.
9. Manage for invasive species. The formation of a "Weed Warriors Program" can help empower local citizenry to engage in restoration activities.
10. Encourage community education on ecology, biodiversity and habitat management.

The following are long range conservation goals for Lancaster County:

A combination of efforts will be necessary to provide for the future health of the ecological resources of Lancaster County and to link them with those of the surrounding landscape. These include the active stewardship of specific sites that host unique species and communities, broader-scale planning to maintain and improve the connectivity of its forested regions, and restoration efforts to alleviate water pollution and restore ecological function to damaged landscapes and waterways.

Conservation of habitats for uncommon species has been a primary focus of past County Natural Heritage Inventories. These species typically inhabit small, distinct natural community types that could easily be eliminated by any number of unfortunate events, natural and man-made. Besides the conservation of rare species, this report focuses on conserving and improving the health of the habitats of common species, to help prevent them from becoming rare in the future. A major component of this aspect will be to maintain natural connections within the landscape, to provide a green infrastructure that provides natural linkages between and among habitats.

A major obstacle to overcome for of all of these recommendations is to secure funding for their implementation. It is beyond the capacity of this report to identify those potential sources.

1. Primary conservation actions should focus on securing protection for those Natural Heritage Areas ranked "Exceptional" and for broad swaths of natural habitats that function as regional migratory pathways.
    a. Protect the globally rare State Line Serpentine Barrens Natural Communities. Active management will be necessary to maintain ecological conditions favorable for the globally rare species of concern within these habitats. Coordinate the protection of this landscape between Lancaster and Chester Counties and the state of Maryland.
    b. Protect the forested ravines, slopes, floodplains and river bedrock communities on both shores of the lower Susquehanna River. Coordinate the protection of this landscape between Lancaster and York Counties. Allow the gorges and slopes of the lower Susquehanna River to achieve and maintain old growth conditions.
    c. Protect the quality of cave habitats within the county. The porous nature of limestone bedrock allows groundwater to directly enter cave systems though sinkholes and other fissures. Implement restoration measures to prevent the contamination of groundwater though surface entryways.

2. Preserve, enhance and restore migratory pathways among and between Natural Heritage Areas both locally and regionally.

a. The Susquehanna River, Furnace Hills and Welsh Mountains areas are essential parts of regional migratory pathways through Lancaster County to other parts of Eastern North America and beyond. Preserve, enhance and restore the uninterrupted connection between natural habitats. Protect or restore at least a 300 meter wide strip of native vegetation along both shores of the Susquehanna River where current open space provides this opportunity. Establishment of a 300 meter wide, permanently protected corridor of natural vegetation will help provide habitat and a regional migration corridor for many species of plants and animals.
    i. While the lower Susquehanna River provides an excellent migratory opportunity, the eastern shore of the river north of Turkey Hill will require habitat restoration.
    ii. The Furnace Hills provides habitat and migratory potential across most of northern Lancaster County, but fails to adequately connect to the Susquehanna River. The link between the Furnace Hills and the Susquehanna River along Conewago Creek is in need of restoration.
    iii. Reestablish habitat connections between the north and south sides of the PA Turnpike and other major roadways through the construction of green underpasses, overpasses and culverts. These major roads are impenetrable barriers for many animals, severing the potential for migration and genetic mingling of populations.
b. Protect, enhance and restore wide, native vegetation buffers for all streams, creeks and natural wetlands in the county. In addition to improving water quality for humans and the environment, vegetated riparian buffers can help maintain local and regional migratory pathways. Streams within the county vary in the quality of their riparian buffers. While many streams in the county have wide, forested riparian zones, many streams still completely lack stream side vegetation.
    i. Recognize the 100-year floodplain as part of an active waterway. The riparian buffer should begin at the upper edge of the 100-year floodplain to lessen the impact of human modified landscapes and activities on the river system. The riparian buffer should extend inland optimally 100 meters from the upper edge of the floodplain. Other lesser buffer widths are acceptable as necessary to accommodate existing dwellings and infrastructure, but new construction should be strongly discouraged from this riparian zone.
    ii. Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible. Priorities for restoration of historic floodplain topography should be where the end result would be a functioning floodplain wetland habitat.
    iii. Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous open wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur beyond the historic floodplain of the drainages.
    iv. Restoration efforts should be designed to mimic nearby natural community types of similar topographic and hydrologic conditions by encouraging or planting a similar composition of native trees and shrubs. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
    v. Reestablish the slow moving marsh systems that dominated many of the County's floodplains before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. This may require that road crossings involve bridge systems that would preserve the wide, sluggish waters associated with marshes and slow flowing waterways. Allow beaver activity to help provide cyclical wetland succession in the riparian landscape.

c. Other considerations:

i. The three dams on the Susquehanna River in Lancaster County currently trap much of the sediment and nutrients suspended in the river water before it enters the Chesapeake Bay. These dams are rapidly approaching their sediment holding capacity and are predicted to no longer serve this function in the near future. One of the most important ways to mitigate the loss of this sediment holding capacity is to reduce the amount of sediment and nutrients entering all tributaries to the Susquehanna River. The establishment of wide vegetated riparian buffers can be the most effective means of trapping and filtering sediment and nutrient loads before they enter the Susquehanna's tributaries.
ii. The vegetation communities of the County represent a variety of habitat types. Some of these areas are of higher quality, and could be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor and the associated uplands within the County. Those forests identified as "modified successional forest" are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers. Tilled fields, pastures and wet meadows within the floodplain can potentially be restored back to floodplain forest or other open wetland habitats as appropriate to the topography and hydrology.
iii. Vegetation maintenance crews should be knowledgeable or instructed about the distinction between native and non-native species of plants. Vegetation management should be conducted selectively to reduce invasive species while encouraging the development of native species. Indiscriminate use of mowing, brush-hogging or herbicides should be discouraged.

3. Use the Natural Heritage Inventory in Lancaster County Planning Processes: The following are recommendations that will serve to incorporate the information in this report into planning and land conservation activities in Lancaster County.
    a. The county should work to incorporate the NHI into the implementation of the Green Infrastructure Plan and consequently, the County Comprehensive Plan and to use the NHI to guide future planning, subdivision review, acquisition, development and conservation initiatives.
        i. Make the NHI report available to all municipalities in the county and to local watershed and conservation organizations, such as the Lancaster County Conservancy. GIS layers resulting from the NHI will be available from the Lancaster County GIS Department.
    b. Revise the county future land use planning map by incorporating the NHI core sites into parameters used for designating the Natural Resource Protection Area and the Rural Development Area. Some of the Natural Heritage Areas, such as pastoral features and karst resources, can be compatible with rural land uses, given that appropriate management practices are encouraged, and could be incorporated into the Rural Development Area. Others would be more consistent with the Natural Resource Protection Areas.
    c. Potential zoning options for conservation enhancement:
        i. Pequea Township has a Karst Hazard Overlay District in Article IV-B of its Zoning Ordinance which helps to provide protection of groundwater resources. Other Municipalities with Karst features should consider adopting similar ordinances.
        ii. Most, if not all Townships in the County, have zoning ordinances restricting new development within the floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses. Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff

into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.

iii. Areas currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest cover / natural wetland communities.

iv. Establish a "Riparian Buffer Zoning District" along all watercourses in the county. Lancaster Township's floodplain regulation appears to provide for the establishment of a 100-foot forested riparian buffer on all water courses in the Township, but this may also conflict with a regulation requiring only a 15–foot grass strip between tilled land and water courses (Section 1310.8 A-E). A 100-foot forested riparian buffer along all water courses is a reasonable and achievable goal and would go a long way towards protecting and improving water quality locally as well as regionally, while the 15-foot grass strip will offer a bare minimum of water quality protection. The riparian buffer regulation could go further by beginning at the upper edge of the 100-year floodplain to provide protection for the entire aquatic system, which the floodplain is a part of and by extending 100-meters inland to provide plant and animal habitat and migratory corridors as well as water quality protection.

v. Many Townships have zoning designations that attempt to preserve open space by implementing a Conservation District zone. These regulations typically restrict the minimum building lot to 2 acres or more. While allowing a veneer of habitat to remain under fully built conditions, these regulations do little to protect the intended resources. It would be better to allow cluster housing on a similar footprint percentage of the area and avoid fragmenting the remaining forested habitat with the infrastructure associated with single family dwellings.

vi. Growth within the County should be discouraged to occur within 100 meters of the 100-year floodplain of any water course in the County.

vii. Growth within the County should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary destruction of natural habitat and prime farmland. Municipal and regional land use plans can support connectivity through green infrastructure by encouraging residential or commercial projects to re-develop in existing town centers or re-use previously altered landscapes, rather than orienting new infrastructure through unfragmented natural landscapes.

Environmental Review Considerations:

o *Evaluating Proposed Activity Within Natural Heritage Areas*. A very important part of encouraging conservation of the areas identified within the Lancaster County NHI is the careful review of proposed land use changes or development activities that overlap with Natural Heritage Areas. The following overview should provide guidance in the review of these projects or activities.

- Always contact the Lancaster County Planning Commission.

The County Planning Commission should be aware of all activities that may occur within Natural Heritage Areas in the county so that they may interact with the County Conservation District and other necessary organizations or agencies to better understand the implications of proposed activities. They can also provide guidance to the landowners, developers, or project managers as to possible conflicts and courses of action.

- Conduct free online preliminary environmental reviews.

Applicants for building permits should conduct free, online, environmental reviews to inform them of project-specific potential conflicts with sensitive natural resources. Environmental reviews can be conducted by visiting the PNHP website, at http://www.naturalheritage.state.pa.us/. If conflicts are noted during the environmental review process, the applicant is informed of the steps to take to minimize negative effects on the county's sensitive natural resources. If additional information on species of special concern becomes available during environmental review, the review may be reconsidered by the jurisdictional agency.

Depending upon the resources contained within the Natural Heritage Area, the agencies/entities responsible for them will then be contacted. The points of contact and arrangements for that contact will be determined on a case-by-case basis. In general, the responsibility for reviewing natural resources is partitioned among agencies in the following manner:

- *U.S. Fish and Wildlife Service:* all federally listed plants or animals.
- *Pennsylvania Game Commission:* all birds and mammals.
- *Pennsylvania Fish and Boat Commission*: all reptiles, amphibians, fish, and aquatic invertebrates.
- *Pennsylvania Department of Conservation and Natural Resources*: all plants, all natural communities, and terrestrial invertebrates (with PNHP).

Questions regarding potential conflicts between proposed projects and species of concern mentioned in this report should be directed to the Environmental Review Specialist at the PNHP office in Harrisburg (717) 772-0258. (http://www.naturalheritage.state.pa.us/)

PNHP and agency biologists can provide more detailed information with regard to the location of natural resources of concern in a project area, the needs of the particular resources in question, and the potential impacts of the project to those resources.

- Plan ahead.

If a ground survey is necessary to determine whether significant natural resources are present in the area of the project, the agency biologist reviewing the project will recommend a survey be conducted. PNHP, through the Western Pennsylvania Conservancy (WPC), or other knowledgeable contractors can be retained for this purpose. Early consideration of natural resource impacts is recommended to allow sufficient time for thorough evaluation. Given that some species are only observable or identifiable during certain phases of their life cycle (i.e., the flowering season of a plant or the flight period of a butterfly), a survey may need to be scheduled for a particular time of year.

- Work to minimize environmental degradation.

If the decision is made to move forward with a project in a sensitive area, PNHP can work with municipal officials and project personnel during the design process to develop strategies for minimizing the project's ecological impact while meeting the project's objectives. The resource agencies in the state may do likewise.

Finally, preliminary consultation with PNHP or another agency does not take the place of the environmental review. However, early consultation and planning as detailed above can provide for a more efficient and better integrated permit review, promoting a better understanding among the parties involved as to the scope of any needed project modifications.

INTRODUCTION

Lancaster County is historically one of the most productive agricultural counties in the country. The county is approximately 980 square miles and contains many areas of natural vegetation and approximately 1100 miles of waterways that contribute to the quality of life in the County. The Lancaster County Natural Areas Inventory (1990), or CNAI, identified 45 species of concern and 6 exemplary community types at 27 locations, including the Serpentine Barrens at New Texas and Rock Springs, and 23 areas of local significance for open space conservation. The 1993 Lancaster CNAI update refined the information on species of concern and plant communities in the county.

In the intervening years, Lancaster County, and in particular, the Lancaster County Conservancy has taken steps to protect many of these areas and greenways. However, many of the remaining natural areas are not only isolated by agriculture, but now suburban sprawl development is taking over much of the prime farmland and moving into many of the remaining, unprotected natural lands.

Increasingly, farmland and open space is being sold and developed for residential and commercial uses. Farms represent many generations of cultural heritage and some farms contain a natural component or are adjacent to a natural area. In addition to maintaining high quality agricultural soils for food production, a primary goal of the county should be to ensure that there is sufficient green space in the county to protect air and water quality, to provide for open-space recreation, scenic vistas, and that the remaining natural areas can continue to support native species of plants and animals in a functioning ecosystem.

An ecosystem is "the complex of interconnected living organisms inhabiting a particular area or unit of space, together with their environment and all their interrelationships and relationships with the environment" (Ostroumov 2002). All the parts of an ecosystem are interconnected—the survival of any species or the continuation of a given natural process depends upon the system as a whole, and in turn, these species and processes contribute to maintaining the system. An important consideration in assessing ecosystem health is the concept of biodiversity. Biodiversity can be defined as the full variety of life that occurs in a given place, and is measured at several scales: genetic diversity, species, natural communities, and landscapes.

Like most of southeastern Pennsylvania, very little of Lancaster County's landscape has been left in a "natural" state. Most of the land is relatively flat, very fertile and was converted to agricultural production long ago. The areas that were left with a forest canopy were typically those areas that were too steep, wet or stony to plow. These undeveloped lands are the primary locations for the native plants and animals of the county including those considered rare, threatened or endangered of extinction at the state or federal level.

The goals of this report are to identify areas important in sustaining biodiversity at the species, natural community and landscape levels and to provide that information to more fully inform land use decisions. Conservation of these habitats for "species of concern" has been a principal focus of past County Natural Heritage Inventories. These species typically inhabit small, distinct natural community types that could easily be eliminated by any number of unfortunate events, natural and man-made, making their chances for continued survival that much more precarious. Besides the conservation of species of concern, this report focuses on conserving and improving the health of the habitats of common species, to help prevent them from becoming rare in the future. A major component of this aspect will be to maintain natural connections within the landscape, to protect and enhance a "green infrastructure" that provides natural linkages between and among habitats. Without natural connections, these habitats become isolated islands in a sea of human-impacted landscape.

These "habitat islands" serve as a refuge for many common native species as well as species of concern. However, many natural habitats have been degraded by invasive exotic plants and animals, lessening the ability of these areas to support native species. As development begins to completely surround native habitat islands, native species are less able to maintain populations due to isolation, habitat degradation and competition from non-native species.

The natural areas that comprise the natural heritage of Lancaster County can be easily lost without careful planning of growth and development. Ironically, the scenic and remote nature of these areas may make them prime targets for residential developments. Protecting the integrity of these natural systems provides benefits to humans as well as providing for the survival of all flora and fauna, rare and otherwise. Planning for long-term sustainability can maintain open space that is inclusive of natural environments and the plants and animals associated with them.

Using a Natural Heritage Inventory as a conservation planning tool can steer development away from environmentally sensitive areas, creating a needed balance between growth and the conservation of scenic and natural resources.

It is important that county and municipal government, the public, developers, and planners know the location of such environmentally sensitive areas in order to maintain a balance and protection of these areas. Knowing where these areas are located can help prevent potential land-use conflicts, and help focus conservation efforts and limited funds to the most vulnerable areas. The Pennsylvania Natural Heritage Program (PNHP), under contract with the Lancaster County Planning Commission, has undertaken this project to provide a document and maps that will aid in the identification of these important areas.

This Natural Heritage Inventory (NHI) report presents the known outstanding natural features in Lancaster County. The Inventory provides maps of the best natural communities (habitats) and the locations of animal and plant species of special concern (rare, threatened, or endangered) in Lancaster County. The maps do not pinpoint the location of the species of concern but rather represent the actual habitat as well as likely adjacent habitat for the species. A written description and a summary table of the areas, including quality, degree of rarity, and last-observed date, accompany each map. Potential threats and suggestions for protection of the habitat for the species of concern are included the individual site descriptions.

The information and maps presented in this report provide a useful guide for conserving natural areas, for sighting recreational parks, for planning commercial and residential developments, and for setting priorities for the preservation of the most vulnerable natural areas in the county. All of the natural areas in this report were evaluated for their importance in protecting biological diversity on a state and local level, but many also have scenic value, provide water quality protection, and are potential areas for low-impact passive recreation, nature observation, and/or environmental education.

The NHI will be provided to each municipality through the Lancaster County Planning Commission. The NHI is a conservation tool that will aid in the creation of municipal, county, and comprehensive plans. Its emphasis on biological diversity should inform county and regional open space plans already underway. Lancaster County, its municipalities, land trusts, and other organizations can also use the NHI to identify potential protection projects that may be eligible for funding through state or community grant programs such as the Growing Greener II fund.

Landowners too may find this inventory useful in managing and planning for the use of their land; it gives them the opportunity to explore alternatives that will provide for their needs and still protect the species and habitats that occur on their land. For example, the Forest Stewardship program, coordinated by DCNR's Bureau of Forestry, assists landowners in creating management plans. This plan incorporates landowner objectives (e.g., wildlife or timber management) as well as enhances habitats for natural resources. Other programs include the USDA's Forest Legacy Program, the Pennsylvania Department of Agriculture's Agricultural Land Preservation Program, and landowner assistance programs within PGC and PFBC. Land managers may wish to consult with this report and the PNHP in an effort to avoid potential conflicts in areas with species of special concern and/or identify ways of enhancing or protecting this resource. Users of this document are encouraged to contact the Middletown office of the PNHP (717-948-3962) for additional information.

Questions regarding potential conflicts between proposed projects and species of concern mentioned in this report should be directed to the Environmental Review Specialist at the PNHP office in Harrisburg (717) 772-0258. (http://www.naturalheritage.state.pa.us/)

Particular species names, common and scientific, are provided in coordination with the appropriate jurisdictional agency. Plants, natural communities, and terrestrial invertebrates are under the jurisdiction of the PA Department of Conservation and Natural Resources (DCNR). Mammals and birds are under the jurisdiction of the PA Game Commission (PGC). Aquatic animals, reptiles, and amphibians are under the jurisdiction of the PA Fish and Boat Commission (PFBC). Some species of concern are often subject to unauthorized collection and are therefore not identified in the text of this report, at the request of the agencies, in order to provide some measure of protection.

NATURAL HISTORY OVERVIEW OF LANCASTER COUNTY

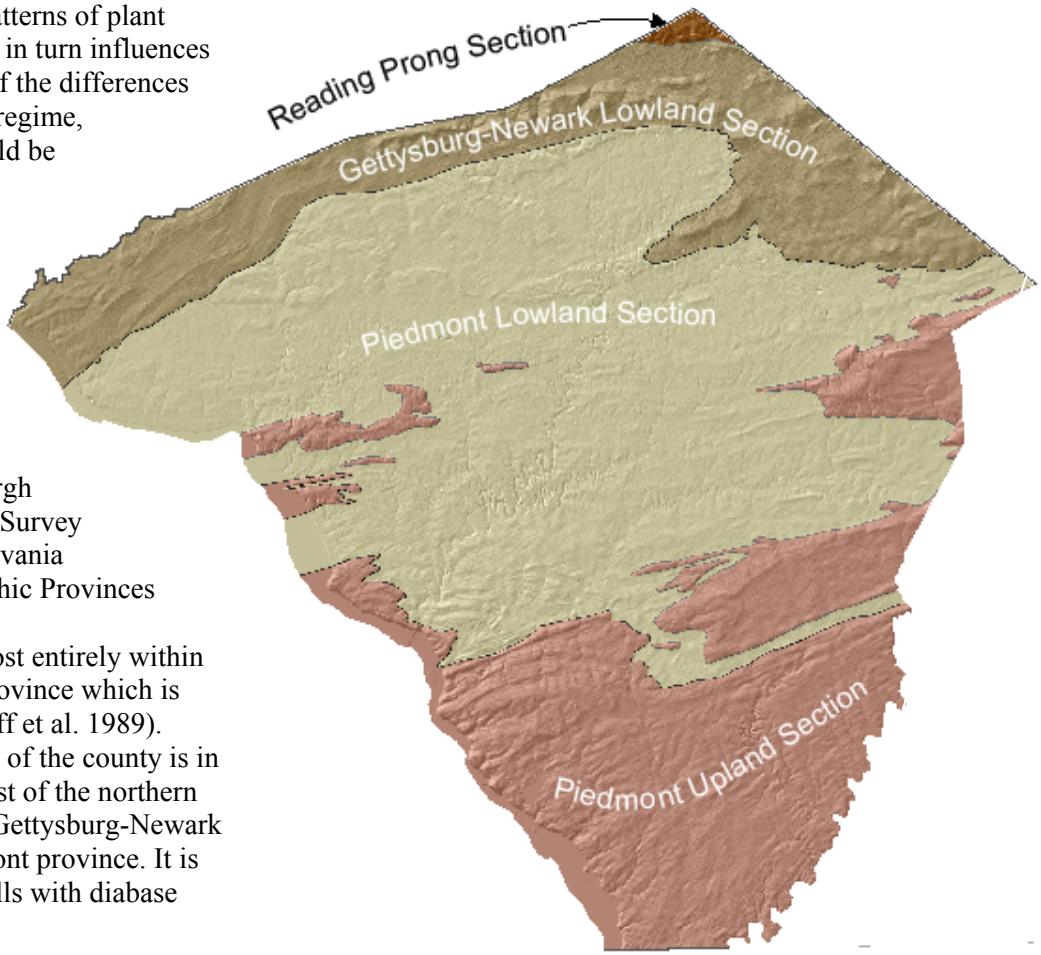
The climate, topography, geology, and soils have been particularly important in development of ecosystems (forests, fields, wetlands) and physical features (streams, rivers, mountains) that occur in Lancaster County. Many disturbances, both natural and human, have been influential in forming and altering many of Lancaster Counties' ecosystems, causing extinction of some species and the introduction of others. These combined factors provide the framework for locating and identifying exemplary natural communities and species of concern in the county. The following sections provide a brief overview of the physiography, geology, soils, surface water, and vegetation of Lancaster County.

Physiography and Geology

Characteristic landscapes and distinctive geological formations classify a Physiographic Province. Physiography relates in part to a region's topography and climate. These two factors, along with bedrock type, significantly influence soil development, hydrology, and land use patterns of an area. Additionally, both physiography and geology are important to the patterns of plant community distribution, which in turn influences animal distribution. Because of the differences in climate, soils, and moisture regime, certain plant communities would be expected to occur within some provinces and not in others. Physiographic and geologic information was obtained from many sources including Ground Water in Northeastern Pennsylvania (Lohman 1957), The Geology of Pennsylvania (PA Geological Survey and Pittsburgh Geological Survey 1999), Soil Survey of Lancaster Counties, Pennsylvania (USDA 1985), and Physiographic Provinces of Pennsylvania (Sevan 2000).

Lancaster County lies almost entirely within the Piedmont physiographic province which is divided into three sections (Cuff et al. 1989).

- While the northernmost tip of the county is in the Reading Prong section, most of the northern portion of the county is in the Gettysburg-Newark Lowland Section of the Piedmont province. It is characterized by low rolling hills with diabase bedrock geology. Large rounded boulders are commonly exposed above ground. Most of this province in Lancaster County is forested due to the diabase bedrock which prevented its conversion to agricultural production.
- The Piedmont Lowland Section makes up most of the central portion of the county. This relatively flat area is underlain by limestone and dolomite bedrock which results in very high quality agricultural soils. Large expanses of agricultural production dominate this area, which is quickly being replaced by suburban development. Caves, sinkholes, springs and other karst features are common in this section as water has dissolved a network of fissures through the limestone bedrock.
- The Piedmont Upland Section is characterized by gently rolling hills and valleys over a predominantly schist bedrock. Smaller farms interspersed with woodlots and stream valleys characterize this landscape. The lower gorges of the Susquehanna River are part of this section. Spectacular views can be had of the region from several lookouts including Chickies rock, House Rock and the Pinnacle Overlook.



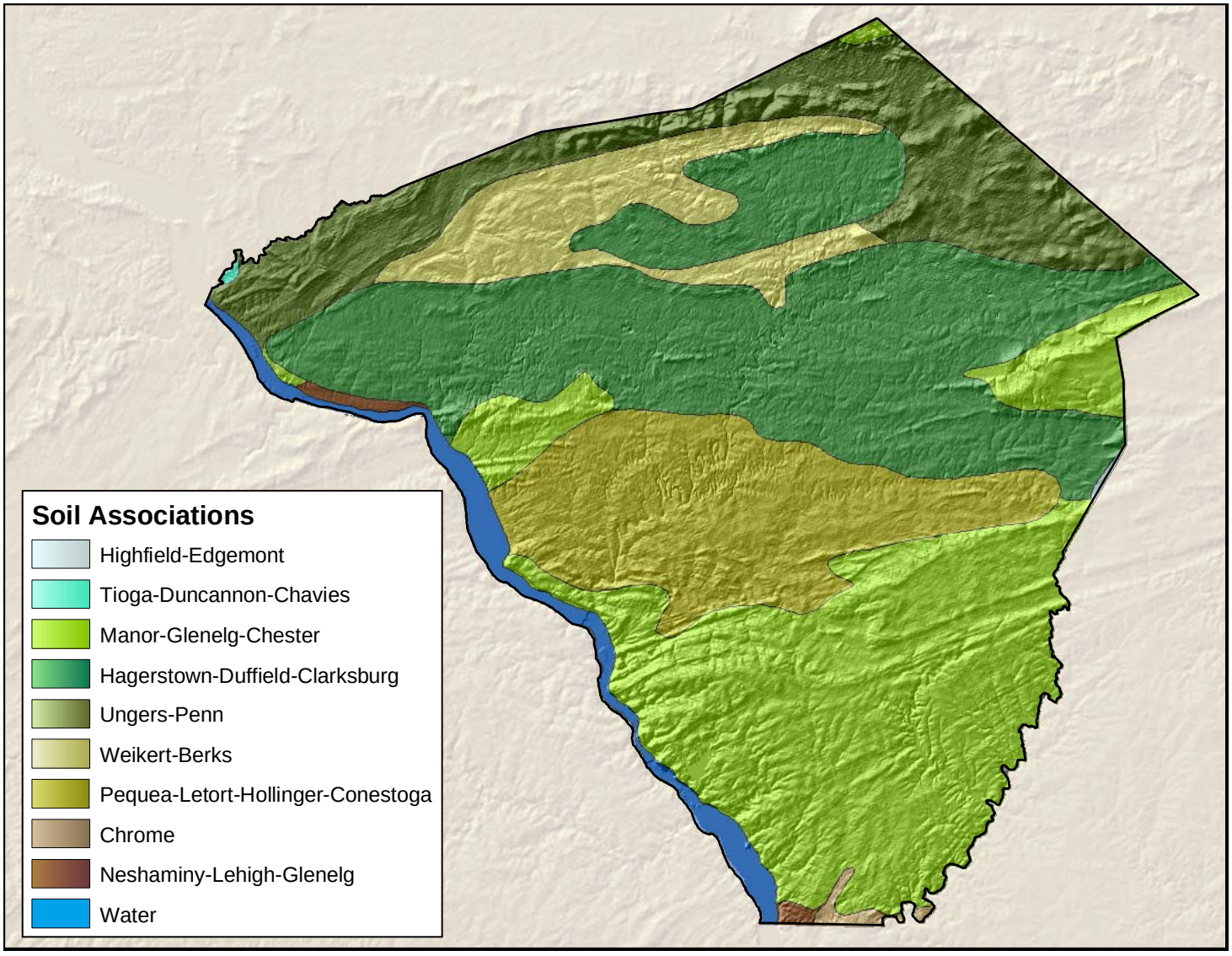
Physiographic Provinces of Lancaster County

Soils

The soils and parent bedrock geology play a very significant role in the ecological composition of the region. A soil association is a group of soils with a distinctive, proportional pattern of occurrence in the landscape. There have been nine soil associations mapped for Lancaster County.

For more information on the soils and geology of Lancaster County please refer to the appropriate references. This depiction of the soils of Lancaster County comes from The Soil Survey of Juniata and Lancaster Counties (USDA, 1981) and more recent information provided by the Lancaster County Conservation District.

Figure X. Soil Associations of Lancaster County



Vegetation

The interaction of geology and climate produces the pattern of vegetation expressed on the landscape. Vegetation provides several critical functions in the landscape including the regulation of biogeochemical cycles (water, carbon and nitrogen), soil formation and wildlife habitat. The classification of vegetation communities typically revolves around the dominant species, habitat and their growth form. Discussion of vegetation communities in this report is divided between terrestrial forested communities and wetland communities. Boundaries between community types in the field are generally less distinct. A sampling of community types are presented below.



a pre and post chestnut blight forest

Forest Communities

Lancaster County lies within the Oak-Chestnut Forest Region as described by Braun (1950). The American chestnut once dominated Lancaster County like many of the Eastern North American Hardwood Forests from Maine to Alabama to the Mississippi River. However, around 1904, a chestnut blight (*Cryphonectria parasitica*) was introduced to North America from Asia. The blight spread from the Bronx Zoo northward and southward, and by 1960, there were basically no mature chestnuts left standing. Today, some young sprouts and shoots still remain, but very few will ever reach maturity due to the blight. The loss of the chestnut from the canopy left huge breaks all across the eastern United States. These holes have since filled with many of the chestnut's associated species, including species of oak and hickory.

These oak species comprise the Appalachian Oak Forest, which is the dominant vegetation type in the drier uplands of Lancaster County (Cuff et al. 1989). White oak (*Quercus alba*), northern red oak (*Q. rubra*), black oak (*Q. velutina*) and chestnut oak (*Q. montana*) dominate the drier upland forest communities along with an array of other hardwood species.

Moving downslope from the dryer hilltops, the diversity of the vegetation increases as soil moisture increases. Forests on the lower sections of the slopes and within narrow, shaded valleys along the lower Susquehanna River tend to be dominated by tulip popular (*Liriodendron tulipifera*), red (*Acer rubrum*) and sugar maple (*A. saccharum*), American beech (*Fagus grandifolia*), basswood (Tilia americana), eastern hemlock (*Tsuga canadensis*) and ash (*Fraxinus americana*). These forests typically support rich shrub and herbaceous layers.

Wetlands

Wetlands are infrequent in the current landscape of Lancaster County. Historically, wetlands likely existed at most locations where water exits the ground at a spring or where the floodplain widened considerably. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries, but some remain or have recovered from a cessation of these activities. The loss of Lancaster County's wetlands has meant the loss of many associated species of plants and animals. Wetlands are the key to the survival of many species considered rare in the state. Even though wetlands account for only two percent of Pennsylvania's total area, they are home to a diverse array of rare plants and animals and are an extremely productive part of the landscape as a whole (Cuff et al. 1989).

Wetlands differ in size, structure, and species diversity. Wetlands also differ according to their placement on the landscape – at stream headwaters, dips in valleys, or on slopes where ground water discharges; and whether the water contained is flowing or stagnant. These different scenarios result in peat wetlands, marshes, swamps, floodplain forests, forested wetlands, wet meadows, and seeps. It may seem out of character to mention peat wetlands, often referred to as bogs, in Lancaster County, as these are more typical of more northern climates, but specimens of plants collected in the 1800's indicate peatlands occurred in scattered locations in the county. Remnant farm ponds exist in

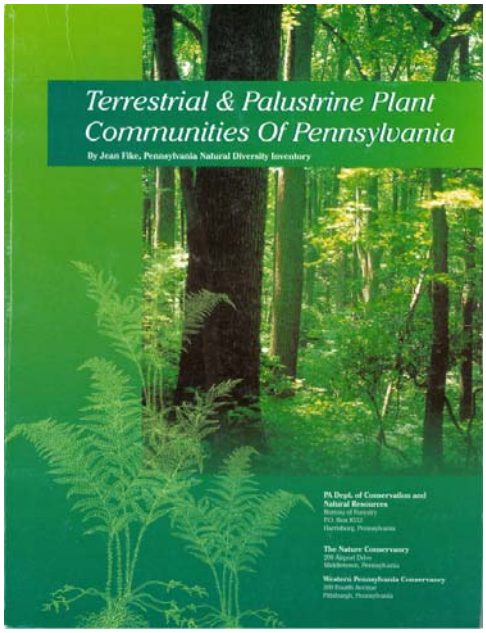
their place, but these are so degraded that their potential for recovery is not very promising.

Besides topographic position, wetlands are frequently categorized based on their dominant vegetation.

- Floodplains of creeks and rivers are seasonally or intermittently flooded and are typically dominated by sycamore (*Platanus occidentalis*), red maple, silver maple (*Acer saccharinum*), riverbirch (*Betula nigra*), ash and box elder (*Acer negundo*). Floodplains are subject to frequent natural disturbances and are commonly heavily influenced by invasive species of plants.
- Forested swamps are usually dominated by red maple, yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadensis*) and ash species (*Fraxinus* spp.). The understory typically consists of shrub species such as highbush blueberry (*Vaccinium corymbosum*), rhododendron and azaleas (*Rhododendron* spp.), winterberry holly (*Ilex verticillata*), alders (*Alnus* spp.), swamp rose (*Rosa palustris*) and many others.
- Seepage swamps are relatively small, forested or shrub-dominated wetlands found on lower slopes where water emerges at the surface as diffuse flow. These seep areas are frequently dominated by hemlock, yellow birch and red maple, with an understory of rhododendron, swamp azalea (*Rhododendron viscosum*), spicebush and highbush blueberry (*Vaccinium corymbosum*). Common herbs in these seepage wetlands include skunk cabbage (*Symplocarpus foetidus*), violets, manna grass (*Glyceria* spp.), various sedges (*Carex* spp.) and ferns, including cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*) and sensitive fern (*Onoclea sensibilis*). Sphagnum (*Sphagnum* spp.) and other mosses typically form a thick mat in these wetlands.
- Graminoid marshes, also known as emergent marshes, are wetlands dominated by grass-like (graminoid) plants such as cattails, sedges, rushes, and grasses. This type of wetland may be found in association with slow streams or in areas with groundwater seepages. Emergent marshes in the county are usually formed as successional communities following the breach of dams or other impoundments.
- Shrub swamps are wetlands occurring on mineral soils usually with a thick accumulation of peat moss (*Sphagnum* spp.) and other organic matter with water near or above the surface most of the year (Cuff et al 1989). Shrubs under 20 feet tall dominate this type of wetland. Shrub swamps in the county frequently include highbush blueberry, chokeberry (*Aronia* spp.), mountain holly (*Nemopanthus mucronatus*), alder, swamp rose, meadowsweet and steeplebush (*Spiraea* spp.), and sedges (*Carex* spp.).
- Due to the rarity of undisturbed examples of wetlands in Lancaster County and Pennsylvania, all good examples of these habitats should be preserved whenever possible. Wetlands provide valuable habitat for breeding and migrating birds, mammals, reptiles, amphibians and insects. Wetlands also provide a refuge for many species of wetland dependent rare plants. These systems also provide critical roles in maintenance of water quality for human communities as well.
-

Classification of Natural Plant Communities in Pennsylvania

Terrestrial & Palustrine Plant Communities of Pennsylvania (Fike 1999) is the most current community classification system for Pennsylvania's palustrine and terrestrial plant communities. This report was developed by the Pennsylvania Natural Heritage Program to update and refine Smith's 1991 report *Classification of Natural Communities in Pennsylvania (draft),* the first effort dedicated specifically to the classification of natural communities in the state. Work is ongoing to improve the current classification system and therefore, future editions may define new community types or alter currently defined types. Aquatic communities (lakes, streams, and rivers), communities where vegetation is absent or not a definitive characteristic (caves, scree slopes), and communities resulting from extensive human disturbance (old agricultural fields, manmade wetlands, etc.), are not addressed in this classification. Until more extensive work can be completed to define these types of communities and incorporate them into a single statewide framework, the County Natural Heritage Inventory reports will provisionally refer to features of ecological interest that fall outside the Fike 1999 system using categories described in Smith 1991. (more information on community classification in Pennsylvania is available at http://www.naturalheritage.state.pa.us/fikebook.aspx)



In addition to the more common and broadly defined habitats described above, Lancaster County has several distinctive habitat types that further define the special character of the county. Different regions of the state have characteristic landforms that contain the regions' most biologically interesting habitats. Northwestern PA has the only Great Lakes habitat in the state, southeastern PA has the state's only tidal marshes, northeastern and northwestern PA have extensive wetland systems formed by glacial activity, north-central PA has large expanses of unbroken forest, including some remnant old growth forests. Lancaster County has its own special places that should be considered unique to the landscape and a source of local satisfaction. These include the Lower Susquehanna River with its outstanding bedrock islands; the adjacent river gorges with their spectacular spring wildflower displays; the serpentine habitats of the state line area that support an assortment of globally rare species in a distinctive specialized habitat; and the system of caves resulting from the county's underlying limestone bedrock geology.

o *Serpentine Habitats.* The serpentine habitats of southern Lancaster and Chester Counties and into Maryland are among the most globally important habitats in Pennsylvania. The bedrock substrate underlying the serpentine habitat is a geologic rarity itself. When it is exposed at the surface of the ground, it typically harbors a suite of plants and associated insects uncommon for the region. Frequently, there are also species that are endemic to these habitats and grow nowhere else. The New Texas Serpentine Barrens contains eleven species of plants and seven species of insects that are rare to the state including the serpentine aster (*Symphyotrichum depauperatum*), which is globally rare, currently known to occur only on the serpentine habitats of the State Line Barrens system.



Serpentine Aster G2, S2 PT
(*Symphyotrichum depauperatum*)

The serpentine habitats of Lancaster and adjacent Chester County are part of a series of habitat islands stretching into Maryland that should be thought of as a single system. These serpentine habitats occur in isolated patches as the bedrock material, serpentinite, is exposed at the surface of the ground in a scattered fashion much like an archipelago chain of islands. Each habitat has a slightly different species composition, largely due to the slightly different environmental conditions found at each distinct location.



New Texas Serpentine Barrens showing a patchwork of herbaceous openings and pine/red cedar/oak woodlands.

Active stewardship of these habitats is necessary, contrary to a hands-off management approach typical to other types of natural areas. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type. The plants that characterize these habitats are adapted to the dry, nutrient poor soils and periodic fire events. A priority for the security of these globally rare habitats should be to establish protection for the core habitats as well as to provide for the landscape context in which natural process can be maintained.

In the past, naturally occurring fires helped maintain the open aspect characteristic of the serpentine barren habitat. Today, active vegetation management, in the form of volunteer work crews, helps to remove trees and shrubs that in the past would have been cleared by fire events. These work crews have made great progress over the years to create the mosaic of patchy openings resembling in places, a grass land, in others, an oak savannah, or pitch pine woodland, or juniper–catbrier shrubland, or mixed oak forest, or bare soil gravel bed. All these, as well as other small patch natural communities, play an important role in sustaining the diversity of plants and animals in these important ecosystems.

A long range goal for these isolated habitats is to recognize them as a single system and plan for their ecological needs. The area between and around these habitats should be maintained to provide the necessary buffer to allow prescribed burns to maintain the open habitat once the bulk of the woody species have been removed. Natural corridors between the barrens will help keep the genetic flow between the isolated populations of species in circulation.

These systems may be best maintained in an agricultural or rural setting. Residential development near or between these barrens should be strongly discouraged. Prescribed fires would likely be no more welcome in a residential neighborhood than many agricultural activities such as the spreading of fresh manure.







Serpentine habitat restoration: In the absence of fire, the herbaceous openings of the serpentine barrens have been colonized by early successional trees, primarily red cedar, Virginia pine and pitch pine. Volunteers working with The Nature Conservancy are restoring herbaceous openings by removing early successional trees. A successfully restored serpentine habitat should include a mosaic of patches of bare ground, herbaceous openings, early successional growth and oak-pine woodlands.

o *Susquehanna River Glens.*

The central portion of Lancaster County is a relatively flat fertile plain, conducive to farming, which it has sustained for centuries. As the landscape approaches the Susquehanna River to the west, the land becomes increasingly folded and hilly until dropping sharply off to the river's edge. The steep and stony nature of the slopes prevented their conversion to agricultural uses.

Though timbering operations have harvested several generations of trees from the area, the deepest ravines have remained relatively untouched by conversion to other land uses and have a surprisingly wild and primordial charm. Many of the glens on both sides of the river south of Turkey Hill contain spectacular spring wildflower assemblages including many plants uncommon in Pennsylvania. The hemlock-tuliptree-birch forests of Benton Ravine, Kelly's Run and Tucquan Glen are considered to be of significant quality and age to be noteworthy examples of their plant community type.

Large, older trees, a range of age classes that provide a layered structure to the forest and the presence of species of plants indicative of a rich, moist habitat contribute to this assessment.

These habitats should be considered the remnants of the forests that once cloaked habitats of topographic and hydrologic similarity along the lower Susquehanna River valley. They should also be considered a reference example of what restoration efforts in the vicinity should try to mimic on similar sites. Allow these areas to achieve old growth conditions. This may sound like a hands-off approach to management, but unfortunately these habitats are severely stressed by the encroachment of invasive species of plants, and in the case of the hemlock tree, introduced insect pests. Intensive hands-on management will be needed to keep these forest remnants from becoming overrun with weedy tree, shrub and herb species.



A long range goal for the river glens if to consider them parts of a larger habitat that occurs on both sides of the river from Turkey Hill and extending southward into Maryland. Treated as a continuous landscape, the area should be managed to achieve and maintain old growth conditions.



Umbrella Magnolia (*Magnolia tripetala*)



Susquehanna trillium (*Trillium sp.*)



o *River Scour Habitats*

The Susquehanna River below Holtwood Dam is one of Pennsylvania's most unusual and picturesque riverine landscapes. The water level of the river fluctuates widely due to seasonal flooding and dry spells alternately inundating and exposing numerous islands in the river. These islands are different than most in the Susquehanna River. While most river islands are composed of deposits of loose material, the Conowingo Island group represents the erosional remnants of schist and gneiss metamorphic bedrock. There are about 60 islands in all, one reaching a height of 200 feet above the water level. Much of the surface of the islands and river bed is composed of exposed bedrock. Deposits of soil have filled cracks, crevices and depressions to provide a distinctive habitat for many species of plants uncommon to Pennsylvania. Sixteen plant species of concern and three animal species of concern contribute to the overall uniqueness of this exceptional natural community. Though the construction of the Holtwood Dam resulted in the disturbance of the upstream portion of this habitat, the utility ownership of the islands and surrounding supporting habitat has likely protected this area from further development. This area should be considered a high priority for conservation action in the county



Eastern Gamma-grass
(Tripsacum dactyloides)



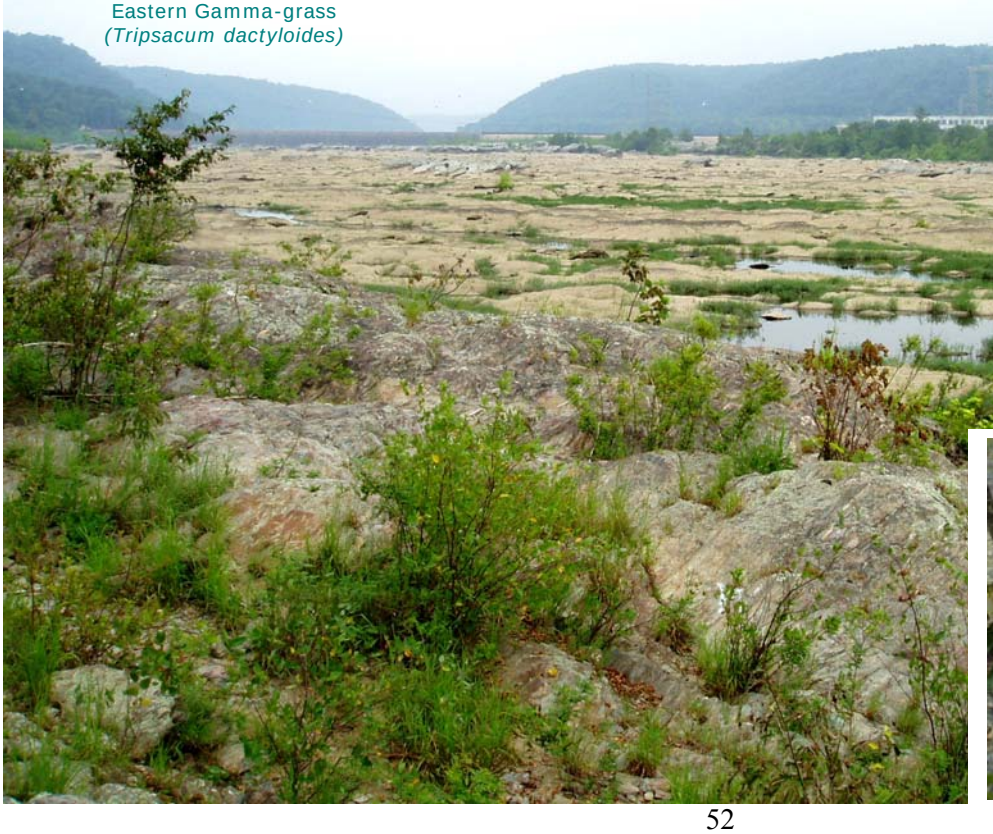
Aster-like Boltonia
(*Boltonia asteroids*)



Fringe-tree (*Chionanthus virginicus*)



Sticky Goldenrod
(*Solidago simplex ssp. randii var. racemosa*)





Wild Oat (*Chasmanthium latifolium*)

o *Cave and Karst Systems*

Lancaster County has a cave and karst system considered ecologically significant habitat for a number of globally rare cave adapted species. They are also delicate environments that offer a window into the region's water resources. The map below shows the general location of these systems along with associated elements such as sinkholes and cave invertebrates.

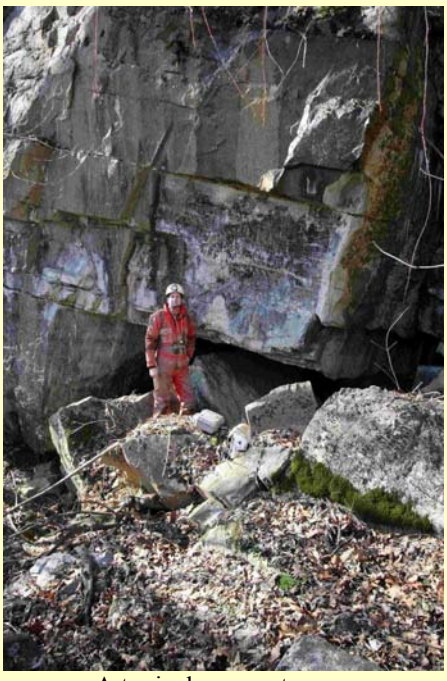
Pennsylvania's karst landscapes with solutional caves are renowned nation-wide. Solutional caves are formed in limestone or dolomite by the dissolving action of groundwater. Water has formed most of the caves in Lancaster County, eroding limestone both physically and chemically. Several of the county's caves, such as Wind Cave have been formed by tectonic processes, involving the movement of rock formations. Karst Conservation Areas in Lancaster County, as shown below, were created using a combination of features including the presence of Threatened or Endangered invertebrate species, presence of significant surface depressions such as sinkholes, underlying rock structure, hydrology and topology to generate a conservation polygon. These areas are also important to the water resources due to the possibility of increased pollution from surface run-off.

Much of Lancaster County is underlain by Ordovician and Cambrian carbonate rocks contained in the Piedmont Lowlands Section of the Piedmont Province. These rocks include elements of the New Oxford, Cocalico and Conestoga formations yielding some of the purist and highest quality limestones in the state. Approximately 60 caves exist ranging in size from small rock shelters less than 5m in size to 10 significant caves over 200m in total length. Although many are found within sinkholes along the karst topography, others are found at joints formed between limestone rocks and other rock types such as sandstones and have somewhat picturesque entrances such as the one pictured below.

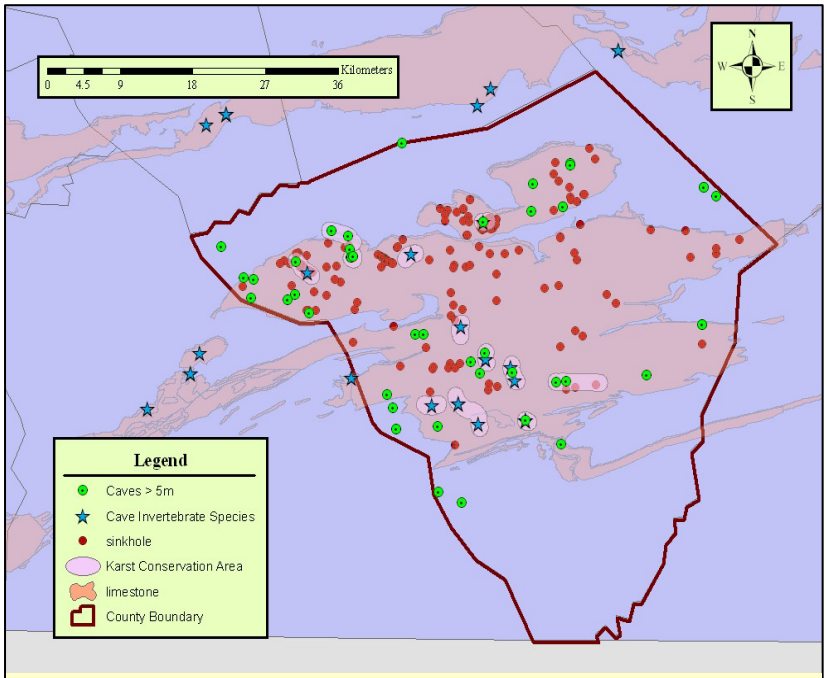
Above ground indicators of underground karst systems include:
- o Closed depressions
- o Open sinkholes
- o Seasonal high water table indicators
- o Unplowed areas in plowed fields
- o Surface drainage into ground
- o "Ghost lakes" after rainfall
- o Lineaments and faults
- o Limonite excavations and quarries
- o Contacts between geologic formations

(Adapted from Pequea Township's Karst Hazard District Zoning Ordinance)

Caves and karst features are fragile resources that have unique recreational and ecological value, providing habitats for common, rare, and threatened and endangered species. Cave systems also serve as direct conduits to the groundwater table, a serious issue for Lancaster County's communities that rely on well water. Many of the areas in the county containing caves are



A typical cave entrance.
Photo source: PNHP



Significant caves and karst areas in Lancaster County.

prime agricultural areas where run-off from both agricultural practices and sedimentation can affect the groundwater resources at a large scale. Conservation of cave and karst resources needs to be a concern for all who use or impact the cave environment as well as for communities in karst areas that rely on clean groundwater.

Many human activities threaten caves and the fauna that depend on them. Terrestrial pollution in karst terrains results in a very real subterranean threat. Because water moves readily from the earth's surface down through solution cavities and fractures and undergoes very little filtration, groundwater in karst limestone is easily polluted. Contamination of groundwater can come from industrial sources as well as sewage, fertilizers, herbicides, and pesticides from municipal, agricultural, and residential sources. Even stormwater may be considered a polluting substance as overland runoff transfers surface material, including pollutants and excessive nutrients, into the fragile underground environment through openings such as the small sinkhole shown below.



Typical surface sinkhole. Photo source: PNHP

Pictured is a typical sinkhole filled with water during a rainstorm. Pequea Township has a Karst Hazard Overlay District in Article IV-B of its Zoning Ordinance which helps to provide protection of groundwater resources. Other Municipalities with Karst features should consider adopting similar ordinances.



Cluster of hibernating bats.
Photo source: PNHP

Although Lancaster County is not known to have caves with significant colonies of hibernating bats, most caves in the county harbor small populations that should not be disturbed from October 1 to May 1. When bats are disturbed in hibernation, they use up much of their fat reserves and may not survive through the winter. While bats have been unjustly feared and persecuted in the past, they play a critical ecological role and also provide benefit to humans in the form of insect control.

Caves are also home to a host of invertebrate species such as isopods, amphipods, flatworms, spiders, crickets and many other species. Most of these species are adapted to the cave environment and spend very little, if any of their lives above ground and are called **Troglobites**. Troglobitic adaptations include the loss, or reduction of eyes, increases in other sensory structures such as antennae, and loss of pigmentation. Most troglobitic invertebrate species are extremely rare globally and in need of conservation efforts. In some cases, cave invertebrate species may only be known from a handful of caves in the world. In Lancaster County, the Refton Cave Planarian (*Sphalloplana pricei*) is a perfect example of this global rarity. The planarian in this cave is only known to still exist in two locations in the world, and the population in Lancaster County is the only one that has been assessed in the last 10 years. Only 20% of Pennsylvania's counties have current records of cave invertebrates, and 20% of all total current records for cave invertebrates are from Lancaster County.

Cave invertebrates are primary processors of the debris washed into a cave during periodic flooding of the cave environment and are very dependant on water quality. In some cases, nutrient flow relationships

between other cave dwellers and the cave crustaceans are known. Bats, woodrats and cave crickets provide nutrient rich waste which is used as a source of nutrient input to these isolated systems. In some cases, carcasses of other animals may fall into the pools in caves and are broken down by cave invertebrates.



A cave crustacean from a Lancaster County cave.
Photo source: PNHP

The nature of these isolated habitats has led to unique speciation of the animals that inhabit these environs. In Pennsylvania, the majority of cave invertebrates are restricted to the karst regions that create limestone solution caves, and are not found very often in tectonic caves. The speciation within these underground systems has led to highly restricted ranges for cave invertebrates. In the lower 48 states, 61% of all cave species are restricted to single counties (Culver et al. 2000). A detailed description of the speciation of troglobites was crafted by Barr and Holsinger (1985) and explains the history behind how caves were colonized by invertebrates and the unique patterns of habitation by this understudied group of organisms.

Cave invertebrates are highly vulnerable to extinction because of their highly restricted ranges, their aquatic life histories, and the susceptibility of groundwater systems to contamination. If cave invertebrate species disappear from a cave system, it is likely that some form of pollution is present. Because of this aspect of their lives, they are sometimes referred to the "canaries of water quality". The hydrology for solutional cave systems is extremely complex and difficult to trace. Depending on the structure of the cave, the time water spends in a cave, known as the residence time, can be measured anywhere from a few hours, to centuries. Inputs of water sources to cave systems housing cave invertebrates must be maintained in good condition, because of the possibility for rapid contamination, in the case of short residence time, and the possibility of lingering contamination of even small pollutant doses, in the case of long residence time.

The links between contamination of surface waters and subsequently cave waters has been documented in several studies (Boyer & Pasquarell 1995, Hobbs 1998, Notenboom et al. 1994, Pasquarell & Boyer 1996), and protection of only the cave will rarely, if ever, protect the inhabitants of these fragile systems (Culver et al. 2000). Rather, cave invertebrates are only protected if the surface waters and vegetation are protected in these drainage basins (Culver et al. 2000).

Identification of cave resources in this report is provided as a highlight of geologic and natural resources of the county and should not be considered a guide to cave exploration. Individual landowners control the access to caves on their property and should be contacted prior to visiting a cave. More information about cave exploration in Pennsylvania is available through the local cave clubs, such as York Grotto, Franklin County Grotto, Pennsylvania Cave Conservancy, and the Mid-Atlantic Cave Conservancy. To contact any of these organizations, please visit the National Speleological Society's website at http://www.caves.org

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Habitat Disturbance

Disturbances to the natural landscape, whether natural or human-induced, have played a key role in shaping many of the natural communities and the associated species. The frequency and scale of these disturbances have played a large part in the appearance of natural communities today.

Natural disturbances such as fire and flooding can actually benefit certain natural communities and species. For example, periodic fires are needed to maintain serpentine barren areas in order to facilitate new growth of the habitat and prevent succession. Floodplain forests benefit from the periodic scouring and deposition of sediments as streams overtop their banks. At the same time, streamside wetlands hold excess water, thus reducing the scale of flooding downstream.

Another disturbance, over-browsing by deer, can have detrimental effects on natural communities and species (Rhoads and Klein, 1993). Excessive deer browse can decrease the understory of some forests, and halt regeneration of new growth of the canopy and understory. Deer feeding preferences can have a direct effect on rare plants and severely decrease essential habitat for other animal species including birds, mammals, reptiles, amphibians and insects. Private landowners should be encouraged to control deer populations by allowing hunting on their lands.

Human and natural disturbances create different habitats in different scenarios, but human disturbances often leave the most lasting effect on the environment. Many human disturbances can be beneficial, especially to species that require an early successional habitat. However, what may be beneficial to a few species is often detrimental to other species. Many rare species have become rare because they cannot adapt to disturbance of their particular habitat, which is often a specialized niche. Consequently, many species have declined due to human alteration of the landscape. Human disturbances are semi-permanent parts of landscape, but decisions about the type, timing, location, and extent of future disturbances are important to the natural ecological diversity that remains.

From a historical perspective, human disturbance to the natural communities of the county has been occurring for hundreds, if not thousands, of years. In many cases, human disturbances have directly affected natural communities and animal and plant species in certain areas. In Lancaster County, farming and urbanization have created biological "islands" where small natural areas are surrounded by agriculture or development. This isolates gene pools of wildlife and/or plant species, inhibiting the gene flow between populations. In addition, logging and mining can affect forest age and natural community structure. For example, old-growth forest has virtually disappeared despite the fact that some scattered old trees remain. Additionally, many wetlands have been intentionally flooded or drained resulting in severe losses of biodiversity at a given site. As farming remains an important industry in Lancaster County, some farm practices and abandoned farmland make conditions favorable for some grassland birds. Birds such as Short-eared Owl, Eastern Meadowlark, Bobolink, Henslow's Sparrow and Vesper Sparrow have benefited from human created and managed early successional habitats, including reclaimed strip mines in western Pennsylvania.

Agriculture, residences, road building, industry, mining and other activities have contributed to the degradation of water quality in many areas of the county. Protecting the quality and purity of surface and groundwater resources contributes to the future well being of all plants and animals including human communities. The Pennsylvania State-wide Surface Waters Assessment Program can provide information on potential sources of water impairment within Lancaster County. Much information on the water and geological resources of the county can be found on the PA DEP eMap web page: http://www.emappa.dep.state.pa.us/emappa/



This photograph showcases the destruction possible from an overpopulation of deer. While many people are attracted to the park-like atmosphere in a forest like this, there is very limited habitat in this type of forest, and it is representative of an unhealthy ecosystem. Allowing hunting on lands could eventually allow this forest to recover, but this particular stand may require hands-on management to remove some of the hay scented fern that carpets the forest floor, shading out sprouting trees and shrubs. Photo source: PNHP

Legacy Sediments

The limestone enriched lands of Lancaster County were quickly recognized by early European settlers as extremely fertile and highly suitable for agricultural production. The productive soils yielded high quantities of grain that needed to be processed into meal and flour. The streams and creeks of the county provided freshwater and fish, but also energy to run grain mills for the first few centuries of European colonization. Each grain mill required a mill pond created behind a dam on the stream to provide the water power to run the mill.

Hundreds if not thousands of dams were built on streams throughout the county. As the fertile limestone soils were converted to intensive agricultural production, the bare, tilled soils readily washed into the adjacent streams with every rainfall. As the stream's water slowed at the pond behind the dam, it dropped its deposit of silt and sediment in the pond.

A recent study of the historic floodplains of Lancaster's creeks conducted by Robert Walter and Dorothy Merritts of Franklin and Marshall College suggest that the form of the stream channel and adjacent floodplain of many, if not most of the sections of creeks within the county have been strongly modified by the accumulation of sediment behind the dams (Walter & Merritts 2008). As the dams were breached, the streams quickly cut deep channels through the accumulated sediment leaving a creek with high, steep banks. The creeks remain trapped in these narrow channels while the historical floodplain remains buried beneath the accumulated sediments from the mill dam, referred to as legacy sediments.

These steep sided creek banks are unnatural and do not reflect the original condition of the streams' floodplains, which were typically much wider, shallower, more diffused, and branching with intermittent peat-accumulating wetlands. Stream restoration efforts in the county should take into account the potential or likely presence of legacy sediments and restore historical floodplains prior to replanting stream banks in an effort to reconnect the stream to its natural floodplain.

Dams

Pennsylvania has thousands of dams on its rivers, creeks and streams. Some of these dams currently serve important purposes, but many of these dams no longer serve their intended uses and have fallen into a state of disrepair. These unnecessary structures can be a liability to their owners, as many run-of-the-river dams create dangerous hydraulic conditions at their base, making them a threat to stream users in the area. Due to this public safety threat, owners of existing run-of-the-river dams and permittees for the construction of new run-of-the-river dams are required to mark the areas above and below the dam to warn river users of the dangerous conditions around the dam structure. This requirement went into effect on January 1, 1999 through an amendment to the Fish and Boat Code known as Act 91 of 1998 (P.L. 702, No. 91).

Besides acting as liabilities and maintenance headaches, dams cause numerous environmental impacts including reduced water quality, thermal pollution, disrupted sediment transport processes that increase sedimentation in impounded areas and increase streambed and streambank erosion in downstream areas, altered flow regimes, and habitat destruction and fragmentation. By removing the unused, unnecessary dams from our rivers and streams, we can re-establish natural free-flowing dynamics which support diverse ecosystems, reduce localized flooding and erosion, improve water quality and restore habitat and access to upstream habitat for aquatic organisms. To address the impacts to resources under their management, the PA Fish & Boat Commission has authority (PA Code Chapter 57, Section 22) to request that dam owners install fish passage structures on dams to benefit migratory or resident fish species.

Pennsylvania currently leads the nation in dam removal and Governor Rendell received a National Award of Merit from the Association of State Dam Safety Officials in 2004 for his commitment to dam safety in Pennsylvania. Numerous agencies, non-profit organizations and engineering firms have experience with dam removal in Pennsylvania. For more information on dam safety, dam owner requirements, and dam removal, please contact the Department of Environmental Protection Division of Dam Safety, at 717-787-8568 or at http://www.dep.state.pa.us/dep/deputate/watermgt/we/damprogram/main.htm.

Invasive Species

Natural habitats within Lancaster County are threatened by the invasion of exotic (non-native) plant and animal species. These invasive species are plants, animals, or other organisms that do not naturally occur in the area and which are likely to cause harm to the natural environment, the economy or to human health. In 2000 the year economic cost in the US of non-native invasive species was estimated at $137 billion (Pimentel et al. 2000). Because they have no natural enemies to limit their reproduction, they usually spread rampantly. Once they are established, it is extremely difficult to control their spread. Invasive species are recognized as one of the leading threats to biodiversity and impose enormous costs to agriculture, forestry, fisheries, and other enterprises, as well as to human health (www.invasivespeciesinfo.gov).

The introduction of non-native species into Pennsylvania first began with initial settlement in the 17th century (Thompson 2002) and continues to this day. Plants and animals have been deliberately introduced for a variety of reasons including food sources, erosion control, landscaping, and game for hunting and fishing. Other species have been accidentally introduced as "stowaways" through increases in global trade and transportation. These introductions have had drastic effects on Pennsylvania's biodiversity over time. For example, over 37% of the plant species now found in the Commonwealth did not occur here during the first period of European settlement (Thompson 2002).

- *Invasive Plants*

Invasive plants are ones that reproduce rapidly, spread quickly over the landscape, and have few, if any, natural controls such as herbivores and diseases to keep them in check. Invasive plants share a number of characteristics that allow them to spread rapidly and make them difficult to remove or control:

1. Spreading aggressively by runners or rhizomes;
2. Producing large numbers of seeds that survive to germinate;
3. Dispersing seeds away from the parent plant through various means such as wind, water, wildlife, and people.

Invasive plants are capable of displacing native plants from natural communities, especially those with rare, vulnerable, or limited populations (Swearingen et al. 2002). This initial impact is worsened by the tendency for native wildlife to prefer native species to invasive species for food. (Swearingen et al. 2002). In some cases, a switch to the invasive plant food supply may affect the physiology of the prey species. For example, many invasive shrubs, including bush honeysuckle, provide fruits that native birds find attractive, yet these fruits do not provide the nutrition and high-fat content the birds need in their diets (Swearingen et al. 2002).

Aggressive invasive plants can also transform a diverse small-scale ecosystem, such as a wetland or meadow, into a monoculture of a single species, drastically reducing the overall plant richness of an area and limiting its ecological value (Swearingen et al. 2002). The decrease in plant biodiversity can, in turn, impact the mammals, birds and insects in an area, as the invasive plants do not provide the same food and cover value as the natural native plant species did (Swearingen et al., 2002).



Edge habitat that has been invaded by aggressive species of plants including tree-of-heaven, Japanese honeysuckle, multiflora rose, and Oriental bittersweet becomes a snarled, poor quality forest referred to in this report as modified successional forest.

Control methods for these invasive species can range from hand pulling to mechanical methods (e.g. mowing) to herbicides. A variety of tools have been developed for control of several of these species (e.g. the Weed Wrench and the Honeysuckle Popper). Herbicide control should only be performed by individuals with proper training and licensing by the Pennsylvania Department of Agriculture. When working in sensitive habitats such as wetlands, a 'wetland-safe' herbicide should be used to avoid indirect effects on other organisms. It should be noted that each different invasive species present on a site may require a different technique or suite of techniques for effective control. Generally speaking, control efforts should be concentrated before these species disperse their seed for the year. Specific control methods for these species can be found at: www.invasive.org/eastern/.

A list of the most prevalent invasive plants in Lancaster County is provided in Table 2.

Table 3. Significant invasive plant species potentially found throughout Lancaster County. See individual fact sheets for more information.

Species	Description and Threat
Norway maple (*Acer platanoides*)	Research has recently shown that forests that have been invaded by Norway maple suffer losses in diversity of native forest wildflowers compared with forests in which the canopy is dominated by native species such as sugar maple.
Tree-of-heaven (*Ailanthus altissima*)	This fast growing tree is a prolific seeder and can also proliferate through vegetative means, outcompeting native vegetation.
Fiveleaf akebia *(Akebia quinata)*	This vigorous vine grows as a groundcover and climbs shrubs and trees by twining. Once established, its dense growth crowds out native plants.
Garlic mustard (*Alliaria petiolata*)	An increasingly common invasive biennial herb spreading through natural areas throughout the region. Recent scientific evidence has shown that this species can disrupt microrhizyl relationships that trees depend on for their growth.
Japanese barberry (*Berberis thunbergii*)	Commonly planted ornamental that escapes and forms dense stands in a variety of habitats, including forests and wetlands, displacing native vegetation.
Oriental Bittersweet (*Celastrus orbiculatus*)	These vines cover and outcompete native vegetation as well as girdle trees by their twining climbing.
Spotted knapweed (*Centaurea stoebe* spp. *micranthus*)	Competes with native species by capturing moisture and nutrients. Poses a high threat to shale barrens and other dry habitats.
Autumn olive (*Elaeagnus umbellata*)	A drought-tolerant species that thrives in many soil conditions. Threatens native ecosystems through competition and alteration of natural succession patterns and nutrient cycling.
Winged burning bush (*Euonymus alatus*)	A shrub that can form dense thickets that displace native woody and herbaceous plants.
English Ivy *Hedera helix*	English ivy climbs trees and covers the ground, forming dense monocultures that kills trees and excludes native plants.
Japanese hops *Humulus japonicus*	A sprawling vine that forms dense mats, covering and excluding native vegetation.
Japanese honeysuckle (*Lonicera japonica*)	These vines cover and outcompete native vegetation as well as girdle trees by twining up them.
Privet (*Ligustrum* spp.)	These shrubs can form dense thickets in floodplains, forests, wetlands, and fields that can outcompete native vegetation.
Bush honeysuckles (*Lonicera tatarica, L. morrowii, and L. maackii*)	Found in a variety of environments from wetlands to uplands. Competes with native plants for moisture, nutrients, and pollinators. Fruits do not provide high energy food for migrating birds.
Purple loosestrife (*Lythrum salicaria*)	A herbaceous wetland invasive that is present at scattered sites throughout the county. Once established in a wetland this species is difficult to eradicate and will displace native species.
Japanese stiltgrass (*Microstegium vimineum*)	A fast-spreading grass that is typically found along forest roads, streambanks, and other cool moist habitats. Outcompetes native vegetation and may have an effect on animal species that use streamside microhabitats.
Mile-a-minute (*Polygonum perfoliatum*)	A vine that invades open and disturbed areas and scrambles over native vegetation in open and disturbed areas, limiting their photosynthesis.
Japanese knotweed (*Polygonum cuspidatum*)	These large fast-growing exotics displace natural vegetation and greatly alters natural ecosystems. Typically found along stream banks and other low-lying areas, as well as old home sites and waste areas.
Kudzu *(Pueraria lobata)*	This extremely aggressive vine climbs trees and covers the ground, forming dense monocultures that kills trees and excludes native plants.
Lesser celandine (*Ranunculus ficaria*)	This spring wildflower is a vigorous growing groundcover that forms large, dense patches in floodplain habitats, displacing and preventing native plants from co-occurring.
Jetbead (*Rhodotypos scandens*)	A shrub that forms dense thickets that displace native woody plants and shades out herbaceous groundcover.
Multiflora rose (*Rosa multiflora*)	Widely planted shrub that invades a variety of habitats excluding most native shrubs and herbs. May be detrimental to the nest of native birds.
Reed canary grass (*Phalaris arundinacea)*	This grass, though native to PA, forms dense, monospecific stands in open wetlands, wet meadows and riparian areas. It effectively excludes all other plant species, causing greatly decreased biological diversity in wetland communities.

- *Invasive Animal Species*

In addition to invasive plants, Pennsylvania is now home to several exotic species of animals including mammals, birds, fish, and reptiles (Table 3). These species can directly threaten populations of native animals through direct competition or predation. Other invasive exotic animals can alter habitats and ecosystems by changing plant cover or diversity. Some of these invasive animals such as the Norway Rat (*Rattus norvegicus*) and House Mouse (*Mus muscula*) are all too common encounters in our homes and built areas.

Arguably, the most significant threat from an invasive animal species to the biodiversity of Lancaster County is the Hemlock Woolly Adelgid (*Adelges tsugae*). This is a small aphid-like insect that feeds on the leaves of eastern hemlock trees (*Tsuga canadensis*). Infestations of the Woolly Adelgid appear as whitish fluffy clumps of feeding adults and eggs along the underside of the branch tips of the hemlock.

Hemlock decline and mortality typically occurs within four to ten years of initial infestation. The adelgid can cause up to 90% mortality in eastern hemlocks, which are important for shading trout streams, provide habitat for about 90 species of birds and mammals, and are an essential element of eastern forests. Several control options are currently being tested. This species originates from Japan and China and was introduced accidentally to North America around 1924 (McClure 2001). It is currently distributed from Maine to Georgia and can be found in most of the counties in Pennsylvania with infection of the entire state expected in the near future (PA DCNR 2007).

The Gypsy Moth (*Lymantria dispar L.*) has caused extensive defoliation of forests in the northeast. This European moth was intentionally introduced to the U.S. in 1869 as part of a failed commercial silk production venture. Its main impact is that it defoliates trees, in particular oak species. This defoliation results in a reduction in the rate of a tree's growth and seed production and possibly the eventual death of the tree.

The European Starling (*Sturnus vulgaris*) was introduced to North America in the late 1890s as part of a plan to introduce all of the birds mentioned in the works of Shakespeare to Central Park in New York City. It has since spread throughout the US. In addition to competing with native bird species for food and space (specifically smaller cavity nesting birds), large flocks of this species can destroy fields of crops.



Hemlock Woolly Adelgid infestation along a hemlock branch
Photo source: Connecticut Agricultural Experiment Station Archives

Several invasive animal species are spreading throughout the streams, rivers, and lakes of Pennsylvania, but in many cases the impact of these species remains unknown. The Zebra Mussel (*Driessena polymorpha*) was accidentally introduced to the Great Lakes in the 1980's and has been spreading in Pennsylvania's waters. Not currently known to Lancaster County, this mussel poses a great threat to industry, recreation, and native fish and mussel species and should be controlled wherever it occurs. Another non-native bivalve, the Asian Clam (*Corbicula fluminea*), has spread throughout most of Pennsylvania's waterways, including the Susquehanna River. Of greatest concern to biodiversity is the capacity of the clam to alter the ecology of an aquatic system, making it less hospitable to the native assemblage of freshwater mussels, fish, invertebrates, and plants. Another aquatic species, the Rusty Crayfish (*Orconectes rusticus*), has been introduced from its native range in the midwestern US to many of Pennsylvania's watersheds. Rusty Crayfish can reproduce in large numbers and reduce lake and stream vegetation, depriving native fish and their prey of cover and food. Their size and aggressive nature keeps many fish species from feeding on them. Rusty Crayfish may also reduce native crayfish, freshwater mussels, and reptile and amphibian populations by out-competing them for food and habitat or by preying on the young of these species. Rusty Crayfish have been found in much of the Susquehanna River watershed in Lancaster County.

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Table 4. Significant invasive animal species for potential to be found throughout Lancaster County.

Species	Description and Threat
Hemlock Woolly Adelgid (*Adelges tsugae*)	This species is causing severe damage to eastern hemlock (*Tsuga canadensis*) killing up to 90% of infected trees, thus greatly modifying ecosystems.
Gypsy Moth (*Lymantria dispar*)	Feeding preferentially on oak trees (*Quercus* spp.) and their relatives this species will eat almost any plant when in need and can cause severe environmental and economic damage.
Common Pine Shoot Beetle (*Tomicus piniperda*)	A pest of pine trees (*Pinus* spp.) this species damages terminal shoots stunting the growth of trees thus weakening the trees and increasing their susceptibility to other pests.
Sirex Woodwasp (*Sirex noctilio*)	A recent invader, this species attacks living pines and is likely to cause great amounts of damage to pine plantations throughout the nation.
Multicolored Asian Ladybird Beetle (*Harmonia axyridis*)	Preying on native insects and invading houses each winter, this species was likely introduced in an attempt to control non-native aphids.
Asian Clam (*Corbicula fluminea*)	Found in extremely high densities along major tributaries and rivers, this species is directly competing with native mussels for food and habitat.
Rusty Crayfish (*Orconectes rusticus*)	Found in many of our streams, this recent invader is displacing native crayfish, reducing fish populations by feeding on young fish, and generally disrupting aquatic systems.
Grass Carp (*Ctnopharyngodon idella*)	A voracious herbivore, this species was introduced to control weeds in eutrophied lakes. However, it now causes significant damage to native wetland vegetation that is important for reducing nutrients in water-bodies.
Common Carp (*Cyprinis carpio*)	Introduced as a food fish, this species is now found anywhere with warm, slow-moving water. As a bottom feeder it greatly increase turbidity and mobilizes large amounts of sediment.
House Sparrow (*Passer domesticus*)	Generally found any place humans are, this species can cause crop damage, but mainly competes with small, native cavity nesting birds.
European Starling (*Sturnus vulgaris*)	Competing directly with native cavity-nesting birds, this species also cause severe crop damage.
Rock Dove / European Pigeon (*Columba livia*)	Generally found around human structures, this species can cause crop damage, is a known carrier for several serious human diseases, and causes a general mess where it nests and roosts.
Mute Swan (*Cygus olor*)	While considered pretty by some, this European invader causes significant damage to wetland vegetation that it "grubs" out during feeding. Additionally, it is fiercely competitive and will exclude all other native waterfowl from its nesting territory to the point of killing intruders.
House Mouse (*Mus musculus*)	Ubiquitous throughout the world, this species carries many diseases, competes directly with many native species, and can cause significant damage to crops and structures.
Norway Rat (*Rattus norvegicus*)	Generally a pest of human infrastructure, the Norway Rat is also found around rivers and other water systems. Known as a carrier for many diseases, this species is a threat anywhere it occurs.
House Cat (*Felis silvestris*)	House Cats, both domestic and feral, can individually kill several small animals each day. Summed among the great number of House Cats out-of-doors this adds up to *billions* of small amphibians, reptiles, birds, and mammals each year in the United States.

Overall Invasive Recommendations

Although Lancaster County has many sites that are free from non-native species, invasive species are an increasing threat to biodiversity harbored within Lancaster County. Successful control of invasive plant species is a time, labor, and resource-intensive process. Prevention or control during the early stages of invasion is the best strategy. In areas where invasive plants are well established, multiple control strategies and follow-up treatments may be necessary. Specific treatment depends on the target species' biological characteristics and population size. Invasive plants can be controlled using biological, mechanical, or chemical methods.

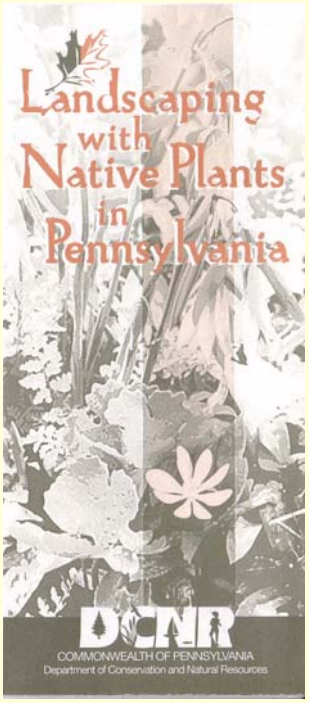
The following are presented as ways to deal with invasive species in the region:

- Natural Heritage Areas identified in this report can serve as useful high conservation value "focus areas" for the control of invasive species.

- Cooperative Weed Management Areas (CWMAs), once largely confined to the western states, are increasingly forming in the east. A CWMA is a partnership of landowners, including federal, state, and local government agencies, individuals, and various interested groups that work together to manage noxious weeds and invasive plants in a defined geographic area. An overview of CWMAs can be found online at: http://www.weedcenter.org/weed_mgmt_areas/wma_overview.html.

- Weed Warriors Program





http://www.dcnr.state.pa.us/forestry/wildplant/invasive.aspx
http://www.dcnr.state.pa.us/forestry/wildplant/native.aspx

- It is far more cost effective to prevent invasive species introductions and to control introductions while they are still small, than to control invasive species populations after they have become established. Some nurseries in Pennsylvania now carry a selection of tree, shrub, and herbaceous species that are native to Pennsylvania, and these are recommended where plantings are necessary in, or adjacent to, natural areas. Additionally, when grown from local seed stock, these native plants are often hardier than non-native cultivars because they are already adapted to Pennsylvania's climate. The Vascular Flora of Pennsylvania (Rhoads and Klein 1993) is a helpful reference for determining whether a plant species is native to the state or not. Additional references include two PA Department of Conservation and Natural Resources publications: *Invasive Plants in Pennsylvania* and *Landscaping with Native Plants in Pennsylvania* .

- Many education resources exist regarding invasive exotic species. Regional groups such as the Mid-Atlantic Exotic Pest Plant Council (MA-EPPC) can help with funding opportunities and educational outreach on invasive species. A membership brochure is available as a pdf file at: http://www.ma-eppc.org .

- Several excellent web sites exist to provide information about invasive exotic species. The following sources provide individual species profiles for the most troublesome invaders, with information such as the species' country of origin, ecological impact, geographic distribution, as well as an evaluation of possible control techniques:
  - Invasive Plant Tutorial http://intraforestry/invasivetutorial/index.htm
  - The Nature Conservancy's Weeds on the Web http://tncweeds.ucdavis.edu/
  - The Virginia Natural Heritage Program's invasive plant page http://www.dcr.state.va.us/dnh/invinfo.htm
  - The Missouri Department of Conservation's Missouri Vegetation Management Manual http://www.conservation.state.mo.us/nathis/exotic/vegman/
  - National invasive species information clearinghouse http://www.invasivespecies.gov/

Pennsylvania has a Noxious Weed law that prevents the propagation, sale, or transport of several weed species within the Commonwealth (Appendix I). This list includes several plants, such as Purple Loosestrife, Mile-a-minute, Canadian thistle and Multiflora rose, that are known to invade natural areas. The Pennsylvania Fish and Boat Commission maintains a list of aquatic nuisance species that are prohibited from possession, sale, barter, or distribution within the Commonwealth (PA Code

58.71.6). This list includes the Zebra Mussel and the Rusty Crayfish among others. (Appendix I)

After intensive removal of invasive species, restoration of natural habitats through replanting with native species is often needed. Nurseries and horticultural professionals can assist with native plant restoration. Complete eradication of invasive non-native plants from a site may not be completely achieved, but it is possible to reduce infestations within native plant communities to a level that can be routinely maintained. Control of invasive plants is critical to the long-term protection of Pennsylvania's natural areas and rare species.

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A REVIEW OF LANCASTER COUNTY'S ANIMAL BIODIVERSITY

Mammals and Mammalian Habitats in Lancaster County

James Hart – Pennsylvania Natural Heritage Program

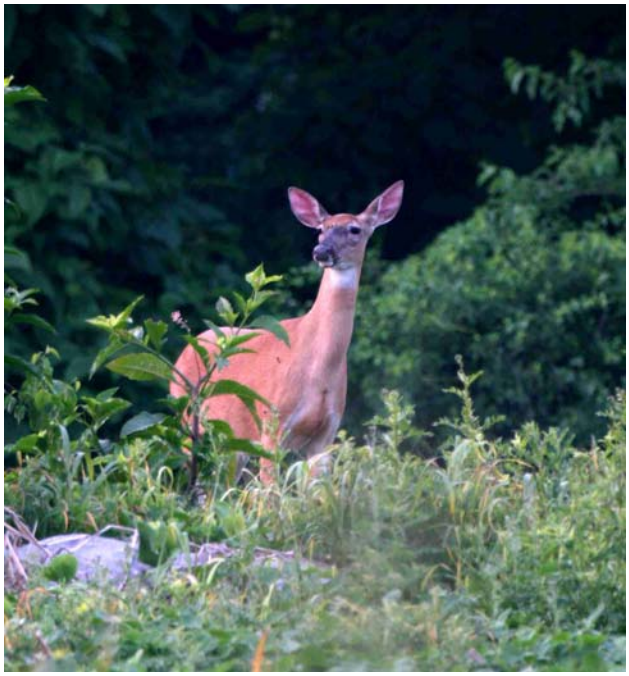
Lancaster County lies in the Piedmont Province, characterized by gentle rolling fields with low elevation forested uplands. As with most counties in this province, Lancaster remains a prime agricultural area within the commonwealth. Although deer hunting is not considered to be an important regional economic factor, Lancaster County contains large populations of white-tailed deer (*Odocoileus virginianus*) where moderately small woodlands and forests lie adjacent to agricultural lands. Vast areas of the county are closed to hunting due to development pressure and urban sprawl. This overpopulation of deer, along with limited access to deer hunting in certain areas, will likely lead to increased conflicts between deer and the residents of Lancaster County.

The over abundance of deer has negatively impacted much of Lancaster County's native species, both plant and animal. Deer will browse all typical forested habitats until food resources are low and then turn to agricultural crops as well as ornamental plantings such as those found around housing developments. As they become more reliant on non-typical food resources, populations continue to grow unchecked by traditional game management techniques. Despite much of the public's perception that deer numbers are dwindling in many portions of the state, a multitude of scientific studies have shown that deer populations in the state remain strong. With the light hunting pressures in Lancaster County, the deer over population remains a challenge to conservation of biodiversity. As early as the 1950s, the Mammal Survey of Southeastern Pennsylvania noted that the deer population in this region was increasing, and in Lancaster County, they were noted as being a nuisance (Roberts & Early 1952).



A dramatic browse line due to an over-abundant deer population.

photo source: PNHP



White-tailed deer (*Odocoileus virginianus*)

photo source: Charlie Eichelberger

Many other mammal species occurring throughout Lancaster County are quite unremarkable in that they possess abilities that ensure their survival in a wide range of habitat types and are well represented throughout the county. These species are termed "generalists" and include the northern short-tailed shrew (*Blarina brevicauda*), gray squirrel (*Sciurus carolinensis*), raccoon (*Procyon lotor*), white-footed mouse (*Peromyscus leucopus*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*),



Beaver (*Castor canadensis*)
photo source: Tim Maret

red fox (*Vulpes vulpes*), coyote (*Canis latrans*) and the ubiquitous chipmunk (*Tamias striatus*). All of these species occur throughout the many and diverse habitats within Lancaster County, and the rest of Pennsylvania, and are in no jeopardy of disappearing from the landscape.

Other species have fairly restricted habitat needs and are termed "habitat specialists". They may be restricted to grassland habitats, the forest interior, upper elevation ridgelines, wetlands and streams or caves and mines. Examples of these species include the meadow vole (*Microtus pennsylvanicus*) which relies on grasslands and meadows, bats which hibernate in caves and mines, and muskrats (*Ondatra zibethicus*) and beaver (*Castor canadensis*) both of which are specialized to live in wetlands and streams. Beaver were extirpated from Pennsylvania by 1912, but reintroduction efforts were underway within a few years. Today, beavers have rebounded remarkably in the state, and while not nearly as common before European settlement, are likely to start appearing soon in Lancaster County. The Allegheny woodrat (*Neotoma magister*) is a resident of upper elevation ridges, as well as caves. This state threatened species has suffered dramatic declines and its existence in Lancaster County is now questionable. Once a resident of some of Lancaster's caves, woodrats are now thought to be gone from this habitat. They may however, still exist in rock outcrops in the county, but are currently undetected in this habitat. More survey work is needed for this species in the county to determine if a population exists.

Wetlands and streams play a major role in providing habitat for mammals as well as serving as corridors for dispersal throughout the county. Whenever biologists research mammals, one of the first environs investigated are marshes and streams, as these habitats are often sites where mammalian diversity is highest. It is not uncommon to find multiple species of shrews, rodents, weasels, and bats as well as sign of the various medium-sized carnivores and deer along these habitats. Some of the weasels, including the ermine (*Mustela erminea*), mink (*Mustela vison*), and long-tailed weasel (*Mustela frenata*), can be found in a variety of habitats, but are frequently associated with these wetlands and waterways where prey items are abundant. An extremely secretive species, the star-nosed mole (*Condylura cristata*) is also associated with wetlands, and is an adept swimmer and diver.

The largest member of Pennsylvania's extant weasels, the river otter (*Lontra canadensis*), has been reintroduced to many regions of Pennsylvania where it was previously trapped to near extirpation. While none of the reintroduction sites were in Lancaster County, the species is making an outstanding comeback and may be spotted along the Susquehanna River in the coming years from source populations of reintroduced animals to the north, or from the rebounding Maryland population from the south.

Open land in the form of meadows and reverting grasslands are commonly found along the valleys of Lancaster County. Species of mammals known to occur within open lands include the eastern cottontail rabbit (*Sylvilagus floridanus*), woodchuck (*Marmota monax*), and meadow jumping mouse (*Zapus hudsonius*). Also found in this habitat, the southern bog lemming (*Synaptomys cooperi*), may exist in very low densities, unlike many other small rodents whose populations are consistently large.

The hairy-tailed mole (*Parascalops breweri*) and eastern mole (*Scalopus aquaticus*) can be found in well drained soils throughout habitats harboring a wealth of subterranean invertebrates, including earthworms.



Allegheny Woodrat (*Neotoma magister*)
photo source: Cal Butchkoski

These mammals offer invaluable benefits to humans, by turning over soils, and keeping some invertebrate pest species in check. Another inhabitant of these well drained areas is the woodland vole (*Microtus pinetorum*), a common species whose stronghold is in the southeastern portion of the state. Also using open habitats is the prairie deer mouse (*Peromyscus maniculatus bairdii*). This native species has been expanding its range in recent years, and could now be found in Lancaster County.

One species that may occur within the fields and meadows of Lancaster County is the least shrew (*Cryptotis parva*), a small mammal species that is currently listed as "state endangered". Once common throughout much of Pennsylvania, only a handful of sites are known to harbor this insectivore. Historically the species was widespread throughout much of the state, occurring in early successional fields and meadows that were kept open by rotational cropping practices or intensive forestry practices. Today it is only known from Adams and York Counties. Although not currently known to occur in Lancaster, it is likely that further inventories of early successional habitats would reveal its presence. The habitat still occurs throughout much of the county but is threatened by intensive development and rising urban sprawl.

The remaining forested tracts of Lancaster County, while relatively small, are also important habitat for the regions mammals. The gray fox (*Urocyon cinereoargenteus*) is primarily a denizen of forests, though it may also be found foraging in more open habitats. This native fox is known to be an adept tree climber, and feeds on rabbits and other small mammals. Also living in forested habitats is the southern red-backed vole (*Clethrionomys gapperi*). This species serves as an important food source for many other mammals, as well as birds of prey. The masked shrew (*Sorex cinereus*), smoky shrew (*Sorex fumeus*), and Maryland shrew (*Sorex fontinalis*) are found in a number of different habitats, but tend to prefer cool, moist forests and woodlands. These shrews can also be found close to waterways where insect populations, the major food source for these species, are healthy.

Favoring conifer patches, the red squirrel (*Tamiasciurus hudsonicus*) is much smaller than the more common widespread gray squirrel. Though much smaller than it's larger gray cousin, the red squirrel is highly territorial, and it's loud staccato "cherr" is used to fend off potential predators. The native eastern fox squirrel (*Sciurus niger vulpinus*) prefers floodplain forests, and possibly occurs in Lancaster County. Little is known about the distribution of this native subspecies in Pennsylvania, but the introduced western subspecies



Least Shrew (*Cryptotis parva*)
photo source: Jim Hart

(*Sciurus niger rufiventer*), which is difficult to distinguish from the native form, is expanding its range complicates study of eastern fox squirrels. More research is needed to determine the interactions between these two subspecies, since anecdotal evidence suggests the western fox squirrel may be overtaking the eastern fox squirrels habitat. The nocturnal southern flying squirrel (*Glaucomys volans*) is also known from Lancaster County, living in mixed forests with adequate tree cavities, in which they nest.

Bats are common residents of Lancaster County, most often encountered during the summer months



Red Bat (*Lasiurus borealis*)
photo source: PNHP

along the streams and open bodies of water. The little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), northern myotis (*M. septentrionalis*), and eastern pipestrelle (*Perimyotis subflavus*) are all year round residents of Lancaster County. These bats spend the active season foraging along waterways and rearing young in forested areas with dead woody timber, or in some cases in man made structures like garages, barns, and sheds. During the winter, these species are known to hibernate in Lancaster County's caves and mines. The state threatened eastern small-footed bat (*Myotis*

leibii) likely occurs in Lancaster, and raises its young among rocky hillsides and boulder fields where crevices provide ample cover to avoid predators. While most of Lancaster's bats disappear into the many caves and mines to hibernate during the winter, several species such as the hoary bat (*Lasiurus cinereus*), red bat (*Lasiurus borealis*), and silver-haired bat (*Lasionycteris noctivagans*) don't over-winter in the state at all and migrate further south to states like the Carolinas and Florida and are thought to spend their winter months in hibernation under deep patches of leaf and forest floor litter.



Northern Myotis (*Myotis septentrionalis*)
photo source: PNHP

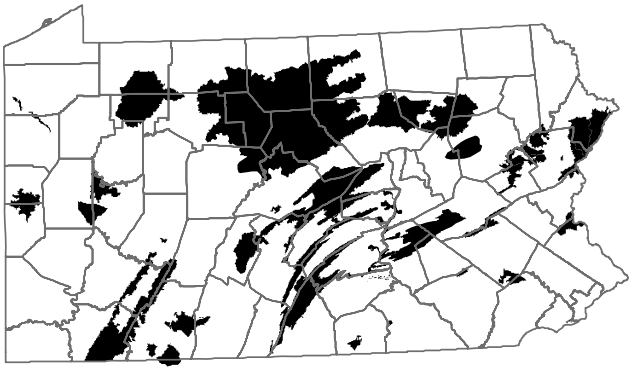
Unfortunately, several invasive mammal species are widespread throughout Lancaster County. Frequently encountered in urban and suburban areas, the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*), both old world species, have become well established. These two introduced species are the true pests of the county, being nuisance to residents, causing much damage to farmer's crops, competing with native species, and altering natural food webs.

With Lancaster County's early conversion from pre-colonial virgin forests to a primarily agrarian landscape, the mammalian fauna of the county was likely one of the earliest in the state to be altered by European colonization. While this change increased the populations of species adapted to more open environments, a corresponding loss of those species considered incompatible with human land use occurred. Lost from the county's mammalian fauna were the bison, elk, martin, fisher, mountain lion, and gray wolf. Though these species would never be able to be reintroduced to the county for many reasons, some mammals formerly abundant in Lancaster County may someday benefit from reintroduction programs, including the Allegheny woodrat, and the least shrew. Monitoring of existing populations of the mammal species of the county could provide a better picture of the conservation needs of Lancaster's mammals, as well as where and when reintroductions may be possible for lost or declining species. Of utmost importance to the diversity of Lancaster County's mammals, is the maintenance of acreage of fallow fields (instead of row crops), avoidance of fragmentation of the remaining forested patches, and protection of existing wetlands. The potential restoration of previously destroyed wetlands is needed to secure those mammal species that live in these declining environs. Though humans can provide this type of habitat restoration, the long term effects that beavers may play in modifying wetland systems may naturally allow for this restoration over time. These restored habitats would serve a multitude of mammal species, as well as many other species of plants and animals, both common and rare, in the county.

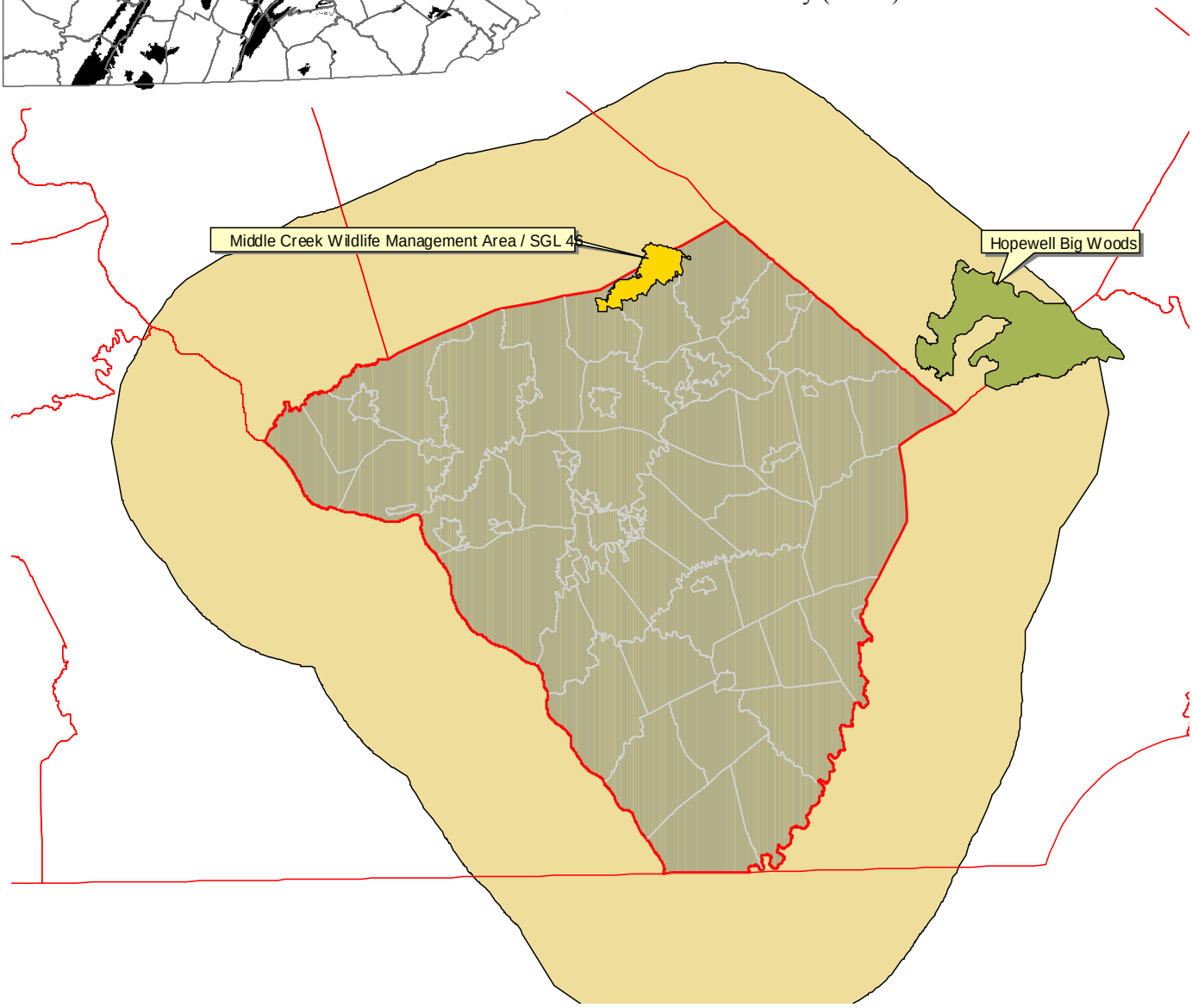
As outlined here, Lancaster County is diverse in terms of the habitats available to the mammal fauna of Pennsylvania. While the large forested blocks common in the north central part of the state are mostly absent in Lancaster County, the Furnace Hills and Welsh Mountain still provide relatively good forested land for many species of mammals. Vegetated stream and river corridors serve as avenues of dispersal to the diverse list of mammals noted to occur in the county. Development of land, splitting of habitats by un-crossable barriers such as major highways, drainage of wetland areas and environmental degradation have all served to confine many mammal species to very localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat or increased predation. These populations may be doomed to what is termed as "localized extinction". If enough of these populations disappear from the landscape, these species' existence in Pennsylvania may be in jeopardy. Continued vigilance as well as enlightened management will ensure that this list will not be shortened and may grow in the future providing opportunities to all Pennsylvanians to enjoy the state's mammalian wildlife.

Important Mammal Areas in Lancaster County

The Important Mammal Areas Project (IMAP) is being carried out by a broad based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Nominated sites are reviewed by IMAP personnel and local scientists, with final site selection managed by the Mammal Survey. The primary concern of the project is to help ensure the future of Pennsylvania's wild mammals, both game and non-game species. Precedence is given to sites with species of special concern but the project is also interested in habitats that have high mammalian diversity or those that offer exceptional educational value.



Important Mammal Areas of Pennsylvania (left), and Lancaster County (below)



Birds of Lancaster County

Adapted by Denise Johnson – Pennsylvania Natural Heritage Program

Pennsylvania provides a variety of habitats for birds and other plant and animal species. Although much of the land use in Lancaster County is currently agricultural, there is still an abundance of habitat available for birds. Birds breed, migrate, and over-winter in the agricultural fields, forests, and wetlands. Those areas that have not been disturbed by agricultural, residential, and industrial development should be considered priorities for conservation in an attempt maintain the species diversity found in the county.

Grassland Birds

By far the most abundant habitat type in Lancaster County, hayfields and other early successional areas provide habitat for some of the most quickly and severely declining bird species in the country. Historically, grasslands in Pennsylvania occurred in small, scattered pockets, as well as naturally occurring grasslands like those in the serpentine barrens. Grasslands became much more abundant around the time of European settlement. During this time, grassland birds expanded their ranges.

Although more grasslands have been created in this historically forested area, a large number of grassland birds appear to be declining throughout the East, as documented in the American Breeding Bird Survey (BBS). Most grassland birds, including common species like Eastern Meadowlark, show a decline of around 40 to 60 percent (Sauer et al. 2000). Their decline has resulted from changes in agricultural practices, habitat fragmentation, pesticide application, natural fire suppression, and human development. Converting hay fields and pasture to row crops limits its use as grassland bird habitat. Currently, almost half of Lancaster County is used for row crops.

Grassland maintenance is difficult due to the natural succession of forests, the timing of agricultural practices, and conflicting views of land managers. Programs like the Conservation Reserve Enhancement Program (CREP) through the US Department of Agriculture provide incentive to farmers to restore habitats to healthy conditions. Additional practices, such as restricting mowing fields until late July, can allow most young birds to fledge.



Barn Owl

Photo source: Bob Moul

Common Grassland Dependent Birds in Lancaster County

Grasshopper Sparrow	*Ammodramus savannarum*
Killdeer	*Charadrius vociferus*
Bobolink	*Dolichonyx oryzivorus*
Horned Lark	*Eremophila alpestris*
Eastern Meadowlark	*Sturnella magna*
Partners In Flight (PIF) Priority Grassland Birds	
Henslow's Sparrow	*Ammodramus henslowii*
Grasshopper Sparrow	*Ammodramus savannarum*
PNHP bird species of special concern found in grasslands	
Short-eared Owl	*Asio flammeus*
Upland Sandpiper	*Bartramia longicauda*
Northern Harrier	*Circus cyaneus*
Dickcissel	*Spiza americana*
Barn Owl	*Tyto alba*

Marsh and Wetland Birds

Wetlands and riparian zones are an imperiled habitat across the state (Myers et al. 2000), and Lancaster County is no exception. From 1956-1979, 38% of Pennsylvania's wetlands with emergent vegetation were drained, filled, or succumbed to succession (Tiner 1990). Of the 1,900 species of breeding birds in North America, 138 require wetlands, many of which are facing severe declines in population.

Wetlands are transitional lands between terrestrial and aquatic systems and have high species diversity and exceptional environmental value. Saturation by water determines the soil development, which in turn influences plant diversity. Common wetland bird species include waterfowl, shorebirds, herons, rails, bitterns, swallows, and sparrows. Many wetland dependent birds are of special concern for the Pennsylvania Natural Heritage Program (PNHP). Many of these birds are also secretive, cryptic, and hard to flush, making marshes difficult areas to survey.



Osprey Photo Source: Bob Moul

These species are very habitat specific and unknown from other habitats.

Wetlands and riparian zones also provide breeding and foraging habitat for various raptors and wading birds. Raptors, such as the Osprey and Bald Eagles, prefer nesting on top of tall trees near water with a good view of the surrounding land. Wading birds prefer clumps of trees to place their rookeries in. Great Blue Herons, Great Egrets, Black-crowned Night-herons, and Yellow-crowned Night-herons are all species of concern
known to nest in rookeries.
Conservation and management programs for marsh birds are critical to sustain healthy populations of breeding birds as well as general ecosystem viability. Immediate needs include the preservation of emergent wetlands that provide nesting, feeding, and wintering habitats. Primary management needs include the protection of wetlands from draining and filling, pollution, siltation, and invasion by exotic plant species.

Wetlands are not only important during the breeding season, but provide important habitat during migration as well. Several areas in Lancaster County provide stopover locations for birds during the spring and fall migration. These areas have all been identified as Important Bird Areas (IBAs) by Audubon Pennsylvania.
Middle Creek Wildlife Management Area has become recognized as one to the best places to see waterfowl migrate. In the spring, hundreds of thousands of Canada and Snow Geese, Tundra Swans, and other waterfowl stop over at the lake and other wetlands in this area.



Black-crowned Night-heron (left) and Yellow-crowned Night-heron (right)
Photo Source: Bob Moul

Conejohela Flats and the Lower Susquehanna River Gorge /Conowingo Reservoir are located along the Susquehanna River and provide breeding habitat for numerous bird species of concern and a feeding and stopover location for migration for many shorebird and waterfowl species. The migratory species are attracted to the mudflats that are exposed as the level of the river is lowered. These areas along the Susquehanna River are some of the few places in Pennsylvania that provide this type of habitat for shorebirds, which is why the shorebird diversity is so high.

Although wetlands make up a small portion of the county, they provide vital habitat to a number of species, many of which are considered species of special concern in the state. Destruction and pollution for agricultural and residential areas threaten the integrity of the remaining wetlands. Wetlands should be a priority for protection and conservation.

Common Wetland Dependent Birds in Lancaster County

Great Blue Heron	*Ardea herodias*
Red-winged Blackbird	*Agelaius phoeniceus*
Swamp Sparrow	*Melospiza georgiana*
Song Sparrow	*Melospiza melodia*
Great Egret	*Ardea alba*

PNHP bird species of special concern found in wetlands

American Bittern	*Botaurus lentiginosus*
Sedge Wren	*Cistothorus platensis*
Marsh Wren	*Cistothorus palustris*)
American Coot	*Fulica americana*
Common Moorhen	*Gallinula chloropus*
Bald Eagle	*Haliaeetus leucocephalus*
Least Bittern	*Ixobrychus exilis*
Yellow-crowned Night-heron	*Nyctanassa violacea*
Black-crowned Night-heron	*Nycticorax nycticorax*
Osprey	*Pandion haliaetus*
Sora	*Porzana carolina*
King Rail	*Rallus elegans*
Virginia Rail	*Rallus limicola*

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Forest Interior Birds

Very little forest remains in Lancaster County, and much of what is left has been fragmented. In fact, Lancaster County is second only to Philadelphia County for the least amount of forest in the state. This makes the few patches of forest remaining in the county an important refuge for interior forest birds. Many of the species that require large tracts of unfragmented forests, such as Northern Goshawk and Cerulean Warbler, do not breed in the county due to the lack of adequately sized forest patches.

Large contiguous tracts of forests, necessary for forest interior species, are declining in most regions (Askins et al. 1991). Forest interior, or core forest, is defined as contiguous forest that is 300 feet and greater from a road or edge (Whitcomb et al. 1981). This critical habitat is declining, with 70% percent of Pennsylvania's core forest land found in patches of 5,000 acres or less, indicating a highly fragmented landscape. As an example a square, unbroken 40-acre patch of forest contains on ly 12 acres of forest interior while a similar 640-acre patch contains 503 acres of interior. Fragmentation and smaller interior area negatively affects the nesting success of these bird species (Whitcomb et al. 1981). Increased forest edges, created by forest management practices such as logging and utility development, exposes nesting birds to greater dangers such as brood parasitism and nest predation (Robinson 1994). For example, interior birds nesting near edges are more often parasitized by Brown-headed Cowbirds, which lay their eggs in other bird nests where they are raised at the owner's expense.



Black and White Warbler
Photo source: Bob Moul

The most heavily forested areas remaining in Lancaster County occur along the northern border and the Susquehanna River. Forest interiors usually have high bird diversity. These communities include a variety of warblers, tanagers, vireos, owls, woodpeckers, and hawks. In addition to conservation efforts for rare species, maintaining viable populations of common birds is increasingly important as formerly common forest interior species have shown a persistent population decline over time (Sauer et al. 2000).



Scarlet Tanager
Photo source: Bob Moul

To sustain viable populations, the remaining forest structure must remain intact. The structural diversity of the forest, such as natural openings (not caused by tree removal or management) and complex vertical layering of trees provides more types of feeding, perching, and nesting habitats. Maintaining structural diversity is accomplished by maximizing the size of contiguous forest tracks, keeping larger forest patches closely grouped, harvesting around forest edges, and establishing forested corridors between contiguous blocks (Pashley et al. 2000).

Common Forest Interior Bird Species in Lancaster County	
Broad-winged Hawk	*Buteo platypterus*
Pileated Woodpecker	*Dryocopus pileatus*
Acadian Flycatcher	*Empidonax virescens*
Black and White Warbler	*Mniotilta varia*
Scarlet Tanager	*Piranga olivacea*
Hairy Woodpecker	*Picoides villosus*
Ovenbird	*Seiurus aurocapillus*
Barred Owl	*Strix varia*
Partners In Flight (PIF) Priority Forest Interior Birds	
Cerulean Warbler	*Dendroica cerulea*
Wood Thrush	*Hylocichla mustelina*
Kentucky Warbler	*Oporornis formosus*
Louisiana Waterthrush	*Seiurus motacilla*
PNHP bird species of special concern found in interior forest	
Northern Goshawk	*Accipiter gentilis*
Northern Saw-whet Owl	*Aegolius acadicus*
Swainson's Thrush	*Catharus ustulatus*
Yellow-bellied Flycatcher	*Empidonax flavescens*

A list of the birds seen in Lancaster County during all times of the year can be found at: http://ebird.org/ebird/GuideMe?cmd=decisionPage&getLocations=counties&counties=US-PA-071&locRSID=RS2571823&bYear=1900&eYear=2008&bMonth=1&eMonth=12&reportType=location&parentState=US-PA&chartID=1884844120&rowsPerPage=294

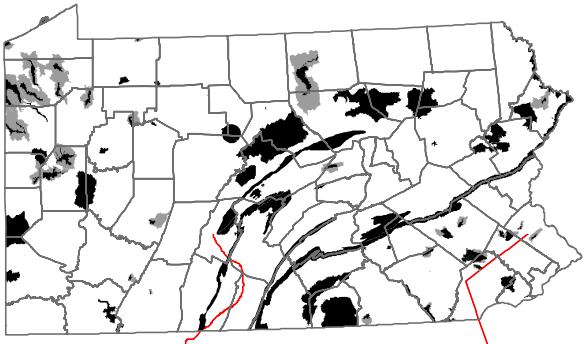
Important Bird Areas of Lancaster County

In an effort to conserve the Commonwealth's avifauna, the Pennsylvania Chapter of the National Audubon Society, along with the Pennsylvania Ornithological Technical Committee of the Pennsylvania Biological Survey, has identified 81 areas within the state that are considered to be a part of a global network of places recognized for their outstanding value to bird conservation. Termed Important Bird Areas, or IBAs, six of these areas occur within Lancaster County:

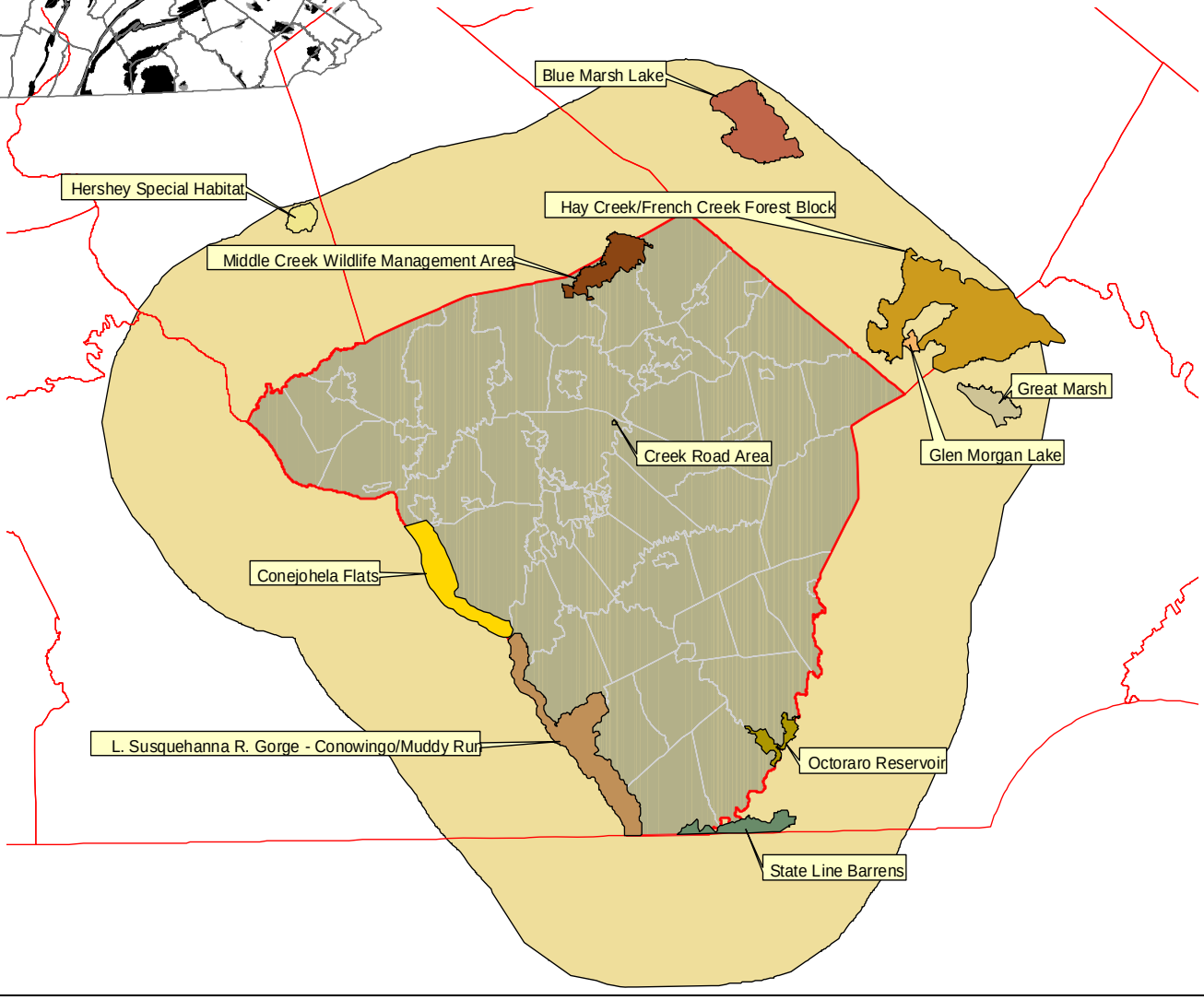
- Conejohela Flats
- Creek Road Area
- Lower Susquehanna River Gorge – Conowingo Reservoir
- Middle Creek Wildlife Management Area
- Octoraro Reservoir
- State Line Barrens

The IBAs extend beyond Lancaster County; therefore, features described below pertain to the entire IBA and are not necessarily confined to the county. The descriptions below are adapted from site reports provided by the Audubon Society of Pennsylvania. More information about the Important Bird Area Program can be found at Audubon PA's website (http://pa.audubon.org/)

Note: the following information is adapted from the Audubon Pennsylvania IBA site descriptions (Audubon 2002).Additional information can be found at http://pa.audubon.org/iba/.



Important bird areas of Pennsylvania (left)
and Lancaster County and surrounding area (below)



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Conejohela Flats IBA

Conejohela Flats is a combination of small brushy islands and mud flats located along the Susquehanna River. The mud flats are exposed when the water level is lowered by the Safe Harbor Dam to generate electricity. The mud flats provide important habitat for shore birds that is found few other places in Pennsylvania. Many other species of wetland birds and waterfowl also use this area during migration. Bald Eagles and Ospreys are regularly seen in this area.



Semi-palmated Sandpiper

Photo source: Bob Moul

This area satisfies the following IBA criteria:

- Large numbers of migratory snow geese and tundra swan, as well as shorebird species, including semi-palmated plover and spotted sandpiper
- Bald Eagle, Osprey, Black Tern, Peregrine Falcon, Short-eared Owl, and Common Tern during winter and migration
- Prothonotary Warbler (Breeding), Green-winged Teal, American Coot, Pied-billed Grebe, Black-crowned Night-heron, Northern Harrier, and Marsh Wren during winter and migration
- Rare habitat: Mud flats provide feeding and stopover for numerous and diverse species
- Lancaster County Bird Club has monitored birds at this site for over 40 years

Creek Road Area IBA

The second largest Black-crowned Night-heron rookery in Pennsylvania is located at the Creek Road Area IBA. The rookery was first seen in 1992, and now contains more than 100 nests, most of which are located in sycamore trees adjacent to Lititz Run Creek.

This area satisfies the following IBA criteria:

- Black-crowned Night-heron rookery with approximately 100 nests
- The colony has been monitored since 1992 after it was first reported by the Game Commission

Lower Susquehanna River Gorge – Conowingo Reservoir IBA

The Conowingo Reservoir was created when Muddy Run was flooded, and a 985 acre pump storage reservoir was created. Mitigation projects created a 100 acre recreational lake, 500 acre park and 1900 acres of old fields, woodland, cultivated fields and plantings by the Game Commission and the Natural Resource Conservation Service are also included in this IBA. This area had provided habitat for 250 species of birds since 1973. There is a variety of available habitat in this IBA including: a stretch of the Susquehanna River than remains ice-free because of the turbulence created by the Muddy Run Power Plant, heavily wooded river hills, fluctuating levels of the pumped-storage reservoir, and old field habitat in the project area.

This area satisfies the following IBA criteria:

- Large numbers of Snow Geese, Tundra Swan, and American Black Duck
- Breeding Bald Eagle and Osprey

Middle Creek Wildlife Management Area IBA

This IBA is owned by the Pennsylvania Game Commission, and is managed as an area for wildlife protection and propagation. Middle Creek was dammed to create a 400 acre man-made lake. This and other marshy ponds and potholes that were created in the area provide habitat for a variety of waterfowl. Middle Creek is best known for the abundance of Snow Geese and Tundra Swans, as well as other waterfowl, that appear in early spring, a sight that draws hundreds of thousands of people every year. Fields surrounding the lake are farmed to provide pasture for waterfowl and other wildlife.



Tundra Swans at Middle Creek
Photo source: Denise Johnson, PNHP

This area satisfies the following IBA criteria:

- Approximately 280 bird species have been recorded at this site, including large numbers of Tundra Swan, Snow Goose, Canada Goose, Common Merganser, and Redhead
- Middle Creek is a dedicated wildlife management area. Long term waterfowl research is being done by the Pennsylvania Game Commission

Octoraro Reservoir IBA

Located on the border with Chester County, Octoraro Reservoir was created by damming Octoraro Creek. The resulting lake provides habitat for wading birds and waterfowl. Migrating shorebirds stop along the mudflats during migration. The surrounding hardwood forest and pine plantation attract a variety of bird species, including seven species of owl, Acadian Flycatcher, Warbling Vireo, Louisiana Waterthrush, Yellow-throated Vireo, and Cerulean Warbler.

This area satisfies the following IBA criteria:

- Large numbers of Canada Goose, Snow Goose, and Common Merganser in the winter and during migration
- Bald Eagle (breeding) and Osprey
- Pied-billed Grebe, Prothonotary Warbler (breeding), and Common Snipe



Bobwhite Quail Photo Source: Bob Moul

State Line Barrens IBA

The group of oak-pine barrens, including Nottingham, Goat Hill, and Chrome, are grouped together as the State Line Barrens. These barrens are one of few places in the country where this type of habitat occurs. The barrens are characterized by small savannas, prairies, and grassy meadows with dry soil that contain numerous rare plant species. Early successional and grassland bird species are common in this IBA.

This area satisfies the following IBA criteria:

- Breeding population of Northern Bobwhite
- Habitat is rare or unusual within state or region. Oak-pine barrens with associated species. Exceptional representative of a characteristic habitat within its physiographic province.
- province.

Reptiles and Amphibians in Lancaster County

Charlie Eichelberger – Pennsylvania Natural Heritage Program

Pennsylvania's mixed landscapes create a great diversity of habitats for a wide range of reptile and amphibian species. Pennsylvania's reptile and amphibian makeup, known as the herpetofauna, is quite unique. The ranges of most Pennsylvania reptiles and amphibians are restricted to certain regions of the state, a testament to the varied topography and physiographic provinces within the region. Today, the Commonwealth is home to 72 native herptile species, including those common in the glaciated regions of the Canadian Shield, many of the southern species from the lower regions of the Appalachians, several associated with western prairies, and a few connected with the coastal plain.

Lancaster County is home to many common, generalist species, such as the Eastern Garter Snake (*Thamnophis sirtalis*), the Red-spotted Newt (*Notophthalmus viridescens*), the Bull and Green Frogs (*Rana catesbeiana*, *R. clamitans*), and the Painted and Snapping Turtles (*Chrysemys picta*, *Chelydra serpentina*). These species occur in many different habitats, exist throughout the entire state, and are the most commonly encountered reptiles and amphibians in the Commonwealth. Along with these common species, Lancaster County includes several less common species of herptiles. Many of these species have restricted ranges or are considered specialists, meaning their life histories have more specific habitat requirements.



Eastern Garter Snake (*Thamnophis sirtalis*)
photo source: Charlie Eichelberger, PNHP



Green Frog (*Rana clamitans*)
photo source: Charlie Eichelberger, PNHP

Much of southeastern Pennsylvania has succumbed to a large amount of habitat degradation, destruction, and fragmentation due to conversion of land to agriculture and development. A small number of larger forested tracts remain in Lancaster County, particularly in the Furnace Hills and Welsh Mountain, as well as along the Susquehanna River corridor. These areas, while small when compared to other portions of the state, provide a good amount of contiguous habitat for Lancaster County's herptiles. The array of habitats within these larger forested blocks serves the generalist and many of the specialist species. In other cases, light agricultural practices which mimic natural expansive openings which historically occurred throughout Pennsylvania, are well suited to the needs of certain specialist species in the county. In many cases, Lancaster County's land use is compatible with herptile conservation and light agriculture benefits some herptile habitats within the county.

Salamanders

The terrestrial woodland salamanders depend on canopied forests with adequate amounts of leaf litter. These salamanders are voracious predators of the forest floor. Their role in limiting the numbers of leaf decomposing invertebrates has been shown to be significant in maintaining a rich layer of organic matter on the forest floor, often an indicator of forest health. The Red-backed and Slimy Salamanders (*Plethodon cinereus*, *P. glutinosis*) are the most common woodland species in Lancaster County's forests.

The numerous waterways and streams of Lancaster County provide habitat for the brook salamanders, including the Northern Dusky Salamander (*Desmognathus fuscus*), the Northern Two-lined and Long-tailed Salamanders (*Eurycea bislineata*, *E. longicauda*) and the Northern Spring Salamander (*Gyrinophilus porphyriticus*). In the cold-water drainages of the county, the brilliant Northern Red Salamander (*Pseudotriton ruber*) can be found under the litter and rocks in seeps and spring heads. All of the streamside salamanders require high water quality.

The largest salamander on the continent, the Hellbender (*Cryptobranchus alleganiensis*) was once found in the Susquehanna River through Lancaster County. Able to reach over two feet in length, this bizarre-looking harmless salamander is rarely seen, as it spends the majority of the time under large flat rocks in swift moving, high quality waters. Hellbender populations have been declining very rapidly due to decreases in water quality and introductions of aggressive non-native crayfish. The highly modified lower Susquehanna River has varied the former Hellbender habitats drastically. The small scour island chains have been replaced with deep, sluggish lakes behind the 3 behemoth dams in Lancaster's stretch of the Susquehanna. Amphibians as a whole are particularly sensitive to pollution. Consequently, pollutants and heavy sediments loads can be detrimental to the Hellbenders inhabiting affected streams. While there have been no directed Hellbender surveys in Lancaster County in recent years, reports of their continued presence in the lower Susquehanna drainage are few.



Spring Peeper (*Pseudacris crucifer*)
photo source: Charlie Eichelberger, PNHP



Long-tailed Salamander (*Eurycea longicauda*)
photo source: Charlie Eichelberger, PNHP

Temporary wetlands and vernal pools are critical to a group of amphibians that rely on the wet/dry annual cycle that eliminates the possibility of fish populations being established. The Spotted Salamander (*Ambystoma maculatum*), which is a vernal pool obligate, is known from Lancaster County and one historical record exists for the Jefferson Salamander (*Ambystoma jeffersonianum*). While the Marbled Salamander is not known from Lancaster, this highly secretive species may occur, but has not yet been documented. These species cannot reproduce without the presence of fish free ephemeral wetlands. The Four-toed Salamander (*Hemidactylium scutatum*) is not a vernal pool obligate but can be found in association with these habitats. This diminutive salamander lays its eggs in peat mosses (*Sphagnum* spp.) and can be found in the margins of seeps, springs and streamsides where Sphagnum moss is found above cool, clear water. The Four-toed Salamander tends its clutch, which is laid in vertical mats of Sphagnum, until the young hatch.

Frogs and Toads

The Wood Frog (*Rana sylvatica*), like the Ambystomatid salamanders discussed earlier, is considered a vernal pool obligate species, however wood Frogs are one of the more "liberal" vernal pool species and can also be found breeding in shallow marshes and ditches. The American Toad (*Bufo amercianus*), Spring Peeper (*Pseudacris crucifer*), Grey Tree Frog (*Hyla versicolor*), and Northern Cricket Frog (*Acris crepitans*) are regular visitors to many different types of wetlands where they breed and forage. Though the Northern Cricket Frog was widespread across Pennsylvania, numbers have dropped off rapidly, and there is currently only one

site in the state where cricket frogs are still known to breed.

The Fowler's Toad (*Bufo fowleri*) is generally less common than the related American Toad, with the former typically inhabiting areas of sandy soils and the latter being far more general in its habitat requirements. The Pickerel Frog (*Rana palustris*) and Northern Leopard Frog (*Rana pipiens*) require heavily vegetated streams and creeks. Once Pennsylvania's most common species of frog, the Northern Leopard Frog has rapidly disappeared from much of its range for mysterious reasons and there is now concern for the future of this species. Likewise, the Upland Chorus Frog (*Pseudacris feriarum*) can be found using herbaceous marshes, riparian backwaters, and ephemeral wetlands where there is plenty of cover among the grasses and sedges. This species has also declined precipitously in the past few decades for unknown reasons.



Stinkpot Turtle (*Sternothrous odoratus*)
photo source: Charlie Eichelberger, PNHP

Turtles

The Spotted Turtle (*Clemmys guttata*) is a small semiaquatic turtle that can inhabit a range of wetlands, from vernal pools, to wet meadows, marshes, and slow moving streams. Spotted Turtles are becoming increasingly rare in the state because of habitat loss, predation, and illegal collection. The Stinkpot Turtle (*Sternothrous odoratus*) inhabits most moderate-to-large wetlands, though it is infrequently encountered because of its secretive nature. The Map Turtle (*Graptemys geographica*) is a common occurrence in the larger tributaries of the Susquehanna River. The semi-aquatic Wood Turtle (*Glyptemys insculpta*) relies on wooded creeks and rivers, and while it can be locally common in areas, the species is becoming increasingly rare across its range. The Eastern Box Turtle (*Terrapene carolina*) is an easily recognized, generalist species found throughout the county. While this species is still considered common, with a lifespan that may reach beyond a century, many biologists believe that Box Turtle populations have been in a steady decline due to road mortality and predation on nests and juveniles. Turtle nests are laid in suitable substrates with sun exposure, frequently along waterways. These sites are used by many nesting females and are easily targeted by overpopulations of raccoons, skunks, and opossums. There is growing concern for many of Pennsylvania's turtles, because numerous populations are nearly void of juvenile turtles, indicating that there is little successful reproduction occurring.



Eastern Box Turtle (*Terrapene carolina*)
photo source: Charlie Eichelberger, PNHP

Two of Pennsylvania's rarest turtles are found in Lancaster County. The Bog Turtle (*Glyptemys muhlenbergii*), is a federally threatened species and is listed as state endangered. This species has suffered severe declines due to habitat destruction, habitat fragmentation, illegal collection, and predation. The distinctive orange spots on either side of the neck are the most obvious identifying character. Bog turtles are habitat specialists, requiring open herbaceous wetlands with spring fed water and mucky soils. Lancaster's wetlands remain critical to the survival of Bog Turtles. More information on the complex management practices for this species can be found in the following section

The Red-bellied Turtle (*Pseudemys rubriventris*) is listed as a Pennsylvania Threatened species. The very restricted range of this species is confined to the southeastern counties of Pennsylvania. One of the concerns for this species is the introduction of the invasive Sliders (*Trachemys scripta*). These turtles are native to the southeastern US, and are now widely

distributed outside of its native range, a result of pet owners releasing their turtles. There is concern that the sliders may be displacing the Red-bellied Turtle. Red-bellied Turtles are also known to travel considerable distances from their aquatic habitats in order to lay their eggs. As these females move across land in search of suitable nesting habitats, they face an onslaught of threats, including predation and road mortality.

Lizards and Snakes

The Northern Fence Lizard (*Sceloporus undulatus*), the Five-lined Skink (*Eumeces faciatus*), and the Broadhead Skink (*Eumeces laticeps*) are all known from Lancaster County. These species occur in relatively small, isolated populations in dry habitats with an abundance of cover objects and basking areas. These habitats often include many sun-exposed rocks and dead woody debris. These species are particularly susceptible to localized extinction because of their populations' small sizes and isolation from other lizard populations. Lancaster County one of only two locales for Broadhead Skinks in the state, and the only recent record for this species. While this species is more common to the south, the Lancaster County record represents the northernmost occurrence of this lizard in the eastern US.

The Northern Black Racer (*Coluber constrictor*) and the Black Rat Snake (*Elaphe allegheniensis*), two fairly common species in the state, can be found in many different habitats across the county. These two species prey upon small mammals including mice and squirrels. The brilliantly patterned Eastern Milk Snake (*Lampropeltis triagulatum*) can be found in a variety of habitats and though it is common, this species is rather secretive and is rarely seen. A more frequently observed snake, Northern Water Snake (*Nerodia sipedon*) is a widespread resident of Lancaster County. This species hunts along open waterways, searching for amphibians and small fish. Often overlapping habitats with the Northern Watersnake is the Queen Snake (*Regina septemvittata*). This snake is smaller than the Northern Watersnake, with an unpatterned olive-brown back, and a belly that is yellowish tan and striped with four black bands that run the length of the snake. This species is specialized to feed on crayfish, and is thought to be declining in the state because of water pollution and the introduction of the invasive Rusty Crayfish. The range of the Eastern Hognose Snake (*Heterodon platirhinos*) extends throughout Lancaster County, though this snake has not yet been documented in the county. This harmless, toad-eating snake is known to flare its neck into a hood, and strike at predators while hissing loudly. If the performance doesn't work, this snake will feign death and roll on its back while becoming limp and gaping its mouth.



Northern Fence Lizard (*Sceloporus undulatus*)
photo source: John Kunsman (PNHP)



Ribbon Snake (*Thamnophis sauritis*)
photo source: Charlie Eichelberger, PNHP

The Eastern Ribbon Snake (*Thamnophis sauritis*), a slender species of garter snake, depends on the sedge and grass covered edges of wetlands and is thought to be declining due to wetland destruction. The Smooth Green Snake (*Liochlorophis vernalis*) is likely common in grassy areas but is difficult to locate because its camouflage allows it to virtually disappear into vegetation. Though this snake is rarely seen, the species is apparently secure in the state. A superficially similar snake, the Rough Green Snake (*Opheodrys aestivus*) is a very rare species in Pennsylvania. Listed as state endangered, this species is only known from two extant locations in the state, including southern Lancaster County and

southwestern Chester County. This species is arboreal, meaning it lives in trees and shrubs, where they can be found foraging for spiders, caterpillars, and grasshoppers. Specific recommendations for Rough Green Snakes can be found in the following section

Several small and secretive snake species in the county include the Northern Brown Snake (*Storeria dekayi*), the Ringneck Snake (*Diadophus punctatus*), the Eastern Worm Snake (*Carphophis amoenus*) and formerly the Smooth Earth Snake (*Virginia valeriae*). The Ringneck Snake and the Northern Brown Snake are common residents and can be found beneath rocks and decaying wood and bark, and in the case of the Northern Brown Snake, in vacant lots in urban settings. Worm Snakes and Smooth Earth Snakes are exclusively fossorial, meaning they spend their lives underground. Little is known about these species in Pennsylvania and recent surveys for the Smooth Earth Snake have been unsuccessful. It has now been over 40 years since the last sighting of a Smooth Earth Snake in the state. More survey work needs to be conducted to update the status of Eastern Worm Snakes and to determine if the Smooth Earth Snake still exists in Pennsylvania.

The Timber Rattlesnake (*Crotalus horridus*) and Northern Copperhead (*Agkistrodon contortrix*) have long been persecuted due to their venomous nature. Although these snakes may deliver a serious bite if threatened, the danger they pose has been drastically over-exaggerated. In fact, there has never been a human fatality in Pennsylvania from a Rattlesnake or Copperhead bite. The forested ridges of Lancaster County likely once housed Timber Rattlesnakes, but the species is now absent from the county. Copperheads are able to use a wide range of habitats and may be encountered throughout the forested portions of the county and can be found from mountaintops to valley floors in dry settings as well as wetland edges. They may forage in a variety of habitats, but favor forested areas with healthy small mammal populations.

Copperheads are considered a game species by the Pennsylvania Fish and Boat Commission and can be collected with an appropriate PAFBC permit. Despite the allowance of Copperhead hunting, the species is in decline, and is considered a "watchlist" species by PNHP.

Lancaster County is a significant spot in the state for the Commonwealth's reptiles and amphibians. The forested tracts, though relatively small, and numerous waterways and wetlands provide critical habitat for the reptiles and amphibians. Of utmost importance to the conservation of the county's herpetofauna is the protection of the region's forests, streams, marshes, and especially the wet meadows. The past half century has seen a dramatic change in agricultural practices. The intense, hard, mechanized approach to agriculture has led to much habitat destruction for Lancaster's reptiles and amphibians, and efforts to restore some of these habitats should be made. The rich and diverse herpetofauna of Lancaster County is unique to Pennsylvania and should be considered in the long term plan of the region.

This text has been created by examining the range maps for Pennsylvania herptile species and examining records found in museums, databases, and various monographs. While this information has been based on decades of scientific research and inventories, the secretive nature of herptiles make them difficult to survey for. Therefore, there could be other herptile species that occur in the county that have not yet been recorded.

Pennsylvania Fish and Boat Commission Regulations

In Pennsylvania, the Fish and Boat Commission has jurisdiction over the reptiles and amphibians. Recently, regulations concerning the herptiles were reviewed and there have been considerable changes with how this group is managed. The regulations now include a list of "no-take" species that are thought to be declining. More information on the amphibian and reptile regulations can be found on the Fish and Boat Commission's website at http://sites.state.pa.us/PA_Exec/Fish_Boat/regs_nongame.htm.

Pennsylvania Herpetological Atlas

The Pennsylvania Herpetological Atlas, begun in 1997, serves to fill some of the gaps in our knowledge of herptile distributions in the state. The atlas is a volunteer based project and citizens are encouraged to submit records for species of conservation concern to the atlas. Submissions may be made online at http://webspace.ship.edu/tjmare/herp.htm.

Bog Turtles

Introduction and Habitat Use

The smallest turtle in North America, the federally *threatended* bog turtle (*Glyptemys muhlenbergii*), was first discovered in Lancaster County in the late 18th century. Since the turtle's discovery, it has remained one of the most obscure reptiles in North America, with very few studies conducted on the species until the 1970's. Lancaster County has traditionally been known as a stronghold for the species and the pioneering ecological studies of the species were conducted in Lancaster County. Newer research techniques have enabled herpetologists to better grasp the ecology of this species and more robust studies are shedding new light on this misunderstood species. As a result, the management recommendations from just a few years ago are being revised to reflect this new research.



The Bog Turtle (*Glyptemys muhlernbergii*) inhabits open canopied wet meadows and marshes that have soft mucky soils and are usually fed by spring waters.
photo source: Charlie Eichelberger, PNHP

Bog turtles have slightly domed, brown to black shells with distinctive orange blotches that flank either side of the turtles head and neck. Being one of the rarest turtles in North America, and the threats posed to the remaining populations and their habitats, the World Wildlife Fund has placed the bog turtle on its list of the ten most endangered vertebrates in the world alongside the black rhinoceros and giant panda (Herman and Tryon 1997). The global population of bog turtles is by no means secure. Population estimates in the early 1970's for the entire species hovered around 15,000 individuals. By the early 1990's those numbers were thought to have halved. Several authors have claimed that the frequent discovery of new sites indicates that the species is not as rare as was once thought, but rather that the turtles are so secretive that they are simply infrequently encountered (Arndt 1977, Herman and George 1985). Although the turtles are secretive, these arguments have been largely discredited (Klemens 2000). These "new" sites often represent the last individuals of non-reproducing colonies (Klemens 1997).

Bog Turtles inhabit open, shallow marshy areas with soft, mucky substrates. These areas are often in the middle stages of hydrarch succession, as open wetlands succeed to upland forests (Ernst 1985). For successful reproduction, bog turtles require open canopied nest areas with *Sphagnum* hummocks or sedge tussocks (usually of the tussock sedge, *Carex stricta*) to lay their eggs. The absence of *Sphagnum* hummocks and sedge tussocks for nesting can lead to the inevitable local extinction of a colony, despite the presence of reproductive adult turtles.

Bog Turtle hibernacula sites are most often found in shrub swamps or swamp forests adjacent to open habitats. Bog turtles can hibernate in spring heads, muskrat tunnels, and on the bottom of small streams if the substrate is suitable, but the preferred hibernacula sites appear to be located in the flooded root systems of woody vegetation. Mesic areas with woody vegetation adjacent to open areas are a critical component of the Bog Turtle habitat.



A wet meadow typical of Bog Turtle habitat. This particular meadow is lightly grazed with cattle, which deters succession of woody plants, and stirs up the soil strata into the mucky soils needed by Bog Turtles. These wet meadows are often placed in conservation programs, such as CREP, where trees are planted to establish forested buffers around waterways. It is important to note that this practice can severely degrade Bog Turtle habitats, and should be discouraged in certain parts of Lancaster County.

photo source: PNHP

In the past, beavers (*Castor canadensis*) played a critical role in the long term sustainability of bog turtle populations (Herman and Tryon 1997, Kivat 1978, Lee and Norden 1996). Beaver dams cause waters to slow and the upstream limits of beaver ponds contain shallow, open marshy areas suitable for bog turtles. Typically beavers will inhabit an area for several years, then abandon their ponds and move to other areas within the watershed. Beavers are capable of creating expansive openings in the forest by both flooding and downing woody vegetation around their ponds. As the structures built by beavers deteriorate, the pond basins, which have accumulated a base of soft sediment and increased solar exposure due to the decrease in the forest canopy, are repatriated by marsh plants (Merritt 1987). The open canopy, soft mud, and marsh gramanoids and mosses serve as ideal bog turtle habitat. In the few remaining places where beavers and bog turtles coexist, this periodic cycle of forest-beaver activity-beaver abandonment-bog turtle colonization has been confirmed (John Behler pers. comm.). Historically, as succession has closed the canopy around bog turtle habitat, the turtles have moved to other open canopy wetlands within large wetland complexes. These wandering individuals served to populate sites newly opened due to natural disturbance via beavers (Lee and Norden 1996).

In the pre-Columbian Appalachians, beavers existed in large numbers (Herman and Tryon 1997). It is estimated that the current number of beavers in North America is about 5% of the numbers that existed prior to European settlement, with most of these remaining beavers occurring in unpopulated areas far from the current range of the bog turtle. In Pennsylvania, the beaver was extirpated by 1912, but reintroduction plans were in place within five years of their disappearance (Merritt 1987). Today, Pennsylvania's bog turtles may be experiencing the delayed effects of too few beavers for too long a time. Many bog turtle sites formerly maintained by beavers are now threatened with succession because beavers are considered undesirable as cohabitants with humans.

In addition to the habitat creation caused by beavers, large numbers of elk (*Cervus elaphus*) and bison (*Bison bison*) grazed, wallowed, and watered in wet meadows and marshes, maintaining their seral condition and perpetuating suitable habitat for bog turtles (Lee and Norden 1996). The historic range of both elk and bison in the Appalachians roughly overlaps the range of the bog turtle and historic evidence shows that these large ungulates created expansive openings around watering holes (Lee and Norden 1996). Bison were extirpated from Pennsylvania in 1801 and elk remained in the Commonwealth until 1877 (Merritt 1987).

Current Threats

Due to successful legislation, wetland destruction has slowed in recent years. Although strides have been made in the protection of the immediate habitats, the links between wetland patches continue to be at risk. Suburban sprawl fragments bog turtle habitat that exist as wetland complexes, thereby eliminating the ability for turtles to move within these complexes (Klemens 1997). Since bog turtles historically functioned in metapopulations, fragmentation due to development severs the connectedness of patches within larger metapopulations (Buhlmann et al. 1997).

Natural succession poses a tremendous threat to Bog Turtle habitat. Fifty years ago, succession was not thought of as a threat to Bog Turtles because the process is considered a natural ecological function. Today, we realize that as open canopied Bog Turtle habitats are invaded by woody species, turtles may remain in small wet pockets that persist, but may not represent viable colonies due to the lack of suitable nesting areas.

The other observed threat of natural succession is the dispersal of adult turtles from habitats becoming unsuitable via natural succession. These individuals may never find additional suitable habitats because of a lack of suitable habitats in wetland systems that have become too fragmented due to development. Wandering individuals are particularly susceptible to predation, as well as being hit by vehicles while attempting to cross roadways in search of suitable habitats.

Increase in road surface and increased road traffic has made it all but impossible for wandering bog turtles to successfully reach suitable pockets of habitat when roadways bisect wetland systems. Road mortality has also been shown to be a significant component of bog turtle mortality when roads lie adjacent to turtle colonies (Arndt 1977).

Exotic plant species also threaten bog turtle habitats. Multiflora rose (*Rosa multiflora*), purple loosestrife (*Lythrum salicaria*), Japanese stilt grass (*Microstegium vimineum*), mile-a-minute weed (*Polygonum perfoliatum*), and the exotic varieties of common reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*) all degrade wetlands used by bog turtles (Klemens 2000, Thorne 2001). In addition to crowding out the native flora that the bog turtle relies on, purple loosestrife, common reed, and reed canary grass all accumulate dead stems which persist over winter. This accumulation can quickly dry up shallow wetlands and eliminate prime early spring basking areas used by bog turtles (Breisch 1997).

Populations of raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), red foxes (*Vulpes vulpes*), and domestic and feral cats (*Felis domesticus*) have increased since the decline of trapping in the late 1970's. Suburban sprawl also aids populations of these generalist predators, subsidizing their diets with human refuse. This artificial food source allows these predators to avoid the natural bottlenecks during periods of natural food shortages, which once naturally kept their numbers under control. Though most of these mesopredators are native, their rising numbers are wreaking havoc on all life stages of the Bog Turtle (Mitchell and Klemens 2000). Predation by mesopredators on bog turtle nests has been well documented (Arndt 1977, Bloomer 2004, Whitlock 2002). The mesopredator issue is a large contributor to bog turtle declines and must be addressed soon or the bog turtle could disappear from the northeast within the next century (Klemens 1997).

Management Recommendations

The reliance of bog turtles on wetlands in the middle stages of hydrarch succession has led to an interest in restoring degraded late-successional habitats through management practices. Removal of woody vegetation from an area should help maintain wetland characteristics, and therefore prolong the period where habitat is suitable for use by bog turtles. This management may be necessary where large dynamic wetland complexes have been altered by fragmentation and destruction.

Zappalorti (1997) found that cutting the woody vegetation at a bog turtle site in New Jersey decreased the canopy cover and improved the integrity of the habitat, though only five years later many of the shrubs and trees had made a considerable comeback. Manual practices for maintaining bog turtle habitat is labor intensive and in certain situations, natural patterns of seral disruption may be the most effective manner of maintaining habitat where natural succession degrades prime habitat.

Today, domestic cattle may be used to mimic the function of bison and elk in maintaining bog turtle habitat. This method must be used with caution, as too many cattle or cattle during certain seasons could degrade the habitat and cause harm to the habitat. The use of domestic animals can be successful in maintaining habitat, but fall short of being able to create bog turtle habitat.

Prescribed burns have been used to control these invasives and although they immediately improve the integrity of the wetlands, burns have not been shown to reduce the spread of these exotics into bog turtle habitat (Breisch 1997). Several other management techniques have been employed to control exotic invasives and disrupt the natural succession which further threatens the continued existence of the bog turtle (Ernst 1985, Zappalorti 1997). These measures include manual weeding, herbicide application, flooding, grazing, mowing, girdling and cutting. Canopy closure jeopardizes suitable habitat by drying up sedge meadows and eliminating the vital plant communities upon which the bog turtle relies.

To address overpopulations of mesopredators, landowners (both private and public) should encourage recreational trapping on their properties to limit predator numbers. Animal control agencies should be instructed

to euthanize any mesopreadators caught within the county, rather than the common "trap and release" method. These efforts can not only be positive for Bog Turtles, but many other declining forms of wildlife will benefit including mammals, birds, freshwater mussels, reptiles and amphibians known to be in decline. These control measures may also be effective at warding off local rabies outbreaks.

In historic bog turtle drainages in Lancaster County, much of the remaining patches of habitat have been severely degraded over the past decades as succession has dried up wet meadows and crowded out much of the bog turtle habitat. Removal of woody vegetation through manual methods can be effective as disrupting succession, however methods employed by humans have fallen short of providing the optimal conditions that beaver modifications can provide. Therefore, in the historical drainages where bog turtles were known to exist, but may currently only exist in small pockets of suitable habitat, the disturbance by beavers for the long term cycle of bog turtle population dynamics, should be embraced.

Reestablishment of wetland systems that allow functioning metapopulations of turtles to exist should be a long term goal of Lancaster County. Ideal conditions for the establishment of functioning metapopulations include a matrix of habitats. Certainly, at known bog turtle sites, management practices should be employed to maintain ideal Bog Turtle habitat. The US Fish & Wildlife Service, as well as the PA Fish & Boat Commission can provide site specific management recommendations at current Bog Turtle sites and must be consulted for habitat management. Along each historical Bog Turtle drainage, open canopy graminoid marshes should be established where open habitats are scarce. These marsh areas need not be massive. Often, Bog Turtle colonies are able to function in only a few hectares if habitat is prime. The establishment of open habitats must be done with caution as considerable manpower may be necessary to control invasive plants in these created habitats. Bog Turtle populations should not be thought of as static sites, rather, the corridor along the drainage should be managed so that the long term cyclic functioning of turtle metapopulations is possible.

It has been over 200 years since the Bog Turtle was discovered in Lancaster County. The management of the remaining habitat and the corridors between these habitats, and control of the mesopredator populations in Lancaster County could secure the county's Bog Turtle populations beyond the next 200 years.

A group of volunteers managing a known Bog Turtle site. By removing invading woody vegetation from this hummocky soggy meadow, the habitat will be suitable to Bog Turtles for foraging, basking, and nesting. These volunteers are part of a group organized by the USFWS and the PFBC. It is critical to note that any habitat management for bog turtles *must* consult the USFWS and the PFBC. The management recommendations in the appendix are only to be used as guidelines for cooperators working with these agencies.
photo source: George Gress (TNC)



Rough Green Snake

Introduction and Habitat Use

The Rough Green Snake (*Opheodrys aestivus*) is primarily thought of as a riparian species, living in shrubs and trees along waterways. The majority of specimens collected throughout the snake's range have been collected within a few meters of large bodies of water. However, if suitable cover and food sources are available, Rough Green Snakes may thrive in woodland areas far from water. The snakes are invertivores, surviving on slugs, caterpillars, spiders, grasshoppers, dragonflies and damselflies and may exist wherever good food sources are available and ample cover exists.

Pennsylvania's extant Rough Green Snake populations are only found in southern Lancaster and Chester Counties. One Rough Green Snake was identified by PNHP in mid 1990s along the Susquehanna River and the population was reconfirmed in 2006 by PNHP. While the population at the Susquehanna River site still exists, the status of the population is unknown. In contacting landowners for access to the known Susquehanna population, PNHP learned that an adjacent property owner noted that two Rough Green Snakes were killed on his driveway within the last five years. More work must be done with this population to determine its status as well as additional surveys on adjacent properties to search for other areas suitable for Rough Green Snakes.

The other site in the county known to house Rough Green Snakes is along the Octoraro Creek. This population on the Lancaster County side of the creek was not assessed in the 2006 season, Rough Green Snakes were located in Chester County, several hundred meters from the Lancaster County border. The snakes on both sides of the creek are thought to be one population as the species is an adept swimmer. The site on the Lancaster County side of the creek is thought to have been healthy in 1991, as snakes were observed at this location regularly. The status of this population is largely unknown as relatively little ground has be covered in surveying for the species.

At both locations assessed in 2006, the snakes were found using patches of greenbrier (*Smilax rotundifolia*, *S. glauca*) located in sparse canopied woodlands. The snakes were found in the thick greenbrier patches where their slender bodies and bright green coloration blends perfectly with the stems of the greenbrier. The common trait among the known Rough Green Snake sites in Pennsylvania is the presence of greenbrier. This plant serves as excellent camouflage for the snakes and provides suitable foraging habitat for the snakes.

Both populations were found considerable distances from water, indicating that the Pennsylvania populations are also likely to be found outside of riparian areas. Rough green snakes have very restricted home ranges, generally using less than a hectare, but able to live in rather high concentrations suggesting that there is high site fidelity but little territoriality among members of populations. Therefore, Rough Green Snake populations have the potential to be small, utilizing a limited area, and are consequently more susceptible to localized extinction.

The serpentine areas of Lancaster County are globally unique and house as number of globally rare species, notably plants and invertebrates. By no means rare, greenbrier is naturally a component of the habitat and while the various species of greenbrier are native, its presence degrades the overall quality of serpentine. Frequently,



The Rough Green Snake (*Opheodrys aestivus*) is listed as state endangered in Pennsylvania.

photo source: Charlie Eichelberger, PNHP

management plans for serpentine habitats target greenbrier invasion as a threat to serpentine habitat. While the globally rare serpentine species must be managed for at these sites, a balance should be made to support areas of greenbrier so that the Rough Green Snake habitat is maintained.

While the Rough Green Snake is not globally rare, the Pennsylvania population is at the periphery of its range. The Pennsylvania observations of this species represent the northernmost occurrence in the snake's entire range. Peripheral species are an important component of the whole of a population. Traditionally, species that occurred in the core of the range of a species were thought to be of greater significance to the species than the populations found on the edge of the species range. Today, conservation biologists recognize the importance of peripheral populations because the unique genetic makeup of these individuals living on the edge of the species range allows them to be better adapted to less than ideal environmental conditions for the species. These outlying populations represent a significant component in the genetic makeup of the species.

Current Threats

Threats to the Rough Green Snake populations in Lancaster County include habitat destruction and modification, as well as predation from domestic and feral cats. Mitchell (1994) cites that cats as one of the main threats to Rough Green Snakes in Virginia.

Pesticide and herbicide use in Rough Green Snake habitat could deplete not only the vegetation used by Rough Green Snakes, but also disrupt the food source for the snakes. As invertivores, these snakes require healthy populations of caterpillars, slugs, and spiders. Special care must be taken to ensure the continuance of patches of greenbrier. While little work has been done to assess the status of the Rough Green Snake population in Pennsylvania, the recent sightings of numerous snakes lead us to believe that the population in the state is small, but healthy. More survey work needs to be done to determine the status of the known populations and to review the extent of the species in the state.

Management Recommendations

While herbicide and pesticide use may not be a factor on certain tracts that contain Rough Green Snakes, others, such as the population along the Susquehanna River could be threatened with herbicide use when controlling the invasive species that are continuing to spread along the Susquehanna River and the adjacent properties.

In some areas where greenbrier exists, Japanese honeysuckle appears to be competing with the greenbrier. In these situations, manual weeding in combination with localized herbicide application may be necessary to maintain patches of suitable Rough Green Snake habitat. The Pennsylvania Fish and Boat Commission must be consulted before managing Rough Green Snake Habitat



Rough Green Snakes are very well camoflauged, appearing as a stem of greenbriar
photo source: PNHP

Introduction to Invertebrates

Betsy Leppo – Pennsylvania Natural Heritage Program

Invertebrates are critical to the healthy functioning of an ecosystem, performing vital ecological services such as pollination, decomposition, and nutrient cycling. They also provide an abundant supply of bite-sized, fat and nutrient-rich morsels for animals including fish, reptiles, amphibians, birds, bats and other small mammals, and even larger mammals like bears.

Over the past several decades, biologists have preferentially studied certain groups of invertebrates in Pennsylvania. Insects like butterflies and dragonflies are popular with collectors because they are large, showy, and easy to find in the daytime. Other species, like caddisflies, mayflies, and stoneflies, are important to fisherman and biologists alike because they indicate good water quality and therefore good fishing. Economically important species are also well studied, such as mosquitoes, black flies, and a wide variety of agricultural pest species. Based on data collected on these species groups, we have a fairly good idea about where and when they can be found, what they feed on, and how common or rare they are. But all of the better known insect taxa combined make up a small fraction of the invertebrate biodiversity found in Pennsylvania. There are thousands of invertebrate species whose life history is a complete blank, or whose presence has not been documented in Pennsylvania. There are certainly species new to science that are waiting to be discovered.

Given these limitations and gaps in our knowledge, it is a challenge to inventory or develop management recommendations for all invertebrates. Strategies are needed that address the requirements of many species, without having to know the identities or life histories of all those that may be present at a site.

One approach is to use a well known species or group of species as a representation of the larger invertebrate community. For example, surveys for an insect intolerant of pollution and associated with high quality wetlands would allow surveyors to focus survey techniques and timing on one species. Sites where the target insect occurs are probably high quality since they support a sensitive species. Protection of habitats with the indicator species would provide umbrella protection to all the other species present that also require that type of wetland. Note that unsuccessful surveys for an invertebrate species does not necessarily mean it is truly absent. True absence of a species cannot be determined unless surveys are repeated under optimal conditions over a period of years, and all yield negative results. A more detailed ecological picture can be painted by conducting inventory for a diverse group of species that is fairly well known. For example, a baseline inventory of moths can provide a good picture of the condition of a forest, and even shed light into past management history. Periodic resurveys of moths every five to ten years can show changes in forest health and composition in response to management techniques or natural trends like succession.

But what if information on indicator species or suites of species is not available for a site? Or when surveys are unsuccessful or inconclusive? A second and complimentary strategy to protect invertebrate biodiversity is a habitat-based approach. On a large scale, identification and protection of a variety of natural habitats within a region will go a great distance in protecting the associated invertebrate communities, since each habitat supports its own suite of species. Once sites have been identified as important for protecting invertebrate biodiversity, a variety of strategies can be used to enhance these sites for invertebrates. Creating naturally vegetated corridors through developed or agricultural landscapes to connect natural habitats would facilitate movement of species between sites and increase long term viability of populations. Management techniques can improve habitats by encouraging native plant species that are adapted to the conditions found in that habitat. It is equally critical to discourage invasive species that disrupt the fine-tuned balance between soils, microbes, insects, plants, and animals. On a local scale, it is also important to identify and protect sub/micro habitats where moisture, soil, elevation, slope, aspect, etc. vary significantly from the surrounding area. Microhabitats can often be easily identified by a change in vegetation composition or structure. The Pennsylvania State Wildlife Action Plan, Invertebrate Section, lists habitats and microhabitats important for invertebrates in Pennsylvania, and also lists species of special concern associated with those habitats and subhabitats.

Whether it be a windswept ridgetop with poor sandy soils, or a rich and moist bottomland, there are a variety of insects that work hand in hand with their plant counterparts to create healthy ecosystems, upon which the larger vertebrate community depends.

There are several rare species of dragonflies, butterflies and moths documented in Lancaster County. The following is a general introduction to their life history and habitat requirements.

Dragonflies and Damselflies: The Odonates

Damselflies and dragonflies are grouped together in the scientific order called Odonata (or informally, the odonates). Odonata comes from the Greek word 'odon,' which means 'tooth'. Both adult and larval (immature) odonates possess mouthparts armed with serrated, tooth-like edges and grasping hooks that help them catch and eat their prey.

Life History And Habitats

Adult odonates lay their eggs (oviposit) in or near water. There are two common methods of oviposition. Some species lay their eggs inside the stems or leaves of living or dead plant material. Other species lay their eggs in the water, singly or in a mass. Odonate eggs develop at different rates depending on the species, but in general development quickens as temperature increases (Brooks 2003). In temperate regions like Pennsylvania, eggs develop over a period of several weeks to several months.



A damselfly

photo source: PNHP

As larvae, odonates are found in a wide variety of aquatic habitats, such as seeps, seasonal pools, streams, rivers, ponds, lakes, and other wetlands. Within each habitat, larvae seek out favorable microhabitats with the right combination of water flow, vegetation, substrate texture, etc. They feed on the other insect larvae that share their aquatic habitat, such as mosquitoes, midges, gnats, and other flies. During larval development, odonates undergo 5-15 molts over a period of a few months for some species and up to several years for others. The number of molts depends upon the species and also on environmental conditions (Westfall and May 1996).

When a larva is fully developed, it undergoes metamorphosis inside its larval skin. Then it crawls out of the water for its final molt. This movement of the larva out of the aquatic habitat to shed its larval skin is called emergence. Once properly positioned, the larval skin is shed one last time and a winged adult emerges.

Odonates emerge from the water, transforming from camouflaged stalkers into jeweled fighter planes. Adult odonates now feed on the emerged adults of the



A dragonfly

photo source: PNHP

community of insects with whom they shared an underwater life as larvae. They also add to their diet additional insects they encounter for the first time as adults, such as butterflies.

Adult odonates are closely associated with the larval habitat during mating and subsequent oviposition when the eggs are laid in suitable habitat. However, it is important to recognize the additional habitat requirements of the adults. For example, some species have specific perching preferences, and will not use a habitat that lacks proper perches, even when suitable larval habitat is present (Westfall and May 1996). Feeding areas are also very important for odonates. After the process of metamorphosis and emergence, a fresh adult has very little energy in reserve and must begin feeding as soon as possible. Young adult females in particular avoid breeding areas for a period of time while they build up mass, mostly in growth of their

ovaries. Males and females can frequently be found feeding far away from breeding habitat, along roadsides, in wooded glades, in open meadows, and other upland and aquatic habitats. Some males and females disperse long distances from their natal aquatic habitat to find



An adult dragonfly, newly emerged from its nymphal exoskeleton
photo source: PNHP

new breeding areas, an important process that strengthens populations by diversifying the gene pool.

Species Diversity In Pennsylvania

In North America, there are an estimated 350 species of dragonflies (Needham et. al. 2000) and 161 species of damselflies (Westfall and May 1996). In Pennsylvania, we currently have 121 species of dragonflies and 55 species of damselflies (PNHP, 2006). Several of these species are tracked as rare in the state because of their sensitivity to habitat loss or poor water quality in wetlands and rivers.

Families of Damselflies (Order Odonata, Suborder Zygoptera) in Pennsylvania:
Calopterygidae – Broad-winged Damselflies
Coenagrionidae – Pond Damsels
Lestidae - Spreadwings

Families of Dragonflies (Order Odonata, Suborder Anisoptera) in Pennsylvania:
Aeshnidae - Darners
Cordulegastridae - Spiketails
Corduliidae - Emeralds
Gomphidae - Clubtails
Libellulidae - Skimmers
Macromiidae - Cruisers
Petaluridae – Petaltails

Butterflies and Moths: The Lepidoptera

Butterflies and moths are grouped together in the scientific order called Lepidoptera. Lepidoptera comes from the Greek words 'lepido,' which means scale, and 'ptera,' which means wing. A butterfly or moth has two forewings and two hindwings. When inspected closely with a hand lens, each wing will reveal thousands of neatly arranged scales of different colors, which form patterns on the wings. Lepidoptera are also characterized by a coiled, tubular mouthpart called the proboscis, which is used to drink nectar. Finally, lepidoptera are a group of insects that undergo complete metamorphosis in a life cycle that includes eggs, caterpillars, pupae, and adults.



American Copper
Photo source: PNHP

Life History And Habitats

The Lepidoptera cycle of life starts with an egg laid on a specific plant called a host plant. The egg hatches and a tiny caterpillar (larva) emerges. The caterpillar feeds and grows larger, and will shed its skin several times to allow for growth. After the caterpillar has grown through several molts (instars), typically 4-6, it is ready to pupate. The pupa emerges when a fully-grown caterpillar sheds its skin and exposes a protective shell. Inside this shell the transformation from caterpillar to adult occurs. After a period of time that varies from species to species, climate, and location, the adult emerges with a plump abdomen and withered wings and immediately begins pumping fluids from the abdomen into the wing veins until they are fully expanded. Then the fluids are withdrawn from the wing veins, the wings harden, and the moth or butterfly takes off on its maiden flight.



Butterfly eggs hatching on the leaf of a foodplant
Photo source: PNHP



Common Least Skipper (*Ancyloxypha numitor*)
photo source: Sally Ray

Butterflies and moths are closely related insects, and they share many features. They have similar life histories and utilize a similar suite of habitats. Butterfly adults have thread-like antennae with a small rounded club at the end. Moths can have plumose (feather-like) or thread-like antennae, but they will not have a small club at the end. Some moths have very plump and fuzzy bodies, while butterflies tend to have sleeker and smoother bodies. Additionally, some moth adults lose their mouthparts and do not feed as adults. Moths typically land and spread their wings open flat, while butterflies will often land and close their wings together over their back, or at 45-degree angles (the skippers). Moths are mostly active at night and butterflies fly during the day, but there are also many day-flying moths. Butterfly pupae have a smooth exterior called a chrysalis, while moth pupae form a cocoon, which is typically wrapped in silky fibers.

Many Lepidoptera depend not only on a specific habitat, but also a specific plant within that habitat. The larvae of many species will often use only a single host plant. The Monarch (*Danaus plexippus*) uses only milkweed (*Asclepias* spp.) or closely related plants. The Spicebush Swallowtail caterpillar (*Papilio*

troilus) prefers to feed on spicebush (*Lindera benzoin*). The same type of relationship exists with many moths.

Species Diversity In Pennsylvania

In North America north of the Mexican border, there are an estimated 13,000 species of Lepidoptera (Wagner 2005). Pennsylvania's varied habitats support a large range of butterflies. Altogether, the state has about 156 species of butterflies and the closely related skippers (Wright 2007; Appendix II), as well as an unmeasured number of species of moths. No state agency is directly responsible for managing Lepidoptera, and scientists suspect the population trends for many species are headed down. This group is understudied, but the PNHP tracks several species of butterflies, skippers, and moths as rare in Pennsylvania and targets them in surveys during the county inventory projects.

Serpentine Barrens Moths and Butterflies

Introduction/Description

Little patches of serpentine barrens are scattered like gemstones across south-eastern Pennsylvania. Lancaster County is home to several of these jewels, the New Texas and Rock Springs barrens. These barrens have a unique combination of geology and soils that support unusual communities of plants and animals, including butterflies and moths that are globally rare.

Moth and Butterfly Species of Concern and Habitats: There are twelve known state-listed moths and butterflies inhabiting the serpentine barrens in Lancaster County. Many of these species are limited in distribution in Pennsylvania to serpentine and other grassland habitats, which are often set in a matrix of open oak and pine woodlands. A list of these lepidoptera and the plants upon which their caterpillars feed are summarized in the table below. Many additional lepidoptera species of special concern are known from the more heavily surveyed serpentine barrens in Chester County. Some of these species are likely to show up in Lancaster County barrens with additional survey effort.

Range

Most of these species are limited in distribution in Pennsylvania to serpentine and other barrens and grassland habitats.

Conservation/Status

Conservation of these lepidoptera species requires protection of the habitat they use during all stages of their life cycles. Changing farming and land management practices, coupled with increased development has led to a decline in grassland and barrens habitats and the species that utilize them.

Maintaining a mosaic of grassland, oak, and pine areas at Lancaster County serpentine barrens sites will create a diverse and healthy habitat capable of supporting the rare lepidoptera listed above. Historically, fire was an important factor in maintaining the unique natural communities found on serpentine barrens. Today, a disturbance regime is still needed to keep grassland patches open, and in wooded areas, to encourage tree species adapted to fire such as pitch pine and scrub oak. Without periodic fires the barrens habitats will eventually succeed to more common shrub and forest habitats. Other management practices that can be used with or in place of fire include mowing,



Small Tolype (*Tolype notialis*) adult
Photo by Ernest C. Bernard,
University of Tennessee Bugwood.org



Small Tolype (*Tolype notialis*) caterpillar
Photo by Ernest C. Bernard,
University of Tennessee Bugwood.org

selective tree and shrub removal, and grazing. In areas where succession is advanced, even scraping away accumulated organic matter may be necessary to rehabilitate a site.

Plantings of native herbaceous food plants and desirable nectar sources may also help increase the existing lepidoptera populations or allow for the reintroduction of other rarities that are missing from Lancaster County barrens but persist at nearby locations in Chester County. Several lepidoptera species typically associated with grassland habitats have been declining across their ranges to the point of extirpation in some states. Two globally rare butterflies, the Frosted Elfin (*Callophrys irus*) whose caterpillars feed on Wild Indigo (*Baptisia tinctoria*), and the Mottled Duskywing (*Erynnis martialis*), whose caterpillars feed on New Jersey Tea (*Ceanothus americanus*), could be reintroduced at Lancaster County serpentine barrens sites with management efforts to improve and maintain the habitat and provide abundant nectar sources and hostplant. Creation of corridors between barrens sites would also encourage movement of species between sites and create more secure populations.

Many historical sites of grasslands and barrens have been lost to residential, commercial, and industrial development in southeastern Pennsylvania, so it is critical to protect the remaining best examples of serpentine barrens and other grassland, old field, and native pine and oak habitats in the state in order to fully protect the rare moths that depend upon these natural communities. Additional inventories and monitoring are needed to determine the distribution and health of lepidoptera species in a variety of barrens communities in Pennsylvania.

Moth and butterfly species of special concern known from Lancaster County serpentine barrens (Feb. 2008)

Taxa	Scientific Name	Common Name	Global Rank	State Rank	Caterpillar Food Plant
Moth	Artace cribraria	Dot-lined White Moth	G5	S1	Mainly oaks, also members of the Rosaceae family.
Moth	*Cisthene packardii*	Packard's lichen moth	G5	S1S3	Lichens
Moth	*Holomolina laeta*	Joyful Holomelina	G4	S1S2	Dandilions and plantain
Moth	*Hypagyrtis esther*	Esther Moth	G5	S2S3	Pines
Moth	*Panthea sp. 1*	a moth	G4	SU	Pitch pine and possibly other hard pines
Moth	*Tolype notialis*	Small Tolype Moth	G4G5	S1	Conifers
Butterfly	*Anthocaris midea*	Falcate Orangetip	G4G5	S3	Crucifers such as *Arabis* and *Cardamine*
Butterfly	*Atrytonopsis hianna*	Dusted Skipper	G4G5	S2	Bluestem grasses (*Andropogon*)
Butterfly	*Callophrys grynea*	Juniper Hairstreak	G5	S3	Red cedar (*Juniperus virginiana*)
Butterfly	*Hesperia leonardus*	Leonard's Skipper	G4	S3	Grasses
Butterfly	*Hesperia metea*	Cobweb Skipper	G4G5	S2	Bluestem grasses (*Andropogon*)

Conservation Recommendations for Insects

The specific habitat requirements of many odonates and Lepidoptera and other insects are not well known. Protecting habitats where species of special concern currently occur is a first step towards ensuring their long-term survival. Alteration or destruction of habitat is the greatest threat to populations of Odonata and Lepidoptera and other insects.

There are a few important pieces of information needed when developing conservation and management plans for Odonata and Lepidoptera that are unique to these taxa:

- **Research and define the specific habitat requirements of each life stage of the species of concern.**

Most research on the habitats of Odonata and Lepidoptera has focused on the larval habitat and foodplants. This makes sense because of the more sedentary nature of the larvae compared to the adults and the subsequently tighter association of larvae to habitat. The adults are also associated with the larval habitat during mating and oviposition when the eggs must be placed in suitable habitat. However, it is important not to lose sight of the additional habitat requirements of the adults such as perching/puddling and upland feeding areas.

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photo source: PNHP

- **Acknowledge and maintain the balance that is necessary between predators and their prey.**

Larval and adult odonates feed on the other insects that share their environment such as mosquitoes, midges, gnats, and other flies. Odonates help control insect species that are considered pests. However, when homes encroach upon wetland habitats, municipalities and homeowners often take pest control into their own hands. The pesticides used to control mosquitoes and other nuisance insects have many negative effects on non-target species. Direct mortality of all insect species occurs when broad-based killing agents are used. More specific killing agents are available that only harm black flies or mosquitoes, but indirectly this still affects predators such as fish and insects, which experience a decrease in food availability when their formerly abundant prey items are eliminated.

Indirect effects of pest control can also severely reduce populations of lepidoptera. These species are vulnerable to changes in the distribution and abundance of the foodplants. Applications of herbicides or vegetation removal (e.g., mowing) while the eggs or larvae are on the plants can cause declines in Lepidoptera and interrupt stages of the life cycle of these animals. Applications of insecticides can have non-target effects as well. In an effort to slow the spread of gypsy moth and to protect timber resources, various insecticides including lead arsenate, DDT, and carbaryl (Sevin), have been sprayed over the years. Presently, the biological insecticide *Bacillus thuringiensis* (*Bt*) and the insect growth regulator diflubenzuron (Dimilin) are considered more environmentally safe than other sprays and are the primary means of gypsy moth control. However, both chemicals affect species of insects beyond the target gypsy moth. The *Bt* variety used against gypsy moth (*Bt kurstaki*) is toxic primarily to caterpillars, or larvae of Lepidoptera. Species with 1st and 2nd instars at the time of spraying and that feed on foliage are most at risk. In order to protect rare or small populations of non-target organisms, the size of the spray blocks and the timing of spraying for gypsy moths can be adjusted on a site-by-site basis.



Great Spangled Fritillaries nectaring on milkweed.
Photo source: PNHP

- **Protect the species and habitats within a healthy, functioning ecosystem.**

Landscape scale conservation of wetland, meadow, and forested habitats and the supporting upland habitat is needed for long term survival of healthy odonate and lepidoptera populations.

Aquatic Community Classification for Lancaster County

Mary Walsh & Jeremy Deeds – Pennsylvania Natural Heritage Program

A statewide project of the PNHP, the Pennsylvania Aquatic Classification Project, collected aquatic datasets from state and federal agencies, interstate basin commissions, and universities, analyzed information with standard statistical methods, and identified community types and habitat associations (Walsh et al. 2007a, 2007b). The most common community type per watershed was chosen to represent typical watershed organisms and habitats. Although other community types may exist in a particular watershed, the major community type is described.

What is an aquatic community?

An aquatic community represents a group of organisms that occur together in a particular habitat. The organisms require similar habitat features, may be dependent on each other for food or other resources, and/or may be dependent on similar processes in their environment.

The aquatic communities in this report refer to three types of organisms: fish, macroinvertebrates, and mussels. Aquatic communities for each type of organism can be used to describe the aquatic resources, habitat types, and stream quality.

Where do aquatic communities occur?

Flowing water habitats, such as rivers and streams, and their community types are addressed herein. Aquatic community types such as lakes, wetlands, and ponds, which are closed systems, have not been assessed to date.

Aquatic communities are identified within watersheds. The term watershed* describes an area of land that drains down slope to the lowest point. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers, which become progressively larger as the water moves on downstream, eventually reaching an estuary and the ocean. Watersheds can be large or small, but all land is part of a watershed. Every stream, tributary, and river has an associated watershed, with small watersheds merging to become larger watersheds. In this report, relatively small watersheds (hydrologic unit code 12 or HUC12) are described by their community types. For example, the Mid-Atlantic Region is a HUC1 covering many states, while a small unnamed headwater would be a HUC14 or higher. For more information on the HUC system see: http://water.usgs.gov/GIS/huc.html.

What do fish, macroinvertebrates, and mussels tell me about my streams and watersheds?

All three types of organisms hold unique places in Pennsylvania's streams and rivers. Macroinvertebrates include aquatic insects, worms, and crustaceans, like crayfish and leeches, which occupy the lower levels of food webs in aquatic systems. The presence of certain macroinvertebrates reflects food availability, water quality, and habitats, and gives an overall picture of stream health. Additionally, these organisms are the major recyclers within any aquatic system.

Fish then prey upon macroinvertebrates and other stream organisms. Food resources and spawning habitats can be specific for fish. They, too, are influenced by the stream quality and the entire watershed environment. For example, fine sediment from unnatural land erosion may degrade fish spawning habitat and reduce fish reproduction and populations.

Many factors influence the occurrence of aquatic communities, including natural variations in stream habitats. Fast-flowing, cold streams arising on ridges provide a different environment than slow, warm rivers meandering through valleys, and aquatic communities reflect their environment. Geology also varies across Pennsylvania and the chemical composition of flowing water is effected by the rock that it contacts.

Any alteration to the landscape causes variation within the connected aquatic environments. If implemented improperly, timber harvest, agriculture, urban development, and roads may cause decreases in water quality and stream habitats from both direct and non-point source pollution. Additional point sources include pollutants form sewage treatment plant discharges, mines drainage, and industrial and agricultural sources.

How are communities described?

Communities of fish and macroinvertebrates are given descriptive names. Other organisms that may be found in the community are also listed. While not every organism described in a community will occur in every community location, organisms listed by community types give a general account of what organisms to expect in a community.

Species of concern (considered state or globally rare) that may occur within each community type are listed with state and global rank. Definitions of these ranks are available in Appendix I. Environmental and water quality habitats typically associated with the community type are also described.

Each community type occurring in Lancaster County has a one-page description. These descriptions include:

1) Community description and habitat - The environment of the stream where the community occurs is described by watershed and stream characteristics. Average values of the community characteristics across their entire range from a large dataset are presented. Size of the stream and watershed, gradient (slope), and elevation are a few habitat characteristics that may be important to the community type. Local conditions are also mentioned. Some water chemistry variables are also valuable in understanding the conditions of the community, including:

- pH – A measure of the concentration of hydrogen ions in a solution with lower numbers indicating more hydrogen ion. A pH >7.4 is basic, a pH <5.5 is acidic, and a pH between 5.5 and 7.4 is circumneutral.

- Water temperature - Important to stream organisms because it influences their metabolism and growth. Each aquatic animal species has a tolerance for a specific temperature ranges and cannot survive outside it.

- Conductivity – Defined as the ability of water to conduct an electrical current. It is expressed in micro Siemens (µS) per centimeter at 25 °C. Conductivity is determined by the types and quantity of dissolved substances in water. In streams, conductivity can be elevated by pollution or natural causes. Note that distilled water has no conductivity.



PNHP staff surveying for freshwater mussels in the Susquehanna River using clear-bottomed buckets.
photo source: PNHP

- Alkalinity - This is a measure of how well a water body is buffered against decreases in pH. If a stream has high alkalinity it can neutralize acids with little change in pH. A low alkalinity stream is less resistant to decreases in pH, which may be naturally occurring or may arise from acid precipitation or human other causes.

2) Stream quality rating - Community locations are generally ranked as low, medium, or high quality based on habitat, water chemistry, and sensitivity of organisms to pollution. The more susceptible a community is to human modification, the higher its quality.

3) Threats and disturbances - Potential pollution sources or other threats that may alter the natural state of the community are listed where known.

4) Conservation recommendations – Created for the county natural resource managers and land planners to consider in protection and management of the watersheds and communities.

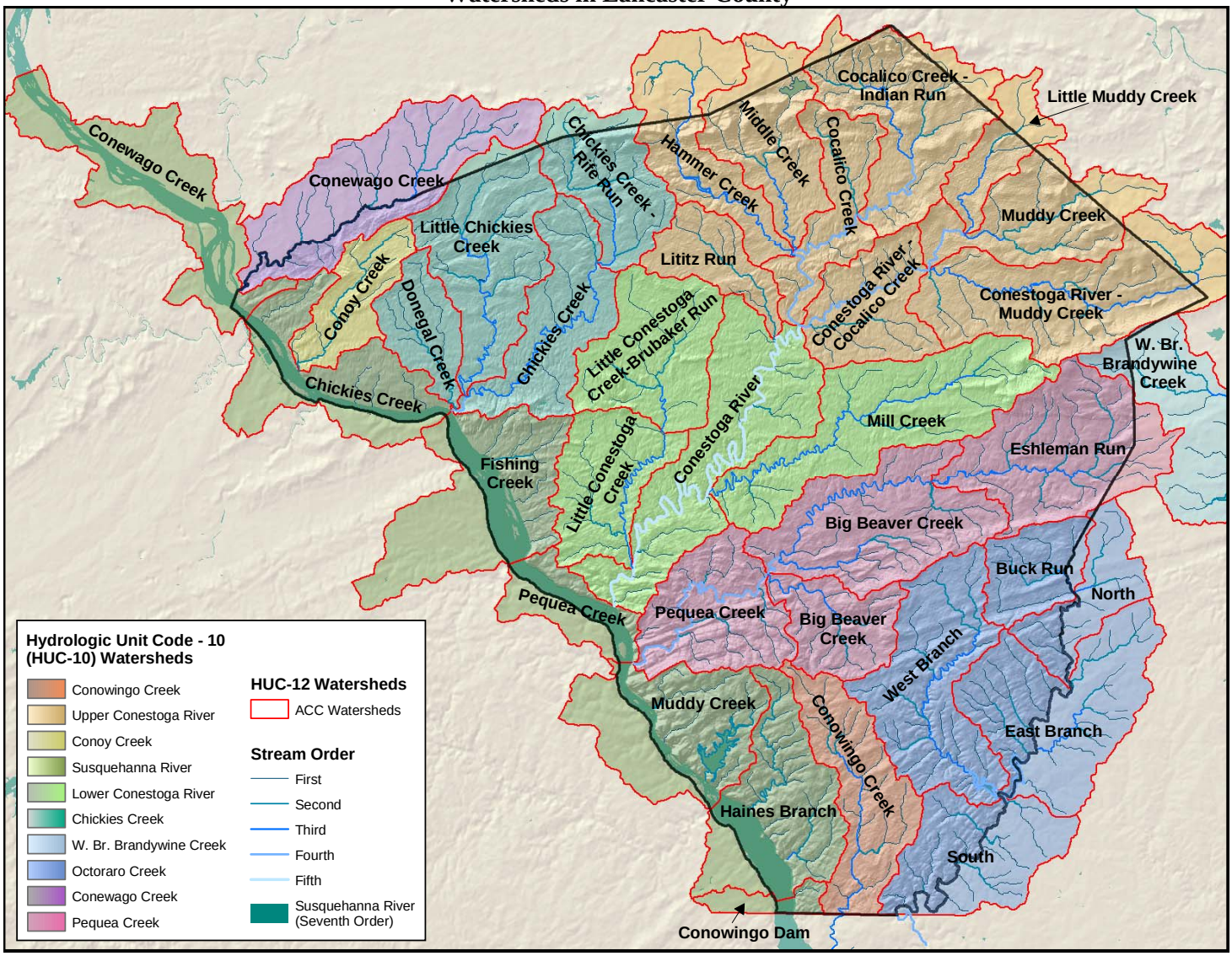
How does this Classification relate to the DEP stream designations?

The purpose and meanings differ between the classes defined in Pennsylvania aquatic life use/special protection designations and aquatic fish assemblages from the Pennsylvania Aquatic Community Classification. The nomenclature of both classifications is similar. In both cases it is meant to relatively define the organisms and aquatic habitats along a gradient of water temperatures (and associated stream size). The PA stream designations broadly encompass habitats occupied by several Aquatic Community Classification fish assemblages and are used in water quality regulation.

Pennsylvania aquatic life uses and special protection water designations and their occurrence with fish assemblages. (EV = Exceptional Value Waters, HQ = High Quality Waters, CWF= Cold Water Fishes, WWF= Warm Water Fishes, TSF= Trout Stocking, MF= Migratory Fishes)

Increasing watershed area ↓	Aquatic Community Classification-Fish	EV	**HQ**	**CWF**	**WWF**	**TSF**	MF
	Coldwater	X	**X**	**X**			
	Warmwater 1, Warmwater 2			**X**	**X**	**X**	X
	River & Impoundment				**X**		X

Watersheds in Lancaster County



Watersheds in Lancaster County and fish and macroinvertebrate community types.

Watershed Name[†]	Fish Communities[1]	Macroinvertebrate Communities[2]	Trout Stocking*
Big Beaver Creek	Warmwater Community 1	Low Gradient Valley Stream Community	Y
Buck Run	Not Assessed**	Not Assessed**	Y
Chickies Creek	Warmwater Community 2	Not Assessed**	
Chickies Creek-Rife Run	Warmwater Community 2	Not Assessed**	
Cocalico Creek	Coolwater Community 2	Limestone / Agricultural Stream Community	
Cocalico Creek-Indian Run	Warmwater Community 2	Limestone / Agricultural Stream Community	Y
Conestoga River	Warmwater Community 2	Low Gradient Valley Stream Community	
Conestoga River-Cocalico Creek	Not Assessed**	Limestone / Agricultural Stream Community	
Conestoga River-Muddy Creek	Coolwater Community 1	Limestone / Agricultural Stream Community	
Conewago Creek	Warmwater Community 1	Low Gradient Valley Stream Community	Y
Conowingo Creek	Warmwater Community 1	Low Gradient Valley Stream Community	
Conoy Creek	Warmwater Community 1	Not Assessed**	Y
Donegal Creek	Coolwater Community 2	Not Assessed**	Y
[†] E. Branch Octoraro Creek	River and Impoundment Community	Not Assessed**	Y
Hammer Creek	Warmwater Community 2	Not Assessed**	Y
Lititz Run	Warmwater Community 2	High Quality Headwater Stream Community	
Little Chickies Creek	Warmwater Community 1	Not Assessed**	Y
Little Conestoga Creek	Not Assessed**	Not Assessed**	Y
Little Conestoga Creek-Brubaker Run	Warmwater Community 2	Not Assessed**	Y
Little Muddy Creek	Warmwater Community 2	High Quality Small Stream Community	Y
Middle Creek	Warmwater Community 2	Not Assessed**	Y
Mill Creek	Warmwater Community 2	Limestone / Agricultural Stream Community	
Muddy Creek	Warmwater Community 1	Limestone / Agricultural Stream Community	Y
Octoraro Creek - North	River and Impoundment Community	Not Assessed**	Y
Octoraro Creek - South	Coolwater Community 1	High Quality Headwater Stream Community	Y

.

Watersheds in Lancaster County and fish and macroinvertebrate community types (continued)

Watershed Name†	Fish Communities[1]	Macroinvertebrate Communities[2]	Trout Stocking*
Pequea Creek	Coolwater Community 1	Low Gradient Valley Stream Community	Y
Pequea Creek-Big Beaver Creek	Warmwater Community 2	Limestone / Agricultural Stream Community	Y
Pequea Creek-Eshleman Run	Warmwater Community 1	Low Gradient Valley Stream Community	
Susquehanna River-Chickies Creek	River and Impoundment Community	High Quality Headwater Stream Community	
Susquehanna River-Conowingo Dam	Coolwater Community 2	High Quality Headwater Stream Community	
Susquehanna River-Fishing Creek	River and Impoundment Community	High Quality Headwater Stream Community	
Susquehanna River-Haines Branch	Coolwater Community 2	High Quality Small Stream Community	Y
Susquehanna River-Muddy Creek	River and Impoundment Community	High Quality Small Stream Community	Y
Susquehanna River-Pequea Creek	River and Impoundment Community	Common Headwater Stream Community	Y
West Branch Octoraro Creek	Warmwater Community 1	Not Assessed**	

Pennsylvania Watershed Boundary Dataset DRAFT, USDA, Natural Resources Conservation Service: Watershed (10-digit hydrologic unit area) and Subwatershed (12-digit hydrologic unit area) delineation based on *Federal Standard for Delineation of Hydrologic Unit Boundaries, October 2004* publication. For more information, go to **http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/**

*A "Y" indicates that the watershed has one or more streams designated as a Trout-Stocked Fishery.

**A lack of assessment may be caused by either a lack of data or existing data that has not yet been incorporated.

[1] Fish community types were developed for all the Pennsylvania basins flowing to the Atlantic Ocean, including the Susquehanna, Potomac, and Delaware watersheds (Walsh et al., 2007).

[2] Macroinvertebrate community types were described in the Susquehanna and Potomac basins (Walsh et al., 2007).

Coolwater Community 1

Typified by*:* Slimy sculpin *(Cottus cognatus),* stocked brown trout *(Salmo trutta),* fathead minnow *(Pimephales promelas),* pearl dace *(Margariscus margarita)*

mean watershed area 54 mi^2
mean elevation 367 m
mean gradient <2.0%

mean alkalinity 54 mg/l
mean conductivity225µS/cm
mean pH 7.0

Community Description and Habitat: This community generally occurs in high gradient streams, downstream of the watershed headwaters in second or third order streams. The community typically is found in relatively small streams high in the watershed, but may also be found in valley streams. Watersheds surrounding the Coolwater Community 1 may be influenced by agricultural practices and to a lesser extent by human settlements.

The fish that indicate this community type prefer cool, rocky streams that may occur in transitional areas between cold-water streams and warm-water ones. The Atlantic Coolwater Community 1 may represent streams with put-and-take trout fisheries or cool streams with seasonally warm temperatures. Community fish may tolerate some conditions of low dissolved oxygen, suspended sediments, or other water quality impairments. Examples of the Coolwater Community 1 habitats are the tributaries to Conestoga River (East Branch Conestoga River), tributaries to Pequea Creek, and tributaries to Octoraro Creek.



Medium size streams are typical of Cool water Community 1.

Photo source: PNHP



Fathead Minnow

photo source: http://www.cnr.vt.edu/efish

Stream quality rating: Low

Threats and Disturbances: This community is found in valley streams degraded from some type of human influence. The most common threat to water quality for Atlantic Coolwater Community 1 is pollution from poorly managed agricultural areas. Excess silt and nutrients are contributed from agricultural runoff. Removal of stream bank vegetation and livestock grazing in streams also contribute to poor conditions. Water temperatures may be warmer than natural temperatures in these altered streams. The tributaries to the Conestoga River are listed as "impaired" by PA DEP for agricultural sources of nutrients and siltation (DEP 2006).

Conservation Recommendations: Restoration of stream habitat and water quality to natural conditions is recommended. Management of storm water runoff and riparian vegetation restoration are critical to improvement of community conditions. Excess nutrient runoff and sedimentation impair some community habitats. Management of runoff with nutrient management and riparian buffers may relieve pollution and habitat degradation to Coolwater Community 1 streams.

Where stocking of non-native fish is occurring with the cool-water community, native fish are displaced. Restoration of fish community to native fish is recommended. The habitat for the Atlantic Coolwater Community 1 represents an important transition between cold headwater streams and warm, larger streams; the habitat is distinct among other habitat types and should be protected and restored.

Coolwater Community 2

Typified by: Blacknose dace *(Rhinichthys atratulus),* white sucker *(Catostomus commersoni),* golden shiner *(Notemigonus crysoleucas)*

Community Description and Habitat: This community type is similar to Atlantic Coolwater Community 1 since it occurs in small to medium size in valley streams. Streams may be low gradient and slow moving compared to streams of a similar size, flowing from ridges. Examples of streams with Coolwater Community 2 habitat are Donegal Creek, Indian Run (a tributary to Cocalico Creek), parts of Fishing Creek, Little Elk Creek, and the headwaters of West Branch White Clay Creek.

mean watershed area 46 mi^2
mean elevation 243 m
mean gradient 1.0 %
mean alkalinity 55.6 mg/l
mean conductivity 213 µS/cm
mean pH 7.2

Fish found in this community type are habitat generalists and generally pollution tolerant. There are few fish species present in the Coolwater Community 2. In some locations this community is coincident with PA DEP designated as Cold Water Fishery streams, or as a Trout-Stocked Fishery. Some species like the blacknose dace and white sucker are also occur with brown trout. Some Cold Water Fishery streams may also be seasonally warm and can still support relatively tolerant brown trout.

Stream quality rating: Low



Coolwater Community 2 is found in a variety of habitats in medium-sized streams and small rivers. Habitat-generalist fish can tolerate slow and silty streams.
photo source: PNHP

Threats and Disturbances: Poorly managed agriculture is the most pressing threat to Atlantic Coolwater Community 2. Excess siltation and nutrients contributed from crop fields and livestock grazing lead to degraded stream conditions. Many of the Coolwater 2 Community habitats are designated as "impaired" by PA DEP (DEP 2006), such as Donegal Creek, Cocalico Creek, Little Elk, and West Branch White Clay Creek. Low dissolved oxygen and siltation are the results of nutrient and sediment runoff into Coolwater Community 2 streams. Urban storm sewers also degrade habitat and water quality in some community streams.



Blacknose Dace
photo source: http://www.ohiodnr.com/dnap

Conservation Recommendations: Sedimentation and excess nutrient loading impair some habitats for the Atlantic Coolwater Community 2. Restoration of stream temperature may be particularly important to improving the habitats for this community type. Re-vegetation of stream banks and restoration of in-stream habitats will bring back more natural conditions where the Atlantic Coolwater Community 2 occurs. Mitigating runoff from crops and livestock pastures will reduce sedimentation and nutrient loading. Upgrades or enhancements in treatment systems for hazardous effluents from industrial and municipal point sources can vastly improve water quality.

Warmwater Community 1

Typified by: Central stoneroller (*Campostoma anomalum*), northern hogsucker (*Hypentelium nigricans*), river chub (*Nocomis micropogon*), longnose dace (*Rhinichthys cataractae*), cutlips minnow (*Exoglossum maxillingua*), mottled sculpin (*Cottus bairdii*), margined madtom (*Noturus insignis*), creek chub (*Semotilus atromaculatus*), rosyface shiner (*Notropis rubellus*), fantail darter (*Etheostoma flabellare*), greenside darter (*Etheostoma blennioides*)

Community Description and Habitat: This community usually occurs in small to medium size streams and small rivers at moderate to high elevation and with low gradient streams.

mean watershed area 128 mi^2 mean elevation 255 m mean gradient <1%
mean alkalinity 50 mg/l mean conductivity 175 µS/cm mean pH 7.2

Streams have moderate alkalinity and conductivity relative to other groups, and nearly neutral pH values. Warm water temperatures are also characteristic of this community group. Thermal tolerances of fish in the community group are higher than fish from other communities. Habitat preferences of indicator taxa suggest this community occurs in warm-water streams with moderate to high gradients and currents with little silt.



Medium-sized streams without many groundwater inputs are typical of Warmwater Community 1 streams. photo source: PNHP



Northern Hogsucker
photo Source: http://www.ohiodnr.com/dnap

The community occurs in sections of Muddy Creek, Pequea Creek, Conoy Creek, Conewago Creek, Conowingo Creek, and West Branch Octoraro Creek. Waters that flow from small headwaters warm when they reach the valley, supporting a community that is not principally defined by the presence of coldwater species. However, stocked or naturalized brown trout may also occur in some community locations. The community habitat in some sections may be classified as Trout Stocked Fishery, Cold Water Fishery, or Warm Water Fishery by PA DEP.

Stream Quality Rating: medium

Threats and Disturbances: Water quality and habitat are influenced by non-point source pollution. Poorly managed agriculture can be a threat to this community. Nutrient enrichment and excess sedimentation of streams from mismanaged agricultural practices impair many streams in watersheds with this community type. Some community streams were designated as impaired by PA DEP (2006). Impairment status is related to poorly managed agriculture, particularly grazing, and organic enrichment, siltation, low dissolved oxygen, and habitat degradation in Muddy Creek., Pequea Creek, Conewago Creek, Big Beaver Creek, Conowingo Creek, and West Branch Octoraro Creek.

Conservation Recommendations: This community is a high conservation priority. Warmwater streams in good condition are not common. The fish associates of this community type are not especially rare individually; however, the community group occupies habitats in need of restoration in Pennsylvania. Protecting Lancaster County's streams designated by PA DEP as High Quality-Warm Water Fishery is recommended.

Since warmwater streams mainly occur in valleys dominated by human modified landscapes, they are often subject to pollution from non-point sources. Top restoration priorities should addressing pollution from poorly managed farming practices contributing to stream impairment.

Warmwater Community 2

Typified by: Sunfish (*Lepomis spp.*), rock bass (*Ambloplites rupestris*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), common shiner (*Luxilus cornutus*), satinfin shiner (*Cyprinella analostana*), spotfin shiner (*Cyprinella spiloptera*), spottail shiner (*Notropis hudsonius*), swallowtail shiner (*Notropis procne*), shield darter (*Percina peltata*), tessellated darter (*Etheostoma olmstedi*), American eel (*Anguilla rostrata*), bluntnose minnow (*Pimephales notatus*), common carp (*Cyprinus carpio*)



Redbreast Sunfish
photo source: http://www.ohiodnr.com/dnap

Community Description and Habitat: The Atlantic Warmwater Community 2 is found in many larger waterways. The typical habitat is low-gradient, medium-to-large sized streams at low elevations. Typical water chemistry values are moderate alkalinity and conductivity. The pH is neutral and water temperatures are warm.

mean watershed area 626 mi^2
mean elevation 96 m
mean gradient 1.1%

mean alkalinity 47 mg/l
mean conductivity 237 µS/cm

The community fish prefer pools in warm streams. Some indicator fish are tolerant of low dissolved oxygen and turbid waters. Many community fish are habitat generalists including game fish, which were likely stocked in many locations and have since become naturalized.

In Lancaster County, the valley creeks flowing to the Susquehanna River were classified as the Warmwater 2 Community. Community habitats occur in Little Cocalico Creek, Little Muddy Creek, Middle Creek, Hammer Creek, Chickies Creek, Little Conestoga Creek, and Conestoga River.

Stream Quality Rating: medium

Threats and Disturbances: Non-point source pollution is a threat to the community. The large amounts of watershed agricultural land cover leads to some degradation of habitat and water quality of valley streams in Lancaster County. In addition to PA DEP's impairment classification (DEP 2006) for agricultural pollution from nutrients and siltation in the Hammer Creek, Chickies Creek, Little Conestoga River, and Eshleman Run, the community habitat is threatened by urban runoff in Lititz Run and Little Conestoga River. DEP also finds that the fishery resource in Conestoga River is has high levels of mercury.



This community occurs in large streams and rivers with warm waters because of variety of habitats supports a diverse fish community.
photo source: Andrew Strassman (PNHP)

Because developments and roads occur near valley streams, poor watershed management and associated stream discharges are particularly detrimental to this community group. Urban runoff and sewer discharge contain silt, nutrients, and other pollutants that damage stream conditions.

Many fish in the community were not originally present in the Susquehanna River watershed that covers the eastern and central regions of Pennsylvania. For instance, rock bass and smallmouth bass were introduced into the Susquehanna River Basin and are widely stocked.

Conservation Recommendations: This community is downstream of many human settlements and has been altered to some degree from its natural condition. Protection of the variety of habitats in small rivers is important for maintaining a diverse fish community. Shallow and deep pools (slow moving areas) and swift current habitats are examples of habitat types in a small river. Control of combined sewer overflows, residential and road runoff, and stream habitat improvements in populated areas would improve community quality. Alternatively, the restoration of riparian buffer zones, exclusion of livestock from streams, rotational grazing, and soil conservation are some mitigation techniques to control non-point source pollution in agricultural streams.

River and Impoundment Community

Typified by: Walleye (*Sander vitreus*), yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), goldfish (*Carassius auratus*)

Community Description and Habitat: The River and Impoundment Community habitat is relatively low gradient large streams and rivers at low elevations. Dam impoundments along rivers create deep pools with soft-sediment stream bottoms. This environment occurs at moderate elevation in streams with low gradients. Streams are characterized by warm-waters with relatively high conductivity and alkalinity, and slightly alkaline pH. Landscape associates of large streams and rivers were

mean watershed area 325 mi^2
mean elevation 203 m
mean gradient <0.5%

mean water temperature 18.6°C
mean alkalinity 60 mg/l
mean conductivity 256 µS/cm
mean pH 7.4

Some examples of community habitat are the East Branch Octoraro Creek and the Susquehanna River. The presence of game fish in larger streams and rivers, where there is diverse flowing water habitat, is indicative of this community type.

Stream Quality Rating: medium

Threats and Disturbances: Large streams and rivers, downstream of many human settlements, are subject to many types of pollution. Large rivers, like the Susquehanna River, may receive effluents from industrial, sewage treatment plants, and storm water

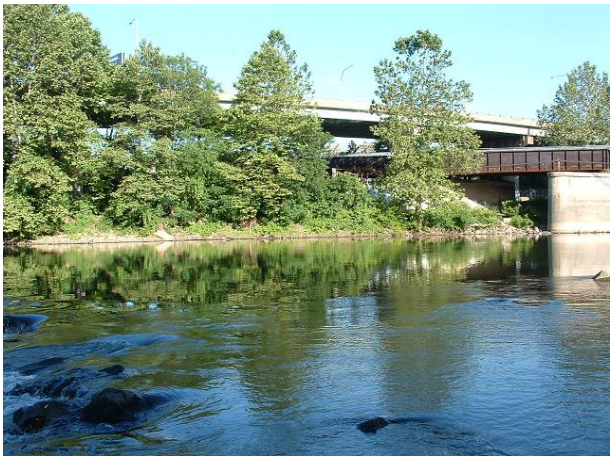


Yellow Perch
photo source: http://www.cnr.vt.edu/ef

discharges. Non-point source pollution from agricultural pollution contributes excessive silt and nutrients to the rivers. The East Branch of Octoraro Creek is classified as impaired by PA DEP (DEP 2006) for agriculture and organic enrichment. The modification of the ecology and habitat in the Susquehanna River from the series of large dams on the river is the largest threat to its natural state. Natural hydrology, habitat connectivity, migration of fishes, such as American eel and American shad, are severely disrupted by the presence of the dams.

This community is primarily composed of fish that are not native to the Susquehanna River watersheds. Walleye, black crappie, and goldfish are introduced species to the Atlantic basins in eastern and central Pennsylvania. Many game fish have also been introduced and are actively stocked around Pennsylvania. These fish may have become naturalized and are now wild-reproducing.

Conservation Recommendations: Large stream and river habitats in good quality condition are rare. Although the potential sources of pollution to the river and impoundment community are many, solutions to



Rivers, like the Susquehanna River, and impoundments are common habitats of this community type.

pollution problems are possible by minimizing point source pollution and managing water quality in the smaller tributaries. Reducing pollution impacts from storm sewers, sewage treatment plants, and any industrial point sources could improve some water quality and in-stream habitat. Additionally, local watershed managers and municipal planners should address non-point source pollution especially from agricultural areas. Restoration of riparian buffer zones, exclusion of livestock from streams, rotational grazing, and soil conservation are some mitigation techniques to control non-point source pollution in agricultural streams

High Quality Small Stream Community

Typified by: Brushlegged mayfly (Isonychiidae), fingernet caddisfly (Philopotamidae), dobsonfly (Corydalidae), saddlecase maker (Glossosomatidae), watersnipe fly (Athericidae), common burrower (Ephemeridae), snail-case maker caddisfly (Helicopsychidae)

Community Description and Habitat: This community is found in small to medium-size streams of moderate elevation and intermediate gradient. Like other streams in Lancaster County, agricultural land in the watershed may have some adverse influence on water quality where this community resides.

mean watershed area 67 mi^2
mean elevation 251 m
mean gradient 1.4%

mean alkalinity 53 mg/l
mean conductivity 203 µS/cm
mean pH neutral

The High Quality Small Stream Community is typically found in streams with sandy bottoms mixed with larger cobble and boulders. This community type is usually indicative of high quality streams, but community members may tolerate some pollution.



Typical community habitats are small to medium-sized streams with diverse stream-bottom habitats and high water quality. photo source: Andrew Strassman (PNHP)

Water chemistry values of the streams that support this community type are usually typified by moderate alkalinity, moderate conductivity, and a neutral pH.

In Lancaster County, the community was found at the headwaters of Little Muddy Creek, of Muddy Creek, of Pequea Creek, and of West Branch Brandywine Creek. A tributary to the Susquehanna River, Fishing Creek, was also inhabited by this community.



Brushlegged Mayfly
photo source: www.dec.state.ny.us

Stream Quality Rating: high

Threats and Disturbances:
High quality habitats and water quality are suggested for the streams that this community occupies. Although the community habitat may have fewer impairments than that associated with other assemblages in Lancaster County, degradation may result in a shift to a community indicative of poor water quality. Impairments resulting from poorly buffered agricultural land include excess nutrient and sediment input from cropland or livestock pastures. Some streams occupied by this community, such as Little Muddy Creek, Conestoga River, and Pequea Creek, are impaired because of excess sediment and nutrients, contributed from crop and livestock grazing agricultural sources (PA DEP 2006).

Conservation Recommendations: While some non-point source pollution occurs in watersheds supporting this community, the pollution problems here are less severe than in other stream types. In areas where non-point source agricultural pollution is occurring, runoff and stream bank erosion can be controlled with riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. We also recommend practices for soil conservation, nutrient management, and other reduced-impact agriculture to protect County streams.

High Quality Headwater Stream Community

Typified by: Rolledwinged stonefly (Leuctridae), small minnow mayfly (Baetidae), crayfish (Cambaridae), trumpetnet caddisfly (Polycentropodidae), darner dragonflies (Aeshnidae)

Habitat: In most locations, the community is typically found in small, swift streams; this community is indicative of high quality stream habitats. Some community organisms are relatively intolerant of poor water quality. However, a shift in the relative dominance of organisms in the community may occur under the stress of pollution and habitat degradation. In Lancaster County, the community primarily occurs in waters with sandstone geology. The terrain, e.g., low elevation rolling hills in the County, limits the number of small streams that are fast flowing in contrast to some Pennsylvania regions, where steep ridges form the high gradient watershed headwaters. In Lancaster County, the community may be associated with streams that are low to relatively high gradients, but community habitats nearly always occur in small watersheds.



Small, high-gradient streams with rocky habitats are typical of this community type.

Photo source: PNHP

This community is typified by a diverse group of macroinvertebrates that are sensitive to organic pollution. However, the community may be dominated by some species of small minnow flies, where habitats are degraded. Small tributaries to the Susquehanna River, the headwaters of Santo Domingo Creek, and the headwaters of Octoraro Creek were the community habitat in Lancaster County.



Small minnow mayfly
Photo source: www. guillaume.doucet.free.fr

Stream quality rating: High

Threats: This community type occurs in watersheds with low to moderate amounts of agricultural influences. In some locations, siltation and excess nutrients from agriculture may be impairing stream systems. Some of the community habitats are classified as "impaired" by PA DEP (DEP 2006). For instance, livestock grazing agriculture and crop agriculture contributes to the impairment status in parts of Little Muddy Creek, Conestoga River, and Pequea Creek, where the community habitat occurs.

Conservation recommendations: Conserving small headwater streams in good condition is important for maintaining watershed health and the Community habitats. Reducing runoff from poorly buffered agricultural land would be most beneficial for improving stream quality for the High Quality Headwater Stream Community. In areas such as these, runoff and stream bank erosion can be controlled by installing riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. Stream habitats will improve over time with the addition of riparian buffers. Benefits to the fishery resource and macroinvertebrate communities can also be accomplished with nutrient management and soil conservation practices.

mean alkalinity 51 mg/l
mean conductivity 223 µS/cm
mean pH neutral

mean watershed area 33 mi^2
mean elevation 397 m
mean gradient 2.3%

Common Headwater Stream Community

Typified by: little plain brown sedge *(Lepidostomatidae)*, slender winter stonefly *(Capniidae)*, spiketail dragonflies *(Cordulegastridae)*

Habitat: The Common Headwater Stream Community is generally found in small, high gradient streams. Community habitats appear to have a diversity of in-stream habitat types with little channelization or riparian disturbance.

Streams that support this community type generally have low amounts of dissolved ions; this community type is associated with non-calcareous streams.
The community habitat or water quality may be threatened by point sources, mining, or watershed disturbances. In Lancaster County, poorly managed agricultural practices are the main threat to small streams. The community habitat is mainly small tributaries of the Susquehanna River.

mean watershed area 10mi^2
mean elevation 397 m
mean gradient 3.0%

mean alkalinity 22 mg/l
mean conductivity 269 µS/cm
mean pH neutral

Stream quality rating: Low to moderate



slender winter stonefly
photo source: www.dec.state.ny.us

Threats:
Because small, headwater streams are the most numerous in Pennsylvania waterways and contribute the most stream miles of all flowing water types, the quality of small streams can have a great influence on the overall status of the Commonwealth's waters.



Small, high-gradient tributaries to the Susquehanna River are typical of this community type.

Photo source: PNHP

Nutrient enrichment and sedimentation of many small waterways in the Susquehanna River Basin contributes to the pollution and degradation of the Chesapeake Bay. Concerted conservation efforts to protect the large number of small streams from non-point source pollution will improve the Bay's water quality.

Conservation Recommendations:
Addressing point source pollution and particularly non-point source pollution from agricultural sources should be the primary conservation strategy for small, headwater streams in Lancaster County. Restoring degraded water quality and habitat with riparian buffers to exclude livestock and to buffer sediment and nutrients runoff. will benefit streams conditions. Habitat improvements in degraded channels may also benefit aquatic life. Conservation measures like easements and land protection for headwater streams will ensure that high quality headwater streams will persist.

Limestone / Agricultural Stream Community

Typified by: Scud (Amphipoda), black fly (Simuliidae), aquatic sowbug (Isopoda), Planaria (Turbellaria), segmented worms (Annelida), midge (Chironomidae), common pond snail (Physidae), predacious diving beetle (Dytiscidae), ram's horn snail (Planorbidae)

Community Description and Habitat: This community is found in large streams with low gradients. It occurs at moderate to low elevation mainly in valley streams with calcareous geology, including limestone and dolomite formations types that are common in central Lancaster County. Non-point source pollution from agriculture and urban areas in the watershed may contribute to degradation of stream habitat.

mean watershed area 368 mi^2
mean elevation 200 m
mean gradient 1.1%

mean alkalinity 95 mg/l
mean conductivity 364 µS/cm
mean pH neutral



Scud
Photo source: www.dec.state.ny.us

Stream fauna, such as scuds and sowbugs, are associated with the relatively alkaline waters. Organisms may be specialized for habitats and water chemistry associated with limestone streams. Examples of the community type occur in Meadow Run, upper Conestoga River, and Mill Creek.

Stream Quality Rating: Low

Threats and Disturbances: Because high quality agricultural lands occur in limestone bedrock valleys, intensive watershed land use in agriculture is common. Minimally degraded limestone streams are very rare in the Commonwealth. In Lancaster County, there are no streams with the state's highest water quality class, Exceptional Value, in watersheds dominated by calcareous geology.

Landscape alterations can have negative effects on stream habitat. Poorly buffered agricultural areas can lead to excess nutrient loading and siltation of streams, altering habitat and adversely affecting resident communities. DEP designates some community habitats as "impaired" such as Meadow Run, parts of Conestoga River, and Mill Creek (DEP 2006). Aquatic life in impaired streams is threatened by siltation and excess nutrient loading from poorly managed farming practices.

Conservation Recommendations:
Protecting high quality mid to large-sized calcareous streams should be a priority for watershed managers. The long-term health of stream communities is linked to the maintenance of high quality water conditions and habitat. Ensuring that agricultural operations implement measures to protect streams, like stream bank fencing, riparian buffers, rotational grazing, and soil conservation, will maintain this community. The agricultural non-point source pollution issues associated with this community may be more severe than in streams indicated by other community types, based on watershed characteristics and the characteristic taxa. In areas where agricultural pollution is occurring, installing riparian buffers along pastures and crop fields and excluding livestock from streams and riparian zones can control bank erosion and improve stream habitats over time.



Low gradient streams in calcareous geology provides habitat for the Limestone / Agricultural Stream Community.
Photo source: PNHP

Low Gradient Valley Stream Community

typified by: Riffle beetle (Elmidae), waterpenny beetle (Psephenidae) netspinning caddisfly (Hydropsychidae), Asian Clam (*Corbicula fluminea*), narrow-winged damselfly (Coenagrionidae), rusty dun mayfly (Caenidae), fingernail clam (Sphaeriidae), freshwater limpet (Ancylidae), broad-winged damselfly (Calopterygidae)

Community Description and Habitat: This community generally occurs in medium-sized streams, intermediate- gradient valley streams.

mean watershed area 75.3 mi^2
mean elevation 201 m
mean gradient 1.0%

The water chemistry associated with this community is distinct from other macroinvertebrate communities because alkalinity and conductivity are relatively high, but pH is neutral. Moderately high amounts of urban and agricultural land cover in the watershed contribute to water quality issues in watersheds where this community occurs. Additionally, forest cover is relatively low in these watersheds.

mean alkalinity 76 mg/l
mean conductivity 318 µS/cm

In Lancaster County, valley streams like Pequea Creek, Conestoga River, Big Beaver Creek, and South Fork Big Beaver Creek characterized this community's habitat.



Riffle Beetle
photo source: www.epa.gov

Stream Quality Rating: intermediate

Threats and Disturbances: The exotic Asian Clam (*Corbicula fluminea*) commonly occurs with this community type. The Asian clam is a threat to other bivalves due to competition for food resources and habitat.

The habitat for this community type may receive pollution from agricultural sources. In streams where this community is found, water quality may be moderately degraded from excess nutrients, habitat modification, and siltation due to improper agricultural practices. Community habitat in Pequea Creek, South Fork Big Beaver Creek, and Conowingo Creek is impaired for excess nutrients, low dissolved oxygen, and/or siltation (PA DEP 2006). Fish in Conestoga River are under a fish consumption advisory because of mercury contamination.

Conservation Recommendations: Where this community is common, non-point source pollution from the surrounding watershed is contributing to moderately degraded water quality and habitat conditions. Although this community type does not signify extremely poor stream quality, some stresses to stream condition are indicated.

Areas with large amounts of agriculture and roads have the potential for non-point source pollution. In agricultural environments, runoff and stream bank erosion can be controlled by rehabilitating riparian buffers of an adequate width along pastures and crop fields and excluding livestock from streams and riparian zones. Practicing soil conservation and low impact crop agriculture is also recommended to maintain healthy valley streams.



This community is typically found in low gradient valley streams with some influence from agricultural practices in the watershed.
photo source: PNHP

Recommended for other valley streams, management of storm water from roads and urban developments and mitigation of any stream effluents is recommended. Retention and treatment of storm water is ideal and would ameliorate water quality in streams receiving urban effluents. Keeping sewage treatment systems up-to-date would also improve stream habitats that support aquatic communities. Air pollution bringing mercury to county stream may be contributed from long-distance sources and may need to be address in regional initiatives or national legislation.

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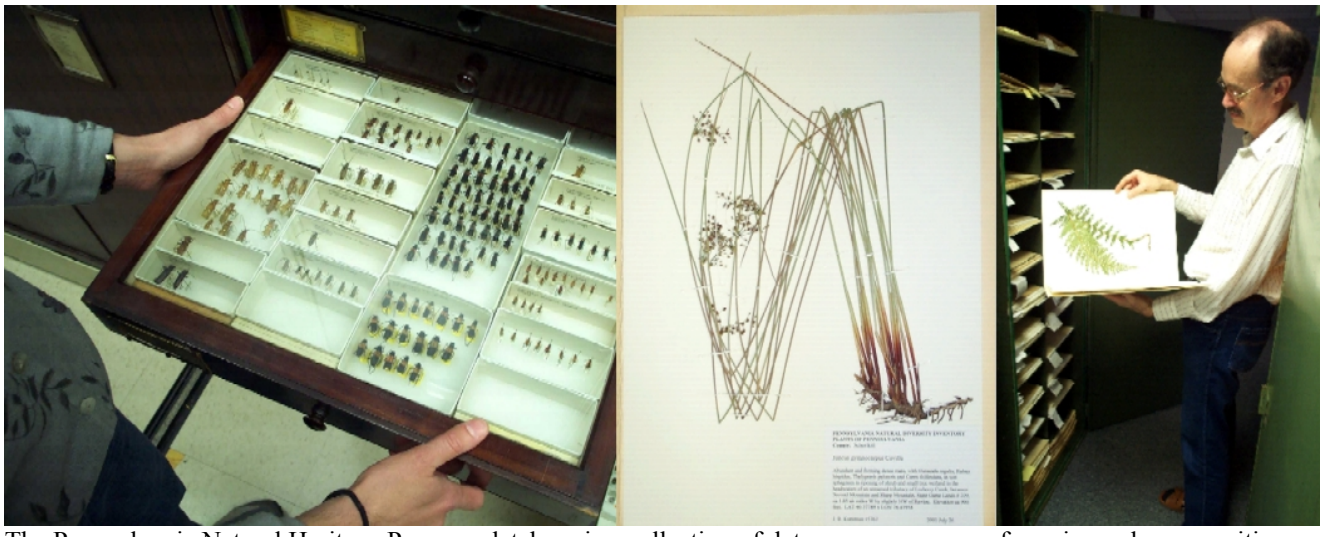
Methods used in the Lancaster County Natural Heritage Inventory Update for the most part followed Pennsylvania Natural Heritage Program (PNHP) procedures of past biological inventories. However, since a previous county inventory had been conducted, and since a lot of information exists on the relatively few areas of natural habitat in the county, emphasis for this project was placed on providing more detailed information on the existing high quality natural areas. The inventory proceeded in three stages: 1) information was gathered from a number of sources: the PNHP database files, Lancaster County GIS department, local experts, and map and air photo interpretation; 2) ground surveys conducted (preceded by one low-altitude flight over the county); and 3) data are analyzed and mapped.

Pennsylvania Natural Heritage Program Data System

The Pennsylvania Natural Heritage Program (PNHP) was established in 1982 as a joint venture between the PA Department of Environmental Resources, The Nature Conservancy, and the Western Pennsylvania Conservancy (WPC). Today this partnership continues under the leadership of WPC, the Department of Conservation and Natural Resources (DCNR), the Pennsylvania Game Commission (PGC), and the Pennsylvania Fish and Boat Commission (PFBC). The PNHP database has become Pennsylvania's chief storehouse of information on outstanding natural habitat types (natural communities) and sensitive plant and animal species of special concern. Several other noteworthy natural features are also stored in the database, including Department of Environmental Protection (DEP)-designated Exceptional Value Streams (Shertzer 1992) and outstanding geologic features (based on recommendations from Geyer and Bolles 1979 and 1987).

The database includes existing data on occurrences of species and communities of special concern, gathered from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists. From this foundation, PNHP has focused its efforts on, and conducts systematic inventories for, the best occurrences of the priority species and natural communities.

As of January 2007, PNHP has recorded nearly 18,000 detailed occurrences of species and communities of special concern, largely the result of field surveys. These are stored in computer and manual files and denoted on topographic maps. Additional data are stored in extensive manual and digital files set up for over 200 natural community types, 1,400 animals, and 3,500 plants. These files are organized by each of Pennsylvania's 881 7½ USGS topographic quadrangle maps using a geographic information system (GIS).
In order to conduct an inventory of significant flora, fauna, and natural communities in the county, biologists from the Middletown office first consulted the database maintained by the PNHP. They then used this systematic inventory approach to identify the areas of highest natural integrity in Lancaster County. The natural community and sensitive species data are the basis for judging the biological values of sites within the county. Protecting the sites with the best occurrences of the county's natural communities, and viable populations of sensitive plant and animal species can help to insure that a full range of biological



The Pennsylvania Natural Heritage Program database is a collection of data on occurrences of species and communities (elements) of special concern, drawing from publications, herbarium and museum specimens, and the knowledge of expert botanists, zoologists, ecologists, and naturalists.

diversity in Lancaster County is preserved for the future.

- **Information Gathering**

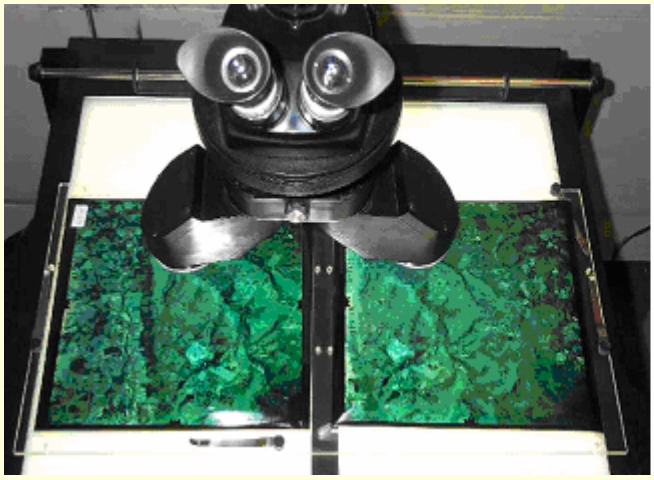
A list of natural features found in the county was prepared from the PNHP database and supplemented with information volunteered by local individuals and organizations familiar with Lancaster County. PNHP staff solicited information about natural communities, plant species of special concern and important wildlife breeding areas from knowledgeable individuals and local conservation groups. The Lancaster County GIS Department provided voluminous spatial data to assist in the analysis of the county's natural landscape

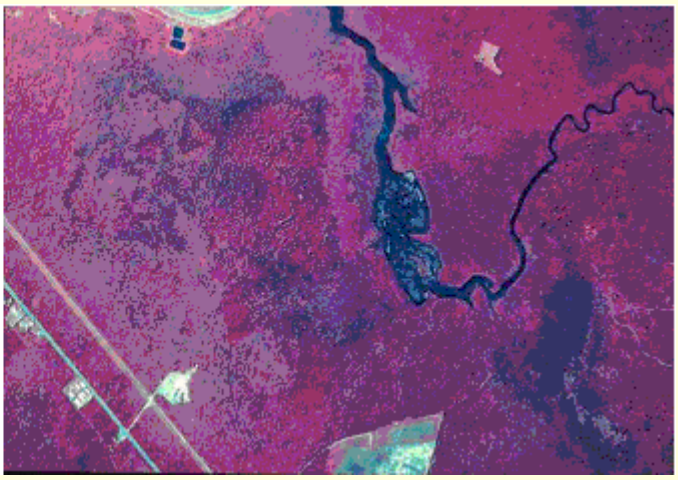
- **Map and Air Photo Interpretation**

PNHP ecologists familiarized themselves with the air photo characteristics of high quality natural communities already documented. Additional data from vegetation maps, soil survey maps, field survey records and other sources were consulted to gain familiarity with Lancaster County's natural systems. This information, along with references on physiography, geology, and soils, was used to interpret photos and designate probable vegetation types and potential locations for exemplary communities and rare species. In many instances, vegetation was classified at an ecosystem level, and it was therefore critical that an ecologist or person with similar training interpret the maps and aerial photos.

Work progressed systematically within the area encompassed by each USGS topographic map. The natural area potential of all parcels of land was assessed using aerial photographs. Areas on Lancaster County aerial imagery that continued into adjacent counties were examined in their entirety. Topographic maps used during field surveys were marked to indicate locations and types of potential natural heritage sites based on characteristics observed on the photos. For example, an uneven canopy with tall canopy trees could indicate an older forest; a forest opening, combined with information from geology and soils maps, could indicate a seepage swamp community with potential for several rare plant species. Baseline information on sites appearing to have good quality communities or potential for rare species was compiled to help prioritize fieldwork.

After an initial round of photo interpretation, field surveys were conducted to evaluate the potential targets. In March of 2007, a low altitude reconnaissance flight was flown over the county to provide a more accurate overview of the current condition and extent of known natural heritage sites and to assess the potential of any additional areas. Locations with minimally disturbed natural communities or with species of special concern were noted on topographic quadrangle maps. The photo signatures (characteristic patterns, texture, tone of vegetation, and other features on the photos) of these sites were then used as a guide for continued photo interpretation and future field surveys. Photo signatures with poor quality sites led to the elimination of further fieldwork on other sites with similar signatures.





Using aerial photography, skilled PNHP staff are able to identify areas with characteristic signatures that potentially indicate areas with high biological significance. Aerial photography interpretation can give a quick overview of the condition of particular areas in the county and is helpful in identifying and delineating vegetation community composition.

- **Field Work**

Experienced PNHP biologists and contractors conducted targeted field surveys to the most ecologically significant areas in Lancaster County. Biologists evaluated the degree of naturalness of habitats (including assessment of percent of native vs. non-native plant species, degree of human disturbance, age of trees, etc.) and searched for plant and animal species of concern. Workers also categorized the vegetation of each potential site visited. An evaluation of quality was made for each potential natural community element, with care being taken to give reasons for the quality rank. Boundaries of the community types were redrawn, if needed, based on new field information. Community information recorded included the dominant, common, and other species, as well as disturbances to the community. Field forms were completed for all occurrences of plant and animal species of special concern and natural communities (see sample Field Survey Form, Appendix III), the quality of each population or community was assessed, and locations were marked with GPS units.

- **Data Analysis**

To organize the natural features data and set conservation priorities, each natural community or species (element) is ranked using factors of rarity and threat on a state-wide (state element ranking) and range-wide (global element ranking) basis (see Appendix I). Each location of a species (an element occurrence) is ranked according to naturalness, its potential for future survival or recovery, its extent or population size, and any threats to it. An explanation of the five element occurrence quality ranks is given in Appendix II.

The element-ranking and element occurrence-ranking systems help PNHP personnel to simultaneously gauge the singular importance of each occurrence of, for example, a Hemlock-tuliptree-birch Natural Community or puttyroot orchid occurrence in Lancaster County, as well as the statewide or world-wide importance of these natural features. Obviously, sites with a greater number of highly ranked elements merit more immediate attention than sites with a smaller number of lower ranked elements.

Field data for natural communities of D-rank or better, and for all plant and animal species of concern found, were combined with existing data and summarized on PNHP Element Occurrence Records for mapping and computerization. Mapped locations of natural features, including approximate watershed or subwatershed supporting habitat boundaries, were then created and added electronically to PNHP's Geographical Information System (GIS) layer.



Experienced PNHP staff conduct botanical surveys and habitat assessments for species of special concern. All sites are evaluated for their natural condition. Associated disturbances and threats are noted and recommendations are made to minimize negative impacts.

Information on the needs of the rare species in this report has come from a variety of sources, including field guides and research publications. For reptiles and amphibians, the major sources are Hulse et al. (2001) and DeGraaf and Rudis (1981); for birds, Brauning (1992) McWilliams and Brauning (2000); for moths, Covell (1984); for butterflies, Opler and Krizek (1984) and Opler and Malikul (1992); Schweitzer (1981) provided much of the information on rare moth and butterfly species in Pennsylvania. A list of Plant and Animals of Concern in Lancaster County is provided in Appendix VIII.

- **Species Ranking**

Each year biologists representing various taxonomic groups of the Pennsylvania Biological

Survey meet to discuss and rank the most important species for the protection of biodiversity in Pennsylvania. The various Biological Technical Committees include the Bryophyte and Lichen Technical Committee, the Fish Technical Committee, the Fungi Technical Committee, the Herpetological Technical Committee, the Invertebrate Technical Committee (with subcommittees of aquatic, terrestrial, arachnid and mollusk), the Mammal Technical Committee, the Ornithological Technical Committee, and the Vascular Plant Technical Committee. These meetings consist of a review and ranking of species of concern within the state, in terms of the rarity and quality of the species or habitats of concern, potential threats, and protection needs. The results of these meetings provide a baseline for evaluating the statewide significance of the species recognized in the Natural Heritage Inventory.

- **Landscape Analysis**

Background: Fragmentation of the landscape by roads, utility lines, and other human disturbances can impact the surrounding landscape significantly. A road or utility line cut through a forested block cleaves the large block into two smaller blocks and significantly increases the amount of edge habitat within the forest. When a forest with a closed canopy is disturbed by road building activities, the newly disturbed soil and open canopy favor the establishment of invasive species of plants and animals. Many of these will out-compete and displace native species in this disturbed habitat.

These smaller forest fragments will have significantly more edge habitat and less forest interior than the original forest block. Furthermore, fragmentation of large forest blocks decreases the ability of many species to migrate across manmade barriers such as roads. Migration corridors, once severed, isolate populations of species one from another, limit the gene flow between populations and create islands of suitable habitat surrounded by human activity. Much of the native biological diversity of an area can be preserved by avoiding further fragmentation of these large forested areas.

Historically, edge habitat was created to provide habitat for animals, namely game species, which often thrive in disturbed areas. Today, we realize that by fragmenting forests we are eliminating habitats for the forest interior species. Those species that utilize edge habitats are typically considered generalists, capable of utilizing many different habitats and are usually not of immediate conservation concern.

The larger forested blocks in the county have been highlighted in an effort to draw attention to the significance of large forested blocks within the county. Besides being habitat suitable for many native species, large unfragmented forest blocks in close proximity to each other become natural corridors for species movement within and through the county. In many cases, by highlighting the larger forested blocks, and the smaller blocks between them, the most natural landscape corridors become evident.

- **Site Mapping and Ranking**

Boundaries defining core habitat and supporting natural landscape for each species of concern were delineated based on PNHP conservation planning specifications for the elements of concern. These specifications are based on scientific literature and professional judgment for individual species or animal assemblages and may incorporate physical factors (e.g., slope, aspect, hydrology), ecological factors (e.g., species composition, disturbance regime), and input provided by government agencies with jurisdiction over the species. Boundaries tend to vary in size and extent depending on the physical characteristics of a given site and the ecological requirements of its unique natural elements. For instance, two wetlands of exactly the same size occurring in the same region may require very different buffers if one receives mostly ground water and the other mostly surface water, or if one supports migratory waterfowl and the other does not.

Sites were then assigned a significance rank to help prioritize future conservation efforts. The PNHP considers several criteria when ranking NHI sites to ensure that all sites, regardless of ecological differences, are evaluated systematically. Each criterion is considered independently and then all are examined collectively to ensure that no one criterion receives more emphasis than another. First, the commonness/rareness of the species at a site, defined by the global and state ranks (G & S ranks Appendix I), is considered in the site ranking process. Those sites that include rarer species with higher ranks (i.e. G3 or S1) are given precedence over sites with more common, lower ranked species (i.e. G5 or S3). Next, the number of different species occurring at a site is also considered in the ranking process. Sites with multiple species of concern are considered to be higher conservation priorities than sites with fewer species of concern. The ecological characteristics of the species at each site are also considered in the ranking process. For example, species that have highly specialized habitat requirements and are not known to readily disperse during periods of disturbance are under greater ecological pressure than species that have more general habitat requirements and have a greater capacity for dispersion. Finally, the site ranking process examines the landscape context of each site. For example, a site that is entirely isolated due to fragmentation, with little chance of restoration of connectedness, is a lower conservation priority than a site that remains connected to other suitable patches of habitat. Site connectedness is critical because the potential for connected populations to remain viable is far greater than small isolated populations. By considering these criteria, the conservation priorities within Lancaster County are highlighted to promote appropriate use of conservation dollars and efforts.

The Natural Heritage Areas of Lancaster County are ranked into four significance categories: **Exceptional**, **High**, **Notable**, and **Local** . These ranks have been used to prioritize all identified sites and suggest the relative attention that sites should receive for protection (see below).

County Natural Heritage Areas Significance Ranks

Ranks	*Description*
Exceptional	Sites that are of exceptional importance for the biological diversity and ecological integrity of the county or region. Sites in this category contain one or more occurrences of state or national species of special concern or a rare natural community type that are of a good size and extent and are in a relatively undisturbed condition. Sites of exceptional significance merit quick, strong, and complete protection.
High	Sites that are of high importance for the biological diversity and ecological integrity of the county or region. These sites contain species of special concern or natural communities that are highly ranked, and because of their size or extent, and/or relatively undisturbed setting, rate as areas with high potential for protecting ecological resources in the county. Sites of high significance merit strong protection in the future.
Notable	Sites that are important for the biological diversity and ecological integrity of the county or region. Sites in this category contain occurrences of species of special concern or natural communities that are either of lower rank (G and S rank) or smaller size and extent than exceptional or high ranked areas, or are compromised in quality by activity or disturbance. Sites of notable significance merit protection within the context of their quality and degree of disturbance.
Local	Sites that have great potential for protecting biodiversity in the county but are not, as yet, known to contain species of special concern or state significant natural communities. Often recognized because of their size, undisturbed character, or proximity to areas of known significance, these sites invite further survey and investigation. In some cases, these sites could be revealed as high or exceptional sites.

RESULTS AND DISCUSSION

- **Landscape-scale Conservation**

Several factors have to be weighed with respect to landscape scale conservation and the identification of natural wildlife corridors through the region. Different groups of animals, and the plant propagules (seeds) traveling along with them, will utilize different aspects of the landscape for migration and local movement. Large mammals frequently prefer forest canopy, often traveling along forested streams, valleys and ridges. Some species of birds are more likely to follow the edges of woodlands, while others require grassy openings, or open water, or interior forest. Aquatic animals are restricted to waterways, but animals that require both wetland and upland habitats such as turtles, some birds and mammals, dragonflies etc, will require a safe means of traveling between the two habitats. Forests and waterways are the primary landscape features considered for this corridor analysis.

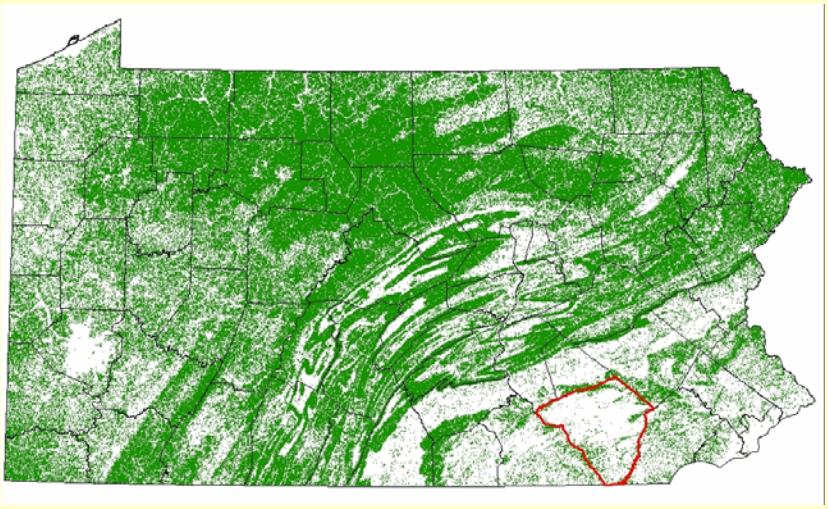
- **Forest Block Analysis--Landscape-scale Conservation**

Forest blocks were identified in Lancaster County and grouped into several size classes to help highlight the larger contiguous forest blocks. The largest blocks are concentrated among the Furnace Hills along Lancaster's northern border with Lebanon County and the Welsh Mountains in the east-central part of the county along the border with Chester County. A discussion of the importance of considering these large remaining forested areas in conservation follows.

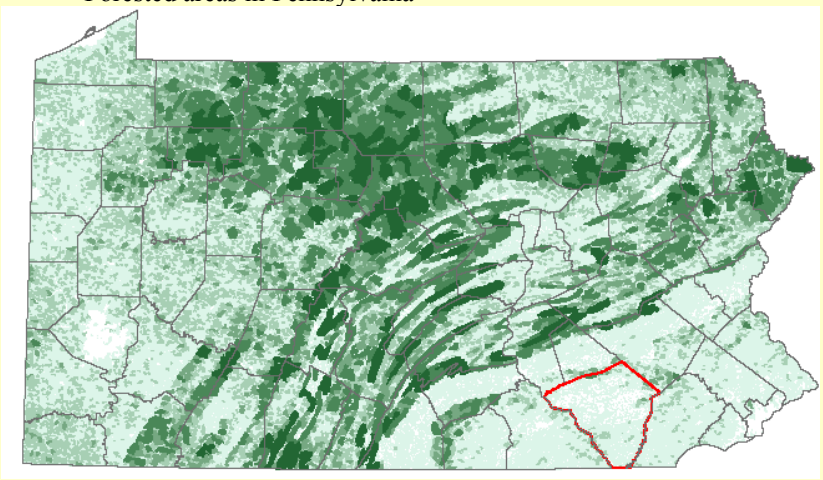
Prior to European settlement, forest covered more than 90% of Pennsylvania (Goodrich et al. 2003). Today, 62% of the state is forested (map (a) above), comprising an area of over 17 million acres (Goodrich et al. 2003, Myers et al. 2000). However, much of this forest exists as relatively small islands isolated by surrounding linear features such as roads, utility right-of-ways, railroads and all-terrain vehicle and snowmobile trails, as well as non-forest lands. Map (b) above shows forested areas greater than 250 acres that remain in Pennsylvania after fragmentation by interstate, US, and state highways; state and local roads; public forest roads; utility right-of ways; and active railroads. The forest blocks represent potential contiguous habitat for animals sensitive to all scales of fragmenting features, such as amphibians and interior forest birds. The acreage size c lasses shown in this figure roughly correspond to area-sensitive species requirements.

A number of studies have looked at the effects of roads and other linear features on the landscape.

Forested areas of Pennsylvania before (a) and after fragmentation due to human created features (b).



Forested areas in Pennsylvania



b. Forested areas, greater than one acre, that remain after fragmentation by interstates, state and local roads, active railroads, and utility right-of-ways.

Ecological impacts of these fragmenting features include:

(1) direct mortality of wildlife from vehicles
(2) disruption of wildlife dispersal
(3) habitat fragmentation and loss
(4) imposition of edge effects
(5) spread of exotic species
(6) alteration of the chemical environment

Roads can be a significant source of mortality for a variety of animals. Amphibians may be especially vulnerable to road-kill, because their life histories often involve migration between wetland and upland habitats, and individuals are inconspicuous. One study conducted in southeastern Pennsylvania documented over 100 road-killed salamanders and frogs in one rainy night on a one-mile stretch of road in the spring breeding season (Goodrich et al. 2003).

Large and mid-sized mammals are particularly susceptible to vehicle collisions on secondary roads, while birds and small mammals are most vulnerable on wider, high-speed highways (Forman and Alexander 1998). In Upper St. Clair Township, Allegheny County, Pennsylvania, over the last four years, white-tailed deer (*Odocoileus virginianus*) mortality due to road-kills was approximately four times higher than mortality due to hunting (Upper St. Clair Township Department of Deer Management). Six hundred thirty seven bobcats (*Lynx rufus*) were reported as road-kills in Pennsylvania from 1985 to 2000 (Goodrich et al. 2003). A 10-year study of road mortality in New Jersey recorded 250 raptors representing 12 species along a 90-mile section of road (Loos and Kerlinger 1993, cited in Goodrich et al. 2003).

Animals may alter their behavior in the presence of a road. One study found that small forest mammals (e.g., eastern chipmunk, eastern gray squirrel, and deer mouse) were reluctant to venture onto road surfaces where the distance between forest margins exceeded 20 m. The same study concluded that a four-lane divided highway might be as effective a barrier to the dispersal of small forest mammals as a body of fresh water twice as wide (Oxley et al. 1974). A study conducted in North Carolina found that black bears shift their home ranges away from areas with high road densities (Brody and Pelton 1989). Traffic noise has been shown to interfere with songbird vocal communication thus affecting their territorial behavior and mating success (Seiler 2001). Roads, wide trails, and grassy corridors can also function as barriers restricting the movement of invertebrates and amphibians. Populations of microhabitat-specific species like land snails and salamanders, that generally require moist habitats, may be isolated by inhospitable, xeric corridors (Williams 1995, Blaustein et al. 1994). Some forest butterflies, like the West Virginia white (*Pieris virginiensis*), will not cross open habitats and its current rarity may be a function of habitat fragmentation and isolation (Williams 1995). Consequences of the isolation of populations include reduced genetic diversity and low recruitment rates that can, in turn, result in local extinctions (Seiler 2001).

Large forested blocks are critical habitats for plants and animals that are dependent of forest interior conditions such as many migrating bird species, fishers, bobcats, Northern Goshawks and Barred Owls. These forest blocks and their adjacent streams should be considered the backbone of wildlife habitat in the county. Conservation efforts in the county should concentrate on maintaining these large forest blocks by avoiding further fragmentation with additional roads, development, and utility rights-of-way.

Fragmentation of contiguous forested landscapes into smaller, isolated tracts has an effect on plant and animal distribution and community composition. When an extensive forest tract is fragmented, the resulting forest islands may lack the full range of microhabitats that existed in the original tract or may be smaller than the minimum area required by a given species (Lynch and Whigham 1984). For example, the Louisiana Waterthrush (*Seirus motacilla*) is rarely found in small woodlots, because they require upland forest streams within their territory, and most small woodlots lack this necessary component (Robbins 1980, Robinson 1995). Area-sensitive species such as Northern Goshawk (*Accipiter gentilis*), Barred Owl (*Strix varia*), Bobcat, and Timber Rattlesnake (*Crotalus horridus*) require interior forest areas in excess of 6,000 acres to accommodate breeding and foraging territories (Squires and Reynolds 1997,



Even a moderately sized gravel road can act as a fragmenting feature in a large tract of forest.
Photo source: PNHP

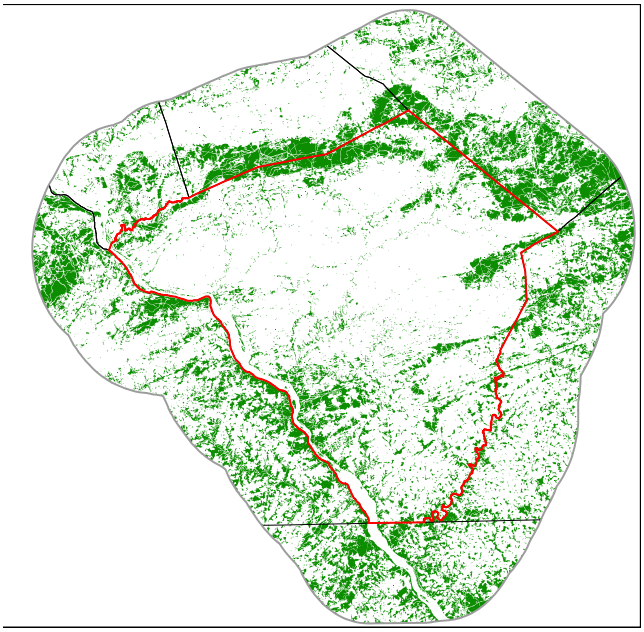
Mazur and James 2000, Ciszek 2002, NatureServe 2005).

Along with a reduction in total forested area, forest fragmentation creates a suite of "edge effects" which can extend more than 300 meters into the remaining fragment (Forman and Deblinger 2000). Edge forest is composed of a zone of altered microclimate and contrasting community structure distinct from the interior, or core forest (Matlack 1993). Edges experience increased light intensity, altered insect and plant abundance, a depressed abundance and species richness in macroinvertebrate soil fauna, and a reduced depth of the leaf-litter layer (Yahner 1995, Haskell 2000, Watkins et al. 2003). The macroinvertebrate fauna of the leaf litter is significant for the pivotal role it plays in energy and nutrient cycling; these macroinvertebrates also provide prey for salamanders and ground-feeding birds. A number of studies have shown that the nesting success of forest-interior songbirds is lower near forest edges than in the interior because of increased densities of nest predators and brood parasites (reviewed in Murcia 1995).

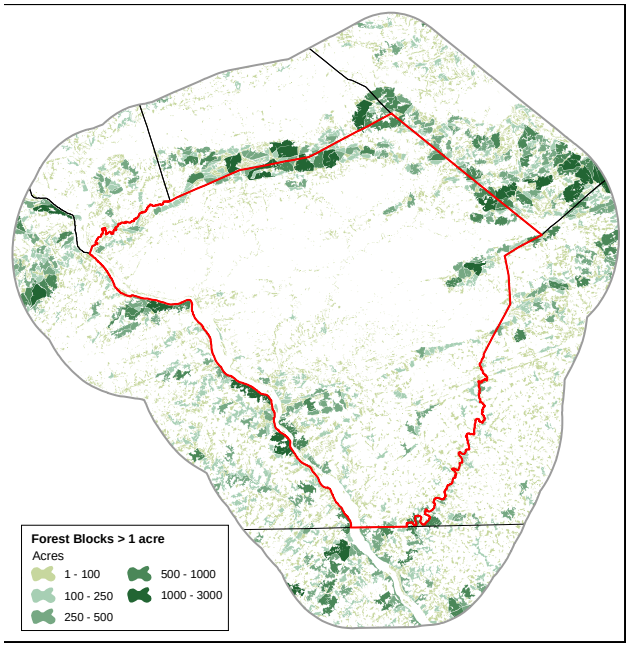
Roads can act as corridors for plant dispersal, and exotic species increase their range by spreading along roadsides (Watkins et al. 2003). Vehicles and road-fill operations transport exotic plant seeds into uninfested areas, and road construction and maintenance operations provide safe sites for seed germination and seedling establishment (Schmidt 1989; Greenberg et al. 1997; Trombulak and Frissell 2000).

Road traffic and maintenance of right-of-ways contribute at least six different classes of chemicals to the environment: heavy metals, salt, organic pollutants, ozone, nutrients, and herbicides (Forman and Alexander 1998, Trombulak and Frissell 2000). Heavy metals such as lead and iron contaminate soils, plants, and invertebrates up to 200 meters from roads, as well as vertebrate fauna foraging within the affected zone (Trombulak and Frissell 2000). Deicing salts contribute ions to the soil, altering pH and soil chemical composition, which affects plant growth (Forman and Alexander 1998, Trombulak and Frissell 2000). Airborne sodium chloride from road salt may cause leaf injury to trees up to 120 meters from a road (Forman and Alexander 1998). Organic pollutants such as dioxins and polychlorinated biphenyls (PCBs) are present in higher concentrations along roads, and hydrocarbons may accumulate in aquatic ecosystems near roads (Trombulak and Frissell 2000). Storm runoff from roads, particularly where roads abut or cross water bodies, results in the transport of nutrients and sediments into aquatic ecosystems (Trombulak and Frissell 2000). Drifting or misapplied herbicides applied to roadsides and utility right-of-ways to control woody plant growth may damage forest edge and interior plant species (Williams 1995).

Humans are an integral part of natural history, where we function as ecosystem engineers, altering the landscape around us to suit our needs. Some species benefit from human-induced changes, such as birds that inhabit the early successional and edge habitats provided by utility corridors or disturbance-adapted plants that colonize roadsides. But as is more often the case, species with specific habitat requirements tend to suffer declining numbers when faced with human encroachment. Given the pervasiveness of human influence throughout the northeastern United States, the ecological importance of large areas of relatively



Total forest cover of Lancaster County > 1 acre.



Forested blocks in Lancaster County.

pristine habitat cannot be overstated. Not only are they potential habitat for a number of area-sensitive species, they are also important for the maintenance of vital ecosystem processes such as nutrient cycling, pollination, predator-prey interactions, and natural disturbance regimes (Heilman et al. 2002). In addition, large forested areas also serve to filter and regulate the flows of streams within watersheds and store large quantities of carbon as biomass.

- **Recommendations for all Forest Blocks**

A significant portion of the land encompassed by these forest blocks is under public ownership, which presents land managers with the opportunity to coordinate sustainable management as well as biodiversity conservation. The Pennsylvania Game Commission, which is responsible for managing a significant portion of land within these largest forest blocks, focuses on management practices aimed at enhancing habitat for game wildlife. The utility companies also own significant forested parcels, primarily along the Susquehanna River. It is recommended that both of these agencies take into consideration the uniqueness of the contiguous forest contained within these areas, managing for older forests through longer rotations and silvicultural practices that enhance multiple-aged forest structure.

A number of resources, listed in Appendix VII, are available to private landowners interested in sustainably managing their forestlands for biodiversity conservation, forest health, and forest products including timber, mushrooms, and high-value medicinal herbs. A good place to start is the Forest Stewardship Program, which assists landowners in developing a forest management plan based on their envisioned goals for their land. Landowners interested in bringing deer numbers back into balance with their habitat may want to consider enrolling in the Pennsylvania Game Commission's Deer Management Program.

Forest fragmentation can be minimized by utilizing existing disturbed areas for new projects (e.g., wind farms) rather than clearing additional forest, by consolidating roads and right-of-ways where multiple routes exist, and by restoring unused cleared areas such as abandoned roads or railroad tracks to forest. When planning development, it is preferable to avoid complete division of the forest block to minimize impacts. Contiguity could be improved by establishing forested corridors at least 300 meters (1000 feet) wide between forest blocks that are separate. The impact of individual features such as wells, roads, right-of-ways, or other clearings can also be minimized by the use of ecologically informed best management practices in construction and maintenance.

- **Riparian Buffer Recommendations**

Riparian areas are lands directly adjacent to streams, creeks, and rivers. Land adjacent to waterways and wetlands has an immediate influence on the quality of the water and the habitat it supports. An undisturbed (no-cut) riparian buffer of 100 meters is recommended adjacent to all streams. The riparian buffers recommended in this report also include wetlands, while artificially created farm ponds have been excluded from this riparian buffer.

The literature varies with regard to buffer distances. From a strictly water quality standpoint, wetland buffers of 35-100 feet are thought to be sufficient for water quality maintenance (Wenger 1999). However, many of these buffer recommendations do not take wildlife habitat into account. Unfortunately, many states still refer to older literature with regard to wetland buffers and many of these studies are now considered to be rather obsolete. Newer scientific techniques have allowed researchers to conduct better studies with regard to habitat buffers. For example, wetland buffers of 15-30 meters were once thought to be sufficient to protect vernal pool amphibians. A series of papers from Conservation Biology (Semlitsch and Brodie 2003 - Buffer Zones for Wetlands and Riparian Habitats) conclude that buffers of this size are inadequate to protect terrestrial habitats for amphibians and reptiles. As the size of a buffer increases, the functions of that buffer for water quality, flow, and wildlife habitat expand (Wenger 1999, Palone and Todd 1997). Many species of mammals and birds require much larger forested buffers to persist.

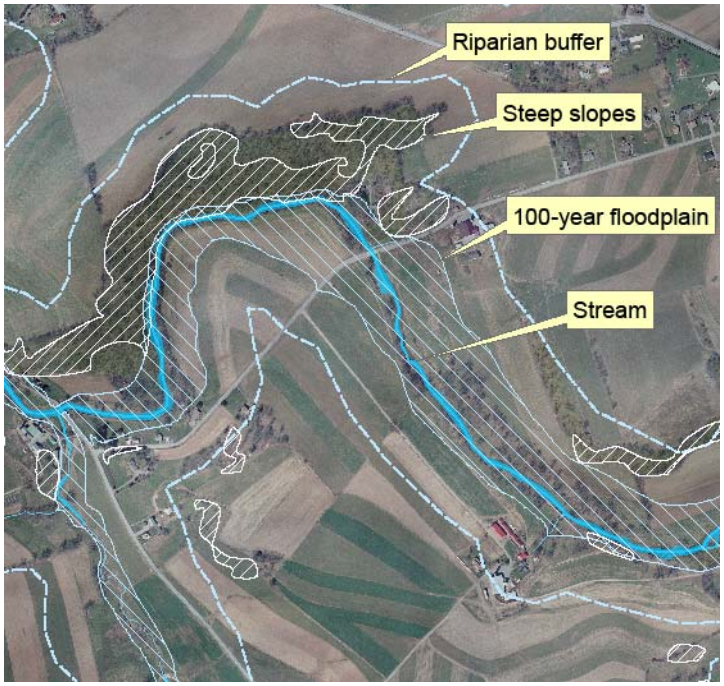
Based on studies of variously-sized riparian buffers, a general width of 100 meters (328 feet) from creek bank is recommended to maintain the water quality of the stream or wetland as well as to support many of the species of wildlife found in these sites. This results in a uniform buffer that is easy to apply.

Another approach that can be tailored to a particular location involves calculating buffer width based on site specific variables (Wegner 1999).

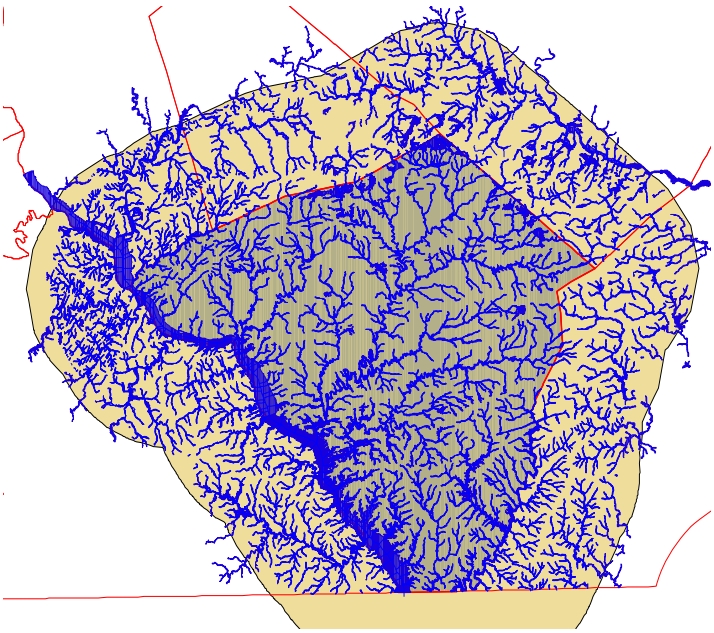
These include :

- Base width: 100 ft (30.5 m) from stream edge plus 2 ft per 1% of slope.
- Extend to edge of floodplain.
- Include adjacent wetlands. The buffer width is extended by the width of the wetlands, which guarantees that the entire wetland and an additional buffer are protected.
- Existing impervious services in the riparian zone do not count toward buffer width (i.e., the width is extended by the width of the impervious service, just as it is for wetlands).
- Slopes over 25% do not count towards the width (buffer width is increased by the length of the slope >25%).
- The buffer applies to all perennial and intermittent streams.

These buffers were not created for any one



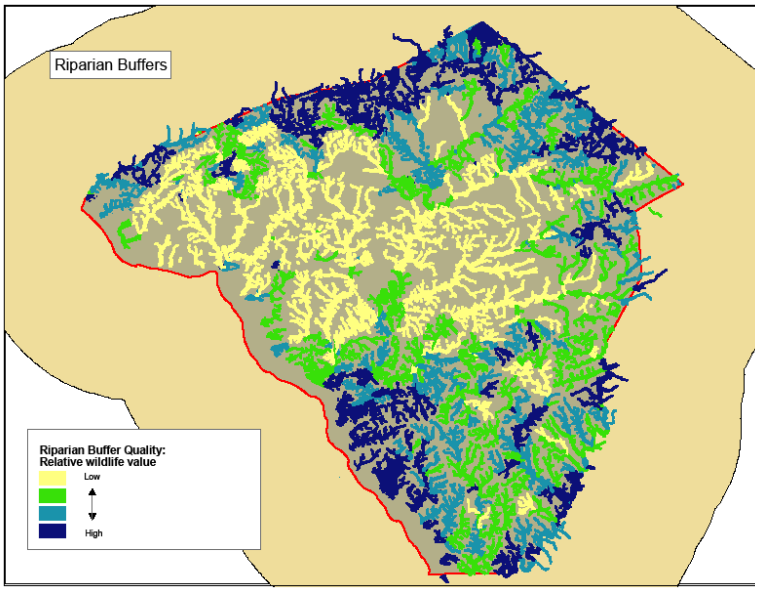
Riparian corridor example


Recommended riparian buffers of Lancaster County

particular species but are thought to overlap the habitats used by both common and rare species found at these sites. Certainly, expanding these buffers will still provide water quality protection while increasing habitat for species that require larger blocks of contiguous forest, such as the Fisher and Northern Goshawk.

Each riparian buffer segment in the county, excluding the mainstem of the Susquehanna River, was analyzed using eight variables and ranked according to their potential cumulative effect on water quality (see map below). Predictably, the highest quality stream buffers are found at the margins of the county, where they coincide with established tree cover. Those streams though the center of the county pass through the most intensively developed and most thoroughly cultivated agricultural landscapes of the county and reflect the lack of vegetated buffers.

Where these buffers coincide with large forested blocks, the riparian corridor is a priority for conservation. Where the creek edges lack vegetated buffers, these are riparian corridors that should be considered priorities for restoration.







Riparian buffers through large forest blocks, such as this section of the Octararo Creek (above), should be considered a priority for conservation

Riparian buffers through non-forested areas should be considered a priority for restoration (left). This all-to-common sight in Lancaster County results in significant degradation of the water quality of the County, the Susquehanna River and the Chesapeake Bay. Restoration of vegetated/forested stream buffers along all streams in the county will greatly help improve water quality throughout the region.

As outlined above, Lancaster County is highly diverse in terms of the habitats available to plants and animals. In most portions of the county, habitats are fragmented and the ecosystems necessary for the survival of many species have become small, occupied blocks within a matrix of inhospitable habitat. Development of land, splitting of habitats by un-crossable barriers such as major highways, drainage of wetland areas and environmental degradation have all served to confine many animal species to localized populations that become limited in their ability to survive any major change in food resources, availability of nesting habitat or increased predation. These populations may be doomed to what is termed as "localized extinction." If enough of these populations disappear from the landscape, these species' existence in Pennsylvania may be in jeopardy. Conservation of critical habitats and responsible land use and development will ensure that this list will not be shortened and may grow in the future.

To conserve the native biological diversity of Lancaster County we recommend the use of a two-tiered approach to selecting areas for their contribution to the entire ecological environment. The "fine-filter/coarse-filter" approach focuses attention on both the immediate habitat of the at-risk species, as well as the larger landscape scale processes that help to keep common species common.

- The fine-filter approach targets protection for uncommon species that generally occur in specialized and discrete habitats. Focusing conservation efforts on these smaller habitats will help defend these species from local or global extinction. This fine-filter approach has been the focus of past field surveys – to find the locations of these unique species and their habitats, and to draw attention to the potential for their inadvertent destruction. These at-risk species and their habitats are described in the Natural Heritage Areas (NHAs).
- The coarse-filter approach suggests that whole suites of species as well as general ecological and environmental processes can be offered protection by focusing conservation efforts on large expanses of quality habitats of all types. We address the coarse filter approach by highlighting the largest unfragmented forest/natural habitats and creek, stream and river riparian corridors. The highest priority landscape scale habitats in the county are referred to as Hubs and their potential connecting corridors as Greenways. See descriptions of the Hubs and Greenways in the Executive Summary.

Besides these highest priority landscapes, all of the habitats of the county will benefit from conservation of large forested blocks and forested riparian corridors. Through a combined effort of these two approaches, we can help to assure that uncommon species avoid local or global extinction and that common species stay common in Lancaster County.

Sixty-seven Natural Heritage Areas were identified in the Lancaster County Natural Heritage Inventory (see the fold-out Site Index). Table 1 prioritizes sites with species of concern and exemplary natural communities documented in Lancaster County. This table ranks sites from the most important and threatened to the least, with "Exceptional" representing the highest priority sites and "Local" representing the lowest priority Natural Heritage Areas for the conservation of biodiversity in the county. All of the species of concern core habitats are highly important for the species of concern they harbor, but ranking them based on number of species of concern and the degree of rareness helps to illustrate the relative importance of each area in relation to one another. The State Line Serpentine Barrens and the Conowingo Islands are the most significant areas for species of concern in the county. This is due to the high numbers of species of concern documented at these locations as well as the relative degree of state and global rarity of each species.

Detailed maps and descriptions of each Natural Heritage Area follows, organized alphabetically by Natural Heritage Area name. For each site, a map, summary table, and full report are provided. The Natural Heritage Area description sections include:

- A designation of a Natural Heritage Area's relative significance is listed after the site name. Table 1 (has a summary of sites by significance category.
- Listed under each site name are any state-significant natural communities and species of concern that have been documented within the area.
- Some species perceived to be highly vulnerable to intentional disturbance are referred to as "Sensitive species of concern" rather than by their species name, and no ranks are revealed at the request of

the jurisdictional agency overseeing its protection.

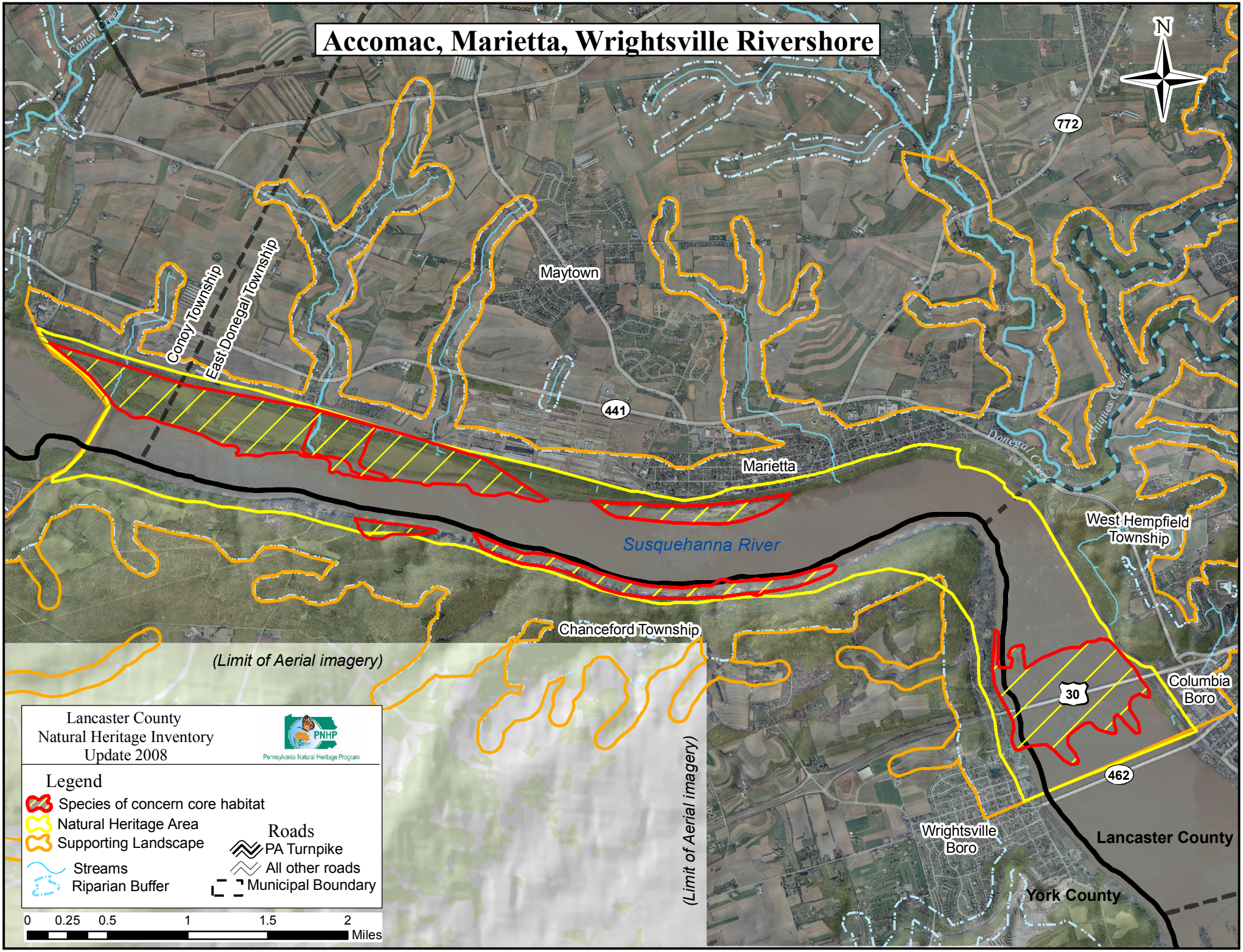
- The PNHP rarity ranks and current legal status (detailed in Appendix I) are listed for each community and species.
- The text that follows each table discusses the natural qualities of the site and includes descriptions, potential threats, and recommendations for protection.

Each of the primary Natural Heritage Areas identified in this report has associated with it areas mapped as Core Habitat and Supporting Natural Landscape. **Core Habitat** areas are intended to identify the essential habitat of the species of concern or exceptional natural community that can absorb very little activity or disturbance without substantial impact to the natural features. The **Supporting Landscape** identifies areas surrounding or adjacent to Core Habitat that are not considered the primary habitat of the species of concern or natural community, but may serve as secondary habitat. These areas provide support by maintaining vital ecological processes as well as isolation from potential environmental degradation. Supporting Natural Landscape areas may be able to accommodate some types of activities without detriment to natural resources of concern. Each should be considered on a site-by-site and species-by-species basis.

NATURAL HERITAGE AREAS OF LANCASTER COUNTY



Kelly's Run Photo source: PNHP


Accomac, Marietta, Wrightsville Rivershore
N
Conoy Creek
Conoy Township
East Donegal Township
Maytown
772
441
Marietta
Donegal Creek
Chiques Creek
West Hempfield Township
Susquehanna River
Chanceford Township
(Limit of Aerial imagery)
(Limit of Aerial imagery)
30
462
Columbia Boro
Wrightsville Boro
Lancaster County
York County
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
0 0.25 0.5 1 1.5 2
Miles

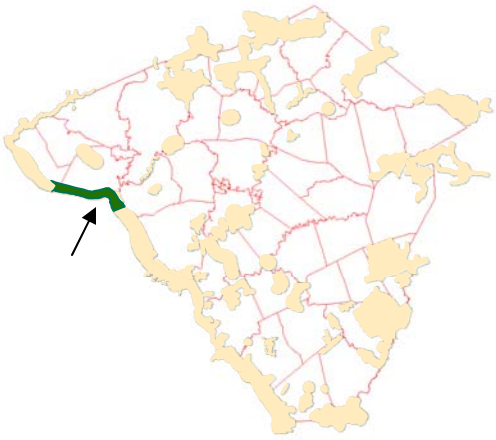
Accomac, Marietta, Wrightsville Rivershore – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Scarlet ammannia (*Ammannia coccinea*)	G5	S2	PE	2006-10-03	C
Waterpod (*Ellisia nyctelea*)	G5	S2	PT	1991-05-14	C
Carolina leaf-flower (*Phyllanthus caroliniensis*)	G5	S1	PE	2006-10-03	BC
Tooth-cup (*Rotala ramosior*)	G5	S3	PR	2006-10-03	C
River bulrush (*Schoenoplectus fluviatilis*)	G5	S3	PR	2006-10-03	C
Sida (*Sida hermaphrodita*)	G3	S2	PE	2006-10-03	CD
Susquehanna trillium *(Trillium sp.)*	GU	SU	TU	1996-05-01	C
Animals:					
Bronze copper butterfly (*Lycaena hyllus*)	G5	SU	-	1996-08-31	E
Sensitive species of concern[3]	-	-	-	1994	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This section of the Susquehanna River is roughly seven miles long, running from the railroad bridge just north of the Conoy / East Donegal Township line to the Columbia / Wrightsville Bridge, and includes riverside portions of the Borough of Marietta.

- Municipalities:
  - Conoy Township, (Lancaster County)
  - East Donegal Township, (Lancaster County)
  - Marietta Borough, (Lancaster County)
  - West Hempfield Township, (Lancaster County)
  - Hellam Township, (York County)
  - Wrightsville Borough, (York County)
- USGS Quadrangles:
  - Columbia West Quadrangle
  - York Haven Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Vinegar Ferry" – (Columbia West Quadrangle)



Description: The low, flood prone shoreline primarily on the Lancaster side of the Susquehanna River provides the appropriate habitat for most of the species of concern documented at this location. Flooding and river ice scour the shoreline, removing and replacing soil seasonally, which helps to create conditions favorable to annual plants that can go from seed to maturity in one growing season. The seasonally flooded areas and shallow mudflats between the railroad tracks and the river are of particular interest for plant species that thrive in the habitat created by this natural disturbance. Mudflats and shallow water habitats occur among the bedrock outcrops on either side of the Route 30 Bridge west of Columbia Borough; directly in front of the Borough of Marietta; on the west shore of the river and adjacent to Riverfront Park at Vinegar Ferry Road. The shallow mudflats exposed during periods of low river level provide habitat for wading birds who feed on

aquatic plants and animals. This habitat also provides an important migratory stopping place for these and other birds that use the Susquehanna River as a migratory pathway.

Species of Concern Considerations:

Plants:

- Four plant species of concern documented at this location are annual plants: the globally secure (G5), state imperiled (S2) scarlet ammania; the globally secure (G5), state imperiled (S2) waterpod; the globally secure (G5), state critically imperiled (S1) Carolina leaf-flower; and the globally secure (G5), state rare (S3) tooth-cup. They reach maturity from seed in a single season. They are adapted to the seasonal flooding disturbance and shallow water conditions inherent along the floodplain of the Susquehanna River and do well in habitats favoring 'weedy' species of plants. Populations of these species can be enhanced by maintaining the natural seasonal fluctuations in the water level of the river and the natural conditions of its shoreline.
- River bulrush is a globally secure (G5), state rare (S3) perennial plant that is also adapted to the natural disturbance of seasonal flooding along the river. It is an emergent aquatic plant that can form dense stands from spreading roots. Populations of this plant can be enhanced by maintaining the natural seasonal fluctuations in the water level of the river and the natural conditions of its shoreline.
- Sida is considered globally rare (G3) and state imperiled (S2) due to the few localized populations that occur around the world. Sida is a tall, robust, perennial plant that is also adapted to the natural disturbance of seasonal flooding along the river. Populations of this plant can be enhanced by maintaining the natural seasonal fluctuations in the water level of the river and the natural conditions of its shoreline.
- Susquehanna trillium occurs in a forest ravine on the York County side of the Susquehanna River. The populations of declined trillium in the lower Susquehanna ravines are plants of uncertain taxonomy, which is to say, the populations of this trillium do not fall neatly into one species characterization. These populations may be hybrids between declined trillium and purple trillium (*Trillium flexipes* and *Trillium erectum*) and may be unique to the lower Susquehanna River. With the taxonomic uncertainty in mind, the Susquehanna trillium has not been given global and state status ranks. This taxonomic puzzle needs to be investigated further, but either way, the populations of these trilliums are worthy of conservation action. Conservation of the rich forested habitat should provide the protection needed for this species. Unauthorized collection for wildflower gardens is also a potential threat.

Animals:

- The principal habitat of the globally secure (G5), state undetermined (SU) bronze copper butterfly is found in wet meadows and marshes especially along river floodplains. The primary food source of the caterpillars of this species are plants in the buckwheat family (Polygonaceae) such as peach-leaved dock (*Rumex altissimus*). Conservation and expansion of this type of habitat in the area will help ensure continued breeding success for this species. Mowing of the area should be nonexistent, or selective and infrequent to help promote growth of host plants supporting this butterfly species of concern.
- The core habitat for this sensitive species of concern is primarily in the adjacent Brunner (Lows) Island Natural Heritage Area to the north. This sensitive species of concern requires abundant food source and breeding areas. This can be achieved by preserving and improving the water quality of the Susquehanna River and by protecting and expanding the natural vegetation buffer along the river.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- Most of the York County side of the river and adjacent hills is in nearly continuous forest cover dominated by a dry oak - heath forest and includes significant patches of interior forest. The narrow western shoreline floodplain has been largely converted to residential uses.
- The Lancaster County side of the river is dominated by agriculture, urban and suburban land uses with only a few small parcels of forest cover remaining. The floodplain between the railroad tracks and the

river adjacent to Riverfront Park is seasonally flooded and contains remnants of a silver maple floodplain forest and wet meadows interspersed with active agricultural fields and parkland.

Ownership:

- Much of the species of concern core habitat occurs in floodplain habitat that is subject to such intense flooding as to be considered part of the river. Floodplain areas between the river and the railroad tracks in this section are mostly owned by the respective municipalities.
- A portion of the widest section of floodplain contains a small public park (Riverfront Park).
- An industrial complex occupies a large parcel north of the Borough of Marietta.
- The remaining river floodplain is held in several agricultural parcels and numerous urban residential parcels.

Habitat Disturbances:

- Historic –
  - The original forest cover of the area had been removed and converted to agricultural uses over the past several centuries, leaving little of the original vegetation in place. The borough of Marietta was constructed on the banks of the river including a portion of the floodplain.
  - Railroad tracks were built along the shoreline of the river, effectively severing the river from much of the original floodplain and the adjacent uplands.
  - Aerial photographs from 1940 indicate that a railroad siding/transfer hub appears to have been constructed north of Marietta, which is currently a large industrial complex.
- Current –
  - Most of the eastern shore of this section of the river fails to function as a terrestrial habitat corridor through the region. A much wider and enhanced vegetated buffer is needed on the floodplain on the eastern shore of the Susquehanna River. The vegetated area between the railroad tracks and the river is in many areas too narrow to adequately function as a terrestrial habitat corridor. Animals traveling northward though the extensive forested river hills area are suddenly forced into a very narrow strip of land between the river and the railroad tracks to avoid the heavily urban, suburban and agricultural land uses north of Washington Borough, Columbia and Marietta.
  - The borough of Marietta has not grown significantly since 1940, although suburban growth has effectively filled the open space between Marietta and Maytown. Stormwater runoff from Marietta and the surrounding communities flows into the river system with little opportunity to be filtered, a potentially significant non-point source of pollution. Treated wastewater from Marietta is also returned to the river system.
  - The railroad hub north of Marietta has grown into a large industrial complex. Runoff from past and present activities at this complex could be a significant source of thermal and chemical pollution directly entering the Susquehanna River. A past survey of the river shoreline near Marietta indicated that aluminum shavings were washing from a nearby factory into the river.
  - A significant section of mature floodplain forest south of Vinegar Ferry Road has been cleared. This was an unfortunate elimination of a good example of this habitat type for this area.
  - Many cottages and residences have been built along the western shore of the river in York County, disturbing, altering and removing the natural river shore floodplain habitat. Several new access roads, utility rights-of-way and residences have been built on the hills overlooking the river, fragmenting this otherwise intact forest. Portions of the forest that had been in active agriculture in 1940 photographs have since returned to forest cover.
  - Wave action from motorboats can also have an impact on the shallow water habitats in the area. Increased wave action can dislodge small plants from mudflats. Boaters should also avoid harassing nesting and feeding birds.
  - Garden debris and other refuse dumped into the river floodplain can be a significant source of invasive plant species and general habitat degradation.
- Exotic Species –

- The natural disturbance of seasonal flooding and ice scour create ideal conditions for many introduced species of plants. Consequently, the river shoreline is prone to invasion from a large number of invasive species. Past site surveys were unlikely to document newly introduced highly aggressive species such as mile-a-minute (*Polygonum perfoliatum*) and Japanese stiltgrass *(Microstegium vimineum*) which are likely to occur in these habitats. Invasive species that were recorded during past surveys include:
  - Japanese honeysuckle (*Lonicera japonica*)
  - Garlic mustard *(Alliaria petiolata)*
  - Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
  - Multiflora rose (*Rosa multiflora*)
  - Asiatic bittersweet (*Celastrus orbiculatus*)
  - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
  - Japanese knotweed (*Polygonum cuspidatum*)
  - Purple loosestrife (*Lythrum salicaria*)
  - Tree-of-heaven (*Ailanthus altissima*)

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and York Counties.
- Protect and expand the natural vegetation along the eastern shore of the river floodplain and adjacent upland. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along the eastern shore of the river.
- Avoid building, replacing or expanding dams on the Susquehanna River.
- Riparian corridors of all stream tributaries to this section of the Susquehanna River and the river shoreline itself on the Lancaster County side need additional restoration measures. Many stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from agricultural runoff.
- High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat in this section of the river. Establish at least 100 m (328 ft) buffer of woody vegetation along the river shore and all segments of tributary streams to help protect the water quality of the river by reducing erosion, sedimentation, and pollution. Best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river.

Within the Core Habitat:

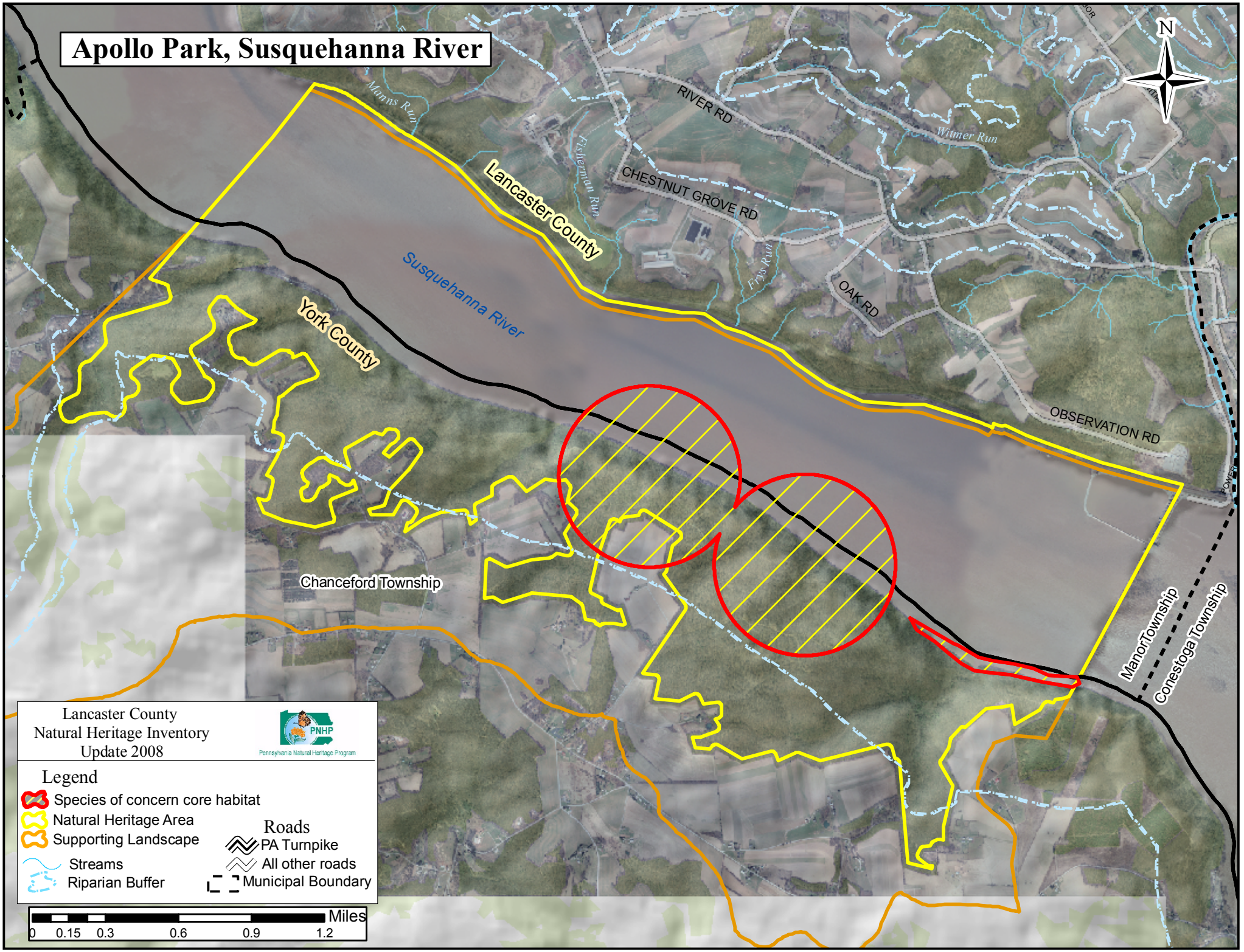
- Most of the species of concern core habitat occurs within the riverbed or its adjacent floodplain. Maintain the natural hydrology of the river system by avoiding building dams. Maintain and improve water quality of the river by providing vegetated buffers along inflows to the river. Detention basins and rain gardens can be incorporated into borough infrastructure to allow stormwater to be filtered before entering the river.
- The floodplain adjacent to Riverfront Park should be considered a priority for restoration to wet meadow and floodplain forest natural communities, perhaps as an expansion of Riverfront Park. Emphasis should be on promoting a viable floodplain natural community rather than expansion of active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding wet meadow areas with native vegetation and restoration and protection of the natural condition of the shoreline.
- The rainwater runoff from the agricultural fields and pastures should be considered a potential source of significant contamination for the river. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention

basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.

Within the Supporting Landscape: The supporting landscape was drawn around the subwatersheds leading to this stretch of the Susquehanna River. Activities and land use patterns in the subwatersheds can have a significant impact on the water quality of the river and the habitats of the species of concern.

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- In addition, the intensively cultivated landscape offers little natural habitat for native species of plants and animals. Portions of the area, particularly the unnamed tributaries to the Susquehanna River culminating at Rowenna, Marietta and through the industrial complex should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
- Preserve and improve the integrity of the large unfragmented forest blocks on the western shore of the Susquehanna River. These large forested areas provide a significant filter for runoff entering the river from these slopes. The steep, rocky nature of the wooded slopes likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites. Avoid activities that would fragment this habitat or create more edge areas, such as road building, which encourages the introduction of invasive plants or edge-adapted species.
- The immediate watershed draining into the river includes some forested areas and agricultural fields. Logging of wooded areas, specifically along steep slopes and riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers and other sources can accumulate in the river leading to algal blooms and the consequent death of aquatic organisms. The amount of impervious surfaces around the river can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the river.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along the eastern shore of the river. Expand the native vegetation along the river corridor to include land within 300 meters of the river's banks. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- The habitat of the western shoreline floodplain would be improved by the removal of the residences lining the floodplain of the river.
- Pursue conservation easements and fee simple acquisition on properties along the river shoreline, the adjacent slopes and forested plateaus to help conserve the effectiveness of the Susquehanna River natural corridor.
- Educate homeowners about the effects of the overuse of fertilizers, pesticides, and herbicides on groundwater. Promote groundwater quality awareness when conducting education and outreach programs, and provide educational information about potential threats to water supply.
- Potential zoning options for conservation enhancement:
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% would help prevent the forested slopes from being converted to other uses.
    - Conoy, East Donegal and West Hempfield Townships all have a zoning ordinance in their Comprehensive Plans restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
        - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.

        - West Hempfield Township's floodplain ordinance requires a minimum 15 foot filter strip planted in grass between any watercourse and any tilled land. The ordinance should be updated to allow native trees and shrubs to be planted in the filter strip. Mowing along filter strips should be discouraged.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Parcels currently forested should be zoned to conserve this attribute.
    - Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest cover / natural wetland communities.
    - Growth within the Township should be discouraged to occur within 300 meters of the 100-year floodplain of the Susquehanna River or within 100 meters from the floodplain of its tributaries.
    - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction.
- Potential restoration activities:
    - Streams through forested areas should be considered high priority for conservation in the habitat. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be restored with native trees and shrubs appropriate to the habitat.
        - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - Riparian Buffers:
            - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
            - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
            - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.
    - Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management. Aggressive invasive species along the floodplain can have a significant impact on the available habitat for the species of concern, particularly sida and river bulrush, which can occupy much the same habitat as purple loosestrife and Japanese knotweed. Control of invasive species along the river floodplain will require extensive and continual effort. Focus non-chemical control efforts on selected areas surrounding species of concern.
        - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
        - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
        - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
        - Continual invasive species monitoring and control will be necessary.
    - Litter removal along the shores of the river will need to be conducted on a periodic and continual basis due to the seasonal flooding regimen of the river.


Apollo Park, Susquehanna River
N
RIVER RD
CHESTNUT GROVE RD
OAK RD
OBSERVATION RD
Manns Run
Fisherman Run
Witmer Run
Frys Run
Lancaster County
York County
Susquehanna River
Chanceford Township
ManorTownship
Conestoga Township
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PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.15 0.3 0.6 0.9 1.2

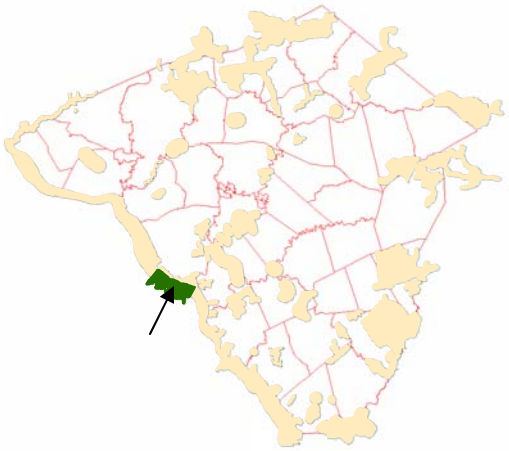
Apollo Park, Susquehanna River – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
River bulrush (*Schoenoplectus fluviatilis*)	G5	S3	PR	1995-07-19	BC
Animals:					
Sensitive species of concern[3]	-	-	-	2006	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: Though primarily in York County, the area selected for this description includes the section of the Susquehanna River between Turkey Hill to the north and Safe Harbor Dam to the south.

- Municipalities:
  - Manor Township, (Lancaster County)
  - Chanceford Township, (York County)
- USGS Quadrangle:
  - Safe Harbor Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - None



Description: The western shore of this section of the Susquehanna River has excellent forest cover likely due to its topographic unsuitability for agriculture. The forested hills and steep rocky slopes leading to the western shore of the Susquehanna River include Apollo County Park in York County. This section of the river has been dammed by the Safe Harbor Dam, and the resulting slow body of water is referred to as Lake Clark. The slow, open water is popular for recreational boating activities.

Species of concern considerations:

Plants:

- River bulrush is a globally secure (G5), state imperiled (S2) perennial plant that is also adapted to the natural disturbance of seasonal flooding along the river. It is an emergent aquatic plant that can form dense stands from spreading roots. Populations of this plant can be enhanced by maintaining the natural seasonal fluctuations in the water level of the river and the natural conditions of its shoreline.

Animals:

- The core habitat for this sensitive species of concern is both the river and the adjacent upland forest. This sensitive species of concern requires an abundant food source in the river and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Susquehanna River and by protecting and expanding the natural vegetation buffer along the river.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective

ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- This Natural Heritage Area is drawn around the large unfragmented forested blocks among the hills on the York County side of the river. Consequently, almost the entire terrestrial portion of the Natural Heritage Area is in continuous forest cover. The western shoreline of the river remains intact, with little disturbance from roads, utility corridors or residences. The majority of the upland hills are dominated by dry oak-heath forest, while the narrow, shaded ravines and northeast-facing steep slopes are dominated by hemlock (white pine)-red oak mixed hardwood forest.
  - Red oak-mixed hardwood forest
  - Dry oak-heath forest
  - Hemlock (white pine)-red oak mixed hardwood forest

Ownership: The terrestrial portions of this Natural Heritage Area are in York County, where tax parcel information was not obtained as part of this project.

Habitat Disturbances:

- Historic –
  - Safe Harbor Dam was built across the Susquehanna River in the 1930s for electric power generation forming what is referred to as Lake Clark. This large, nearly still portion of the river significantly differs from the original hydrology of the river that was much more influenced by the natural disturbances of seasonal flooding and ice scour. A number of islands and bedrock outcrops were permanently flooded as water backed up behind the dam. The original shoreline of the river was also permanently flooded. This modification of the river environment likely permanently flooded seasonally shallow water habitats that would likely have supported plants and animals in similar habitats including many species of concern. Much of the silt and other particulates transported by erosion in the Susquehanna River watershed settle to the riverbed as the swifter river water enters the slow waters of Lake Clark. This deposition of material will eventually fill all the space behind the dam.
- Current –
  - The western Susquehanna River shoreline and adjacent uplands is remarkably intact and unfragmented by roads, residences and utility rights-of-way.
  - Safe Harbor Dam continues to modify the natural hydrology of the river and reduce the influence of natural flooding on the environment.
  - Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species – Unknown.

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and York Counties.
- Protect the natural vegetation along the shore of the river floodplain and the integrity of the large interior forest within the adjacent uplands by avoiding additional fragmenting features such as roads, residences and utility rights-of-ways.
- Avoid building, replacing or expanding dams on the Susquehanna River.

Within the Core Habitat:

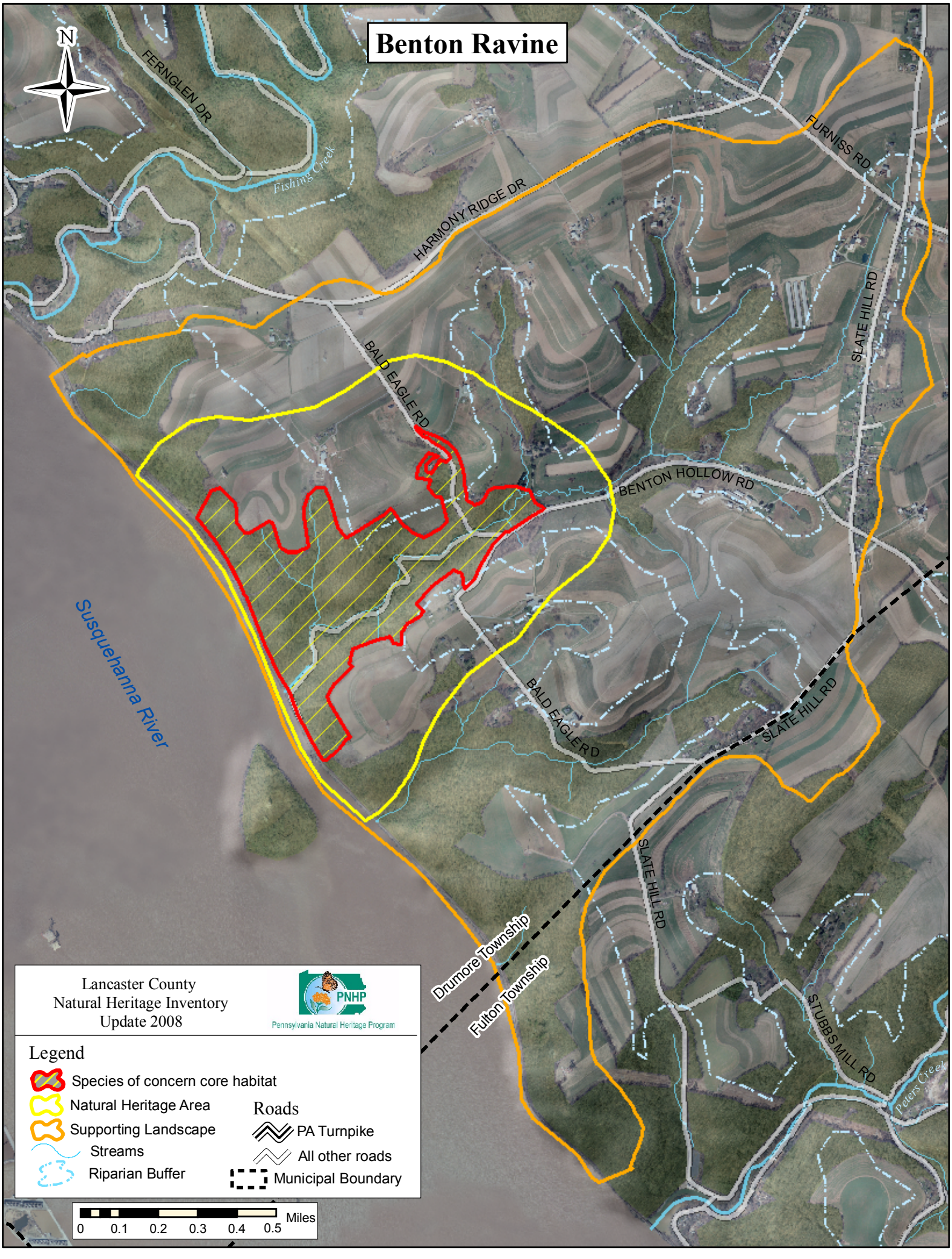
- The sensitive species of concern at this location use the waters of the river for feeding and the forested uplands for breeding habitat, so both must be considered.
- Preserve and improve the water quality of the Susquehanna River to help provide a continued and increased food chain. All tributaries within the adjacent watersheds to this stretch of the river can help improve water quality by decreasing unfiltered runoff from non-point sources of pollution. Restore vegetated riparian buffers along all tributaries to the river.
- Maintain the unmodified western shoreline of the river. Avoid building roads, docks, residences and utility rights-of-way along the shoreline. Cluster these amenities in existing locations to avoid unnecessary habitat disturbance.
- Maintain and improve interior forest conditions within the uplands adjacent to the river. Avoid building roads, residences and utility rights-of-way though unfragmented patches of forest. Cluster these amenities in existing locations to avoid unnecessary habitat disturbance.
- Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management. Aggressive invasive species along the floodplain can have a significant impact on the available habitat for the species of concern, particularly sida and river bulrush, which can occupy much the same habitat as purple loosestrife and Japanese knotweed. Control of invasive species along the river floodplain will require extensive and continual effort. Focus non-chemical control efforts on selected areas surrounding species of concern.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
    - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.

<u>Within the Supporting Landscape:</u> The supporting landscape was drawn around the subwatersheds leading to this stretch of the Susquehanna River. Activities and land use patters in the subwatersheds can have a significant impact on the water quality of the river and the habitats of the species of concern.

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- Activities within the supporting landscape should focus primarily on reducing non-point sources of pollution from entering the river environment. Much of the supporting landscape is in active agricultural production. While the river-facing slopes are well forested, the hill-top plateaus are in active agricultural production. Most of the streams in the immediate subwatersheds appear to have adequate forested/vegetated riparian buffers, which should be conserved. The rainwater runoff from the agricultural fields and pastures should be considered a potential source of significant contamination for the river. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat.
- Preserve and improve the integrity of the large unfragmented forest blocks on the western shore of the Susquehanna River. These large forested areas provide a significant filter for runoff entering the river from these slopes. The steep, rocky nature of the wooded slopes likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites. Avoid any additional fragmenting features such as roads,

utility corridors or suburban development within these large forest blocks. Avoid development of the hill-top plateaus adjacent to the river-facing slopes.

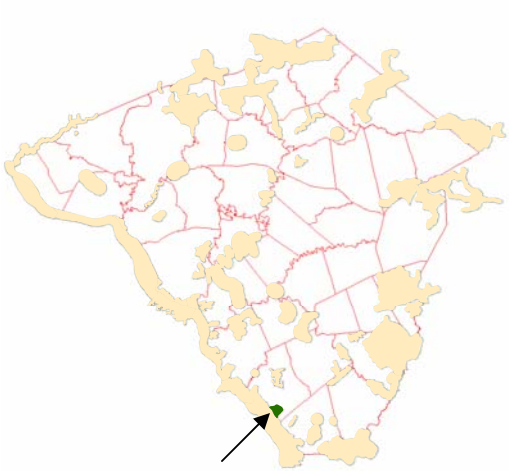
- Agricultural fields on high quality soils should be maintained as such and considered fully built out. Poorer quality agricultural soils and those within the 100 year floodplain should be encouraged to regenerate into natural vegetation/forest cover appropriate to the topography and hydrology of the area.
- Growth within the Township should be discouraged to occur within 300 meters of the 100-year floodplain of the river or within 100 meters of the floodplain of its tributaries.


Benton Ravine
N
FERNGLEN DR
Fishing Creek
HARMONY RIDGE DR
FURNISS RD
SLATE HILL RD
BALD EAGLE RD
BENTON HOLLOW RD
Susquehanna River
BALD EAGLE RD
SLATE HILL RD
SLATE HILL RD
Drumore Township
Fulton Township
STUBBS MILL RD
Peters Creek
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
0 0.1 0.2 0.3 0.4 0.5
Miles

Benton Ravine, Ferncliff – *High significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot *(Aplectrum hyemale)*	G5	S3	PR	1987-10-29	D
Susquehanna trillium (*Trillium sp.*)	G?	S?	TU	2006	E
Exceptional Natural Communities:					
Hemlock-tuliptree-birch forest	GNR	S2	N/A	1987-10-29	C

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location: This Natural Heritage Area includes a forested ravine along the Susquehanna River in southern Drumore Township.

- Municipalities:
  - Drumore Township
- USGS Quadrangles:
  - Holtwood Quadrangle
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Benton Ravine" (Holtwood Quadrangle)
  - "Benton Ravine" (Wakefield Quadrangle)

Description**:** Benton Ravine, also known as Ferncliff Wildflower & Wildlife Preserve, is a forested, steep-sided narrow valley with a cascading stream, large rock exposures, and a rich spring wildflower display. The area has been designated a National Natural Landmark. The deeper portion of the ravine is dominated by a hemlock-tuliptree-birch forest of high enough quality for its type to be considered an exceptional natural community. An unpaved road follows the creek through the ravine to the Susquehanna River. The landscape drops off abruptly towards the Susquehanna River, forming a ridgeline of steep bluffs overlooking the river. At the mouth of the creek there are several small dwellings and a makeshift boat dock which provides access to the Susquehanna beneath an active railroad that parallels the river shoreline.

Species of Concern Considerations:

Plants:

- Puttyroot occurs sparingly in this ravine. Last documented at this location in 1987, this population of puttyroot should be the object of future ground surveys. This is a plant of moist, rich, mature woodlands. Conservation of this habitat and its quality will help this plant population persist at this location.
- The populations of Susquehanna trillium in the lower Susquehanna ravines are plants of uncertain taxonomy, which is to say, the populations of this trillium do not fall neatly into one species characterization. These populations may be hybrids between declined trillium and purple trillium (*Trillium flexipes* and *Trillium erectum*). This taxonomic puzzle needs to be investigated further, but either way, the populations of these trilliums are worthy of conservation action. Conservation of the rich forested habitat should provide the protection needed for this species. Unauthorized collection for wildflower gardens is also a potential threat.

- Other plant species of concern have been reported from this area. Additional surveys are recommended.

Exceptional Natural Communities:

- The hemlock-tuliptree-birch forest at this location is considered a good quality example of this forest community type. The hemlock component of this forest is likely subject to stress by the hemlock woolly adelgid, an introduced pest of hemlocks that has the potential to devastate the hemlocks in the area. As biological control measures for this insect pest are developed, they should be deployed in this area to allow the hemlock to reestablish. The forest should be allowed to approach old growth characteristics. The adjacent forest acts as a very important buffer for this forest community.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- All of the species of concern core habitat is forested, while approximately 50% of the Natural Heritage Area and roughly 35% of the supporting landscape have forest cover. The forest has been fragmented by a small unpaved road through the ravine, but still contains a small patch of interior forest. Part of the species of concern core habitat is drawn around a good quality example of a hemlock-tuliptree-birch forest, which is of high enough quality for its type to be considered an exceptional natural community.
    - Hemlock-tuliptree-birch forest
    - Tuliptree-beech-maple forest
    - Dry oak-heath forest
    - Pitch pine-heath woodland
    - modified successional forest*

Ownership**:** The Natural Heritage Area for this area contains 490 acres of mixed forest and adjacent agricultural fields.

- Approximately 15% of the Natural Heritage Area, 73 acres, and most of the species of concern core habitat is owned by the Lancaster County Conservancy and maintained as a nature preserve.
- Smaller portions of the Natural Heritage Area and supporting landscape are owned by Exelon Corporation and PPL Corporation, primarily as transmission corridors though the area.
- Norfolk Southern Railroad maintains an active rail line along the banks of the Susquehanna River.
- Agricultural easements are currently maintained on 198 acres, or 28% of the Natural Heritage Area area.
- There are several primary landowners of the remaining area of the Natural Heritage Area and supporting landscape.

Habitat Disturbances:

- Historic –
    - There has been very little change in the landscape within the Natural Heritage Area in the past 65 years according to aerial photography from 1940. Forest and agricultural fields were in virtually the same places in 1940 as they are today.
    - Two power transmission corridors have been run through the northern and southern ends of the Natural Heritage Area since 1940.
    - A small unpaved road has followed the creek through Benton Ravine to provide access to the Susquehanna River and several dwellings along the shoreline.
- Current –
    - There has been a slight increase in residential development along Slate Hill Road, but its impact on Benton Ravine should be minimal as the long as the residents bear in mind the consequences of their daily activities on downstream ecosystems.

- The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may regard the railroad as an insurmountable obstacle.
- Active agriculture dominates much of the Natural Heritage Area and supporting landscape. In most cases, the adjacent streams are well buffered with forested riparian zones, though in sections, forested buffers are lacking. Some sections appear to lack livestock fencing, allowing livestock direct access to the streams and creeks. Without fenced and heavily vegetated buffers, streams can fill with sediment, herbicides, pesticides, fertilizers and other non-point sources of agricultural pollution ultimately impacting the Susquehanna River and the Chesapeake Bay.
- Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.

o Exotic Species –

- Few invasive plant species were listed in field forms from past surveys for this area. This would indicate that this area is relatively weed free, so priority habitat management at this location should be to regularly monitor for and eradicate pioneer populations of invasive species to keep this habitat in good condition. English Ivy is relatively easy to remove by hand, but should be hauled off site or burned. This persistent vine will require repeated removal efforts. Invasive species may dominate the borders of the railroad rights-of-way along the river shoreline as well as the transition zones between forested and agricultural habitats. Control options for invasive plants range from mechanical to chemical. Invasive species documented in past surveys include:
  - Multiflora rose (*Rosa multiflora*)
  - Japanese honeysuckle (*Lonicera japonica*)
  - Garlic mustard *(Alliaria petiolata)*
  - English ivy (*Hedera helix*)
  - Orange day-lily (*Hemerocallis fulva*)

Conservation Actions:

Overall:

- Safeguard the expanse and quality of the native forest canopy within the species of concern core habitat. While providing the primary habitat for the population of puttyroot, the forested landscape also helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge for a multitude of other forest dependent species. Most of the critical species of concern core habitat is owned by the Lancaster County Conservancy and likely will not be vulnerable to land use changes or logging activities.
- Prevent the conversion of the surrounding agricultural lands to residential or industrial development.
- Establish wide, forested buffers along streams and creeks where they are lacking and preserve and enhance them where they are present.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat.
  - Most of the core habitat is owned by the Lancaster County Conservancy, whose mission statement provides for the continued protection of lands under its ownership.

- Approximately 20% of the forested core habitat, including a portion of the bluffs adjacent to the Susquehanna River, is privately owned by a single landowner and should be considered a priority for conservation easement or acquisition. The steep, rocky nature of the immediate habitat of the species of concern likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites.
- Avoid logging within the core habitat. The forest itself is considered an exceptional natural community and should be allowed to achieve and maintain old growth conditions.
- Maintain existing invasive-free conditions within the Natural Heritage Area by regular monitoring for and eradication of pioneer populations of weedy shrubs, trees, vines and herbs.

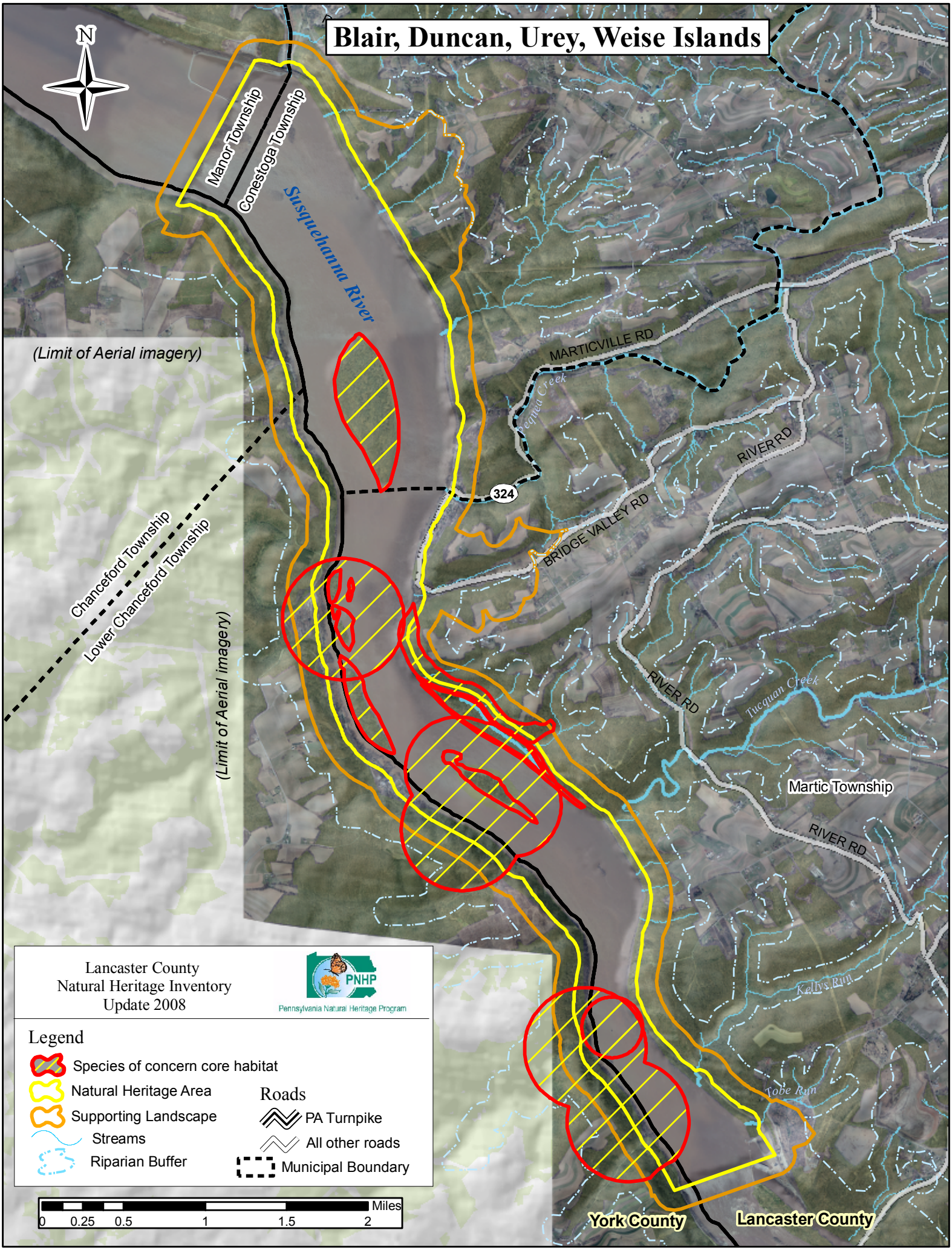
Within the Natural Heritage Area / Supporting Landscape:

- The Natural Heritage Area for this location was drawn to exclude the most unnatural portions of the adjacent habitat, which are primarily active agricultural fields and residential areas. The supporting landscape for this Natural Heritage Area is derived from the sub-watershed feeding the creek flowing through Benton Ravine. Activities within the watershed can have a direct impact on the core habitats of the Natural Heritage Area and the species of concern it contains.
  - Conservation easements or transfer of development rights should be sought for forested and agricultural properties adjacent to the Natural Heritage Area to provide a buffer to this habitat and to help provide connectivity to other nearby Natural Heritage Areas. Additional populations of species of concern could occur on adjacent parcels.
  - The riparian corridor leading to Benton Ravine in the supporting landscape is conspicuously forested through most of its course in what appears to be the modified successional forest type. This forest type is typically the product of early successional processes and may be in the process of recovering from past logging, grazing or other agricultural activities. These disturbed habitats are typically highly susceptible to colonization by invasive species of plants and often become severely infested. Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose, Asiatic bittersweet and common privet.
  - Agricultural fields on poor quality soils adjacent to the core habitat should be encouraged to return to forest to expand the area of interior forest at this location and to provide an additional buffer for the core habitat. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs or varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Avoid logging in this area.
  - Allow the forest to return to old-growth conditions.
  - Leave fallen trees in place to help build soil nutrients, humus, tilth and plant and animal microhabitats.
    - Trees that have fallen over approved trails can be cut through as necessary.
  - Remove non-native trees and shrubs. The railroad rights-of-way and forest/agricultural transition zones are likely the primary location of non-native trees and shrubs within this area.
  - Encourage native tree and shrub recruitment.
    - Reduce the size of the deer herd. Uncommon species of plants are particularly susceptible to deer herbivory.
  - Block access to forested areas by off road vehicles, ATVs and other motorized vehicles.
  - Additional surveys for species of concern are recommended.
- Potential restoration activities:
  - Conservation, expansion and improvement of this forested riparian corridor should be considered a priority for activities within the supporting landscape for this area. The headwaters

of several small tributaries to Benton Ravine pass unbuffered though active pastures or cultivated fields. These areas should be fenced to exclude livestock and encouraged to be reforested. Forested zones along waterways help filter runoff from roads, residences and agricultural areas, removing many contaminants contained in the runoff before it enters larger streams and rivers. Forested creek edges also slow the speed and force of runoff, allowing the water to percolate into the groundwater.

- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
        - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
        - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain

- <u>Potential zoning options for conservation enhancement:</u>
    - Drumore Township has a zoning ordinance restricting construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses.
        - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats. Additionally, wetlands should be afforded the same protection as floodplains in zoning ordinances to help protect most of the species of concern core habitat at this location.
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 80% of the area within the core habitat, ~33% of the Natural Heritage Area and ~10% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this area.


Blair, Duncan, Urey, Weise Islands
N
Manor Township
Conestoga Township
Susquehanna River
(Limit of Aerial imagery)
MARTICVILLE RD
Pequea Creek
RIVER RD
324
BRIDGE VALLEY RD
Chanceford Township
Lower Chanceford Township
(Limit of Aerial imagery)
RIVER RD
Tucquan Creek
Martic Township
RIVER RD
Kelly's Run
Tobe Run
York County
Lancaster County
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.25 0.5 1 1.5 2

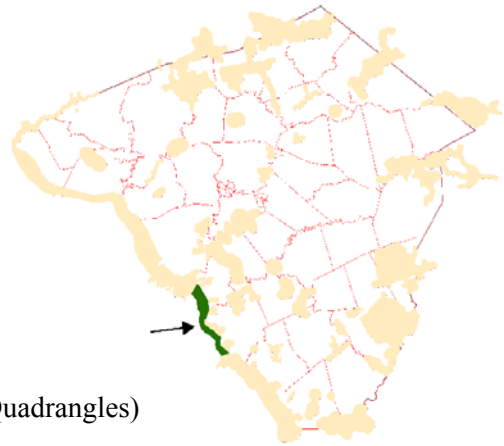
Blair, Duncan, Urey, Weise Islands – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Scarlet ammannia (*Ammannia coccinea*)	G5	S2	PE	1987-08-03	A
Upright primrose-willow (*Ludwigia decurrens*)	G5	S1	PE	1987-08-03	C
Tooth-cup (*Rotala ramosior*)	G5	S3	PR	1985-08-09	A
Sida (*Sida hermaphrodita*)	G3	S2	PE	1987-08-09	F
Animals:					
Osprey (*Pandion haliaetus*)	G5	S2B	PT	1998	E
Prothonotary Warbler (*Protonotaria citrea*)	G5	S2S3B	_	2005-06-21	E
Sensitive species of concern[3]	_	_	_	2005-06-21	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This includes the portion of the Susquehanna River between Safe Harbor Dam to the north and Holtwood Dam to the south, which includes a large impounded area of the river referred to as Lake Aldred.

- Municipalities:
  - Conestoga Township, (Lancaster County)
  - Manor Township, (Lancaster County)
  - Martic Township, (Lancaster County)
  - Chanceford Township, (York County)
  - Lower Chanceford Township, (York County)
- USGS Quadrangles:
  - Airville Quadrangle
  - Conestoga Quadrangle
  - Holtwood Quadrangle
  - Safe Harbor Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Urey Islands" - (Airville, Conestoga, Safe Harbor Quadrangles)



Description: This section of the Susquehanna River is between Holtwood Dam to the south and Safe Harbor Dam to the north. Holtwood Dam creates the flat water area known as Lake Aldred, which is used extensively for recreational boating and fishing. There are several large and small islands and bedrock outcrops within the river that provide the required habitat conditions for several species of concern. A broad area of bedrock outcrop is exposed during seasonal low water conditions just below the Safe Harbor Dam. The surrounding uplands on both sides of the river are primarily forested, though roads, railroads, utility rights-of-ways and small villages occur scattered along the banks of the river and the adjacent uplands.

Species of Concern Considerations:

Plants:

- Scarlet ammannia is a globally secure (G5) though state imperiled (S2) plant that inhabits various damp to wet habitats, especially on the shorelines of rivers, streams, and ponds, and may also be found in human-created disturbances that simulate natural habitats. Conservation of this habitat type will help this species persist at this location.
- Upright primrose-willow is a globally secure (G5), state critically imperiled (S1) plant that has only been documented in the state at this location. The viability of the single known occurrence can be enhanced by maintaining the natural seasonal fluctuations in the water levels and the natural condition of the shoreline and islands of the Susquehanna River.
- Tooth cup is a globally secure (G5), state rare (S3) annual plant that occupies exposed shorelines, stream margins, streambed outcrops, and other damp, open places. The populations of toothcup that occur along streams and rivers can be enhanced by maintaining the natural seasonal fluctuations in the water level of the stream and the natural conditions of its shoreline.
- Sida is considered globally rare (G3) and state imperiled (S2) due to the few localized populations that occur around the world. Sida is a tall, robust, perennial plant that is also adapted to the natural disturbance of seasonal flooding along the river. Last observed in 1987, this species was unable to be relocated during recent surveys. Additional surveys on the river shoreline and islands are recommended for this globally rare species.

Animals:

- Ospreys have been increasing in number along the Susquehanna River and its tributaries due to a reintroduction program in the 1980s. These birds adapt readily to human activity and often construct nests on man-made structures (Brauning 1992). Being primarily fish eaters, Ospreys utilize aquatic habitats for food gathering and upland habitats or prominent features as nesting areas. The forested edge of the river as well as the aquatic habitat of the river are both important components of this species habitat preferences.
- This population of Prothonotary Warblers overlaps with the Natural Heritage Area "Reed Run". This forested floodplain is intermediate habitat between the aquatic river habitat and the upland terrestrial habitat. Prothonotary Warblers were observed in late June 2005, hunting and continually returning to the same place, evidently feeding young. The typical nesting period for this bird species is between May 25th and July 20th, so this observation is considered a nesting location for this species. The forested floodplain and associated wetlands along the Susquehanna River is the primary habitat for this species at this location. Because this bird nests in tree cavities, dead trees along the river shore and adjacent wetlands should be left standing to provide nesting habitat.
- An additional sensitive species of concern was documented along this stretch of the river. The core habitat for this sensitive species of concern is both the river and the adjacent upland forest. This sensitive species of concern requires abundant food source in the river and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Susquehanna River and by protecting and expanding the natural vegetation buffer along the river.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- This Natural Heritage Area is drawn relatively tightly around the river and the immediately adjacent uplands. The natural community types present represent the floodplains and upland forests in immediate proximity to the river. The dominant natural community types are:
    - Terrestrial (upland) communities:
        - Hemlock-tuliptree-birch forest
        - Hemlock (white pine)-red oak-mixed hardwood forest
        - Dry oak-heath forest
        - Dry oak-heath woodland
        - Red oak-mixed hardwood forest

- Tuliptree-beech-maple forest
- Palustrine (wetland) communities:
  - River birch-sycamore floodplain scrub
  - Sycamore (river birch)-box elder floodplain forest
  - Silver maple floodplain forest
  - Water willow-smartweed riverbed community

Ownership:

- The PPL Corporation owns much of the shoreline and adjacent uplands along the river as well as most of the islands in the river.
- Norfolk Southern Railroad maintains an active rail line along the banks of the Susquehanna River.
- A portion of State Game Lands #181 is included in this Natural Heritage Area.
- The Lancaster County Conservancy owns portions of the adjacent Natural Heritage Areas - Reed Run and Tucquan Glen.

Habitat Disturbances:

- Historic –
  - Blair and Urey Islands show a much more open appearance in aerial photos from the 1940s, suggesting that they may have been grazed or heavily timbered. They have since reverted to forest cover.
  - Reed and Hartman Islands appear much reduced in size compared to 1940s photos, but this may be an artifact of seasonal water level fluctuation.
  - The natural disturbance of the seasonally fluctuating water level helps to provide the ideal bare-soil habitat for the plant species of concern documented at this location.
  - Holtwood Dam was built in the early 1930s to create electric power. As the water backed up to create Lake Aldred, shallow water habitats and many smaller islands were permanently flooded. The construction of many smaller dams on the Susquehanna River and its tributaries in the early 1800s severely reduced the American shad and other anadromous fish (which live in the ocean, but spawn in freshwater) from much of their traditional spawning streams. Catadromous fish such as American eel, which live in fresh water habitats but spawn in the ocean, were also severely affected by dams large and small in the Susquehanna River watershed. Many dams were breached in the late 1800s and the fish migration temporarily resumed. The construction of the series of four large hydroelectric dams on the Susquehanna River between 1904 and 1932 eliminated the anadromous and catadromous fish from the upper reaches of the Susquehanna almost to the close of the century. Fish trap and transport programs implemented during the 1970s moved fish upriver by trucks in an effort to bolster shad populations. Improved fish ladders were constructed on the Holtwood and Safe Harbor dams in the 1990s to reopen the upper Susquehanna River for shad spawning. Effective downstream fish passages for eels have not been developed and eels remain eliminated from their historic range in the Susquehanna watershed.
  - By 1940 the railroad had already been constructed along the eastern shore of the Susquehanna River, effectively severing the river from upland habitats for many small animal populations.
  - The native forests were replaced by agricultural fields on much of the flat terraces overlooking the Susquehanna River. Some of these fields have since reverted to forest or conifer plantations.
- Current –
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like reptiles, amphibians and small mammals that may consider the railroad an insurmountable obstacle.
  - The four hydroelectric dams on the Susquehanna River provide the major obstacle to anadromous and catadromous fish migration. Recently installed fish ladders have improved the condition for anadromous fishes, but catadromous fishes continue to be excluded from the Susquehanna River watershed.

- Residential development has increased along the York County side of the river.
- There are several small seasonal cabins on a few of the islands.

- Exotic Species –
  - The river floodplain is naturally susceptible to weedy plant invasion. The railroad rights-of-way and the transition zone between forested and agricultural landscapes are also areas of greatest invasive plant species concentrations.
    - Norway Maple (*Acer platanoides*)
    - Tree-of-heaven (*Ailanthus altissima*)
    - Garlic mustard (*Alliaria petiolata*)
    - Kudzu (*Pueraria lobata*)
    - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
    - Oriental bittersweet (*Celastrus orbiculatus*)
    - Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
    - Japanese & European barberry (*Berberis thunbergii, Berberis vulgaris*)
    - English ivy (*Hedera helix*)
    - Mile-a-minute (*Polygonum perfoliatum*)
    - Multiflora rose (*Rosa multiflora*)
    - Common mugwort (*Artemisia vulgaris*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Japanese knotweed (*Polygonum cuspidatum*)
    - Purple loosestrife (*Lythrum salicaria*)
    - Japanese stilt grass (*Microstegium vimineum*)
    - Princess tree (*Paulownia tomentosa*)
    - Wineberry (*Rubus phoenicolasius*)
    - Japanese hops (*Humulus japonicus*)

Conservation Actions:

Overall:

- Almost all of the core habitat is currently owned by the PPL Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the assumption that the current land use and ownership will remain for the foreseeable future. Continue protection of this landscape as an important ecological resource. If the utility companies choose to divest themselves of portions of this landscape, it should be considered a high priority for conservation acquisition.
- Coordinate the protection of this landscape between Lancaster and York Counties. Property ownership is unknown for the York County side of the river and may be more susceptible to conversion to inappropriate uses.
- Encourage agricultural areas at the edge of the river bluffs to retreat from the slope's edge and to revert to a forested landscape. The forested landscape helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species.
- Avoid building, replacing or expanding dams.
- Improve fish passage for both anadromous fish (American shad) and catadromous fish (American eel).
- Restore the river to its original hydrologic regime as the end of Holtwood Dam's life expectancy nears.

Within the Core Habitat:

- Most of the priority core habitat within Conowingo Islands is owned by the Exelon and PPL utility producing companies and is presently considered to be of secondary concern for conversion to incompatible uses based on the current management regime.
- The steep, rocky, inaccessible and flood-prone nature of the immediate habitat of the species of concern likely precludes most types of development activity.

- Discouraged the establishment of seasonal cottages and year-round residences along the river shoreline and river islands. Limit and reduce the impact of seasonal cabins on the shoreline and islands of the river. Septic systems for these structures are frequently inadequate or nonexistent. Disturbance on shorelines and islands includes loss or impairment of critical habitat due to construction of cabins, access roads, boat docks, lawns and vegetation clearing. Some vegetation removal can be beneficial to the habitat, but an increase in island or shoreline cottages can only result in a decrease in habitat for species adapted to these specific habitat conditions. The western shoreline floodplain would be improved by the removal of the residences lining the banks of the river.
- Indiscriminate herbicide use is inappropriate for this location.
- Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.

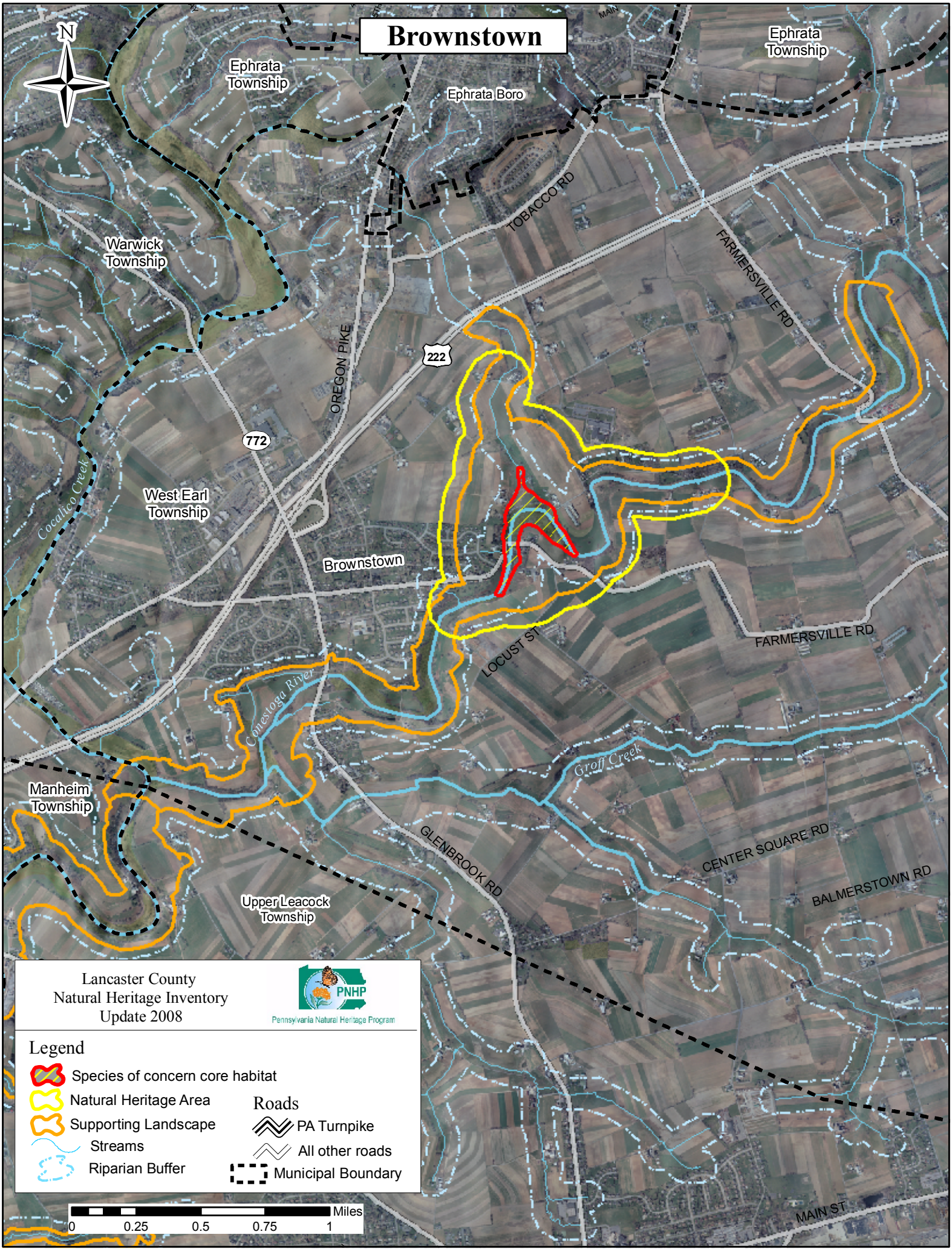
- Conserve the intact forest canopy.
  - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.
  - Avoid logging activities on slopes adjacent to the Susquehanna River to allow for the development of old growth conditions.

Within the Supporting Landscape:

The supporting landscape for this Natural Heritage Area is drawn closely around the Natural Heritage Area and rare species core habitats. Conservation actions appropriate for these zones also apply to the supporting landscape.

- Potential zoning options for conservation enhancement:
  - Conestoga, Manor and Martic Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
  - Growth within the Township should be discouraged to occur within 300 meters of the 100-year floodplain of the river or within 100 meters of the floodplain of its tributaries.
- Potential restoration activities:
  - Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
  - Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management.

- Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, Japanese hops, multiflora rose and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
- Invasive species are a significant feature of the railroad rights-of-way and river shoreline. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
- Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
- Continual invasive species monitoring and control will be necessary.


Brownstown
N
Ephrata Township
Ephrata Boro
Ephrata Township
Warwick Township
TOBACCO RD
FARMERSVILLE RD
OREGON PIKE
222
772
Cocalico Creek
West Earl Township
Brownstown
LOCUST ST
FARMERSVILLE RD
Conestoga River
Groff Creek
Manheim Township
GLENBROOK RD
CENTER SQUARE RD
BALMERSTOWN RD
Upper Leacock Township
MAIN ST
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
0.75
1

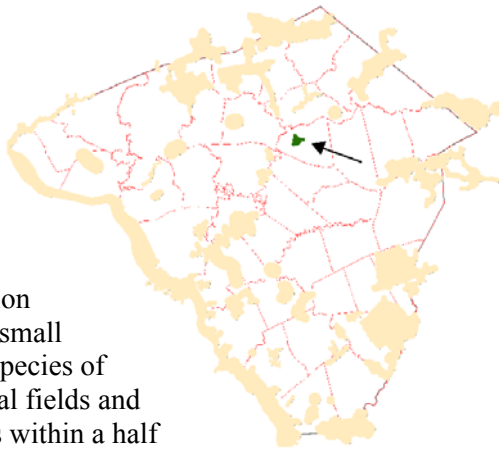
Brownstown – *Notable significance*

Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Animals:					
Sensitive species of concern[3]	G5	S1B	PE	1999	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location:

- Municipalities:
  - West Earl Township
- USGS Quadrangles:
  - Ephrata Quadrangle
  - Leola Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: There is a strong curve in the Conestoga River just east of Brownstown where the floodplain widens and a small portion of the natural floodplain forest along the river remains intact. The small patch of forest here supports a breeding population of a sensitive species of concern. The adjacent landscape is dominated by active agricultural fields and pastures, as well as the borough of Brownstown. Route 222 passes within a half mile to the floodplain forest patch.

Species of Concern Considerations:

- Though considered secure at the global level, there are only a few locations where this sensitive species of concern is known to breed in Pennsylvania, where it is considered critically imperiled. Most of the recently documented occurrences of this species are along the Conestoga River in Lancaster County and several locations along the lower Susquehanna River. This species lives and breeds in the forested habitat adjacent to waterways and feeds primarily on aquatic organisms in smaller streams and rivers. This species is apparently not sensitive to human activity as it has been found in urban and suburban settings as long as the appropriate habitat is available.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- This small patch of silver maple floodplain forest is surrounded by human altered landscape. The forest includes some sycamore (*Platanus occidentalis)* and river birch (*Betula nigra*), but appears dominated by silver maple (*Acer saccharinum).* The understory of small patches of forest in this context is typically dominated by invasive species. This area may also be used as a grazing pasture for livestock. The riparian buffer of the Conestoga River through the area is limited to a single row of trees in most places, and entirely lacking vegetation in others.

Ownership: Most of the suitable habitat for the species of concern is held in large agricultural parcels. Ownership fragmentation along the shoreline of the Conestoga River may impede future conservation actions.

Habitat Disturbances:

- Historic –
  - The landscape surrounding this Natural Heritage Area was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today. This small patch of floodplain forest has remained a fixture of the landscape since 1940 based on aerial photos taken during the era.
  - A small dam is apparent on the Conestoga River just upstream from the forested floodplain in 1940 photographs. Several other historic milldams occurred along the Conestoga River in the vicinity of this Natural Heritage Area. The legacy sediments that are trapped behind the dams alter the topography of the floodplain and trap stream banks in unnatural channels when they are suddenly breached.
- Current –
  - Large expanses of cultivated fields dominate the landscape with little interruption from any natural habitat.
  - Little natural habitat remains in the area except for an intermittent narrow band of trees along the Conestoga River. Restoration of wide, vegetated/forested stream buffers should be a priority for the entire watershed.
- Exotic Species –
  - The exotic species composition and threat of this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall:

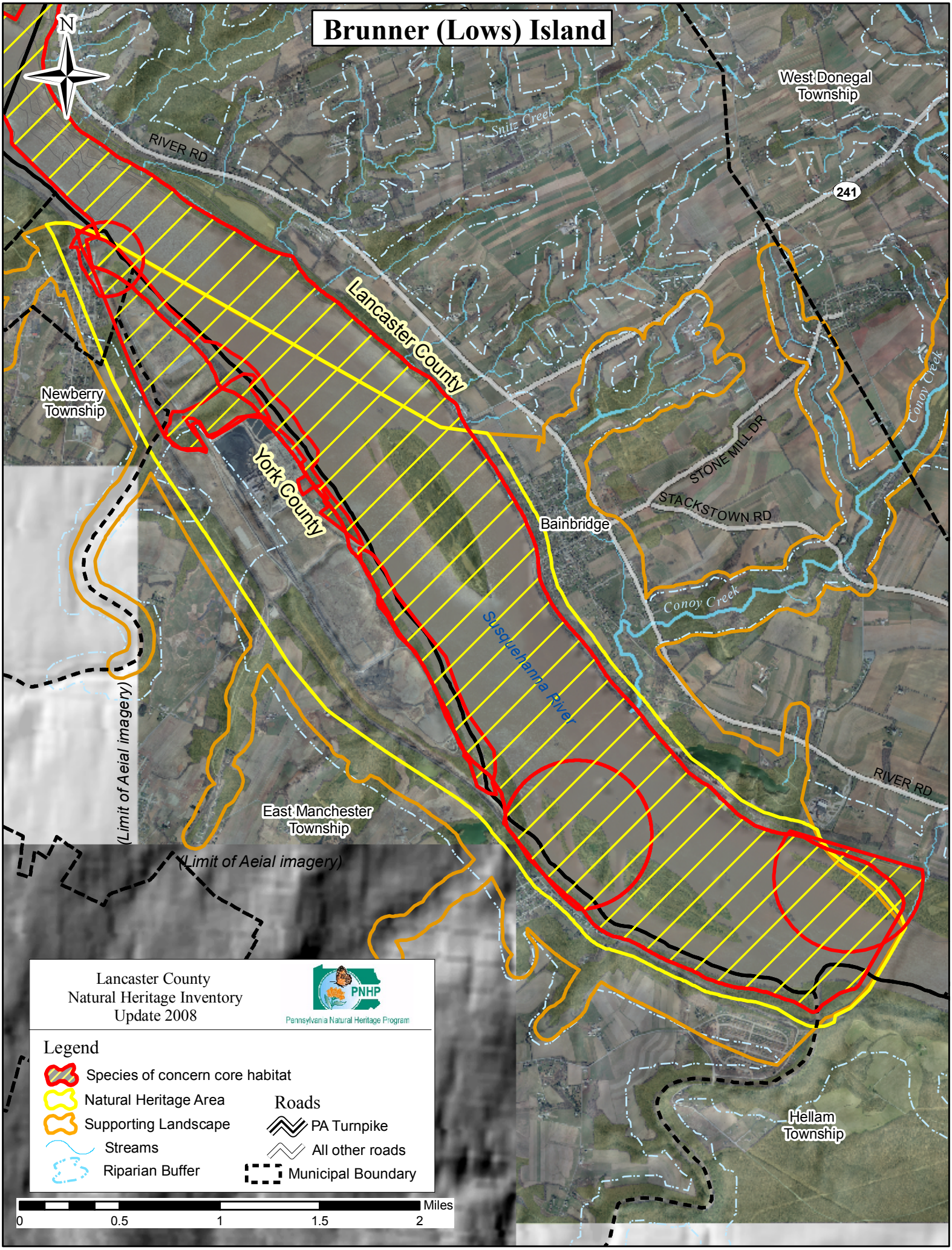
Within the Core Habitat:

- Most of the core habitat for the species of concern falls within the floodplain for the river. Strict enforcement of zoning regulations to prohibit building activity within the 100-year floodplain of the Conestoga River would help protect the habitat of this species of concern.
- The forested floodplain along this stretch of the Conestoga may be an appropriate location for a municipal park serving Brownstown and West Earl Township. Emphasis should be on promoting a viable floodplain natural community rather than on active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding areas with native vegetation and restoration and protection of the natural condition of the shoreline.
- Restoration of vegetated stream buffers along the Conestoga River and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conestoga River, Susquehanna River and the Chesapeake Bay.
- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions. Use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the water quality at this location. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern. The rainwater runoff from the agricultural fields and pastures should be considered a potential source of significant surface water contamination. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants

than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.

Within the Natural Heritage Area/Supporting Landscape:

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- The intensively cultivated adjacent landscape offers little natural habitat for native species of plants and animals. Portions of the area, particularly along the floodplain of the Conestoga River should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and water courses in the area will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
- West Earl Township zoning ordinances currently restrict development within the floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
- Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out.
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat and farmland destruction.


Brunner (Lows) Island
N
West Donegal Township
Snitz Creek
RIVER RD
241
Lancaster County
York County
Newberry Township
Conoy Creek
STONE MILL DR
STACKSTOWN RD
Bainbridge
Conoy Creek
Susquehanna River
RIVER RD
East Manchester Township
(Limit of Aeial imagery)
(Limit of Aeial imagery)
Hellam Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
1.5
2

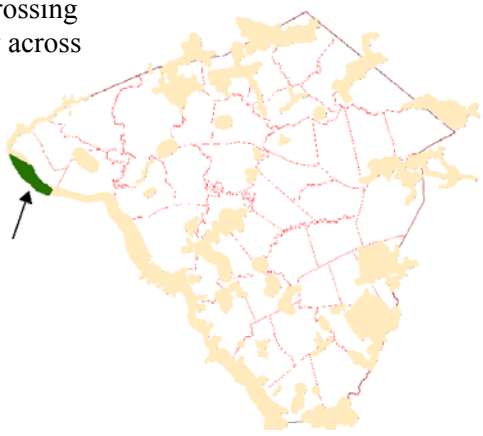
Brunner (Lows) Island – *Exceptional significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Scarlet ammannia (*Ammannia coccinea*)	G5	S2	PE	1997-08-10	C
Tooth-cup (*Rotala ramosior*)	G5	S3	PR	1997-08-10	C
Animals:					
Elktoe mussel (*Alasmidonta marginata*)	G4	S4	-	2002-08-31	E
Triangle floater mussel (*Alasmidonta undulata*)	G4	S3S4	-	1999-08-06	E
Yellow lampmussel (*Lampsilis cariosa*)	G3G4	S3S4	-	2006-08-19	E
Osprey (*Pandion haliaetus*)	G5	S2B	PT	2003	E
Virginia Rail (*Rallus limicola*)	G5	S3B	-	1987	E
Sensitive species of concern (A)[3]	-	-	-	2002	E
Sensitive species of concern (B)[3]	-	-	-	2003	E
Sensitive species of concern (C)[3]	-	-	-	1996-05-30	D

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area includes the section of the Susquehanna River south of the borough of York Haven to the railroad bridge crossing the river at the mouth of Codorus Creek. Brunner Island is directly across the river from the borough of Bainbridge in Lancaster County.

- Municipalities:
  - Conoy Township, (Lancaster County)
  - Hellam Township, (York County)
  - East Manchester Township, (York County)
  - Newberry Township, (York County)
  - York Haven Borough, (York County)
- USGS Quadrangles:
  - York Haven Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Haldeman Island" – (York Haven Quadrangle)



Description: As Conewago Creek enters the Susquehanna River it divides into several channels and cuts the delta-like Brunner Island (the lower portion is also called Lows Island) from the main shore of York County. Brunner Island is the site of a PPL owned coal-fired electric generating plant that began operating in the early 1960s. Several other large islands occur in this section of the river including Haldeman, Ely and Pole Islands. The majority of these islands retain most of their natural conditions. This portion of the river also contains an extensive region of bedrock outcrop, referred to as Haldeman Riffles,

which is dramatically revealed during times of seasonally low water. A public hiking trail is along the remnants of the Pennsylvania Canal.

Species of Concern Considerations:

Plants:

- Scarlet ammannia is a globally secure (G5) though state imperiled (S2) plant that inhabits various damp to wet habitats, especially on the sandy shorelines, mudflats and intermittently flooded zones of rivers, streams, and ponds, and may also be found in human-created disturbances that simulate natural habitats. Conservation of this habitat type will help this species to persist at this location.
- Tooth cup is a globally secure (G5), state rare (S3) annual plant that occupies exposed shorelines, stream margins, streambed outcrops, and other damp, open places. The populations of toothcup that occur along streams and rivers can be enhanced by maintaining the natural seasonal fluctuations in the water level of the stream and the natural conditions of its shoreline.

Animals:

- Ospreys have been increasing in number along the Susquehanna River and its tributaries due to a reintroduction program in the 1980s. These birds adapt readily to human activity and often construct nests on man-made structures (Brauning 1992). Being primarily fish eaters, Ospreys utilize aquatic habitats for food gathering and upland habitats or prominent features as nesting areas. The forested edge of the river, as well as the aquatic habitat of the river are both important components of this species habitat preferences.
- Three freshwater mussel species of concern, elktoe, triangle floater and yellow lampmussel, along with four additional species of mussels were documented in this section of the Susquehanna River by local naturalist, Larry Coble. Historically, the dwarf wedge mussel, a federally endangered species, was also documented as occurring in the Susquehanna River near this location. Mussels are filter feeders and are strongly impacted by poor water quality and unsuitable creek bed substrate. Mussels exist as a parasite on certain fish species in their early life stage, and decreased populations of the host fish can negatively affect mussel populations. Dams that impede fish migration also restrict the habitat available to mussels. All streams, creeks and tributaries to the Susquehanna River should have wide forested/vegetated buffers in order to help ensure proper water quality for freshwater mussel habitat. Impediments to fish movement such as dams and improper stream crossings should be corrected to improve available habitat for mussels and their fish hosts.
- The river is habitat for a sensitive species of concern documented over several years at this location. Maintain and improve water quality and movement above dams for fish migration to improve the habitat for this species of concern.
- Two additional sensitive species of concern were documented along this stretch of the river. The core habitat for these sensitive species of concern is both the river and the adjacent upland forest. These sensitive species of concern require an abundant food source in the river and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Susquehanna River and by protecting and expanding the natural vegetation buffer along the river and all its tributaries

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- This Natural Heritage Area is drawn relatively tightly around the river and the immediately adjacent uplands. The natural community types present represent the floodplains and upland forests in immediate proximity to the river. The dominant natural community types are:
    - Terrestrial (upland) communities:

- Hemlock-tuliptree-birch forest
- Tuliptree-beech-maple forest
- Palustrine (wetland) communities:
  - Red maple-black gum palustrine forest
  - Red maple-elm-willow floodplain swamp
  - River birch-sycamore floodplain scrub
  - Silver maple floodplain forest
  - Sycamore (river birch)-box elder floodplain forest

Ownership:

- Most of the islands in this section of the river are privately owned.
- Three small, but ecologically significant islands are owned by the Commonwealth of Pennsylvania.
- A small piece of Haldeman Island and a significant portion of the eastern shore of the Susquehanna River north of Bainbridge is owned by the PPL Corporation.

Habitat Disturbances:

- Historic – The landscape surrounding this Natural Heritage Area was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today.
  - The borough of Bainbridge was built along the banks of the Susquehanna River.
  - The Pennsylvania Canal and then the Pennsylvania Railroad line were built along the eastern shore of the river and a railroad was built along the western shore of the river as well.
  - Numerous roads were built as infrastructure for the growing population of the area.
  - Most of the adjacent land in Lancaster and York counties was in agricultural production, with scattered quarry operations in 1940.
  - Brunner Island was almost entirely in active agricultural production based on aerial photographs taken in 1940.
  - The small channel that used to separate Brunner Island from Lows Island was filled.
  - The PPL coal-fired electric generating plant was opened on the island in 1961.
- Current –
  - Most of the eastern and western shorelines of this section of the river fail to function as a terrestrial habitat corridor through the region. A much wider and enhanced vegetated buffer is needed adjacent to the floodplain on both shores of the Susquehanna River. While the Susquehanna River acts as a primary migratory pathway for many species of birds and bats, the vegetated area between the railroad tracks and the river is in most areas too narrow to adequately function as a regional terrestrial habitat corridor. Animals traveling northward though the extensive forested River Hills area of Lancaster County are suddenly forced into a very narrow strip of land between the river and the railroad tracks to avoid the heavily urban, suburban and agricultural land uses north of Turkey Hill. Similarly, the extensively forested areas in the southwestern shore of the river in York County dissipate northward where the landscape has been converted to agricultural and urban land uses.
  - The habitat of Bruner Island has been almost entirely converted to industrial uses though the perimeter of the island remains vegetated. Coal piles, fill and residue cover most of the island area, which can lead to coal pile runoff and decrease river water quality. Water heated by coal to produce steam for electric generation is returned back into the river, raising the local temperature of the surrounding river water.
  - In contrast to some of Lancaster County's more intensively cultivated landscapes, many of the streams and smaller tributaries to the Susquehanna River have retained moderately

sized vegetated buffers despite the high level of agricultural conversion of the natural landscape. These narrow habitat corridors help provide a natural environment for native species of plants and animals, but due to the narrowness of the corridor in the disturbed landscape, are typically strongly dominated by invasive species of plants.
    - Residential development activity is increasing in the Conoy Creek watershed.
    - Illegal dumps occur scattered throughout the river floodplain.
- Exotic Species – The natural disturbance of seasonal flooding and ice scour create ideal conditions for many introduced species of plants. Consequently, the river shoreline is prone to invasion from a large number of invasive species. In addition, when cultivated land is idled, it is highly susceptible to invasion by aggressive invasive plants. Some of the former fields and clearings along the river have succeeded to a very weed infested woody landscape. The Pennsylvania Canal trail is particularly infested with invasive species of plants. Native grapevines contribute to the tangled aspect of the forest. Invasive species observed include:
    - Norway Maple (*Acer platanoides*)
    - Tree-of-heaven (*Ailanthus altissima*)
    - Common mugwort (*Artemisia vulgaris*)
    - Japanese & European barberry (*Berberis thunbergii, Berberis vulgaris*)
    - Oriental bittersweet (*Celastrus orbiculatus*)
    - English ivy (*Hedera helix*)
    - Asiatic day lily (*Hemerocallis fulva*)
    - Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
    - Purple loosestrife (*Lythrum salicaria*)
    - Japanese stilt grass (*Microstegium vimineum*)
    - Princess tree (*Paulownia tomentosa*)
    - Common reed (*Phragmites australis)*
    - Japanese knotweed (*Polygonum cuspidatum*)
    - Mile-a-minute (*Polygonum perfoliatum*)
    - Callery 'Bradford' pear (*Pyrus calleryana*)
    - Jetbead (*Rhodotypos scandens*)
    - Multiflora rose (*Rosa multiflora*)
    - Wineberry (*Rubus phoenicolasius*)

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and York Counties.
- Protect and expand the natural vegetation along both shores of the river floodplain and adjacent upland. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along both shores of the river.
- Avoid building, replacing or expanding dams on the Susquehanna River.
- Riparian corridors of all stream tributaries to this section of the Susquehanna River and the river shoreline itself need additional restoration measures. Several stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from agricultural and urban runoff.
- High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat in this section of the river. Establish at least 100 meter buffer of woody vegetation along the river shore and all segments of tributary streams to help protect the water quality of the river by reducing erosion, sedimentation, and pollution. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater

should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river.

Within the Core Habitat:

- Most of the species of concern core habitat occurs along the shorelines of the islands and of the adjacent river floodplain. Maintain the natural hydrology of the river system by avoiding building dams or draining or permanently flooding adjacent wetlands. Preserve and improve the water quality of the Susquehanna River to help provide a continued and increased food chain. Maintain and improve water quality of the river by providing vegetated buffers along inflows to the river and along the river shoreline. Detention basins and rain gardens can be incorporated into borough infrastructure to allow stormwater to be filtered before entering the river.
- The industrialization of Brunner Island severely limits the short tem potential for habitat restoration on the majority of this island. The perimeter of the island is in a relatively natural condition and should be preserved and expanded as area is available. The area along Wago Road is one of the narrowest vegetated buffers for the island. Shallow areas along the perimeter of the island should not be dredged. Material piles on the island should be strongly contained or covered to prohibit runoff from entering the river. The PPL Corporation maintains nature preserves and hosts many nature related activities for the public on this island as well as its other landholdings in Lancaster & York Counties. These activities help promote local stewardship of important natural resources.
- The river floodplain between the river shoreline and River Road north of Bainbridge Borough should be considered a priority for conservation and expansion of natural habitats, and would be suitable for a passive recreation park. The area currently has a walking trial along the old Pennsylvania Canal. Emphasis for restoration in this area should be on promoting a viable floodplain natural community and protection of the natural condition of the shoreline rather than the addition of active park facilities and infrastructure.
- Other large islands should be considered a priority for conservation acquisition or easements. Biological inventories of these islands are recommended.

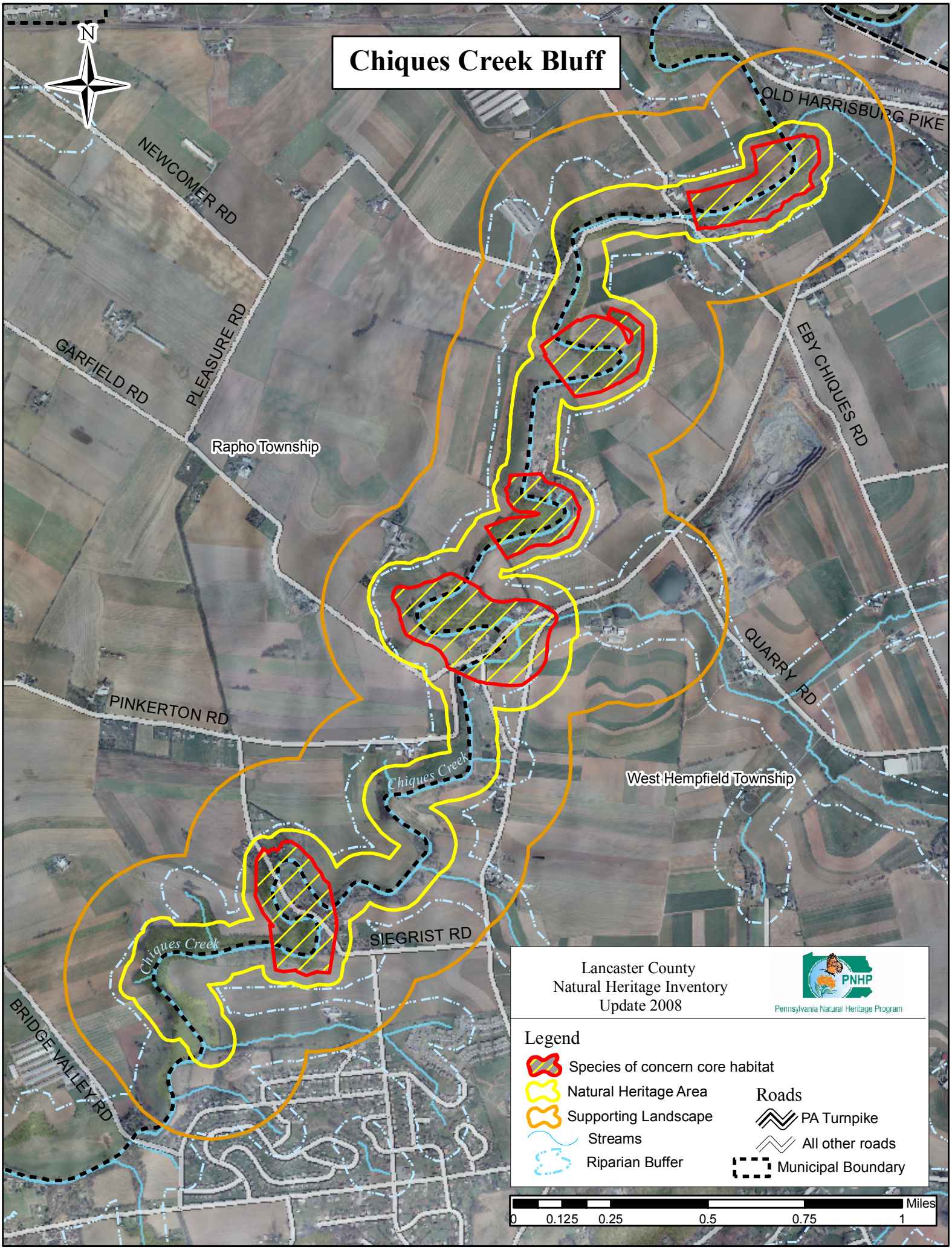
Within the Supporting Landscape: The supporting landscape was drawn to include a 300 meter buffer to this section of the Susquehanna River and a 100-meter riparian buffer for all tributaries. Activities and land use patters in the adjacent subwatersheds can have a significant impact on the water quality of the river and the habitats of the species of concern.

- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along both shores of the river. Expand the native vegetation along the river corridor to ideally include land within 300 meters of the river's banks. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- The rainwater runoff from the agricultural, urban, suburban and industrial sources should be considered a potential source of significant contamination for the river. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented within Bainbridge and other urban/suburban lands to slow the overland movement of stormwater. Existing wetlands also fulfill this function without the need for additional expenditures.
- The surrounding intensively cultivated landscape offers only modest natural habitat for native species of plants and animals. Conoy Creek has a respectable riparian buffer through Conoy

Township and should be considered a priority for conservation. There are, however, intermittent agricultural fields that abut the creek with very little buffer. Within West Donegal Township the riparian buffers dwindle to inadequate on many of the smaller tributaries feeding the larger Conoy Creek. These small feeder streams can have a significant impact on the overall sediment and pollution load of Conoy Creek and should be considered priorities for restoration of vegetated riparian buffers within this watershed.

- Pursue conservation easements and fee simple acquisition on properties along the river shoreline to help conserve and improve the effectiveness of the Susquehanna River as a natural corridor.
- Potential zoning options for conservation enhancement:
    - Conoy Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
        - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Parcels currently in agriculture outside of the floodplain that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those in the 100-year floodplain should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within 300 meters of the 100-year floodplain of the river or within 100 meters of the floodplain of its tributaries.
    - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction though suburban sprawl.
- Potential restoration activities:
    - Numerous historic milldams occurred along the length of Conoy Creek and its branches. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts. All tributaries to the Susquehanna River should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
        - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain

    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
        - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
        - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
- Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management. Aggressive invasive species along the floodplain can have a significant impact on the available habitat for the species of concern, which can occupy much the same habitat as many invasive species. Control of invasive species along the river floodplain will require extensive and continual effort. Focus non-chemical control efforts on selected areas surrounding species of concern.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose, common privet, Jetbead, and callery pear. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Invasive species are a significant feature along the old canal and railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
    - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.
- Illegal dumps should be removed and monitored for future activity.
- Litter removal along the shores of the river will need to be conducted on a periodic and continual basis due to the seasonal flooding regimen of the river.


Chiques Creek Bluff
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NEWCOMER RD
OLD HARRISBURG PIKE
GARFIELD RD
PLEASURE RD
EBY CHIQUES RD
Rapho Township
QUARRY RD
PINKERTON RD
Chiques Creek
West Hempfield Township
SIEGRIST RD
Chiques Creek
BRIDGE VALLEY RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.125
0.25
0.5
0.75
1

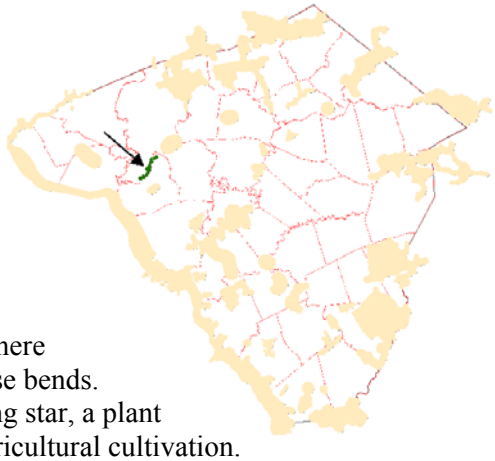
Chiques Creek Bluff - *Notable significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Jeweled shooting-star (*Dodecatheon radicatum*)	G5	S2	PT	1991-05-04	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location:

- Municipalities:
  - Rapho Township
  - West Hempfield Township
- USGS Quadrangles:
  - Columbia East Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP509" (Columbia East Quadrangle)



Description: Chiques Creek forms a series of tight loops as it passes along the border between Rapho and West Hempfield Townships. There are nearly vertical, north-facing limestone outcrops in several of these bends. One of these steep outcrops supports a population of jeweled shooting star, a plant species of concern. The surrounding landscape is under intensive agricultural cultivation. Very little natural habitat occurs in the vicinity of this section of Chiques Creek.

Species of Concern Considerations:

Plants:

- Jeweled shooting star is a spring wildflower that, in the Susquehanna watershed, prefers moist, shaded north-facing limestone outcrops that tend to exhibit a dripping quality. The habitat at this location has been degraded by removal of the surrounding tree cover, changing the local microclimate from cool and moist to a much drier and warmer environment. Infestation by invasive species of plants is also a considerable problem at this location. A site survey is necessary to establish that the species still occupies this site. Careful removal of invasive species of plants and restoration of the upland forest are likely necessary to maintain jeweled shooting star at this location. Additional surveys along this stretch of Chiques Creek are recommended. Several adjacent locations may be suitable for careful expansion of the population of jeweled shooting star.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from interpretation of 2005 aerial photography and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- Almost the entire surrounding landscape is under intensive agricultural cultivation, with little native vegetation remaining except for small isolated patches of forest along Chiques Creek. Those remaining fragments appear to include patches of Sycamore (river birch)-box elder floodplain forest and several small wet meadow openings, the rest being modified successional forest.

Ownership: The small forested patch that contains the species of concern core habitat is primarily owned by a single landowner. Most of the area within the supporting landscape is held in large agricultural parcels. Future ownership fragmentation along the banks of Chiques Creek may impede future

conservation actions. Conservation action along the creek corridor should be set in motion before ownership fragmentation makes this more difficult.

Habitat Disturbances:

- Historic –
  - The landscape surrounding this Natural Heritage Area was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today. Little natural vegetation remains to provide habitat for native plants and animals. This limestone outcrop with its small patch of forest has remained a fixture of the landscape since 1940 based on aerial photos taken during the era, likely because it was too steep and stony to cultivate.
  - Several milldams were active along this stretch of Chiques Creek including one at the base of the rock outcrop of the jeweled shooting star. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process.
  - Several small quarries were in the vicinity in 1940.
  - Several roads and bridges cross Chiques Creek at this location.
- Current –
  - The loss of the forest cover along Chiques Creek is the major downfall of this habitat. Large expanses of cultivated fields dominate the landscape with little interruption from any natural habitat. Clearing the land resulted in warmer and drier habitat conditions along the length of the creek including the area for the jeweled shooting star, which requires cool, wet conditions.
  - Prospect Road was constructed and passes within feet of the top of the cliff.
  - One of the quarries has grown to a considerable size. Runoff from this large mining operation may contribute considerable sediment and other pollutants to the surface water entering Chiques Creek.
  - A former small quarry site along the outcrops overlooking the creek appears to have a large collection of machinery and other debris scattered around the property. This is a potential source of chemical contamination for Chiques Creek.
  - Little natural habitat remains in the area except for an intermittent narrow band of trees along the Chiques Creek. Restoration of wide, vegetated/forested stream buffers should be a priority for the entire watershed.
  - Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
- Exotic Species – Site surveys were last conducted in 1991. Invasive species were considered a considerable threat at the time. Since then, several invasive plants have become serious problems throughout Lancaster County. These species were documented as present and potentially impacting the jeweled shooting star at this location, while others are also likely present:
  - Norway maple (*Acer platanoides*)
  - Garlic mustard (*Alliaria petiolata*)
  - Japanese honeysuckle (*Lonicera japonica*)

Conservation Actions:

Overall:

- Restoration of wide forested riparian corridors along Chiques Creek and all tributaries should be a priority for this section of the Chiques Creek watershed.
- Use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the water quality at this location. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the

natural habitat. The rainwater runoff from the agricultural fields and pastures should be considered a potential source of significant surface water contamination. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Storm water management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.

Within the Core Habitat:

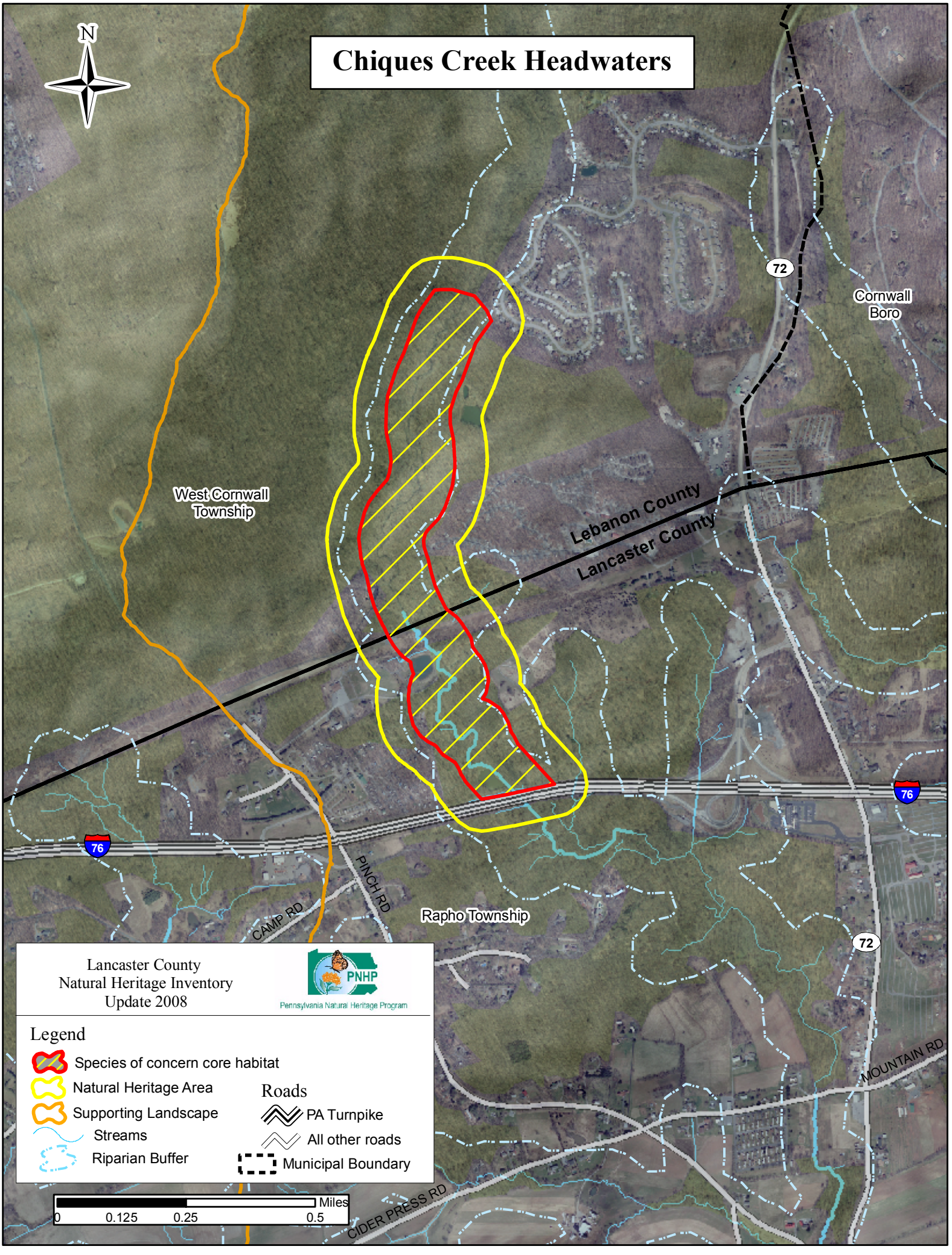
- Most of the core habitat for the species of concern occurs on a small, steep cliff at a bend in the creek. This steep rocky cliff is an unlikely building site, but may be vulnerable to mining activity due to the limestone bedrock present. Prohibit mining at any creek side bedrock exposures, or within 300 meters of the creek.
- A grassy pasture is at the top of the cliff and livestock should be blocked from grazing near the wooded portion of the cliff edge.
- Restoration:
  - Restore the forested canopy to within 100 feet of the top of the cliff to help provide cool, moist microclimate conditions. Recommended trees for restoration of the uplands include basswood *(Tilia americana),* red oak *(Quercus rubra*), white oak (*Quercus alba*), black birch (*Betula lenta*), hop-hornbeam (*Ostrya virginiana*) and hackberry (*Celtis occidentalis*),which are all native species documented at this location.
  - Remove excessive machinery and debris from property overlooking the creek. Runoff from this property is a potential source of chemical contamination for the creek.
  - Restore vegetated stream buffers along Chiques Creek and its tributaries to help increase the quality of the habitat while improving water conditions for Chiques Creek, the Susquehanna River and the Chesapeake Bay. Floodplain plantings should strive to mimic natural communities identified for this location: Sycamore (river birch)-box elder floodplain forest (see Fike 1999 for a description of the typical species composition for this natural community type).
  - Remove invasive species of plants. Focus initial attention on hand pulling non-native competition for the jeweled shooting star population. Extreme care must be taken not to detrimentally impact the jeweled shooting star population. Herbicide use would be inappropriate at this location.

Within the Supporting Landscape:

- Pursue conservation easements and fee simple acquisition on properties along Chiques Creek to help conserve and improve its effectiveness as a natural corridor.
- Potential zoning options for conservation enhancement:
  - Rapho and West Hempfield Townships have a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest cover.
  - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this location.

- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction though suburban sprawl.

- Potential restoration activities:
  - Several steep north-facing limestone outcrops occur along Chiques Creek in the vicinity of this occurrence of jeweled shooting star. These locations may be suitable for expansion of this population. The sites should be evaluated for their ability to provide the necessary habitat for jeweled shooting star. Reintroduction efforts should only be made with seed source collected from the adjacent site.
  - All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
  - Numerous historic milldams occurred along the length of Chiques Creek and its branches. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts.
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be restored with native trees and shrubs appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
  - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
    - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
  - Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
  - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
  - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
  - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain


Chiques Creek Headwaters
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West Cornwall Township
Lebanon County
Lancaster County
Cornwall Boro
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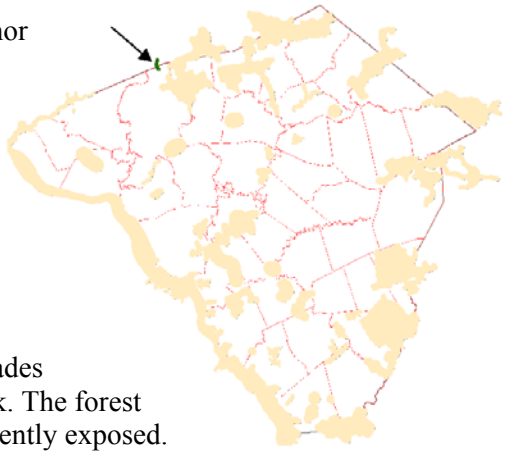
76
76
72
PINCH RD
CAMP RD
Rapho Township
MOUNTAIN RD
CIDER PRESS RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.125
0.25
0.5

Chiques Creek Headwaters – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Clinton's wood fern *(Dryopteris clintoniana)*	G5	S2	-	2002-07-20	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location: Chiques Creek begins in the springs and seeps of Governor Dick Park in Lebanon County before flowing into Lancaster County north of the Pennsylvania Turnpike.

- Municipalities:
  - Rapho Township, (Lancaster County)
  - West Cornwall Township, (Lebanon County)
- USGS Quadrangles:
  - Manheim Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: The large forested expanse of Governor Dick Park shades the springs and seeps that become the headwaters of Chiques Creek. The forest is underlain by diabase bedrock, with large rounded boulders frequently exposed. Though logged repeatedly in the past, the forest is maturing and has an interesting mix of trees, shrubs and wildflowers associated with the rich habitat provided by the slightly calcareous diabase bedrock.

Species of Concern Considerations:

- Clinton's wood fern grows in swampy woodlands. In Pennsylvania, it has been documented historically in numerous widespread counties. About 15 populations, mostly of them in the northwestern region, are currently known from the state. The viability of the known populations of Clinton's wood fern and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry oak-mixed hardwood forest
  - Dry white pine (hemlock)-oak forest
  - modified successional forest*

Ownership: The forested habitat of this Natural Heritage Area in Lancaster County is privately owned and held in a few larger sized parcels. In Lebanon County, most the primary habitat is part of the Governor Dick Park, though residential subdivision has occurred on the east side of Chiques Creek.

Habitat Disturbances:

- Historic –

- The trees of the area had been harvested several times since colonial days for lumber and as a source of charcoal for iron furnaces.
- Aerial photos from the 1940s show the area in Lebanon County as almost fully forested, with few fragmenting features such as roads or agricultural fields. In Lancaster County, there appears to have been more recent disturbances to the forested landscape with recent cutting and agricultural fields occurring adjacent to the creek.

o Current –

- Residential development and a campground have fragmented the forested landscape on the eastern side of the creek in Lebanon County.
- A utility rights-of-way was cut through the forest, roughly paralleling the Lancaster / Lebanon County border.
- Excessive deer browsing has reduced the quality and quantity of native understory vegetation including the regeneration of tree seedlings.
- A large artificial pond was created along the creek at a sportsman's association.

o Exotic Species – High priority for invasive species control at this site should be targeted towards removing small populations of newly established invasive plants in the most weed-free areas of the Natural Heritage Area , in particular bush honeysuckles, Japanese barberry, multiflora rose and tree-of-heaven. Invasive species control efforts should try to maintain weed-free areas first, and then concentrate on removing invasive species in lightly infested areas, continually pushing back the line of invasion. This needs to be an unending process of monitoring and control efforts.

Conservation Actions:

Overall:

- Coordinate the management of this Natural Heritage Area between Lancaster and Lebanon Counties.
- Since much of this Natural Heritage Area occurs within the Governor Dick Park, proper stewardship of the natural resources present is the top priority.
- Conserve the intact forest canopy and a healthy native shrub layer.
- Allow the forest to approach old growth conditions.
- Control invasive species of plants.
- Reduce the size of the deer herd.

Within the Core Habitat:

- Pursue conservation easements, transfer of development rights and fee simple acquisition on larger parcels along Chiques Creek.
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-ways. Park infrastructure improvements should stay clustered in close proximity to existing infrastructure to avoid fragmenting the forest canopy.
- Avoid logging of the forest. Allow the forest to achieve and maintain old-growth conditions. Leave fallen trees in place to help build soil nutrients, humus, tilth and plant and animal microhabitats. Removal of non-native species of trees is encouraged but clear cut or selective harvesting should be avoided. Deer browsing pressure has reduced the quality of the understory and future canopy of the forest. Deer exclosures may need to be erected to allow tree seedlings to mature above the reach of deer.
- Reduce the size of the deer herd. Native and uncommon species of plants are particularly susceptible to deer herbivory. Over browsing by white-tailed deer is a serious threat to the overall understory plant diversity and future forest canopy composition. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food

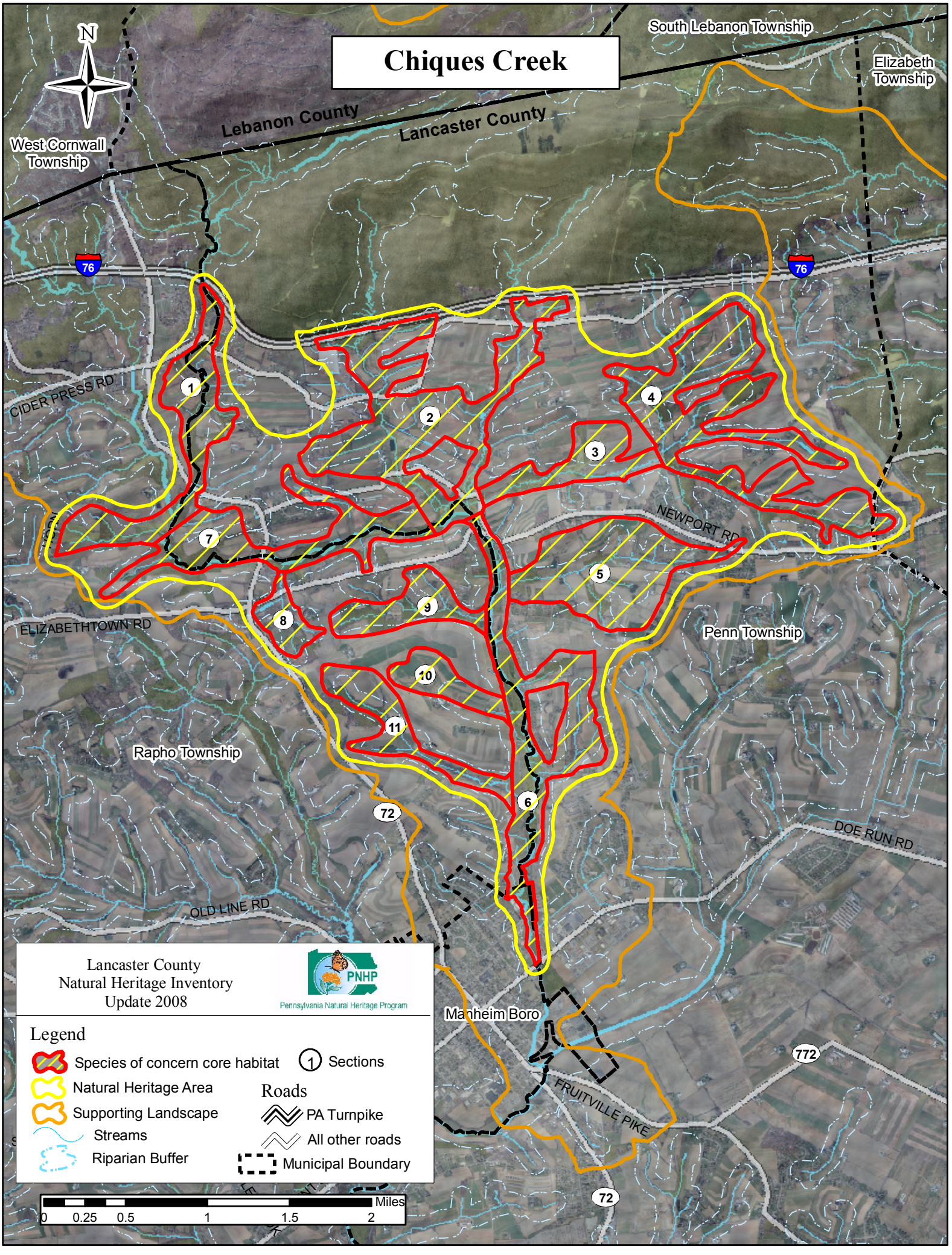
leaving poorer, less diverse species to mature and dominate the forest. Over browsing by deer severely impacts the future composition of the forest by eating favored food sources first, and leaving less palatable species, frequently introduced weed species to populate the forest. Hunting is currently prohibited in Governor Dick Park. This policy of the park should be amended to allow deer hunting on the property to protect the future forest composition.

- Remove non-native species of plants. Invasive species are a significant feature of the utility rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
- The clearing associated with the utility rights-of-way, while fragmenting the forested landscape, in turn provides habitat conditions favorable for a number of native plants and animals more adapted to open canopy conditions. Invasive species management needs to be coordinated by individuals familiar with native species as well as the invasive species present.
- Block access to forested areas by off road vehicles, ATVs and other motorized vehicles.
- Additional surveys for rare species are recommended.

Within the Supporting Landscape:

- Preserve the habitat connections between this Natural Heritage Area and others within the Furnace Hills Forests Hub. This Natural Heritage Area is part of a larger forested landscape covering the northern boundary of Lancaster County that is a component of a critical regional migratory corridor between the Susquehanna River and areas within Lebanon and Berks Counties.
    - Pursue conservation easements or fee simple acquisition of properties as a potential link between State Game Lands #146 and #156
    - Establish habitat connections between the north and south sides of the PA Turnpike. This could be achieved by the construction of green underpasses, overpasses and culverts. Restoration at key locations can help re-establish the migratory corridor function to the landscape.
- Potential zoning options for conservation enhancement:
    - Rapho Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
        - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this area.
- Recommended restoration activities:
    - Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
        - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.

- An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
- An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
- A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.


Chiques Creek
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West Cornwall Township
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Lancaster County
South Lebanon Township
Elizabeth Township
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NEWPORT RD
ELIZABETHTOWN RD
Penn Township
Rapho Township
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DOE RUN RD
OLD LINE RD
Manheim Boro
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Riparian Buffer
Sections
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.25 0.5 1 1.5 2

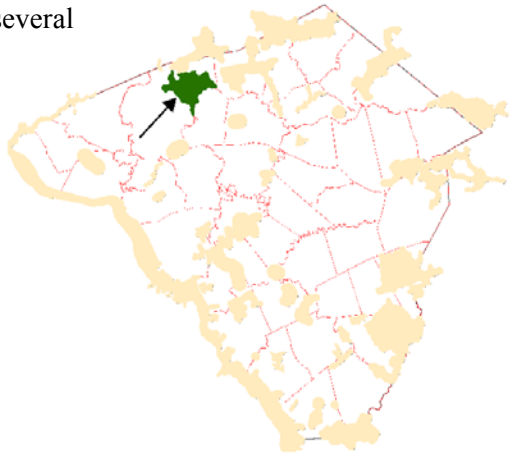
Chiques Creek – *Exceptional significance*

Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Sensitive species of concern[3]	-	-	-	2007	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This large Natural Heritage Area covers portions of several sub-watersheds including Shearers Creek, Boyer's Run and the section of Chiques Creek Watershed between the Pennsylvania Turnpike and Manheim Borough.

- Municipalities:
  - Manheim Borough
  - Penn Township
  - Rapho Township
- USGS Quadrangles:
  - Lititz Quadrangle
  - Manheim Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "White Oak - SA511" - (Manheim Quadrangle)



Description: This portion of Chiques Creek watershed is in a landscape that has long been dominated by agricultural activities. The relatively flat topography of the region, while being conducive to agriculture, also allows water to pool in low lying areas, creating wetlands of varying types. Historically, wetlands likely existed at most locations where water exits the ground at a spring or where the floodplain widened considerably. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries, but some remain or have recovered from a cessation of these activities. These wetland fragments should be considered the backbone for a restoration of this habitat type in the Chiques Creek watershed.

Species of Concern Considerations:

- The species of concern inhabiting these shallow wetlands require specific plant communities with a matrix of open canopied habitats. In addition to the species of concern currently found at this site, several plant species of concern and an animal species of concern were lost from this area when streams and wetlands were modified for agricultural purposes. Round-leaf eupatorium (*Eupatorium rotundifolium*), southern bog clubmoss (*Lycopodiella appressa*), cross-leaved milkwort (*Polygala cruciata*), pink milkwort (*Polygala incarnata*), and an animal species of special concern were historically known from this area and the reestablishment of the marshes at this site would recreate suitable habitat for these species, and in some cases, the species of concern may return once the habitat has been restored.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from interpretation of 2005 aerial photography and were followed up with minimal selective

ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The majority of the landscape of the Chiques Creek watershed has been converted from its original native vegetation to intensive agricultural production. The fragments that remain are primarily narrow strips along the banks of streams, forming the framework of riparian corridors. Some of these remnants are considered of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the watershed. The natural communities within this area include:
  - Terrestrial (upland) habitats
    - Hemlock-tuliptree-birch forest
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - modified successional forest*
    - shrubland*
  - Palustrine (wetland) habitats:
    - Sycamore (river birch)-box elder floodplain forest
    - Red maple-black gum palustrine forest
    - Red maple-mixed shrub palustrine woodland
    - Tussock sedge marsh
    - Bluejoint-reed canary grass marsh
    - Cattail marsh
    - shrub wetland*
    - wet meadow*

Ownership: This entire Natural Heritage Area appears to be in private ownership. Much of the area of the sub-watershed is in large agricultural parcels including most of the area considered to be of highest ecological significance. Future ownership fragmentation along the banks of the many branches of Chiques Creek may impede future conservation actions. Conservation action along the creek corridor should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover and the wetlands drained or dammed to accommodate the expansion of intensive agriculture that we see today. Little natural vegetation remained to provide habitat for native plants and animals.
  - Aerial photos of the area taken in 1940 show that agricultural fields abutted wetlands, most of which were grazed, mowed or cultivated. Few streams had any tree cover.
  - Several milldams were active along this stretch of Chiques Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Many of these stream reaches of the Chiques Creek watershed remain trapped in these deep narrow channels.
  - Roads crisscross the landscape, including the Pennsylvania Turnpike, which effectively severs the habitat of the Chiques Creek headwaters from sections south of the turnpike.
  - A rail line was built along Chiques Creek between White Oak and Manheim.
- Current –
  - The rail line along Chiques Creek has since become inactive, though the berms used to create an even grade for the tracks continue to divide the drainage.
  - Many wet areas that had been devoid of trees now have considerable tree cover. Unfortunately, many of the areas that now have tree cover are areas that had been open wet sedge meadows, which provide critical habitat for a number of species of concern.

- Exotic Species – The natural disturbance of seasonal flooding in conjunction with agricultural clearing creates ideal conditions for many introduced species of plants. Consequently, the creek floodplain is prone to invasion from a large number of invasive species.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented in this stretch of Chiques Creek in the near future if they don't already exist there.

Within the Core Habitat:

- Long term goals of this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were compatible with the species of concern found at this site.
- All of the species of concern that have been lost from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
    - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
    - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
    - Ironically, the conversion of wetlands for production of row crops limited the consistent water supplies used for irrigation, livestock watering, and farm fire protection. To compensate for the loss of wetlands, farm ponds were created to provide a consistent supply of water for farming uses. Many of these farm ponds were built where drainage was poor, often on top of existing springs, seeps, and other natural wetlands. These natural wetlands were replaced with highly modified deep, steep sided ponds, which serve little to no use for wildlife. Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be encouraged, in order to recreate the natural flows of the landscape.
    - Because the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within this Natural Heritage Area.
    - Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.

- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the many branches of Chiques Creek:
  (Refer to Chiques Creek Sections map)

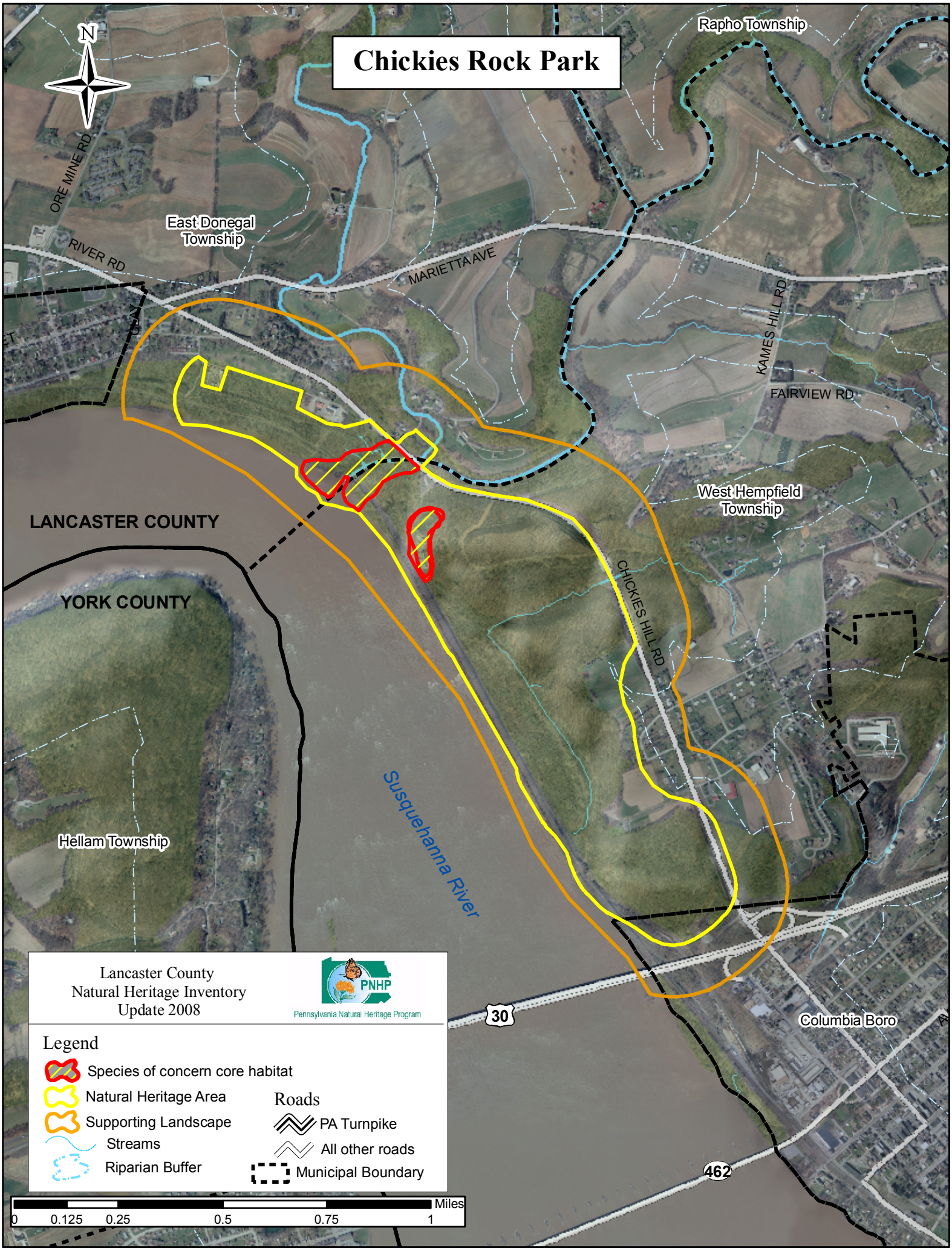
A- The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced; rather, their basins should naturally revert to their original condition.
B- Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
C- Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
D- Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
E- Current land use is compatible with this section; sparsely pasturing animals in this area could benefit the habitat.
F- Legacy sediments should be removed above the former mill dam.
G- Any remaining railroad tracks that may exist along the abandoned railway corridor should be removed.
H- The heavy agriculture in portions of this area should be allowed to revert back to natural drainages; light to moderate grazing in this area would be compatible.
I- The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.

Stream section ID	Recommendation Priority				
	1	2	3	4	5
1	A	B	C	D	
2	A	B	C	D	H
3	B	C	D	E	
4	A	B	C	D	H
5	A	H			
6	B	C	D	F	I
7	B	C	D	I	
8	A	B			
9	A	H	I		
10	A	H			
11	A	H			

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- There are multiple landowners that own the property within this Natural Heritage Area. Pursue conservation easements, fee simple acquisition and other programs that may restore the wetlands on properties along the branches of Chiques Creek to help conserve and improve its effectiveness as a natural corridor.
- Avoid subdivision of large parcels as this would likely impede broad conservation initiatives. Agricultural zoning is compatible with this Natural Heritage Area.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into natural vegetation cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
- Reestablishment of the wide floodplain, and wet meadows would serve as an effective buffer to flooding that may occur downstream in the town of Manheim.
- The western side of Chiques Creek is currently zoned Agricultural Resource (RR-AR) while the eastern side is zoned Agricultural 1 (RR-A1). Agricultural zoning is compatible with this Natural Heritage Area.
- Penn and Rapho Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
  - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and

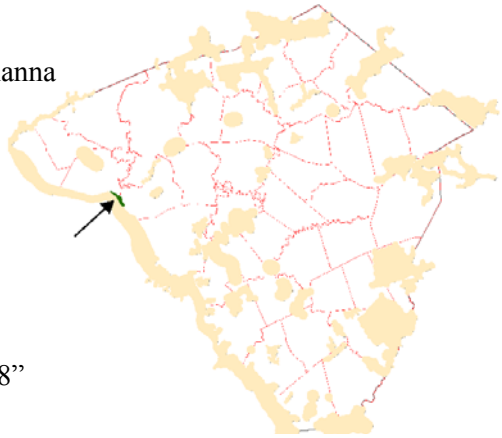
sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - In addition, the floodplain regulation should remove farm pond construction from its list of permitted uses.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the topography and hydrology.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
    - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.


Chickies Rock Park
N
Rapho Township
ORE MINE RD
East Donegal Township
RIVER RD
MARIETTA AVE
KAMES HILL RD
FAIRVIEW RD
West Hempfield Township
LANCASTER COUNTY
YORK COUNTY
CHICKIES HILL RD
Susquehanna River
Hellam Township
30
Columbia Boro
462
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.125
0.25
0.5
0.75
1

Chickies Rock Park – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bradley's spleenwort *(Asplenium bradleyi)*	G4	S1	PE	1997-10-20	C
Waterpod *(Ellisia nyctelea)*	G5	S2	-	1991-05-14	C
Exceptional Natural Communities:					
Little bluestem-Pennsylvania sedge opening	-	S2	-	2007	C
Geologic Features:					
Chickies Rock Anticline	-	-	-	-	-

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location: Chickies Rock County Park is located along the Susquehanna River between Marietta and Columbia Boroughs.

- Municipalities:
  - East Donegal Township
  - West Hempfield Township
  - Columbia Borough
- USGS Quadrangles:
  - Columbia West Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference:
  - "Chickies Rock County Park: SP505, NA529, GE518" - (Columbia West Quadrangle)

Description: The dominant feature of the landscape is the large quartzite outcrop formed as part of an anticline, where the bedrock has been folded sharply upward in an arching fashion. From the top of the anticline there is a spectacular view of the Susquehanna River and its western shore. This popular public park includes sheer cliff faces as well as bottomland habitats along Chickies Creek at its confluence with the Susquehanna River. The parkland is mostly forested and provides necessary habitat for a number of native species due to its variety of habitat types. This large natural landscape functions as an important terrestrial component of the Susquehanna River regional habitat corridor.

Species of Concern Considerations:

Plants:

- Bradley's spleenwort is a fern of very limited distribution in Pennsylvania. Rock outcrops along the river-facing slopes provide habitat for Bradley's spleenwort at this location. Portions of the population occur on outcrops directly adjacent to the railroad rights-of-way. Rock outcroppings along this section of the track should be posted as "no spray" zones and vegetation managed by mechanical means only, with the presence of the rare species always a consideration. Removal of the forested canopy around rock out crops could alter the microhabitat conditions that the fern prefers; therefore, logging operations should not occur along the slopes facing the Susquehanna River. All of the currently known populations of this plant in PA occur on similar rock outcrops along the Susquehanna River or other scattered locations in Lancaster County. Since all of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large responsibility for its

continued existence in the state. The exact location of this species at all locations in the county should be limited to authorized researchers to avoid its extirpation by unauthorized collection. There are numerous outcrops in this area that should be considered potential habitat for this species. Additional surveys are recommended to more accurately determine the current extent of this species.

- Waterpod is a spring annual plant that grows on damp, shady stream banks with rich alluvial soils and sometimes in disturbed ground. The rich shady stream banks that ellisia depends upon are highly influenced by flooding events. Alteration of the natural flood cycle, dam building, increased erosion, and clearing of floodplain forests all affect the quality of suitable habitat. Populations are also threatened by loss of habitat from development and displacement by invasive plants. Protection of ellisia will require maintenance of known populations and preservation of rich, shaded stream bank communities. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.

Exceptional Natural Communities:

- The particular collection of plants covering portions of the sheer rock face of Chickies Rock is considered a "Little bluestem-Pennsylvania sedge opening" or, as it was known in the original Lancaster County NHI, a "Northern Appalachian Acidic Cliff Natural Community". These openings typically occur on dry, acidic sites where woody invasion is prevented or slowed by thin soil, droughty conditions, frequent fire or other natural disturbances (Fike 1999).

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Most of the park area is forested and includes both upland and floodplain communities including:
  - Terrestrial (upland) Communities:
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - modified successional forest*
    - shrubland*
  - Palustrine (wetland) communities:
    - Silver maple floodplain forest
    - Sycamore (river birch)-box elder floodplain forest

Ownership:

- Most of the species of concern core habitat as well as most of the supporting landscape is owned by the County of Lancaster and operated as a public park.
- The Norfolk Southern Rail Corporation owns a rights-of-way paralleling the shore of the Susquehanna River.
- PPL owns several parcels at the southern end of the Natural Heritage Area.

Habitat Disturbances:

- Historic –
  - The area was formerly used for mining and historical iron mills. Remnants of these activities are scattered through the site.
  - The landscape was considerably altered when Route 441 was rerouted and straightened, fragmenting the forested landscape into two smaller pieces. A valley was filled to level the road grade.
  - By 1940, the railroad had already been constructed along the eastern shore of the Susquehanna River, effectively severing the river from upland habitats for many species of small animals.

- Current –
  - The old trolley road is a popular hiking trail though the park, but is a wide fragmenting feature in the forested habitat that provides invasive species an avenue into the forest interior.
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders and small mammals that may consider the railroad an insurmountable obstacle.
  - Excessive deer browsing has reduced the quality and quantity of native understory vegetation including the regeneration of tree seedlings.
- Exotic Species –
  - Much of the top of the park is infested with numerous invasive plants due in part to the past mining disturbances and subsequent landscape alterations. The forest bordering the old trolley line is particularly overgrown with mile-a-minute, Japanese honeysuckle and tree-of-heaven.
  - The river floodplain is naturally susceptible to weedy plant invasion. The lower part of the park along Chickies Creek is a floodplain habitat that is invaded by fiveleaf-akebia, periwinkle, lesser celandine, and several large stands of bamboo in addition to the more common invasive plant species.
  - The railroad rights-of-way and the transition zone between forested and agricultural landscapes are also areas of considerable invasive plant species concentrations.
    - Norway Maple (*Acer platanoides*)
    - Tree-of-heaven (*Ailanthus altissima*)
    - Fiveleaf Akebia (*Akebia petiolata*)
    - Oriental bittersweet (*Celastrus orbiculatus*)
    - Garlic mustard (*Alliaria petiolata*)
    - Dame's rocket (*Hesperis matronalis*)
    - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
    - Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Japanese stilt grass (*Microstegium vimineum*)
    - Mile-a-minute (*Polygonum perfoliatum*)
    - Bamboo (*Pseudosasa japonica*)
    - Lesser celandine (*Ranunculus ficaria*)
    - Multiflora rose (*Rosa multiflora*)
    - Periwinkle (*Vinca minor*)

Conservation Actions:

Overall:

- Since this Natural Heritage Area is almost entirely within the County Park System, proper stewardship of the natural resources present is the top priority.
- Conserve the intact forest canopy and a healthy native shrub layer. Prohibit logging on the slopes facing the Susquehanna River. Removal of the forest canopy would likely result in drier and warmer microclimate conditions. Allow the forest of Chickies Rock Park to approach old growth conditions.
- Control invasive species of plants.

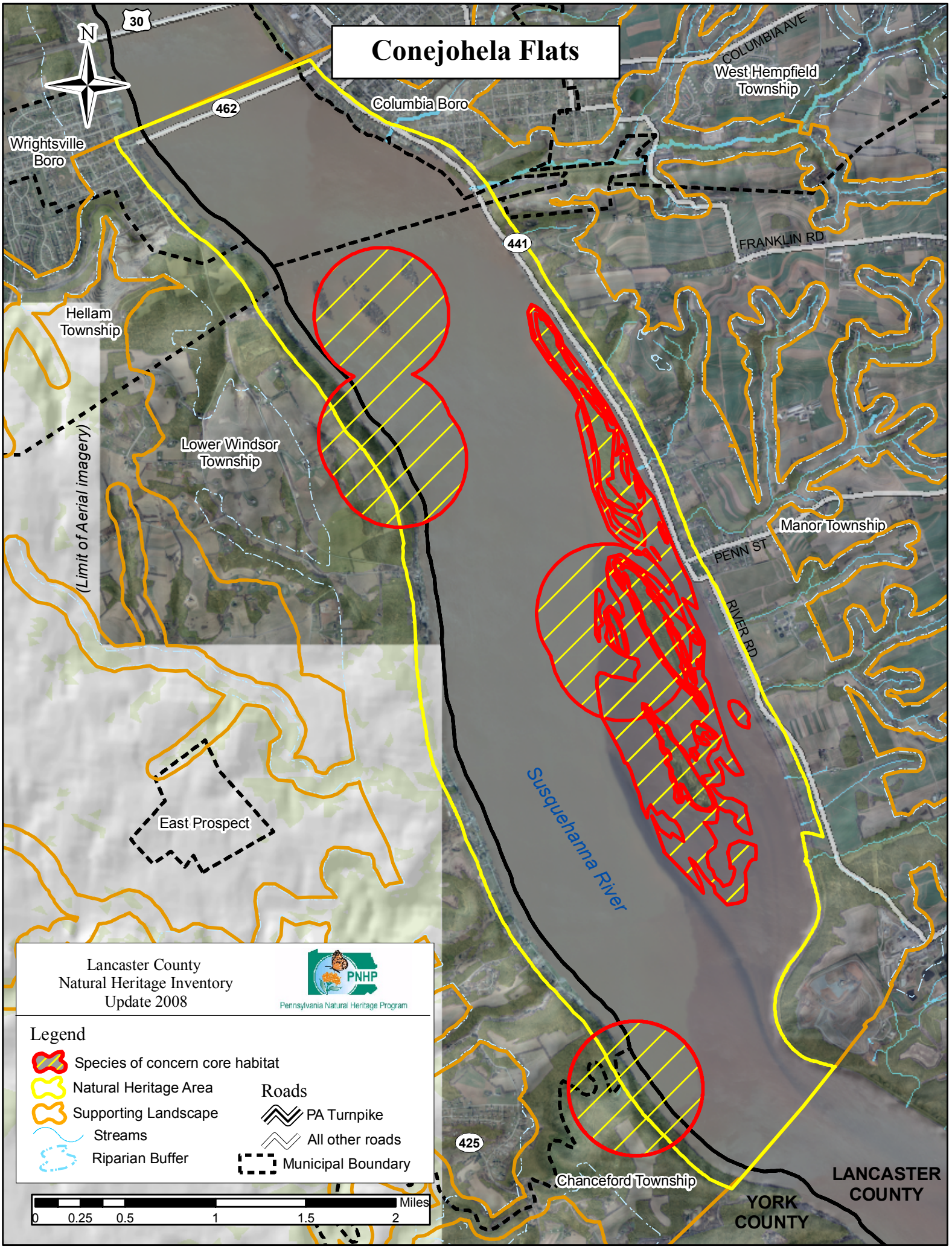
Within the Core Habitat:

- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-ways.

- Remove non-native species. The park is heavily infested with a variety of aggressive invasive plants. Radical measures may need to be taken in parts of the landscape, particularly in the floodplain of Chickies Creek and along the old trolley line at the top of the park.
  - Invasive species are typically a significant feature of the railroad rights-of-way and river floodplain. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
  - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
- Encourage native tree and shrub recruitment. Planting additional native species may be necessary. Insist that plants that are introduced into the landscape be native to the county and from local seed source. Strive to mimic the species composition of similar high quality natural communities in nearby locations.
- Reduce the size of the deer herd. Native and especially uncommon species of plants are particularly susceptible to deer herbivory. Over browsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominate the forest.
- Block access to forested areas by off road vehicles, ATVs and other motorized vehicles.
- Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.
- Additional surveys for rare species are recommended.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics.
- Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.
- Streams through forested areas should be considered high priority for conservation in the habitat.
- Stream segments lacking natural vegetation buffers should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
  - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
  - Intermediate forested buffer of 100 feet from 100-year floodplain
  - Minimum forested buffer of 35 feet from 100-year floodplain


Conejohela Flats
N
30
462
441
Columbia Boro
Wrightsville Boro
West Hempfield Township
COLUMBIA AVE
FRANKLIN RD
Hellam Township
Lower Windsor Township
(Limit of Aerial imagery)
Manor Township
PENN ST
RIVER RD
Susquehanna River
East Prospect
425
Chanceford Township
YORK COUNTY
LANCASTER COUNTY
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1
1.5
2

Conejohela Flats – *Exceptional significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Scarlet ammannia (*Ammannia coccinea*)	G5	S2	PE	2003-08-15	B
Tooth-cup (*Rotala ramosior*)	G5	S3	PR	2003-08-15	B
Animals:					
Great Egret (*Casmerodius albus*)	G5	S1B	PE	1986	F
Prothonotary Warbler (*Protonotaria citrea*)	G5	S2S3B	-	1989-06-02	B
Sensitive species of concern-(A)[3]	-	-	-	1991-05-18	E
Sensitive species of concern-(B)[3]	-	-	-	2003	E
Sensitive species of concern-(C)[3]	-	-	-	1989-06-02	E
Sensitive species of concern-(D)[3]	-	-	-	1987	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area describes the section of the Susquehanna River and the adjacent banks between the Columbia – Wrightsville Bridge down river to Turkey Hill, south of Washington Borough. The water level of this section of the river is impacted by Safe harbor Dam, which forms this slow water area referred to as Lake Clarke, a popular area for recreational boating.

- Municipalities:
  - Manor Township, (Lancaster County)
  - West Hempfield Township, (Lancaster County)
  - Columbia Borough, (Lancaster County)
  - Washington Borough, (Lancaster County)
  - Chanceford Township, (York County)
  - Hellam Township, (York County)
  - Lower Windsor Township, (York County)
  - Wrightsville Borough, (York County)
- USGS Quadrangles:
  - Columbia East Quadrangle
  - Columbia West Quadrangle
  - Red Lion Quadrangle
  - Safe Harbor Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference:
  - "Rookery Islands (Conejohela Flats)" – (Columbia East Quadrangle)
  - "Rookery Islands (Conejohela Flats)" – (Safe Harbor Quadrangle)



Description: Conejohela Flats is a combination of small brushy islands and mud flats located in the Susquehanna River just west of Washington Borough. The series of islands and the shoreline are periodically

disturbed by seasonal flooding and scouring by ice. The mud flats are also exposed when the water level is lowered by the Safe Harbor Dam to generate electricity. This area has been designated an Important Bird Area by the Pennsylvania Audubon Society primarily because the mud flats provide an important habitat for shore birds that is found in few other locations in Pennsylvania. A rookery, (a concentrated breeding area for birds), exists within the island habitat. Many other species of wetland birds and waterfowl also use this area during migration. During one survey, 73 species of wadding birds, ducks and shorebirds were observed. Grassy flats and gravel bars are important for feeding and resting during both spring and fall migration. The adjacent uplands and forested slopes are an important aspect of this Natural Heritage Area, as these terrestrial habitats provide essential nesting and breeding locations for several of the species of concern.

Species of Concern Considerations:

Plants:

- Scarlet ammannia is a globally secure (G5) though state imperiled (S2) plant that inhabits various damp to wet habitats, especially on the shorelines of rivers, streams, and ponds, and may also be found in human-created disturbances that simulate natural habitats. The core habitat for this species is primarily along the damp edges of the islands, mudflats and shallow water areas. The higher elevations of the islands are not considered part of the primary habitat for this species. Conservation of this habitat type will help this species persist at this location.
- Tooth cup is a globally secure (G5), state rare (S3) annual plant that occupies exposed shorelines, stream margins, streambed outcrops, and other damp, open places. The populations of toothcup that occur along streams and rivers can be enhanced by maintaining the natural seasonal fluctuations in the water level of the stream and the natural conditions of its shoreline. The core habitat for this species is primarily along the damp edges of the islands, mudflats and shallow water areas. The higher elevations of the islands are not considered part of the primary habitat for this species.

Animals:

- Prothonotary Warblers were documented successfully nesting for much of the 1980s. Recent records for this bird's success at this location are lacking. The islands and the adjacent floodplain forests are the primary habitats for this species at this location. Because this bird nests in tree cavities, dead trees along the river shore and adjacent wetlands should be left standing to provide nesting habitat. Recreational boaters can have a significant negative impact on the breeding success of this species. Harassment of nesting locations can cause adults to abandon the site. A buffer from boating activities needs to be established around nesting locations during breeding season to help prevent inadvertent conflict.
- Great Egret was observed successfully nesting at this location in 1986, but has not been documented recently. This area was considered a failed breeding location for this species in 1988 and 1989. Though the species has been regularly observed in the area, only breeding occurrences are considered as core habitat for bird species of concern. Regular breeding season surveys of the area should be conducted with consideration of the potential to disrupt nesting behavior. Recreational boaters can have a significant negative impact on the breeding success of this species. Harassment of nesting locations can cause adults to abandon the site. A buffer from boating activities needs to be established around nesting locations during breeding season to help prevent inadvertent conflict.
- A sensitive species of concern (A) utilizes the steep, dry, southwest-facing wooded slopes along the Susquehanna River. The suitable habitat for this species is mapped as occurring from Turkey Hill all the way down to the mouth of the Conestoga River. The core habitat for this species overlaps with the Fry's Run Slopes Natural Heritage Area. A dead specimen was found between the two rails of the train tracks along the river. The railroad can be a substantial barrier for small animal movement between upland and lowland habitats. Periodic under-track culverts, or other means of mitigating the barrier effect of the tracks, should be integrated into future railroad maintenance plans.

- Several populations of three additional sensitive species of concern (B, C & D) were documented along this stretch of the river. The core habitat for these sensitive species of concern is both the river and the adjacent upland forest. These sensitive species of concern require abundant food source in the river and its tributaries as well as breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Susquehanna River and by protecting and expanding the natural vegetation buffer along the river and all its tributaries. Recreational boaters can have a significant negative impact on the breeding success of these species. Harassment of nesting locations can cause adults to abandon the site. A buffer from boating activities needs to be established around nesting locations during breeding season to help prevent inadvertent conflict.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- This Natural Heritage Area is drawn tightly along the banks of the Susquehanna River, with most of the area in the river itself. The natural communities are primarily associated with the river floodplain, which is dominated by silver maple floodplain forest and river birch-sycamore floodplain scrub. Lower islands have expanses of grassy flats and sand/gravel bars.
- The western shore of the river and the adjacent uplands have significant patches of forest cover including several interior forest blocks.
- The Lancaster County side of the river is dominated by agriculture, urban and suburban land uses with only a few small parcels of forest cover remaining. The floodplain between the railroad tracks and the river is seasonally flooded and contains remnants of a silver maple floodplain forest.
    - Terrestrial (upland) communities:
        - Red oak-mixed hardwood forest
        - Hemlock-tuliptree-birch forest
        - Dry oak-heath forest
        - modified successional forest*
    - Palustrine (wetland) communities:
        - River birch-sycamore floodplain scrub
        - Silver maple floodplain forest

Ownership:

- Much of the species of concern core habitat occurs in floodplain habitat that is subject to such intense flooding that it should be considered part of the river.
- Most of the islands in the river are owned by Safe Harbor Water Power Corporation, and many contain areas leased for seasonal cabins. Safe Harbor also owns several parcels along the river shoreline.
- Lancaster County Conservancy owns a forested parcel just north of Turkey Hill.
- The Norfolk Southern Rail Corporation owns a rights-of-way paralleling the shore of the Susquehanna River.
- The Lancaster Area Sewer Authority owns several large parcels just south of Washington Borough.
- Much of the undeveloped floodplain and upland shoreline is owned by a number of private property owners and maintained in agricultural production.

Habitat Disturbances:

- Historic –
    - The original forest cover of the area had been removed and converted to agricultural uses over the past several centuries, leaving little of the original vegetation in place on the

Lancaster County side of the river. Portions of the York County side of the river remains in natural forest cover likely due to the steepness of the terrain. Where the topography was flat enough, first agriculture then suburban development replaced the original forest cover. The boroughs of Columbia, Wrightsville & Washington were constructed on the banks of the river including a portion of the floodplain. Additional narrow areas along the river shoreline were developed on both sides of the river, especially Long Level Road in York County.

- Aerial photographs from the 1940s show that many of the smaller islands, which were less affected by flooding than the larger ones, were mostly cleared and used for agriculture.
- Safe Harbor Dam was built in the early 1930s to create electric power. As the water backed up to create Lake Clarke, shallow water habitats and many smaller islands were permanently flooded. The construction of many smaller dams on the Susquehanna River and its tributaries in the early 1800s severely reduced the American shad and other anadromous fish (which live in the ocean, but spawn in freshwater) from much of their traditional spawning streams. Catadromous fish such as American eel, which live in fresh water habitats but spawn in the ocean, were also severely affected by dams large and small in the Susquehanna River watershed. Many dams were breached in the late 1800s and the fish migration temporarily resumed. The construction of the series of four large hydroelectric dams on the Susquehanna River between 1904 and 1932 eliminated the anadromous and catadromous fish from the upper reaches of the Susquehanna almost to the close of the century. Fish trap and transport programs implemented during the 1970s moved fish upriver by trucks in an effort to bolster shad populations. Improved fish ladders were constructed on the Holtwood and Safe Harbor dams in the 1990s to reopen the upper Susquehanna River for shad spawning. Effective downstream fish passages for eels have not been developed and eels remain eliminated from their historic range in the Susquehanna watershed.
- Railroad tracks were built along the shoreline of the river, effectively severing the river from much of the original floodplain and the adjacent uplands.

o Current –

- The four hydroelectric dams on the Susquehanna River provide the major obstacle to anadromous and catadromous fish migration. Recently installed fish ladders have improved the condition for anadromous fishes, but catadromous fishes continue to be excluded from the Susquehanna River watershed.
- Several of the islands are heavily populated with leased seasonal cabins. The habitat of the islands is significantly degraded by the density of cabins, their outbuildings, docks and debris. Recent aerial photographs show the islands as flooded. These flooded seasonal residences can contribute significantly to the contamination of the Susquehanna River.
- The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like reptiles, amphibians and small mammals that may consider the railroad an insurmountable obstacle.
- Residential development has increased along the York County side of the river.
- Many small towns, cottages and residences have been built along the both shores of the river, disturbing, altering and removing the natural river shore floodplain habitat.
- Recreational boaters can have a significant negative impact on the breeding success of nesting birds. Harassment of nesting locations can cause adults to abandon the site. A buffer from boating activities needs to be established around the large islands during breeding season, which host most of the nesting locations, to help prevent inadvertent conflict. Wave action from motorboats can also have an impact on the shallow water habitats in the area. Increased wave action can dislodge small plants from mudflats.

- Turkey Hill, to the north of the Natural Heritage Area, has been developed as a landfill for Lancaster County.
- Garden debris and other refuse dumped into the river floodplain can be a significant source of invasive plant species and general habitat degradation.

- Exotic Species –
  - The river floodplain is naturally susceptible to weedy plant invasion. The railroad rights-of-way and the transition zone between forested and agricultural landscapes are also areas of greatest invasive plant species concentrations. The river's edge is particularly susceptible to invasion by purple loosestrife and Japanese knotweed, which are common invaders of wetland edges.
    - Tree-of-heaven (*Ailanthus altissima*)
    - Mile-a-minute (*Polygonum perfoliatum*)
    - Multiflora rose (*Rosa multiflora*)
    - Common mugwort (*Artemisia vulgaris*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Japanese knotweed (*Polygonum cuspidatum*)
    - Purple loosestrife (*Lythrum salicaria*)
    - Japanese hops (*Humulus japonicus*)

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and York Counties.
- Prevent fragmentation and incursions into the forested landscape.
- Protect and expand the natural vegetation along both shores of the river floodplain and adjacent upland. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along the eastern shore of the river. Encourage agricultural areas along the banks of the river and its adjacent bluffs to retreat from the river's edge and to revert to a forested landscape. The forested landscape helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species.
- Avoid building, replacing or expanding dams on the Susquehanna River.
- While many sections of tributaries to the Susquehanna River here have adequate vegetated riparian buffers, many sections of streams, as well as the river shoreline itself, need additional restoration measures. Numerous stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from agricultural runoff. High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat in this section of the river. Establish a 300-meter buffer of native woody vegetation along the Susquehanna River shore where open space exists and a 100-meter vegetated buffer along all segments of tributary streams to help protect the water quality of the river by reducing erosion, sedimentation, and pollution. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river.
- Suppress the establishment and spread of invasive species of plants.
- Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics.

Within the Core Habitat:

- Discourage the establishment of seasonal cottages and year-round residences along the river shoreline and river islands. Limit and reduce the number of seasonal cabins on the shoreline and islands of the river. There are currently too many seasonal cabins on many of the islands, particularly Mud Island, Garden Island and Heises Island. Septic systems for these structures

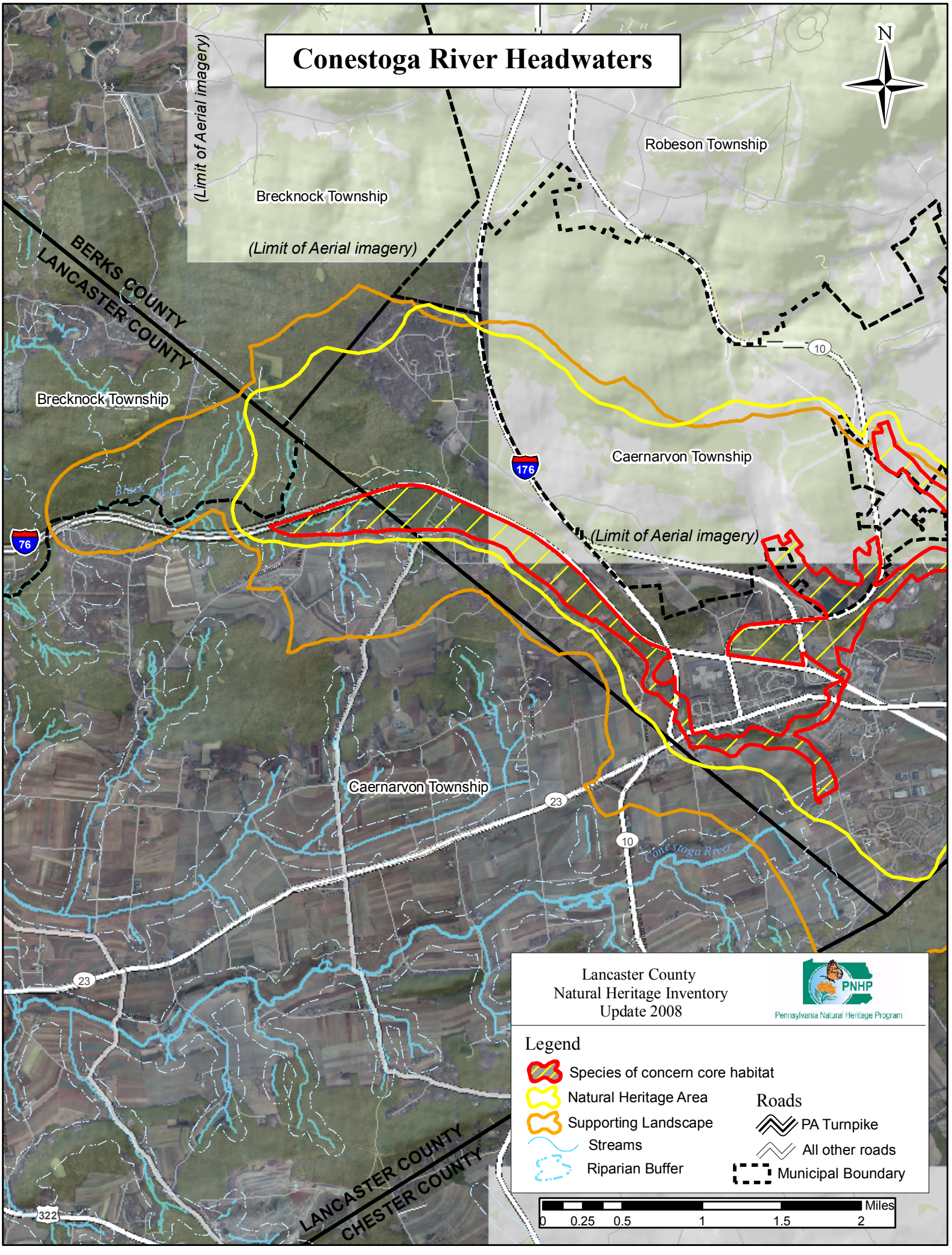
are frequently inadequate or nonexistent. Disturbance on shorelines and islands includes loss or impairment of critical habitat due to construction of cabins, access roads, boat docks, lawns and vegetation clearing. Some vegetation removal can be beneficial to the habitat, but an increase in island or shoreline cottages can only result in a decrease in habitat for species adapted to these specific habitat conditions. The floodplain habitat of the river would be improved by the removal of the residences within the floodplain. The island habitat would be improved by the removal of seasonal cabins.

Within the Natural Heritage Area / Supporting Landscape:

- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along both shores of the river. Expand the native vegetation along the river corridor to include land within 300 meters of the river's banks. Reforestation efforts should be designed to mimic the adjacent natural community type by recruiting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way especially along the river shoreline and any large forested blocks. Preserve and improve the integrity of the large unfragmented forest blocks on the western shore of the Susquehanna River. These large forested areas provide a significant filter for runoff entering the river from these slopes. The steep, rocky nature of the wooded slopes likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites. Avoid activities that would fragment this habitat or create more edge areas, such as road building, which encourage the introduction of invasive plants or edge-adapted species and diminish the habitat available to interior forest dwelling species.
- Avoid logging activities on slopes adjacent to the Susquehanna River to allow for the development of old growth conditions. The immediate watershed draining into the river includes some forested areas and agricultural fields. Logging of wooded areas, specifically along steep slopes and riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers and other sources can accumulate in the river leading to algal blooms and the consequent death of aquatic organisms. The amount of impervious surfaces around the river can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the river.
- The habitat of the shoreline floodplain would be improved by the removal of residences within the floodplain of the river.
- Pursue conservation easements and fee simple acquisition on properties along the river shoreline, the adjacent slopes and forested plateaus to help conserve the effectiveness of the Susquehanna River natural corridor.
- Potential zoning options for conservation enhancement:
    - Manor and West Hempfield Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to unsuitable uses and help protect most of the species of concern core habitat.
        - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% would help prevent the forested slopes from being converted to other uses.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Parcels currently forested should be zoned to conserve this attribute.

- Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
- Growth within the Township should be discouraged to occur within 300 meters of the 100-year floodplain of the river or within 100 meters of the floodplain of its tributaries.
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction, particularly along the shoreline of the Susquehanna River.

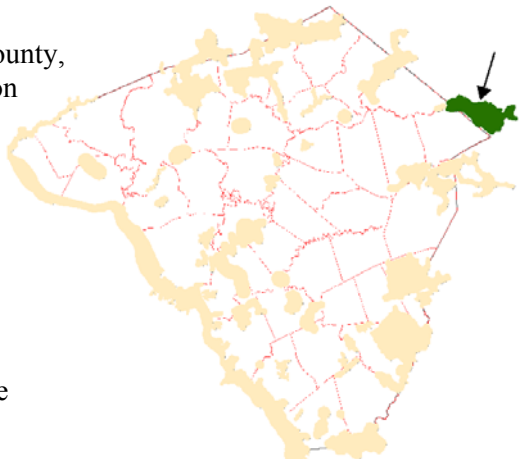
- Potential restoration activities:
  - Streams through forested areas should be considered high priority for conservation in the habitat. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
  - Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, Japanese hops, multiflora rose and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Invasive species are a significant feature of the railroad rights-of-way and river shorelines. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
    - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.


Conestoga River Headwaters
N
(Limit of Aerial imagery)
Brecknock Township
Robeson Township
(Limit of Aerial imagery)
BERKS COUNTY
LANCASTER COUNTY
Brecknock Township
Caernarvon Township
(Limit of Aerial imagery)
Caernarvon Township
Conestoga River
LANCASTER COUNTY
CHESTER COUNTY
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.25 0.5 1 1.5 2

Conestoga River Headwaters – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Sensitive species of concern [3]	-	-	-	2000-06-17	CD

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3]This species is not named at the request of the agency overseeing its protection



Location: Most of this Natural Heritage Area occurs in Berks County, with only a small portion occurring in Brecknock and Caernarvon Townships in Lancaster County.

- Municipalities:
  - Brecknock Township, (Lancaster County)
  - Caernarvon Township, (Lancaster County)
  - Caernarvon Township, (Berks County)
- USGS Quadrangles:
  - Elverson Quadrangle
  - Morgantown Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: This landscape contains a diversity of habitats within a landscape formerly dominated by agriculture, which is rapidly converting to other uses. Large blocks of forest remain in the area, likely due to the presence of a hard diabase bedrock which prevented its conversion to agricultural uses. Though the large forested blocks have been fragmented by many roads including the PA Turnpike and US-176, significant patches of interior forest remain. Wetlands along the Conestoga River and its tributaries provide habitat for wetland species of plants and animals. The forested habitats and stream corridors of this Natural Heritage Area help connect the Furnace Hills and Welsh Mountains Hubs to similar habitats within the Bowmansville Hills Forests Hub and to locations outside of the county.

Species of Concern Considerations:

- The sensitive species of concern inhabiting these shallow wetlands requires specific plant communities within a matrix of open canopied habitats. Restoration of the marshy habitats historically associated with the creek floodplains will help to provide expanded habitat opportunities for this sensitive species of concern.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The forested hillsides are dominated by a tuliptree-beech-maple forest, while smaller patch communities occur along the creek floodplains.
  - Terrestrial (upland) communities:
    - Tuliptree-beech-maple forest
  - Palustrine (wetland) communities:
    - Red maple-black gum palustrine forest
    - Red maple-mixed shrub palustrine woodland
    - Bluejoint-reed canary grass marsh

Ownership: Most of the supporting landscape extending into Lancaster County for this area is owned by the PA Game Commission and maintained for hunting. Property ownership within Berks County was not considered for this project.

Habitat Disturbances:

- Historic –
  - Morgantown was established along the Conestoga River floodplain and most of the river valley had been converted to agriculture, mining and other uses over several centuries.
- Current –
  - The large highways split formerly intact habitats and present an impenetrable barrier to many animals. These isolated populations need to be reconnected to allow genetic intermingling of these populations.
  - The highways that intersect here have initiated the construction of associated commercial, industrial and residential development in the vicinity of Morgantown.
- Exotic Species –
  - The exotic species composition and threat of this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as a linear wetland complex, composed of multiple types of wetlands along a wide forested upland stream corridor. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. If beavers expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented in the near future if they don't already exist here.

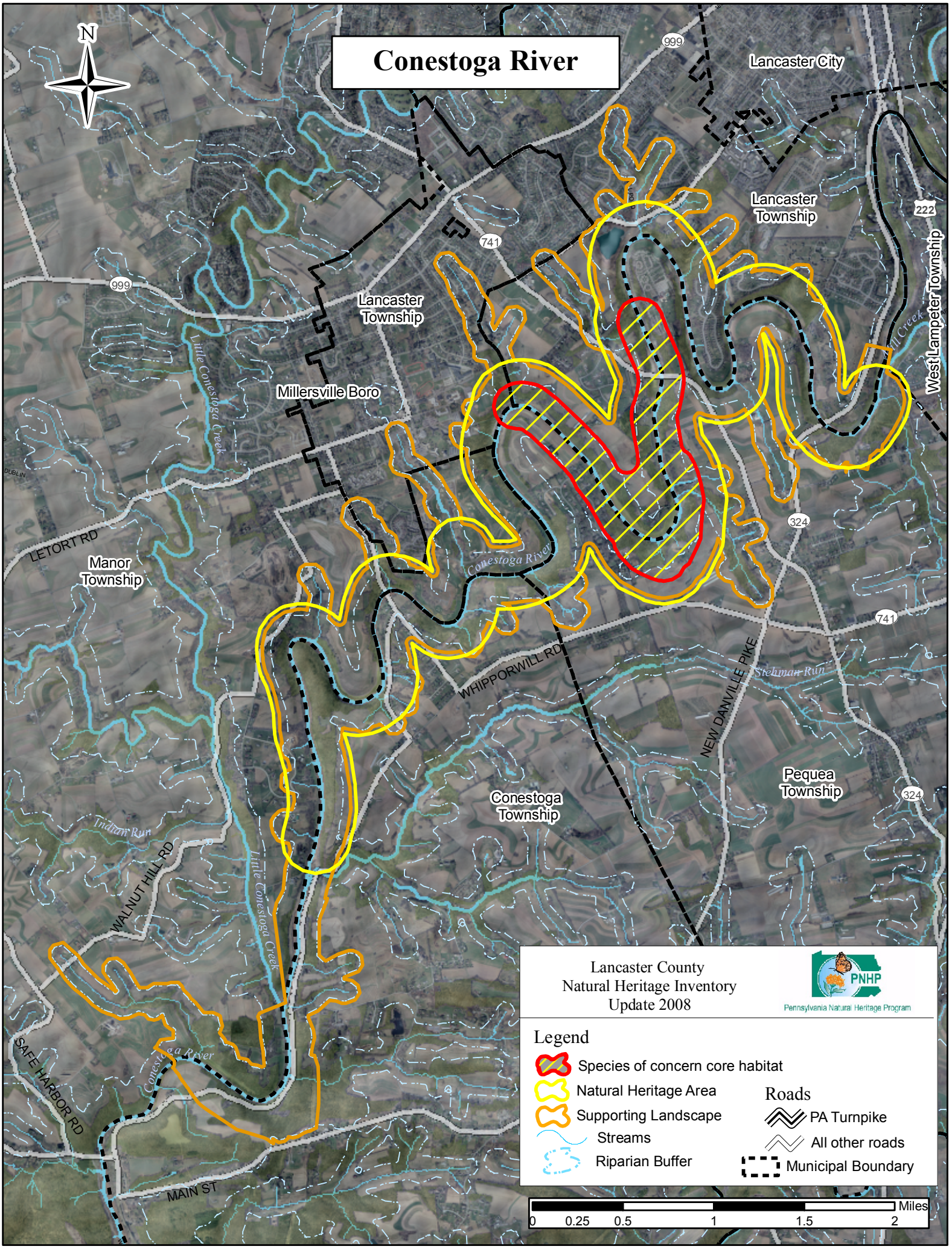
Within the Core Habitat:

- Long term goals of this Natural Heritage Area should be to restore a series of slow moving marsh systems along this portion of the Conestoga River and its tributaries.
- The sensitive species of concern known from this Natural Heritage Area would benefit from habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
  - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
  - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
  - Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be explored, in order to recreate the natural flows of the landscape.
  - Because several of the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within in this Natural Heritage Area.

- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for the species of concern core habitat:
  - The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced; rather, their basins should naturally revert to their original condition.
  - Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
  - The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.

Within the Supporting Landscape:

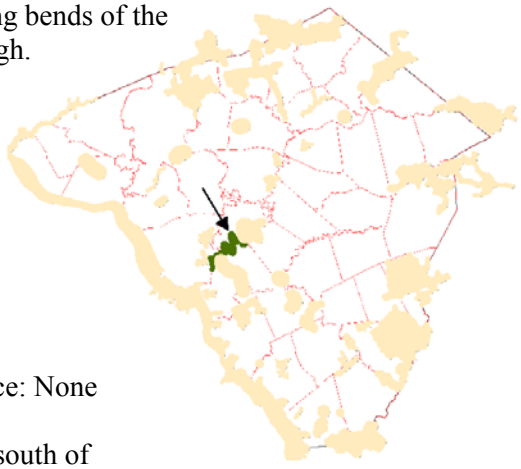
- Preserve the integrity of large forested areas by avoiding additional fragmenting features such as roads, development and utility infrastructure.
- Reestablishment of the wide floodplain and its associated wetlands, swamps and wet meadows would serve as an effective buffer to flooding that may occur downstream.
- Restore and enhance habitat connections between the north and south sides of the PA Turnpike. This could be achieved by the construction of green underpasses, overpasses and culverts. Restoration at key locations can help re-establish the migratory corridor function to the landscape.
- Clay and West Cocalico Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. In addition, Clay Township also includes the 500-year floodplain and lands containing alluvial or floodplain soils in its floodplain district. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
  - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the floodplain district as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
  - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
    - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
    - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.


Conestoga River
N
Lancaster City
Lancaster Township
Millersville Boro
Manor Township
Conestoga Township
Pequea Township
West Lampeter Township
LETORT RD
WHIPPORWILL RD
NEW DANVILLE PIKE
WALNUT HILL RD
SAFE HARBOR RD
MAIN ST
Little Conestoga Creek
Indian Run
Stehman Run
999
741
222
324
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
0 0.25 0.5 1 1.5 2
Miles

Conestoga River – *High significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Animals:					
Sensitive species of concern- (A)[3]	-	-	-	2003	E
Sensitive species of concern- (B)[3]	-	-	-	1982-06	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area is located along the winding bends of the Conestoga River between Lancaster City and Millersville Borough.



- Municipalities:
  - Conestoga Township
  - Lancaster Township
  - Manor Township
  - Millersville Borough
  - Pequea Township
- USGS Quadrangles:
  - Conestoga Quadrangle
  - Lancaster Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference: None

Description: The Conestoga River makes a series of tight bends south of Lancaster City, on its way to the Susquehanna River. Much of the adjacent upland has adequate forest cover on the steep slopes along portions of the shoreline. The Conestoga River appears to be a divide between the heavily urbanized Lancaster City and its surroundings on the northern side of the river, and the intensively cultivated agricultural landscape on the southern side of the river.

Species of Concern Considerations:

- Two sensitive species of concern were documented along this stretch of the Conestoga River. The core habitat for these sensitive species of concern is both the river and the adjacent upland forest. These species may utilize slightly different locations up and down this stretch of the river every year. These sensitive species of concern require abundant food source in the river and its tributaries as well as breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Conestoga River and by protecting and expanding the natural vegetation buffer along the river and all its tributaries. Harassment of nesting locations can cause adults to abandon the site. Additionally, the forested upland area in the core habitat needs to be protected from disturbances during the spring and early summer breeding season. An expansion of the vegetated/forested buffer along the length of the Conestoga River will help improve water quality and nesting habitat and can be the primary factor for continued success of this species at this location.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The natural communities within this area include:
  - Terrestrial (upland) communities:
    - Hemlock (white pine)-red oak-mixed hardwood forest
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - modified successional forest*
    - shrubland*
    - grassland*
  - Palustrine (wetland) communities:
    - Sycamore (river birch)-box elder floodplain forest
    - wet meadow*
- The Natural Community types are closely associated with the Conestoga River, its floodplain and the adjacent uplands. The majority of the landscape of the Conestoga River watershed has been converted from its original native vegetation to intensive agricultural production and the highly urban and suburban surroundings of Lancaster City. The fragments that remain are primarily narrow strips along the banks of streams and steep slopes, forming the framework of riparian corridors. Most of these narrow strips of forest are highly impacted by edge effects and are considered "modified successional forest". Some of these remnants are considered of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as modified successional forest are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers.

Ownership: This Natural Heritage Area is in close proximity to the heavily populated Lancaster City and its suburbs. Most of the habitat is broken into many small private lots particularly on the northern side of the river, making broad conservation action less likely. However, several larger parcels remain in this rapidly developing region of the county, primarily on the southern side of the river. Conservation activity should focus on these larger parcels before land subdivision impedes conservation progress.

- Millersville University owns several large parcels along the river in close proximity to the core habitat for the species of concern.
- Lancaster County Conservancy owns a small portion of forested slope along the river corridor at the northern edge of the supporting landscape.
- Lancaster Township owns a small partly wooded and grassy parcel at the tip of a bend in the river that appears to function as a public park for the adjacent housing development.
- The remaining large parcels are privately owned. Several are owned by real estate development corporations and are currently undergoing subdivision and conversion to residential development.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture, which in turn was largely replaced by urban and suburban development. Only small isolated pockets of natural vegetation remained to provide habitat for native plants and animals.
  - Two milldams were active along this stretch of the Conestoga River. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a

deep channel through the accumulation of sediment. Portions of the historic Conestoga River floodplain remain trapped in these deep, narrow channels.
    - A quarry had been operating along the banks of the river, but has since filled with water.
- Current –
    - Much of the landscape that had in the past been dedicated to agricultural production has since been converted to residential development. In particular, most of the land north of the river and several of the loops within the Conestoga River have been completely or partially filled with residential development. A campground completely occupies another river loop.
- Exotic Species –
    - The exotic species composition and threat to this location is undocumented, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants. Control of invasive plants and restoration of native vegetation will likely be necessary.

Conservation Actions:

- The overall objective for this area should be to restore and establish a wide forested/vegetated riparian corridor along this stretch of the Conestoga River and its tributaries.
- Protect and expand the natural vegetation along both shores of the river floodplain and adjacent upland. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along the shoreline of the river. Encourage agricultural areas along the banks of the river to retreat from the river's edge and to revert to a forested or wetland landscape as is suitable to the topography and hydrology. The forested/vegetated landscape helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for many species of animals and plants.
- Suppress the establishment and spread of invasive species of plants.
- Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics.
- The establishment of a wide linear habitat corridor along the river could be compatible with a carefully sited public hiking / biking trail.

Overall:

Within the Core Habitat:

- Establish a corridor of naturally vegetated public space within 100 meters of the river's edge. Fragmentation of ownership of the habitat limits the potential for consistent conservation habitat management. The forested floodplain along this stretch of the Conestoga could be an appropriate location for a linear municipal park serving Lancaster City and Millersville Borough. Emphasis should be on promoting a viable floodplain natural community rather than on active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protection and expansion of areas with native vegetation and restoration and protection of the natural condition of the shoreline. Any trails constructed though the area should stay at least 50 feet from the river banks to avoid degrading the fragile shoreline.
- Incorporate the public space/ natural corridor into future subdivision development plans along the river.
- Restoration of vegetated stream buffers along the Conestoga River and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conestoga River, Susquehanna River and the Chesapeake Bay.
- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions. Storm water runoff through urban areas can be a significant source of chemical pollutants for the river, which can severely impact water quality and the food chain of the river. The use of herbicides, pesticides and fertilizers in agricultural production can also have a

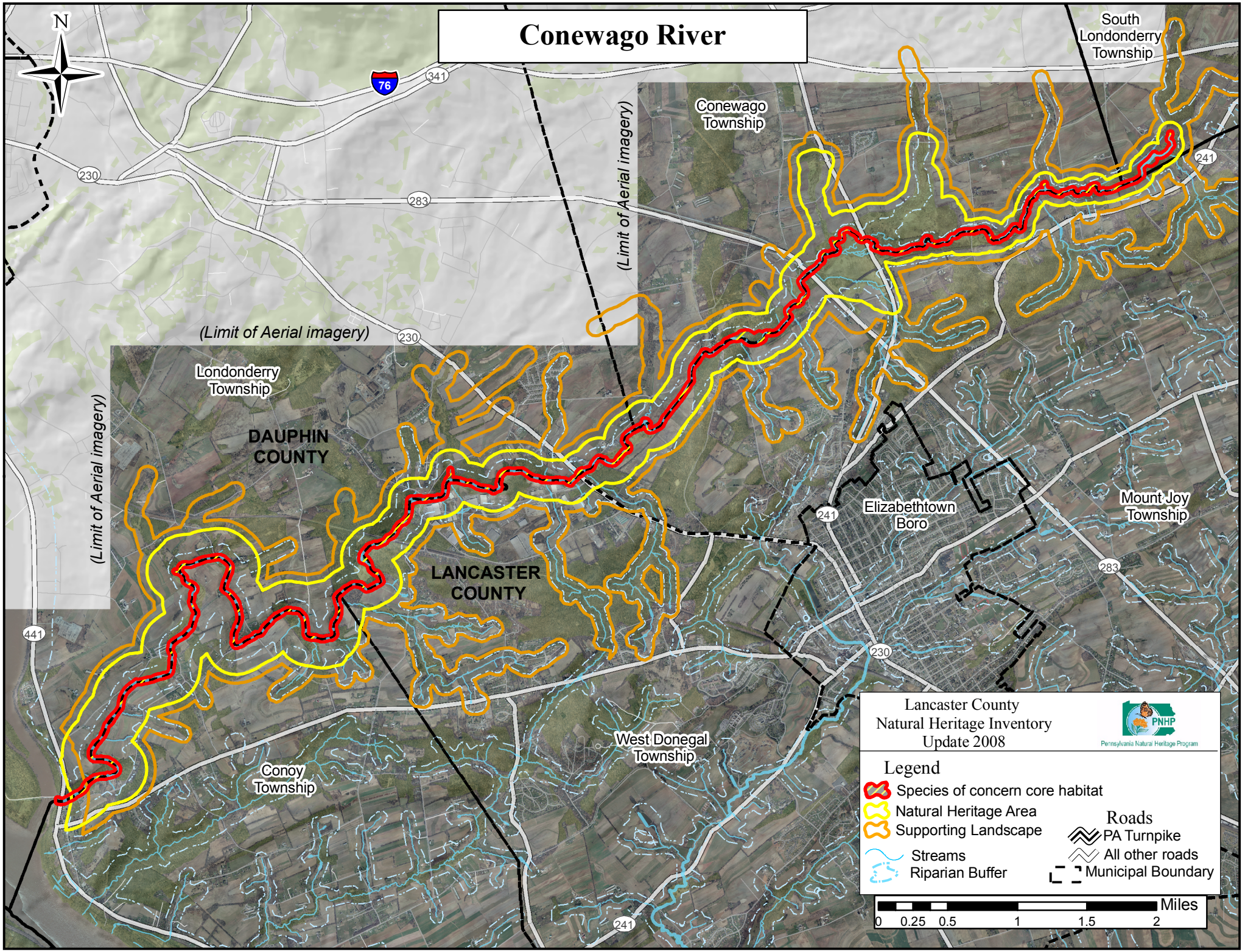
significant impact on the water quality at this location. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to slow and capture water flow in these expanses of urban and cultivated landscapes. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern.

Within the Natural Heritage Area / Supporting Landscape:

- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along both shores of the Conestoga River. Ideally, expand the native vegetation along the river corridor to include land within 100 meters of the river's banks. Alternately, the 100 foot riparian buffer can substitute for the 100 meter buffer where development has already eliminated the preferred option. Reforestation efforts should be designed to mimic the adjacent natural community type in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way especially along the river shoreline and any remaining natural habitats. These natural habitats provide a significant filter for runoff entering the river from the adjacent uplands.
- The immediate watershed draining into the river includes some forested areas and agricultural fields. Logging of wooded areas, specifically along steep slopes and riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers, road and parking lot runoff and other sources can accumulate in the river leading to the consequent death of aquatic organisms. The amount of impervious surfaces around the river can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the river. Specific recommendations for reducing and preventing pollution of surface and groundwater can be found in various sources including the Urban Subwatershed Restoration Manual Series produced by the Center for Watershed Protection (http://www.cwp.org/index.html)
- Pursue conservation easements and fee simple acquisition on properties along the river shoreline, the adjacent slopes and adjacent farmlands to help improve the effectiveness of the Conestoga River as a habitat and natural corridor.
- Potential zoning options for conservation enhancement:
  - Conestoga, Lancaster, Manor and Pequea Townships all have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. In addition, Lancaster and Pequea Townships extend the floodplain district to the 500-year floodplain.
    - Lancaster Township's floodplain regulation appears to provide for the establishment of a 100-foot forested riparian buffer on all water courses in the Township, but this appears to conflict with a regulation requiring only a 15–foot grass strip between tilled land and water courses (Section 1310.8 A-E). A 100-foot forested riparian buffer along all water courses is a reasonable and achievable goal and would go a long way towards protecting and improving water quality locally as well as regionally, while the 15-foot grass strip will offer a bare minimum of water quality protection.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.

- Strict enforcement of regulations restricting building activity on slopes greater than 25% would help prevent the adjacent forested slopes from being converted to other uses.
- Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Parcels currently forested should be zoned to conserve this attribute.
- Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest/natural vegetation cover.
- Growth within the Township should be discouraged to occur within 100 meters of the 100-year floodplain of the Conestoga River or the recommended riparian buffer of its tributaries.
    - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction.

- <u>Potential restoration activities</u>:
    - Riparian buffers:
        - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
        - All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
            - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
            - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests.
                - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
                - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
                - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain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DAUPHIN COUNTY
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Elizabethtown Boro
Mount Joy Township
West Donegal Township
Conoy Township
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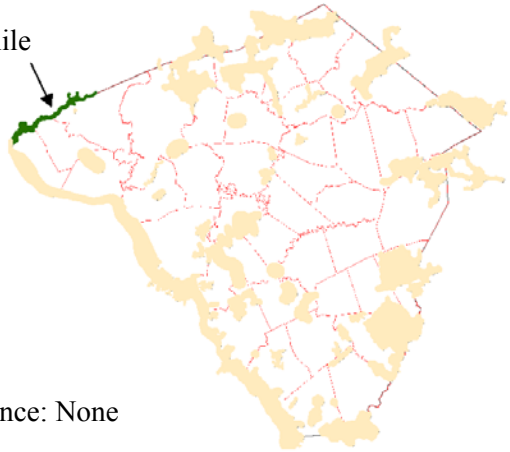
441
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.25 0.5 1 1.5 2

Conewago Creek – *Notable significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Triangle floater mussel (*Alasmidonta undulata*)	G4	S3S4	-	2004-08-07	E
Yellow lampmussel (*Lampsilis cariosa*)	G3G4	S3S4	-	2004-08-07	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This Natural Heritage Area is designated along the ten mile length of Conewago Creek between the Pennsylvania Turnpike to the Creek's confluence with the Susquehanna River.



- Municipalities:
  - Conoy Township, (Lancaster County)
  - Mount Joy Township, (Lancaster County)
  - West Donegal Township, (Lancaster County)
  - Londonderry Township, (Dauphin County)
- USGS Quadrangles:
  - Middletown Quadrangle
  - Elizabethtown Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference: None

Description: Conewago Creek is the boundary between Lancaster and Dauphin Counties. The creek passes though a mostly agricultural landscape, but includes significant blocks of forested habitat, including several interior forest patches. Though the creek is largely bedded in shale-sandstone, there is a large intrusion of diabase bedrock paralleling the length of the creek. Large patches of forest in the area coincide with exposed rounded boulders and thin soils over diabase bedrock, which discouraged agricultural activities. Conewago Creek should be considered potentially one of the primary forested riparian corridors in the county. The creek and surrounding natural habitats, with some careful restoration, can facilitate animal migration in an east-west direction, connecting the Furnace Hills forested corridor to the Susquehanna River. A wide forested, naturally vegetated corridor along both shores of the creek would be compatible with a linear park or trail system. The Conewago Recreational Trail already serves as the trail, but the area would benefit from the restoration of floodplain forests and marshes on both sides of the creek.

Species of Concern Considerations:

- Two freshwater mussel species of concern, triangle floater and yellow lampmussel have been documented at several locations along the length of the creek along with three additional native species of mussels during surveys conducted by local naturalist, Larry Coble. The occurrences are within a close enough proximity to be considered a single population occurrence, so the entire length of the creek from the headwaters to its confluence with the Susquehanna River should be considered core habitat for these freshwater mussel species. Mussels are filter feeders and are strongly impacted by poor water quality and unsuitable creek bed substrate. Mussels exist as a parasite on certain

fish species in their early life stage, and decreased populations of the host fish can negatively affect mussel populations. Dams that impede fish migration also restrict the habitat available to mussels. All streams, creeks and tributaries to the Conewago Creek should have wide forested/vegetated buffers in order to help ensure proper water quality for freshwater mussel habitat. Impediments to fish movement such as dams and improper stream crossings should be corrected to improve available habitat for mussels and their fish hosts.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The floodplain of the creek is dominated by modified successional forest, which is typically associated with fragmentation and past disturbances dominated by early successional, weedy tree species, invasive plants, and vines and are likely in the early stages of recovery from past agricultural activity. The floodplain and adjacent uplands do contain small remnant stands of higher quality natural communities that can be considered reference communities for future restoration activities.
- The diabase bedrock area is dominated by several forest types, primarily tuliptree-beech-maple forest and dry oak-mixed hardwoods forest. The forests along the diabase bedrock intrusion includes many patches of interior forest. In addition, these natural community types were delineated in this large area:
  - Terrestrial (upland) communities:
    - Hemlock-tuliptree-birch forest
    - Tuliptree-beech-maple forest
    - Red oak-mixed hardwood forest
    - Dry oak-mixed hardwood forest
    - juniper-hardwood woodland*
    - modified successional forest*
    - juniper-mixed shrub woodland*
    - shrubland*
    - grassland/hay/agriculture*
  - Palustrine (wetland) communities:
    - Silver maple floodplain forest
    - Sycamore (river birch)-box elder floodplain forest
    - Red maple-elm-willow floodplain swamp
    - River birch-sycamore floodplain scrub
    - Red maple-mixed shrub palustrine woodland
    - Black willow scrub/shrub wetland
    - Bluejoint-reed canary grass marsh
    - Bottomland oak-hardwood palustrine forest
    - shrub wetland*
    - wet meadow*

Ownership: Almost the entire landscape bordering the creek is privately owned. Much of the immediate border of the creek is held in larger parcels. Conservation actions should proceed before parcel subdivision makes this more difficult.

- Elizabethtown Area Park Authority owns several parcels near where the creek is crossed by Route 743.

- Milton Hershey Farm owns several large parcels near where Route 283 crosses the creek.

Habitat Disturbances:

- Historic –
  - Clearing for agricultural practices removed much of the original vegetation of the area, replacing it with a limited number of agricultural commodities. Elimination of creek side buffers allowed large amounts of sediment and agricultural runoff to enter the aquatic system, reducing water quality while increasing stream temperatures due to lack of shading. Existing wetlands were drained to provide additional agricultural acreage. Several areas were not converted to agricultural and remain forested, likely due to the shallow soils which barely cover the stony diabase bedrock.
  - Three historic milldams are documented to have occurred along the length of the creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the natural floodplain in the process.
  - Rural roads and railroads crisscrossed the landscape, frequently crossing the creek.
  - Some small patches of forest were beginning to regenerate by the time 1940 aerial photographs were taken.
- Current –
  - Additional roads and utility infrastructure were built though the area and across the creek including the four-lane Route 283.
  - Many wetland, floodplain and riparian forested areas along the length of the creek are currently recovering from past clearing and draining including the expansive marsh where Route 283 crosses the creek.
  - Conewago Industrial Park occupies a large parcel along the banks of the creek. A few buildings are within the secondary floodplain. Storm water runoff from these expansive impervious surfaces can have a significant impact on the temperature and water quality of the creek.
  - There has been a substantial increase in residential development near the border with Dauphin County, principally near Elizabethtown, including areas that had previously remained forested due to the diabase bedrock. Subdivision of the few remaining large forest patches in the county severely limits the future ability of the habitat to support many forest dependent species.
- Exotic Species –
  - The natural disturbance of seasonal flooding in conjunction with agricultural clearing creates ideal conditions for many introduced species of plants. Consequently, the creek shoreline is prone to invasion from a large number of invasive species. Invasive species that are likely to occur include:
    - Tree-of-heaven (*Ailanthus altissima*)
    - Garlic mustard *(Alliaria petiolata)*
    - Asiatic bittersweet (*Celastrus orbiculatus*)
    - Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
    - Purple loosestrife (*Lythrum salicaria*)
    - Japanese stiltgrass *(Microstegium vimineum*)
    - Common reed (*Phragmites australis*)
    - Japanese knotweed (*Polygonum cuspidatum*)
    - Mile-a-minute (*Polygonum perfoliatum*)

- Multiflora rose (*Rosa multiflora*)

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and Dauphin Counties.
- Regard the Conewago Creek and the adjacent large forest patches of the diabase bedrock region as a single unit that combine to form a link in a regional migration corridor between the Furnace Hills and the Susquehanna River. This link is in danger of erasure due to infill from suburban sprawl.
- Prevent the conversion of agricultural or natural lands adjacent to Conewago Creek or its tributaries to residential or industrial development.
- High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat in this section of the river. Protect and expand the natural vegetation along both shores of the creek floodplain and adjacent upland. Implement the conservation / restoration of a wide strip of native vegetation as a terrestrial habitat corridor along both shores of the creek. Riparian corridors of all stream tributaries to Conewago Creek and the creek shoreline itself need additional restoration measures. Many stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from agricultural, residential and roadway runoff. Establish at least 100 meter (328 ft) buffer of woody vegetation along the Conewago Creek shore and a 100 ft buffer along all segments of tributary streams to help protect the water quality of the creek by reducing erosion, sedimentation, and pollution. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river. Forested buffers will also help shade the creek, cooling the water temperature, which allows the water to carry more oxygen for a healthier aquatic system.
- Avoid building, replacing or expanding dams on the Conewago Creek.

Within the Core Habitat:

- The species of concern core habitat occurs within the riverbed, but the adjacent floodplain and a small portion of the uplands was included as the core area as contributing most to the immediate water quality of the creek. Maintain the natural hydrology of the creek by avoiding building dams. Maintain and improve water quality of the creek by providing wide vegetated buffers along the creek and all tributaries. Detention basins and rain gardens can be incorporated into Municipal infrastructure to allow storm water to be slowed and filtered before entering the river from road crossings and other breaks in the vegetated buffer.
- Many areas along and within the floodplain currently in agricultural activities (hay, pasture, row crops) are good potential floodplain restoration sites. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by restoring seasonally flooded areas to natural habitats.
- The creek floodplain where the creek crosses Route 282 and Route 743 north of Elizabethtown, should be considered a priority for restoration to wet meadow and floodplain forest natural communities, perhaps as an expansion of Elizabethtown Area Park. This area is currently an extensive marsh complex that is currently recovering from past agricultural activity. Emphasis should be on promoting a viable floodplain/marsh natural community rather than expansion of active park

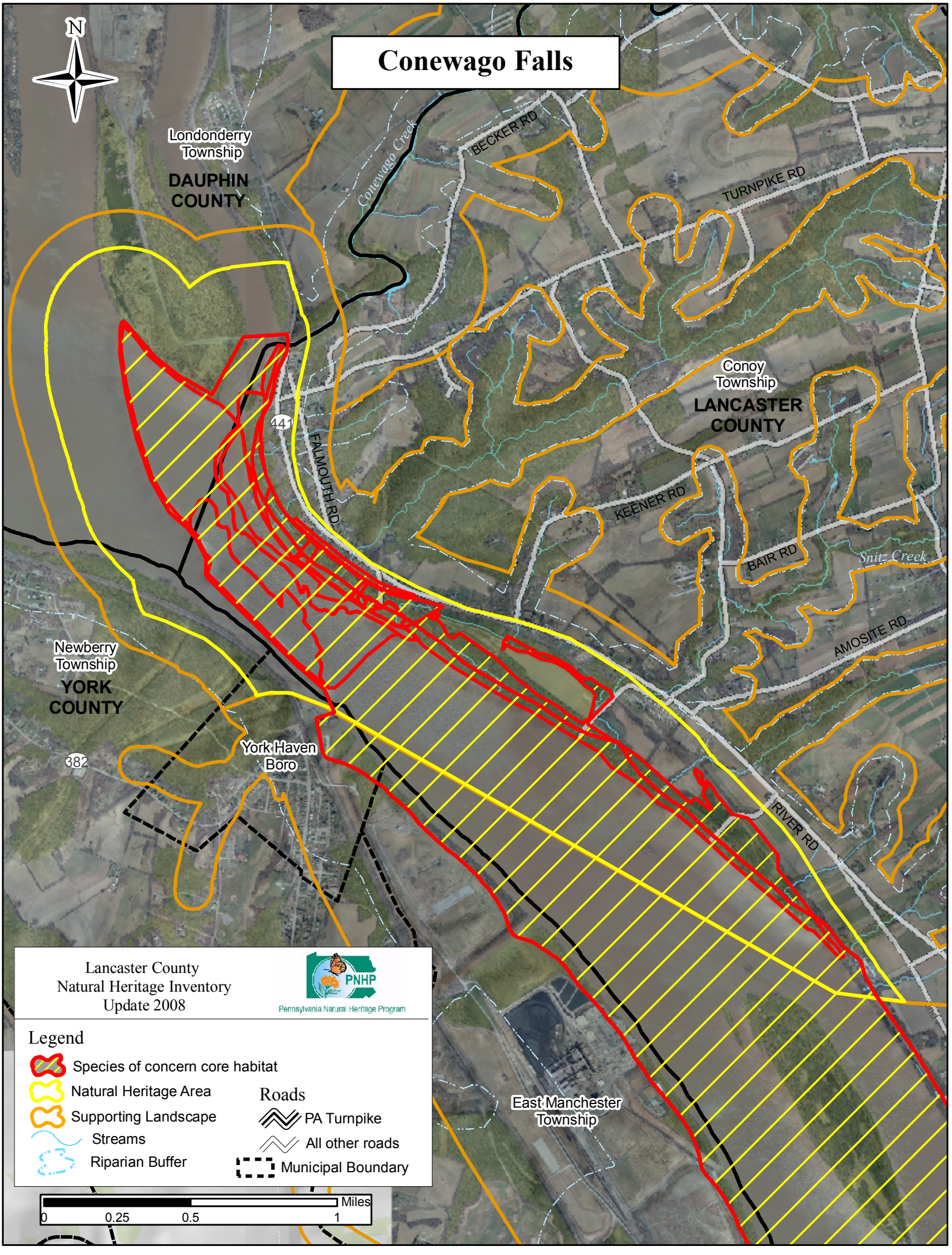
facilities and infrastructure. The Conewago Recreational Trail passes through portions of this habitat. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding wet meadow and marsh habitats and restoration and protection of the natural condition of the floodplain.

Within the Supporting Landscape

- Protect and expand the natural vegetation along both shores of the creek floodplain and adjacent upland. The rainwater runoff from the adjacent agricultural fields and pastures should be considered a source of significant contamination for the creek. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a vegetated natural habitat. Storm water management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.
- Restore and enhance habitat connections between both sides of Route 283. This could be achieved by the construction of green underpasses, overpasses and culverts to allow for more successful animal migration. Restoration at key locations can help re-establish the migratory corridor function to the landscape.
- Pursue conservation easements and fee simple acquisition on properties along Conewago Creek to help conserve and improve its effectiveness as a natural corridor.
- Preserve the integrity of unfragmented forested areas. Subdivision and fragmentation of large forested areas severely degrades its utility to interior forest dependent species, such as many species of neotropical migrant songbirds. Most lands with diabase bedrock had avoided past conversion to agricultural uses. Future development projects should be discouraged within these habitats.
- Potential zoning options for conservation enhancement:
  - Conoy, Mount Joy and West Donegal Townships all have a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat. Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into natural vegetation cover.
  - Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
  - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction though suburban sprawl.
  - All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats,

providing a corridor for animal and plant movement within this portion of the county.

- Potential restoration activities:
  - Three historic milldams occurred along the length of Conewago Creek. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts.
    - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
- Riparian buffers:
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
      - An ideal vegetated stream buffers should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
      - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
      - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.
- Remove invasive species of plants. The creek floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management. Aggressive invasive species along the floodplain can have a significant impact on the available habitat for native species of plants, which can occupy much the same habitat as purple loosestrife and Japanese knotweed. Control of invasive species along the creek floodplain will require extensive and continual effort.
  - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
  - Implement a "Weed Warriors" program to allow citizen involvement in invasive species control on public lands.
  - Continual invasive species monitoring and control will be necessary.
- Litter removal along the shores of the creek will need to be conducted on a periodic and continual basis due to the seasonal flooding regimen of the creek.


Conewago Falls
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TURNPIKE RD
Conoy Township
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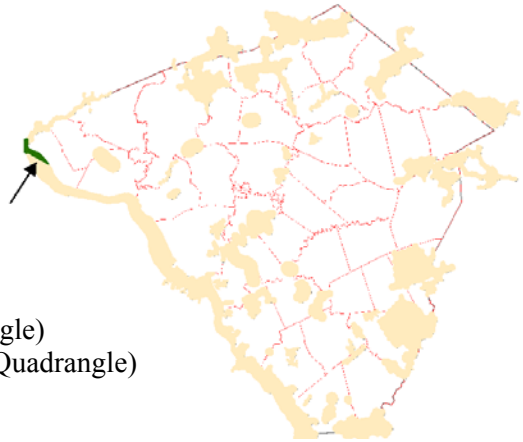
FALMOUTH RD
KEENER RD
BAIR RD
Snitz Creek
AMOSITE RD
Newberry Township
YORK COUNTY
382
York Haven Boro
RIVER RD
East Manchester Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Conewago Falls – *High significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Plants:					
Aster-like boltonia (*Boltonia asteroides*)	G5	S1	PE	2001-08-21	D
Sedge (*Carex shortiana*)	G5	S3	N	2001-06-18	CD
Flat-stemmed spike-rush (*Eleocharis compressa*)	G4	S1	PE	1991-09-09	C
Waterpod (*Ellisia nyctelea*)	G5	S2	PT	1996-05-06	B
Animals:					
Elktoe mussel (*Alasmidonta marginata*)	G4	S4	-	2002-08-31	E
Triangle floater mussel (*Alasmidonta undulata*)	G4	S3S4	-	1999-08-06	E
Yellow lampmussel (*Lampsilis cariosa*)	G3G4	S3S4	-	2006-08-19	E
Bronze copper butterfly (*Lycaena hyllus*)	G5	SU	-	1995-09-03	E
Prothonotary warbler (*Protonotaria citrea*)	G5	S2S3B	-	2006-07	E
Sensitive species of concern [3]	-	-	-	2002	E
Exemplary Natural Communities					
Riverside Outcrop Community	GNR	S1S2	-	1992-07-07	CD

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3]This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area encompasses the section of the Susquehanna River from the Safe Harbor Dam down river to Bainbridge. The focus is on the area of shallow water below the dam referred to as Conewago Falls and the eastern shore of the river.

- Municipalities:
  - Conoy Township, (Lancaster County)
  - Londonderry Township, (Dauphin County)
  - Newberry Township, (York County)
  - York Haven Borough, (York County)
- USGS Quadrangles:
  - Middletown Quadrangle
  - York Haven Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Conewago Falls: NC511" (Middletown Quadrangle)
  - "Conewago Falls: SP509, NC513" (York Haven Quadrangle)



Description: The Susquehanna River cuts though a diabase bedrock intrusion forming a low falls or rapids area with highly sculpted outcrops referred to as "potholes". Seasonally fluctuating river levels alternately flood, scour and expose the bedrock boulders. Deposits of soil have filled cracks, crevices and depressions to provide a distinctive habitat for several species of plants uncommon to Pennsylvania. A wooded public walking trail is maintained by Conoy Township along the old canal towpath. The floodplain forest north of Bainbridge includes wetland habitats. The habitats of the river shoreline and floodplain would be compatible for an expanded passive recreation park system.

Species of Concern Considerations:

Plants:

- Aster-like Boltonia is adapted to the area of the river that is subject to periodic flooding, but usually remains well above the water line. This area includes the bedrock outcrops where plants colonize the cracks and crevices of the ice-scoured and flood-prone river shoreline. The species appears well-adapted to the seasonal fluctuations in water levels, especially the lower water levels of summer and fall when the plant is flowering and fruiting. The viability of populations of aster-like boltonia and its habitat depends on maintaining the natural hydrology and natural condition of the shoreline and islands of the lower Susquehanna River. Invasive species represent a threat to this species and its habitat.
- *Carex shortiana* grows in wet meadows, bottomlands, swamps, or in moist woods, especially on calcareous (limestone) substrates. Creating buffers around wetlands, controlling invasive species, and protecting wetland hydrology will help to maintain occurrences of Short's sedge.
- Flat-stemmed spike-rush thrives in a sandy, silty or muddy substrate in shallow water at the edges of the islands and along the river shoreline. The viability of the known populations of this species will require maintaining the natural hydrology of the rivers, with the seasonal fluctuations and scouring, as well as retaining the natural conditions of the shorelines, riverbed outcrops, and islands.
- Waterpod is a spring annual plant that grows on damp, shady stream banks with rich alluvial soils and sometimes in disturbed ground. The rich shady stream banks that ellisia depends upon are highly influenced by flooding events. Alteration of the natural flood cycle, dam building, increased erosion, and clearing of floodplain forests all affect the quality of suitable habitat. Populations are also threatened by loss of habitat from development and displacement by invasive plants. Protection of *Ellisia* will require maintenance of known populations and preservation of rich, shaded stream bank communities. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.

Animals:

- Three freshwater mussel species of concern, elktoe, triangle floater and yellow lampmussel, along with four additional species of mussels were documented in this section of the Susquehanna River during surveys conducted by local naturalist, Larry Coble. Historically, the dwarf wedge mussel, a federally endangered species, was also documented as occurring in the Susquehanna River near this location. Mussels are filter feeders and are strongly impacted by poor water quality and unsuitable creek bed substrate. Mussels exist as a parasite on certain fish species in their early life stage, and decreased populations of the host fish can negatively affect mussel populations. Dams that impede fish migration also restrict the habitat available to mussels. All streams, creeks and tributaries to the Susquehanna River should have wide forested/vegetated buffers in order to help ensure proper water quality for freshwater mussel habitat. Impediments to fish movement such as dams and improper stream crossings should be corrected to improve available habitat for mussels and their fish hosts.
- The principal habitat of the bronze copper butterfly is found in wet meadows and marshes especially along river floodplains. The primary food source of the caterpillars of this species are plants in the buckwheat family (Polygonaceae) such as peach-leaved dock (*Rumex altissimus*). Conservation and expansion of this type of habitat in the area will help ensure continued

breeding success for this species. Mowing of floodplain and riverbank areas should be discouraged, or selective and infrequent to help promote growth of host plants supporting this butterfly species of concern.

- Prothonotary Warblers breed at several locations in this forested floodplain, which is intermediate habitat between the aquatic river habitat and the upland terrestrial habitat. The forested floodplain and associated wetlands along the Susquehanna River is the primary habitat for this species at this location. Because this bird nests in tree cavities, dead trees along the river shore and adjacent wetlands should be left standing to provide nesting habitat.
- The river is habitat for a sensitive species of concern documented over several years at this location. Maintain and improve water quality and movement above dams for fish migration to improve the habitat for this species of concern.

Exemplary Natural Communities:

- Riverside Outcrop Community - This sparsely vegetated community is found on outcrops of circumneutral or calcareous rock along rivershores. Substrates are usually dolomite, limestone, or slate. Most are flooded annually at high water; this helps to maintain open conditions and also provides silt that accumulates in the rock crevices. The annual disturbance pattern of flooding and ice-scour restricts the vegetation to tough crevice-rooting herbs and low shrubs. Total vegetation cover is often less than 20%. Floristic composition can vary considerably (NatureServe, 2007)

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- The floodplain of the river is dominated by a silver maple-floodplain forest while the wooded uplands of the diabase bedrock are dominated by a tuliptree-beech-maple forest.
  - Terrestrial (upland) communities:
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - modified successional forest*
    - shrubland* (mostly along powerline clearings)
  - Palustrine (wetland) communities:
    - Silver maple floodplain forest
    - Red maple-black gum palustrine forest
    - Red maple-elm-willow floodplain swamp
    - River birch-sycamore floodplain scrub
    - Red maple-mixed shrub palustrine woodland
    - Bluejoint-reed canary grass marsh
    - Cattail marsh
    - wet meadow*

Ownership:

- The Commonwealth of Pennsylvania owns key portions of the river bedrock outcrops at this location. A river access boat ramp is maintained by the PA Fish & Boat Commission.
- Conoy Township owns a narrow strip along the old canal towpath, which is maintained as a public walking trail.
- PPL Corporation owns several larger parcels north of Bainbridge, including some wetland habitat, which it maintains as a nature preserve.
- Norfolk Southern Railroad maintains an active rail line along the banks of the Susquehanna River.
- Most of the remaining private property along the river floodplain and adjacent uplands is held in larger parcels. Future ownership fragmentation or parcel subdivision may impede conservation action.

Habitat Disturbances:

- Historic –
  - Much of the original vegetation of the level expanses of land adjacent to the Susquehanna River had been cleared for agricultural production over several centuries. Large patches of forest remained where soil, slope, wetness or bedrock conditions prevented their conversion to agricultural uses.
  - Water quality of the river was severely degraded by direct pollution from sewage, industry, mining, agriculture and was exacerbated by the removal of most of the forest canopy within the upstream watershed at the turn of the century.
  - The York Haven Dam was constructed across the river contributing to limited migration potential for anadromous and catadromous fishes, which spend part of their lives in salt water and part of their lives in fresh water. Runoff from agricultural fields and erosion from all types of earth disturbances including coal mining has resulted in sediments being deposited behind the dam. Over time, the dam will be completely filled in with sediment from runoff.
  - The construction of many smaller dams on the Susquehanna River and its tributaries in the early 1800s severely reduced the American shad and other anadromous and catadromous fish from much of their traditional spawning streams. Many dams were breached in the late 1800s and the shad migration temporarily resumed. The construction of the series of four large hydroelectric dams on the Susquehanna River between 1904 and 1932 eliminated the American shad from the upper reaches of the Susquehanna almost to the close of the century. Fish trap and transport programs implemented during the 1970s moved fish upriver by trucks in an effort to bolster shad populations. Improved fish ladders were constructed on the Conowingo, Holtwood, Safe Harbor and York Haven dams in the 1990s to reopen the upper Susquehanna River for shad spawning.
  - With the elimination of anadromous and catadromous fishes from much of their historic range in the Susquehanna watershed, several species of freshwater mussels, which depend on suitable fish hosts for a portion of their lifecycle, also experienced declines. The total range of fish hosts for several mussel species is clearly understood, but recent studies indicate that the American eel may have been an important host for several mussel species. Since the eel is eliminated from much of the Susquehanna River, this may have led to considerable declines in mussel populations.
  - The railroad was built along the Susquehanna River.
  - Two milldams historically occurred along Snitz Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the natural floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Portions of the creek remain trapped in these deep narrow channels.
- Current –
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may consider the railroad an insurmountable obstacle.
  - The four hydroelectric dams on the Susquehanna River present the major obstacle to anadromous and catadromous fish migration. Recently installed fish ladders have improved the condition for anadromous fishes, but catadromous fishes continue to be excluded from the Susquehanna River watershed.
  - Several additional utility corridors were recently cut through the otherwise forested blocks on both shores of the river.
  - Residential development has replaced agricultural landuse in many areas and also is beginning to encroach on previously unfragmented forested areas.
- Exotic Species – The natural disturbance of an active floodplain creates ideal conditions for many invasive species of plants, which are typically adapted to open, disturbed conditions. The

narrow linear canal towpath park is exceptionally infested with a number of aggressive invasive plants. Control efforts should be directed toward eradicating small populations of pioneer species, before they get established in the area. See fact sheets on invasive species for specific control options. Invasive plants to target for removal to improve the riparian habitat include:

- Norway Maple (*Acer platanoides*)
- Tree-of-heaven (*Ailanthus altissima*)
- Common mugwort (*Artemisia vulgaris*)
- Japanese & European barberry (*Berberis thunbergii, Berberis vulgaris*)
- Asiatic bittersweet (*Celastrus orbiculatus*)
- English ivy (*Hedera helix*)
- Japanese honeysuckle (*Lonicera japonica*)
- Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
- Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
- Purple loosestrife (*Lythrum salicaria*)
- Japanese stilt grass (*Microstegium vimineum*)
- Princess tree (*Paulownia tomentosa*)
- Japanese knotweed (*Polygonum cuspidatum*)
- Mile-a-minute (*Polygonum perfoliatum*)
- Callery "Bradford" pear (*Pyrus calleryana* and its cultivars)
- Jetbead *(Rhodotypos scandens)*
- Multiflora rose (*Rosa multiflora*)
- Wineberry *(Rubus phoenicolasius)*

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster, Dauphin and York Counties.
- Protect and expand the natural vegetation along both shores of the river floodplain and adjacent upland. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along both shores of the river.
- Avoid building, replacing or expanding dams on the Susquehanna River.
- Riparian corridors of all stream tributaries to this section of the Susquehanna River and the river shoreline itself need additional restoration measures. Several stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from agricultural and urban runoff.
- High water quality and appropriate substrate are both critical aspects to sustaining suitable habitat in this section of the river. Establish at least 100 meter (328 ft) buffer of woody vegetation along the river shore and 100 foot buffer along all segments of tributary streams to help protect the water quality of the river by reducing erosion, sedimentation, and pollution. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river.
- Preserve the integrity of the adjacent unfragmented forested areas. Subdivision and fragmentation of large forested areas severely degrades its suitability to interior forest dependent species, such as many species of neotropical migrant songbirds. Most lands with diabase bedrock in this area had avoided past conversion to agricultural uses. Future development projects and subdivision should be discouraged within these habitats.

Within the Core Habitat:

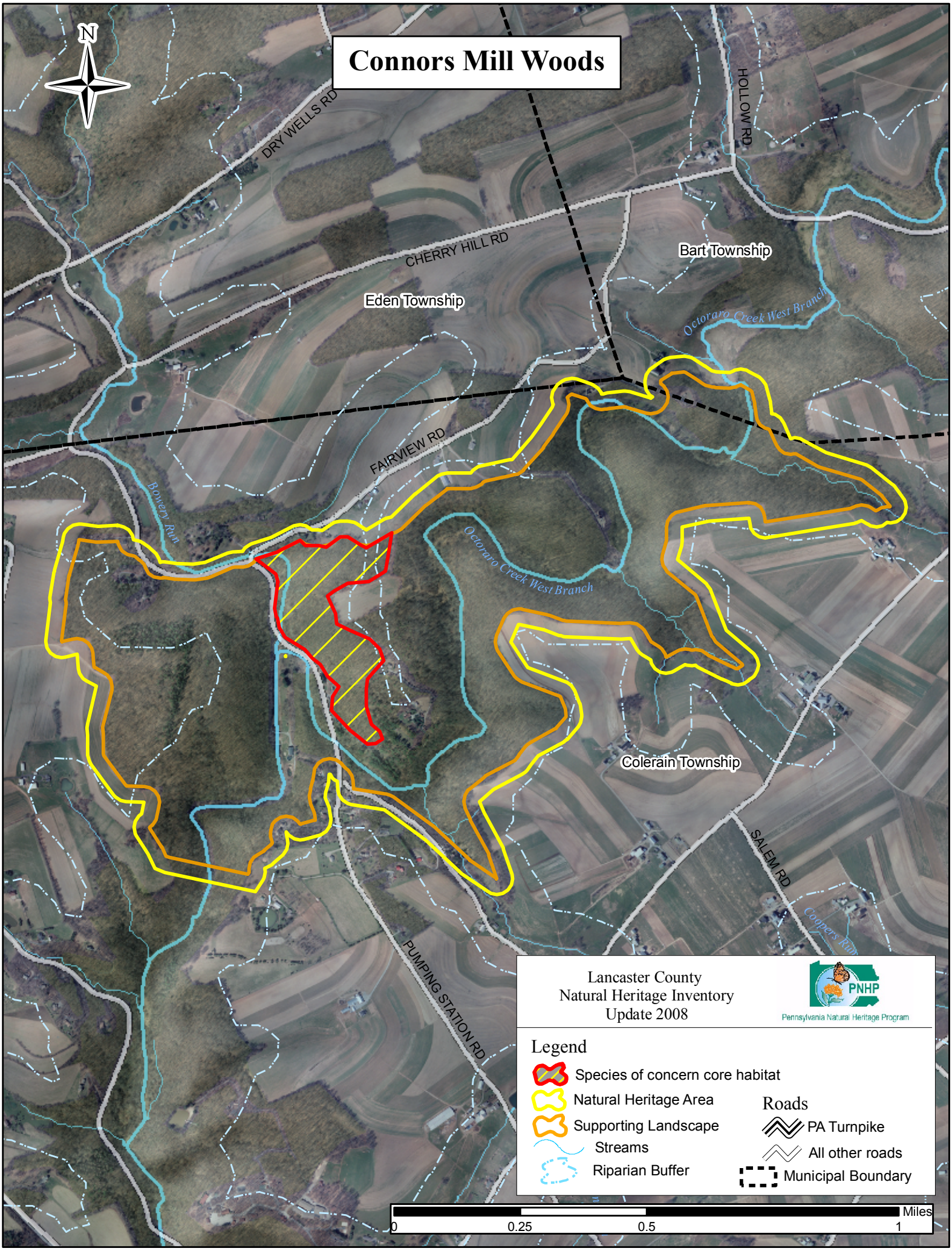
- Acquire larger parcels within the 100-year and secondary floodplains of the Susquehanna River. These areas would be compatible with a passive recreation park. Emphasis should be on promoting a viable floodplain natural community rather than construction of active park facilities and infrastructure. Mowing of the area should be minimized or eliminated

with special emphasis on protecting and expanding floodplain forest areas with native vegetation and restoration and protection of the natural condition of the shoreline.
- Seek conservation easements on larger parcels within 300 meters of the river floodplain.
- Stormwater runoff from agricultural fields, residences, industry and roadways should be considered a potential source of significant contamination for the river. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to intercept runoff at its source and at road crossings or other breaks in the vegetated buffer.
- Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa. Care must be taken not to inadvertently drain the wetlands north of Bainbridge due to culvert construction.

Within the Supporting Landscape: The supporting landscape was drawn around the 100 meter riparian buffer of all tributaries leading to this stretch of the Susquehanna River. It also includes a 300 meter buffer from the 100-year floodplain of the Susquehanna River itself. Activities and land use patterns in these areas can have a significant impact on the water quality of the river and the habitats of the species of concern.

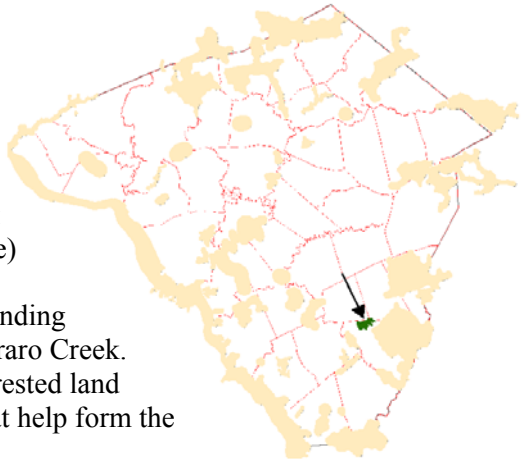
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along the river. Expand the native vegetation along the river corridor to include land within 300 meters of the river's banks. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Riparian buffers of stream tributaries to this section of the Susquehanna River and the river shoreline itself have substantial forest/natural vegetation cover. With moderate effort to extend these attributes to the recommended width, these riparian buffers could become very good examples of restored/conserved riparian habitat corridors for this portion of the county.
- Conoy Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Potential restoration activities:
    - Two milldams occurred on Snitz Creek. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts.
    - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
        - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.

        - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
            - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
                - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
                - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
                - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.
- Remove invasive species of plants. The river floodplain and areas of past agricultural activity are naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management. Aggressive invasive species along the floodplain can have a significant impact on the available habitat for native species, which can occupy much the same habitat as purple loosestrife and Japanese knotweed. Control of invasive species along the river floodplain will require extensive and continual effort. Focus non-chemical control efforts on selected areas surrounding species of concern.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose, jetbead, Asiatic bittersweet and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Invasive species management needs to be coordinated by individuals familiar with native species as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.
- Remove and monitor illegal dumps. Litter removal along the shore of the river will need to be conducted on a periodic and continual basis due to the seasonal flooding regimen of the river.


Connors Mill Woods
N
DRY WELLS RD
HOLLOW RD
CHERRY HILL RD
Bart Township
Eden Township
Octoraro Creek West Branch
FAIRVIEW RD
Bowery Run
Octoraro Creek West Branch
Colerain Township
SALEM RD
Coopers Run
PUMPING STATION RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Conners Mill Woods – *High significance*					
Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bradley's spleenwort (*Asplenium bradleyi*)	G4	S1	PE	1995-10-17	C

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Colerain Township
- USGS Quadrangles:
  - Gap Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference:
  - "West Branch Octoraro Creek" – (Gap Quadrangle)

Description: Conners Mill Woods is a steep, wooded ravine surrounding Bowery Run near its confluence with the West Branch of the Octoraro Creek. The site contributes to a large, relatively un-fragmented tract of forested land along the West Branch of the Octoraro Creek and its tributaries that help form the backbone of a natural corridor to Octoraro Reservoir.

Species of concern considerations:
- Bradley's spleenwort is a fern of very limited distribution in Pennsylvania. Rock outcrops of Wissahickon Schist occur along the steep hillsides that provide habitat for Bradley's spleenwort at this location. The outcrop containing Bradley's spleenwort is surrounded by a buffer of undisturbed woodland. The outcrops and surrounding woods should be left in their current condition. Removal of the forested canopy around the rock outcrops could alter the microhabitat conditions that the fern prefers; therefore, logging operations should not occur along the steep slopes facing Bowery Run and the West Branch of the Octoraro Creek. All of the currently known populations of this plant in PA occur on similar rock outcrops along the Susquehanna River and a few other scattered sites in Lancaster County like the one at this location. Since all of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large responsibility for its continued existence in the state. The exact location of this species at all locations in the county should be limited to authorized researchers to avoid its extirpation by unauthorized collection. There are numerous outcrops along the West Branch of the Octoraro Creek that should be considered potential habitat for this species. Additional surveys are recommended to more accurately determine the current extent of this species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.
- Tuliptree-beech-maple forest occurs along the lower slopes near Bowery Run, while the well-drained upper slopes support a dry oak-heath forest, dominated by trees such as chestnut oak (*Quercus prinus*), sweet birch (*Betula lenta*), and red oak (*Quercus rubra*). These forests include several patches of interior forest that help form the backbone of a natural corridor following the West Branch of the Octoraro Creek to Octoraro Reservoir.

Connors Mill Woods

Ownership: Most of the wooded habitat is held in a number of private parcels ranging in size from 5 acres to about 40 acres. Conservation actions should focus on these larger parcels before land subdivision impedes conservation progress.

- The County of Lancaster owns about 40 acres of upland forested property along Bowery Run and Pumping Station Road.
- The Pennsylvania American Water Company owns a 20 acre parcel along Bowery Run.

Habitat Disturbances:

- Historic:
  - The patch of woods identified as the supporting landscape for this Natural Heritage Area was mostly forested and mostly undisturbed based on 1940 aerial photographs of the area. Small patches were open cleared fields, and several larger patches contained conifer plantations, which may offer suitable habitat for a small group of plants and animals, but contribute little to the overall biological integrity of the area.
  - Several milldams were active along this stretch of Bowers Run and the West Branch of the Octoraro Creek including one near the confluence of the two streams. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Portions of the historic West Branch of the Octoraro Creek floodplain may remain trapped in these deep, narrow channels.
- Current:
  - This site appears to have little visitation and disturbance. A trail for off-road vehicles extends along the stream, and adjacent to the trail there is an old quarry. Lands upslope of the core habitat are in residential or agricultural use. Disturbance in the form of logging, fragmentation or development of the upland areas of the Natural Heritage Area would likely impact the quality of habitat down slope of the core habitat.
  - Conifer plantations still exist on several parcels of the upland habitat.
- Invasive Species:
  - Invasive species were not noted past survey to the outcrops, but do occur along the off-road trail and stream banks. Efforts should focus on mechanical or water-safe chemical removal of invasive plants along the stream bank and trail. Off-road vehicle use can facilitate trash dumping and the spread of invasive plants, so limiting use or closing trails to off-road vehicle traffic will help to reduce further disturbance.

Conservation Actions:

Overall:

- This site is comprised of a number of parcels owned by private landowners, Lancaster County and Pennsylvania American Water Company. Permanent protection of these lands, particularly in the core habitat, through conservation easements or acquisition should be a priority. Emphasis should be placed on preserving this site's intact forest canopy, which provides important habitat requirements for Bradley's spleenwort.
- The wooded landscape is compatible with passive recreation such as fishing, hunting and hiking, but more intensive recreational opportunities are not recommended for the core or supporting landscape for this area.

Within the Core Habitat:

- Provide permanent protection of the forested land on properties through acquisition or conservation easements, particularly focusing on areas that include rock outcrops.

- Easements should include language that maintains limited, passive use of forests and prohibits the construction of numerous or wide trails.
- Preserve an intact forest canopy.
  - Close trails to off-road vehicles and limit the construction of new trails.
  - Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way.
    - Bradley's spleenwort is sensitive to the changes in light level and humidity that accompany fragmentation and may not persist at this site if forested land in the core is reduced.
  - Avoid logging in this area.
    - Logging in areas upslope from Bradley's spleenwort populations may be particularly detrimental.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
    - Encourage native tree and shrub recruitment.
      - Reduce the size of the deer herd. Native species of plants are particularly susceptible to deer herbivory.
- Allow agricultural fields immediately adjacent to core habitat to return to forest cover.
  - This will provide an important buffer and enhance habitat quality for Bradley's spleenwort populations.
- Remove invasive species of plants.
  - Invasive plants along the trail and stream bank as well as pioneer populations should be targeted.
  - Invasive species management should be coordinated by individuals familiar with native species as well as the invasive species present.
  - Continual invasive species monitoring and control will be necessary.
- Additional surveys for Bradley's spleenwort and other rare species are recommended.
  - Lobed spleenwort, another member of the *Asplenium* genus and species of concern, grows nearby. Habitat at this site is suitable for lobed spleenwort as well.

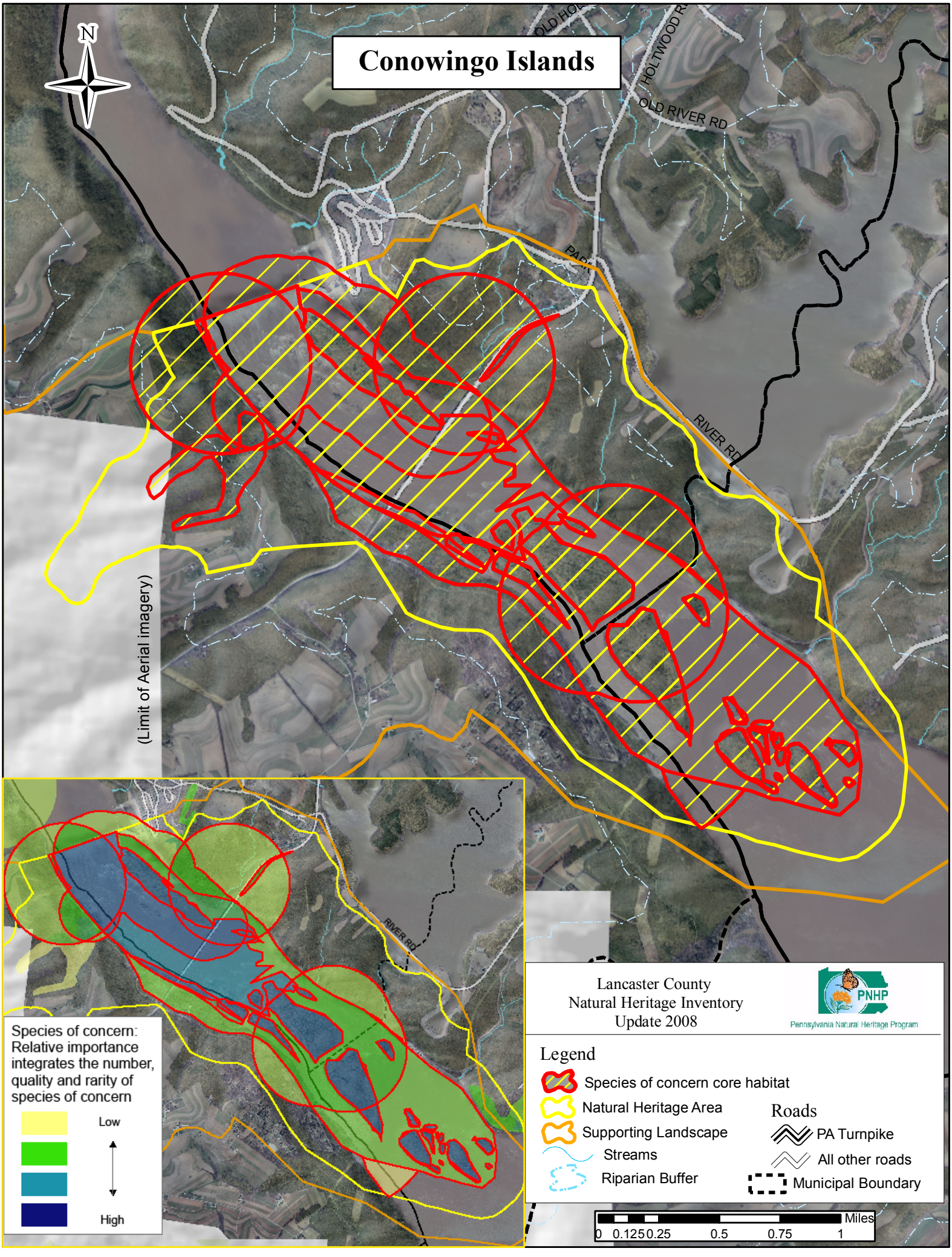
<u>Within the Supporting Landscape:</u>

- The forest cover of the steep slopes along the creeks should be allowed to achieve and maintain old-growth characteristics.
- Permanently protect and maintain connectivity to adjacent forested land through acquisition or conservation easement.
  - This site is part of a large forested block and is connected along wooded floodplains and steep slopes to other Natural Heritage Areas, forming a natural corridor though the area. Rock outcrops along these wooded corridors may provide additional habitat for Bradley's spleenwort.
- County owned land within the supporting landscape should be retained and maintain its current management.
- Harvest conifer plantations and plant in native tree and shrub cover to mimic adjacent natural communities in a similar topographic and hydrologic situation.
- Additional surveys for species of concern are recommended.
- <u>Potential restoration activities:</u>
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Other narrow waterways outside of the supporting landscape

have been strongly channelized in the intensively cultivated fields and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.

- All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
        - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
        - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
        - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
    - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests.

- <u>Zoning options for conservation enhancement:</u>
    - Enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for most of the core habitat and preserve potential habitat in nearby areas.
    - Colerain Township has a zoning ordinance restricting new construction within the 500-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
        - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks.
    - Conservation of the 100 foot riparian buffer option will offer protection for most of the core habitat and supporting landscape and provide a high degree of habitat connectivity though the area.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out.
    - Growth within the Township should be discouraged within the core or supporting landscape identified for this area.

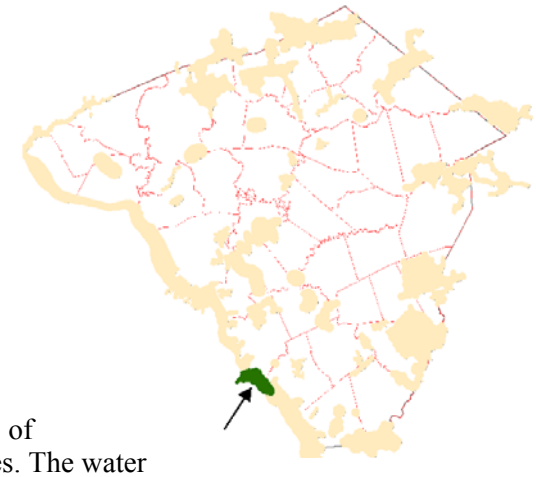

Conowingo Islands
N
OLD RIVER RD
HOLTWOOD RD
RIVER RD
(Limit of Aerial imagery)
Species of concern: Relative importance integrates the number, quality and rarity of species of concern
Low
High
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.125 0.25 0.5 0.75 1

Conowingo Islands – *Exceptional significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Arrow-feathered three awn (*Aristida purpurascens*)	G5	S2	PT	1985-09-13	A
Bradley's spleenwort (*Asplenium bradleyi*)	G4	S1	PE	1982-08-16	D
Aster-like boltonia (*Boltonia asteroids*)	G5	S1	PE	2006-08-15	A
Wild oat (*Chasmanthium latifolium*)	G5	S1	PE	2006-08-15	B
Fringe-tree (*Chionanthus virginicus*)	G5	S3	PT	2006-08-15	BC
Reflexed flatsedge (*Cyperus refractus*)	G5	S1	PE	1991-09-20	C
Flat-stemmed spike-rush (*Eleocharis compressa*)	G4	S1	PE	1993-06-23	B
Bicknell's hoary rockrose (*Helianthemum bicknellii*)	G5	S2	PE	2006-08-15	BC
American holly (*Ilex opaca*)	G5	S2	PT	1995-06-06	A
Swamp dog-hobble (*Leucothoe racemosa*)	G5	S2S3	PT	2006-08-15	BC
Common hemicarpa (*Lipocarpha micrantha*)	G5	S1	PE	1995-09-19	C
False loosestrife seedbox (*Ludwigia polycarpa*)	G4	S1	PE	1993-10-02	D
Three-flowered melic-grass (*Melica nitens*)	G5	S2	PT	1995-06-21	C
Tooth-cup (*Rotala ramosior*)	G5	S3	PR	1995-09-19	CD
Sticky golden-rod (*Solidago simplex ssp. randii var. racemosa*)	G5T3?	S1	PE	1995-08-08	B
Eastern gamma-grass (*Tripsacum dactyloides*)	G5	S1	PE	2006-08-15	C
Sensitive species of concern (A)[3]	-	-	-	2000-7-12	C
Animals:					
Osprey (*Pandion haliaetus*)	G5	S2B	PT	2003	E
Russet-tipped clubtail dragonfly (*Stylurus plagiatus*)	G5	S1	-	2004-09-11	E
Sensitive species of concern (B)[3]	-	-	-	2004	E
Exemplary Natural Communities					
Riverside Outcrop Community	GNR	S1S2	-	1987-06-16	A

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3]This species is not named at the request of the agency overseeing its protection

Conowingo Islands



Location:

- Municipalities:
  - Drumore Township, (Lancaster County)
  - Martic Township, (Lancaster County)
  - Lower Chanceford Township, (York County)
- USGS Quadrangles:
  - Holtwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Conowingo Islands" – (Holtwood Quadrangle)

Description: The Susquehanna River below Holtwood Dam is one of Pennsylvania's most unusual and picturesque riverine landscapes. The water level of the river fluctuates widely due to seasonal flooding and dry spells, alternately inundating and exposing numerous islands in the river. These islands are different than most in the Susquehanna River. While most river islands are composed of deposits of loose material, the Conowingo Island group represents the erosional remnants of schist and gneiss metamorphic bedrock. There are about 60 islands in all, one reaching a height of 200 feet above the water level. Much of the surface of the islands and river bed is composed of exposed bedrock.



Deposits of soil have filled cracks, crevices and depressions to provide a distinctive habitat for many species of plants uncommon to Pennsylvania. Sixteen plant species of concern and three animal species of concern contribute to the overall uniqueness of this exceptional natural community. Though the construction of the Holtwood Dam resulted in the disturbance of the upstream portion of this habitat, the utility ownership of the islands and surrounding supporting habitat has likely protected this area from further development. This area should be considered a high priority for conservation action in the county.

Species of Concern Considerations:

Plants:

The plant species of concern here are generally near the northern limit of their geographic ranges. The uncommon plants present in this habitat can be grouped according to their common habitat preference at this location. There is a good probability of locating other populations of rare species during future surveys.

- Several of the plants are found primarily along the main river shore or in deeper soils on higher ground on several of the islands. These plants could be considered "high-and-dry", and are not adapted to the ice and flood scour conditions found in lower parts of the river. These include Bradley's spleenwort, American holly, wild oat, three-flowered melic-grass, arrow-feathered three awn and a sensitive species of concern (A). The Bradley's spleenwort occurs in cracks in high-and-dry rock outcrops while American holly can be found on several of the islands with deeper soil and scattered sparsely on the shoreline.
- Other plants are adapted to the area slightly lower in the river system which is subject to periodic flooding, but usually remains well above the water line. This area includes many of the lower bedrock

outcrops where plants colonize the cracks and crevices and the flood-prone river shoreline. These include aster-like boltonia, reflexed flatsedge, fringe-tree, Bicknell's hoary rockrose , swamp dog-hobble, false loosestrife seedbox, sticky golden-rod, eastern gamma-grass

- Those plants that thrive in the lowest regions of the river inhabit the regularly wet areas in a sandy, silty or muddy substrate at the edges of the islands and along the river shoreline. These include flat-stemmed spike-rush, common hemicarpa and tooth-cup.

Animals:

- Ospreys have been documented successfully nesting in the Conowingo Islands area for the past two decades.
- The russet-tipped clubtail dragonfly is typically associated with soft substrates, like mucky, freshwater tidal habitats and is likely taking advantage of similar habitats along this section of the river.
- An additional sensitive species of concern (B) has also been documented as a resident of this Natural Heritage Area. The core habitat for this sensitive species of concern is both the river and the adjacent upland forest. This sensitive species of concern requires abundant food source in the river and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Susquehanna River and by protecting and expanding the natural vegetation buffer along the river.

Exemplary Natural Communities:

- Riverside Outcrop Community - This sparsely vegetated community is found on outcrops of circumneutral or calcareous rock along rivershores. Substrates are usually dolomite, limestone, or slate. Most are flooded annually at high water; this helps to maintain open conditions and also provides silt that accumulates in the rock crevices. The annual disturbance pattern of flooding and ice-scour restricts the vegetation to tough crevice-rooting herbs and low shrubs. Total vegetation cover is often less than 20%. Floristic composition can vary considerably (NatureServe, 2007)

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Dry white pine (hemlock)- oak forest
  - Tuliptree-beech-maple forest
  - Red oak-mixed hardwood forest
  - Dry oak-heath forest
  - Virginia pine-mixed hardwood forest
  - modified successional forest*
- Palustrine (wetland) communities:
  - Silver maple floodplain forest
  - Riverside ice scour community
- The Natural Heritage Area and supporting landscape are drawn fairly tightly around the adjacent slopes along the Susquehanna River's edge. Most of the Natural Heritage Area and supporting landscape is forested or with natural vegetation covering with a few exceptions around active power generating facilities and includes several large blocks of interior forest. The west-facing slopes on the Lancaster side of the river are dominated by dry oak-heath forests, while the east-facing slopes on the York side of the river are dominated by tuliptree-beech-maple forests. The larger islands are predominantly dry white pine (hemlock)-oak forests with smaller patches of other plant community types scattered around the area as bedrock substrate, topography, sunlight and available moisture dictate.

Conowingo Islands

Ownership:

- Virtually all of the property on the Lancaster County side of the Susquehanna River at this location is controlled by four primary owners. Exelon Corporation owns the primary group of islands below the Route 372 bridge as well as the entire area of Muddy Run Reservoir and the adjacent slopes.
- PPL Corporation owns the Holtwood Dam and most of the islands between the dam and the Route 372 bridge as well as the adjacent slopes and uplands.
- Susquehannock State Park owns the uplands in the southern portion of this Natural Heritage Area.
- Norfolk Southern Rail Corporation owns a rights-of-way corridor paralleling the Susquehanna River shoreline.

Habitat Disturbances:

- Historic –
  - Water quality of the river was severely degraded by direct pollution from sewage, industry, mining, agriculture and was exacerbated by the removal of most of the forest canopy within the upstream watershed at the turn of the century.
  - Before the construction of the Holtwood Dam, the interesting habitat present below the dam likely existed above the dam as well. The construction of the dam has resulted in the long-term flooding of the habitat. Runoff from agricultural fields and erosion from all types of earth disturbances including coal mining has resulted in sediments being deposited behind the dam. Over time, the dam will be completely filled in with sediment from runoff.
  - The construction of many smaller dams on the Susquehanna River and its tributaries in the early 1800s severely reduced the American shad and other anadromous and catadromous fish from much of their traditional spawning streams. Many dams were breached in the late 1800s and the shad migration temporarily resumed. The construction of the series of four large hydroelectric dams on the Susquehanna River between 1904 and 1932 eliminated the American shad from the upper reaches of the Susquehanna almost to the close of the century. Fish trap and transport programs implemented during the 1970s moved fish upriver by trucks in an effort to bolster shad populations. Improved fish ladders were constructed on the Conowingo, Holtwood, Safe Harbor and York Haven dams in the 1990s to reopen the upper Susquehanna River for shad spawning.
  - With the elimination of anadromous and catadromous fishes from much of their historic range in the Susquehanna watershed, several species of freshwater mussels, which depend on suitable fish hosts for a portion of their lifecycle, also experienced declines. The total range of fish hosts for several mussel species is clearly understood, but recent studies indicate that the American eel may have been an important host for several mussel species. Since the eel is eliminated from much of the Susquehanna River, this may have led to considerable declines in mussel populations.
  - The railroad was built along the Susquehanna River.
  - Active agricultural fields crowd the slopes near Muddy Run.
- Current –
  - Muddy Run has since been dammed to create a power generating reservoir.
  - Powerline corridors were cut and transmission towers were built in the river, on several islands and on the adjacent shoreline slopes.
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may consider the railroad an insurmountable obstacle.
  - The four hydroelectric dams on the Susquehanna River present the major obstacle to anadromous and catadromous fish migration. Recently installed fish ladders have improved the condition for anadromous fishes, but catadromous fishes continue to be excluded from the Susquehanna River watershed.
  - Route 372 and its bridge over the Susquehanna River were built on foundations in the river.

- Residential development has increased along the York County side of the river, particularly in the large forest block at Boeckel Landing.
- There are several small seasonal cabins on a few of the islands.

o Exotic Species – The natural disturbance of an active floodplain creates ideal conditions for many invasive species of plants, which are typically adapted to open conditions. The Susquehanna River floodplain at this location is no exception, but the bedrock islands are surprisingly uninvaded at this time. Control efforts should be directed to eradicating small populations of pioneer species, before they get established in the area. Control of invasive species on the islands would be very difficult for a number of reason including inaccessibility and proximity to the aquatic habitat. The river shoreline would benefit from invasive plant control. See fact sheets on invasive species for specific control options. Invasive plants to target for removal to improve the riparian habitat include:

- Norway Maple (*Acer platanoides*)
- Tree-of-heaven (*Ailanthus altissima*)
- Kudzu (*Pueraria lobata*)
- Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
- Oriental bittersweet (*Celastrus orbiculatus*)
- Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
- Japanese & European barberry (*Berberis thunbergii, Berberis vulgaris*)
- English ivy (*Hedera helix*)
- Mile-a-minute (*Polygonum perfoliatum*)
- Multiflora rose (*Rosa multiflora*)
- Common mugwort (*Artemisia vulgaris*)
- Japanese honeysuckle (*Lonicera japonica*)
- Japanese knotweed (*Polygonum cuspidatum*)
- Purple loosestrife (*Lythrum salicaria*)
- Japanese stilt grass (*Microstegium vimineum*)
- Princess tree (*Paulownia tomentosa*)
- Wineberry (*Rubus phoenicolasius*)

Conservation Actions:

Overall:

- Almost all of the core habitat is currently owned by the PPL Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the assumption that the current land use and ownership will remain for the foreseeable future. Continue protection of this landscape as an important ecological resource. If the utility companies choose to divest themselves of portions of this landscape, it should be considered a high priority for conservation acquisition.
- Coordinate the protection of this landscape between Lancaster and York Counties. Property ownership on the York County side of the river was not reviewed for this report and may be more susceptible to conversion to inappropriate uses.
- Avoid building, replacing or expanding dams.
- Improve fish passage for both anadromous fish (American shad) and catadromous fish (American eel).
- Restore the river to its original hydrologic regime as the end of Holtwood Dam's life expectancy nears.

Within the Core Habitat:

- The steep, rocky, inaccessible and flood-prone nature of the immediate habitat of the species of concern likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites.

- Most of the priority core habitat within Conowingo Islands is owned by the Exelon and PPL utility producing companies and is presently considered to be of secondary concern for conversion to incompatible uses based on the current management regime.
- Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Limit and reduce the impact of seasonal cabins on the shoreline and islands of the river. Septic systems for these structures are frequently inadequate or nonexistent. Disturbance on islands includes loss or impairment of critical habitat due to construction of cabins, boat docks, lawns and vegetation clearing. Some vegetation removal can be beneficial to the habitat, but an increase in island or shoreline cottages can only result in a decrease in habitat for species adapted to these specific habitat conditions.
- Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.
- Indiscriminate herbicide use is inappropriate for this location.

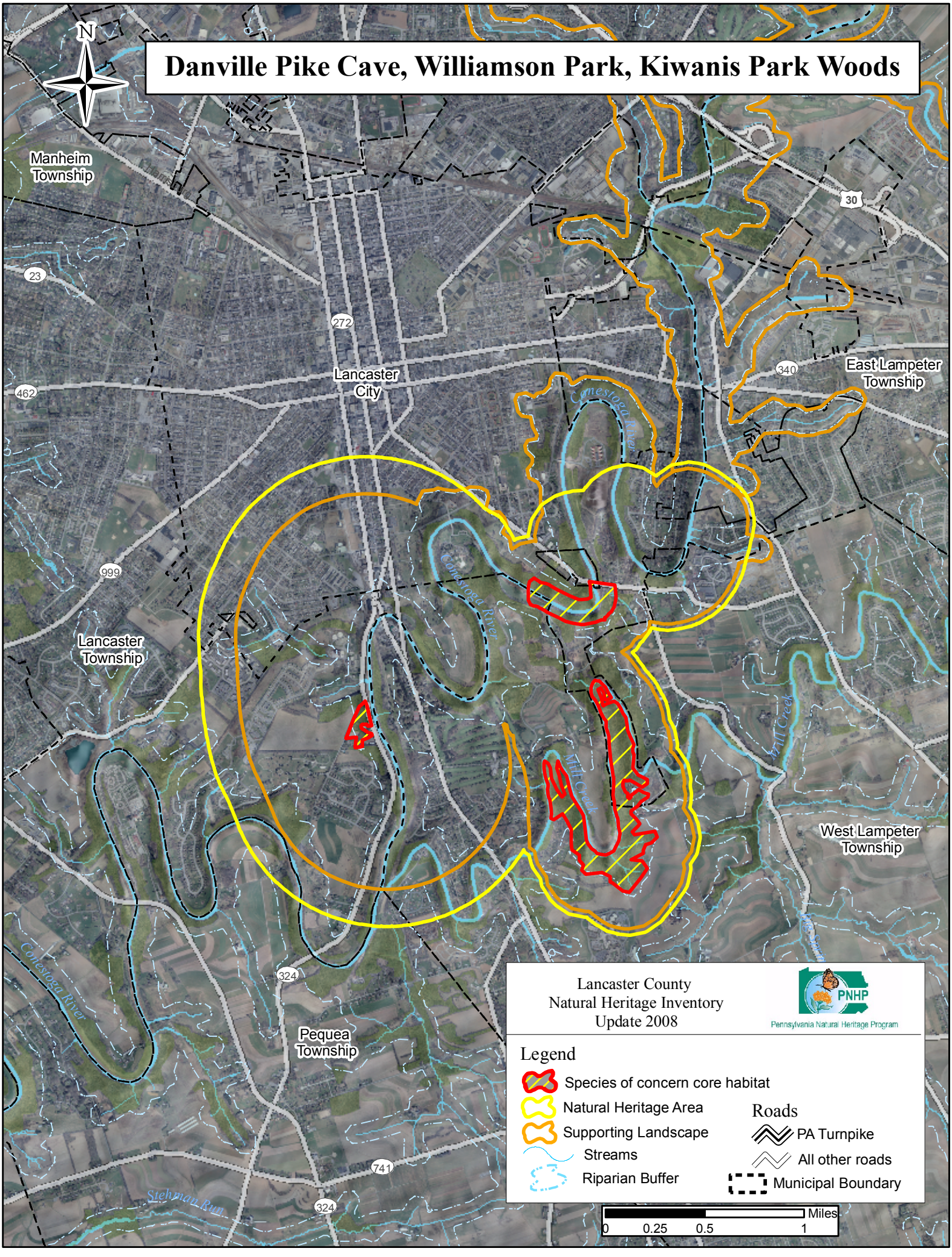
- Conserve the intact forest canopy.
  - Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way.
  - Avoid logging activities in this area to allow for the development of old growth conditions.

Within the Natural Heritage Area / Supporting Landscape:

The supporting landscape for this Natural Heritage Area is drawn closely around the species of concern core habitat. Conservation actions appropriate for these zones also apply to the supporting landscape.

- Avoid logging in this area.
  - Allow the forest to return to near old-growth conditions.
  - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
    - Trees that have fallen over approved trails can be cut through as necessary.
  - Remove non-native trees and shrubs. The railroad rights-of-way and the river floodplain are the primary locations of non-native trees and shrubs within this area.
  - Encourage native tree and shrub recruitment.
    - Reduce the size of the deer herd. Uncommon species of plants are particularly susceptible to deer herbivory.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
  - Block access to forested areas by off road vehicles, ATVs, motorcycles and bicycles.
- Additional surveys for rare species are recommended.
- Potential zoning options for conservation enhancement:
  - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 80% of the area within the core habitat, ~90% of the Natural Heritage Area and ~50% of the supporting landscape.
  - Drumore & Martic Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those

within the 100-year floodplain should be encouraged to regenerate into natural habitats or forest cover suitable to the topography and hydrology.
    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this area.
    - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary destruction of natural habitat and prime farmland.
- Recommended restoration activities:
    - Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
        - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
        - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
    - Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management.
        - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
        - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
        - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
        - Continual invasive species monitoring and control will be necessary.


Danville Pike Cave, Williamson Park, Kiwanis Park Woods
N
Manheim Township
Lancaster City
East Lampeter Township
Lancaster Township
West Lampeter Township
Pequea Township
Conestoga River
Mill Creek
Stehman Run
23
272
462
30
340
999
324
741
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

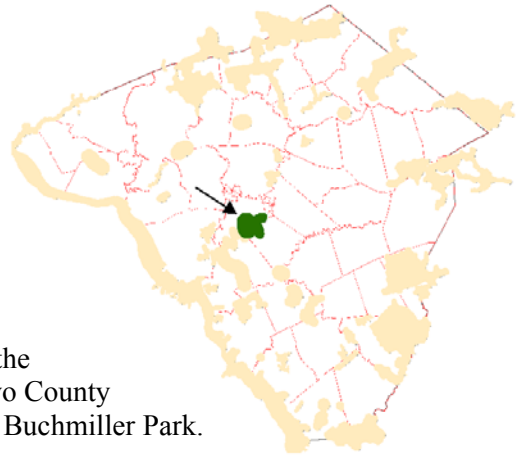
Danville Pike Cave, Williamson Park, Kiwanis Park Woods – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	1992-02-25	BC
Jeweled shooting star (*Dodecatheon radicatum*)	GNR	S2	PT	1991-05-02	B
Animals:					
Price's cave amphipod (*Caecidotea pricei*)	G5	S2S3	-	1993-02-19	C
Pizzini's cave amphipod (*Stygobromus pizzinii*)	G3G4	S1	-	1993-02-19	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: Most of this Natural Heritage Area occurs within Lancaster County Central Park and the adjacent Buchmiller County Park.

- Municipalities:
  - Lancaster City
  - Lancaster Township
  - Pequea Township
  - West Lampeter Township
- USGS Quadrangles:
  - Lancaster Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP518" – (Lancaster Quadrangle)



Description: This Natural Heritage Area includes several loops in the Conestoga River just south of the City of Lancaster. Portions of two County parks are included in this area, Lancaster County Central Park and Buchmiller Park.

Species of Concern Considerations:

Plants:

- Puttyroot is a plant of moist, rich, mature woodlands. Potential habitat for this plant occurs thoughout the wooded portions of the park. Conservation of this habitat and its quality will help this plant population persist at this location. Excavation activities (perhaps as an expansion of park facilities and infrastructure) and lawn creation within the park have been recorded as detrimentally affecting the population of puttyroot at this location. An update on the status of this population is recommended.
- Jeweled shooting star is a spring wildflower that, in the Susquehanna watershed, prefers moist, shaded north-facing limestone outcrops that tend to exhibit a dripping quality. The population at this location has been recorded as robust and healthy. It sits within County Park property and should be secure in its current situation as long as expansion of park infrastructure does not disturb the tree canopy near the slope or the adjacent hilltop. Invasive species of plants can overwhelm the habitat of jeweled shooting star. Rock climbing should also be prohibited at this location. Rock climbing activities could easily dislodge plants and destroy the habitat for this plant species. Additional surveys

for this species in similar habitats along this stretch of the Conestoga Creek are recommended. Several adjacent locations may be suitable for careful expansion of this population.

Animals:

- Pizzini's cave amphipod and Price's cave amphipod are small cave-dwelling crustaceans that have been documented among the leaf litter where the spring from a small cave opening empties into a catchment basin. These species are presumably more prevalent in the connected subterranean habitat. The focus of conservation efforts for this species, and the underground cave habitat as a whole, is the protection of the quality of the groundwater. The specific hydrology of underground systems is difficult to determine, but in general, conditions above ground have a significant effect on the habitat underground. Avoid contamination of the groundwater by preventing agricultural, residential, industrial and roadway runoff from entering the system.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Narrow bands of forest remain along the banks of the Conestoga River where the steep slopes have historically prevented their conversion to other uses such as agriculture. The smaller and narrower patches of forest are highly influenced by edge effects, producing a weedy forest in the early stages of recovery from past disturbances referred to as modified successional forest. The larger patch of forest along Mill Creek, including the majority of Lancaster Central Park, is dominated by a tuliptree-beech-maple forest.
    - Terrestrial (upland) communities:
        - Tuliptree-beech-maple forest
        - Dry oak-mixed hardwood forest
        - modified successional forest*
    - Palustrine (wetland) communities:
        - Sycamore (river birch)-box elder floodplain forest

Ownership:

- Much of the core habitat for both of the plant species of concern is part of Lancaster County Central Park.
- Lancaster County Conservancy owns or holds conservation easements on several smaller wooded parcels along the banks of the Conestoga River.
- Several cemeteries and a golf course occur in this area.
- A few larger parcels remain in agricultural production, with the balance in highly subdivided private parcels. Fragmentation of ownership of the habitat may limit the potential for consistent conservation habitat management.

Habitat Disturbances:

- Historic –
    - Most of the habitat identified for this Natural Heritage Area was gradually cleared of its original forest cover over 200 years ago and replaced by an intensively cultivated landscape, which in turn was converted to the urban city and its suburban component that we see today. Only small isolated pockets of natural vegetation remained to provide habitat for native plants and animals.
    - Several milldams were historically active along this stretch of the Conestoga River and Mill Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Portions of the historic

Conestoga River and Mill Creek floodplains may remain trapped in these deep, narrow channels.

- Current –
  - Subdivision and residential development have replaced many of the former farms in the area. Runoff from impervious surfaces can degrade groundwater quality.
  - Most of the area surrounding the spring/cave opening has been cleared and converted to agricultural and then residential development.
- Exotic Species –
  - The exotic species composition and threat to this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall: A long term objective for the area should be to restore the forested/vegetated floodplain of the Conestoga River, Mill Creek and the adjacent slopes and uplands to include all the area within the 100-meter riparian buffer. An additional objective should be to protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-dwelling species of concern present at this location.

Within the Core Habitat:

- Opportunity still exists to preserve and restore a riparian buffer of 100 meters in this rapidly developing area of the county. The riparian corridor would be compatible with a passive recreational trail or linear park which could help connect Lancaster City to Millersville. Emphasis should be on promoting a viable floodplain natural community and its adjacent uplands rather than construction of active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding floodplain forest areas with native vegetation and restoration and protection of the natural condition of the shoreline. Any trails constructed though the area should stay at least 50 feet from the river banks to avoid degrading the fragile shoreline.
- The subterranean habitat of the cave-dwelling species can be considerably impacted from above ground land use decisions. Storm water runoff through urban areas can be a significant source of chemical pollutants for the river, which can severely impact water quality and the food chain of both surface and subsurface waters. The use of herbicides, pesticides and fertilizers in residential, park, golf course and cemetery grounds can also have a significant impact on the water quality at this location. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Storm water management measures such as the creation of detention basins or vegetated swales should be implemented to slow and capture water flow in these expanses of urban and cultivated landscapes. Conservation efforts should focus on protecting and improving the quality of the surface and ground water for both the local human community as well as for the habitat for native plants and animals and species of concern.
- Incorporate the public space/ natural corridor into future subdivision development plans along the Conestoga River and Mill Creek.
- Restoration of vegetated stream buffers along the Conestoga River and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conestoga River, Susquehanna River and the Chesapeake Bay.

Within the Supporting Landscape:

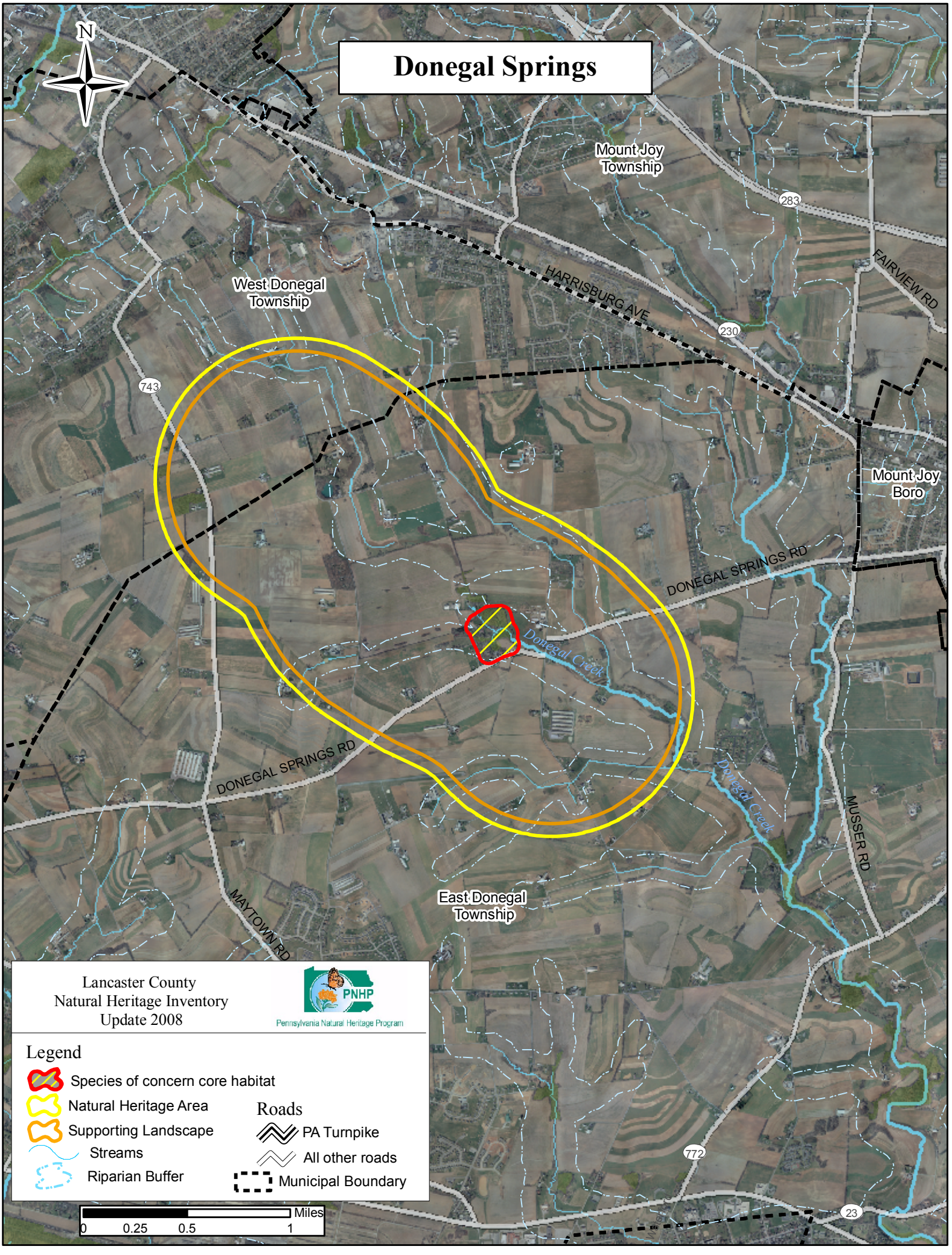
- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along both shores of the Conestoga River. Ideally, expand the native

vegetation along the river corridor to include land within 100 meters of the river's banks. Alternately, the 100 foot riparian buffer can substitute for the 100 meter buffer where development has already eliminated the preferred option. Reforestation efforts should be designed to mimic the adjacent natural community type in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.

- Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way especially along the river shoreline and any remaining natural habitats. These natural habitats provide a significant filter for runoff entering the river from the adjacent uplands.
- The immediate watershed draining into the river includes some forested areas and agricultural fields. Logging of wooded areas, specifically along steep slopes and riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers, road and parking lot runoff and other sources can accumulate in the river leading to the consequent death of aquatic organisms. The amount of impervious surfaces around the river can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the river.
- Pursue conservation easements and fee simple acquisition on properties along the river shoreline, the adjacent slopes and adjacent farmlands to help improve the effectiveness of the Conestoga River as a habitat and natural corridor.
- <u>Potential zoning options for conservation enhancement</u>:
  - Lancaster, Pequea and West Lampeter Townships have zoning ordinances restricting new construction within the 500-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict agricultural activities within the 500-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Lancaster Township's floodplain regulation appears to provide for the establishment of a 100-foot forested riparian buffer on all water courses in the Township, but this appears to conflict with a regulation requiring only a 15–foot grass strip between tilled land and water courses (Section 1310.8 A-E). A 100-foot forested riparian buffer along all water courses is a reasonable and achievable goal and would go a long way towards protecting and improving water quality locally as well as regionally, while the 15-foot grass strip will offer a bare minimum of water quality protection.
  - Consider implementing an Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect ground water resources.
  - Strict enforcement of regulations restricting building activity on slopes greater than 25% would help prevent the adjacent forested slopes from being converted to other uses.
  - Growth within the Township should be discouraged to occur within 100 meters of the 100-year floodplain of the Conestoga River or the recommended riparian buffer of its tributaries.
  - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction.
- <u>Recommended restoration activities</u>:
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.

- All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
    - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.
        - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.

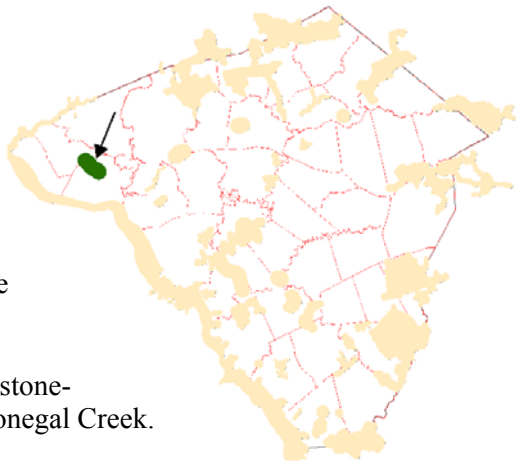
Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.


Donegal Springs
N
Mount Joy Township
West Donegal Township
HARRISBURG AVE
FAIRVIEW RD
283
230
743
Mount Joy Boro
DONEGAL SPRINGS RD
Donegal Creek
DONEGAL SPRINGS RD
Donegal Creek
MUSSER RD
MAYTOWN RD
East Donegal Township
772
23
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Donegal Springs – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Price's Cave Isopod (*Caecidotea pricei*)	G5	S2S3	_	1995-02-01	BC

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - East Donegal Township
  - West Donegal Township
- USGS Quadrangles:
  - Columbia West Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: The spring emerges from a wall and empties into a stone-walled pool. The pool has a channelized outflow that leads to Donegal Creek.

Species of Concern Considerations:
- Pizzini's cave amphipod is a small cave-dwelling crustacean that has been documented among the leaf litter where the spring empties into the pool. The focus of conservation efforts for this species, and the underground cave habitat as a whole, is the protection of the quality of the groundwater. The specific hydrology of underground systems is difficult to determine, but in general, conditions above ground have a significant effect on the habitat underground. Avoid contamination of the groundwater by preventing agricultural, residential, industrial and roadway runoff from entering the system.

Forest Cover / Natrual Communities: The surrounding church property is maintained in an open park-like setting with large shade trees. North of the spring, Donegal Creek passes though a small, deciduous woodlot. Active agricultural fields and pastures dominate the surrounding area.

Ownership: Donegal Springs is located on property owned by Donegal Presbyterian Church.

Habitat Disturbances:
- Historic – Most of the core habitat identified for this species has been relatively unchanged since 1940 based on aerial photos taken during the era. The surrounding landscape was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today.
- Current – The park-like land surrounding the springs helps to buffer the groundwater from non-point sources of pollution. However, chemical treatments of the park grounds should be avoided to prevent groundwater contamination. The land surrounding the church property is intensively cleared and cultivated for agriculture. Runoff from non-point sources of pollution, particularly silt, nutrients and chemicals from agricultural activities, has a high potential to

severely degrade the quality of the ground water. There has been minor subdivision of the lands adjacent to the church property.

- Exotic Species – The subterranean habitats of the cave-dwelling species of concern at this location are not currently at risk from invasive species.

Conservation Actions:

Overall: A long term objective for this habitat should be to protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-swelling species of concern present at this location.

Within the Core Habitat:

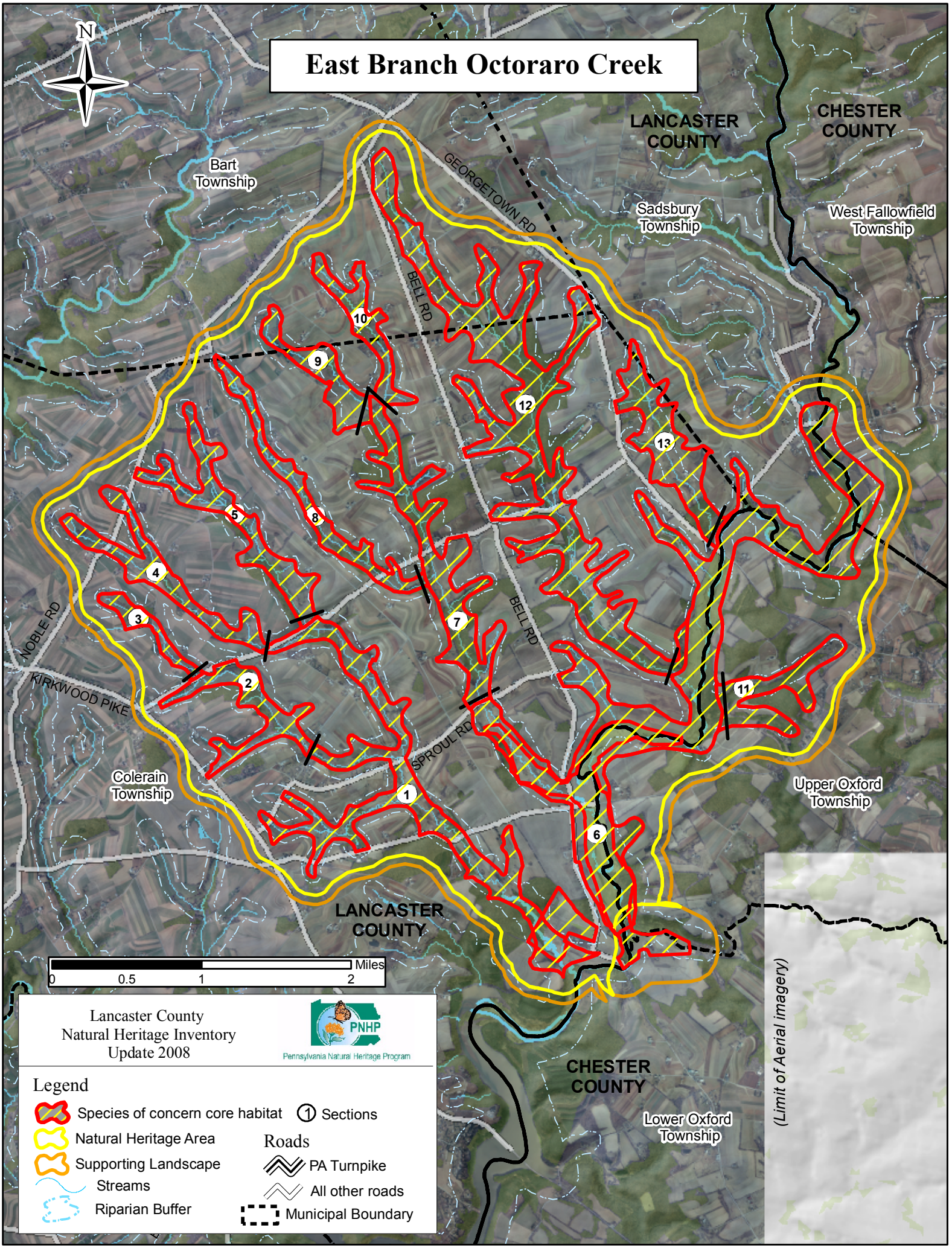
- The cave-dwelling species of concern feeds among the leaf litter at the spring opening. Avoid the temptation to clean leaf debris out of the pool area.
- Conservation easements should be sought for forested properties adjacent to the Church property to provide a buffer to this habitat. Additional populations of cave dwelling species of concern could occur at spring openings and caves on adjacent parcels.
- The subterranean habitat of the cave-dwelling species can be considerably impacted from above ground land use decisions. Use of herbicides and pesticides should be avoided within the Church grounds and the adjacent properties. The rainwater runoff from the adjacent roads and agricultural fields should be considered a potential source of significant groundwater contamination. Runoff from these sources can have significantly higher levels of silt, nutrients and other pollutants than runoff filtered through a natural habitat.
- Conserve and expand the forested aspect of the Church grounds and the adjacent larger woodlot along Donegal Creek. Include restoration of native shrub and herb layers to provide increased habitat diversity. Expand the forested riparian buffer around the spring, the tributary to Donegal Creek and Donegal Creek throughout the area.

Within the Supporting Landscape: Since the groundwater recharge area for the springs is largely undetermined, the supporting landscape for this area is derived from a perimeter around the cave opening in alignment with subsurface geology. Activities within the surrounding area can have a direct impact on the subterranean habitat of the species of concern.

- Consider implementing an Aquifer Protection or Karst Hazard Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect groundwater resources.
- Numerous sinkholes are apparent from aerial photography of the area. Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution. Sinkholes should be buffered with native vegetation to help slow the flow of water before it enters the sinkhole. Water that is reduced in velocity will drop sediment and other heavy particles as it slows down.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
- The intensively cultivated adjacent landscape offers little natural habitat for native species of plants and animals. Portions of the area, particularly along the floodplain of Donegal Creek should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and water courses in the area will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
- The section of Donegal Creek between Kraybill Church Road and Meeting House Run Road has a well developed vegetated riparian buffer. Portions of this buffer that are currently in a wet

meadow habitat should not be considered for conversion to forest though programs such as CREP, but rather the forested habitat should begin at the edges of these wetland openings. This section of Donegal Creek should be considered an example of successful streamside fencing practices and imitated along other portions of the creek. Reforestation efforts should be concentrated on areas adjacent to the creek with greater slope. Reforestation of stream banks will help improve overall water quality by filtering runoff and shading the creek. The oxygen holding capacity of the water is greater in cold water that warm water, improving conditions for cold water species like native trout.

- Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
- East Donegal & West Donegal Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
        - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
        - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.

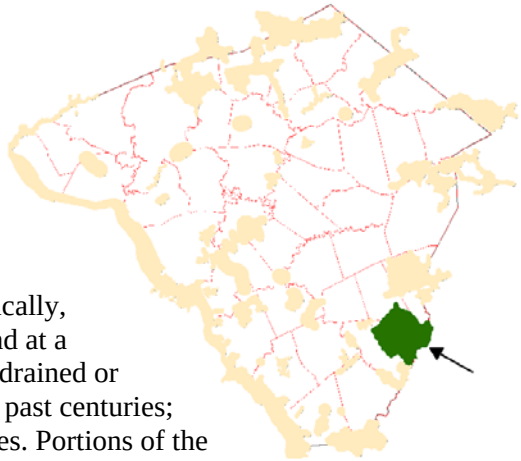

East Branch Octoraro Creek
N
LANCASTER COUNTY
CHESTER COUNTY
Bart Township
Sadsbury Township
West Fallowfield Township
GEORGETOWN RD
BELL RD
BELL RD
NOBLE RD
KIRKWOOD PIKE
SPROUL RD
Colerain Township
Upper Oxford Township
LANCASTER COUNTY
CHESTER COUNTY
Lower Oxford Township
1
2
3
4
5
6
7
8
9
10
11
12
13
0 0.5 1 2 Miles
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Sections
Roads
PA Turnpike
All other roads
Municipal Boundary
(Limit of Aerial imagery)

East Branch Octoraro Creek – *High significance*					
Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Maryland golden-aster (*Chrysopsis mariana*)	G5	S1	PT	1996-10-10	D
Stiff cowbane (*Oxypolis rigidior*)	G5	S2	TU	1997-09-13	BC
Sensitive species of concern [3]	-	-	-	2002	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3]This species is not named at the request of the agency overseeing its protection

Location: The East Branch Octoraro Creek forms the boundary between Lancaster and Chester Counties.

- Municipalities:
  1. Colerain Township, (Lancaster County)
  2. Lower Oxford Township, (Chester County)
  3. Upper Oxford Township, (Chester County)
- USGS Quadrangles:
  1. Kirkwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: The East Branch Octoraro Creek meanders across a wide floodplain that has been used for pasture and hay crops. Historically, wetlands likely existed at most locations where water exits the ground at a spring or where the floodplain widens. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries; but some remain or have recovered from a cessation of these activities. Portions of the floodplain have become revegetated in characteristic floodplain plant communities, mostly on the Chester County side of the creek. These wetland fragments should be considered the backbone for a restoration of this habitat type in the East Branch Octoraro Creek watershed. A revegetated floodplain and its adjacent reforested uplands could be compatible with a carefully sited recreational trail.

Species of Concern Considerations:

- Maryland golden-aster grows in woodland borders, successional openings, open woods, and serpentine barrens. In Pennsylvania, it is near a northern border of its range, and has been documented historically in a few southeastern counties, with about 10 populations currently known in the state. Existing populations of Maryland golden-aster are threatened by natural succession, invasive species, and the indiscriminate application of herbicide. Given the preference of the species for relatively open habitats, active management – such as fire, mowing, or invasive species removal – is often required to maintain the proper successional stage at sites where it grows. This population of Maryland golden-aster is growing in a mowed meadow or hayfield. Early season yearly mowing may help to keep the habitat open and favorable for this species, but cultivation could potentially destroy the site.
- Stiff Cowbane at this location occurs in a red maple shrub swamp along the floodplain of the East Branch Octoraro Creek. A portion of the site is currently protected under a conservation easement.
- The sensitive species of concern inhabiting these shallow wetlands require specific plant communities within a matrix of open canopied wetland habitats.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- The natural communities within this area include:
  - Terrestrial (upland) communities:
    - Dry oak-mixed hardwood forest
    - Dry oak-heath forest
    - modified successional forest*
    - grassland/hay/agriculture*
  - Palustrine (wetland) communities:
    - Sycamore (river birch)-box elder floodplain forest
    - Red maple-elm-willow floodplain swamp
    - Red maple-mixed shrub palustrine woodland
    - Tussock sedge marsh
    - Bluejoint-reed canary grass marsh
    - wet meadow*
- Much of the floodplain of the East Branch Octoraro has been identified as "wet meadow", a generic term applied to open floodplain habitats that have been utilized in some form of agricultural production, typically as hay or pasture. This type of habitat is suitable for the plant species of concern identified for this area. Natural oxbow ponds occur scattered throughout the floodplain and may be important for waterfowl and other wildlife. The wet meadow habitats have good potential for floodplain restoration.
- Much of the adjacent woodlands are in narrow strips that are characterized as "modified successional forest", which are highly impacted by edge effects. Small patches of floodplain forest and upland forest appear to exhibit more mature and less disturbed qualities. Some of these remnants are considered of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as modified successional forest are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers.

Ownership: A small portion of this Natural Heritage Area is owned by the Chester Municipal Authority as a buffer to Octoraro Reservoir. The remainder is primarily held in large parcels in agricultural production. Fragmentation of the habitat and subdivision of parcels limits the potential for consistent conservation habitat management. Conservation activity should focus on these large parcels before land subdivision impedes conservation progress.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture. Several pockets of natural vegetation remained on areas less easily converted to agricultural purposes. These habitat fragments continue to provide habitat for native plants and animals.
  - Two milldams occurred within the Natural Heritage Area, one on Bells Run and one on Coopers Run. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Portions of the historic floodplains of these two creeks may remain trapped in deep, narrow channels.
  - The creeks were crossed in several locations by roads.

- Current –
  - The landscape remains mostly as it was when aerial photos were taken in 1940. The exception is that portions of the floodplains of the creeks have reverted to floodplain forest or other wetland communities from former agricultural activities. Fencing to keep livestock out of the streams in this area appears to have had very positive consequences on the riparian habitat. Ironically, the species of concern currently known from this location are adapted to more open canopy conditions. Removal of some woody vegetation in selected areas may be necessary to maintain the open wetland conditions.
  - Other portions of the floodplain remain in agricultural activities.
- Exotic Species – The exotic species composition and threat of this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented here in the near future if they aren't already present.

- Coordinate the protection of this landscape between Lancaster and Chester Counties.
- The overall objective for this area should be to restore and establish a wide naturally vegetated riparian corridor along the East Branch Octoraro Creek and its tributaries.
- Protect and expand the natural vegetation along both shores of the creek floodplain, adjacent upland and its tributaries. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along the floodplain of the creek. The forested/vegetated landscape helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for many species of animals and plants.
- Suppress the establishment and spread of invasive species of plants.
- The establishment of a wide linear habitat corridor along the creek floodplain could be compatible with a carefully sited public hiking / biking trail.

Within the Core Habitat:

- Long term goals of this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were in harmony with the species of concern found at this site.
- All of the species of concern from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
  - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
  - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the

historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.

- Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be explored, in order to recreate the natural flows of the landscape.
- Because the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within in this Natural Heritage Area.
- Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.

- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the many branches of Chiques Creek:

A - The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced; rather, their basins should naturally revert to their original condition.
B - Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
C - Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
D - Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
E - Current land use is compatible with this section; sparsely pasturing animals in this area could benefit the habitat.
F - Legacy sediments should be removed above the former mill dam.
G - Any remaining railroad tracks that may exist along the abandoned railway corridor should be removed.
H - The heavy agriculture in portions of this area should be allowed to revert back to natural drainages; light to moderate grazing in this area would be compatible.
I - The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.

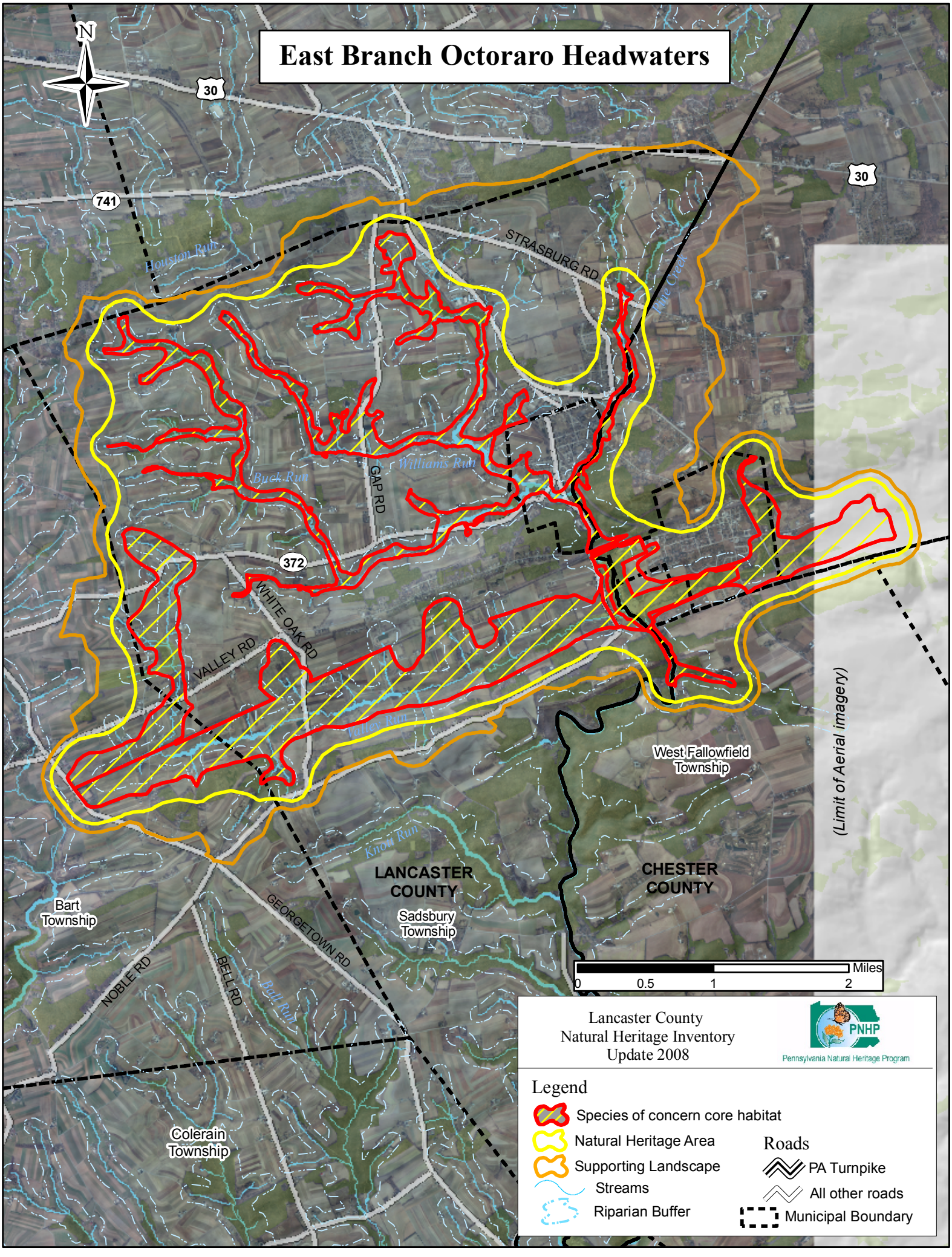
Stream section ID	Recommendation Priority				
	1	2	3	4	5
1	A	B	C	D	
2	D	J			
3	A	D			
4	B	C	D		
5	C	D			
6	B	C	D	H	
7	I				
8	D	H			
9	C	D			
10	C	D			
11	C	D			
12	B	I			
13	A	B	I		

- Establish a corridor of naturally vegetated habitat within 100 meters of the creek's floodplain. Mowing every other year within the area of the species of concern may help increase the suitable habitat for Maryland golden-aster. Any trails constructed though the floodplain area should stay at least 50 feet from the edge of the floodplain to avoid degrading the fragile habitat.
- Restoration of vegetated floodplain buffers along the East Branch Octoraro Creek and its tributaries will help increase the quality of the habitat for the plant species of concern while improving water conditions for the Octoraro Creek, Susquehanna River and the Chesapeake Bay.
- Incorporate the conservation of the natural floodplain and the adjacent 100-meter upland buffer into any future subdivision development plans along the creek and its tributaries.

- Remove invasive species of plants. The creek floodplain and areas of past agricultural activity are highly susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management. Aggressive invasive species along the floodplain can have a significant impact on the available habitat for native species, which can occupy much the same habitat. Control of invasive species along the floodplain will require extensive and continual effort.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose, Asiatic bittersweet and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Invasive species management needs to be coordinated by individuals familiar with native species as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.

<u>Within the Supporting Landscape:</u>

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- Expansion of native vegetation in a series of wetland habitats along the creeks and water courses in the area will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
- Streams through forested or naturally vegetated areas should be considered high priority for conservation in the habitat. Streams through non-vegetated areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat. Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings. See riparian corridor section for site specific recommendations.
        - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
        - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
        - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain.
- Colerain Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat and farmland destruction.


East Branch Octoraro Headwaters
N
30
741
30
STRASBURG RD
Houston Run
Pine Creek
Buck Run
Williams Run
GAP RD
372
WHITE OAK RD
VALLEY RD
Valley Run
West Fallowfield Township
(Limit of Aerial imagery)
Knou Run
LANCASTER COUNTY
CHESTER COUNTY
Bart Township
Sadsbury Township
GEORGETOWN RD
NOBLE RD
BELL RD
Bell Run
Colerain Township
Miles
0
0.5
1
2
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary

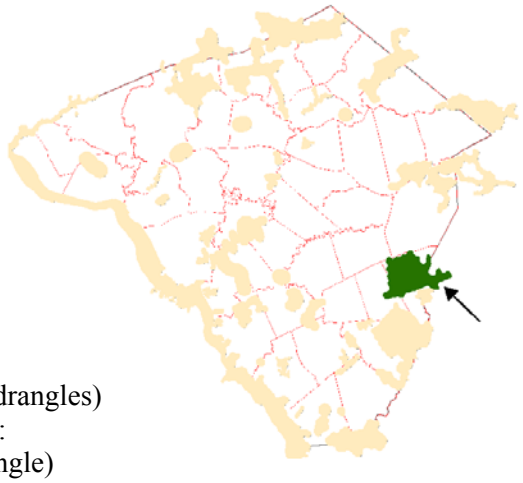
East Branch Octoraro Headwaters – *High significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Rigid sedge (*Carex tetanica*)	G4G5	S2	PT	1993-06-03	C
Animals:					
Sensitive species of concern [3]	-	-	-	2004-05-12	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area includes most of the northern half of Sadsbury Township, and extends into Chester County.

- Municipalities:
  - Bart Township, (Lancaster County)
  - Christiana Borough, (Lancaster County)
  - Sadsbury Township, (Lancaster County)
  - Atglen Borough, (Chester County)
  - West Fallowfield Township, (Chester County)
  - West Sadsbury Township, (Chester County)
- USGS Quadrangles:
  - Gap Quadrangle
  - Parkesburg Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Valley Run Wetland" – (Gap & Parkesburg Quadrangles)
- 1994 Chester County Natural Areas Inventory reference:
  - "Atglen Meadow - SP515" – (Parkesburg Quadrangle)



Description: The floodplains of Pine Creek and Valley Creek combine at this site to form a rich bottomland wet meadow habitat dominated by grasses and grass-like plants.

Species of concern considerations:

- Rigid sedge (*Carex tetanica*) is a plant that is considered apparently secure at the global level (G4/G5), but imperiled within the state (S2). This plant occupies an open wet meadow habitat that is underlain by a strip of limestone bedrock, which creates calcareous, rich soils preferred by this species. The moist, open habitat conditions need to be maintained for the continued presence of this species.
- The sensitive species of concern inhabiting these shallow wetlands requires specific plant communities within a matrix of open canopied habitats. Restoration of the marshy habitats historically associated with the creek floodplains will help to provide expanded habitat opportunities for this sensitive species of concern.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The core habitat here is a grass and sedge dominated wet meadow that is maintained by saturated soils and infrequent grazing. Red maple-mixed shrub palustrine woodland and red maple-black gum palustrine forest are also present in scattered patches.
    - Terrestrial (upland) communities:
        - Tuliptree-beech-maple forest
        - Dry oak-heath forest
        - Dry oak-mixed hardwood forest
        - modified successional forest*
        - shrubland*
    - Palustrine (wetland) communities:
        - Red maple-black ash palustrine forest
        - Red maple-black gum palustrine forest
        - Red maple-mixed shrub palustrine woodland
        - Tussock sedge marsh
        - Bluejoint-reed canary grass marsh
        - wet meadow*

Ownership:

- All of this Natural Heritage Area is privately owned, including a rights-of-way maintained by PECO Energy Corp and a rail line owned by Norfolk Southern Rail Corp.
- Parcel information is not known for the Chester County portion of this site, but current land use suggests that most of the core habitat is held in large agricultural properties. Suburban subdivisions encroach at the edges of the core habitat.

Habitat Disturbances:

- Historic-
    - The surrounding landscape was gradually cleared of its original forest cover over 200 years ago and replaced by an intensively cultivated landscape. Most of the core habitat identified for this Natural Heritage Area has been relatively unchanged since 1940 based on aerial photos taken during the era. In fact, the wet meadows of the core habitat may be under less cultivation that in 1940.
    - The small borough of Parkesburgh occupies land immediately adjacent to wet meadow habitats.
    - Several railroads, local roads and utility corridors cross the area, avoiding the wetlands for the most part.
    - Numerous milldams were active along this stretch of the East Branch Octoraro Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Many of these stream reaches of the watershed remain trapped in these deep narrow channels.
- Current-
    - The landscape here is mostly unnatural and consists primarily of cropland and residential areas. A powerline, railroad, and several roads cut through the area. All of these modifications of the landscape around the core habitat provide opportunity for disturbance and for the introduction of invasive plant species.
    - The borough of Parkesburg has nearly doubled in size since 1940 with the addition of a sub-development on its southern and western boundaries. What appears to be an oval racetrack, has been built along the banks of Valley Run, a Lancaster County tributary to Pine Creek.
    - Grazing is an important disturbance that impacts this site. It can be beneficial or detrimental depending on its extent. The current low intensity grazing helps to maintain the open conditions of the meadow. However, excessive grazing would compact soil, encourage

growth of exotic species, and may be particularly hard on palatable species such as rigid sedge.
    - Modification of the hydrologic regime would also be a disturbance. Any attempts to drain or flood the wet meadow habitats would degrade habitat quality. Alteration to flooding patterns or baseflow of the East Branch Octoraro Creek and Valley Creek would also impact the habitat's hydrology.
- Exotic Species- The exotic species composition and threat of this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall:
- Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented in this stretch of the Octoraro Creek in the near future if they don't already exist there.
- Ownership of this site is made up of a number of private landowners and it is currently unprotected. Permanent protection of these properties, particularly in the core habitat, through conservation easements, transfer of development rights or acquisition should be a priority. Conservation actions should focus on maintaining current low intensity grazing and increasing natural habitat around the species of concern core habitat.

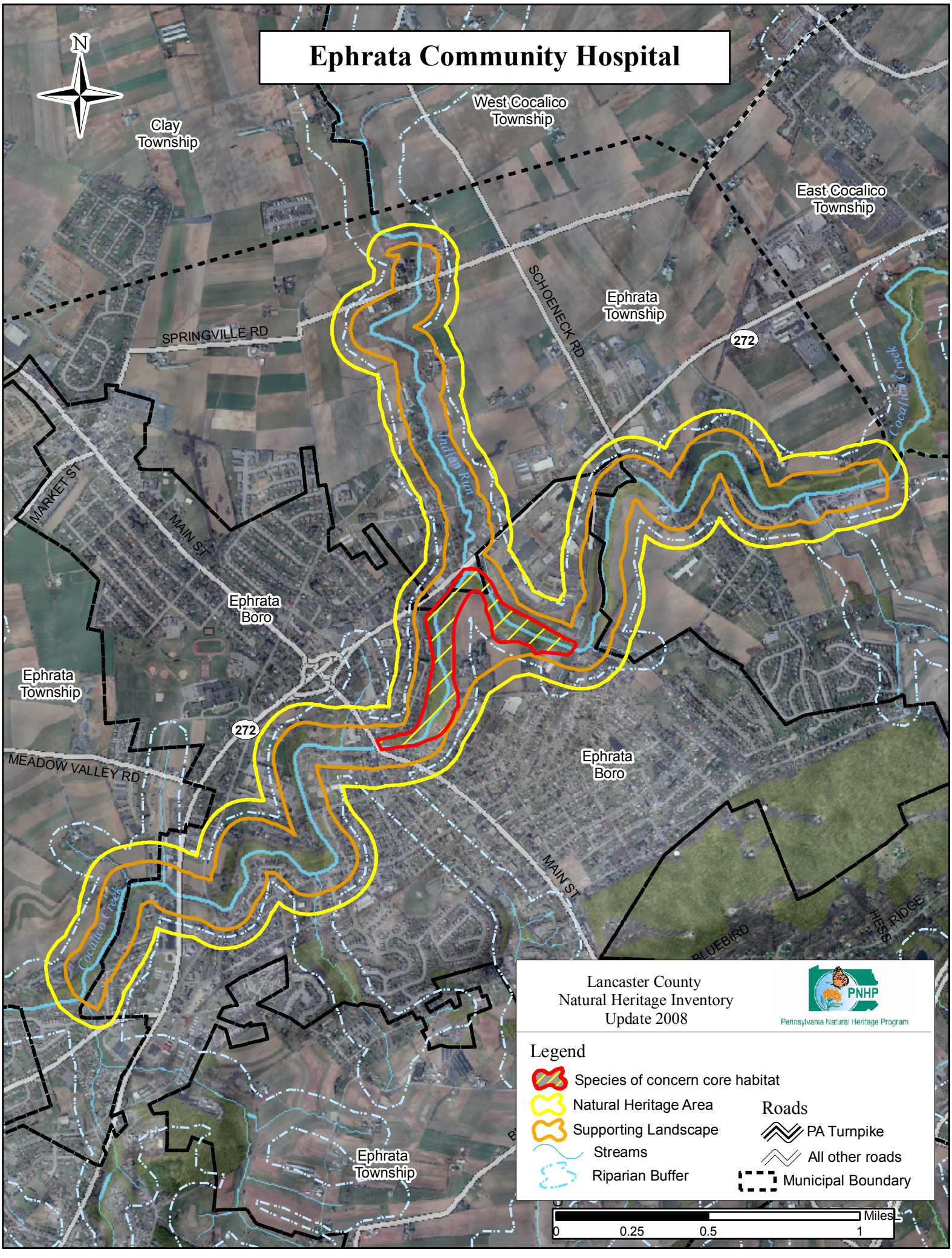
Within the Core Habitat:
- Long term goals of this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were in harmony with the species of concern found at this site.
- All of the species of concern that have been documented from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
    - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
    - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
    - Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be explored, in order to recreate the natural flows of the landscape.
    - Because the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be

avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within in this Natural Heritage Area.
    - Numerous mill dams occurred along the branches of Octoraro Creek within this Natural Heritage Area. Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.
- Maintain the existing hydrologic regime.
    - This includes protecting the water quality, baseflow and natural flooding patterns of Valley Creek and the East Branch of the Octoraro Creek. Water quality is an important consideration and is likely impacted by excess nitrogen and sediment load from neighboring agricultural areas as well as effluent from a nearby sewage treatment plant.
    - Wet meadows should be protected from drainage or flooding or "improvements" for agriculture.
- Remove invasive species of plants.
    - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
- Additional surveys for rigid sedge and other species of concern are recommended.

<u>Within the Supporting Landscape</u>:

- Allow agricultural fields immediately adjacent to core habitat to return to natural communities. Increasing the amount of natural area on surrounding lands, whether in the form of wet meadow, shrubland or forest will provide an important buffer and help to protect the quality of the core habitat.
- Existing natural habitats within the area should be conserved with conservation easements or through acquisition.
- As the area contains some highly residential areas, fencing areas of the core habitat bordering residential areas could help provide protection from disturbances such as ATV use by neighboring residents.
- Remove invasive species of plants in surrounding natural areas.
    - The power cut and road banks are prime corridors for invasive species establishment and invasive plants in these areas should be targeted.
- There are a number of wet meadow habitats along nearby tributaries. Efforts should be made to protect and maintain or to restore these sites and to provide for natural connections between wetlands along riparian corridors.
    - Wet meadows in the vicinity provide additional habitat for rigid sedge as well as other native species while also providing regional flood protection and groundwater filtration.
    - Establish a cluster of connected sites with similar habitats to allow populations to expand, which facilitates the genetic exchange that is vital for small populations.
- Additional surveys for species of concern are recommended.
- Restore stream corridors with native vegetation appropriate to the topography and hydrology.
    - This will increase habitat for many species, provide travel corridors, and may help to reduce sedimentation and nitrate load in stream and ground water.
    - Careful determination is needed to avoid planting trees in floodplains that contain wet meadows. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Continue implementation of agricultural Best Management Practices in the area to improve water quality.
- <u>Potential zoning options for conservation enhancement</u>:
    - Growth within the Township should be discouraged to occur within 100 meters of the 100-year floodplain of creeks and streams of the area.

- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into natural habitats.
- Growth within the Township should be discouraged within the core habitat identified for this area.


Ephrata Community Hospital
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Clay Township
West Cocalico Township
East Cocalico Township
Ephrata Township
SPRINGVILLE RD
SCHOENECK RD
272
Indian Run
Cocalico Creek
MARKET ST
MAIN ST
Ephrata Boro
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272
MEADOW VALLEY RD
Ephrata Boro
MAIN ST
Cocalico Creek
BLUEBIRD
HESS RIDGE
Ephrata Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Ephrata Community Hospital – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Sensitive species of concern[3]	G5	S2S3B	PE	2006-06-01	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location:
- Municipalities:
  - Ephrata Borough
  - Ephrata Township
- USGS Quadrangles:
  1. Ephrata Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Indian Run joins Cocalico Creek at Ephrata Borough where small portions of the natural floodplain forest remain intact. The small patch of forest here supports a breeding population of a sensitive species of concern. The adjacent landscape is dominated by the Ephrata Borough and the neighboring suburbs.

Species of Concern Considerations:
- This sensitive species of concern lives and breeds in the forested habitat along waterways and feeds primarily on aquatic organisms in smaller streams and rivers. The core habitat for this sensitive species of concern is both the creek and the adjacent upland forest. This species is apparently not sensitive to human activity as it has been found in urban and suburban settings as long as the appropriate habitat is available. This sensitive species of concern requires abundant food source in the river and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of Cocalico Creek and by protecting and expanding the natural forested/vegetation buffer along the creek, its floodplain and all its tributaries.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.
- Several small patches of silver maple floodplain forest are surrounded by human altered landscape. The forest includes some sycamore (*Platanus occidentalis)* and river birch (*Betula nigra*), but appears dominated by silver maple (*Acer saccharinum).* The understory of small patches of forest in this context is typically dominated by invasive species. The riparian buffer of the Cocalico Creek through the area is limited to a single row of trees in many places, and entirely lacking vegetation in others.

Ownership:
Ephrata Borough, Ephrata School District, Ephrata Community Hospital and other public or quasi-public entities all own parcels containing floodplain or the adjacent uplands along Cocalico Creek.

Conservation Actions:

Overall:

- Prevent the conversion of agricultural or natural lands adjacent to Conewago Creek or its tributaries to residential or industrial development.
- Protect and expand the natural vegetation along both shores of the creek floodplain and adjacent upland. Implement the conservation / restoration of a wide strip of native vegetation as a terrestrial habitat corridor along both shores of the creek. Riparian corridors of all stream tributaries to Cocalico Creek and the creek shoreline itself need additional restoration measures. Avoid building, replacing or expanding dams on the Cocalico Creek.

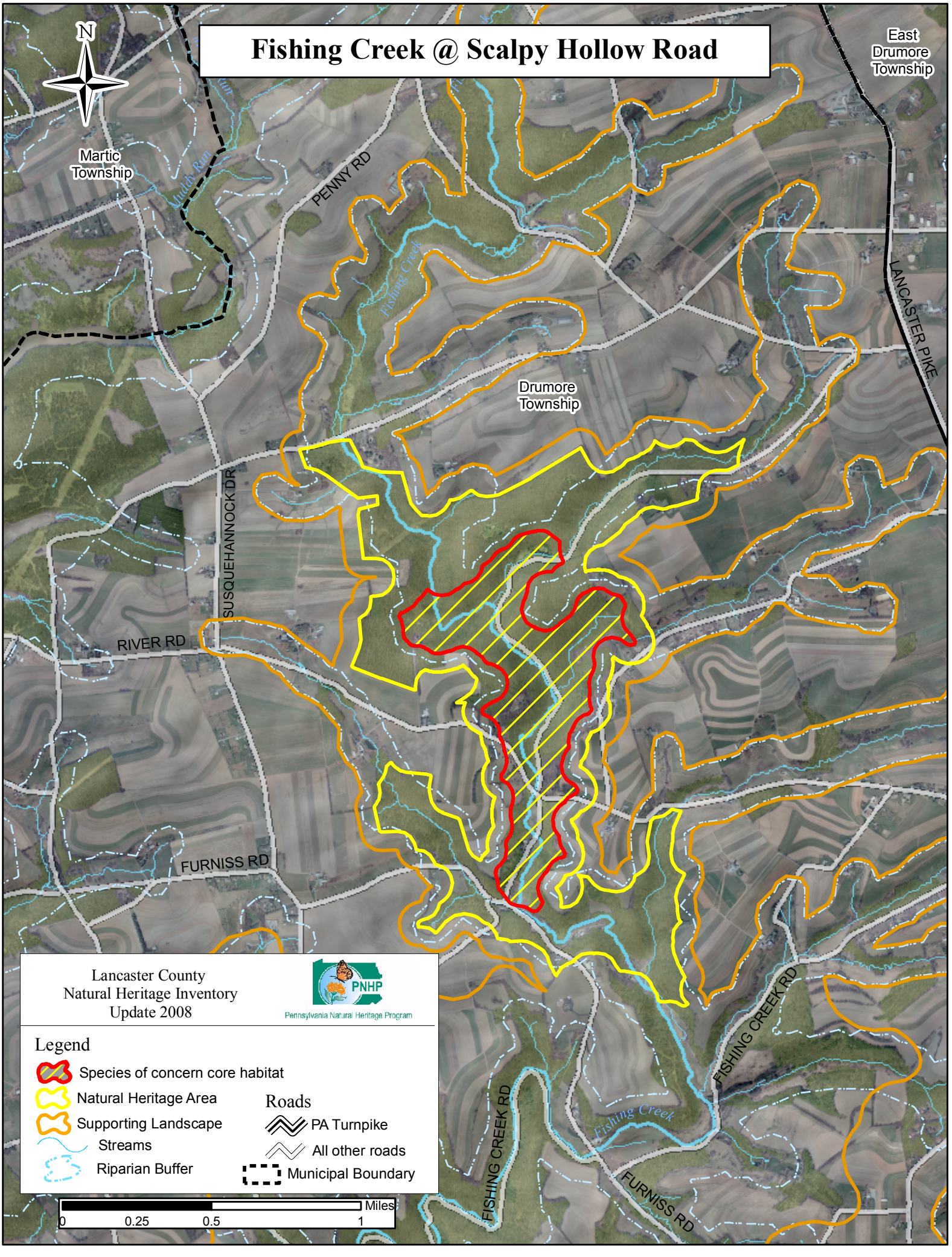
Within the Core Habitat:

- Most of the core habitat for the species of concern falls within the floodplain for the river. Strict enforcement of zoning regulations to prohibit building activity within the 100-year floodplain would help protect the habitat of this species of concern.
- The forested floodplain and the adjacent uplands may be an appropriate location for a municipal park serving Ephrata Borough. Emphasis should be on promoting a viable floodplain natural community rather than on active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding areas with native vegetation and restoration and protection of the natural condition of the floodplain.
- The rainwater runoff from the roofs, roads and parking lots of the adjacent schools and businesses should be considered a potential source of significant groundwater contamination. Runoff from these sources can have significantly higher temperatures and levels of pollutants than runoff filtered through a natural habitat. Storm water management measures such as creation of detention basins and rain gardens can be incorporated into Municipal infrastructure to allow storm water to be slowed and filtered before entering the creek from road crossings and other breaks in the vegetated buffer. Restoration of vegetated stream buffers along Cocalico Creek and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the creek, Susquehanna River and the Chesapeake Bay.
- Ephrata Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.

Within the Natural Heritage Area / Supporting Landscape:

- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions, especially upstream from the core habitat. Upstream use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the water quality and food chain at this location. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern. The rainwater runoff from the urban, suburban and agricultural areas should be considered a potential source of significant surface water contamination. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.

- Many stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from urban, residential, agricultural and roadway runoff. Establish at least 100 foot buffer of woody vegetation along the Cocalico Creek through the Borough of Ephrata and a 100 meter buffer outside of areas that have already been highly built up to help protect the water quality of the creek by reducing erosion, sedimentation, and pollution. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river. Forested buffers will also help shade the creek, cooling the water temperature, which allows the water to carry more oxygen for a healthier aquatic system.


Fishing Creek @ Scalpy Hollow Road
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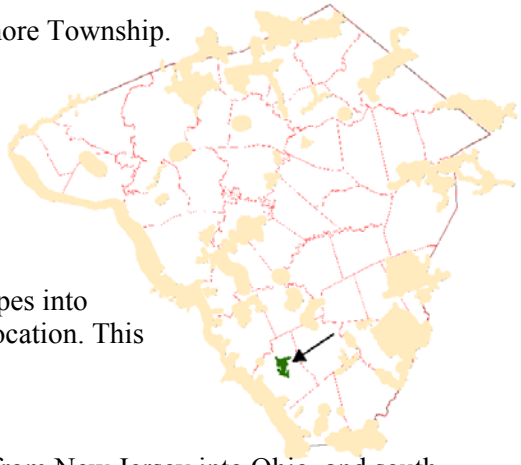
Martic Township
East Drumore Township
Drumore Township
PENNY RD
LANCASTER PIKE
SUSQUEHANNOCK DR
RIVER RD
FURNISS RD
FISHING CREEK RD
Muddy Run
Fishing Creek
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Fishing Creek @ Scalpy Hollow Road – *Exceptional significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Glade spurge (*Euphorbia purpurea*)	G3	S1	PE	2007-06-06	BC

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location: This Natural Heritage Area is in the very center of Drumore Township.

- Municipalities:
  - Drumore Township
- USGS Quadrangles:
  - Holtwood Quadrangle
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Numerous springs and seeps flow off the adjacent slopes into Fishing Creek as it winds its way though a forested ravine at this location. This area is entirely within Drumore Township.

Species of Concern Considerations:

- Glade spurge has a relatively small global range, extending from New Jersey into Ohio, and south into North Carolina. Currently, around 50 populations are known to exist worldwide. Fewer than 10 populations, most of them with only a few individuals, are currently known from Pennsylvania. At this location, glade spurge is growing in the moist seepages and along damp road banks. Portions of the glade spurge population occur in close proximity to the road edge. *Inappropriate road maintenance activities could easily eliminate portions of this population.* Coordinate road maintenance activities between land stewards of the Lancaster County Conservancy and Drumore Township road maintenance crews to provide adequate protection considerations for this species. The viability of the known populations of glade spurge and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. Logging of the adjacent slopes is a potential concern. This species may be impacted by excessive browsing by deer in some locations
- Other plant species of concern have been reported from this area. Additional surveys are recommended.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry white pine (hemlock)-oak forest
  - Dry oak-heath forest
  - modified successional forest*
  - grass-shrubland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest

- Forest canopy covers almost all of the core habitat and Natural Heritage Area, with only minor incursions from roads, residences and agricultural fields. The forest type is predominantly dry oak-heath, but also includes smaller pockets of dry white pine (hemlock)-oak forest, tuliptree-beech-maple forest, and sycamore (river birch)-box elder floodplain forest. The large interior forest block is divided into two smaller portions by Fishing Creek Hollow Road.

Ownership: The core habitat is drawn to include the steep slopes adjacent to Fishing Creek. The Natural Heritage Area includes the surrounding forested habitat.

- The most critical portions of the species of concern core habitat are owned by the Lancaster County Conservancy, which owns about 40% of the core habitat area.
- The remainder is held in about 30 private property lots of varying size.

Habitat Disturbances:

- Historic – By 1940, most of the area outside of the Natural Heritage Area had been converted to active agricultural uses. The area within the Natural Heritage Area was densely forested except for a few clearings which have since reverted to forest.
- Current –
    - There are currently few disturbances to this habitat. Fishing Creek Hollow Road fragments an otherwise contiguous block of interior forest, following the creek. The presence of this road along the creek also has a negative impact on the water quality of the creek by allowing sediment and other non-point sources of pollution to directly enter the creek.
    - Illegal dumping has occurred in areas adjacent to the road. Fill has been dumped over the roadside bank, nearly burying a portion of the glade spurge population.
    - Road maintenance activities have the potential to destroy portions of the glade spurge.
    - There has been a marked increase in residences along most roads in the vicinity of the Natural Heritage Area since 1940, though the land use continues to be strongly agricultural.
    - Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species – Control options for invasive plants range from mechanical to chemical (see individual fact sheets). Invasive species of plants known at this location include, but are not likely limited to:
    - Tree-of-heaven (*Ailanthus altissima*)
    - Garlic mustard (*Alliaria petiolata*)
    - Gill-over-the-ground (*Glechoma hederacea*)

Conservation Actions:

Overall:

- Protect the glade spurge from inappropriate road maintenance or other land use activities.
- Conserve the native forest canopy. While providing the primary habitat for the populations of glade spurge, the forested landscape also helps to protect water quality of the small streams that drain through this Natural Heritage Area into Fishing Creek and provides refuge for other forest dependent species. Most of the critical species of concern habitat is owned by the Lancaster County Conservancy and likely will not be vulnerable to land use changes or logging activities.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat.

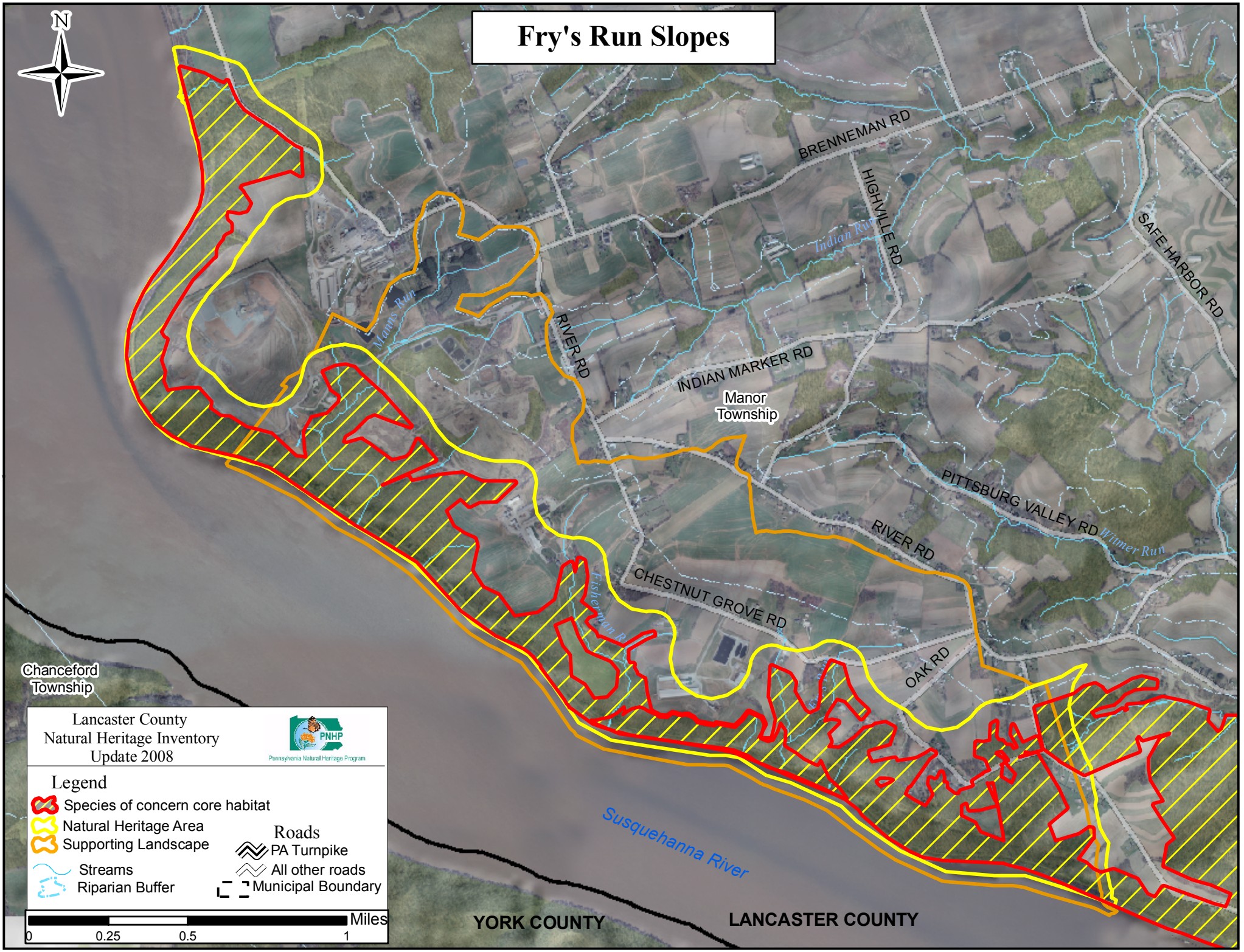
- Approximately 40% of the core habitat is owned by the Lancaster County Conservancy, whose mission statement provides for the continued protection of lands under its ownership.
- First, coordinate road maintenance activities between the Lancaster County Conservancy land stewards and the Drumore Township road maintenance crew to avoid destruction of the glade spurge habitat.
- Second, consider fee-simple acquisition, or conservation easement options with the largest property owners of the core outside of the Lancaster County Conservancy property holdings. Many adjacent landowners own a small portion of the wooded landscape. The steep slopes of the immediate habitat of the species of concern likely prevent most types of development activity. The flatter hilltops, however, could prove tempting building sites.
- Fencing of the population of glade spurge may be necessary to avoid herbivory by deer or inadvertent destruction from foot traffic.

- Avoid logging in this area.
  - Allow the forest to return to near old-growth conditions.
  - Leave fallen trees in place to help build soil nutrients, humus and tilth.
    - Trees that have fallen over approved trails can be cut through as necessary.
  - Removal of non-native trees will be necessary.
- Remove invasive species of plants.
  - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
  - Coordinate invasive species management along the roadways.
  - Continual invasive species monitoring and management is recommended.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
  - Block access to forested areas by off road vehicles, ATVs, motorcycles and bicycles.
- Additional surveys for species of concern are recommended.

<u>Within the Supporting Landscape:</u>

- The supporting landscape for this location was drawn to exclude the most disturbed portions of the adjacent habitat, which are primarily active agricultural fields and residential areas.
  - Agricultural fields within the supporting landscape should be encouraged to return to forest to expand the area of interior forest at this location. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs or varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Adjacent forested properties should be acquired or provided with conservation easements to help provide a buffer to this habitat. Additional populations of species of concern could occur on adjacent forested parcels.
- Remove invasive species of plants.
  - Monitor and control invasive species of plants especially at the transition zone between forest and agricultural fields.
- Avoid logging in this area.
  - Allow the forest to return to near old-growth conditions.
- Remove non-native trees and shrubs.
  - Encourage native tree and shrub recruitment.
    - Reduce the size of the deer herd. Native species of plants are particularly susceptible to deer herbivory.
  - The interior forest habitat at this location can be significantly increased by closing Fishing Creek Hollow Road. There are nearby parallel roads that can serve the same function as Fishing Creek Hollow Road, so its closure would have minimal impact on the local community while providing significant benefits to the landscape.

- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the topography and hydrology.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
        - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
        - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.
- Potential zoning options for conservation enhancement:
    - Strict enforcement of regulations restricting building activity on 100 year floodplains and slopes greater than 25% will provide protection for virtually all of the area within the core habitat and ~65% of the Natural Heritage Area.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this area.


Fry's Run Slopes
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BRENNEMAN RD
HIGHVILLE RD
SAFE HARBOR RD
Indian Run
Mams Run
RIVER RD
INDIAN MARKER RD
Manor Township
PITTSBURG VALLEY RD
Witmer Run
RIVER RD
CHESTNUT GROVE RD
OAK RD
Fisherman R
Chanceford Township
Susquehanna River
YORK COUNTY
LANCASTER COUNTY
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Species of concern core habitat
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Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

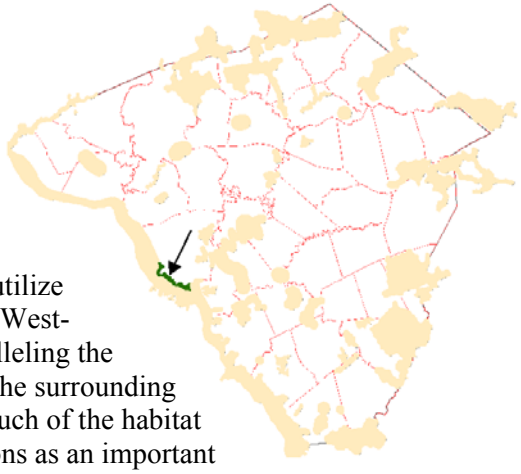
Fry's Run Slopes– *High significance*

Species of Concern:	PNHP Rank [1] Global	PNHP Rank [1] State	State Status [1]	Last Observed (y-m-d)	Quality [2]
Plants:					
Wild oat *(Chasmanthium latifolium)*	G5	S1	PE	2006-10-10	E
Animals:					
Sensitive species of concern [3]	-	-	-	1991-05-18	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location:

- Municipalities:
  - Manor Township
- USGS Quadrangles:
  - Safe Harbor Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: This Natural Heritage Area is drawn around the steep, forested, river-facing slopes above the Susquehanna River in this otherwise agricultural landscape. Active agricultural fields utilize the flat uplands often right up to the edge of the steep river slopes. West-facing bedrock outcrops are exposed along the railroad tracks paralleling the shoreline. Fry's Run, Fisherman's Run and Mann's Run drain off the surrounding agricultural uplands down the forested slopes and into the river. Much of the habitat is a dry, oak-dominated forest. This large natural landscape functions as an important terrestrial component of the Susquehanna River regional habitat corridor.

Species of Concern Considerations:

Plants:

- Wild oat at this location is growing on dry, thin, schist-derived soils on rock ledges adjacent to the railroad tracks along the Susquehanna River. This plant is adapted to the disturbed, open conditions created by the railroad and will likely persist in the absence of competition from invasive species. Indiscriminate use of herbicides for vegetation management is not advisable in this location. Establish a "no spray" zone along the tracks in this area. This plant will likely respond favorably to the reduction of competition through periodic mowing. Maintenance activities should strongly consider their impact on this and other rare plants in the rights-of-way.

Animals:

- A sensitive species of concern utilizes the steep, dry, southwest-facing wooded slopes along the Susquehanna River. The suitable habitat for this animal species is mapped as occurring from Turkey Hill all the way down to the mouth of the Conestoga River. A dead specimen was found between the two rails of the train tracks along the river. The railroad can be a substantial barrier for small animal movement between upland and lowland habitats. Periodic under-track culverts, or other means of mitigating the barrier effect of the tracks, should be integrated into future railroad maintenance plans.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- The species of concern core habitat is drawn around the forested portions of the immediate landscape, so this entire habitat is forested. The Natural Heritage Area for this site has roughly 65% forest cover. The supporting landscape is mostly in active agriculture with few areas covered by forest. The forest appears dominated by dry oak-heath forest. Other forest communities present include:
  - Terrestrial (upland) communities:
    - Tuliptree-beech-maple forest
    - Red oak-mixed hardwood forest
    - Dry oak-mixed hardwood forest
    - Dry oak-heath forest
    - Red maple terrestrial forest
    - Dry oak-heath woodland
    - Pitch pine- mixed hardwood woodland
    - Virginia pine-mixed hardwood woodland
    - modified successional forest*
    - juniper woodland*

Ownership:

- The Lancaster County Refuse Authority owns most of the river-facing slopes from Turkey Hill to Fisherman's Run.
- PPL owns several narrow utility rights-of-way corridors and a larger parcel at the southern end of the Natural Heritage Area.
- The Norfolk Southern Rail Corporation owns a wide rights-of-way paralleling the shore of the Susquehanna River that includes quite a bit of the steep slopes of this area.
- The remainder of the area, including a significant portion of the river slopes is privately owned and held in various-sized parcels.

Habitat Disturbances:

- Historic –
  - Most of the suitable landscape had been converted to agricultural uses by 1940 based on aerial photographs from the era. The relatively flat landscape on top of the slopes overlooking the Susquehanna River encouraged forests to be cleared right up to the edge of the steep drop off. This provided very little buffer for runoff from agricultural practices. Erosional gullies can be seen draining cultivated fields towards the river, likely loaded with silt, nutrients and agricultural chemicals.
  - By 1940 the railroad had already been constructed along the Susquehanna River.
- Current –
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may consider the railroad an insurmountable obstacle.
  - Active agricultural fields continue to press up against the edge of the Susquehanna River slopes.
  - Turkey Hill, to the north of the Natural Heritage Area, has been developed as a landfill for Lancaster County.
  - Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources.

Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.

- Exotic Species –
  - Few invasive species were noted during past field surveys, but the railroad rights-of-way and the transition zone between forested and agricultural landscapes are likely the areas of greatest invasive plant species concentrations. Invasive species noted included a well established invasion of Japanese honeysuckle.

Conservation Actions:

Overall:

- Create "no spray" zones along the most sensitive areas of the railroad rights-of-way to avoid unintentional destruction of the species of concern or their habitats.
- Safeguard the quality and expanse of the forested landscape along the river-facing steep slopes.
- Encourage agricultural areas at the edge of the river bluffs to retreat from the slope's edge and to revert to a forested landscape. The forested landscape helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species.
- Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants.
- Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat through conservation easements and fee-simple acquisition.
  - The species of concern core habitats overlap along the narrow band of steep slopes facing the Susquehanna River. The lower portion of the slopes is currently owned by Norfolk Southern Railroad Corporation. Indiscriminate railroad herbicide use is inappropriate for this location. A "no spray" zone should be established at rock outcrops and where the wild oat population occurs. Vegetation should be managed mechanically in these areas to avoid unintentional collateral damage to the rare plant population.
  - Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.
  - A significant portion of the species of concern core habitat is owned by various private property owners. The steep slopes of the habitat likely prevent most types of development activity, the flatter hilltops, however, could prove tempting building sites. Logging of these sensitive slopes is also a potential threat. The forested portions of these parcels should be considered a high priority for fee-simple acquisition or conservation easement options for this Natural Heritage Area. The agricultural portions of these properties should be considered a secondary priority for conservation or agricultural easements. Protection of the adjacent agricultural landscape will help provide a buffer for the core habitat from other, less-reversible types of development.
- Conserve the intact forest canopy and a healthy native shrub layer.
  - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.

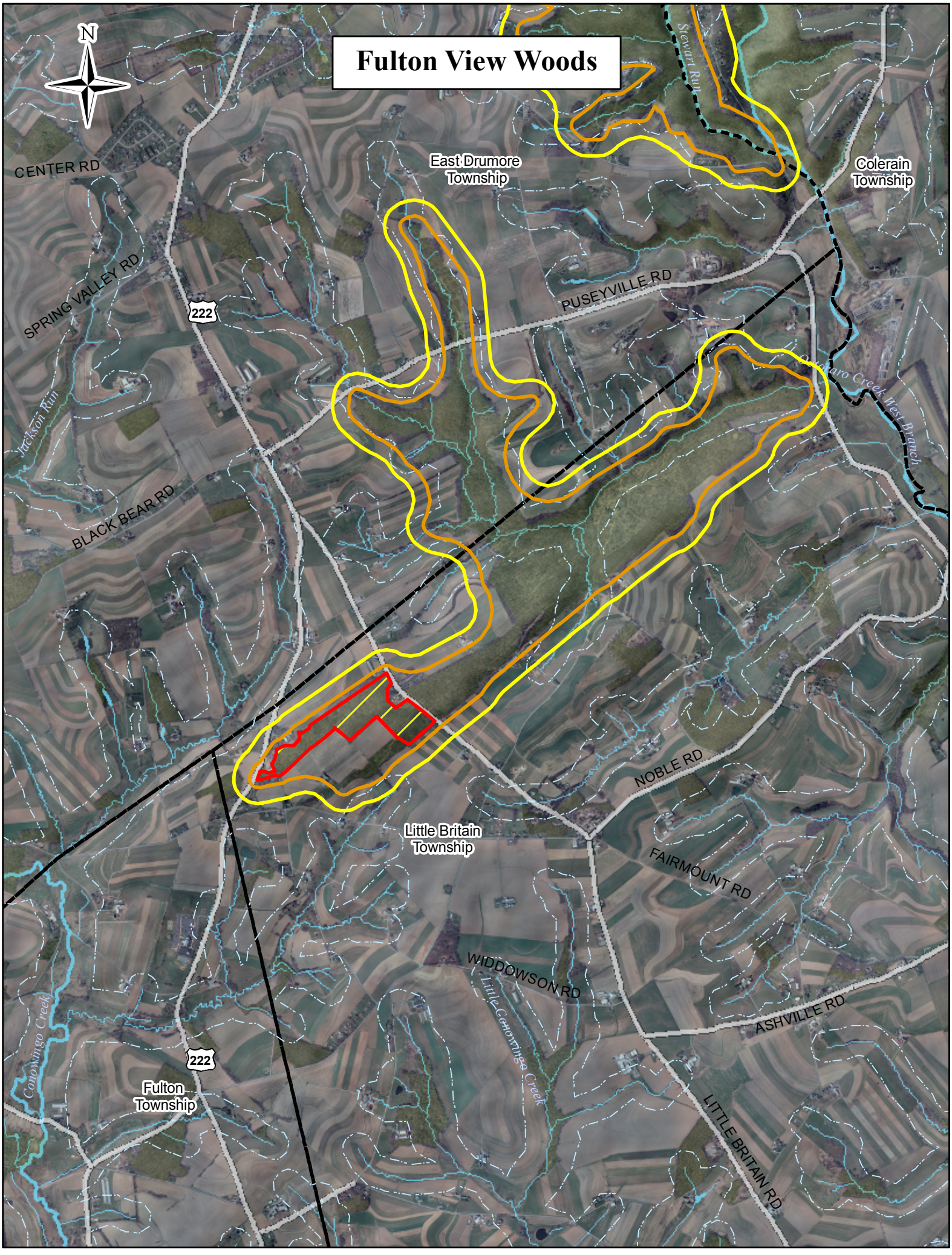
Within the Natural Heritage Area / Supporting Landscape:

The supporting landscape for this Natural Heritage Area is derived from the sub-watershed of Haines Branch and the adjacent sub-watersheds entering the Susquehanna River. Activities within the watersheds can have a direct impact on the core habitats of the Natural Heritage Area and the species of concern it contains.

- Encourage agricultural areas at the edge of the river bluffs to retreat 100 meters from the slope's edge and to revert to a forested landscape. The forested landscape helps to protect the water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species.
- Agricultural fields on high quality soils should be maintained as such. Agricultural easements may be the appropriate tool for these properties.
- Agricultural fields on poor quality soils adjacent to the core habitat should be encouraged to return to forest to expand the area of interior forest at this location and to provide an additional buffer for the core habitat. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants
- Remove non-native trees and shrubs. The railroad rights-of-way and forest/agricultural transition zones are likely the primary location of non-native trees and shrubs within this area. Care must be taken to distinguish between native and non-native species of plants. Coordinate invasive species control with those familiar with plant identification.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Plant species of concern are particularly susceptible to deer herbivory.
- Block access to forested areas by off road vehicles, ATVs and other motorized vehicles
- Additional surveys for species of concern are recommended.
- Conservation easements should be sought for agricultural properties adjacent to the Natural Heritage Area to provide a buffer to this habitat and to help provide connectivity to other nearby greenway Natural Heritage Areas.
- <u>Potential zoning options for conservation enhancement:</u>
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% could provide protection for approximately 80% of the area within the core habitat, ~45% of the Natural Heritage Area and ~5% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this area.
- <u>Recommended restoration activities:</u>
    - Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
        - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
            - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
            - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
            - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.
    - Remove invasive species of plants.
        - Invasive species are typically a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable.

A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern. Mechanical control, (mowing) is an option that will also require attention to the location and timing of mowing. Early-mid spring season mowing will result in stunted growth for most of the invasive species. Allow the plant species of concern to bloom and set seed before late season mowing takes place.

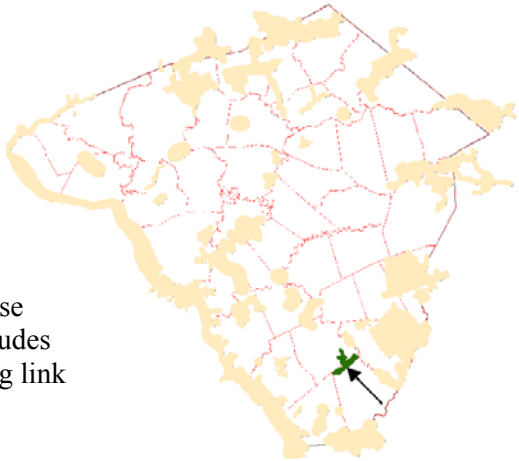
- Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.


Fulton View Woods
N
CENTER RD
East Drumore Township
Colerain Township
Stewart Run
SPRING VALLEY RD
222
PUSEYVILLE RD
Jackson Run
Octoraro Creek West Branch
BLACK BEAR RD
NOBLE RD
Little Britain Township
FAIRMOUNT RD
WIDDOWSON RD
Little Conowingo Creek
ASHVILLE RD
Conowingo Creek
222
Fulton Township
LITTLE BRITAIN RD

Fulton View Woods – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
American holly (*Ilex opaca*)	G5	S2	PT	1991-06-27	D

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Little Britain Township
- USGS Quadrangles:
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: This Natural Heritage Area includes a patch of forest along a tributary to the West Branch Octoraro Creek that is otherwise surrounded by agricultural activity. The eastern end of the area includes patches of interior forest. This forested habitat represents an existing link in a habitat corridor supporting the Octoraro Creek watershed.

Species of Concern Considerations:

Fulton View Woods supports a healthy herb and shrub layer including a stand of American holly (*Ilex opaca*), a plant species of concern. The conservation of American holly in Pennsylvania has concentrated on protecting populations that are believed to be indigenous and that represent native genotypes. Occurrences of the species that have resulted from escapes from plantings are of uncertain genetic origin and are not considered to be of conservation significance. As a woodland species, proper forest management and control of invasive species are important for the long term viability of American holly. Gathering of the branches of wild trees for winter decoration should be discouraged.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- Fulton View Woods is a rich forested site dominated by species typical of a dry oak-mixed hardwood forest, such as chestnut oak (Quercus prinus), black oak (Quercus velutina), and white oak (Quercus alba). Additional patches of forest are considered to be a tuliptree-beech-maple forest. The remainder is modified successional forest which is considered a forest type in the early stages of recovery from past disturbances such as farming, grazing or clear cutting. This site is adjacent to a relatively large forested block that serves as a buffer to tributaries of the West Branch of the Octoraro Creek.

Habitat Disturbances:

- Historic-
  - Aerial photos from the 1940s show that the area that is currently forested was forested then, though some areas had been recently harvested.
  - The surrounding landscape is mostly in agricultural production, though many streams have forested buffers.
- Current-

    - The portion of the forest that had been logged in the 1940s appears not to have regenerated very well, or has been selectively cut again. This frequently logged area is considered "modified successional forest" in the early stages of recovery from past disturbances. Also, as the forest is adjacent to commercial and residential use, it has been exposed to accidental fire and a sizable portion was burned in 1991. Trails have been cut into the forest for off-road vehicle use, which compacts soil, disturbs understory growth, and provides a favorable environment for the spread of invasive plants.
- Exotic Species– A number of invasive plant species have been documented at this site, including:
    - Barberry (Berberis thunbergii)
    - Japanese honeysuckle (Lonicera japonica)
    - Japanese stilt grass (Microstegium vimineum)
    - Beefsteak plant (Perilla frutescens)
    - Multiflora rose (Rosa multiflora)
    - Wineberry (Rubus phoenicolasius)

These invasive species often thrive in disturbed sites and along forest edges, so minimizing disturbance and fragmentation of this area will help to reduce further spread of these species. In addition, mechanical or chemical removal of plants in areas where they are well established may be needed. The edges of the forest and the patch of modified successional forest are the primary sources of invasive species of plants. The logged portion of the forest is part of a larger patch of interior forest that could be improved if allowed to mature more thoroughly before the next timber harvest.

Conservation Actions:

Overall:

- Fulton View Woods is in private ownership and electively maintained as forested land by its owners. Permanent protection of this land should be sought through conservation easements or acquisition. A primary conservation goal for this site is the maintenance of an intact forest canopy, which provides key habitat for American holly, helps to protect water quality of local streams and serves as a travel corridor to the West Branch Octoraro Creek for many forest dependent species.

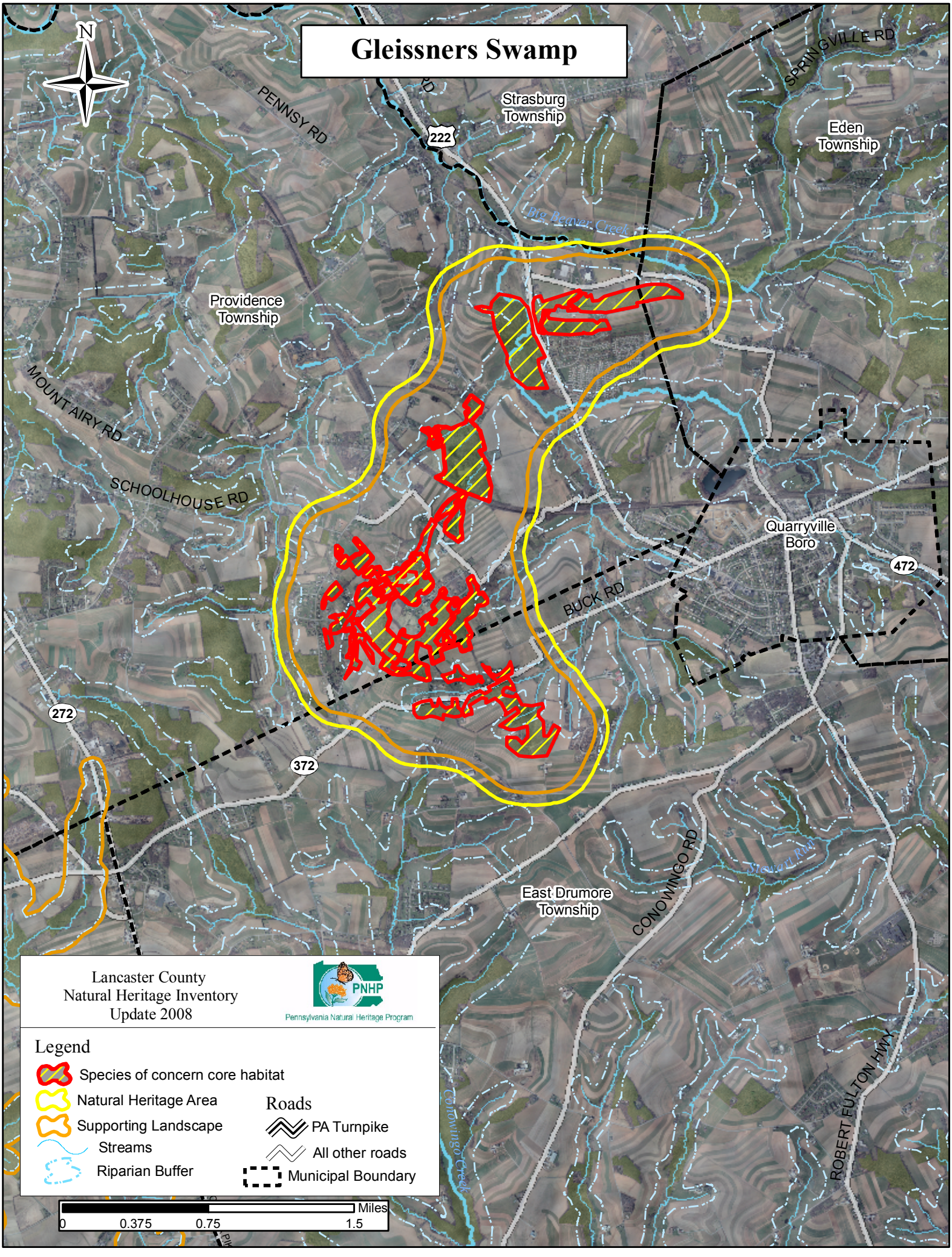
Within the Core Habitat:

- Protect the core habitat of the species of concern through acquisition, easements, and landowner education. Develop forestland tax matching programs to provide incentives to help keep adjacent forested parcels as forested.
- Maintain an intact forest canopy.
    - Avoid logging in the core habitat to minimize disturbance to the American holly population and maintain habitat quality.
    - Close off-road vehicle trails and avoid the construction of roads or buildings that would fragment the forest canopy.
- Remove invasive species of plants.
    - Invasive plant populations in immediate proximity to American holly should have high priority for elimination.
    - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.

Within the Natural Heritage Area / Surrounding Landscape:

- Maintain integrity of forested tract and connectivity to nearby forested land.

  - Fragmentation of this parcel may eliminate interior forest within the area and degrade the habitat quality.
  - This site is narrowly connected to a much larger block of forested land along tributaries of the West Branch of the Octoraro Creek. This connection should be maintained and widened to provide a travel corridor for forest species and link to other potential habitat for American holly.
- Avoid logging in this area.
  - Allow the forest to return to near old-growth conditions. Discourage the use of high-grading timber harvest practices, which lower the quality of future forests. Use timber harvest only to improve the quality of the forest, culling the low quality trees while retaining the high quality species and individuals. Avoid fragmenting the forest with logging roads or off road vehicle trails.
  - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
  - Encourage native tree and shrub recruitment.
  - Reduce the size of the deer herd. Encourage/allow increased deer hunting on private property. Plant species of concern are particularly susceptible to deer herbivory.
- Provide additional forested buffer between residential area and core habitat by providing agricultural easements on adjacent properties and considering them fully built out.
- Permanently protect adjacent forested land through acquisition or conservation easement. These lands provide additional potential habitat for American holly and also serve to protect the water quality of local streams while increasing habitat connectivity.
  - Reforesting riparian areas along the West Branch of the Octoraro Creek would establish connectivity between large forested parcels in the area and link this Natural Heritage Area to a large forest block that includes portions of State Game Lands #136.
- Provide a forested buffer around the site.
  - The American holly population occurs near the edge of this long and narrow forested area. Adjacent agricultural fields should be encouraged to return to forest, to provide a buffer for the population and expand its available habitat.
- Potential zoning options for conservation enhancement:
  - Zoning regulations should encourage the conservation of contiguous or interior forest blocks.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
  - Growth within the Township should be discouraged to occur within the core Natural Heritage Area or supporting landscape identified for this area.
- Additional surveys for species of concern are recommended.
  - There is a historical record from the area for white milkweed (*Asclepias variegata*), another plant species of concern. Habitat within the Natural Heritage Area appears suitable for white milkweed.


Gleissners Swamp
N
PENNSY RD
Strasburg Township
222
SPRINGVILLE RD
Eden Township
Big Beaver Creek
Providence Township
MOUNT AIRY RD
SCHOOLHOUSE RD
Quarryville Boro
472
BUCK RD
272
372
East Drumore Township
CONOWINGO RD
Stewart Rd
Conowingo Creek
ROBERT FULTON HWY
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.375
0.75
1.5

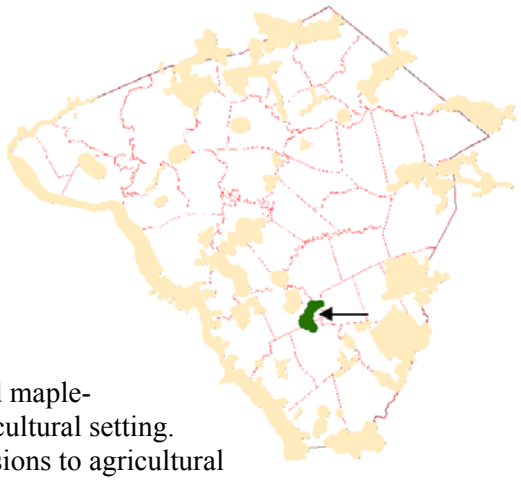
Gleissners Swamp – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Rough-leaved aster (*Eurybia radula*)	G5	S2	N	1993-09-10	D
American holly (*Ilex opaca*)	G5	S2	PT	1993-06-29	D
Sweet bay magnolia (*Magnolia virginiana*)	G5	S2	PT	1993-06-29	BC
Shining panic-grass (*Panicum lucidum*)	GNR	S1	TU	1993-09-10	D
Possum-haw (*Viburnum nudum*)	G5	S1	PE	1993-06-29	D

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: Just west of the Borough of Quarryville

- Municipalities:
  - Eden Township
  - East Drumore Township
  - Providence Township
- USGS Quadrangles:
  - Quarryville Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Gleissner's Swamp: SP506, SP517, SP525" – (Quarryville Quadrangle)



Description: Gleissners Swamp is an isolated, streamside red maple-magnolia coastal plain palustrine forest in a primarily agricultural setting. This habitat has largely been destroyed due to past conversions to agricultural activities and by recently expanded grazing. Though severely degraded, this relatively diverse community is ecologically significant as it represents an uncommon community in this part of the state that is more frequently found in coastal New Jersey and Delaware. It currently supports five plant species of concern, though historically, seven additional species of concern were documented from this location. Additional potential core habitat patches are scattered around the actual swamp habitat and include modified successional forests, tuliptree-beech-maple forests, and grazed wet meadows. These fragmented patches of habitat may be able to serve as the backbone of future habitat restoration efforts of this ecologically significant area. The wetlands of this area should be preserved as a dedicated nature sanctuary.

Species of Concern Considerations:

Plants:

- Rough-leaved aster grows in wet woods, swamps, seeps, bogs, and along streams. The viability of known populations of rough-leaved aster and its habitat may be enhanced by creating buffers around wetlands, controlling of invasive species, and protecting the natural hydrology surrounding wetlands. Excessive browsing by deer may be a threat in some locations.
- The conservation of American holly in Pennsylvania has concentrated on protecting populations that are believed to be indigenous and that represent native genotypes.

Occurrences of the species that have resulted from escapes from plantings are of uncertain genetic origin and are not considered to be of conservation significance. As a woodland species, proper forest management and control of invasive species are important for the long term viability of American holly. Gathering of the branches of wild trees for winter decoration should be discouraged.

- Sweet bay magnolia is a southerly species that has been documented in several southeastern counties. It occurs in wetlands, particularly swamps and seepy woodlands. The viability of populations of sweet bay magnolia and its habitat type will be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. Excessive deer browse may be a threat in some locations. This and other populations of sweet bay magnolia occurring west of the Coastal Plain in the state have significance for plant geography and possibly for genetic diversity.
- Shining panic-grass grows in swamps, seepy woods, bog places, and along low volume streamlets. In Pennsylvania, it has been documented historically in a few southeastern counties. The viability of known populations of shining panic-grass and its habitat type can be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. More field work is needed to determine the range, relative frequency, and ecological requirements of this species.
- Possum-haw has a mostly coastal range from New York west and south into Texas and Florida. In Pennsylvania, it represents a southerly species and has been documented in a few southeastern counties. It grows in wetlands, particularly swamps, wet thickets, and the margins of ponds. Fewer than 10 populations, most of them with only a few individuals, are known from the state. The viability of known populations of possum-haw and its habitat would be enhanced by creating buffers around wetlands, controlling of invasive species, and protecting the hydrology of the wetland and its surroundings. This species may be impacted by deer browsing in some locations.

Forest Cover/ Natural Communities: The plant community types depicted are only approximations delineated from interpretation of 2005 aerial photography and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Much of the natural vegetation is dominated by "modified successional forest" which is typically an early stage of recovery from past disturbance such as intensive logging or agricultural production. Tuliptree-beech-maple forests area also frequent in portions of the landscape.
- Of particular concern are the unusual Red maple-magnolia coastal plain palustrine forests which are considered isolated remnants of a habitat type more common along the coastal regions of Delaware and New Jersey. These and other communities likely present include:
    - Terrestrial (upland) communities:
        - Hemlock-tuliptree-birch forest
        - Tuliptree-beech-maple forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath forest
        - modified successional forest*
    - Palustrine (wetland) communities:
        - Red maple-magnolia coastal plain palustrine forest
        - Red maple-mixed shrub palustrine woodland
        - Tussock sedge marsh

- wet meadow*

Ownership: Much of the habitat is broken into several private lots making broad conservation action more difficult, though several larger parcels remain. Conservation activity should focus on these larger parcels before land subdivision impedes conservation progress

Habitat Disturbances:

- Historic-
  - Past habitat disturbances to this area have been extensive. The landscape surrounding the forested wetlands was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today. This small wetland and patch of forested wetland has remained a fixture of the landscape since 1940 based on aerial photos taken during the era, likely because it was too wet to cultivate.
  - A railroad passes though the Natural Heritage Area.
- Current –
  - Pastured and cultivated land surrounds much of the core habitat. Though grazing and drainage continue to be significant disturbances that impair the quality of this site, the area that is now in wetland vegetation appears to be much greater than it was in 1940. Past agricultural activities appear to have receded from the wetlands since 1940. Surveys in the 1980s and 1990s suggest just the opposite, that the wetland has substantially decreased in size due to grazing activity.
  - Drainage ditches are evident in pastured areas. The unique community supported by this site is made possible by the site's wetland hydrology. Altering the wetland hydrology of the swamp forest eliminates critical wetland habitat.
  - The swamp is in close proximity to agricultural fields and is likely exposed to agricultural run-off. Nutrients, chemical compounds and sediments carried in run-off may impact water and habitat quality.
  - Clearing trees and firewood cutting in forests also disturb the site by altering light and humidity levels.
  - Many areas that are currently isolated patches of forest were being used for agriculture in the 1940s, so there has been some recover in the area
  - Though forest cover has recovered from agricultural uses in some areas, others have been converted to residential development. Residential development from Fairview Road, Good Road and Shenks Wood Court has recently removed some potential habitat of this uncommon natural community.
- Exotic species– Japanese stilt grass (*Microstegium vimineum*) and multiflora rose (*Rosa multiflora*) are both present here and Japanese stilt grass is particularly abundant in heavily grazed areas. Other invasive species are likely invading the habitat as well.

Conservation Actions:

Overall:

- The wetlands of this area should be preserved as a dedicated nature sanctuary.
- Wetland habitats at this location are too delicate to withstand recreational pressure and are not suitable for public use.
- The overall objective for this area should be to restore and establish a wide forested/vegetated corridor between these isolated wetlands and Big Beaver Creek.

Gleissners Swamp

- The core habitats here are a series of modified, patchy natural areas surrounded by land in agricultural or residential use. Permanent protection of the core habitats, particularly the red maple-magnolia swamp, should be a high priority.
- A 300 meters protective forested buffer of should be established around the core habitat areas. Natural habitat should be expanded at the site to provide additional habitat and buffer and to help connect these isolated communities to help provide a long term viable habitat context for this area.
- This site is owned by a number of private landowners and it is unprotected for conservation. Encourage the establishment of farmland/forestland tax incentive programs or transfer of development rights to help keep land that is currently in agriculture/forest from being converted to other residential, commercial or industrial uses.

<u>Within the Core Habitat:</u>

- The wetlands of this area should be preserved as a dedicated nature sanctuary. The red maple-magnolia swamp should be considered a high priority for protection through acquisition or conservation easement.
    - The remaining natural habitats within the area should also be considered for similar protection.
    - Conservation easements should include language that provides protection for the specific habitat required by the species of concern.
- Grazing and drainage of the red-maple magnolia swamp and other riparian areas should be eliminated. Fence wetlands to eliminate grazing from swamp and streamside areas.
    - Critical swamp habitat has been greatly reduced in size due to increased pasture encroachment. These grazed areas should be encouraged to regenerate and expand swamp habitat.
- Restore wetland hydrology to drained areas and remove drainage features.
- Expand and restore natural areas along streams and around core habitat.
    - Allow cropland or pasture adjacent to core habitats to return to forested or natural cover in order to provide a buffer from disturbance.
    - Reforest streamside corridors in appropriate areas. This will expand potential habitat and protect water quality.
        - Careful determination is needed to avoid planting trees in floodplains that contain wet meadows or shrublands. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Avoid logging and fragmentation of forests. Allow forests to return to near old-growth conditions. Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. The Deer Management Assistance Program can be used by private landowners to register their land for increased deer hunting opportunities.
- Remove invasive species of plants.
    - Invasive plants in the swamp should be targeted for careful eradication.
    - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
    - Continual invasive species monitoring in the swamp will be needed.
- Conduct update surveys of the forested wetlands and the species of concern they contain. Develop a monitoring plan to gauge population trends, natural community health and

management success at this location. Additional wet habitats in the vicinity could also contain similar species.

Within the Natural Heritage Area / Supporting Landscape:

- A nearby Natural Heritage Area provides additional habitat for sweet bay magnolia and rough-leaved aster in a similar wetland habitat. Connection between these two sites via contiguous forested tracts and riparian corridors is desirable and could be achieved though restoration at key locations.
    - Protection of multiple populations of these species could be used to help restore populations between sites and may help to ensure the continued survival of the species of concern.
- Considering the significant potential for this community type to harbor species of concern, efforts should be made to restore other sites in the vicinity that have the potential to support this habitat.
- Discourage clearing or fragmenting the remaining forested land in the area, particularly in riparian areas.
- Avoid significant alteration of hydrology or stream channels in this area.
- Potential zoning options for conservation enhancement:
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils or areas with hydric soils should be encouraged to regenerate into natural cover.
    - Growth within the Township should be discouraged within the core and supporting landscape identified for this area.
- Providence and East Drumore Townships have zoning ordinances restricting construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats. Additionally, wetlands should be afforded the same protection as floodplains in zoning ordinances to help protect most of the species of concern core habitat at this location.
- Recommended restoration activities:
    - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff
    - All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
        - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests.

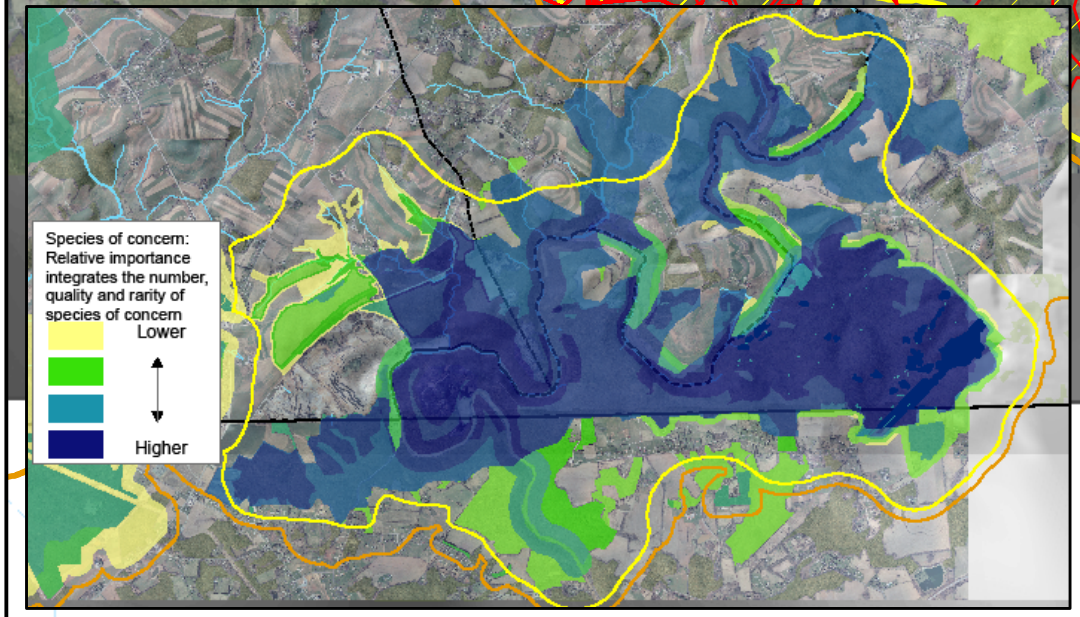
- Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
  - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
  - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
  - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.

Other plant species of concern historically documented from this habitat or nearby include:

Common name	**Scientific name**	**G-Rank**	**S-Rank**	**Last observed**
Colic-root	*Aletris farinosa*	G5	S1	1924-07-09
Red Milkweed	*Asclepias rubra*	G4G5	SX	1957-07-12
Brown Sedge	*Carex buxbaumii*	G5	S3	1929-07-21
Matted Spike-rush	*Eleocharis intermedia*	G5	S2	1910-09-05
Soapwort Gentian	*Gentiana saponaria*	G5	S1S2	1938-10-22
Quillwort	*Isoetes valida*	G4?	SU	1965-07-06
Southern Bog Clubmoss	*Lycopodiella appressa*	G5	S2	1936-09-12
Swamp Lousewort	*Pedicularis lanceolata*	G5	S1S2	1910-09-05
Cross-leaved Milkwort	*Polygala cruciata*	G5	S1	1957-07-02
Bushy Aster	*Symphyotrichum dumosum*	G5	S2	1910-09-05
Twisted Yellow-eyed Grass	*Xyris torta*	G5	S1	1924-08-02

Gleissners Swamp

Goat Hill Serpentine Barrens



Lancaster County
Natural Heritage Inventory
Update 2008

PNHP
Pennsylvania Natural Heritage Program

Legend

- Species of concern core habitat
- Natural Heritage Area
- Supporting Landscape
- Streams
- Riparian Buffer

Roads

- PA Turnpike
- All other roads
- Municipal Boundary

Miles
0 0.375 0.75 1.5

Goat Hill Serpentine Barren– *Exceptional significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Arrow-feather (*Aristida purpurascens*)	G5	S2	PT	2006-10-19	E
Richardson's sedge (*Carex richardsonii*)	G4	S1	PE	2005-05-03	BC
Serpentine chickweed (*Cerastium arvense var. villosissimum*)	G5T1Q	S1	PE	1999-08-27	A
Fringe-tree (*Chionanthus virginicus*)	G5	S3		2001-07-20	D
Maryland golden-aster (*Chrysopsis mariana*)	G5	S1	PT	1996-09-28	C
Tufted hairgrass (*Deschampsia cespitosa*)	G5	S3	TU	2003-07-02	B
Nuttalls' tick-trefoil (*Desmodium nuttallii*)	G5	S2	TU	1991-08-21	CD
Elephant's foot (*Elephantopus carolinianus*)	G5	S1	PE	1991-10-21	C
Glade spurge (*Euphorbia purpurea*)	G3	S1	PE	2000-06-23	B
Sandplain wild flax (*Linum intercursum*)	G4	S1	PE	1990-07-21	B
Serpentine panic-grass (*Panicum annulum*)	GNR	S2	PT	1995-06-14	B
Virginia ground-cherry (*Physalis virginiana*)	G5	S1S2	PE	1994-08-03	BC
Southern red oak (*Quercus falcata*)	G5	S1	PE	1992-07-08	D
Few-flowered nutrush (*Scleria pauciflora*)	G5	S2	PT	1992-07-08	CD
Serpentine aster (*Symphyotrichum depauperatum*)	G2	S2	PT	2007	A
Plain ragwort (*Senecio anonymus*)	G5	S2	PR	1995-06-14	CD
Prairie dropseed (*Sporobolus heterolepis*)	G5	S1	PE	1990-08-14	C
Cranefly orchid (*Tipularia discolor*)	G4G5	S3	PR	1992-04-05	B
Sensitive species of concern (A)	-	-	-	2007	B
Animals:					
Sensitive species of concern (B)[3]	-	-	-	1991-06-22	A
Sensitive species of concern (C)[3]	-	-	-	2006-04-05	E
Sensitive species of concern (D)[3]	-	-	-	1997-05-14	D
Butterflies & Moths:					
Common roadside-skipper (*Amblyscirtes vialis*)	G5	S2S4	-	1995-06-02	E
Spiny oakworm moth (*Anisota stigma*)	G5	S1S2	-	2004-07-16	C
Falcate orangetip (*Anthocharis midea*)	G4G5	S3	-	1995-06-02	E
A geometer moth (*Apodrepanulatrix liberaria*)	G4	S3	-	2001-10-13	CD
Dot-lined white moth (*Artace cribraria*)	G5	S1	-	2000-07-01	E
Dusted skipper (*Atrytonopsis hianna*)	G4G5	S2S3	-	1997-05-14	C
Juniper hairstreak (*Callophrys gryneus*)	G5	S2S4	-	1997-05-14	CD
Packard's lichen moth (*Cisthene packardii*)	G5	S1S3	-	2004-08-27	C

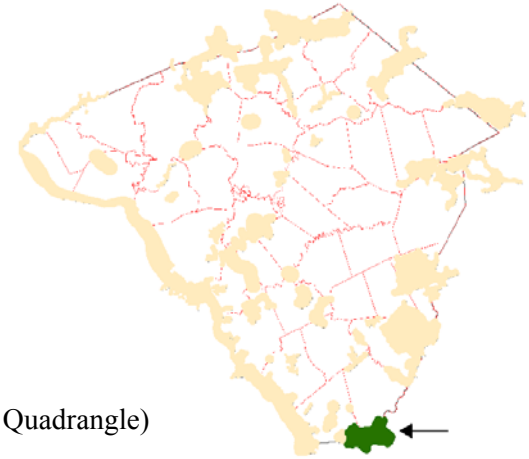
Goat Hill Serpentine Barren– *Exceptional significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Butterflies & Moths: (continued)					
Lead colored lichen moth (*Cisthene plumbea*)	G5	S1	-	2004-08-27	E
Regal moth (*Citheronia regalis*)	G4G5	SU	-	2004-07-16	E
Pure lichen moth *(Crambidia pura*)	G4	SU	-	2004-08-27	E
A moth (*Elaphria cornutinis*)	G5	SU	-	2004-07-16	E
Broad-lined erastria moth (*Erastria coloraria*)	G4	S1	-	2002-06-22	CD
Mottled duskywing (*Erynnis martialis*)	G3G4	SH	-	1987-05-13	X?
Barrens buckmoth (*Hemileuca maia*)	G5	S1S2	-	1997-05-14	C
Leonard's skipper (*Hesperia leonardus*)	G4	S3S4	-	2002-09-07	B
Cobweb skipper (*Hesperia metea*)	G4G5	S2S3	-	1997-05-14	C
A wave moth (*Idaea violacearia*)	G4	S1	-	2001-10-13	B
Black-waved flannel moth (*Lagoa crispata*)	G5	S1	-	2004-06-12	C
Footpath sallow moth (*Metaxaglaea semitaria*)	G5	S2	-	2000-09-30	E
A moth (*Panthea sp. 1*)	G4	SU	-	2004-08-27	C
A moth (*Papaipema pterisii*)	G5	-	-	2000-08-26	E
A moth (*Parahypenodes quadralis*)	G4	SU	-	1998-08-31	E
A moth (*Renia sp. 1 nr. discoloralis*)	G4	S1?	-	2000-08-26	C
A noctuid moth (*Richia acclivis*)	G4G5	S1S2	-	2000-08-26	E
A moth (*Sutyna privata teltowa*)	G5T4	S1	-	2001-09-15	C
Tolype moth (*Tolype notialis*)	G4G5	S1	-	2004-07-16	C
Southern variable dart moth (*Xestia elimata*)	G5	S2S3	-	2004-08-27	C
A zale moth (*Zale curema*)	G3G4	S1	-	1997-05-14	C
Oblique zale moth (*Zale obliqua*)	G5	S1	-	1998-07-02	C
A zale moth (*Zale squamularis*)	G4	S2S3	-	2004-07-16	C
A zale moth (*Zale submediana*)	G4	S2	-	1997-05-14	C
Pine barrens zanclognatha (*Zanclognatha martha*)	G4	S1S2	-	2004-08-27	C
Exceptional Natural Communities:					
Eastern serpentine barrens	G2	S2	-	2007	A

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3]This species is not named at the request of the agency overseeing its protection

Goat Hill Serpentine Barren

Location: This Natural Heritage Area occurs along the Lancaster / Chester County boundary along the Octoraro Creek at the Maryland State line. Much of the critical habitat for this area occurs in Chester County, though significant portions of several species of concern core habitat also occur in Lancaster County.

- Municipalities:
  - Fulton Township, (Lancaster County)
  - Little Britain Township, (Lancaster County)
  - West Nottingham Township , (Chester County)
  - Cecil County, (Maryland)
- USGS Quadrangles:
  - Conowingo Dam Quadrangle
  - Kirkwood Quadrangle
  - Rising Sun Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP519" (Rising Sun Quadrangle)
  - "Horseshoe Boy Scout Camp" (Conowingo Dam Quadrangle)



Description: This area contains approximately 450 acres of globally rare serpentine habitat in a mosaic of the characteristic serpentine barrens plant communities including open gravel areas, grassy meadows and conifer and deciduous dominated woodland habitats. Goat Hill is one of several serpentine habitats that make up the State Line Serpentine Barrens, an ecologically unique system. The serpentine habitats are often referred to as grasslands, and they do have a strong representation of warm season grasses and grass-like plants, but they also contain a good diversity of other plant species, many uncommon at the state and global levels. Goat Hill is known to support 19 plant species of concern and 36 animal species of concern, most of which are butterflies & moths that feed on the unique variety of plants present. The serpentine community itself is considered globally imperiled due to the limited occurrences of this habitat type around the world.

Species of Concern Considerations:

Plants:

- Many of the plant species of concern found within this large Natural Heritage Area are found primarily within the strongly serpentine influenced small herbaceous openings or within the adjacent thin woodlands. Among these include arrow feather, richardson's sedge, serpentine chickweed, Maryland golden-aster, tufted hairgrass, elephant's foot, sandplain wild flax, serpentine panic-grass, Heller's witchgrass, Virginia ground-cherry, few-flowered nutrush, serpentine aster, plain ragwort, prairie dropseed and a sensitive species of concern. In the past, natural disturbance, such as wild fires, would have helped to keep these areas in an open condition. With the relatively recent suppression of fire, the open areas have gradually closed due to natural succession. An active restoration effort to restore the serpentine openings will be necessary to ensure the continued existence of these habitats and the species they contain.
- Other plants within this area are not specifically adapted to the open habitats, but are more closely associated with wooded and forested habitats. These include fringe-tree, Nuttalls' tick-trefoil, glade spurge, southern red oak & cranefly orchid. Efforts to restore serpentine openings should take into account the presence of these species and avoid disturbing the habitat where they occur.
- Several of the plants noted above deserve special mention based on their potential for global extinction due to their extremely limited global populations.
  - The serpentine chickweed at this location may be a taxonomically distinct variety of this species and this location is currently the only known location for the plant in the world. The utmost care should be exercised to preserve the known and potential habitat for this species until its taxonomic identity is more clearly understood.

- Serpentine aster is only known to occur in the eastern serpentine barrens of Pennsylvania and Maryland. This extremely limited distribution has given this species the status of G2 – globally imperiled. Serpentine aster is typically found in the more open areas of serpentine barrens, suggesting that fire may be needed to weed out woody overgrowth and maintain this preferred habitat.
- Glade spurge has a relatively small global range, extending from New Jersey into Ohio, and south into North Carolina. Currently, around 50 populations are known to exist worldwide. Fewer than 10 populations, most of them with only a few individuals, are currently known from Pennsylvania. At this location, glade spurge is growing in the moist seepages of tributaries to the Octoraro Creek. The viability of the known populations of glade spurge and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. Logging of the adjacent slopes is a potential concern. This species may be impacted by excessive browsing by deer in some locations.

Animals:

- The sensitive species of concern (B) at this location is sensitive to alteration of its habitat and food source by herbicides and pesticides. Preserve the native vegetation at this location, including a mosaic of trees, shrubs, vines and herbaceous plants to help maintain the proper habitat for this species.
- Sensitive species of concern (C) was documented along this stretch of the Octoraro Creek. This sensitive species of concern requires abundant food source in the creek and its tributaries as well as breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Octoraro Creek and by protecting and expanding the natural vegetation buffer along the creek and all its tributaries. Harassment of nesting locations can cause adults to abandon the site. Additionally, the forested upland area in the core habitat needs to be protected from disturbances during the spring and early summer breeding season.
- Sensitive species of concern (D) requires qrassy-mixed forb openings with sheltering nearby trees and shrubs. The creation of a mosaic of interspersed openings and woodland edges should help to maintain the habitat for this species.
- Butterflies & moths (Lepidoptera): Many of these species are limited in distribution in Pennsylvania to serpentine and other grassland habitats, which are often set in a matrix of open oak and pine woodlands. Conservation of these species requires protection of the habitat they use during all stages of their life cycles. Maintaining a mosaic of grassland, oak, and pine areas at Lancaster County serpentine barrens sites and the surrounding area will create a diverse and healthy habitat capable of supporting the rare Lepidoptera listed above. Plantings of native herbaceous food plants and desirable nectar sources may also help increase the existing Lepidoptera populations. Creation of corridors between barrens sites would also encourage movement of species between sites and create more secure populations. Pesticide application, especially for the control of gypsy moths, can have a devastating effect on populations of Lepidoptera species of concern and should be eliminated in this area.

Forest Cover / Natural Communities:The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow “Terrestrial & Palustrine Plant Communities of Pennsylvania” (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

The area most influenced by the serpentine bedrock is primarily in Chester County and is currently a mix of habitat types dominated by a serpentine pitch pine-oak forest, which contains small pockets of other serpentine influenced habitat types. Most of the plant species of concern occur within these small open habitats. This habitat was historically less dominated by woody trees and shrubs, but recent fire prevention has favored the expansion of wooded habitats at the expense of herbaceous openings. Invasion of serpentine herbaceous openings by woody trees and shrubs can influence the surrounding habitat. As woody

vegetation encroaches on the openings, they tend to trap more organic debris and allow deeper soils to accumulate. As deeper soils occur on the site, they succeed to more common woodland and forest types. Fire disturbances have maintained these herbaceous openings in the past. Active woody vegetation removal will be necessary to maintain these openings in the absence of fire.

The habitats toward the eastern portion of this Natural Heritage Area are less influenced by serpentine bedrock and are dominated by a dry oak-heath forest community. These and other communities delineated from aerial photo inspection include:

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Tuliptree-beech-maple forest
  - Red oak-mixed hardwood forest
  - Dry oak-heath forest
  - Dry oak-mixed hardwood forest
  - Virginia pine-mixed hardwood forest
  - Pitch pine-mixed oak forest
  - Serpentine pitch pine-oak forest
  - Serpentine Virginia pine-oak forest
  - Serpentine grassland
  - Serpentine gravel-forb community
  - modified successional forest*
  - juniper woodland*
  - shrubland*
  - grass-shrubland*
  - grassland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest
  - wet meadow*

Ownership: Much of this Natural Heritage Area is in Chester County, including the best portion of the serpentine barrens habitat.

- A large portion of the most significant habitat is under the jurisdiction of the PA Bureau of Forestry and managed as a Wild Plant Sanctuary.
- An adjacent important habitat is owned by The Nature Conservancy.
- The Boy Scouts of America own an ecologically significant area overlooking the Octoraro Creek.
- The Chester County municipal Authority has jurisdiction over a narrow strip of land along the banks of the Octoraro River.
- Fulton Township Supervisors have jurisdiction over a 45 acre wooded parcel along Quarry Road.
- A large quarry operates on a significant portion of the serpentine bedrock area along the banks of the Octoraro Creek in Lancaster County.
- Several other large private property parcels own portions of the ecologically important serpentine influenced habitat. Future ownership fragmentation of this globally significant habitat may impede future conservation actions. Conservation activities throughout this Natural Heritage Area should be set in motion before ownership fragmentation makes this more difficult.

Habitat Disturbances:

- Historic –
  - Historically, wildfires likely helped to maintain the open aspect of these habitats. Early accounts record the intentional setting of fire in these habitats by Native Americans to help open the area for greater potential hunting success.

- Based on aerial photos from the 1940s, small portions of the serpentine habitat were cleared for farming or grazing in the past, while much of this area had a thin cover of conifer trees. Considerable erosion from cleared fields is evident in the photos.
- The Maryland side of the state line boundary has had much more conversion of this habitat to agricultural uses than in Pennsylvania.
- In the 1940 photos, the wooded slopes on the east shore of the Octoraro Creek show signs of a recent fire and appear severely charred. Smoke from an active fire is also evident within the serpentine habitat. The chance capture of this fire event during aerial photography may indicate the past prevalence of fire in this habitat.
- Several small quarries operated in the area.

o Current –

- Ironically, the lack of natural fire disturbance poses one of the greatest threats to this habitat. In the absence of natural fire events, most of the open serpentine barrens habitats will gradually succeed to more common woody vegetation such as junipers, pines and oaks.
- Some residential development has been occurring at the periphery of the serpentine habitat.
- An extensive quarry operates on the western shore of the Octoraro Creek. This quarry has greatly altered the globally significant serpentine habitat at this location. The former hill and its unique plant and animal community have been reduced to crushed stone material. There is virtually no buffer between the quarry operation and the Octoraro Creek and sediment from the operation appears to flow freely into the creek.
- The state boundary between Pennsylvania and Maryland can be clearly seen in current aerial photos based on the differences in land use between the two states. While the serpentine habitat in Pennsylvania is mostly in natural woody or open habitats, parcels on the Maryland side of the border are in active agriculture or residential development.
- Similarly, the Chester County side of the Octoraro Creek is mostly in natural habitats, while the Lancaster side is dominated by agricultural activities.

o Exotic Species –

- Most of the serpentine habitat is naturally resistant to invasion by introduced species of plants due to its unusual chemical makeup, but invasive species are present in some areas especially the invasive grass, Japanese stilt grass (*Microstegium vimineum*).

Conservation Actions:

Overall:

- A management plan specifically for Goat Hill was recently developed by the PA Natural Heritage Program with input and participation from other serpentine experts and organizations. Consult that plan for fine details about management recommendations at this location.
- Coordinate the conservation of this habitat between Lancaster and Chester Counties and the state of Maryland. The state line serpentine habitats are part of a series of habitat "islands" stretching into Maryland that should be thought of as a single system.
- Active stewardship of these habitats is necessary. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type.
- Habitat restoration activities should strive to establish a mosaic of habitat types to accommodate the variety of organisms and their diverse habitat preferences. While some of these plants will only thrive in the open on thin soils, or even bare bedrock conditions, others need the limited shelter of scattered trees or even the deep shade provided by a mature forest. Some of the insect species require conifers during part of their life cycle while others need deciduous trees or specific shrubs or wildflower host plants. There is no "one-size-fits-all" management recommendation for this habitat other than to provide for a mosaic of habitat diversity.

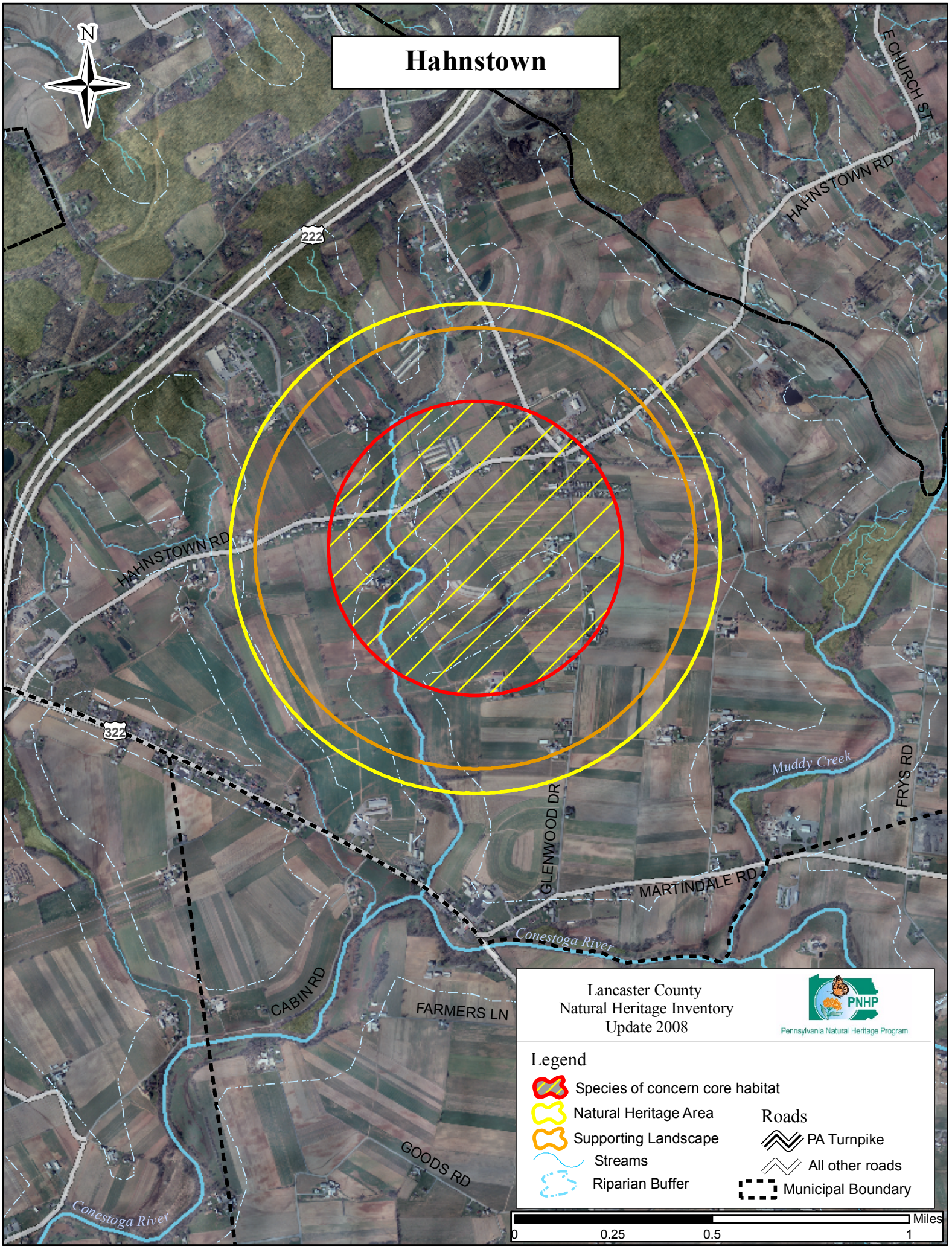
- Conservation of the core habitat and supporting landscape and connecting linkages between this serpentine habitat and those nearby should be considered the highest conservation priority in the county.

Within the Core Habitat:

- While much of the core serpentine habitat is protected by the PA Bureau of Forestry and The Nature Conservancy, much more known and potential habitat for species of concern occurs outside of the protected areas. Focus conservation efforts on acquisition of the largest parcels within the lower loops of the Octoraro Creek. Transfer of development rights, conservation easements and fee simple acquisition are all appropriate tools for securing the conservation status of the parcels of varying ecological significance.
- Expand herbaceous openings on convex landscapes by removing trees and other woody plants. Focus woody plant removal on pines and junipers, which tend to indicate dryer thinner soils. The establishment of hardwoods should be taken as an indicator of deeper, moister soils. Where deeper soils occur, soil removal may be necessary to establish thin soils over serpentine bedrock.
- Locate, preserve and expand nectar plants for specialized Lepidoptera species, in particular, wild indigo (*Baptisia tinctoria*) and New Jersey tea (*Ceanothus americanus*). These species are the preferred larval host for two Lepidoptera species of concern. Deer exclosures may be necessary to protect these host plant populations.

Within the Supporting Landscape:

- These serpentine habitats occur in isolated patches as the bedrock material, serpentinite, is exposed at the surface of the ground in a scattered fashion much like an archipelago chain of islands. Each habitat has a slightly different species composition, largely due to the slightly different environmental conditions found at each distinct location. A long range goal for these isolated habitats is to recognize them as a single system and plan for their ecological needs. The area between and around these habitats should be maintained to provide the necessary buffer to allow prescribed burns to maintain the mosaic of open habitat once a network of the woody species have been removed. Natural habitat corridors between the barrens will help keep the genetic flow between the isolated populations of species in circulation.
- The plants that characterize these habitats are adapted to the dry, nutrient poor soils and periodic fire events. A priority for the security of these globally rare habitats should be to establish protection for the core habitats as well as to provide for the landscape context in which natural process can be maintained.
- In the past, naturally occurring fires helped maintain the open aspect characteristic of the serpentine barren habitat. Today, active vegetation management, in the form of volunteer work crews, helps to remove trees and shrubs that in the past would have been cleared by fire events. These work crews have made great progress over the years to create the mosaic of patchy openings resembling in places, a grass land, in others, an oak savannah, or pitch pine woodland, or juniper–catbrier shrubland, or mixed oak forest, or bare soil gravel bed. All these, as well as other small patch natural communities, play an important role in sustaining the diversity of plants and animals in these important ecosystems.
- These systems may be best maintained in an agricultural or rural setting. Residential development near or between these barrens should be strongly discouraged.
- Educate the adjacent landowners on the significance of the globally rare habitat and the need for ongoing management activities.


Hahnstown
N
E CHURCH ST
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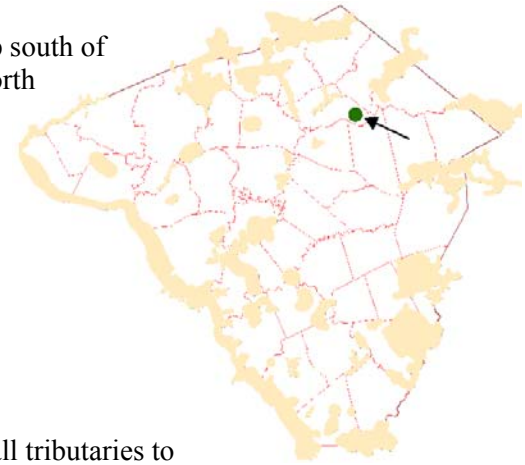
HAHNSTOWN RD
322
Muddy Creek
FRYS RD
GLENWOOD DR
MARTINDALE RD
Conestoga River
CABIN RD
FARMERS LN
GOODS RD
Conestoga River
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Hahnstown – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Sensitive species of concern[3]	-	-	-	2006	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location: This Natural Heritage Area occurs in Ephrata Township south of Route 222. This area is adjacent to a large forested block to the north and to the Conestoga River to the south which are part of the Bowmansville Hills Forests Hub and the Conestoga River Greenway.

- Municipalities:
  1. Ephrata Township
- USGS Quadrangles:
  - Ephrata Quadrangle
  - Terre Hill Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: This agriculture dominated area contains several small tributaries to the Conestoga River, but offers little natural habitat. In spite of the intensively cultivated landscape, the remnants of streamside vegetation have attracted a sensitive species of concern.

Species of Concern Considerations:

- A sensitive species of concern was documented along these tributaries to the Conestoga River. The core habitat for this sensitive species of concern is both the creek and the adjacent upland riparian habitat. This sensitive species of concern requires abundant food source in the waterways and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the local waterways and by protecting and expanding the natural vegetation buffer along the Conestoga River and all its tributaries

Forest Cover / Natural Communities: This Natural Heritage Area is nearly devoid of natural vegetation. There are currently only very narrow intermittent strips of trees along portions of these tributaries to the Conestoga River.

Ownership: All of this Natural Heritage Area is privately owned with most of the area in large parcels in active agricultural production. Future ownership fragmentation within this area may impede coordination of future conservation actions. Conservation action along the creek corridor should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
  - The landscape surrounding this Natural Heritage Area was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today. The cultivated fields extend right up to the banks of the streams and creeks in

the area. Examination of aerial photos from 1940 show erosional gullies leading off of cultivated fields into the streams. Little natural vegetation remained to provide habitat for native plants and animals.

- Current –
  - The loss of the forest cover along these tributaries to the Conestoga River is the major downfall of this habitat. Large expanses of cultivated fields dominate the landscape with little interruption from any natural habitat. Clearing the land resulted in siltation of the waterways and allowed chemical and nutrient runoff to directly enter the stream system.
  - Little natural habitat remains in the area except for an intermittent narrow band of trees along these tributaries. Restoration of wide, vegetated/forested stream buffers should be a priority for the entire watershed. Other narrow waterways have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
  - Residential development has increased along Hahnstown Road and Glenwood Road. Residential development can contribute significantly to the non-point source pollution of the creeks and streams in the area. Improperly functioning septic systems can also impact the regional groundwater and surface water.
- Exotic Species – The invasive species concerns for this area are not well known.

Conservation Actions:

Overall:

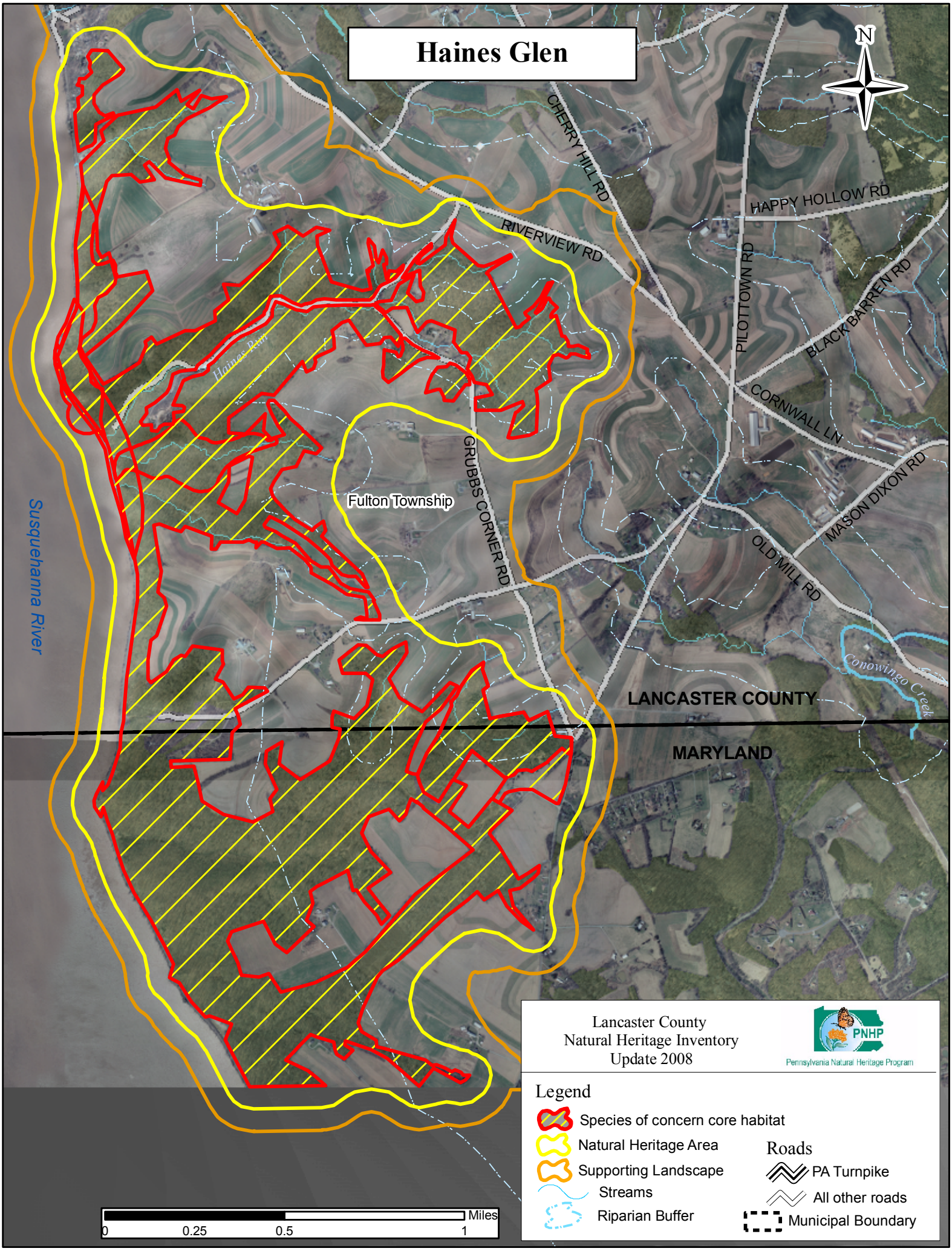
Within the Core Habitat:

- Restoration of wide forested riparian corridors along the Conestoga River and all its tributaries should be a priority for this watershed.
- The 100-year floodplain should be restored to natural vegetation appropriate to the floodplain topography and hydrology.
- Use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the water quality at this location. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the natural habitat. The rainwater runoff from the agricultural fields and pastures should be considered a source of significant surface water contamination. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Storm water management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.

Within the Supporting Landscape:

- Pursue conservation easements and transfer of development rights on properties along tributaries to the Conestoga River to help conserve and improve its effectiveness as habitat and as a natural corridor.
- Restoration:
  - Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that contain or could be restored to herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
      - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain

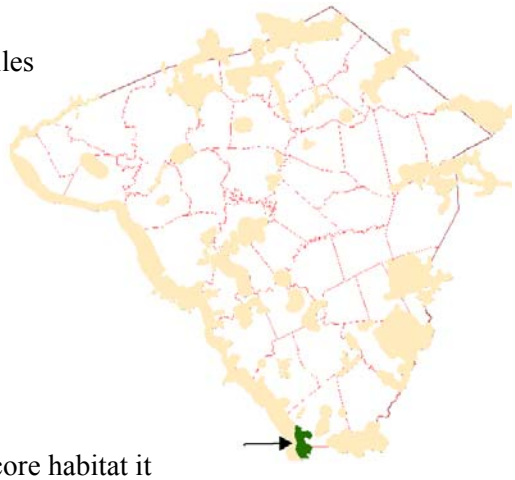
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
- Potential zoning options for conservation enhancement:
    - Ephrata Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
        - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into natural vegetation/forest cover.
    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this location.
    - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction and loss of prime farmland though suburban sprawl.


Haines Glen
N
CHERRY HILL RD
HAPPY HOLLOW RD
RIVERVIEW RD
PILOTTOWN RD
BLACK BARREN RD
Haines Run
CORNWALL LN
GRUBBS CORNER RD
MASON DIXON RD
Fulton Township
OLD MILL RD
Susquehanna River
Conowingo Creek
LANCASTER COUNTY
MARYLAND
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Haines Glen – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Lobed spleenwort *(Asplenium pinnatifidum)*	G4	S3	PR	1995-10-11	D
Wild oat *(Chasmanthium latifolium)*	G5	S1	PE	2007	E
Annual fimbry *(Fimbristylis annua)*	G5	S2	PT	1989-09-12	D
Cranefly orchid *(Tipularia discolor)*	G5	S1	PR	1984-12-17	C
Animals:					
Sensitive species of concern [3]	-	-	-	2006-10-04	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location: This section of the Susquehanna River is roughly seven miles long, running from the railroad bridge just north of the Conoy / East Donegal Township line to the Columbia / Wrightsville Bridge, and includes riverside portions of the Borough of Marietta.

- Municipalities:
  - Fulton Township, (Lancaster County)
  - (Extends into Maryland)
- USGS Quadrangles:
  - Conowingo Dam Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP523 & SP565" – (Conowingo Dam Quadrangle)

Description**:** This Natural Heritage Area and the species of concern core habitat it contains are drawn around the surrounding forested area which extends from southern Fulton Township into neighboring Maryland. The hilly upland features remain forested in this otherwise agricultural landscape. Steep forested bluffs drop down to the Susquehanna River, exposing west-facing bedrock outcrops along the railroad tracks paralleling the shoreline. Much of the forested habitat is dry, oak-dominated forest underlain by blueberries, mountain laurel and a thick tangle of greenbrier.

Species of Concern Considerations:

Plants:

- The lobed spleenwort is a small fern that utilizes the lightly shaded rock outcrops along the Susquehanna River as its primary habitat. There are numerous outcrops in this area that potentially support additional populations of this species. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. A "no spray" zone should be established near all rock outcrops along this section of the railroad rights-of-way. Additional surveys are recommended to more accurately determine the current extent of this species.

- Wild oat at this location is growing on dry, thin, schist-derived soils on rock ledges adjacent to the railroad tracks along the Susquehanna River. Indiscriminate use of herbicides for vegetation management is not advisable in this location. Establish a "no spray" zone along the tracks in this area. This plant will likely respond favorably to the reduction of competition through periodic mowing. Maintenance activities should strongly consider their impact on this and other rare plants in the rights-of-way.
- Annual fimbry is a small, annual grass-like plant that, in Pennsylvania, occurs in association with serpentine substrates and habitats. This location has a small juniper-grassland opening among larger patches of juniper, pines and mixed hardwoods. The invasive plants multiflora rose and Japanese honeysuckle were noted as potential threats to the habitat as were general closure of the canopy due to natural succession. Serpentine habitats in PA have been shaped by past natural disturbances, particularly fire. Since naturally occurring fires are now quickly extinguished, these habitats typically require active management to prevent the successive growth of shrubs and trees from converting the habitat to forest cover. Review historical aerial photos to help develop a management plan to restore the serpentine habitat in this area. Additional surveys to this area are encouraged to assess the quality and restoration potential of the serpentine habitat.
- The cranefly orchid is a plant of moist, rich forests. It is usually found individually, with few other specimens in the area. It can be easily overlooked due to its small size and individual nature. The entire rich, moist, forest environment should be considered potential habitat for this plant. Maintain the native forest canopy and encourage native tree and shrub recruitment into the understory to continue to provide sufficient available habitat for this species.

Animals:

- The sensitive species of concern at this location is sensitive to alteration of its habitat and food source by herbicides and pesticides. Preserve the native vegetation at this location, including trees, shrubs, vines and herbaceous plants to help maintain the proper habitat for this species. Establish a "no spray" zone along the railroad rights-of-way at this location.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Though appearing highly fragmented due to clearing for agriculture and scattered roads and residences, this Natural Heritage Area contains several fair sized patches of interior forest. Most of the area is dominated by dry oak-heath forest, with smaller patches of other natural community types scattered as topography, sunlight and available moisture dictate including:
    - Terrestrial (upland) communities:
        - Dry oak-heath forest
        - Dry oak-heath woodland
        - Tuliptree-beech-maple forest
        - Red oak-mixed hardwood forest
        - Pitch pine-mixed oak forest
        - Hemlock-tuliptree-birch forest
        - Serpentine grassland
        - modified successional forest*
- Of particular interest in this area is the presence of a small serpentine grassland natural community. This habitat type is uncommon globally, and presents an unsuitable environment to most other types of plants. This has given rise to a suite of plants and associated insects that can tolerate these typically inhospitable conditions. Some of these species are only found in serpentine habitats along the Pennsylvania/Maryland state line area. Conservation of these serpentine habitats should be a priority concern for Lancaster County.

Ownership:

- Most of this Natural Heritage Area is owned by several large private property owners who maintain active farms.
- Nearly 300 acres of this Natural Heritage Area is enrolled in agricultural easements.
- PECO/Excelon Corporation owns the steep west-facing slopes adjacent to the Susquehanna River and allows access for recreational purposes.
- Norfolk Southern Rail Corporation owns a narrow rights-of-way along the shoreline of the River.

Habitat Disturbances:

- Historic –
  - Aerial photos from 1940 show that most of the forested habitat of this area had been converted to agricultural uses. Those lands left forested were likely too steep, stony, or wet to be easily converted to agricultural uses.
- Current –
  - Comparison of aerial photos from 1940 and 2005 indicate that forests and agricultural fields are in roughly the same areas now as they were then, though some agricultural areas have been converted to forest and visa versa.
  - The 1940 aerial photos show a much larger serpentine grassland natural community straddling the Pennsylvania / Maryland border. Most of this open serpentine habitat has succeeded to forested habitats. Active management will be necessary to restore this important natural community type.
  - One forest block in particular has undergone fragmentation since 1940 by cutting a long road though the middle of a large interior forest block along Haines Branch for a single house on a bluff overlooking the river. It is unfortunate that this large, healthy expanse of forest has been disfigured by this intrusion into the landscape. Since there are so few large interior forest blocks left in the county, every effort should be made to avoid this type of unnecessary landscape fragmentation. This particular misuse of the landscape should be held up as an example of what should be avoided elsewhere in the county and especially along the bluffs overlooking the Susquehanna River.
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may consider the railroad an insurmountable obstacle.
  - Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species –
  - Few invasive species were noted during past field surveys, but the railroad rights-of-way and the transition zone between forested and agricultural landscapes are likely the areas of greatest invasive plant species concentrations. Invasive species noted include:
    - Princess tree (*Paulownia tomentosa*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Multiflora rose (*Rosa multiflora*)

Conservation Actions:

Overall:

- Safeguard the quality and expanse of the forested landscape. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect the water

quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve and maintain old-growth characteristics.

- Create "no spray" zones along the most sensitive areas of the railroad rights-of-way to avoid unintentional destruction of the species of concern or their habitats.
- Develop a restoration plan for the small serpentine influenced habitat. This will necessitate tree and shrub removal and perhaps more drastic measures such as scraping the surface to expose the thin serpentine derived soils or managing with carefully orchestrated prescribed fires.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat through conservation easements and fee-simple acquisition.
    - The species of concern core habitats overlap along the narrow band of steep slopes facing the Susquehanna River. This area is currently owned by PECO/Exelon Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the assumption that the current land use and ownership will remain for the foreseeable future. If PRCO/Exelon chooses to divest itself of the property, it should be considered a high priority for conservation acquisition.
    - The remaining area of the Natural Heritage Area is privately owned and divided into a number of large parcels. The forested portions of these parcels should be considered a high priority for fee-simple acquisition or conservation easement options for this Natural Heritage Area. The agricultural portions of these properties should be considered a secondary priority for conservation or agricultural easements. Protection of the adjacent agricultural landscape will help provide a buffer for the species of concern core habitat.
    - The steep, rocky nature of the immediate habitat of the species of concern likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites.
    - Indiscriminate railroad herbicide use is inappropriate for this location. Establish "no spray" zones at rock outcrops adjacent to the railroad. Control of native vegetation along the remainder of the railroad rights-of-way should be done by mechanical means. Limited spot treatments at other locations along the railroad may be necessary to control heavy infestations of invasive species.
    - Provide periodic culverts or other crossing opportunities for small animals to traverse the railroad tracks from river to uplands and visa versa.
- Conserve the intact forest canopy and a healthy native shrub layer.
    - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.
    - Consider native shrubs and vines an important component of the forest understory. Remove non-native species, but be careful to leave native shrub species such as spicebush, mountain laurel, blueberries and greenbrier as an essential part of the habitat.
- Remove invasive species of plants.
    - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern. Mechanical control, (mowing) is an option that will also require attention to the location and timing of mowing. Early-mid spring season mowing will result in stunted growth for most of the invasive species. Allow the plant species of concern to bloom and set seed before late season mowing takes place.
    - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.

Within the Natural Heritage Area / Supporting Landscape:

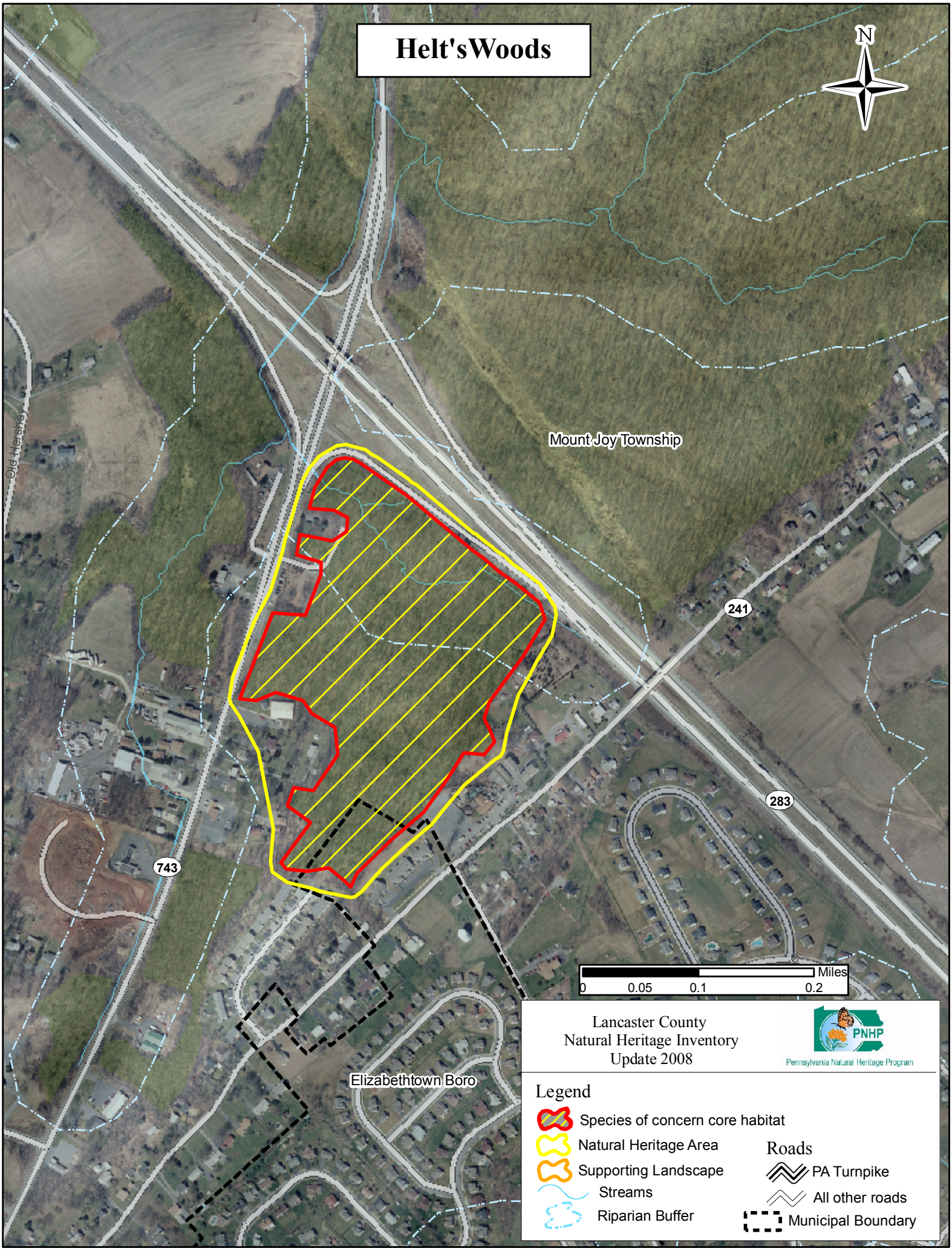
The supporting landscape for this Natural Heritage Area is derived from the sub-watershed of Haines Branch and the adjacent sub-watersheds entering the Susquehanna River. Activities within the watersheds can have a direct impact on the core habitat and the species of concern it contains.

- Forested properties adjacent to the core habitat should be acquired or provided with conservation easements to help provide a buffer to this habitat. Additional populations of species of concern could occur on adjacent forested parcels.
- Agricultural fields on high quality soils should be maintained as such. Agricultural easements may be the appropriate tool for these properties.
- Agricultural fields on poor quality soils adjacent to the core habitat should be encouraged to return to forest to expand the area of interior forest at this location and to provide an additional buffer for the core habitat. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants
- Remove non-native trees and shrubs. The railroad rights-of-way and forest/agricultural transition zones are likely the primary location of non-native trees and shrubs within this area. Care must be taken to distinguish between native and non-native species of plants. Coordinate invasive species control with those familiar with plant identification.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Plants species of concern are particularly susceptible to deer herbivory.
- Block access to forested areas by off road vehicles, ATVs and other motorized vehicles
- Additional surveys for species of concern are recommended.
- Conservation easements should be sought for forested and agricultural properties adjacent to the Natural Heritage Area to provide a buffer to this habitat and to help provide connectivity to other nearby greenway Natural Heritage Areas. Additional populations of species of concern could occur on adjacent parcels.
- Recommended restoration activities:
    - Almost the entire system of streams and creeks in this area has well developed forested buffers and can be considered appropriate examples to emulate. Streams through forested areas should be considered high priority for conservation in the habitat.
        - Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
            - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
                - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
                - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
                - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.
- Potential zoning options for conservation enhancement:
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 60% of the area within the core habitat and ~10% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.

- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this area.

Other plant species of concern historically documented from this habitat or nearby include:

Common name	**Scientific name**	**G-Rank**	**S-Rank**	**Last obs.**
Lobed Spleenwort	*Asplenium pinnatifidum*	G4	S3	1959-04-27
Eastern Baccharis	*Baccharis halimifolia*	G5	S3	1939-11-06
Jeweled Shooting-star	*Dodecatheon radicatum*	GNR	S2	1907
St Andrew's-cross	*Hypericum stragulum*	G5	S2	1860-09-10
Florida Paspalum (Beadgrass)	*Paspalum floridanum var. glabratum*	G5TU	SNA	1933-08-06
Carolina Leaf-flower	*Phyllanthus caroliniensis*	G5	S1	1932-09-04
Blackseed Needlegrass	*Piptochaetium avenaceum*	G5	S1	1904-07
River Bulrush	*Schoenoplectus fluviatilis*	G5	S3	1866-07-22
Horse-gentian	*Triosteum angustifolium*	G5	S1	1909-05-18
Eastern Gamma-grass	*Tripsacum dactyloides*	G5	S1	1933-08-06


Helt'sWoods
N
Mount Joy Township
Old Hershey
241
283
743
Elizabethtown Boro
Miles
0
0.05
0.1
0.2
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary

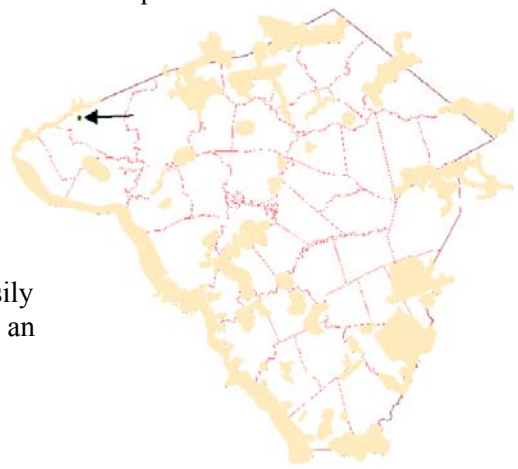
Helt's Woods – *Notable significance*

Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	1993-06-10	C

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This small Natural Heritage Area occurs at the Elizabethtown exit ramp from Route 283.

- Municipalities:
  1. Elizabethtown Borough
  2. Mount Joy Township
- USGS Quadrangles:
  1. Elizabethtown Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: This small patch of woods occurs in one quadrant of a highway exit ramp. The bedrock geology is diabase, which is not easily converted to agriculture uses hence the area has remained wooded in an otherwise agricultural landscape.

Species of Concern Considerations:

- A small patch of puttyroot occurs in this fragmented patch of forest. There is more potential habitat for this small, inconspicuous orchid in the large forested area on the eastern side of Route 283 and additional surveys may reveal that this is part of a larger population that was split by the highway construction.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types.

- This small patch of woods is considered a red oak-mixed hardwood forest. It was separated from the larger forest to the east by the construction of Route 283.

Ownership:

- The woodlot is privately owned. It's proximity to the interchange may lead to commercial development.
- The Elizabethtown Park Authority owns several parcels on the opposite side of the highway from this population of puttyroot.

Habitat Disturbances:

- Historic – This large forested landscape has historically avoided dramatic habitat disturbances because the diabase bedrock is not suitable for agriculture.
- Current –

- The construction of Route 283 and other infrastructure fragmented the forest into smaller parts.
- Residential development is encroaching on the forested habitat.

- Exotic Species – Invasive species of plants were not noted during surveys in the early 1990s.

Conservation Actions:

Overall:

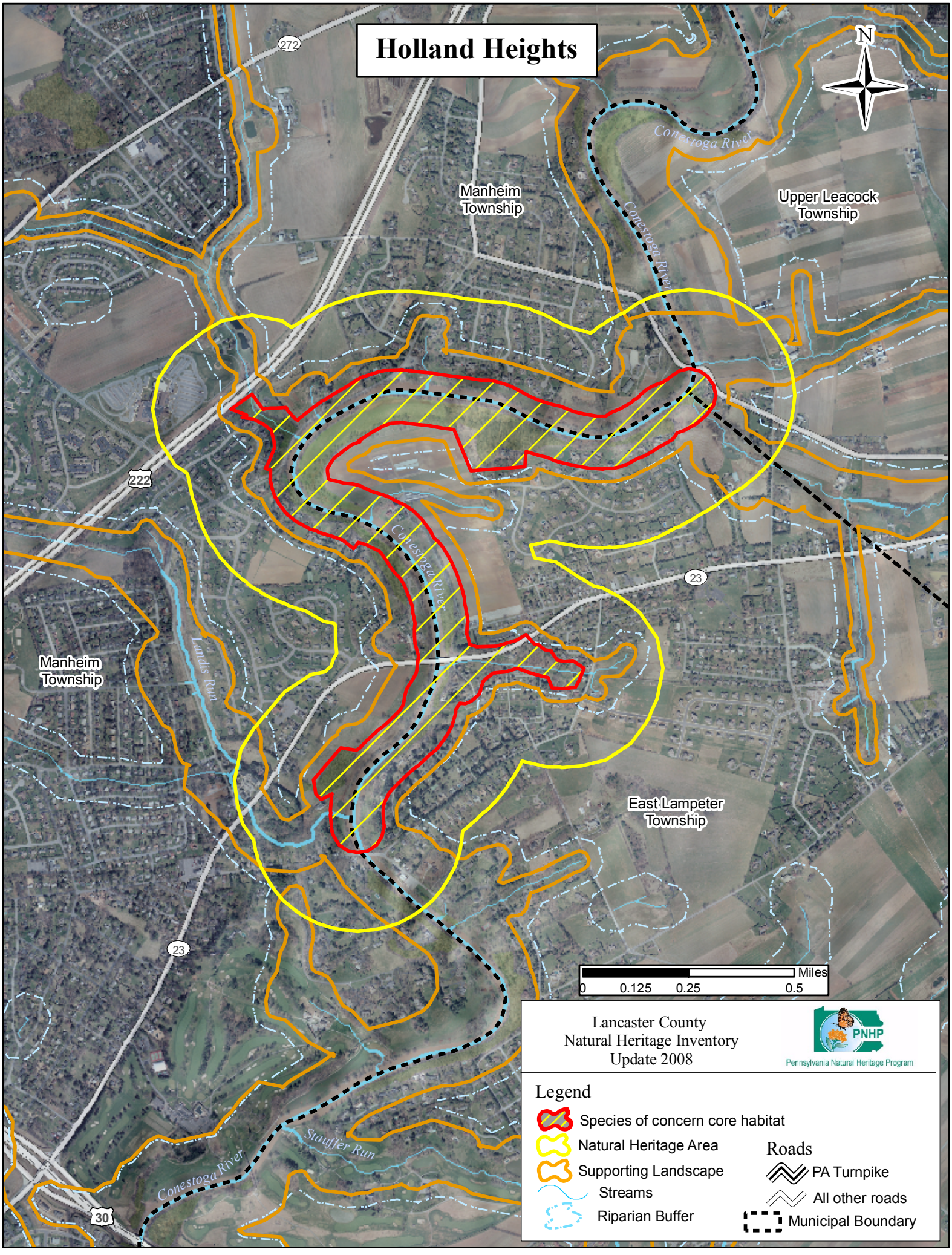
- Consider this small patch of woods a part of the larger habitat corridor of the diabase bedrock area and the adjacent Conewago Creek. The entire diabase area represents one of the few remaining large forested areas of the county. Avoid further subdivision and development of any portion of the diabase bedrock habitat.

Within the Core Habitat:

- Avoid development of this small patch of woods. The population of puttyroot will likely persist at this location if disturbance is kept to a minimum.

Within the Supporting Landscape: The supporting landscape for this habitat should be considered to be the entire forested diabase bedrock area. Additional populations of puttyroot are likely to be found throughout this similar habitat.

- Avoid subdivision or fragmentation of the forested diabase bedrock area.


Holland Heights
N
Manheim Township
Upper Leacock Township
Conestoga River
Manheim Township
Landis Run
East Lampeter Township
Stauffer Run
272
222
23
23
30
Miles
0
0.125
0.25
0.5
Lancaster County
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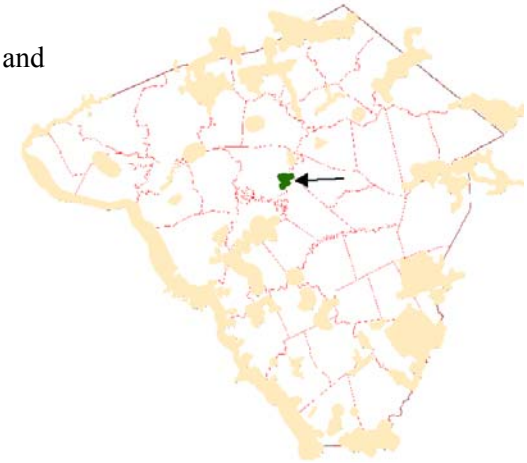
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary

Holland Heights – *Notable significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Animals:					
Sensitive species of concern[3]	G5	S1B	PE	1997	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location: This Natural Heritage Area occurs along the floodplain and adjacent riparian corridor of the Conestoga River north of the Borough of Eden.

- Municipalities:
  - East Lampeter Township
  - Manheim Township
  - Upper Leacock Township
- USGS Quadrangles:
  - Lancaster Quadrangle
  - Leola Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SA542" – (Lancaster Quadrangle)

Description: The Conestoga River though this area has a wide, well defined, naturally vegetated floodplain, while the surrounding uplands are nearly filled with suburban development. Some portions of the river's riparian buffer are in active agricultural production, while much of the remainder has been converted to suburban development. Potential still exists to expand the natural habitat along the Conestoga River to include a forested riparian buffer adjacent to the active floodplain. A sensitive species of concern has been documented at various locations along this section of the river over a number of years.

Species of Concern Considerations:

- This sensitive species of concern lives and breeds in the forested habitat along waterways and feeds primarily on aquatic organisms in smaller streams and rivers. The core habitat for this sensitive species of concern is both the creek and the adjacent upland forest. This species is apparently not sensitive to human activity as it has been found in urban and suburban settings as long as the appropriate habitat is available. This sensitive species of concern requires abundant food source in the river and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Conestoga River and by protecting and expanding the natural forested/vegetation buffer along the creek, its floodplain and all its tributaries.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The Natural Community types are closely associated with the Conestoga River, its floodplain and the adjacent uplands. The majority of the landscape of the Conestoga River watershed has been

converted from its original native vegetation to intensive agricultural production and the highly urban and suburban surroundings of Lancaster City. The fragments that remain are primarily narrow strips along the banks of streams and steep slopes, forming the framework of riparian corridors. Most of these narrow strips of forest are highly impacted by edge effects and are considered "modified successional forest". Some of these remnants are considered of higher quality, and are identified as "Sycamore (river birch)-box elder floodplain forest" and "Tuliptree-beech-maple forest" and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as "modified successional forest" are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers.

Ownership: This Natural Heritage Area is in close proximity to the heavily populated Lancaster City and its suburbs. Most of the habitat is broken into many small private lots making broad conservation action less likely. However, several larger parcels remain in this rapidly developing region of the county. Conservation activity should focus on these larger parcels before land subdivision impedes conservation progress.

- Manheim Township owns several acres of river floodplain north of New Holland Pike that is maintained as a public park.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture, which in turn was largely replaced by urban and suburban development. Only small isolated pockets of natural vegetation remained to provide habitat for native plants and animals.
  - Three milldams were active along this stretch of the Conestoga River. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Portions of the historic Conestoga River floodplain remain trapped in these deep, narrow channels.
- Current –
  - Much of the landscape that had in the past been dedicated to agricultural production has since been converted to residential development. Stormwater runoff from developed areas can flow into the river system with little opportunity to be filtered, creating a potentially significant non-point source of pollution.
  - Garden debris and other refuse dumped into the river floodplain can be a significant source of invasive plant species and general habitat degradation.
- Exotic Species –
  - The exotic species composition and threat to this location is undocumented, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants. Control of invasive plants and restoration of native vegetation will likely be necessary.

Conservation Actions:

Overall:

Within the Core Habitat:

- Most of the core habitat for the species of concern falls within the floodplain for the river and the adjacent uplands. Strict enforcement of zoning regulations to prohibit building activity within the 100-year floodplain of the Conestoga River would help protect the habitat of this species of concern. In addition, restore a native vegetated / forested riparian buffer within 100 meters of the upper edge of the floodplain, or within 100 feet from the upper edge of the floodplain where development has already precluded this option. Any trails constructed

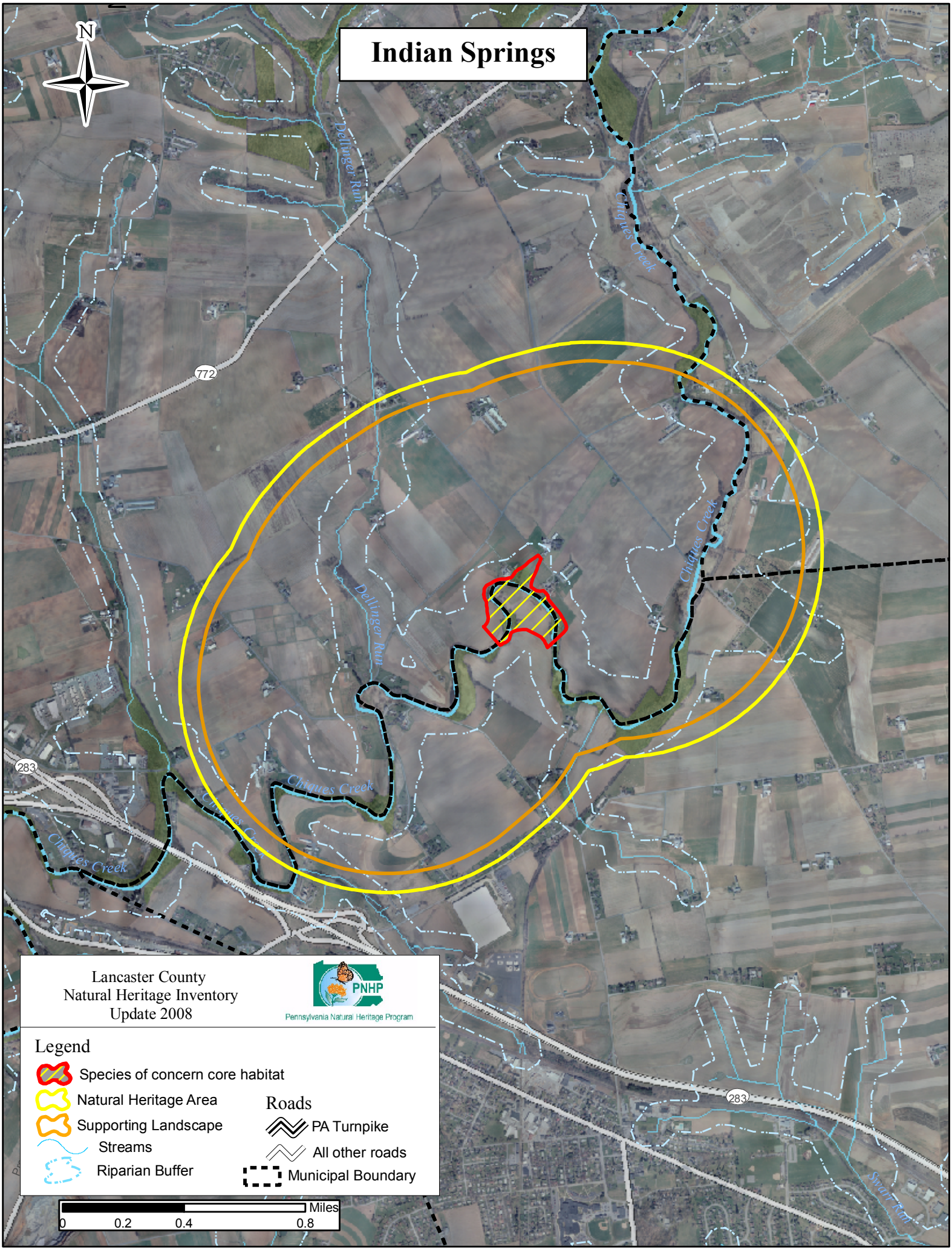
though the area should stay at least 50 feet from the river banks to avoid degrading the fragile shoreline.

- Incorporate the public space/ natural corridor into future subdivision development plans along the river.
- Restoration of vegetated stream buffers along the Conestoga River and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conestoga River, Susquehanna River and the Chesapeake Bay.
- The forested floodplain along this stretch of the Conestoga may be an appropriate location for a municipal park serving East Lampeter and Manheim Townships. Emphasis should be on promoting a viable floodplain natural community rather than on active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding areas with native vegetation and restoration and protection of the natural condition of the shoreline.
- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions. Storm water runoff through suburban areas can be a significant source of chemical pollutants for the river, which can severely impact water quality and the food chain of the river. The use of herbicides, pesticides and fertilizers in agricultural production can also have a significant impact on the water quality at this location. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to slow and capture water flow in these expanses of urban and cultivated landscapes. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern.

<u>Within the Supporting Landscape:</u>

- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along both shores of the Conestoga River and all its tributaries. Ideally, expand the native vegetation along the river corridor to include land within 100 meters of the river's banks. Alternately, the 100 foot riparian buffer can substitute for the 100 meter buffer where development has already eliminated the preferred option. Reforestation efforts should be designed to mimic the adjacent natural community type in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way especially along the river shoreline and any remaining natural habitats. These natural habitats provide an essential filter for runoff entering the river from the adjacent uplands, but road crossings can significantly reduce their effectiveness.
- The immediate watershed draining into the river includes some forested areas and agricultural fields. Logging of wooded areas, specifically along steep slopes and riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers, road and parking lot runoff and other sources can accumulate in the river leading to the consequent death of aquatic organisms. The amount of impervious surfaces around the river can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the river. Specific recommendations for reducing and preventing pollution of surface and groundwater can be found in various sources including the Urban Subwatershed Restoration Manual Series produced by the Center for Watershed Protection: (http://www.cwp.org/index.html)

- Pursue conservation easements, transfer of development rights and fee simple acquisition on properties along the river shoreline, the adjacent slopes and adjacent farmlands to help improve the effectiveness of the Conestoga River as a habitat and natural corridor.
- Potential zoning options for conservation enhancement:
  - East Lampeter and Upper Leacock Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest/natural vegetation cover.
  - Strict enforcement of regulations restricting building activity on slopes greater than 25% would help prevent the adjacent forested slopes from being converted to other uses.
  - Growth within the Township should be discouraged to occur within 100 meters of the 100-year floodplain of the Conestoga River or its tributaries.
  - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary destruction of natural habitat and prime farmland.
    - Many Townships have a Conservation District zoning designation that attempts to preserve open space by restricting the minimum building lot to 2 acres or more. While allowing a veneer of habitat to remain under fully built conditions, these regulations do little to protect the intended resources. It would be better to allow cluster housing on a similar footprint percentage of the area and avoid fragmenting the remaining forested habitat with the infrastructure associated with single family dwellings.
- Restoration:
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
  - All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the upland periphery of natural wetland openings.
    - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests as appropriate to the topography and hydrology.
  - Riparian buffers:
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain.


Indian Springs
N
Dellinger Run
Chiques Creek
772
283
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.2
0.4
0.8
Swart Run

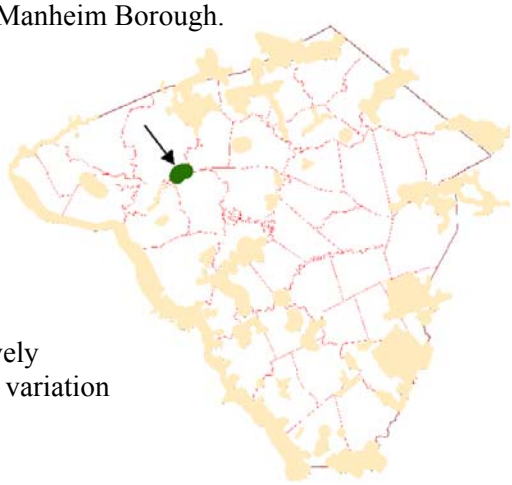
Indian Springs – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Price's Cave Isopod (*Caecidotea pricei*)	G5	S2S3	-	1993-02-04	BC

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: These spring openings occur near Chiques Creek south of Manheim Borough.

- Municipalities:
  - East Hempfield Township
  - Penn Township
  - Rapho Township
- USGS Quadrangles:
  - Columbia East Quadrangle
  - Manheim Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: Two small springs issue from the ground in this intensively agricultural setting. The surrounding landscape has little topographic variation providing ample opportunity for large agricultural fields.

Species of Concern Considerations:

- Price's cave amphipod is a small cave-dwelling crustacean that has been documented among the leaf litter where water issues from the springs. The focus of conservation efforts for this species, and the subterranean habitat as a whole, is the protection of the water quality. The specific hydrology of underground systems is difficult to determine, but in general, conditions above ground have a significant impact on the habitat underground. Avoid contamination of the groundwater by preventing agricultural, residential and roadway runoff from entering the system.

Forest Cover / Natural Communities:

The entire area is in active agricultural fields except for a narrow band of trees and shrubs along the banks of Chiques Creek.

Ownership:

The land that contains the springs is privately owned and under active agricultural production. A portion of the supporting landscape is owned by the Penn State College of Agricultural Sciences and is also in active agricultural production.

Disturbances:

- Historic –The natural community that once occupied this area was replaced by the agrarian landscape modifications of the European colonists over 200 years ago.
- Current – The landscape is intensively cultivated, with little of the natural vegetation remaining.
- Exotic Species – The subterranean habitats of the cave-dwelling species of concern at this location are not currently at risk from invasive species.

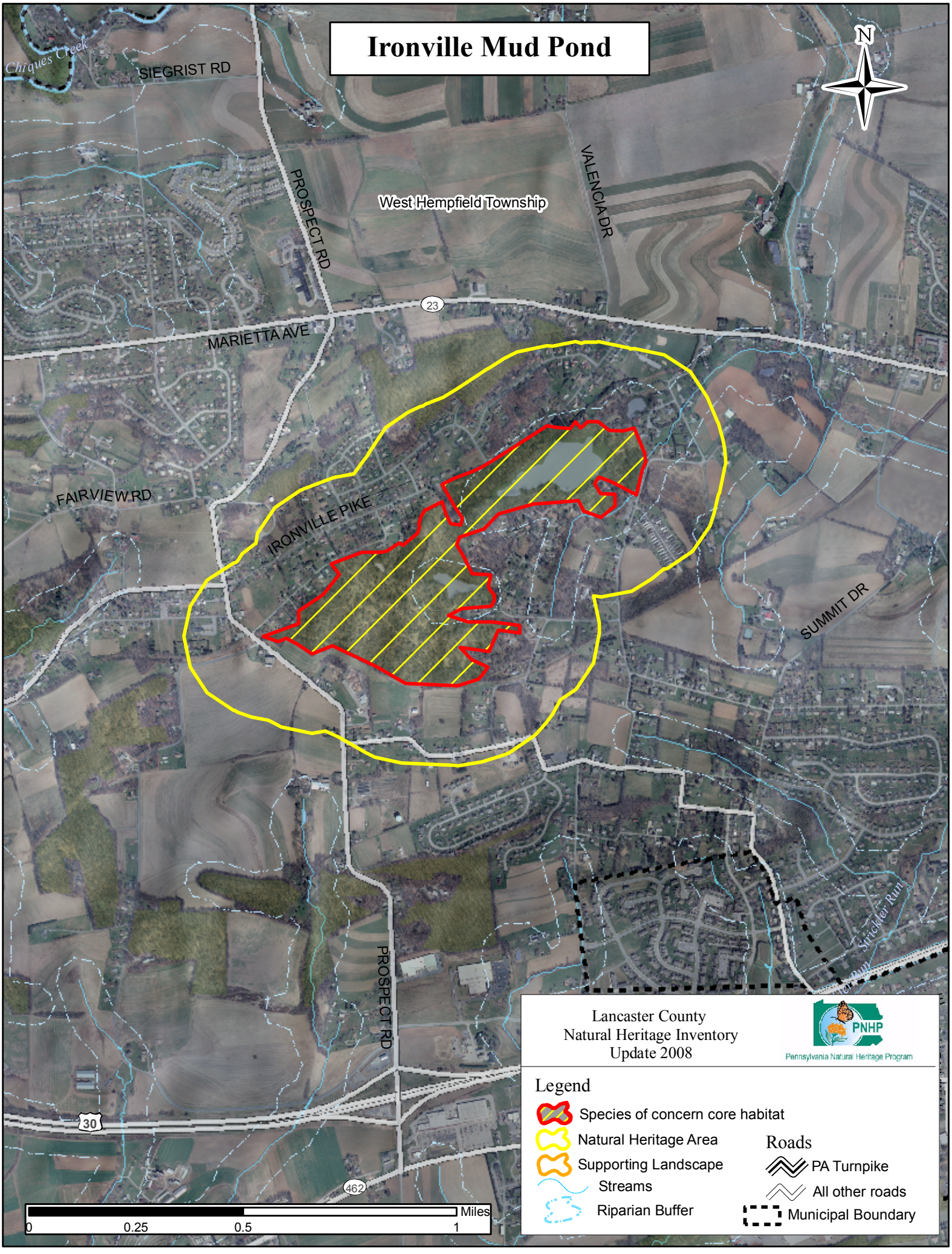
Conservation Actions:
Overall: A long term objective for this habitat should be to protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-swelling species of concern present at this location.

Within the Core Habitat:

- The subterranean habitat of the cave-dwelling species can be considerably impacted from above ground land use decisions. Use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the groundwater quality and the cave-dwelling species of concern at this location. Since both the intensive agricultural landscape and the cave species of concern have been coexisting for considerable time, it is uncertain what effect agricultural practices have on the biology of the species. Despite this uncertainty, it would be prudent to protect and improve the quality of the groundwater for both the local human community as well as for the habitat for the cave species of concern. The rainwater runoff from the agricultural fields and pastures should be considered a potential source of significant groundwater contamination. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.
- Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution. Sinkholes should be buffered with native vegetation to help slow the flow of water before it enters the sinkhole. Water that is reduced in velocity will drop sediment and other heavy particles as it slows down.

Within the Supporting Landscape: Since the groundwater recharge area for the springs is largely undetermined, the supporting landscape for this area is derived from a perimeter around the cave opening in alignment with subsurface geology. Activities within the surrounding area can have a direct impact on the subterranean habitat of the species of concern.

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- In addition, the intensively cultivated landscape offers little natural habitat for native species of plants and animals. Portions of the area, particularly along the floodplains of Chiques Creek and Dellinger Run should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
- Consider implementing an Aquifer Protection / Karst Hazard Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect groundwater resources.
- East Hempfield, Penn & Rapho Townships all have zoning ordinances restricting construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect the water quality entering the groundwater habitat of the species of concern.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.


Ironville Mud Pond
N
Chiques Creek
SIEGRIST RD
PROSPECT RD
West Hempfield Township
VALENCIA DR
23
MARIETTA AVE
FAIRVIEW RD
IRONVILLE PIKE
SUMMIT DR
PROSPECT RD
Strickler Run
30
462
Miles
0
0.25
0.5
1
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary

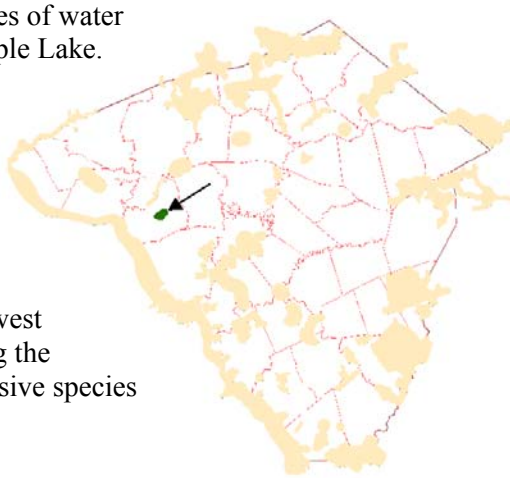
Ironville Mud Pond– *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Southern bog clubmoss (*Lycopodiella appressa*)	G5	S2	PT	1993-09-08	CD

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: A former quarry site north of Mountville contains three bodies of water resulting from past quarrying activity: Mud Lake, Grubb Lake and Purple Lake.

- Municipalities:
  1. West Hempfield Township
- USGS Quadrangles:
  - Columbia East
- 1990 Lancaster Natural Areas Inventory reference:



Description: This area contains an abandoned iron ore quarry with standing water and a small intermittent stream entering from the northwest corner. Most of the quarry pit is steep sided with river birch dominating the quarry margins. The surrounding woodlot is densely infested with invasive species and weedy native plants.

Species of Concern Considerations:

- Southern bog clubmoss grows in sandy to peaty seepages, depressions, and damp successional openings with a mostly coastal distribution from Nova Scotia west and south into Texas and Florida. About 12 populations are currently documented in Pennsylvania, where it has a PA legal rarity status of Threatened. At this location, a small population of southern bog clubmoss grows on open soil along the edge of the quarry pit where vegetation is sparse and competition is low. The viability of known populations of southern bog clubmoss and its habitat type can be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. This species can colonize certain types of disturbed ground, such as abandoned quarries and utility rights-of-way, if the proper substrate and moisture conditions are present. Natural succession, invasive species, and the indiscriminate application of herbicide can be threats at these sites.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- The natural habitat of this area is the result of mining disturbance. The weedy woodland surrounding the quarry is considered a "modified successional forest", an early stage of recovery from past disturbance. Preserve native trees within these woods and selectively remove low quality vegetation to help improve the quality of this small woodlot.

Ownership:

- One of the quarry lakes, Grubb Lake and the accompanying 55 acres is owned by Mountville borough and maintained as a public park with nature trails.
- Other portions of the former quarry are privately owned.
- The area surrounding the former quarry is mostly comprised of suburban development, though a few larger agricultural parcels remain adjacent to the quarry site.

Habitat Disturbances:

- Historic –
  - The area was mined in the past, disturbing the natural landscape and hydrology.
  - The natural vegetation of the surrounding landscape was converted to agricultural uses over several centuries.
- Current –
  - The former quarry pits have filled with water and the adjacent area has grown up in a young, weed-infested forest.
  - Residential subdivision has replaced farms in the surrounding area, particularly adjacent to Ironville Pike.
  - There is a network of ATV trails though the woodlot and some areas of dumping and litter.
- Exotic Species –
  - The woodlot surrounding the former iron quarry pits is a highly disturbed, weed infested habitat. Invasive species noted from past surveys include but is likely not limited to:
    - Oriental bittersweet (*Celastrus orbiculatus*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
    - Japanese stilt grass (*Microstegium vimineum*)
    - Mile-a-minute (*Polygonum perfoliatum*)

Conservation Actions:

Overall:

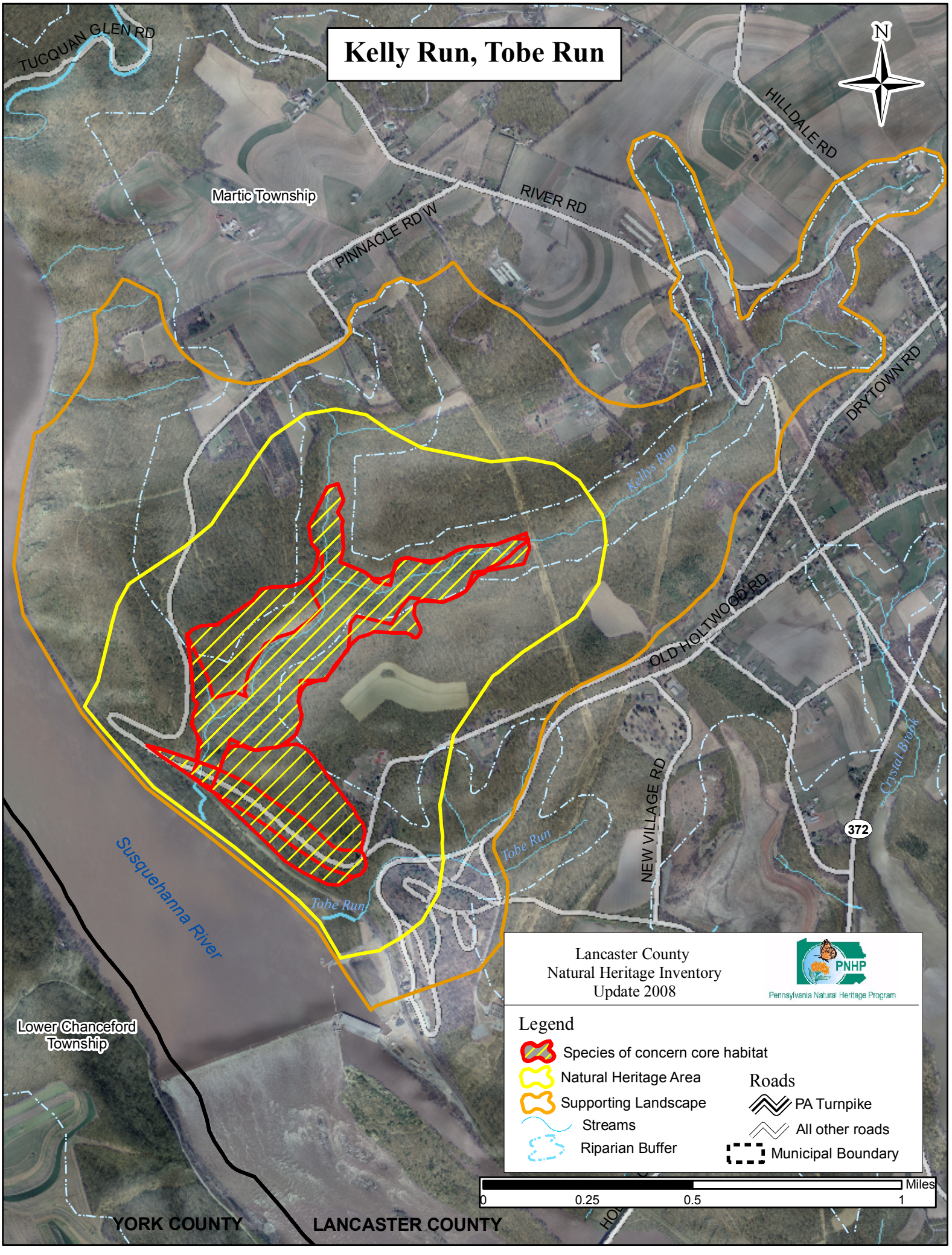
- Pursue acquisition of the other quarry pits and the remainder of the adjacent woodlot as an expansion of the Grubb Lake Public Park.
- Remove invasive species of plants from the woodlot to improve the future composition of the forest.
- Additional surveys to update the status of this plant and search for other this and other species of concern is recommended.

Within the Core Habitat:

- The southern bog clubmoss occurs on the exposed banks of the former quarry pit at Mud Lake. Maintain the open aspect of the shoreline to prevent trees and shrubs from crowding out the species of concern. Avoid building trails or infrastructure along the bank of Mud Lake.
- ATV traffic has been a past disturbance along the shore of the quarry pit. Close the area to ATV traffic and block existing trails.

Within the Supporting Landscape:

- Much of the area surrounding the former quarry has already been converted to suburban development. Opportunity still exists to provide vegetated riparian buffers to the unnamed tributary leading out of Grubb Lake all the way to its confluence with Chiques Creek.


Kelly Run, Tobe Run
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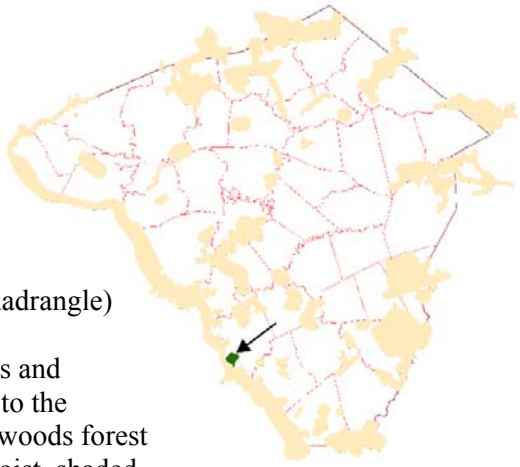
TUCQUAN GLEN RD
HILLDALE RD
Martic Township
RIVER RD
PINNACLE RD W
DRYTOWN RD
Kellys Run
OLD HOLTWOOD RD
NEW VILLAGE RD
Crystal Brook
372
Tobe Run
Tobe Run
Susquehanna River
Lower Chanceford Township
YORK COUNTY
LANCASTER COUNTY
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Kelly Run, Tobe Run – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
American holly (*Ilex opaca*)	G5	S2	PT	1988-11-18	C
Oblique milkvine (*Matelea obliqua*)	G4	S1?	PE	1994-08-25	E
Leaf-cup (*Polymnia uvedalia*)	G4G5	SNR	PT	2002-08-14	BC
Appalachian gametophyte fern (*Vittaria appalachiana*)	G4	S2	PT	2005-04-19	B
Exceptional Natural Communities:					
Hemlock-tuliptree-birch forest	GNR	S4	-	1988-11-18	CD

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Martic Township
- USGS Quadrangles:
  - Holtwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Kelly's Run – SP612, SP617, NC619" – (Holtwood Quadrangle)

Description**:** Scenic Kelly Run tumbles past impressive rock outcrops and scattered boulders though this steep-sided forested ravine on its way to the Susquehanna River. In portions of the ravine, a hemlock-mixed hardwoods forest is underlain with a thick stand of rhododendron producing a cool, moist, shaded microclimate. The habitat is exceptionally scenic and hosts a portion of the popular Conestoga Trail, which passes through the ravine.

Species of Concern Considerations:

Plants:
- A few scattered American holly trees of varying age occur within this area. The species has a PA legal rarity status of Threatened. Populations of holly in the lower Susquehanna ravines are some of the few in the state to be considered native to the state, and not the result of cultivation, or naturalized from cultivated specimens. As a woodland species, proper forest management and control of invasive species are important for the long term viability of American holly. Collecting for holiday greens may be the biggest threat for this species at this location.
- Oblique milkvine grows in limestone glades, open woodlands, and thickets. It has a PA legal rarity status of Endangered. This species seems to do particularly well in open woodlands created by fire. At this location, it occurs on the west facing forested slope adjacent to the Susquehanna River along a gated, little-used road leading down the slope to the river's edge. The habitat is exceptionally weedy with much Japanese honeysuckle, tree-of-heaven and Norway maple. Improper maintenance of this road could eliminate this part of the oblique milkvine population. Maintenance of known populations and preservation of the open communities where oblique milkvine grows will be

crucial to its survival. Removal of overgrowth and invasive species with the integration of fire regimes, when appropriate, will help to preserve the integrity of the sites.

- Leaf-cup typically grows in ravines, moist thickets, and along the banks of streams or rivers. It has a PA legal rarity status of Threatened. At this location, it is found primarily along an old, gated, little-used road leading to the Susquehanna River. Protection of leaf-cup will require maintenance of known populations and preservation of stream and riverbank habitat. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.
- The Appalachian gametophyte fern occupies a few of the cool, damp, shaded overhangs on the large cliffs in the ravine. These microclimate conditions appear to be critical for this species. It has a PA legal rarity status of Threatened. The viability of the known populations of Appalachian gametophyte fern and its habitat can be enhanced by maintaining a buffer of forest immediately surrounding the rock outcrop that supports the population. Since hemlock is often a major constituent of the forest at populations of this fern, the loss of hemlock due to the hemlock woolly adelgid represents a threat. Loss of the hemlock canopy could result in a drier, warmer habitat that would likely prove unsuitable for this species.

Exceptional Natural Communities:

- During surveys in 1988, the hemlock-tuliptree-birch forest at this location was considered to qualify as one of the better quality examples of this community type in the state. Since then, the hemlock woolly adelgid, an introduced insect pest of hemlocks, has killed many of the older hemlocks in this ravine. Though the hemlock component of the forest may be severely depleted, the other elements of this natural community remain. The hemlocks may be able to recover from the woolly adelgid infestation in time. Allow the forest to achieve old growth characteristics. Remove non-native trees and shrubs to allow the native trees and shrubs to regenerate.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Forests cover almost all of the species of concern core habitat and approximately 90% of this Natural Heritage Area, which also contains a large interior forest block. A primary conservation goal for this area is to conserve this uninterrupted aspect of the forest canopy. There are currently only minor incursions or disturbances to this area. The forest cover on the north-facing slopes of the ravine is a fair quality example of a hemlock-tuliptree-beech forest with structural elements that approach old growth conditions. The remainder of the Natural Heritage Area contains several other dominant forest community types including:
  - Terrestrial (upland) communities:
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - Dry oak-heath forest
    - Dry oak-heath woodland
    - modified successional forest*

Ownership:

- Approximately 70% of the Natural Heritage Area is owned by the PPL Corporation who allows public access in a park-like setting.
- An adjacent 8% of the Natural Heritage Area is owned by the Lancaster County Conservancy. Together, these two entities protect most of the sensitive habitat within this Natural Heritage Area.
- Norfolk Southern Railroad owns a rights-of-way paralleling the Susquehanna River shoreline.

Disturbances:

- Historic –
  - The amount of forest cover along the edges of the Natural Heritage Area has increased since the 1940 aerial photos were taken, where areas that were active agriculture have reverted to forest. These areas that were formerly agricultural fields and are now forest are primarily of the modified successional forest type – a rather weedy, poor quality forest that represents the initial stages of succession from bare ground. Forests of this type should be targets for forest management techniques that improve the forest composition, favoring a reestablishment of native species-dominated late-successional forest cover, mimicking forest types found in similar habitats nearby. Older native trees should be considered valuable as local seed sources rather than as lumber and left standing.
  - The railroads and utility rights-of-way were already in place by the 1940s.
- Current –
  - The ravine has been spared from past road building activities, which leaves the interior forest intact. Numerous small logging roads or ATV trails twist through the forest on the northern side of the ravine. Several small residential and agricultural areas occur towards the outer perimeter of the Natural Heritage Area.
  - A utility rights-of-way clear cut crosses the eastern tip of the Natural Heritage Area with two more crossing the eastern tip of the supporting landscape.
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may consider the railroad an insurmountable obstacle.
  - The habitat created by the railroad rights-of-way is a product of habitat disturbance. The rights-of-way is a narrow band of exceptional weediness in this otherwise intact landscape. This habitat disturbance has also resulted in habitat creation for a species of concern at this location. Leaf-cup is a plant adapted to disturbed conditions and may disappear from the site in the absence of some form of disturbance.
  - There has been much residential building activity since 1940 along the southeastern boundary of the Natural Heritage Area, particularly along Drytown Road, Street Road and Old Holtwood Road on land that was formerly active agricultural fields.
  - Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the affect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species – The steepest parts of the ravine and the creek edge are mostly free of invasive plant species and the weed-free slopes have an almost unvegetated appearance in early spring. The upper slopes, however, are becoming quite tangled with a variety of herbaceous, vine and shrub invasive weed species.
  - Of particular interest is the dominance in the understory of burning bush (*Euonymus alatus)*, an invasive shrub commonly used in landscape plantings.
  - Also of interest is the occurrence of a sizable patch of kudzu along a road in the vicinity of Old Pinnacle Road. The PA Department of Agriculture is currently targeting all known populations of kudzu in the state for eradication.
  - The railroad rights-of-way is also heavily infested with a variety of invasive species of plants and should be considered a major source of unwanted weed species.
  - The transition zone between forest and agricultural fields is also heavily infested with weed species, especially multiflora rose and Japanese honeysuckle.

- An insect pest on hemlock trees, the hemlock woolly adelgid, which was accidentally introduced from Asia, has killed numerous hemlock trees in the ravine. Additional information on this insect pest can be obtained from the PA Bureau of Forestry web site at <http://www.dcnr.state.pa.us/forestry/woollyadelgid/index.aspx>. If this insect pest succeeds in decimating the hemlock population at this location, it could have a severe affect on the microclimate of the ravine, creating a drier and warmer environment.
- Other invasive plants documented at this site include, but are not likely limited to:
    - Norway maple (*Acer platanoides*)
    - Tree-of-heaven (*Ailanthus altissima*)
    - Garlic mustard (*Alliaria petiolata*)
    - Burning bush (*Euonymus alatus)*
    - Gill-over-the-ground (*Glechoma hederacea*)
    - English ivy (*Hedera helix*)
    - Japanese honeysuckle (*Lonicera japonica*)
    - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
    - Kudzu (*Pueraria lobata*)
    - Multiflora rose (*Rosa multiflora*)
- Control options for invasive plants range from mechanical to chemical (see individual fact sheets). High priority for invasive species control at this site should be targeted towards removing small populations of newly established invasive plants in the most weed-free areas of the Natural Heritage Area , in particular burning bush, bush honeysuckles, multiflora rose and tree-of-heaven. Invasive species control efforts should try to maintain weed-free areas first, and then concentrate of removing invasive species in lightly infested areas, continually pushing back the line of invasion. This needs to be an unending process of monitoring and control efforts.

Conservation Actions:

Overall:

- The primary conservation concern for this habitat should be to focus on safeguarding the quality and expanse of the forested landscape. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve and maintain old-growth characteristics.
- Since most of this habitat is currently protected as a nature sanctuary by PPL and Lancaster County Conservancy, this area is considered a low priority for conservation action. If PPL chooses to divest itself of this property, it should be considered a high priority for conservation acquisition.

Within the Core Habitat:

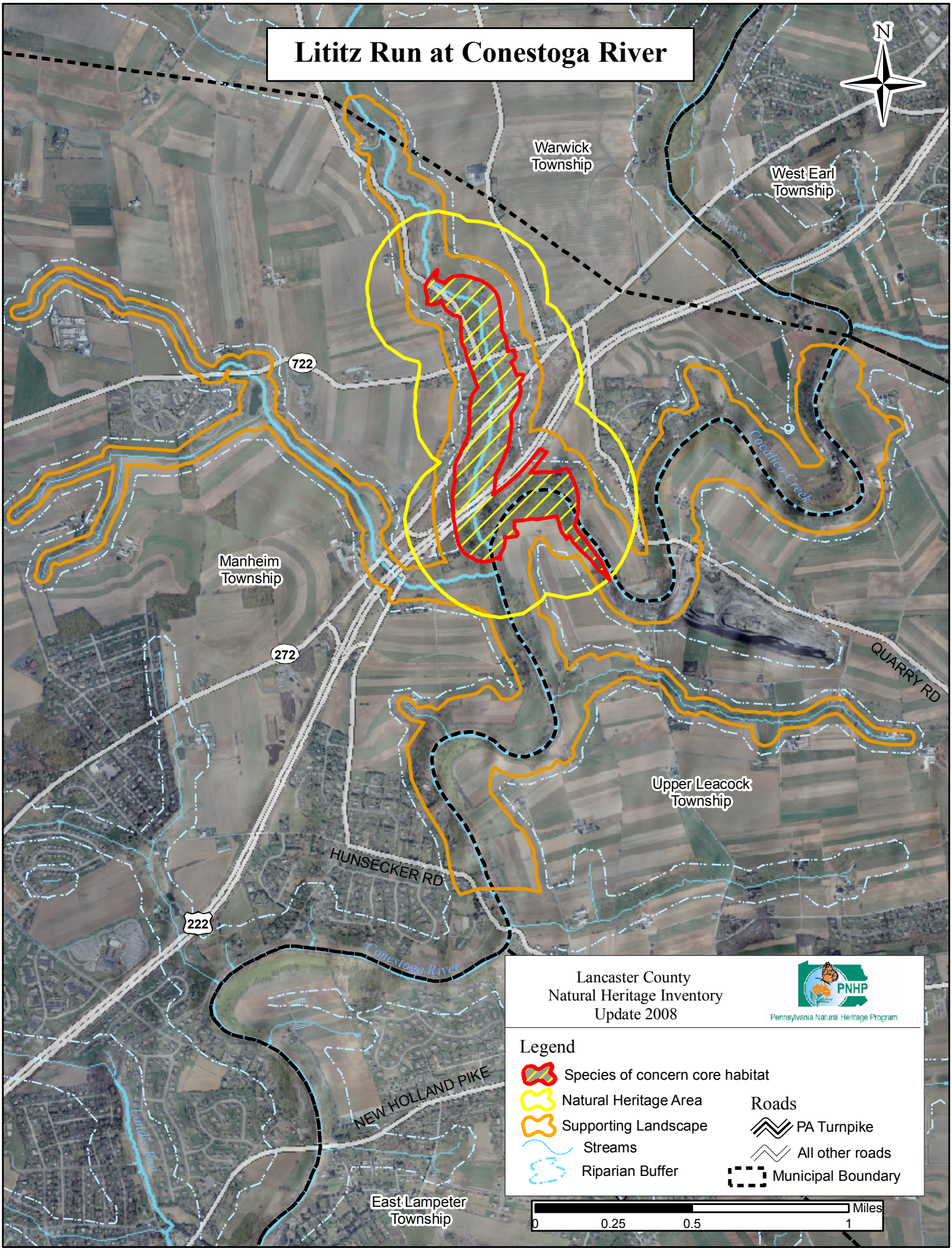
- Provide for the long-term protection of the core habitat.
    - Much of the priority core habitat within Kelly Run is currently owned by PPL Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the current management regime. A significant portion is also owned by the Lancaster County Conservancy, whose mission statement provides for the continued protection of lands under its ownership.

        - Consider fee-simple acquisition, or conservation easement options with the largest property owners of the core habitat outside of the Lancaster County Conservancy and PPL Corporation property holdings
        - Consider fee-simple acquisition, or conservation easement options with the PPL Corporation property holdings to provide long-tem protection for this area.
    - The steep, rocky nature of the immediate habitat of the species of concern likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites.
    - Indiscriminate herbicide use along railroad rights-of-way is inappropriate for this location.
- Conserve the intact forest canopy of Kelly's Run.
    - It may be necessary to encourage or replant hemlock seedlings for the eventual restoration of the hemlock component of this habitat.
    - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way. The forested landscape of Kelly Run has avoided past road building disturbances like those that have fragmented the forest of similar nearby ravines. Avoid the temptation to provide vehicular access to the ravine by building a road. Such a road would ruin the very attributes which make this place a high quality environment.
    - Avoid logging activities in this area to allow for the development of old growth conditions.
- Provide open conditions favorable for the oblique milkvine population where it occurs. Invasive species removal in the vicinity of the population would provide most of this opening. Monitor for changes in population size in reaction to habitat modification.
- Remove invasive species of plants.
    - Focus weed management activities on pushing the line of infestation back away from the floor of the ravine. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
        - Target pioneer populations of invasive shrubs for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose, English ivy and burning bush.
    - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern. Mechanical control, (mowing) is an option that will also require attention to the location and timing of mowing. Early-mid spring season mowing will result in stunted growth for most of the invasive species. Allow the plant species of concern to bloom and set seed before late season mowing takes place.
    - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
    - Continual invasive species monitoring and control will be necessary.

<u>Within the Natural Heritage Area / Supporting Landscape:</u> The supporting landscape for this Natural Heritage Area is derived from a portion of the Kelly Run watershed. Activities within the watershed can have a direct impact on the core habitats of the Natural Heritage Area and the species of concern it contains.

- Conservation easements should be sought for adjacent forested and agricultural properties to provide a buffer to this habitat and to help provide connectivity to other nearby Natural Heritage Areas. Focus conservation actions first on parcels exhibiting high quality forest types (ranked 2 or 3). Additional populations of species of concern could occur on adjacent parcels.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.

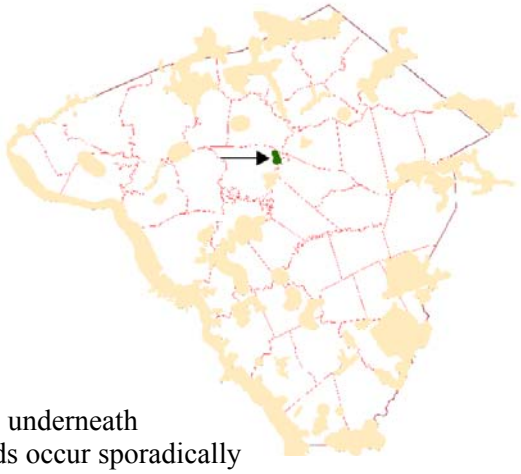
    - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
        - Trees that have fallen over approved trails can be cut through as necessary.
    - A utility rights-of-way clear cut crosses the eastern tip of the Natural Heritage Area effectively severing connectivity for many forest adapted species. Encourage reforestation in the ravine, which is well below the high tension wires.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd by allowing hunter access. Rare species of plants are particularly susceptible to deer herbivory.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
- Block access to forested areas by off road vehicles.
- Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
- Additional surveys for species of concern are recommended.
- <u>Potential zoning options for conservation enhancement:</u>
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 80% of the area within the core habitat, ~50% of the Natural Heritage Area and ~30% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this location.


Lititz Run at Conestoga River
N
Warwick Township
West Earl Township
722
Cocalico Creek
Manheim Township
272
QUARRY RD
Upper Leacock Township
HUNSECKER RD
222
Conestoga River
NEW HOLLAND PIKE
Landis Run
East Lampeter Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Lititz Run at Conestoga River – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Sensitive species of concern[3]	G5	S2S3B	PE	1992-04-16	E
Sensitive species of concern[3]	G5	S1B	PE	1988-05-18	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location: Confluence of Lititz Run with the Conestoga River
- Municipalities:
  - Manheim Township
  - Upper Leacock Township
- USGS Quadrangles:
  - Lancaster Quadrangle
  - Leola Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SA502" – (Leola Quadrangle)

Description: Lititz Run joins the Conestoga River after passing underneath several busy roads including Route 222. Small patches of woods occur sporadically along the banks of both Lititz Run and the Conestoga River here. The surrounding landscape has been dominated by agriculture, but suburban development is beginning to fill in portions of the area. Limestone quarries also occur in the area.

Species of Concern Considerations:
- Two different sensitive species of concern were documented at the confluence of these two creeks in the 1980's and 1990's, but have not been documented since. These species may utilize slightly different locations up and down this stretch of the waterways every year. An update to these two occurrences is needed to see if either of the species is still using the area. Both of these sensitive species of concern live and breed in the forested habitat along waterways and feed primarily on aquatic organisms in smaller streams and rivers. The core habitat for these sensitive species of concern is both the creek and the adjacent upland forest. These species are apparently not sensitive to human activity as they have been found in urban and suburban settings as long as the appropriate habitat is available. This sensitive species of concern requires abundant food source in the waterways as well as breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of Lititz Run and the Conestoga River and by protecting and expanding the natural forested/vegetated buffer along the creek, its floodplain and all its tributaries.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.
- Only small fragments of natural habitat remain in this area. Most of these narrow strips of forest are highly impacted by edge effects and are considered "modified successional forest". Some of

these remnants appear to be of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as modified successional forest are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers. Within the floodplain of the run and river are small remnant patches of Sycamore (river-birch)-box elder floodplain forest and Silver maple floodplain forest. Wet meadows and pastures within the floodplain can potentially be restored back to floodplain forest or other wetland habitats as appropriate for the topography and hydrology.

Ownership: There are numerous private landowners with parcels of various sizes throughout the area. Fragmentation of ownership of the habitat may limit the potential for consistent conservation habitat management.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture, which in turn was largely replaced by urban and suburban development. Only small isolated pockets of natural vegetation remained to provide habitat for native plants and animals.
- Current –
  - A limestone quarry is active on the banks of the Conestoga River, providing very little buffer between the quarry operation and the river.
  - Major and minor roads cross the Conestoga River and its tributaries including Route 222.
  - Residential development occurs scattered along the Conestoga River and its tributaries.
- Exotic Species –
  - The exotic species composition and threat to this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall: The riparian streamside forests need to be restored all along Lititz Run, the Conestoga River and its tributaries.

- Prevent the conversion of agricultural or natural lands adjacent to Lititz Run, the Conestoga River or its tributaries to residential or industrial development.
- Protect and expand the natural vegetation along the creek floodplain and adjacent upland. Implement the conservation / restoration of a wide strip of native vegetation as a terrestrial habitat corridor along the run and river. Riparian corridors of all stream tributaries to Lititz Run and the Conestoga River in this area need additional restoration measures. Avoid building, replacing or expanding dams on waterways.
- Restoration of vegetated stream buffers along the Lititz Run, Conestoga River and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conestoga River, Susquehanna River and the Chesapeake Bay.

Within the Core Habitat:

- Protect and expand the natural vegetation along all waterways, their floodplains and adjacent upland. Consider expansion of a wide strip of native vegetation as a terrestrial habitat corridor along the shoreline of waterways. Encourage agricultural areas along the banks of the run/river to retreat from the river's edge and to revert to a forested or wetland landscape as is suitable to the topography and hydrology. The forested/vegetated landscape helps to protect the water quality of the small streams that drain through this Natural

Heritage Area into the Susquehanna River and provides refuge and habitat for many species of animals and plants.

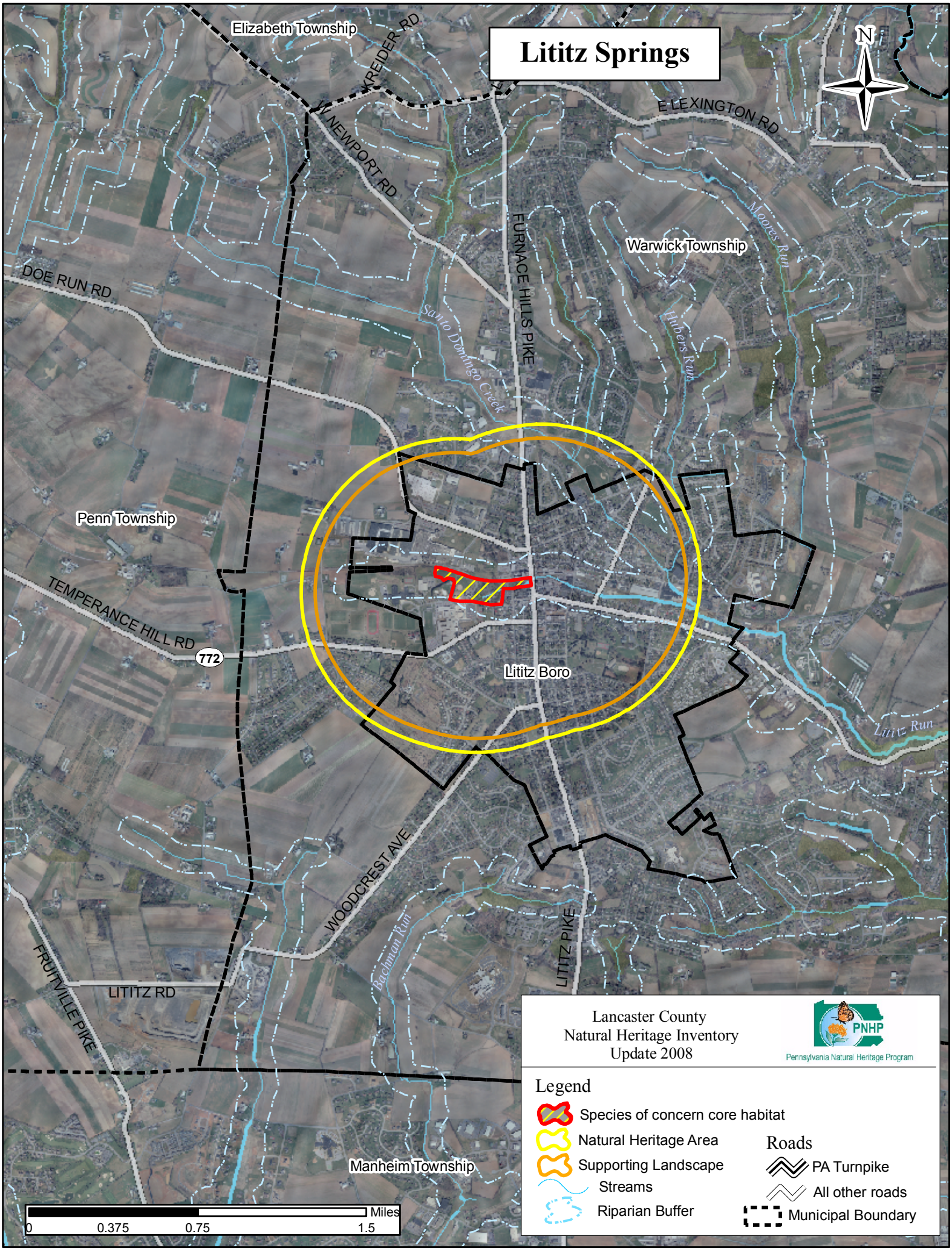
Within the Supporting Landscape:

- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions, especially upstream from the core habitat. Upstream use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the water quality and food chain at this location. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern. The rainwater runoff from the urban, suburban and agricultural areas should be considered a potential source of significant surface water contamination. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.
- Many stretches of streams in this area lack vegetated riparian buffers and are nearly or fully unprotected from urban, residential, agricultural and roadway runoff. Establish at least 100 foot buffer of woody vegetation along waterways through developed areas and a 100 meter buffer outside of areas that have already been highly built up to help protect the water quality of the creek from erosion, sedimentation, and pollution. Additionally, best management practices (BMPs) that focus on limiting nutrient and soil loss into surface and groundwater should be applied to surrounding agricultural lands. This would help maintain and improve water quality in the river. Forested buffers will also help shade the creek, cooling the water temperature, which allows the water to carry more oxygen for a healthier aquatic system.
- The forested floodplain and the adjacent uplands may be an appropriate location for a municipal park serving Manheim and Upper Leacock Townships. Emphasis should be on promoting a viable floodplain natural community along the Conestoga River rather than on active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding areas with native vegetation and restoration and protection of the natural condition of the floodplain.
- Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain of all creeks and streams. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest/natural vegetation cover.
- Growth within the Township should be discouraged to occur within 100 meters of the 100-year floodplain of the Conestoga River or its tributaries.
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary destruction of natural habitat and prime farmland.
    - Many Townships have a Conservation District zoning designation that attempts to preserve open space by restricting the minimum building lot to 2 acres or more. While allowing a veneer of habitat to remain under fully built conditions, these regulations do little to protect the intended resources. It would be better to allow cluster housing on a similar footprint percentage of the area and avoid fragmenting the remaining forested habitat with the infrastructure associated with single family dwellings.

- Restoration:
    - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside

conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.

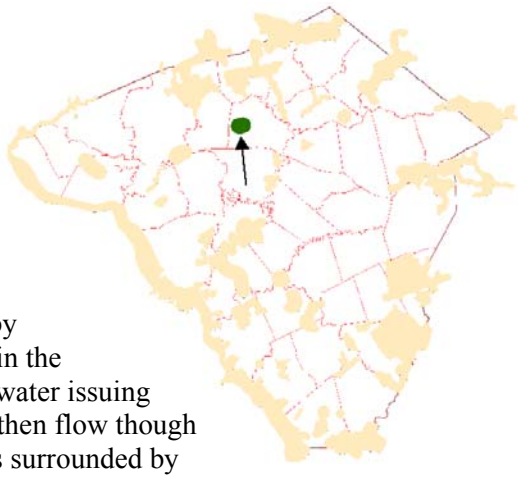
- All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the upland periphery of natural wetland openings.
    - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests as appropriate to the topography and hydrology.
- Riparian buffers:
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain.
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain.


Lititz Springs
N
Elizabeth Township
KREIDER RD
E LEXINGTON RD
NEWPORT RD
FURNACE HILLS PIKE
Warwick Township
Moores Run
DOE RUN RD
Santo Domingo Creek
Hubers Run
Penn Township
TEMPERANCE HILL RD
772
Lititz Boro
Lititz Run
WOODCREST AVE
Bachman Run
LITITZ PIKE
FRUITVILLE PIKE
LITITZ RD
Manheim Township
Miles
0
0.375
0.75
1.5
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary

Lititz Springs – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Price's Cave Isopod (*Caecidotea pricei*)	G5	S2S3	-	1993-02-15	CD

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Lititz Borough
  - Warwick Township
- USGS Quadrangles:
  - Lititz Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Lititz Springs is on private land owned and operated by the Lititz Moravian Congregation and maintained as a public park in the borough of Lititz. The small pond within the park is fed by groundwater issuing from several small cave openings in the limestone bedrock, which then flow though a constructed channel though the park to the pond. The park land is surrounded by residences, schools and businesses in the town of Lititz.

Species of Concern Considerations:
- Pizzini's cave amphipod is a small cave-dwelling crustacean that has been documented among the leaf litter where water issues from the cave openings. The focus of conservation efforts for this species, and the cave habitat as a whole, is the protection of the water quality of the cave. The specific hydrology of underground systems is difficult to determine, but in general, conditions above ground have a significant effect on the habitat underground. Avoid contamination of the groundwater by preventing agricultural, residential, industrial and roadway runoff from entering the system. Specific recommendations for reducing and preventing pollution of the groundwater can be found in various sources including the Urban Subwatershed Restoration Manual Series produced by the Center for Watershed Protection (http://www.cwp.org/index.html)

Forest Cover / Natural Communities:
- The scattered trees within the manicured park setting help provide shade to the area and also contribute as a small patch of habitat for plants and animals.

Ownership: The land that contains the cave openings and springs is privately owned and operated as a public park. The current land use is compatible with this species of concern.

Disturbances:
- Historic – Historic records indicate that several acres of wetlands occurred along the northern side of the springs. The area surrounding these springs has been cleared, cultivated and developed for over 200 years. The natural community that once occupied this area was replaced by the agrarian landscape modifications of the European colonists to provide for food, clothing and shelter including stone walls around the springs, stream and pond.

- Current – The park land surrounding the springs helps to buffer the groundwater from non-point sources of pollution. However, chemical treatments of the park grounds should be avoided to prevent groundwater contamination.
- Exotic Species – The subterranean habitats of the cave-dwelling species of concern at this location are not currently at risk from invasive species.

Conservation Actions:

Overall:

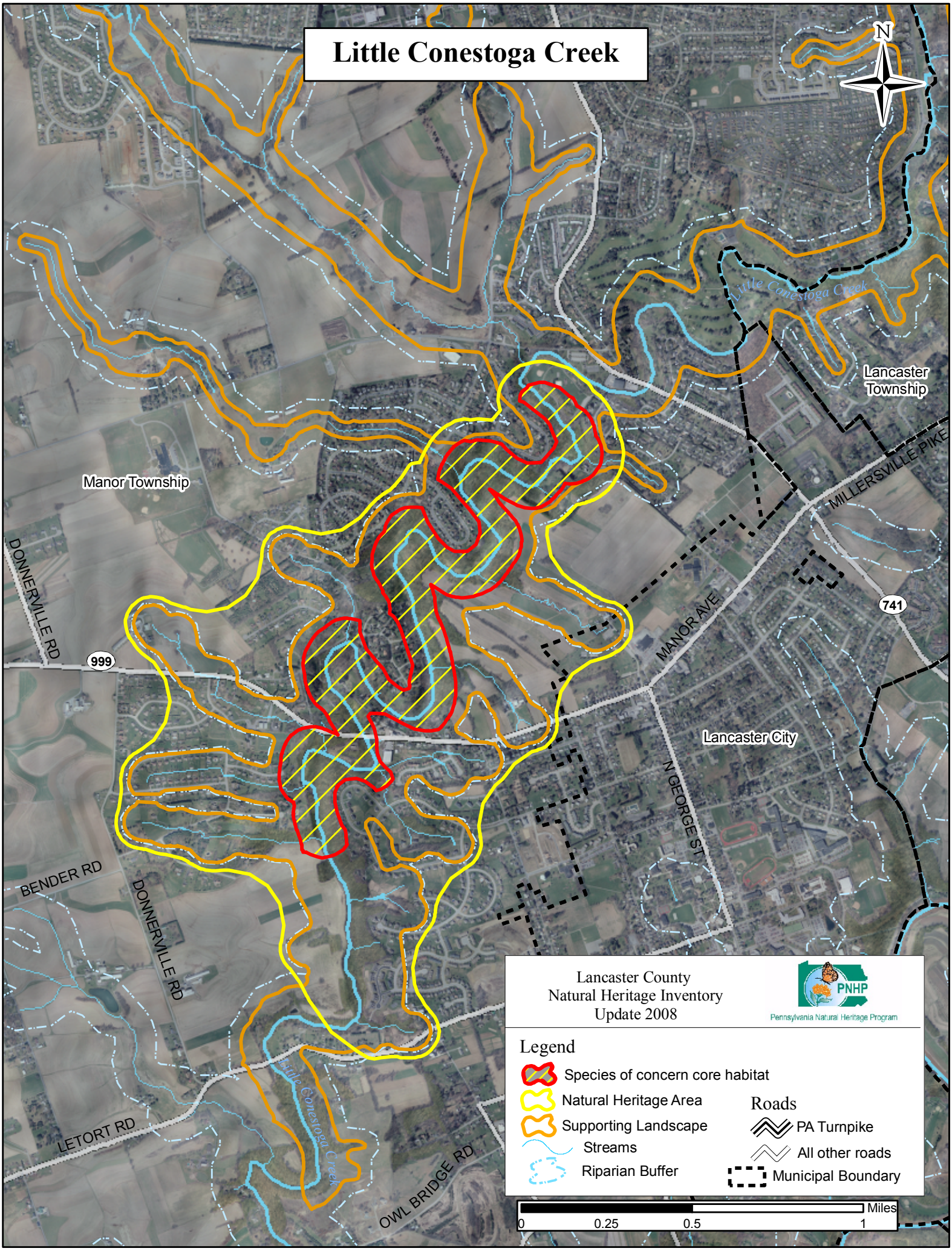
- A long term objective for this habitat should be to protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-swelling species of concern present at this location.

Within the Core Habitat:

- The subterranean habitat of the cave-dwelling species can be considerably impacted from above ground land use decisions. Use of herbicides and pesticides should be avoided within the park grounds and the adjacent school yards. The rainwater runoff from the roofs, roads and parking lots of the adjacent schools and businesses should be considered a potential source of significant groundwater contamination. Runoff from these sources can have significantly higher temperatures and levels of pollutants than runoff filtered through a natural habitat. Stormwater management measures such as creation of detention basins and rain gardens need to be implemented if they are not already in place for these large impervious surfaces.
- The manicured park offers little natural habitat for native species of plants and animals. As trees die, they should be replaced with trees species native to Lancaster County. For the most part, the park lacks a native shrub or herb layer. Portions of the park could be restored to include these stratified native vegetation layers to provide habitat diversity for a wider range of native plants and animals. Restoration of a wetland with native vegetation along the spring and channel would also improve the park for native species.

Within the Supporting Landscape: Since the groundwater recharge area for the cave is largely undetermined, the supporting landscape for this area is derived from a perimeter around the cave opening in alignment with subsurface geology. Activities within the surrounding area can have a direct impact on the subterranean habitat of the species of concern.

- Consider implementing an Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect groundwater resources.
- Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution. Sinkholes, especially within agricultural areas, should be buffered with native vegetation to help slow the flow of water before entering the sinkhole. Water that is reduced in velocity will drop sediment and other heavy particles.
- Retention basins and rain gardens should be implemented to slow and halt the flow of rainwater in urbanized areas with a greater degree of impervious surfaces such as roofs, roads and parking lots. Halting the flow of water by capturing it in retention basins will allow the water to filter though the soil before entering the groundwater.


Little Conestoga Creek
N
Little Conestoga Creek
Lancaster Township
Manor Township
MILLERSVILLE PIKE
DONNERVILLE RD
999
MANOR AVE
741
Lancaster City
N GEORGE ST
BENDER RD
DONNERVILLE RD
Little Conestoga Creek
LETORT RD
OWL BRIDGE RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
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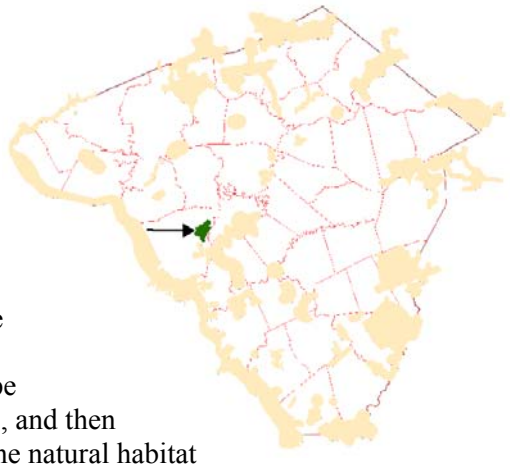
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Little Conestoga Creek – *High significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Animals:					
Sensitive species of concern[3]	G5	S1B	PE	1989-06-02	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area occurs along the Little Conestoga River west of the Borough of Millersville.



- Municipalities:
  - Manor Township
- USGS Quadrangles:
  - Columbia East Quadrangle
  - Conestoga Quadrangle
  - Lancaster Quadrangle
  - Safe Harbor Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: The Little Conestoga River flows though a landscape dominated by urban and suburban development. First agriculture, and then extensive subdivision and development has drastically reduced the natural habitat of the area. Surprisingly, much of the creek though this Natural Heritage Area retains a wide forested buffer.

Species of Concern Considerations:

- The core habitat for this sensitive species of concern is both the Little Conestoga Creek and the adjacent upland forest where it may utilize slightly different locations up and down this stretch of the creek every year. The sensitive species of concern requires abundant food source in the creek and its tributaries as well as breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Little Conestoga Creek and by protecting and expanding the natural vegetation buffer along the creek and all its tributaries. Harassment of nesting locations can cause adults to abandon the site. Additionally, the forested upland area in the core habitat needs to be protected from disturbances during the spring and early summer breeding season. An expansion of the vegetated/forested buffer along the length of the Little Conestoga Creek will help improve water quality and nesting habitat and can be the primary factor for continued success of this species at this location.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- The wooded banks of the creek are dominated by modified successional forest, which is considered a forest type in the early stages of recovery from past disturbances such as farming, grazing or clear cutting. Patches of tuliptree-beech-maple forest also occur in the lower portion of this Natural Heritage Area and could be considered a forest type to emulate for upland streamside restoration. These wooded patches serve as a riparian buffer to the Little Conestoga Creek.

Ownership: The landscape has been highly fragmented and repeatedly subdivided making consistent conservation actions more difficult. Many residential lots are long and narrow, with each parcel retaining a small portion of the creek and its floodplain. Future subdivision plans should provide for preservation of a 100 meter buffer from the creek floodplain, or a 100 foot buffer where development has already precluded this option.

- Manor Township owns several key parcels of floodplain along the Little Conestoga Creek. Together, they begin to form a linear park along the length of the portion of the creek.
- Several larger parcels are still actively farmed. Conservation easements on a 100 meter buffer from the creek's floodplain should be a top conservation goal for these parcels.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture, which in turn was largely replaced by urban and suburban development. Only small isolated pockets of natural vegetation remained to provide habitat for native plants and animals.
- Current –
  - The formerly agricultural landscape surrounding Little Conestoga Creek has been almost entirely converted to suburban development. Nearly all of the open space between Lancaster City and the small town of Millersville has been subdivided and developed. The area between Lancaster City and Columbia is also quickly filling in.
  - In the absence of vegetated/forested streams and creeks, both agricultural activities and suburban development severely degrade water quality entering the surface water and ground water.
  - Agricultural activities present extreme modifications to the environment, but urban/suburbanization typically represents a more permanent habitat erasure.
  - Many small properties each contain a portion of the creek bank or floodplain. Many properties have removed most of the vegetation within the floodplain, converting the area into a lawn.
  - With the amount of natural habitat lost, first to agriculture, then to suburban development, the value of the currently forested riparian corridors along the Little Conestoga should be fully appreciated for the many services it provides to the residents of the area.
- Exotic Species –
  - Narrow corridors in disturbed surroundings are frequently highly invaded with aggressive introduced plants, which will require dedicated persistent action to give native species a chance to compete.

Conservation Actions:

Overall: The long term goal for the area should be to conserve/restore the mature floodplain forests and the associated upland buffer forests along both shores of the Little Conestoga Creek and it s tributaries. Reforestation efforts should be designed to mimic the adjacent natural community type in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.

Within the Core Habitat:

- Establish a corridor of naturally vegetated public space within 100 meters of the creek's edge or 100 feet where development has already precluded this option. Fragmentation of ownership of the habitat limits the potential for consistent conservation habitat management.

- The forested floodplain along this stretch of the Little Conestoga Creek could be an appropriate location for a linear nature park as an extension of Manor Township Park. Emphasis should be on promoting a viable floodplain natural community and its adjacent upland forest rather than on active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protection and expansion of areas with native vegetation and restoration and protection of the natural condition of the floodplain. Any trails constructed though the area should stay at least 50 feet from the creek banks to avoid degrading the fragile shoreline.
- Incorporate the public space/ natural corridor into future subdivision development plans along the creek and its tributaries.
- Restoration of vegetated stream buffers along the creek and its tributaries will help increase the quality of the habitat and food source for the species of concern and other native plants and animals while improving water conditions for the County, the Susquehanna River and the Chesapeake Bay.
- Minimize or eliminate mowing within 100 feet of the creek floodplain. Properties abutting the creek floodplain should be encouraged to restore native tree, shrub and herbaceous vegetation.
- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions. Storm water runoff through urban areas can be a significant source of chemical pollutants for the creek, which can severely impact water quality and the food chain of the waterway. The use of herbicides, pesticides and fertilizers in agricultural production can also have a significant impact on the water quality at this location. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to slow and capture water flow in these expanses of urban and cultivated landscapes. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern.
- Residents that live within the supporting landscape should keep in mind the effect their everyday actions has on the natural habitat that adjoins or includes part of their property.
    - Domestic pets (cats and dogs) can take a significant toll on native animals. Pets should be kept indoors, on leashes or within enclosed yards.
    - Trails for all-terrain-vehicles can fragment the landscape, damage understory vegetation and disrupt wildlife. ATV trails through the area should be blocked and their use discouraged or prohibited.
    - Individual households can be a significant source of pesticide, herbicide, nutrient and other chemical runoff entering the streams and creeks. Minimize the use of yard chemicals and watering by using native species of plants that are already adapted to the local growing conditions. Native plants in the yard can help increase the available habitat for native plants and animals, especially native birds and insect pollinators.
    - Municipal sewage and residential septic systems may need to be upgraded to help improve water quality.
    - Yard waste dumped into or near natural areas can be a significant source of invasive species of plants.
    - Even outdoor lighting can affect the quality of the natural habitat for native animals. Street and residential lighting should have shielding to direct lights downward. Unnecessary outdoor lighting should be minimized or eliminated.

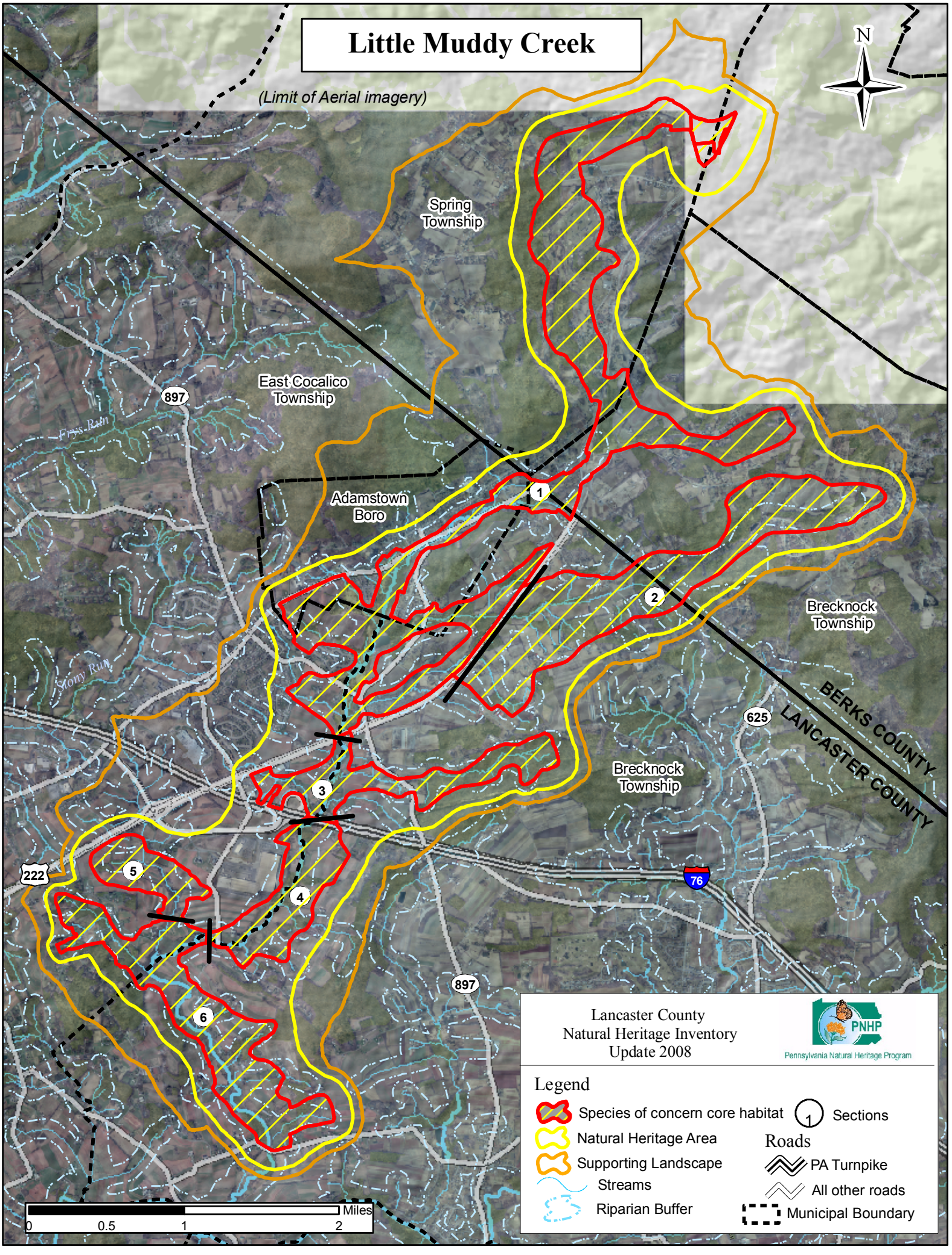
<u>Within the Supporting Landscape</u>:

- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- The rainwater runoff from the roofs, roads and parking lots of the adjacent residences, schools and businesses should be considered a potential source of significant surface and

groundwater contamination. Runoff from these sources can have significantly higher temperatures and levels of pollutants than runoff filtered through a natural habitat. Storm water management measures such as creation of retention basins and rain gardens can be incorporated into Municipal infrastructure to allow storm water to be slowed and filtered before entering the creek from road crossings and other breaks in the vegetated buffer. Restoration of vegetated stream buffers along Little Conestoga Creek and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the creek, Susquehanna River and the Chesapeake Bay.

- The floodplain and the adjacent forested uplands would be compatible with a linear municipal nature park. Manor Township already owns several key parcels along the creek and additional conservation easements on the largest parcels could provide much of the additional corridor. Any subdivision plans for areas adjacent to the creek or its tributaries should include a provision to protect the floodplain and a 100 foot forested/vegetated buffer as a public natural space.
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way especially along the creek shoreline and any remaining natural habitats. These natural habitats provide a significant filter for runoff entering the river from the adjacent uplands.
- Logging of wooded areas, specifically within 100 feet of the creek floodplain would be damaging to the watershed. The amount of impervious surfaces around the creek can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the creek.
  - Pursue conservation easements and fee simple acquisition on properties adjacent to the creek floodplain, the adjoining slopes and neighboring farmlands to help improve the effectiveness of the Conestoga River as a habitat and natural corridor.
  - Zoning options for conservation enhancement:
    - Manor Township has a zoning ordinance restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat. Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - In addition, building should be restricted from the 100-meter riparian buffer where the property is currently undeveloped or from the 100-foot riparian buffer where development has already precluded this option.
    - Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest/natural vegetation cover.
    - Rezone areas within the 100-foot riparian buffer as Urban Open Space (UG-OS).
    - Currently, several large agricultural parcels with a narrow meandering tributary are zoned light industrial (UG-I1). These parcels lie east of Centerville Road and north of Charlestown Road. The zoning should be modified to exclude the 100 meter riparian buffer areas from the industrial zone. In addition, the portion of the parcels south west of the tributary should be rezoned as Agricultural Resource (RR-AR) similar to the parcels west of Centerville Road.
    - Growth within the Township should be discouraged to occur within 100 meters of the recommended riparian buffer of the Little Conestoga Creek or its tributaries.
    - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction.
- <u>Restoration</u>:

- Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
- All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
- Three historic milldams occurred along this portion of the Little Conestoga Creek. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts.
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
        - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
    - Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
    - Ideal forested stream buffers should be 100 meters in width from the edge of the 100-year floodplain
        - Include adjacent wetlands
        - Add a buffer equal to the width of the wetland
        - Slopes over 25% should not count toward the buffer
        - Non-porous surfaces should not be included in the buffer calculation
    - Intermediate forested buffer of 100 feet from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet from creek bank

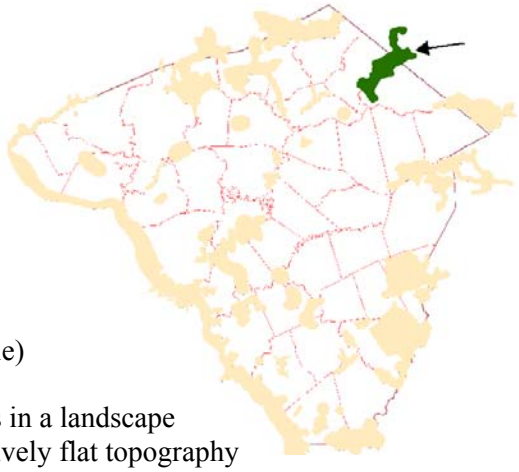

Little Muddy Creek
(Limit of Aerial imagery)
N
Spring Township
East Cocalico Township
Adamstown Boro
Brecknock Township
Brecknock Township
BERKS COUNTY
LANCASTER COUNTY
897
897
222
625
76
1
2
3
4
5
6
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Sections
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
2

Little Muddy Creek – *High significance*					
Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Sensitive species of concern [3]	-	-	-	2001	BC

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area spans the boundary between Brecknock and East Cocalico Townships in Lancaster County and also extends into Chester County.

- Municipalities:
  - Adamstown Borough, (Lancaster County)
  - Brecknock Township, (Lancaster County)
  - East Cocalico Township, (Lancaster County)
  - Brecknock Township, (Berks County)
  - Spring Township, (Berks County)
- USGS Quadrangles:
  - Sinking Spring Quadrangle
  - Terre Hill Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Adamstown Marsh - SA503" (Terre Hill Quadrangle)



Description: This portion of the Little Muddy Creek watershed is in a landscape that has long been dominated by agricultural activities. The relatively flat topography of the region, while being conducive to agriculture, also allows water to pool in low lying areas, creating wetlands of varying types. Historically, wetlands likely existed at most locations where the floodplain widens, or where water exits the ground at a spring. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries, but some remain or have recovered from a cessation of these activities. These wetland fragments should be considered the backbone for a restoration of this habitat type in the Little Muddy Creek watershed.

Species of Concern Considerations:
The sensitive species of concern inhabiting these shallow wetlands require specific plant communities with a matrix of open canopied habitats. The reestablishment of the open canopy marshes and wetlands in appropriate locations along all tributaries within this watershed would help improve suitable habitat for these species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The natural communities within this area include:
  - Terrestrial (upland) communities:
    - Hemlock-tuliptree-birch forest
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - Red maple terrestrial forest

        - modified successional forest*
        - juniper-hardwood woodland*
        - juniper woodland*
        - juniper-mixed shrub woodland*
        - juniper-grass woodland*
        - grass-shrubland*
        - grassland*
    - Palustrine (wetland) communities:
        - Hemlock-mixed hardwood palustrine forest
        - Sycamore (river birch)-box elder floodplain forest
        - Red maple-black gum palustrine forest
        - Red maple-mixed shrub palustrine woodland
        - Red maple-sedge palustrine woodland
        - Tussock sedge marsh
        - Bluejoint-reed canary grass marsh
        - Cattail marsh
        - wet meadow*
- The natural habitats within this area are primarily small scattered fragments within a landscape dominated by agricultural activity. The fragments that remain are mostly narrow strips along the banks of streams, forming the framework of riparian corridors. Some of these remnants are considered of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the watershed.
- Areas identified as "Fike types" could be considered potential reference communities when restoring habitats in similar topographic and hydrologic settings. Those identified as "modified successional forest" are typically in an early stage of recovery from past disturbances such as agricultural activity or repeated logging. These habitats are often heavily infested with invasive species of plants and will require long term active management to help accelerate the recovery process. Invasive species control and encouragement of native species regeneration are the primary activities necessary to help these habitats recover.

Ownership: While the ownership of the portion of this Natural Heritage Area in Chester County is unknown, the area within Lancaster County is entirely in private ownership. Most of the parcels are relatively large and maintained in agricultural production. Future ownership fragmentation along the banks of the many tributaries of Little Muddy Creek may impede future conservation actions. Conservation action along the creek corridor should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
    - The landscape within this Natural Heritage Area was cleared of most of its original forest cover and the wetlands drained or dammed to accommodate the expansion of intensive agriculture that we see today.
    - Based on aerial photos from 1940, some natural vegetation remained in the landscape including wide vegetated floodplain corridors, and on top of diabase bedrock that helped to provide habitat for native plants and animals.
    - Several milldams were active within this portion of the Little Muddy Creek watershed. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Many of these stream reaches of the Little Muddy Creek watershed remain trapped in these deep narrow channels.

- Current –
  - Agriculture, road building and suburban sprawl have further reduced the naturally vegetated portions of this area since 1940, limiting the potential natural habitat for native plants and animals.
  - Roads crisscross the landscape, including the Pennsylvania Turnpike and Route 222, both of which can be an impenetrable barrier for many species of animals, effectively disconnecting the habitat on either side of the road.
- Exotic Species – The invasive species concerns for this area are not known. The natural disturbance of seasonal flooding in conjunction with agricultural clearing and road building activities creates ideal conditions for many introduced species of plants. Consequently, the creek floodplain and roadsides in this area are prone to invasion from a large number of invasive species.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as an expansive wetlands complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented in this stretch of Little Muddy Creek in the near future if they don't already exist here.

Within the Core Habitat:

- Long term goals of this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were compatible with the species of concern found at this site.
- The sensitive species of concern known from this Natural Heritage Area would benefit from habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
  - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
  - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
  - Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be explored, in order to recreate the natural flows of the landscape.
  - Because the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within in this Natural Heritage Area.

- Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.

- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the several branches of Little Muddy Creek:

Stream section ID	Recommendation				
	1	2	3	4	5
1	A	B	C	D	I
2	A	B	C	D	I
3	B	I			
4	A	B	C	D	F
5	C	H	I		
6	A	B	C	F	

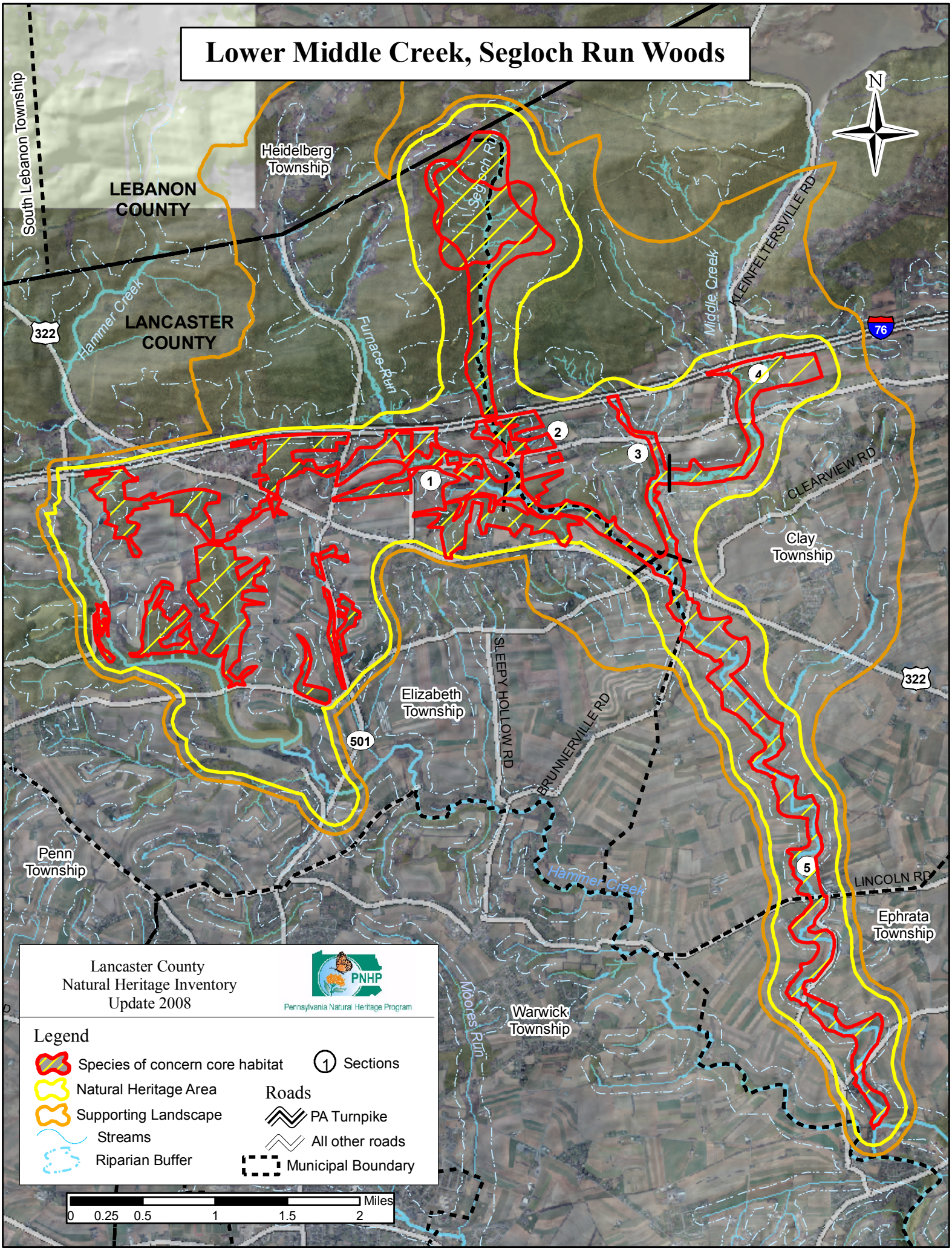
A. The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced, rather, their basins should naturally revert to their original condition.
B. Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
C. Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
D. Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
E. Current land use is compatible with this section; sparsely pasturing animals in this area could benefit the habitat.
F. Legacy sediments should be removed above the former mill dam.
G. Any remaining railroad tracks that may exist along the abandoned railway corridor should be removed.
H. The heavy agriculture in portions of this area should be allowed to revert back to natural drainages; light to moderate grazing in this area would be compatible.
I. The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- There are multiple landowners that own the property within this Natural Heritage Area. Pursue conservation easements, fee simple acquisition and other programs that may restore the wetlands on properties along the branches of Little Muddy Creek to help conserve and improve its effectiveness as a natural corridor.
- Avoid subdivision of large parcels as this would likely impede broad conservation initiatives. Agricultural zoning is compatible with this Natural Heritage Area.
- Restore and enhance habitat connections between the north and south sides of the PA Turnpike and Route 222. This could be achieved by the construction of green underpasses, overpasses and culverts to allow for more successful animal migration. Restoration at key locations can help re-establish the migratory corridor function to the landscape.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into natural vegetation cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
- Reestablishment of the wide floodplain and its associated wetlands, swamps and wet meadows would serve as an effective buffer to flooding that may occur downstream.
- Brecknock and Caernarvon Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. In addition, Caernarvon Township includes the 500-year floodplain and alluvial or floodplain soils in the definition of floodplain area. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat. Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application

within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.

- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal vegetated stream buffers should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
    - A minimum vegetated buffer should me at least 35 feet in width from the edge of the 100-year floodplain.

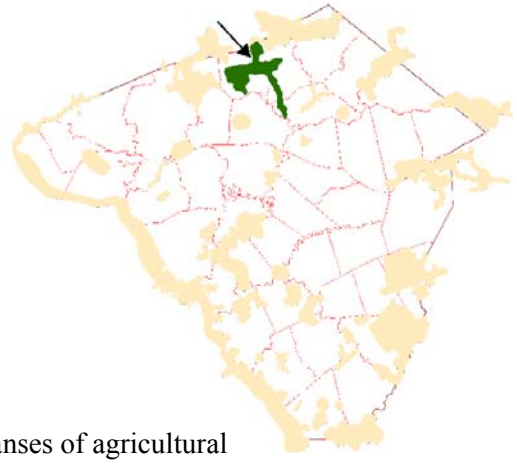

Lower Middle Creek, Segloch Run Woods
N
South Lebanon Township
LEBANON COUNTY
Heidelberg Township
LANCASTER COUNTY
Hammer Creek
322
Furnace Run
Segloch Rd
Middle Creek
KLEINFELTERSVILLE RD
76
4
2
3
1
CLEARVIEW RD
Clay Township
322
SLEEPY HOLLOW RD
BRUNNERVILLE RD
Elizabeth Township
501
Penn Township
Hammer Creek
5
LINCOLN RD
Ephrata Township
Moores Run
Warwick Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Sections
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.25 0.5 1 1.5 2

Lower Middle Creek, Segloch Run Woods– *Exceptional significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bog bluegrass (*Poa paludigena*)	G3	S3	PR	2001-05-30	BC
American Holly (*Ilex opaca*)	G5	S2	PT	2001-05-30	D
Animals:					
Tawny Emperor (*Asterocampa clyton*)	G5	S3S4	-	1997-07-12	E
Baltimore Checkerspot (*Euphydryas phaeton*)	G4	S2S4	-	1999-06-26	E
Black Dash (*Euphyes conspicuous*)	G4	S3	-	1999-06-26	E
Giant Swallowtail (*Papilio cresphontes*)	G5	S2	-	1999-06-06	E
Mulberry Wing (*Poanes massasoit*)	G4	S3	-	1997-07-12	E
Coral Hairstreak (*Satyrium titus*)	G5	S3S4	-	1999-06-26	E
Southern Cloudywing (*Thorybes bathyllus*)	G5	S3S4	-	1997-07-12	E
Sensitive species of concern [3]	-	-	-	2006-06-01	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area includes most of the Middle Creek watershed between the PA Turnpike and where Middle Creek meets Cocalico Creek. The western edge of this area includes Speedwell Forge Lake County Park, while the northern portion is part of State Game Lands #46.

- Municipalities:
  - Clay Township
  - Ephrata Township
  - Elizabeth Township
- USGS Quadrangles:
  - Ephrata Quadrangle
  - Lititz Quadrangle
  - Richland Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Hopeland – SA513" – (Lititz Quadrangle)
  - "Segloch Run" – (Richland Quadrangle)
  - "Speedwell Forge" – (Lititz Quadrangle)



Description: This Natural Heritage Area is made up of large expanses of agricultural fields interspersed with a mosaic of woodlots and wetlands associated with the network of streams feeding into Middle Creek. Historically, wetlands likely existed at most locations where water exits the ground at a spring or where the floodplain widened. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries, but some remain or have

recovered from a cessation of these activities. These wetland fragments should be considered the backbone for a restoration of this habitat type in the Middle Creek watershed.

Species of Concern Considerations:

Plants:

- Bog bluegrass is a globally rare species that grows in swamps, seepy woods, and along spring-fed streamlets. The viability of populations of bog blue-grass and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. The areas supporting populations should be managed in a way that ensures the continuation of excellent water quality and neutral or calcareous water chemistry. At this location along Segloch Run, preserve the forested canopy and hydrology of seepy habitats feeding the stream.
- American holly grows on wooded slopes and streambanks. In Pennsylvania, it is near the northern end of its range, and occurs mostly in the southeastern counties. It has also been grown as an ornamental, particularly in the southeastern counties, and may escape locally to woodlots, thickets, and fencerows. The conservation of American holly in Pennsylvania has concentrated on protecting populations that are believed to be indigenous and that represent native genotypes. Occurrences of the species that have resulted from escapes from plantings are of uncertain genetic origin and are considered to be of much lower conservation significance. As a woodland species, proper forest management and control of invasive species are important for the long term viability of American holly. Gathering of the branches of wild trees for winter decoration should be discouraged

Animals: Seven butterfly species of concern were documented among a total of 33 species identified during a Fourth of July butterfly count, which has been held annually for five years in the Brickerville area.

- The Tawny emperor butterfly can be found in thickets, watercourses, ridge tops, woodland edges and clearings, fencerows, and parks where it is closely associated with hackberry trees. Two broods occur in most of this species' range. Mature caterpillars occur in May and June, then again in July and August. Adults occur mostly June through July and August through early September. Since the larvae overwinter in leaf litter, don't rake around hackberry trees to help improve habitat for this species.
- Black Dash is associated with wet meadows and fresh-water marshes. Presence of swamp milk-weed is a good indicator. Larval host plants are sedges (*Carex spp*).
- Baltimore checkerspot had formerly been considered scarce and local in damp meadows with stands of turtlehead. It appears to have increased in some areas where larvae feed on introduced English plantain. The preferred habitat for this species is wet meadows, open floodplains, and less commonly, fields. The larval host plants include turtlehead (*Chelone glabra*), which is favored for egg laying, but plantain (*Plantago*) and yellow foxglove (*Aureolaria = Digitalis*) are also used.
- Giant Swallowtail larvae feed on prickly ash (*Xanthoxylum americanum*) and hop tree (*Ptelia trifoliata*), which are closely linked to calcareous (limestone) substrates. Preferred habitat for this species is shrubby areas containing these plants. The residue from a commonly used insecticide, Bt (*Bacillus thuringiensis*) is very lethal to this species
- Mulberry Wing is associated with wet meadows, open freshwater marshes, fens, or bogs. The larval host plant includes sedges (*Carex spp.*)
- Coral Hairstreak is associated with cherry, chokeberry, and other members of the rose family (Rosaceae), which are the preferred larval host plants for this species.
- Southern Cloudywing is associated with a wide variety of open situations, especially dry fields with low brushy areas where adults like to perch. Larval host plants include native bush clovers (*Lespedeza spp.*) and other legumes.

- The sensitive species of concern inhabiting these shallow wetlands requires specific plant communities with a matrix of open canopied habitats. Conservation and reestablishment of the marshes along Middle Creek and its tributaries will help to provide the necessary habitat for the continued survival of this species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The landscape along this portion of Middle Creek and its tributaries is a mixture of agricultural fields, woodlots and, in the upper reaches of Speedwell Forge Lake, a mosaic of wetlands, forested wetlands and floodplains. North of the PA Turnpike, Segloch Run passes though a large area of interior forest.
- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Hemlock (white pine)-red oak-mixed hardwood forest
  - Tuliptree-beech-maple forest
  - Red oak-mixed hardwood forest
  - Dry oak-mixed hardwood forest
  - Red maple terrestrial forest
- Palustrine (wetland) communities:
  - Red maple-black gum palustrine forest
  - Sycamore (river birch)-box elder floodplain forest
  - Red maple-mixed shrub palustrine woodland
  - Black willow scrub/shrub wetland
  - Tussock sedge marsh
  - Bluejoint-reed canary grass marsh
  - Cattail marsh
  - shrub wetland*
  - shrub-emergent wetland*

Ownership:

- Most of the area is held in large agricultural parcels. Ownership fragmentation of large forested parcels and along the floodplains of Hammer Creek, Furnace Run, Middle Creek and Segloch Run and their tributaries may impede future conservation actions. Conservation action along these riparian corridors should be set in motion before ownership fragmentation makes this process more difficult.
- North of the PA Turnpike, most of this Natural Heritage Area is managed as State Game Lands #46.
- A portion of Speedwell Forge County Park occurs along the western edge of this Natural Heritage Area.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of most of its original forest cover and the wetlands drained or dammed to accommodate the expansion of intensive agriculture that we see today. Little natural vegetation remained south of the PA turnpike to provide habitat for native plants and animals. Many streams in the area were cultivated right to the banks of the stream, allowing sediment and nutrients to flow directly into waterways.

- Numerous milldams were active along Middle Creek and its tributaries, especially Hammer Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Many of these stream reaches within the watershed remain trapped in these deep narrow channels.

o Current –

- The construction of the Speedwell Forge dam flooded the Hammer Creek Valley, submerging quality floodplain and wetland habitats to create a lake. The headwater area of the lake has since become a valuable wetland habitat complex.
- Mary areas formerly in agricultural production have since been converted to other uses. Residential development has expanded along major roads, adjacent to Brickerville and Hopeland, next to Speedwell Forge Lake as well as the Mountain View Mobile Home Park.
- Roads crisscross the landscape, including the Pennsylvania Turnpike, which effectively severs the headwaters habitat of Furnace Run, Segloch Run and Middle Creek from sections south of the turnpike.
- Many streams in the area are still cultivated right to the banks of the stream, allowing sediment and nutrients to flow directly into waterways.

o Exotic Species – The natural disturbance of seasonal flooding in conjunction with agricultural clearing creates ideal conditions for many introduced species of plants. Consequently, the creek floodplain is prone to invasion from a large number of invasive species.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands within the floodplain of the streams and creeks. Improve the filtering capacity of the riparian buffer by establishing a broad strip of native woody vegetation beginning at the upper edge of the floodplain. Open wetlands and wet meadows within the area should be maintained in an open condition. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site.

Within the Core Habitat:

- Long term goals of this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were compatible with the species of concern found at this site.
- All of the species of concern that have been lost from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
  - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
  - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high

financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
  - Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be encouraged, in order to recreate the natural flows of the landscape.
  - Because many of the species of concern noted from this area rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within this Natural Heritage Area.
  - Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.
- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the many branches of Middle Creek:

(Refer to Lower Middle Creek Sections map)

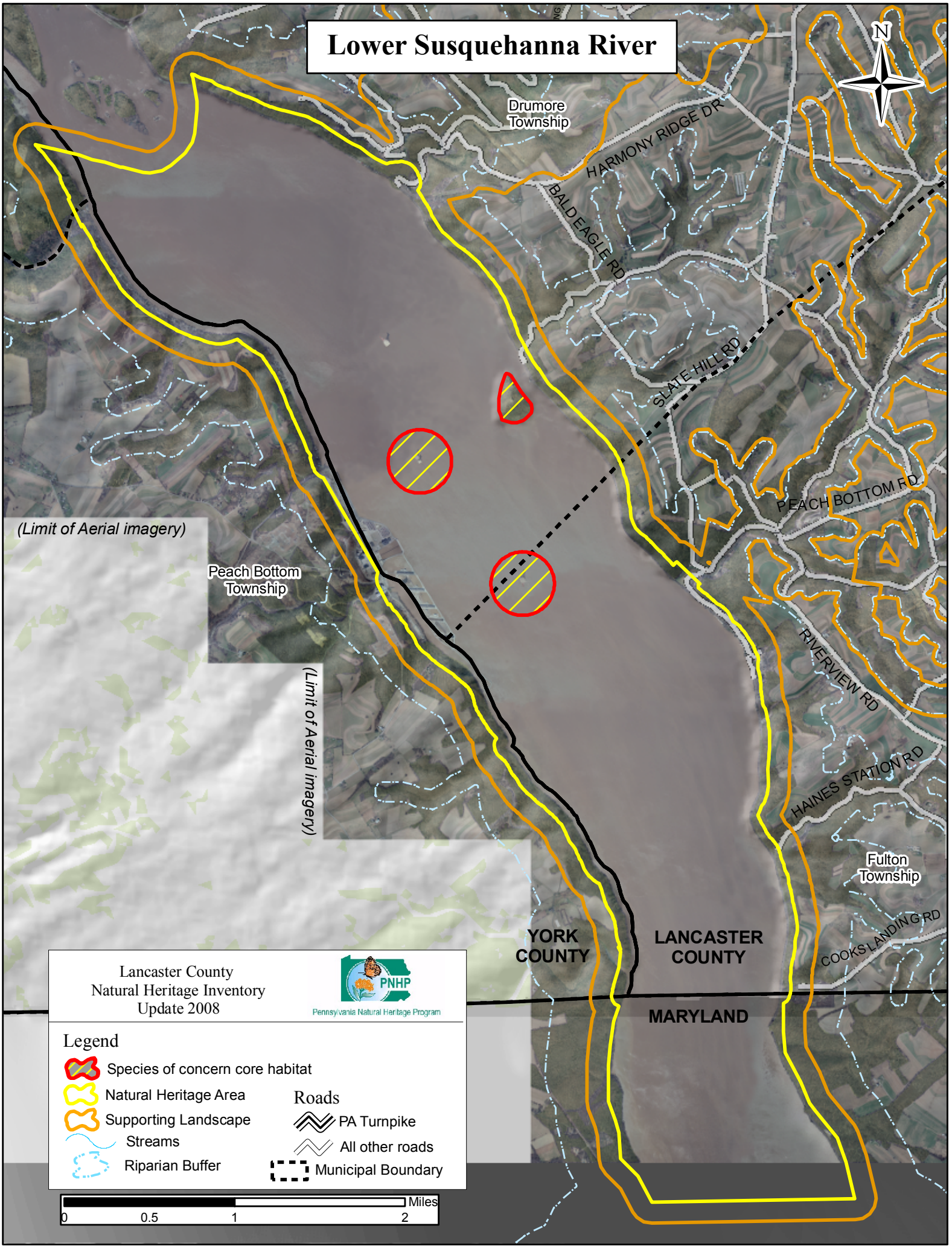
Stream section ID	Recommendation				
	1	2	3	4	5
1	A	B	C		
2	A	B	C	D	
3	B				
4	C	F	B		
5	F	H	B	C	

A. The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced; rather, their basins should naturally revert to their original condition.
B. Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
C. Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
D. Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
E. Current land use is compatible with this section; sparsely pasturing animals in this area could benefit the habitat.
F. Legacy sediments should be removed above the former mill dam.
G. Any remaining railroad tracks that may exist along the abandoned railway corridor should be removed.
H. The heavy agriculture in portions of this area should be allowed to revert back to natural drainages; light to moderate grazing in this area would be compatible.
I. The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- There are multiple landowners that own the property within this Natural Heritage Area. Pursue conservation easements, transfer of development rights, fee simple acquisition and other programs that may help preserve and fund restoration activities of the wetlands on properties along the branches of Middle Creek and its tributaries to help conserve and improve its effectiveness as a natural corridor.
- Restore and enhance habitat connections between the north and south sides of the PA Turnpike. This could be achieved by the construction of green underpasses, overpasses and culverts to allow for more successful animal migration. Restoration at key locations can help re-establish the migratory corridor function to the landscape.
- Avoid subdivision of large parcels as this would likely impede broad conservation initiatives. Agricultural zoning is compatible with this Natural Heritage Area.

- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into natural vegetation cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
- Reestablishment of the wide floodplain and its associated wetlands, swamps and wet meadows would serve as an effective buffer to flooding that may occur downstream.
- Clay, Ephrata and Elizabeth Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. In addition, Clay Township also includes the 500-year floodplain and lands containing alluvial or floodplain soils in its floodplain district. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - In addition, the floodplain regulation should remove farm pond construction from its list of permitted uses.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal vegetated stream buffers should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
    - A minimum vegetated buffer should me at least 35 feet in width from the edge of the 100-year floodplain.


Lower Susquehanna River
N
Drumore Township
HARMONY RIDGE DR
BALD EAGLE RD
SLATE HILL RD
PEACH BOTTOM RD
(Limit of Aerial imagery)
Peach Bottom Township
(Limit of Aerial imagery)
RIVERVIEW RD
HAINES STATION RD
Fulton Township
COOKS LANDING RD
YORK COUNTY
LANCASTER COUNTY
MARYLAND
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
2

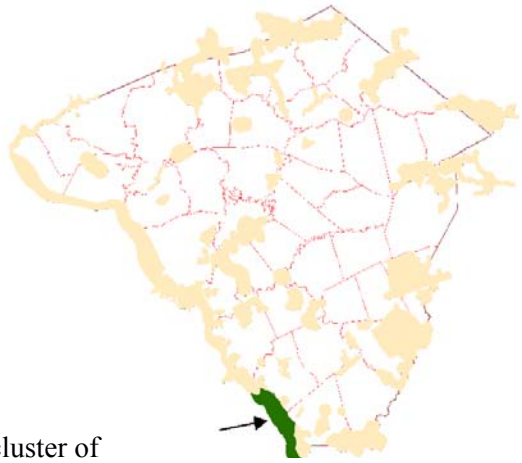
Lower Susquehanna River – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Sensitive species of concern [3]	-	-	-	2000-07-12	C
Animals:					
Osprey (*Pandion haliaetus*)	G5	S2B	PT	2004-06-07	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area includes the section of the Susquehanna River south of the Conowingo Islands below the Holtwood Dam to the Pennsylvania / Maryland border.

- Municipalities:
  - Drumore Township, (Lancaster County)
  - Fulton Township, (Lancaster County)
  - Peach Bottom Township, (York County)
  - Cecil & Harford Counties, Maryland
- USGS Quadrangles:
  - Conowingo Dam Quadrangle
  - Delta Quadrangle
  - Holtwood Quadrangle
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SA592" (Holtwood Quadrangle)



Description: This Natural Heritage Area does not include the cluster of islands and bedrock outcrops just south of the Holtwood Dam, but instead focuses on the flat water area between the Conowingo Dam in Maryland and the first dam on the Susquehanna River in Pennsylvania at Holtwood, referred to as Conowingo Reservoir. The slow, open water is popular for recreational boating activities. This portion of the river has only a few small islands that remain after the flooding of this portion of the river by the construction of the Conowingo Dam in Maryland. The upland shoreline on both sides of the river within 300 meters of the river's floodplain is included within this area.

Species of Concern Considerations:

Plants:

- The sensitive plant species at this location typically grows on dry, open, rocky ground, such as on shale barrens, slopes, and cliffs. Occurrences of this species and its habitat are threatened by human-related habitat loss, natural succession, invasive species, quarrying, and the collection of wild plants by gardeners. Because of the preference of the species for sunny conditions, active management – such as fire or invasive species removal - may be required to maintain the proper successional stage and ecological conditions.

Animals:

- The man-made lake on the Susquehanna River formed by the Conowingo Dam provides habitat for a nesting pair of Ospreys. These birds adapt readily to human activity and often construct nests on man-made structures (Brauning 1992). Being primarily fish eaters, Ospreys utilize aquatic habitats for food gathering and upland habitats or prominent features as nesting areas.

The forested edge of the river and the large body of flat water are both important components of the Osprey's habitat preferences.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Most of this Natural Heritage Area is the open water of the Susquehanna River, but is also includes the forested slopes adjacent to the river. The natural communities delineated for this area include:
    - Hemlock-tuliptree-birch forest
    - Tuliptree-beech-maple forest
    - Red oak-mixed hardwood forest
    - Dry oak-heath forest
    - modified successional forest*
    - shrubland*
- Areas identified as modified successional forest are considered an early stage of recovery from disturbance from past agricultural activity, repeated logging or other intensive land uses. In time, these areas can return to more mature conditions. The process of natural succession can be assisted by invasive species removal, selective removal of early successional trees and reducing deer populations to allow native trees to grow above the browse line. Forest restoration efforts should strive to mimic nearby high quality natural communities in a similar topographic and hydrologic position.

Ownership:

- Norfolk Southern Rail Corp owns an active railroad rights-of-way along the eastern shore of the river.
- Lancaster County Conservancy owns the adjacent Ferncliff
- PECO Energy Corp / Exelon owns Mount Johnson Island, the only sizable island in this portion of the river, much of the uplands adjacent to the river and utility rights-of-way leading east and west across the river.
- Except for the residential lots associated with the towns of Peach Bottom and Fishing Creek, most of the area on the Lancaster County side of the river is held in relatively large parcel size.

Habitat Disturbances:

- Historic –
    - Water quality of the river was severely degraded by direct pollution from sewage, industry, mining, agriculture and was exacerbated by the removal of most of the forest canopy within the upstream watershed at the turn of the century.
    - Conowingo Dam was built across the Susquehanna River in the 1930s for electric power generation forming what is referred to as Conowingo Reservoir. The construction of the dam has resulted in the long-term flooding of the original riverine habitat. This large, nearly still portion of the river significantly differs from the original hydrology of the river that was much more influenced by the natural disturbances of seasonal flooding and ice scour. A number of islands and bedrock outcrops were permanently flooded as water backed up behind the dam. The original shoreline of the river was also permanently flooded. This modification of the river environment likely permanently flooded seasonally shallow water habitats that would likely have supported plants and animals in similar habitats potentially including species of concern. Much of the silt and other particulates transported by erosion in the Susquehanna River watershed settle to the riverbed as the swifter river water enters the slow waters of Conowingo Reservoir. This deposition of material will eventually fill all the space behind the dam.

- The construction of many smaller dams on the Susquehanna River and its tributaries in the early 1800s severely reduced the American shad and other anadromous and catadromous fish from much of their traditional spawning streams. Many dams were breached in the late 1800s and the shad migration temporarily resumed. The construction of the series of four large hydroelectric dams on the Susquehanna River between 1904 and 1932 eliminated the American shad from the upper reaches of the Susquehanna almost to the close of the 20th century. Fish trap and transport programs implemented during the 1970s moved fish upriver by trucks in an effort to bolster shad populations. Improved fish ladders were constructed on the Conowingo, Holtwood, Safe Harbor and York Haven dams in the 1990s to reopen the upper Susquehanna River for shad spawning.
- With the elimination of anadromous and catadromous fishes from much of their historic range in the Susquehanna watershed, several species of freshwater mussels, which depend on suitable fish hosts for a portion of their lifecycle, also experienced declines. The total range of fish hosts for several mussel species is clearly understood, but recent studies indicate that the American eel may have been an important host for several mussel species. Since the eel is eliminated from much of the Susquehanna River, this may have led to considerable declines in native mussel populations.
- The railroad was built along the east shore of the Susquehanna River.
- The native forests were replaced by agricultural fields on much of the flat terraces overlooking the Susquehanna River. Active agricultural fields crowd the slopes of the Susquehanna River in several places.

o Current –

- The Peach Bottom electric generating facility was built along the western shore of the river. Water heated to produce steam for electric generation is returned back into the river, raising the local temperature of the surrounding river water.
- Powerline corridors were cut though the upland forests and transmission towers were built in the river on Mount Johnson Island and on the adjacent shoreline slopes.
- The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like amphibians, reptiles and small mammals that may consider the railroad an insurmountable obstacle.
- The four hydroelectric dams on the Susquehanna River present the major obstacle to anadromous and catadromous fish migration. Recently installed fish ladders have improved the condition for anadromous fishes, but catadromous fishes continue to be excluded from most of the Susquehanna River watershed.
- Residential development has increased along both sides of the river including the floodplain of the river and on the slopes overlooking the river.
- Garden debris and other refuse dumped into the river floodplain can be a significant source of invasive plant species and general habitat degradation.

o Exotic Species –

- The river floodplain is naturally susceptible to weedy plant invasion. The railroad rights-of-way, the utility rights-of-way and the transition zone between forested and agricultural landscapes are also areas of greatest invasive plant species concentrations.

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and York Counties.
- Recognize the river floodplain as an active part of the river and establish riparian buffer protection from the upper edge of the floodplain. Protect the natural vegetation within 300 meters of the river floodplain and the integrity of the large interior forests within the adjacent uplands by avoiding additional fragmenting features such as roads, residences and utility rights-

of-ways. A wide, naturally vegetated corridor along both sides of the river will help provide a minimal habitat and migration corridor for plants and animals in addition to help improve water quality entering the river. The protection of the wide floodplain will also help mitigate the downstream effects of flood events by providing an area where floodwaters can spread out without endangering human communities.

- Encourage agricultural areas along the banks of the river and its adjacent bluffs to retreat from the river's edge and to revert to a forested landscape. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover of the river slopes should be allowed to achieve and maintain old-growth characteristics.
- Avoid building, replacing or expanding dams on the Susquehanna River.

Within the Core Habitat:

- Preserve and improve the water quality of the Susquehanna River to help provide a continued and increased food chain. Maintain and improve water quality of the river by providing vegetated buffers along inflows to the river and along the river shoreline.
- Discouraged the establishment of seasonal cottages and year-round residences along the river shoreline bluffs overlooking the river. Limit and reduce the number of seasonal cabins on the shoreline of the river. Septic systems for these structures are frequently inadequate. Disturbance on shorelines includes loss or impairment of critical habitat due to construction of cabins, access roads, boat docks, lawns and vegetation clearing. Some vegetation removal can be beneficial to the habitat, but an increase in shoreline cottages can only result in a decrease in habitat for species adapted to these specific habitat conditions. The floodplain habitat of the river would be improved by the removal of the residences within the floodplain.
- Maintain and improve interior forest conditions within the uplands adjacent to the river. Avoid building roads, residences and utility rights-of-way though unfragmented patches of forest. Cluster these amenities in existing locations to avoid unnecessary habitat disturbance.
- Remove invasive species of plants. The river floodplain is naturally susceptible to weedy plant invasion and will require a sustained and targeted approach to invasive management.
  - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, Japanese hops, Japanese knotweed, multiflora rose, mile-a-minute and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
  - Invasive species are a significant feature of the railroad and utility rights-of-way and river shorelines. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern.
  - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
  - Continual invasive species monitoring and control will be necessary.

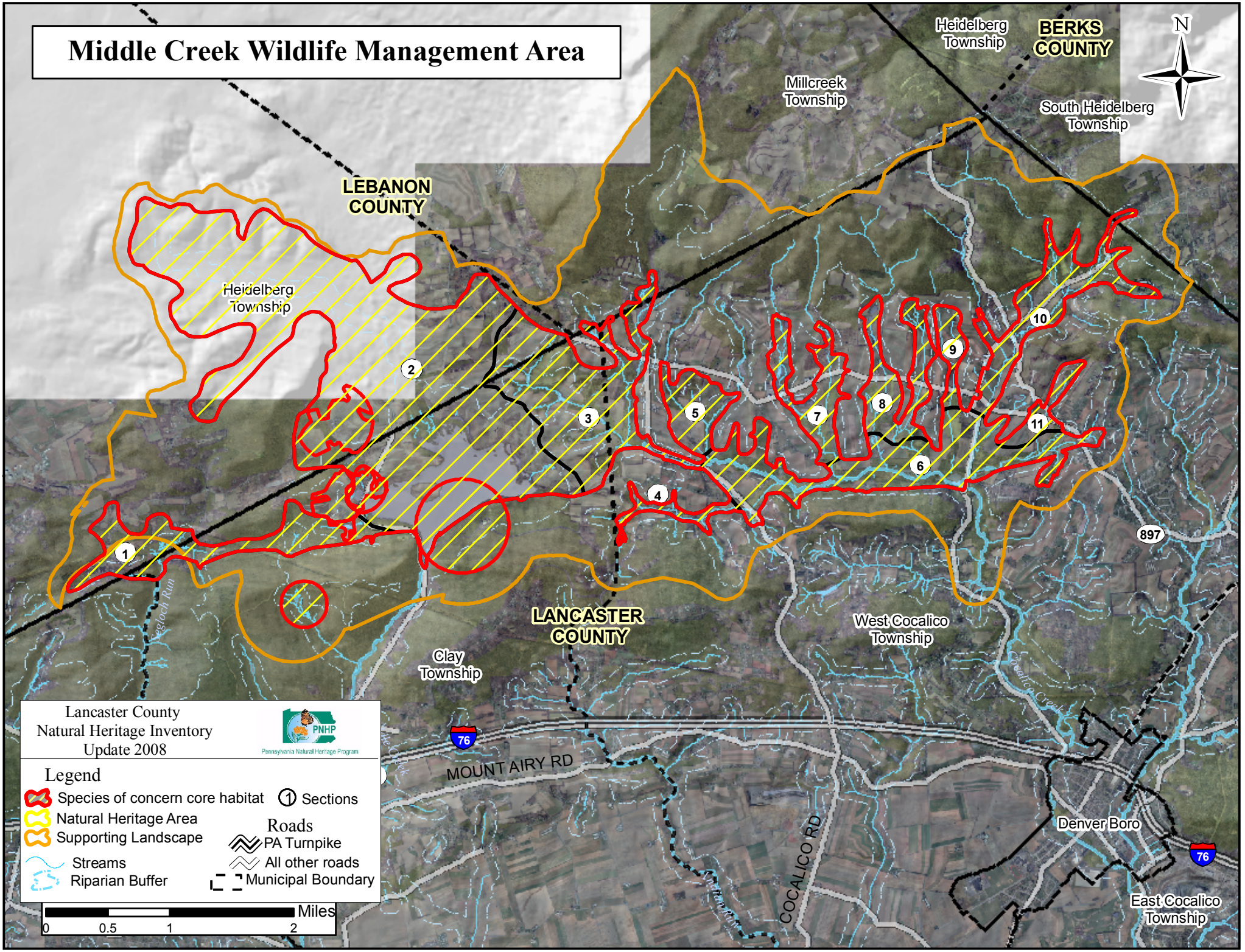
Within the Supporting Landscape: The supporting landscape was drawn to include a 300 meter buffer to this section of the Susquehanna River and a 100-meter riparian buffer for all tributaries. Activities and land use patters in the adjacent subwatersheds can have a significant impact on the water quality of the river and the habitats of the species of concern.

- Most of the conservation actions for the core habitat also apply to the supporting landscape.
- Pursue conservation easements, transfer of development rights and fee simple acquisition on properties along the river shoreline, the adjacent slopes and forested plateaus to help conserve the effectiveness of the Susquehanna River natural corridor.

- The long term goal for the area should be to restore or maintain the mature floodplain forests and the associated upland buffer forests along both shores of the river. Preserve and expand the native vegetation along the river corridor to include land within 300 meters of the river's floodplain. Reforestation efforts should be designed to mimic the adjacent natural community type by recruiting a similar composition of native trees and shrubs of varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way especially along the river shoreline and any large forested blocks. Preserve and improve the integrity of the large unfragmented forest blocks on the western shore of the Susquehanna River. These large forested areas provide a significant filter for runoff entering the river from these slopes. The steep, rocky nature of the wooded slopes likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites. Avoid activities that would fragment this habitat or create more edge areas, such as road building, which encourage the introduction of invasive plants or edge-adapted species and diminish the habitat available to interior forest dwelling species.
- Avoid logging activities on slopes adjacent to the Susquehanna River to allow for the development of old growth conditions. The immediate watershed draining into the river includes some forested areas and agricultural fields. Logging of wooded areas, specifically along steep slopes and riparian borders would be detrimental to the watershed. Nutrients from agricultural fields, failures from septic systems within the watershed, lawn care fertilizers and other sources can accumulate in the river leading to algal blooms and the consequent death of aquatic organisms. The amount of impervious surfaces around the river can allow all types of chemical runoff from roads, building materials etc. to reach and contaminate the river.

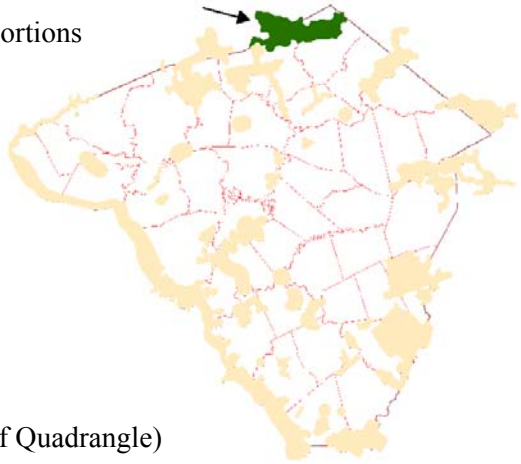
- Streams through forested areas should be considered high priority for conservation in the habitat. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be restored with native trees and shrubs appropriate to the topography and hydrology.
  - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
    - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
    - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.
- <u>Zoning options for conservation enhancement:</u>
  - Drumore and Fulton Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Strict enforcement of regulations restricting building activity on slopes greater than 25% would help prevent the forested slopes from being converted to other uses.
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Parcels currently forested should be zoned to conserve this attribute.

- Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into forest cover.
- Growth within the Township should be discouraged to occur within 300 meters of the 100-year floodplain of the Susquehanna River, or within 100 meters of the floodplain of its tributaries.
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat destruction, particularly along the shoreline of the Susquehanna River.


Middle Creek Wildlife Management Area
Heidelberg Township
BERKS COUNTY
Millcreek Township
South Heidelberg Township
N
LEBANON COUNTY
Heidelberg Township
1
2
3
4
5
6
7
8
9
10
11
897
LANCASTER COUNTY
West Cocalico Township
Clay Township
Conestoga Creek
76
MOUNT AIRY RD
COCALICO RD
Denver Boro
East Cocalico Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Sections
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
2

Middle Creek Wildlife Management Area – *Exceptional significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Animals:					
Sensitive species of concern (A)	-	-	-	2004-08-06	E
Sensitive species of concern (B)[3]	-	-	-	2003	E
Sensitive species of concern (C)[3]	-	-	-	2006-07-17	E
Sensitive species of concern (D)[3]	-	-	-	2006	E
Sensitive species of concern (E)[3]	-	-	-	1988	E
Sensitive species of concern (F)[3]	-	-	-	1985	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location: This large Natural Heritage Area includes the northern portions of Clay and West Cocalico Townships and extends into Lebanon County and slightly into Berks County.

- Municipalities:
  - Clay Township, (Lancaster County)
  - West Cocalico Township, (Lancaster County)
  - Heidelberg Township, (Lebanon County)
  - Mill Creek Township, (Lebanon County)
- USGS Quadrangles:
  - Richland Quadrangle
  - Womelsdorf Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Cocalico Creek Wetlands – SA501" – (Womelsdorf Quadrangle)

Description: This large Natural Heritage Area contains a wide diversity of habitat types, and includes large forested areas, man made wetlands and an agriculture dominated landscape containing important wetland habitats. Middle Creek Wildlife Management Area makes up a significant part of this Natural Heritage Area, which is part of the Furnace Hills Forests Hub. The shallow lakes at Middle Creek provide a rest stop for huge flocks of migrating birds such as Tundra Swan, Snow Goose, Canada Goose, Common Merganser, and Redhead Duck. Six sensitive species of concern have been documented from different parts of this area. The Horseshoe Trail passes though a portion of this area.

Species of Concern Considerations:

- The sensitive species of concern (A & B) require abundant aquatic food source and upland breeding areas. This can be achieved by preserving and improving the water quality of the Middle Creek area

and by protecting and expanding the natural vegetation buffer along all tributary streams and creeks.

- Sensitive species of concern (C) requires appropriate nesting structures such as dead trees and open areas for food gathering. Farming operations that employ infrequent mowing can help maintain the habitat for this species.
- The sensitive species of concern (D & E) require specific wetland plant communities with a matrix of open canopied habitats.
- Sensitive species of concern (F) requires appropriate nesting area, and feeding habitat. This can be achieved by maintaining existing conifer groves or plantations near open field habitats.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).
This Natural Heritage Area is largely dominated by agriculture and open water, with scattered patches of natural habitats primarily along streams. There is a large forested area abutting this Natural Heritage Area to the south which provides part of an important regional migratory corridor connecting to other habitats outside of the county.

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Tuliptree-beech-maple forest
  - Dry oak-mixed hardwood forest
  - Dry oak-heath forest
  - Red maple terrestrial forest
  - modified successional forest*
  - juniper-hardwood woodland*
  - conifer plantation*
  - grassland*
  - grassland/hay/agriculture*
- Palustrine (wetland) communities:
  - Red maple-black gum palustrine forest
  - Red maple-mixed shrub palustrine woodland
  - Black willow scrub/shrub wetland
  - Tussock sedge marsh
  - Bluejoint-reed canary grass marsh
  - Cattail marsh
  - red maple/open water pond*
  - wet meadow*
  - open water*

Ownership:

- A large portion of this area is maintained by the PA Game Commission as State Game Lands #46.
- The remainder of the site is made up of a multitude of private property parcels of varying size. Future ownership fragmentation may impede future conservation actions. Conservation action should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
  - Aerial photos from the 1940's show the Middle Creek area as a mix of wet woods and meandering streams in an agriculture-dominated landscape. Besides the areas of wet

woods, most of the area had been converted to agricultural production, leaving only little natural habitat within the landscape. While most of the area was intensively farmed, aerial photos show that the floodplain of many creeks and streams was not so intensively cultivated, providing a starting point for riparian habitat restoration within the watershed.
    - Several milldams were active along the tributaries to Middle Creek and Cocalico Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Many of these stream reaches of the watershed remain trapped in these deep narrow channels.
    -
- Current –
    - The swamp forest habitats of Middle Creek were flooded to create the shallow open water lake that the area is now known for. While providing an important bird migration stopping place, this action also flooded prime habitat for a number of other native species of plants and animals. Many of these species may still occur on the periphery of the open water habitats, or within the remaining swamp forest habitats.
    - East of the Middle Creek area, the landscape remains dominated by agriculture. Many portions of the tributaries to Cocalico Creek now have forested or vegetated floodplains, though many remain in cultivation or pasture.
- Exotic Species –
    - Invasive species information for this area was unavailable.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented in the near future if they don't already exist here.

Within the Core Habitat:

- The long term goal for this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were compatible with the species of concern found at this site.
- Most of the species of concern known from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
    - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
    - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.

- Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be encouraged, in order to recreate the natural flows of the landscape.
- Because several of the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within this Natural Heritage Area.
- Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.

- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the branches of Middle Creek and Cocalico Creek:

(Refer to Middle Creek sections map)

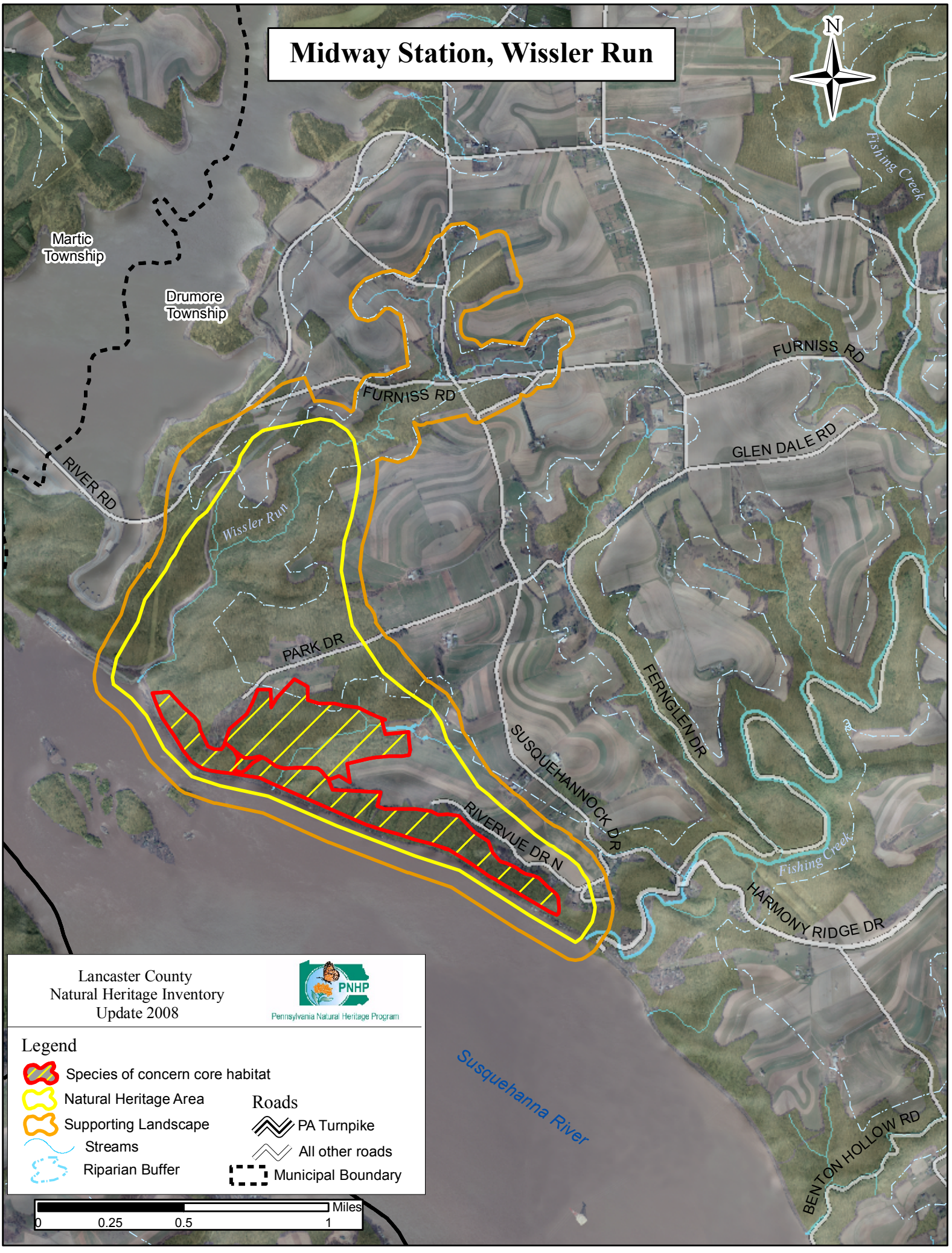
A. The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced; rather, their basins should naturally revert to their original condition.
B. Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
C. Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
D. Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
E. Current land use is compatible with this section; sparsely pasturing animals in this area could benefit the habitat.
F. Legacy sediments should be removed above the former mill dam.
G. Any remaining railroad tracks that may exist along the abandoned railway corridor should be removed.
H. The heavy agriculture in portions of this area should be allowed to revert back to natural drainages; light to moderate grazing in this area would be compatible.
I. The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.
J. Maintain a matrix of different wetlands with ample shallow marshy areas.

Stream section ID	Recommendation				
	1	2	3	4	5
1	A	B	I		
2	C	D	E	J	
3	D	E	J		
4	A	B	C	I	
5	A	H	I		
6	A	B	I		
7	A	B	C	D	E
8	B	C	D		
9	B	C	D		
10	A	C	E	I	
11	A	B	C	H	

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- There are multiple landowners that own the property within this Natural Heritage Area. Pursue conservation easements, transfer of development rights, fee simple acquisition and other programs that may help preserve and fund restoration activities of the wetlands on properties along the branches of Middle Creek and Cocalico Creek to help conserve and improve its effectiveness as a natural corridor.
- Avoid subdivision of large parcels as this would likely impede broad conservation initiatives. Agricultural zoning is compatible with this Natural Heritage Area.

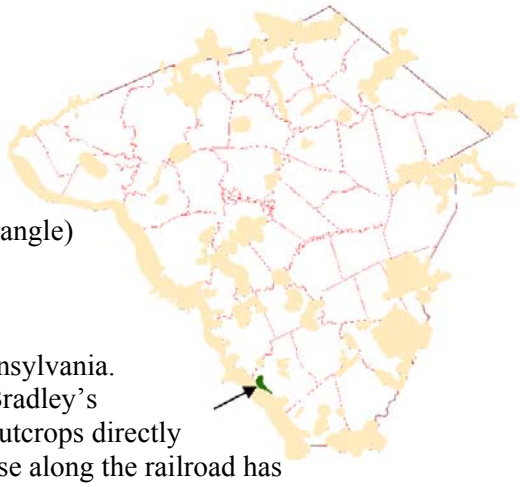
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into natural vegetation cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
- Reestablishment of the wide floodplain and its associated wetlands, swamps and wet meadows would serve as an effective buffer to flooding that may occur downstream.
- Clay and West Cocalico Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. In addition, Clay Township also includes the 500-year floodplain and lands containing alluvial or floodplain soils in its floodplain district. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    1. In addition, the floodplain regulation should remove farm pond construction from its list of permitted uses.
- West Cocalico Township has two additional zoning options that could help contribute toward conservation of ecologically sensitive habitats.
    a. The "Ecologically Sensitive District seeks to protect the wooded hillsides of northern West Cocalico Township within the headwaters of the Cocalico Creek watershed." Unfortunately, this zoning option allows single family detached dwellings to be built on 25-acre lots within the district, reducing its effectiveness for retaining the intact quality of these habitats. This district should be updated to prohibit this building activity from this district to help conserve the unbroken continuity of the forested landscape in this location.
    b. The "Woodland District seeks to preserve and protect open areas, essential watersheds and woodlands from intensive development within the District." Similarly, this designation allows for the construction of single family homes on two-acre lots. If this area were fully built out to this specification, it would result in the severe fragmentation of the forest landscape. This district should also be updated to either encourage cluster housing, or to restrict building activity to preserve the integrity of the forested habitat.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal vegetated stream buffers should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
    - A minimum vegetated buffer should me at least 35 feet in width from the edge of the 100-year floodplain.


Midway Station, Wissler Run
N
Martic Township
Drumore Township
RIVER RD
FURNISS RD
FURNISS RD
GLEN DALE RD
Fishing Creek
Wissler Run
PARK DR
FERNGLEN DR
SUSQUEHANNOCK DR
RIVERVUE DR N
Fishing Creek
HARMONY RIDGE DR
Susquehanna River
BENTON HOLLOW RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Midway Station, Wissler Run – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bradley's spleenwort (*Asplenium bradleyi*)	G4	S1	PE	1995-10-30	BC
Lobed spleenwort *(Asplenium pinnatifidum)*	G4	S3	PR	1995-10-30	D
American holly *(Ilex opaca)*	G5	S2	PT	1995-10-30	D
Cranefly orchid *(Tipularia discolor)*	G4G5	S3	PR	2006-04-25	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:

- Municipalities:
  - Drumore township
- USGS Quadrangles:
  - Holtwood Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference:
  - "Susquehannock State Park: SP564" – (Holtwood Quadrangle)

Species of Concern Considerations:

Plants:

- Bradley's spleenwort is a fern of very limited distribution in Pennsylvania. Rock outcrops along the river-facing slopes provide habitat for Bradley's spleenwort at this location. Portions of the population occur on outcrops directly adjacent to the railroad rights-of-way. Indiscriminate herbicide use along the railroad has eliminated portions of this population in the past few years. Rock outcroppings along this section of the track should be posted as "no spray" zones and vegetation managed by mechanical means only, with the presence of the species of concern always a consideration. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. All of the currently known populations of this plant in PA occur on rock outcrops along the Susquehanna River or other scattered locations in Lancaster County. Since all of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large responsibility for its continued existence in the state. The exact location of this species at all locations in the county should be limited to authorized researchers to avoid its extirpation by unauthorized collection. There are numerous outcrops in this area that should be considered potential habitat for this species. Additional surveys are recommended to more accurately determine the current extent of this species.
- The lobed spleenwort is a small fern that grows on dry shaded cliffs and rock outcrops, particularly on sandstone and schist. There are numerous lightly shaded rock outcrops along the Susquehanna River that potentially support additional populations of this species. The viability of existing populations and its rock outcrop habitat may be enhanced by establishing a surrounding buffer of forest. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. A "no spray" zone should be established near all rock outcrops along this section of the railroad rights-of-way. Additional surveys are recommended to more accurately determine the current extent of this species.

- A few scattered American holly trees of varying age occur within this area. Populations of holly in the lower Susquehanna ravines are some of the few to be considered native to the state, and not the result of cultivation, or naturalized from cultivated specimens. Collecting for holiday greens may be the biggest threat for this species at this location.
- The cranefly orchid is a plant of moist, rich forests. It is usually found individually, with few other specimens in the area. It can be easily overlooked due to its small size and individual nature. The entire rich, moist, forest environment should be considered potential habitat for this plant. Maintain the native forest canopy and encourage native tree and shrub recruitment into the understory to continue to provide sufficient available habitat for this species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- The entire species of concern core habitat has a continuous forest canopy, while approximately 45% of the supporting landscape is forested. The Natural Heritage Area includes two large interior forest patches that are separated by an access road and the building infrastructure of Susquehannock State Park. The area is dominated by dry oak-heath forest with smaller patches of other natural community types scattered as topography, sunlight and available moisture dictate including:
    - Terrestrial (upland) communities:
        - Hemlock-tuliptree-birch forest
        - Tuliptree-beech-maple forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath forest
        - modified successional forest*

Ownership:

- Approximately 230 acres, or 32%, of the Natural Heritage Area is under management of Susquehannock State Park.
- The Exelon Corporation owns approximately 20% of the Natural Heritage Area, part of the Muddy Run Reservoir area west of Wissler Run.
- The Lancaster County Conservancy owns approximately 19 acres, or 13% of the Natural Heritage Area.
- Norfolk Southern Railroad Corporation owns a rights-of-way along the banks of the Susquehanna River.
- Most of the remaining area of the Natural Heritage Area is owned by a few large landowners maintained as active agricultural fields.
- There is a cluster of smaller residential lots along Rivervue Drive. Ownership fragmentation diminishes the future prospects for preservation of large landscape scale features.

Habitat Disturbances:

- Historic –
    - Aerial photographs from 1940 show that agricultural fields existed up to the edge of the bluffs overlooking the Susquehanna River as they do today. The areas of steepest slope were wooded, while all readily tillable land was in agriculture, which continues to be the situation at this location. The railroad was already along the river shoreline by 1940.
- Current –
    - Since 1940, the Muddy Run Reservoir was constructed on the northern border of this Natural Heritage Area, flooding Muddy Run. Supporting infrastructure for the pumping station added access roads and buildings along Wissler Run and the shore of the

Susquehanna River. The access road to the riverside pumping station has spoiled the formerly undisturbed character of Wissler Run and fragmented the large interior forest block that occurred here.

- The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that would consider the railroad an insurmountable obstacle.
- Herbicide use for vegetation management along the railroad has resulted in the decimation of a portion of this population of Bradley's spleenwort.
- Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.

- Exotic Species –
  - Notes from past field surveys of the area do not indicate many invasive species of plants at this location, though Japanese honeysuckle was considered well established. In all likelihood, invasive species dominate the borders of the railroad rights-of-way along the river shoreline as well as the transition zones between forested and agricultural habitats. Invasive species control efforts at this location should concentrate on maintaining weed free conditions where they exist and eliminating pioneer populations of invasive species in newly invaded habitats, effectively enlarging the weed-free habitat.

Conservation Actions:

Overall:

- The primary conservation concern for this area should be to focus on preserving the forested connections along the Susquehanna River ravines while safeguarding the habitat for the two rock outcrop dwelling fern species, Bradley's spleenwort and lobed spleenwort. The rock outcrops along the railroad in this area should be established as "no spray" zones and vegetation management conducted with the knowledge of native plants in the immediate vicinity.
- In addition, conservation efforts should focus on safeguarding the quality and expanse of the forested landscape of the area. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve old-growth characteristics.

Within the Core Habitat:

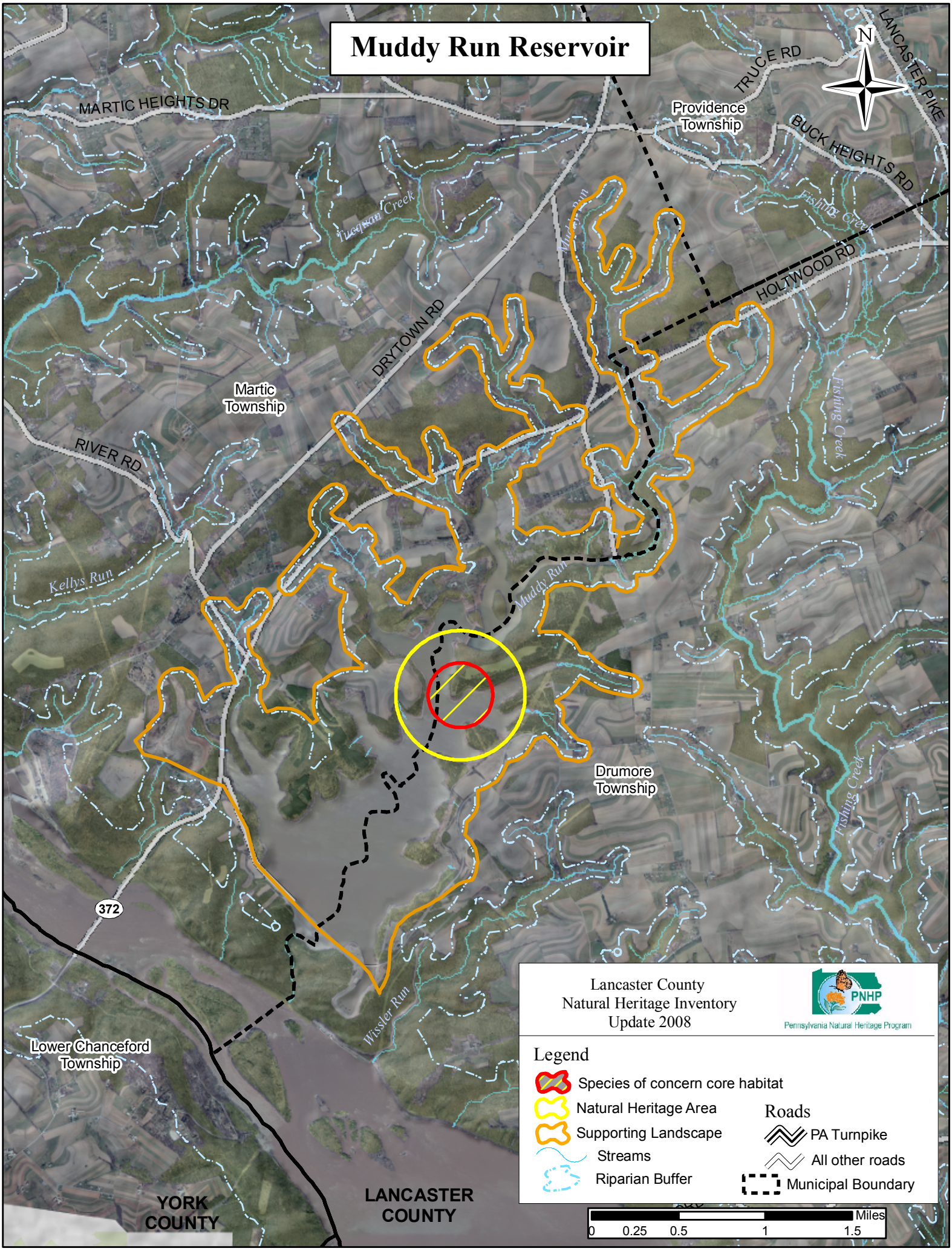
- Provide for the long-term protection of the core habitat.
  - A significant portion of the core habitat along the river bluffs is currently private property and should be considered a priority for acquisition or conservation easements for this Natural Heritage Area. The steep, rocky nature of the immediate habitat of the species of concern likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites.
  - Indiscriminate railroad herbicide use is inappropriate for this location. Establish "no spray" zones at rock outcrops adjacent to the railroad.

Within the Natural Heritage Area / Supporting Landscape:

The supporting landscape for this area is derived from the Wissler Run Watershed and the adjacent Susquehanna River viewshed. Activities within the watershed can have a direct impact on the core habitats and the species of concern it contains.

- The riparian corridor of Wissler Run in the supporting landscape is conspicuously forested through most of its course in what appears to be good quality forest communities. Conservation and expansion of the forested riparian corridor of Wissler Run should be considered a priority for activities within the supporting landscape for this area. The ultimate headwaters of Wissler Run pass unbuffered though active pastures. These areas should be fenced to exclude livestock and encouraged to be reforested. (See riparian buffer guidelines.) Forested zones along creeks help filter runoff from roads, residences and agricultural areas, cleansing the runoff before it enters larger streams and rivers. Forested creek edges also slow runoff, allowing the water to recharge the groundwater. These narrow corridors are highly susceptible to colonization by invasive species of plants. Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet.
- Conservation easements should be sought for forested and agricultural properties adjacent to the Natural Heritage Area to provide a buffer to this habitat and to help provide connectivity to other nearby Natural Heritage Areas. Additional populations of species of concern could occur on adjacent parcels.
- Agricultural fields within the Natural Heritage Area should be encouraged to return to forest to expand the area of interior forest at this location and to provide an additional buffer for the core habitat. Reforestation efforts should be designed to mimic the adjacent natural community type by planting a similar composition of native trees and shrubs or varying age classes. Reforestation is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
        - Trees that have fallen over approved trails can be cut through as necessary.
    - Remove invasive species of plants, trees and shrubs. The railroad rights-of-way and forest/agricultural transition zones are the likely location of non-native trees and shrubs within this area.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Native species of plants are particularly susceptible to deer herbivory.
    - Block access to forested areas by off road vehicles, ATVs and other motorized vehicles.
    - Additional surveys for species of concern are recommended.
- Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings. See riparian corridor section for site specific recommendations.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain

- Potential zoning options for conservation enhancement:
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 90% of the area within the core habitat, ~43% of the Natural Heritage Area and ~15% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this area.


Muddy Run Reservoir
N
MARTIC HEIGHTS DR
TRUCE RD
LANCASTER PIKE
Providence Township
BUCK HEIGHTS RD
Tucquan Creek
Fishing Creek
HOLTWOOD RD
DRYTOWN RD
Martic Township
RIVER RD
Kellys Run
Muddy Run
Drumore Township
372
Wissler Run
Lower Chanceford Township
YORK COUNTY
LANCASTER COUNTY
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0 0.25 0.5 1 1.5

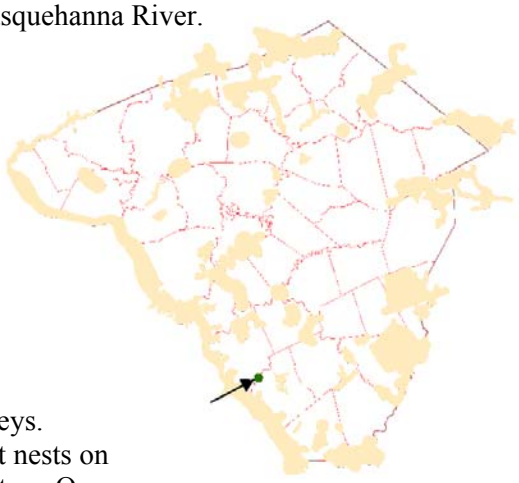
Muddy Run Reservoir – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals					
Osprey (*Pandion haliaetus*)	G5	S2B	PT	2003	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: Muddy Run Reservoir occurs south of Route 372 at the Susquehanna River.

- Municipalities:
  - Drumore Township
  - Martic Township
- USGS Quadrangles:
  - Holtwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: Muddy Run Reservoir was created by damming the Muddy Run Valley for power generation.

Species of Concern Considerations:

- The man-made lake provides habitat for a nesting pair of Ospreys. These birds adapt readily to human activity and often construct nests on man-made structures (Brauning 1992). Being primarily fish eaters, Ospreys utilize aquatic habitats for food gathering and upland habitats or prominent features as nesting areas. The forested edge of the lake as well as the large body of water are both important components of this species habitat preferences.

Forest Cover / Natural Communities**:** The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Most of the area is the open water lake, but the surrounding areas are dominated by a dry white pine (hemlock)-oak forest. Portions of the area contain conifer plantations, while most of the remainder is modified successional forest, an early stage of reforestation from agriculture or other intensive land uses. Plant communities present include:
  - Terrestrial (upland) communities:
    - Hemlock-tuliptree-birch forest
    - Dry white pine (hemlock)-oak forest
    - Virginia pine-mixed hardwood forest
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
    - Dry oak-heath forest
    - modified successional forest*
  - Palustrine (wetland) communities:
    - Silver maple floodplain forest
    - Bluejoint-reed canary grass marsh

Ownership: The entire Muddy Run Reservoir and adjacent uplands habitats are owned by the PECO/Exelon Power Company.

Habitat Disturbances:

- Historic –
  - The reservoir itself is the product of disturbance. The small wooded stream valley of Muddy Run was flooded to create the power generating reservoir. The area surrounding Muddy Run had been primarily in agricultural production except for a wide forested riparian corridor of Muddy Run.
- Current –
  - Conifer plantations on the shore of the reservoir lack biological diversity.
  - Much of the wooded landscape surrounding the reservoir is dominated by modified successional forest, an early stage of recovery from disturbance from agricultural or other intensive land uses.
- Exotic Species – The invasive species of the area are currently unknown, but likely include many common introduced species.

Conservation Actions:

Overall:

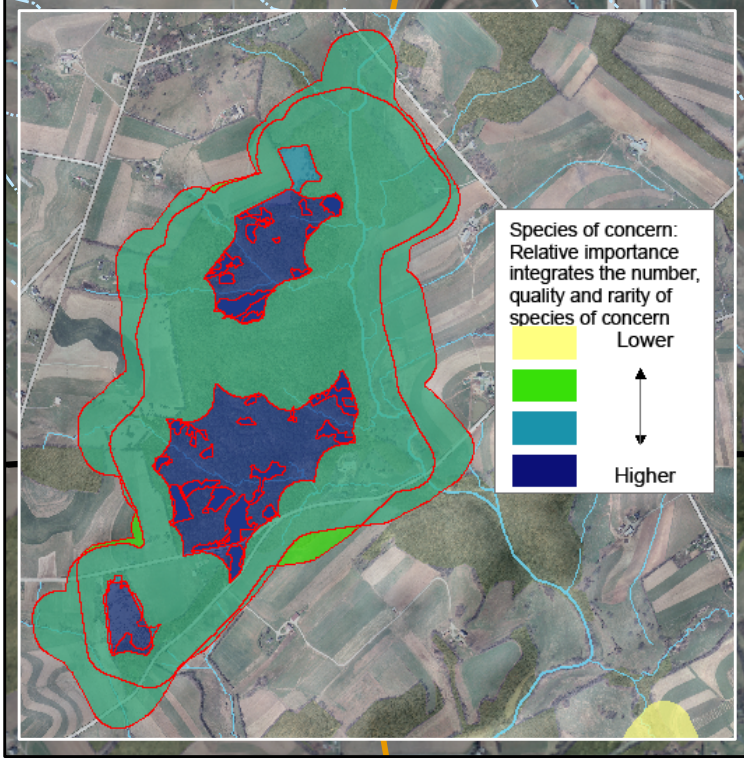
Within the Core Habitat:

- Leave standing snags around the edge of the reservoir. This action will increase nesting opportunities for Ospreys and also increase habitat options for a diversity of other wildlife.

Within the Supporting Landscape:

- Expand the forested buffer surrounding Muddy Run Reservoir to increase the water quality of the reservoir and improve habitat opportunities for other wildlife.
- Replace conifer plantations with native trees and shrubs to mimic quality natural communities in adjacent areas of similar topographic position.
- Silvicultural practices can help improve stands of modified successional forest. Selectively remove non-native and low quality trees, shrubs and vines. Selective harvest could employ draft horses to minimize ground compaction and understory disturbance.

New Texas Serpentine Barrens



Lancaster County
Natural Heritage Inventory
Update 2008

Pennsylvania Natural Heritage Program

Legend

- Species of concern core habitat
- Natural Heritage Area
- Supporting Landscape
- Streams
- Riparian Buffer

Roads

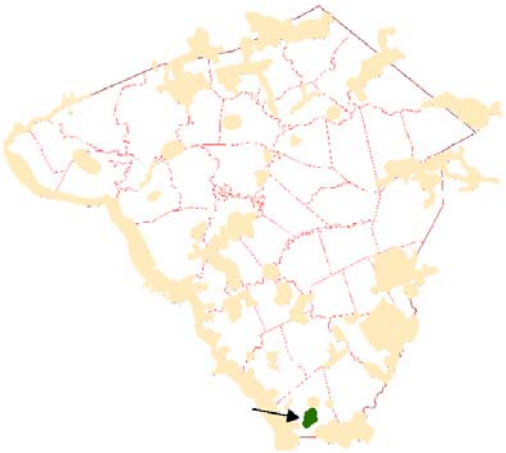
- PA Turnpike
- All other roads
- Municipal Boundary

Miles
0 0.25 0.5 1

New Texas Serpentine Barrens – *Exceptional significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Plants:					
Arrow-feathered three-awn (*Aristida purpurascens*)	G5	S2	PT	1994-09-21	C
Mead's sedge (*Carex meadii*)	G4G5	S1	TU	1993-06-16	C
Annual fimbry (*Fimbristylis annua*)	G5	S2	PT	1994-09-21	C
Forked rush (*Juncus dichotomus*)	G5	S1	PE	1995-06-29	E
Grooved yellow flax (*Linum sulcatum*)	G5	S1	PE	1998-09-12	B
Few-flowered nutrush (*Scleria pauciflora*)	G5	S2	PT	1994-09-21	A
Plain ragwort (*Senecio anonymus*)	G5	S2	PR	1994-09-21	C
Prairie dropseed (*Sporobolus heterolepis*)	G5	S1	PE	1994-09-21	B
Serpentine aster (*Symphyotrichum depauperatum*)	G2	S2	PT	1994-09-21	A
Sensitive Species of Concern (A)[3]	G4	S1	TU	1996-09-12	CD
Sensitive Species of Concern (B)[3]	G4	S2	PT	1994-09-21	B
Animals:					
Falcate orangetip (*Anthocharis midea*)	G4G5	S3	-	1995-05-03	E
Dusted skipper (*Atrytonopsis hianna*)	G4G5	S2S3	-	1995-05-24	C
Juniper hairstreak (*Callophrys gryneus*)	G5	S2S4	-	1996-07-20	C
Red-banded hairstreak (*Calycopis cecrops*)	G5	S4	-	1996-09-05	C
Packard's lichen moth (*Cisthene packardii*)	G5	S1S3	-	1995-08-14	E
Leonard's skipper (*Hesperia leonardus*)	G4	S3S4	-	1995-08-14	E
Cobweb skipper (*Hesperia metea*)	G4G5	S2S3	-	1995-05-24	BC
Exemplary Natural Communities:					
Eastern serpentine barrens	G2	S2	-	1994-09-21	A

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

New Texas Serpentine Barrens



Location: This Natural Heritage Area occurs between Wakefield Borough and the Pennsylvania / Maryland border. Conowingo Creek passes though this area.

- Municipalities:
  - Fulton Township
- USGS Quadrangles:
  - Conowingo Dam Quadrangle
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "New Texas" – (Conowingo Dam Quadrangle)
  - "New Texas" – (Wakefield Quadrangle)

Description: This area contains approximately 200 acres of globally rare serpentine habitat in a very good mosaic of the characteristic serpentine barrens plant communities. The serpentine habitats are often referred to as grasslands, and they do have a strong representation of warm season grasses and grass-like plants, but they also contain a good diversity of other plant species, many uncommon to the state. Fire disturbances have maintained these herbaceous openings in the past. Active woody vegetation removal will be necessary to maintain these openings in the absence of fire.

Species of Concern Considerations:

Plants:

- The plant species of concern currently known to occur within this Natural Heritage Area are found primarily in the strongly serpentine influenced herbaceous openings or within the adjacent thin woodlands. The variety of openings reflects the amount of cover established at each location. Gravel barrens, grasslands and savannas contain all of the known plant species of concern. These include arrow feather, Mead's sedge, annual fimbry, tufted hairgrass, forked rush, grooved yellow flax, few-flowered nutrush, plain ragwort, prairie dropseed, serpentine aster and two sensitive species of concern. In the past, natural disturbance, such as wild fires, would have helped to keep these areas in an open condition. With the relatively recent suppression of fire, the open areas have gradually closed due to natural succession. An active restoration effort to restore the serpentine openings will be necessary to ensure the continued existence of these habitats and the species they contain.
- Serpentine aster, mentioned above, is only known to occur in the eastern serpentine barrens of Pennsylvania and Maryland. This extremely limited distribution has given this species the status of G2 – globally imperiled. Serpentine aster is typically found in the more open areas of serpentine barrens, suggesting that fire may be needed to weed out woody overgrowth and maintain this preferred habitat.

Animals:

- All of the animal species of concern currently known from Rock Springs are butterflies & moths (Lepidoptera). Many of these species are limited in distribution in Pennsylvania to serpentine and other grassland habitats, which are often set in a matrix of open oak and pine woodlands. Conservation of these species requires protection of the habitat they use during all stages of their life cycles. Maintaining a mosaic of grassland, oak, and pine areas at serpentine barrens sites and the surrounding area will create a diverse and healthy habitat capable of supporting the rare Lepidoptera listed above. Plantings of native herbaceous food plants and desirable nectar sources may also help increase the existing Lepidoptera populations. Creation of corridors between barrens sites would also encourage movement of species between sites and create more secure populations. Pesticide application, especially for the control of gypsy moths, can have a devastating effect on populations of Lepidoptera species of concern and should be eliminated in this area.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).
Current open grasslands the result of previous grazing. The grasslands at New Texas are considered the largest of all the PA barrens, but are being lost to Virginia pine encroachment.

The area is currently a mix of habitat types dominated by a Serpentine Virginia pine-oak forest, which contains a network of serpentine influenced herbaceous openings. Most of the plant species of concern occur within these open habitats. This habitat was historically less dominated by woody trees and shrubs, but recent fire prevention has favored the expansion of wooded habitats at the expense of herbaceous openings. Invasion of serpentine herbaceous openings by woody trees and shrubs can influence the surrounding habitat. As woody vegetation encroaches on the openings, they tend to trap more organic debris and allow deeper soils to accumulate. As deeper soils occur on the site, they allow the area to succeed to more common woodland and forest types. Fire disturbances have maintained these herbaceous openings in the past. Active woody vegetation removal will be necessary to maintain these openings in the absence of fire.

- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry oak-heath forest
  - Serpentine Virginia pine-oak forest
  - Red cedar-pine serpentine shrubland
  - Serpentine grassland
  - modified successional forest*
  - shrubland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest
  - Red maple-black gum palustrine forest
  - Red maple-mixed shrub palustrine woodland
  - Tussock sedge marsh
  - wet meadow*

Ownership: This entire habitat is in private ownership. Most of the core species of concern habitat is owned by a few large landowners. Future ownership fragmentation of this globally rare habitat may impede future conservation actions. Conservation action within this Natural Heritage Area should be set in motion before ownership fragmentation makes this more difficult.

Habitat Disturbances:

- Historic –
  - Historically, wildfires likely helped to maintain the open aspect of these habitats. Early accounts record the intentional setting of fire in these habitats by Native Americans to help open the area for greater potential hunting success.
  - Based on aerial photos from the 1940s, much of the serpentine habitat was cleared by grazing in the past, while small portions of this area had a cover of trees, primarily along the stream banks and adjacent valleys. Past grazing activities likely helped to maintain the open aspect of the barrens habitat.
  - Most of the surrounding landscape had been cleared of its original forest cover and converted to agricultural production over several centuries.
- Current –
  - The barrens habitat remains relatively undisturbed, likely due to its low potential for agricultural production. Ironically, the lack of natural fire disturbance poses one of the

greatest threats to this habitat. In the absence of natural fire events, most of the open serpentine barrens habitats will gradually succeed to more common woody vegetation such as junipers, pines and oaks. Volunteers with The Nature Conservancy have worked for the past decade to remove woody vegetation to help prevent the eventual conversion of this globally rare habitat to a more common type of forest.

- Some residential development has been occurring at the periphery of the serpentine habitat.

- Exotic Species –
  - Most of the serpentine habitat is naturally resistant to invasion by introduced species of plants due to its unusual chemical makeup, but invasive species are well established in some areas especially Japanese honeysuckle (*Lonicera japonica*) and Japanese stilt grass (*Microstegium vimineum*).

Conservation Actions:

Overall:

- Conservation of the core habitat and supporting landscape and connecting linkages between this serpentine habitat and those nearby should be considered the highest conservation priority in the county.
- A management plan specifically for Goat Hill Serpentine Barrens was recently developed by the PA Natural Heritage Program with input and participation from other serpentine experts and organizations. Much of management recommendations for Goat Hill also apply to New Texas. Consult that plan for a finer level of management detail.
- The state line serpentine habitats are part of a series of habitat "islands" stretching into Maryland that should be thought of as a single system. Connect these habitats by maintaining natural vegetation along waterways and over serpentine bedrock geology. A surrounding agricultural landscape is suitable for properties adjacent to this Natural Heritage Area.
- Active stewardship of these habitats is necessary. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type.
- Habitat restoration activities should strive to establish a mosaic of habitat types to accommodate the variety of organisms and their diverse habitat preferences. While some of these plants will only thrive in the open on thin soils, or even bare bedrock conditions, others need the limited shelter of scattered trees. Some of the insect species require conifers during part of their life cycle while others need deciduous trees or specific shrubs or wildflower host plants. There is no "one-size-fits-all" management recommendation for this habitat other than to provide for a mosaic of habitat diversity.

Within the Core Habitat:

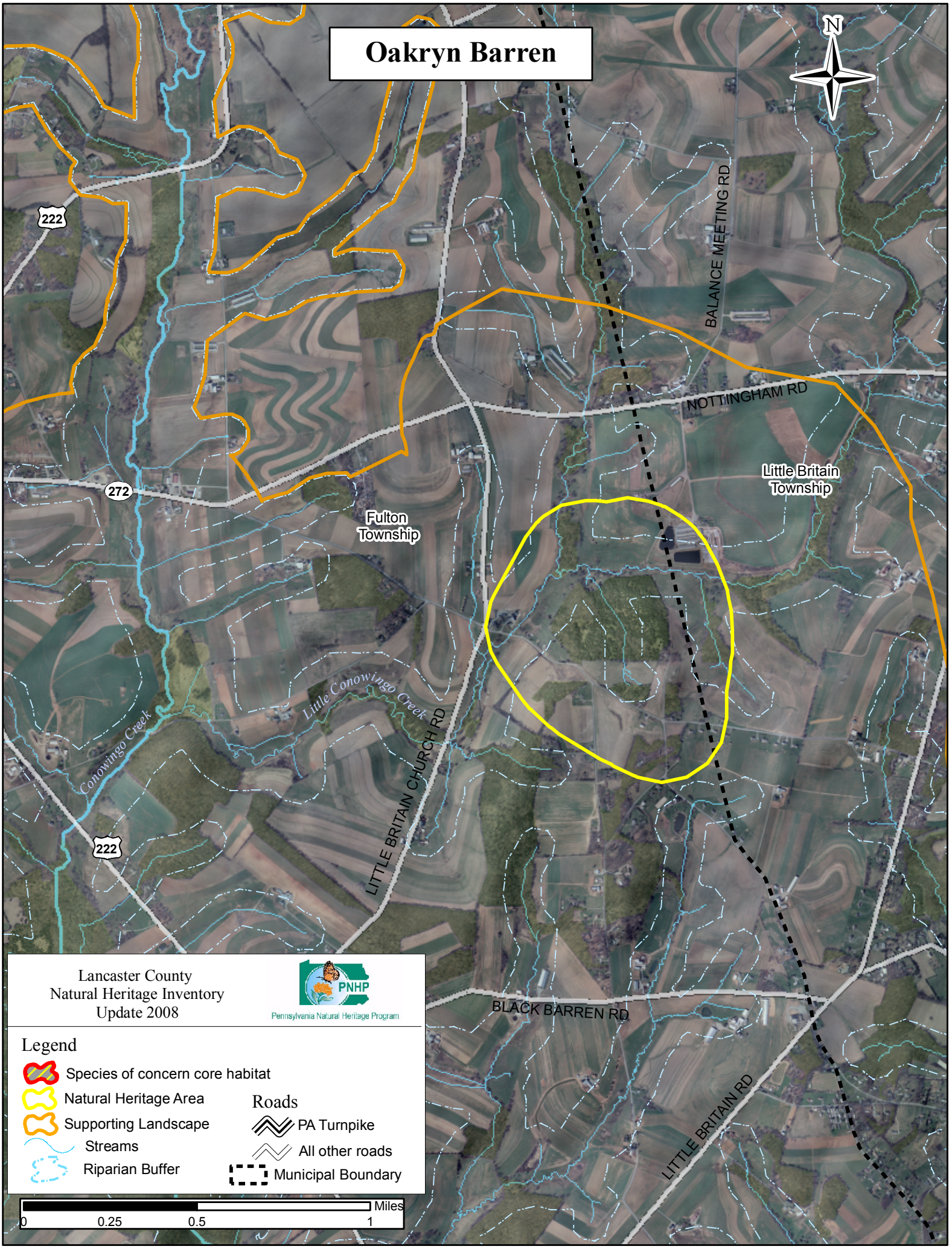
- Focus conservation efforts on acquisition of the largest parcels within the Natural Heritage Area. Transfer of development rights, conservation easements and fee simple acquisition are all appropriate tools for securing the conservation status of the parcels with varying ecological significance. Fee simple acquisition is the most appropriate option for the areas containing the species of concern core habitat.
- In the past, naturally occurring fires helped maintain the open aspect characteristic of the serpentine barren habitat. Today, active vegetation management, in the form of volunteer work crews, helps to remove trees and shrubs that in the past would have been cleared by fire events. These work crews have made great progress over the years to create the mosaic of patchy openings resembling in places a grassland, in others, an oak savannah, or pitch pine woodland, or juniper–catbrier shrubland, or mixed oak forest, or bare soil gravel bed.

All these, as well as other small patch natural communities, play an important role in sustaining the diversity of plants and animals in these important ecosystems.

- Continue woody vegetation management. Expand herbaceous openings on hilltops with a thin cover of juniper and Virginia pine by removing trees and other woody plants. Focus woody plant removal on pines and junipers, which tend to indicate dryer, thinner soils. The establishment of hardwoods should be taken as an indicator of deeper, moister soils. Leave trees on deeper soils and valleys to help create the mosaic of habitats necessary for the variety of plants and animals that this habitat supports.

Within the Supporting Landscape:

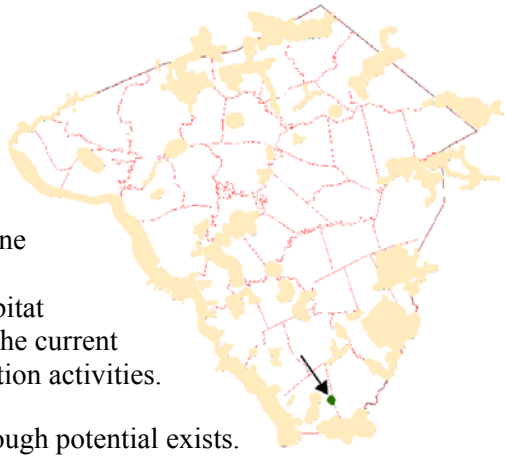
- The plants that characterize these habitats are adapted to the dry, nutrient poor soils and periodic fire events. A priority for the security of these globally rare habitats should be to establish protection for the core habitats as well as to provide for the landscape context in which natural process can be maintained. These systems may be best maintained in an agricultural or rural setting. Residential development near or between these barrens should be strongly discouraged.
- These serpentine habitats occur in isolated patches as the bedrock material, serpentinite, is exposed at the surface of the ground in a scattered fashion much like an archipelago chain of islands. Each habitat has a slightly different species composition, largely due to the slightly different environmental conditions found at each distinct location. The area between and around these habitats should be maintained to provide the necessary buffer to allow prescribed burns to sustain the mosaic of open habitat once a network of the woody species have been removed. A long range goal for these isolated habitats is to recognize them as a single system and plan for their ecological needs. Connect New Texas to Rock Springs, Goat Hill and Oakryn Barren though natural habitat corridors along streams and over serpentine bedrock geology. Natural habitat corridors between the barrens will help keep the genetic flow between the isolated populations of species in circulation.
- Educate the adjacent landowners on the significance of the globally rare habitat and the need for ongoing management activities.


Oakryn Barren
N
222
272
222
BALANCE MEETING RD
NOTTINGHAM RD
Little Britain Township
Fulton Township
Little Conowingo Creek
Conowingo Creek
LITTLE BRITAIN CHURCH RD
BLACK BARREN RD
LITTLE BRITAIN RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Oakryn Barren – *Local significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
None currently known	-	-	-	-	-

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Fulton Township
  - Little Britain Township
- USGS Quadrangles:
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Oakryn Barren is a potential serpentine barren habitat based on the bedrock serpentine geology and the similarity of the current vegetation to that of current serpentine habitats prior to restoration activities.

Species of Concern Considerations: None currently known, though potential exists.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).
- The area is currently dominated by early successional trees and shrubs associated with other nearby overgrown serpentine habitats. Restoration of the serpentine habitat is still very feasible based on the current conditions.
  - Terrestrial (upland) communities:
    - Dry oak-heath forest
    - Virginia pine-mixed hardwood forest
    - Red cedar-pine serpentine shrubland
    - modified successional forest*

Ownership:
- The primary potential serpentine habitat is owned by a single landowner. Conservation action should take place before ownership fragmentation decreases the potential for consistent habitat conservation.
- PECO Energy Company owns a utility rights-of-way though the primary habitat.

Habitat Disturbances:
- Historic –
  - Historically, wildfires likely helped to maintain the open aspect of these habitats. Early accounts record the intentional setting of fire in these habitats by Native Americans to help open the area for greater potential hunting success.

- Based on aerial photos from the 1940s, much of the potential serpentine habitat was open and grassy, likely cleared by grazing in the past, while trees and shrubs and even exposed bedrock occurred in scattered patches.
- Most of the surrounding landscape had been cleared of its original forest cover and converted to agricultural production over several centuries.

o Current –

- The potential barrens habitat remains relatively undisturbed, likely due to its low potential for agricultural production. Ironically, the lack of natural fire disturbance poses one of the greatest threats to this habitat. In the absence of natural fire events, most of the open serpentine barrens habitats have gradually succeed to more common woody vegetation such as junipers, pines and oaks.
- A utility rights-of-way crosses the potential barrens habitat, and all woody vegetation has been removed beneath the wires. Ironically, this disturbance has helped to provide the open conditions favorable for the reestablishment of serpentine adapted plants.

o Exotic Species – Unknown for this location.

Conservation Actions:

Overall:

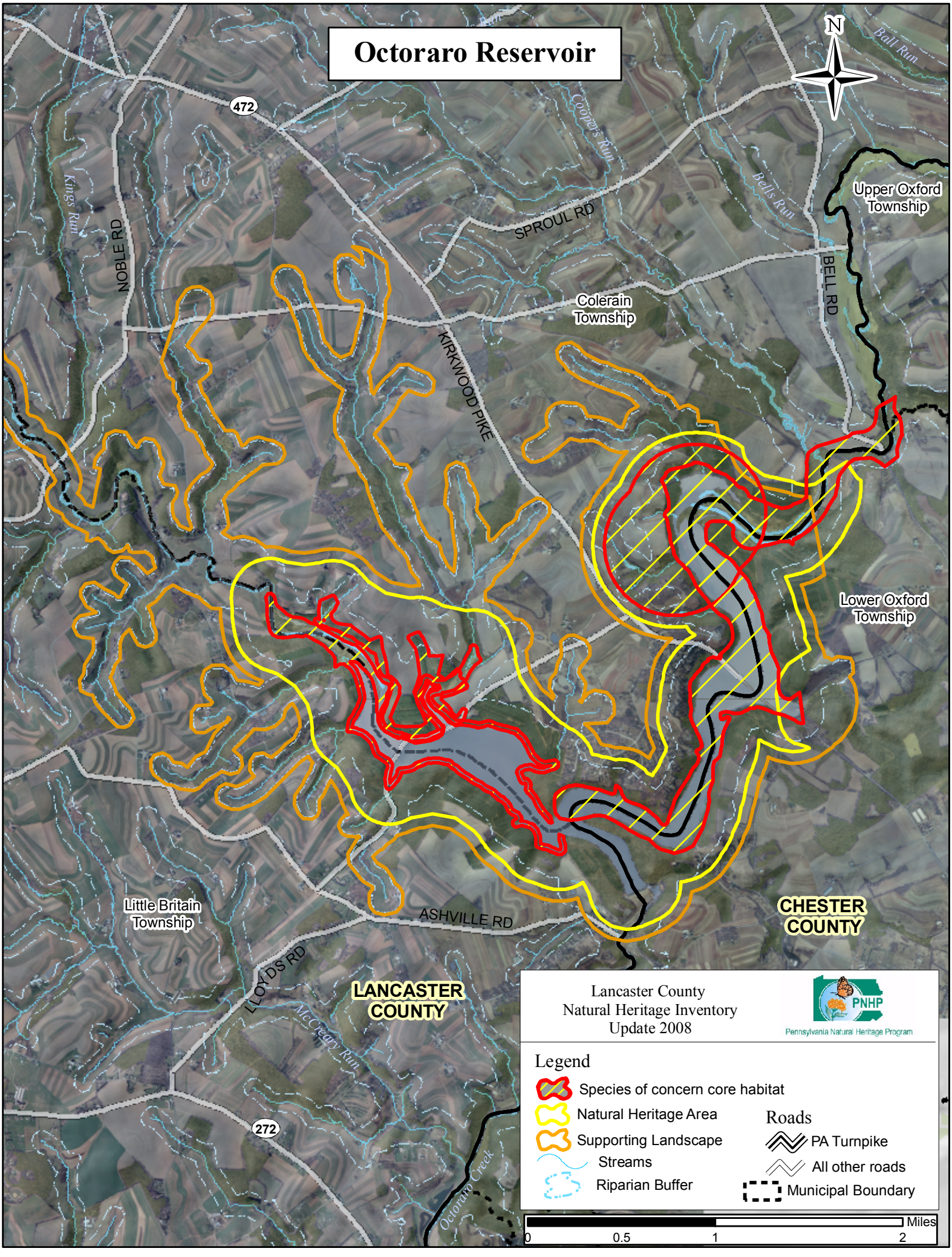
- Ground surveys are needed to establish the potential for restoration of serpentine barrens habitat at this location. Surveys for serpentine adapted plants and associated butterfly and moth species will help determine the restoration potential.

Within the Core Habitat:

- Once the potential for serpentine habitat restoration has been verified, work to acquire the property as part of the state line serpentine barrens system.
- Habitat restoration activities should strive to establish a mosaic of habitat types to accommodate the variety of organisms and their diverse habitat preferences.
- Active stewardship of these habitats is necessary. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type.

Within the Supporting Landscape:

- The state line serpentine habitats are part of a series of habitat "islands" stretching into Maryland that should be thought of as a single system. Connect these habitats by maintaining natural vegetation along waterways and over serpentine bedrock geology.
- The plants that characterize these habitats are adapted to the dry, nutrient poor soils and periodic fire events. A priority for the security of these globally rare habitats should be to establish protection for the core habitats as well as to provide for the landscape context in which natural process can be maintained. These systems may be best maintained in an agricultural or rural setting. Residential development near or between these barrens should be strongly discouraged.

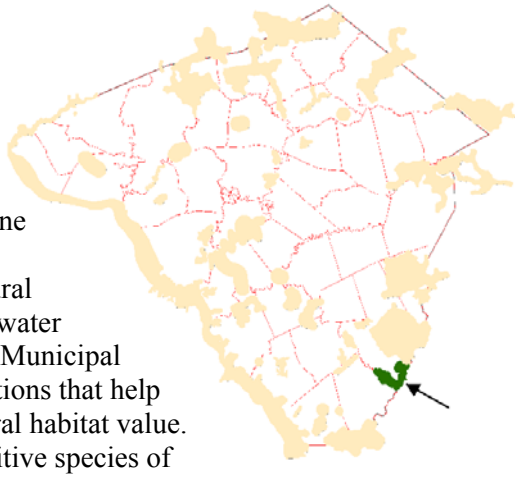

Octoraro Reservoir
N
472
Kings Run
NOBLE RD
Cooper's Run
SPROUL RD
Bells Run
Ball Run
Upper Oxford Township
BELL RD
Colerain Township
KIRKWOOD PIKE
Lower Oxford Township
Little Britain Township
ASHVILLE RD
CHESTER COUNTY
LLOYDS RD
LANCASTER COUNTY
McCreary Run
272
Octoraro Creek
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
2

Octoraro Reservoir – *Notable significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Maryland golden-aster (*Chrysopsis mariana*)	G5	S1	PT	1994-10-01	D
Tooth-cup (*Rotala ramosior*)	G5	S3	PR	1994-08-25	B
Animals:					
Sensitive species of concern [3]	-	-	-	2000	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: Octoraro Reservoir is on the boundary between Lancaster and Chester Counties at the confluence of the east and west branches of Octoraro Creek.

- Municipalities:
  - Colerain Township, (Lancaster County)
  - Little Britain Township, (Lancaster County)
  - Lower Oxford Township, (Chester County)
- USGS Quadrangles:
  - Kirkwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: The Octoraro Reservoir occupies former agricultural and natural lands that were flooded to provide for a municipal water supply. Much of the surrounding area is owned by the Chester Municipal Water Authority. The uplands are dominated by conifer plantations that help to filter the water entering the reservoir, but provide little natural habitat value. Two species of plants associated with open habitats and a sensitive species of concern can be found in this Natural Heritage Area.

Species of Concern Considerations:

- Maryland golden-aster grows in woodland borders, successional openings, open woods, and serpentine barrens. In Pennsylvania, it is near a northern border of its range, where about 10 populations are currently known in the state. Given the preference of the species for relatively open habitats, active management – such as fire, mowing, or invasive species removal – is often required to maintain the proper successional stage at sites where it grows.
- Toothcup grows on exposed shorelines, stream margins, streambed outcrops, and other damp, open places. In Pennsylvania, it has been documented historically in numerous southern counties, particularly along the Susquehanna River. About 30 populations are currently known from the state. The populations of toothcup that occur along streams and rivers can be enhanced by maintaining the natural seasonal fluctuations in the water level of the stream and the natural conditions of its shoreline. Despite its somewhat narrow habitat requirements, this species appears to be fairly successful in reproducing itself and colonizing new areas. Invasive species may be a threat in some locations.
- A sensitive species of concern was documented nesting along this shoreline of the Octoraro Reservoir. The core habitat for these sensitive species of concern is both the

reservoir, the branches of the Octoraro River and the adjacent upland forest. This sensitive species of concern requires an abundant food source in the aquatic habitats as well as breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the Octoraro River and by protecting and expanding the natural vegetation buffer along the reservoir, the river and all its tributaries. Harassment of nesting locations can cause adults to abandon the site. Additionally, the forested upland area in the core habitat needs to be protected from disturbances during the spring and early summer breeding season. An expansion of the vegetated/forested buffer along the length of the Octoraro River and its tributaries will help improve water quality and nesting habitat and can be the primary factor for continued success of this species at this location.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types.

- Most of the area surrounding the open water lake has been converted to conifer plantations, which typically contribute very little towards native biodiversity, but significant areas of natural communities are still present in scattered patches. Plant communities present include:
  - Terrestrial (upland) communities:
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest
  - Palustrine (wetland) communities:
    - Red maple-elm-willow floodplain swamp
    - Black willow scrub/shrub wetland
    - Bluejoint-reed canary grass marsh
    - Cattail marsh

Ownership: Most, if not all of the immediate shoreline as well as significant portions of the upland habitats are controlled by the Chester County Water Authority and maintained as municipal watershed protection. A residential development occurs outside of a narrow buffer of forest owned by the Water Authority. A few other larger private parcels also occur within this Natural Heritage Area.

Habitat Disturbances:

- Historic –
  - The reservoir itself is the product of disturbance. The small stream valley at the confluence of the east and west branches of Octoraro Creek was flooded to create a municipal water supply reservoir. The area adjacent to the branches of Octoraro Creek had been primarily in agricultural production and scattered wooded areas prior to its flooding.
  - Several historic milldams occurred along the branches and tributaries of the Octoraro River in the vicinity of this Natural Heritage Area. The legacy sediments that are trapped behind the dams alter the topography of the floodplain and trap stream banks in unnatural channels when they are suddenly breached.

- Current –
  - The conifer plantations adjacent to the reservoir help to buffer the reservoir from non-point sources of pollution, but contribute very little to the regional biodiversity. These tree farms are uniform stands of single species of trees with minimal understory composition.
  - Residential development near the reservoir shore can contribute to non-point sources of pollution through runoff of chemicals from lawns, impervious surfaces, and from improperly functioning septic systems.
- Exotic Species –
  - The exotic species composition and threat of this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall:

- Coordinate the protection of this landscape between Lancaster and Chester Counties.
- Protect the natural vegetation along the shore of the reservoir and the integrity of the adjacent uplands by avoiding additional fragmenting features such as roads, residences and utility rights-of-ways.

Within the Core Habitat:

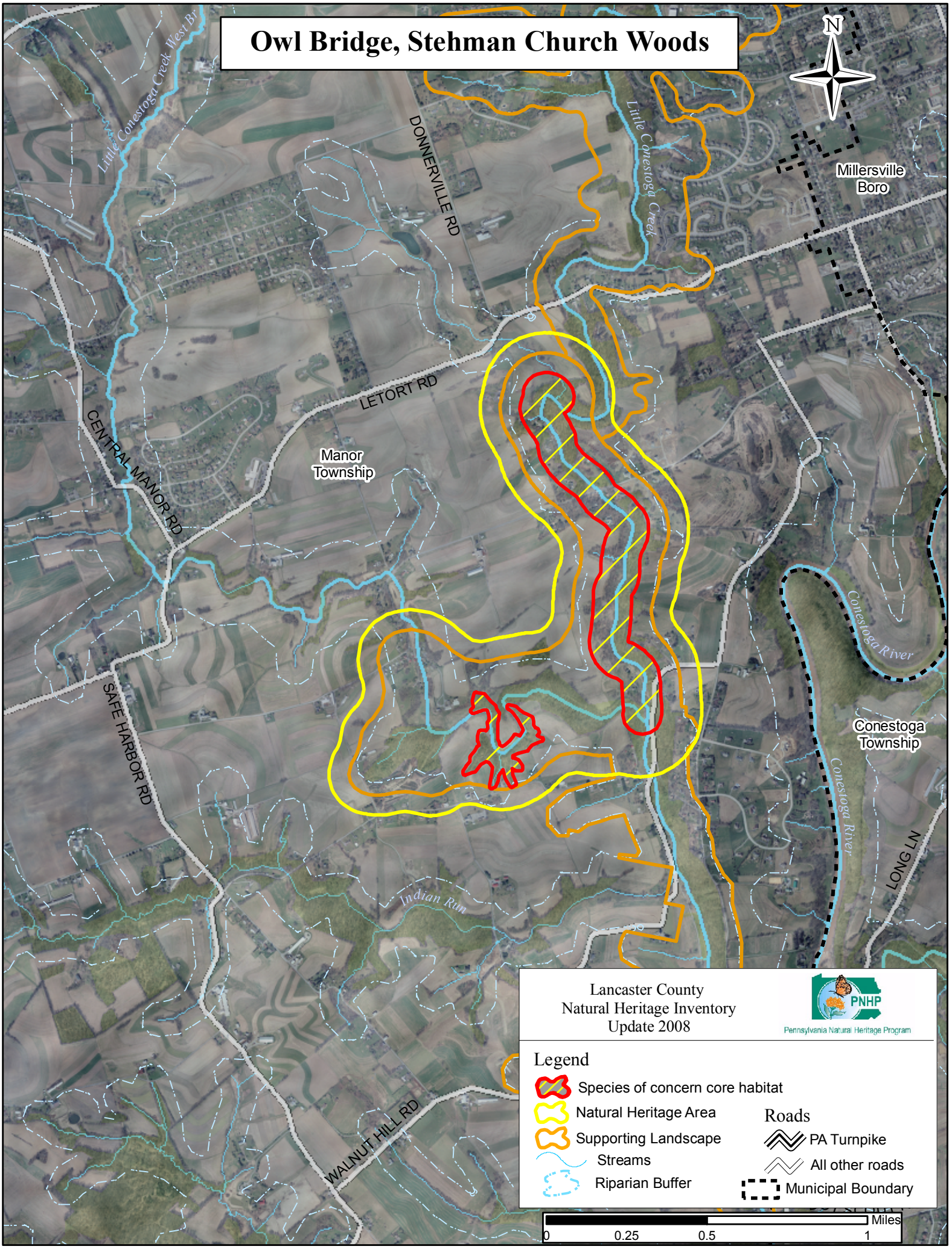
- The sensitive species of concern at this location uses the waters of the reservoir and the nearby tributaries for feeding and the forested uplands for breeding habitat, so both must be considered.
- Avoid building roads, residences and utility rights-of-way though unfragmented patches of forest. Cluster these amenities in existing locations to avoid unnecessary habitat disturbance.
- Replace conifer plantations with native trees and shrubs to mimic quality natural communities in adjacent areas of similar topographic position.

Within the Supporting Landscape:

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- A riparian buffer along all floodplains of all tributaries in the watershed should be restored to native shrubs and trees to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
  - Preserve and improve the water quality of the Octoraro River tributaries to help provide a continued and increased food chain. All tributaries within the adjacent watersheds to this stretch of the river can help improve water quality by decreasing unfiltered runoff from non-point sources of pollution. Restore vegetated riparian buffers along all tributaries to the reservoir.
  - Activities within the supporting landscape should focus primarily on reducing non-point sources of pollution from entering the river environment. Much of the supporting landscape is in active agricultural production. The rainwater runoff from the agricultural fields and pastures should be considered a potential source of significant contamination for the

river. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat.

- Potential conservation zoning options:
  - Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary habitat and farmland destruction.
  - Colerain and Little Britain Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. In addition, Colerain Township extends the floodplain district to the 500-year floodplain. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat. Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
  - Parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those in the 100-year floodplain should be encouraged to regenerate into forest/natural vegetation cover.
- Restoration activities:
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be restored with native trees and shrubs appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings and at the upper edge of floodplains.
  - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
    - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
  - Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain.
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain.


Owl Bridge, Stehman Church Woods
N
Little Conestoga Creek West Br
DONNERVILLE RD
Little Conestoga Creek
Millersville Boro
LETORT RD
CENTRAL MANOR RD
Manor Township
Conestoga River
SAFE HARBOR RD
Conestoga Township
Conestoga River
LONG LN
Indian Run
WALNUT HILL RD
Lancaster County
Natural Heritage Inventory
Update 2008
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Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

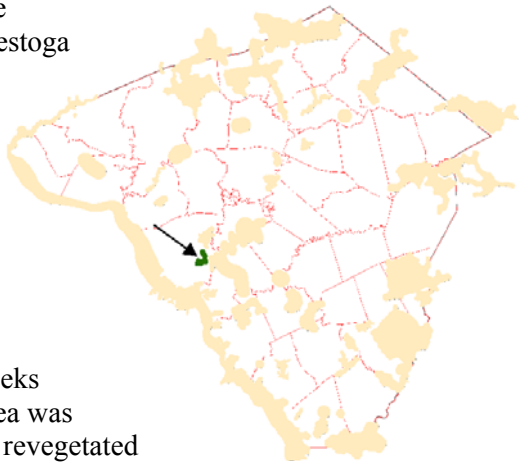
Owl Bridge, Stehman Church Woods – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Jeweled shooting-start (*Dodecatheon radicatum*)	GNR	S2	PT	1984-05-09	C
Limestone petunia (*Ruellia strepens*)	G4G5	S2	PT	1988-07-12	C

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This area southwest of Millersville includes the confluence of the Little Conestoga Creek and the West Branch of the Little Conestoga Creek and the associated upstream habitats.

- Municipalities:
  - Manor Township
- USGS Quadrangles:
  - Safe Harbor quadrangle
  - Conestoga quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP517 & SP547" – (Safe Harbor quadrangle map)



Description: The floodplains and adjacent slopes along these two creeks have seen significant recovery since 1940, when almost the entire area was either farmed or cleared of natural vegetation. The steep slopes have revegetated to young forests and the active floodplain appears to be recovering from past disturbances. Restoration activities should continue with this trend to secure a functioning riparian buffer.

Species of Concern Considerations:

- Jeweled shooting star is a spring wildflower that, in the Susquehanna watershed, prefers moist, shaded north-facing limestone outcrops that tend to exhibit a dripping quality. The habitat at this location can be maintained by protecting the surrounding tree cover, to avoid changing the local microclimate from cool and moist to a much drier and warmer environment. Infestation by invasive species of plants is also a potential problem at this location. A site survey is necessary to establish that the species still occupies this site. Careful removal of invasive species of plants and protection of the upland forest are likely necessary to maintain this population at this location. Additional surveys for this species in similar habitats along both creeks are recommended. Advise the landowner on the importance of these plants and on potential habitat improvements to help maintain its habitat.
- Limestone petunia grows on wooded hillsides, floodplains, and streambanks, especially on calcareous substrates. In Pennsylvania, it has been documented historically in numerous southern counties. About 35 populations are currently known from the state. The viability of populations of limestone petunia and its habitat can be enhanced by maintaining forested conditions on floodplains and streambanks. The population of limestone petunia at this location has not been seen since 1988 despite return visits. Additional habitat for this species exists along the floodplain of both creeks and further surveys are encouraged. If found, seeds from the population should be used to repopulate similar habitat within the nearby area to help secure the future of this population.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry oak-mixed hardwood forest
  - modified successional forest
  - grassland*
- Palustrine (wetland) communities:
  - Silver maple floodplain forest
  - Sycamore (river birch)-box elder floodplain forest
  - wet meadow*

Ownership:

- The Lancaster County Conservancy owns two small parcels within this area.
- The remainder is held in a number of private parcels of varying size. Fragmentation of ownership of the habitat limits the potential for consistent conservation habitat management.

Habitat Disturbances:

- Historic –
  - The area surrounding these two creeks has been cleared, cultivated and developed for over 200 years. The variety of natural communities that once occupied this area were replaced by the agrarian landscape modifications of the European colonists to provide for food, clothing and shelter for a growing population. A review of aerial photos from the 1940s shows that the land was so efficiently converted to agricultural production, that very little natural habitats remain anywhere within this Natural Heritage Area.
  - Two mill dams historically impounded portions of both creeks. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain and the creek bed in the process.
- Current –
  - The habitat of the floodplain and adjacent slopes along both creeks has improved significantly since 1940. The adjacent slopes are mostly forested, and much of the floodplain appears to be out of agricultural production and not impacted by development activities. Though the habitat would benefit from an expansion in width of the adjacent forested habitat, this area is progressing towards a good example of riparian buffer restoration.
- Exotic Species –

Conservation Actions:

Overall:

- The long term goal for the area should be to conserve/restore the mature floodplain forests and the associated upland buffer forests along the Little Conestoga Creek, the West Branch of the Little Conestoga Creek and their tributaries. Restoration efforts should be designed to mimic the adjacent natural community type in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Restoration is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants. The habitats at this location are well on their way towards a functioning riparian buffer, and with additional attention could become a model for other restoration activities.

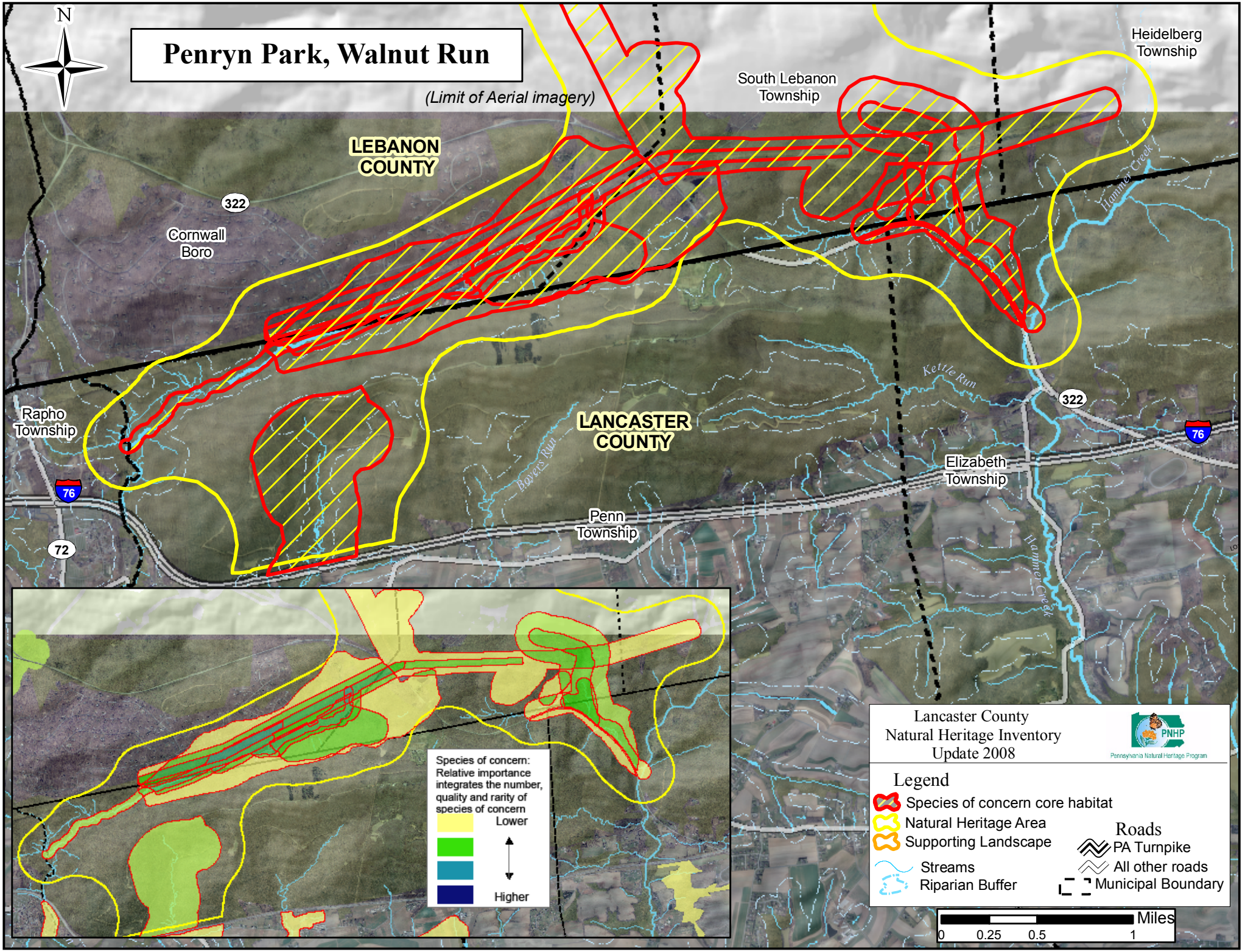
- Restoration activities should also strive to connect this Natural Heritage Area to adjacent ones though the expansion of native vegetation within the riparian buffer corridor of both creeks and their tributaries.

Within the Core Habitat:

- Protect natural habitats along the creek floodplain through land acquisition, conservation easements, and riparian restoration initiatives.
- Work with the current landowners to establish a corridor of native vegetation within 100 meters of the creek's edge or 100 feet where development has already precluded this option.
- Restoration of vegetated stream buffers along the creek and its tributaries will help increase the quality of the habitat for the species of concern and other native plants and animals while improving water conditions for the County, the Susquehanna River and the Chesapeake Bay.
- Properties abutting the creek floodplain should be encouraged to restore native tree, shrub and herbaceous vegetation.
- Incorporate a public space / natural corridor into any future subdivision development plans along the creek and its tributaries.

Within the Supporting Landscape:

- Expand and restore natural areas along both streams and around core habitat.
  - Allow cropland or pasture adjacent to core habitats to return to forested or native floodplain vegetation in order to provide a buffer from disturbance.
  - Reforest streamside corridors in appropriate areas. This will expand potential habitat and protect water quality.
    - Careful determination is needed to avoid planting trees in floodplains that contain wet meadows or shrublands. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
  - Historic milldams occurred along this portion of the Little Conestoga Creek and West Branch Little Conestoga Creek. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts.
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
    - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
- Zoning options for conservation enhancement:
  - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for much of the habitat adjacent to both creeks, including the immediate habitat for the jeweled shooting star.
  - Manor Township has a zoning ordinance restricting construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain habitat to many unsuitable uses.
  - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.


N
Penryn Park, Walnut Run
(Limit of Aerial imagery)
LEBANON COUNTY
LANCASTER COUNTY
Heidelberg Township
South Lebanon Township
Cornwall Boro
Rapho Township
Penn Township
Elizabeth Township
322
76
72
Hammer Creek
Kettle Run
Bowers Run
Species of concern: Relative importance integrates the number, quality and rarity of species of concern
Lower
Higher
Lancaster County Natural Heritage Inventory Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

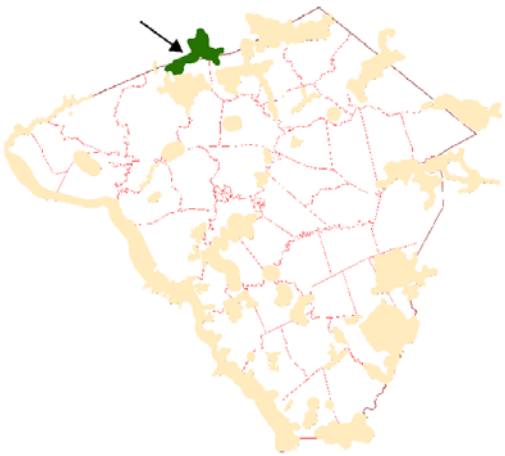
Penryn Park, Walnut Run– *Exceptional significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	1997-06-11	D
Torrey's rush (*Juncus torreyi*)	G5	S2	PT	2002-08-01	BC
Virginia bunchflower (*Melanthium virginicum*)	G5	SU	N	2002-06-21	B
Bog bluegrass (*Poa paludigena*)	G3	S3	PT	2001-06-15	BC
Sensitive species of concern (A)[3]	-	-	-	2002-07-19	B
Sensitive species of concern (B)[3]	-	-	-	2002-04-26	BC
Animals:					
Sensitive species of concern (C)[3]	-	-	-	1987-05-18	B
Sensitive species of concern (D)[3]	-	-	-	2001	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location:

- Municipalities:
  - Elizabeth Township, Lancaster County
  - Penn Township, Lancaster County
  - Rapho Township, (Lancaster County)
  - Cornwall Borough, (Lebanon County)
  - Heidelberg Township, (Lebanon County)
  - South Lebanon Township, (Lebanon County)
- USGS Quadrangles:
  - Lebanon quadrangle
  - Lititz quadrangle
  - Manheim quadrangle
  - Richland quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP509" – (Manheim quadrangle)



Description: This large Natural Heritage Area includes portions of State Game Lands #156 and the YMCA Camp Shand or Penryn Park. The Horseshoe Trail also passes though this area. The landscape is mostly forested on top of diabase and sandstone bedrock. The forest is fragmented by encroaching residential development and a utility rights-of-way, which passes though a wetland. Interestingly, the vegetation clearing done on the utility rights-of-way has helped to provide the habitat conditions favorable for several species of concern. Other species of concern use different portions of this Natural Heritage Area. Overall, eight species of concern are known from within this area.

Species of Concern Considerations:

- Puttyroot grows in moist woodlands and on forested slopes and streambanks. In Pennsylvania, about 40 populations are currently known, primarily in southeastern counties. The known populations of puttyroot have threats from habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.
- Torrey's rush typically requires damp to seepy disturbed soil in full sun. At this location, it is found within the open conditions maintained by the utility rights-of-way though this area. Periodic vegetation management, especially for the control of invasive species of plants, will likely be necessary to retain the conditions favorable for this species.
- Virginia bunchflower occurs in rich woods, thickets and along the margins of swamps and bogs. At this location, the opening maintained by the utility rights-of-way helps to provide the preferred habitat of this species.
- Bog bluegrass has a range primarily in the Great Lakes states and mid Atlantic states, from New York south into North Carolina and west into Minnesota and Iowa. Despite this relatively large range, this species is considered globally vulnerable to extinction due to its limited number of occurrences worldwide. In Pennsylvania, it has been documented historically in numerous widely scattered counties. It grows in swamps, seepy woods, and along spring-fed streamlets. About 30 populations are currently known from the state. The areas supporting populations should be managed in a way that ensures the continuation of excellent water quality and neutral or calcareous water chemistry.
- Two additional sensitive plant species of concern (A & B) and two sensitive animal species of concern (C & D) also occur within this large Natural Heritage Area.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).
A large portion of this Natural Heritage Area lies in Lebanon County and is outside of the area delineated for Natural Communities. The area is primarily dominated by a dry oak-heath forest, but contains a number of other community types as well. Those natural communities within Lancaster County or near to the border include:

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Tuliptree-beech-maple forest
  - Dry white pine (hemlock)-oak forest
  - Dry oak-mixed hardwood forest
  - Dry oak-heath forest
  - modified successional forest*
  - juniper-mixed shrub woodland*
  - shrubland*
  - wet meadow*
  - grassland*
- Palustrine (wetland) communities:
  - Hemlock-mixed hardwood palustrine forest
  - Red maple-black gum palustrine forest

Ownership:

- Most of this Natural Heritage Area in Lancaster County is under the jurisdiction of the PA Game Commission as State Game Lands #156.
- The YMCA Camp Shand (Penryn Park) owns a portion of this area.
- The Lancaster County Conservancy owns several parcels adjacent to this Natural Heritage Area, which helps to provide a buffer to the species of concern core habitat.
- Other parts of this area are privately owned.

Habitat Disturbances:

- Historic –
  - Aerial photos from the 1940 show this area as almost completely forested at that time, indicating it had not been converted to agricultural production in the recent past. In 1940 this large forested area was largely undisturbed and represented a significant expanse of natural habitat for the county.
  - A large clear cut logging operation had recently been completed south of the YMCA camp in 1940 leaving a network of logging trails.
  - A narrow utility rights-of-way was cut through the forest.
  - Several roads were built though this large forested area connecting Lancaster and Lebanon Counties.
- Current –
  - The utility rights-of-way has been widened significantly since 1940.
  - The PA Turnpike skirts the southern border of this large forested area, avoiding the forest, but creating a nearly impassible barrier between this forest and points to the south.
  - A large part of this forest in Lebanon County has been severely fragmented by recent residential development. This has fragmented the otherwise unbroken forest, and has created avenues into the forest interior for invasive species of plants and animals.
  - Several large clearings and associated access roads have been created on the State Game Lands to provide food plots for game animals, but effectively shattering the available interior forest habitat.
- Exotic Species – Many exotic species dominate portions of the utility rights-of-way and the edges of roads and food plots. Some of these include:
  - Norway maple (*Acer platanoides*)
  - Tree-of-heaven (*Ailanthus altissima*)
  - Garlic mustard (*Alliaria petiolata*)
  - Japanese barberry (*Berberis thunbergii*)
  - Autumn olive (*Elaeagnus umbellata*)
  - Japanese honeysuckle (*Lonicera japonica*)
  - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
  - Japanese stilt grass (*Microstegium vimineum*)
  - Multiflora rose (*Rosa multiflora*)

  Control options for invasive plants range from mechanical to chemical (see individual fact sheets). High priority for invasive species control at this site should be targeted towards removing small populations of newly established invasive plants in the most weed-free areas of the Natural Heritage Area , in particular bush honeysuckles, multiflora rose and tree-of-heaven. Invasive species control efforts should try to maintain weed-free areas first, and then concentrate on removing invasive species in lightly infested areas, continually pushing back the line of invasion. This needs to be an unending process of monitoring and control efforts.

Conservation Actions:

Overall: Coordinate the conservation of this landscape between Lancaster and Lebanon Counties.

Within the Core Habitat:

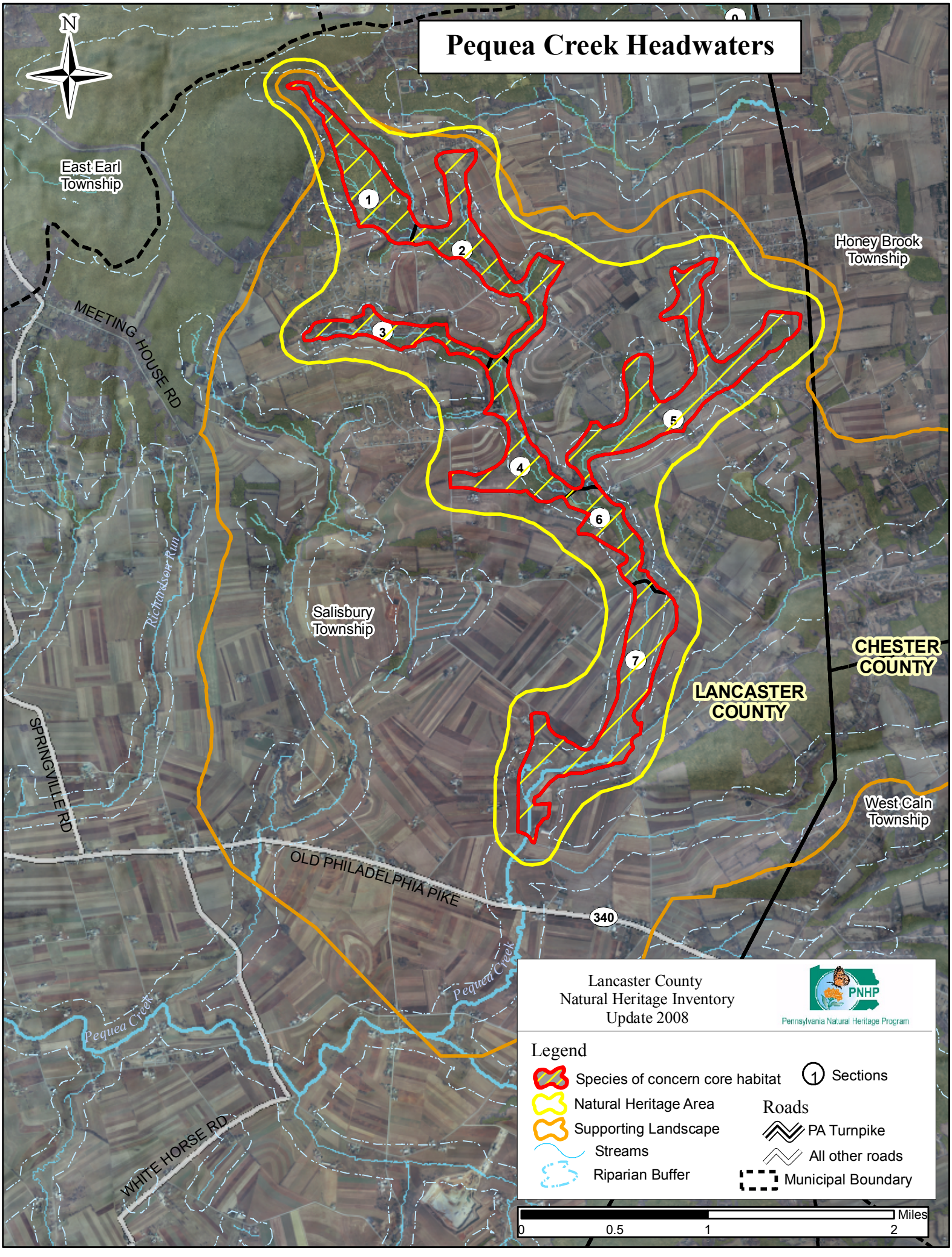
- Provide for the long-term protection of the core habitat.
  - Much of the core habitat is owned by the PA Game Commission and is not currently considered to be of concern for conversion to incompatible uses. The creation of additional food plots and access roads should be avoided.
  - Avoid additional fragmenting features.
  - Consider fee-simple acquisition, transfer of development rights or conservation easement options with the largest property owners of the core habitat outside of the PA Game

Commission property holdings to help expand the protected habitat spanning the Lancaster / Lebanon boundary.

- Maintain the open habitats along the utility rights-of-way. This wet opening helps to provide the habitat requirements of several of the species of concern known from this location.
- The dyked wetlands and farm ponds that occur in this area should not be repaired or replaced; rather, their basins should naturally revert to their original condition.
- Remove invasive species of plants and encourage native tree and shrub recruitment. Improve the forest composition by removing non-native trees and shrubs.
  - The understory of many parts of the forest is dominated by invasive species of shrubs. Invasive species removal, especially surrounding food plots and their access roads should be a priority conservation activity in this area.
  - Reduce the size of the deer herd. Uncommon native species of plants are particularly susceptible to deer herbivory.
  - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
  - Coordinate invasive species management within the utility rights-of-way.
  - Continual invasive species monitoring and control is recommended.
- Additional surveys for species of concern are recommended.

<u>Within the Supporting Landscape:</u>

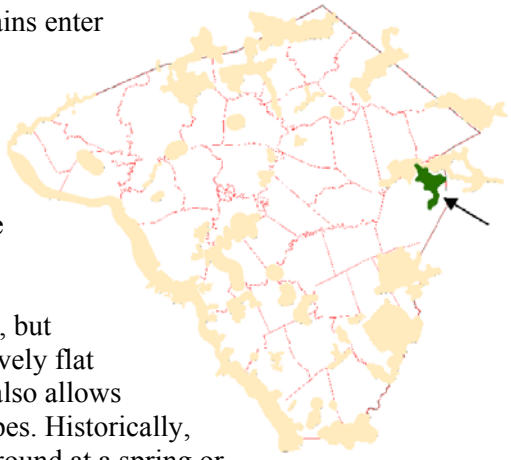
- Preserve the intact forest canopy. This site is part of one of the most contiguous tracts of forest in the county and forested land extends well beyond the Natural Heritage Area. Establish permanent protection and maintain connectivity to adjacent forested land to provide a large expanse of interior forest habitat as well as an extensive habitat corridor linking to similar habitats out of the county.
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-ways.
- Growth within the Township should be discouraged within the core habitat, supporting landscape or Natural Heritage Area identified for this location.
- Restore and enhance the habitat connections between the north and south sides of the PA Turnpike. This could be achieved by the construction of green underpasses, overpasses and culverts. Restoration at key locations can help re-establish the migratory corridor function to the landscape.
- Elizabeth, Penn and Rapho Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
  - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
  - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal forested stream buffer should be at least 100 meters in width from the upper edge of the 100-year floodplain.
    - An intermediate forested stream buffer should be at least 100 feet in width from the upper edge of the 100-year floodplain.
    - A minimum forested buffer should be at least 35 feet in width from the upper edge of the 100-year floodplain.


Pequea Creek Headwaters
N
East Earl Township
Honey Brook Township
MEETING HOUSE RD
Richmondale Run
Salisbury Township
CHESTER COUNTY
LANCASTER COUNTY
West Caln Township
SPRINGVILLE RD
OLD PHILADELPHIA PIKE
340
Pequea Creek
Pequea Creek
Pequea Creek
WHITE HORSE RD
1
2
3
4
5
6
7
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Sections
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
2

Pequea Creek Headwaters – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Sensitive species of concern [3]	-	-	-	2001-06	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection



Location: The tributaries that flow south from the Welsh Mountains enter the agriculturally dominated landscape of Pequea Creek valley.

- Municipalities:
  - Salisbury Township
- USGS Quadrangles:
  - Honeybrook Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: This portion of the Pequea Creek watershed is in a landscape that has long been dominated by agricultural activities, but is quickly being converted to residential development. The relatively flat topography of the region, while being conducive to agriculture, also allows water to pool in low lying areas, creating wetlands of varying types. Historically, wetlands likely existed at most locations where water exits the ground at a spring or where the floodplain widened considerably. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries, but some remain or have recovered from a cessation of these activities. These wetland fragments should be considered the backbone for a restoration of this habitat type in the Pequea Creek watershed.

Species of Concern Considerations:

- The sensitive species of concern inhabiting these wetland habitats requires specific plant communities with a matrix of open canopied habitats. Conservation and reestablishment of the marshes along Pequea Creek and its tributaries will help to provide the necessary habitat for the continued survival of this species. Woody vegetation removal may be necessary to maintain wetland openings preferred by this species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*)

- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry oak-heath forest
  - modified successional forest*
  - grassland*
- Palustrine (wetland) communities:
  - Tussock sedge marsh
  - wet meadow*
- This Natural Heritage Area is largely dominated by agriculture with scattered patches of natural habitats primarily along streams that help to form a habitat corridor through the area. There is a

large forested area abutting this Natural Heritage Area to the north which provides part of an important regional migratory corridor connecting to other habitats outside of the county.

Ownership: All of this area is privately owned. Most of the habitat along Pequea Creek and its tributaries are currently held in larger parcels and are under active agricultural production. Numerous residential housing developments are replacing the larger agricultural parcels with many smaller residential lots. Future ownership fragmentation along the banks of the branches of Pequea Creek may impede future conservation actions. Conservation action along the creek corridor should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover and the wetlands drained or dammed to accommodate the expansion of intensive agriculture that we see today.
  - Aerial photos of the area taken in 1940 show that many streams and creeks, though flowing through agricultural landscapes, had wide naturally vegetated floodplains, providing a framework for a natural habitat corridor. Other streams though this area were cultivated or grazed right to their banks, providing no vegetated buffer for water quality protection or natural habitat.
  - Several milldams were active along this stretch of Pequea Creek. Milldams frequently trapped many tons of sediment behind them, altering the topography of the floodplain in the process. When the dams were breached, the streams frequently cut a deep channel through the accumulation of sediment. Many of these stream reaches of the Pequea Creek watershed remain trapped in these deep narrow channels.
- Current –
  - Residential development has increased considerably in the area, replacing farmland, forests and natural habitat in the area including one development ironically called “Farm View Acres”.
  - A few wet meadow habitats appear to have been recently ditched to drain the fields to make them more suitable for agricultural production.
  - Recent farm ponds have been constructed in what had formerly been wetland and floodplain habitats.
- Exotic Species – The natural disturbance of seasonal flooding in conjunction with agricultural clearing creates ideal conditions for many introduced species of plants. Consequently, the creek floodplain is prone to invasion from a large number of invasive species.

Conservation Actions:

Overall: Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site.

Within the Core Habitat:

- The long term goal for this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were compatible with the species of concern found at this site.

- The species of concern known from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
  - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
  - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
  - Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be encouraged, in order to recreate the natural flows of the landscape.
  - Because several of the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within this Natural Heritage Area.
  - Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.
- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the branches of Pequea Creek and its tributaries:

Stream section ID	Recommendation				
	1	2	3	4	5
1	B	I			
2	B	C	D		
3	A	B	C	D	
4	B	C	I		
5	A	B	C	D	H
6	B	I			
7	B	C	D	H	

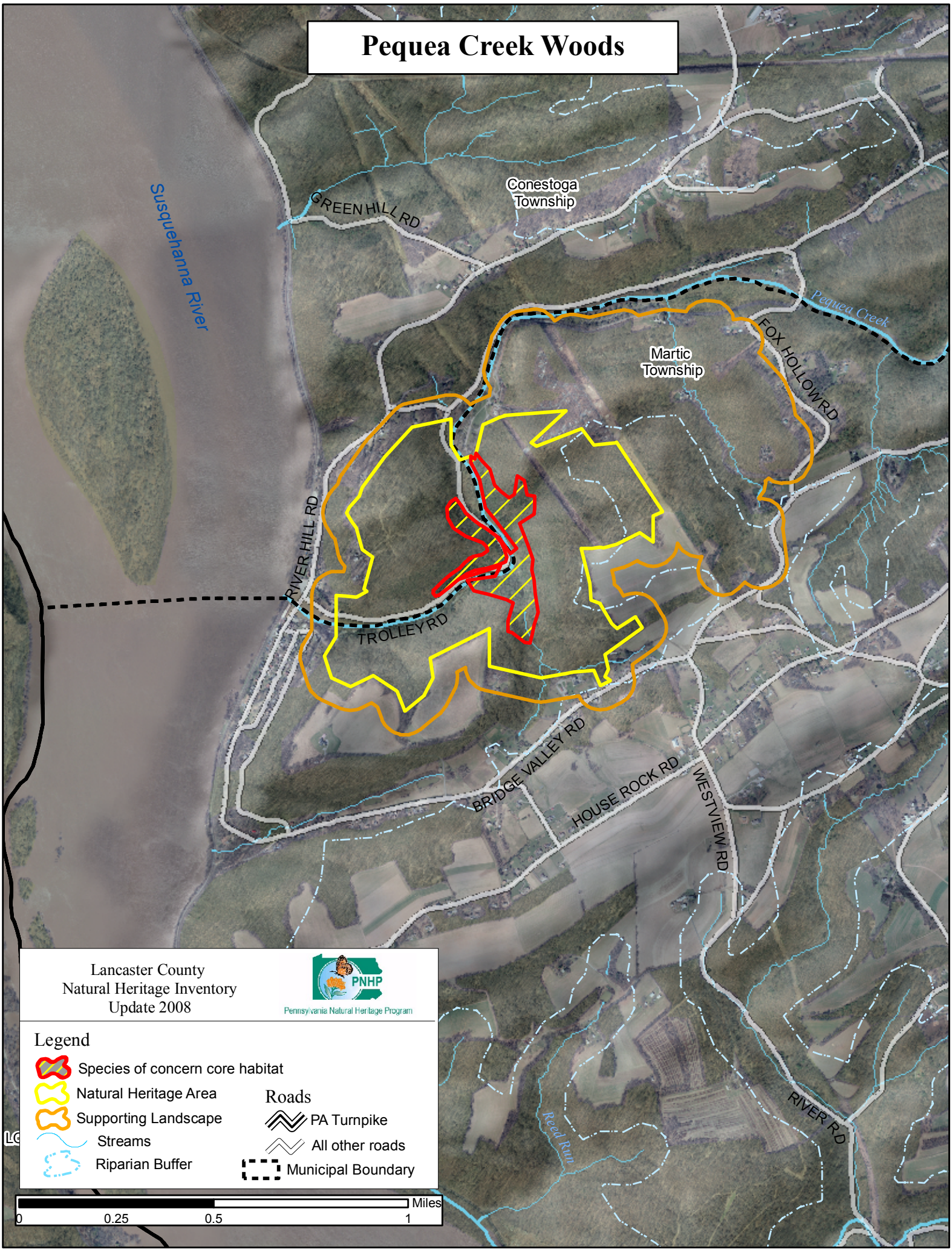
A. The dyked wetlands and farm ponds that occur in this stretch should not be repaired or replaced, rather, their basins should naturally revert to their original condition.
B. Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
C. Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
D. Existing wet meadows should not be modified (i.e. dammed, planted in trees or farmed).
E. Current land use is compatible with this section; sparsely pasturing animals in this area could benefit the habitat.
F. Legacy sediments should be removed above the former mill dam.
G. Any remaining railroad tracks that may exist along the abandoned railway corridor should be removed.
H. The heavy agriculture in portions of this area should be allowed to revert back to natural drainages; light to moderate grazing in this area would be compatible.
I. The wetlands in this area could be improved by active management to setback succession by cutting trees and shrubs.
J. Maintain a matrix of different wetlands with ample shallow marshy areas.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- There are multiple landowners that own the property within this Natural Heritage Area. Pursue conservation easements, transfer of development rights, fee simple acquisition and other programs that may help preserve and fund restoration activities of the wetlands and

riparian buffers on properties along the branches of Pequea Creek and its tributaries to help conserve and improve its effectiveness as a natural corridor.

- Avoid subdivision of large parcels as this would likely impede broad conservation initiatives. Agricultural zoning is compatible with this Natural Heritage Area.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils and those in the 100-year floodplain should be encouraged to regenerate into natural vegetation cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
- Reestablishment of the wide floodplain and its associated wetlands, swamps and wet meadows would serve as an effective buffer to flooding that may occur downstream.
- Salisbury Township has a zoning ordinance restricting new construction within the 500-year floodplain of all waterways. Strict enforcement of this regulation will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict tilling of fields and chemical or nutrient application within the floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    1. In addition, the floodplain regulation should remove farm pond construction from its list of permitted uses.
- Salisbury Township has an additional zoning option intended to help contribute toward conservation of ecologically sensitive habitats. The Open Space Zone "…seeks to protect environmentally-sensitive areas of the Township that also have significant value for passive/active recreation pursuits. Specifically, forested areas, steep slopes, stream and creek valleys, lakes and floodplains are included. Permitted uses within this zone encourage the most appropriate conservation/recreation activities for these areas; however, some forms of development are allowed under prescribed criteria."
    a. Unfortunately, this zoning option allows single family detached dwellings to be built on 1-acre lots within the district, reducing its effectiveness for retaining the intact quality of these habitats. This district should be updated to prohibit this building activity from this district to help conserve the remaining unbroken continuity of the forested landscape in this Township.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - An ideal vegetated stream buffers should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
    - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
    - A minimum vegetated buffer should me at least 35 feet in width from the edge of the 100-year floodplain.


Pequea Creek Woods
Susquehanna River
GREEN HILL RD
Conestoga Township
Pequea Creek
FOX HOLLOW RD
Martic Township
RIVER HILL RD
TROLLEY RD
BRIDGE VALLEY RD
HOUSE ROCK RD
WESTVIEW RD
RIVER RD
Reed Run
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

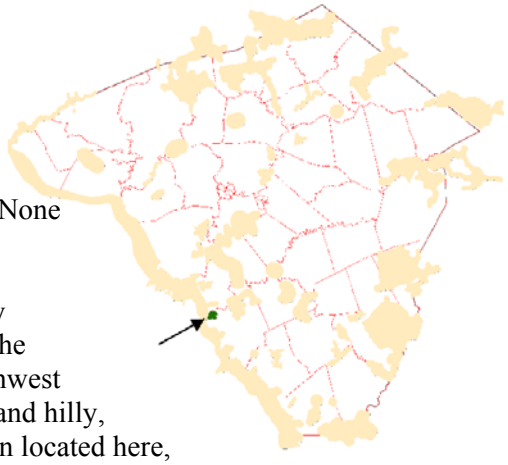
Pequea Creek Woods – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Lobed spleenwort (*Asplenium pinnatifidum*)	G4	S3	PR	1995-04-26	CD
Cranefly orchid (*Tipularia discolor*)	G4G5	S3	PR	1995-04-26	D
Susquehanna trillium (*Trillium sp.*)	G?	S?	TU	2006-04-10	A

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location:

- Municipalities:
  - Conestoga Township
  - Martic Township
- USGS Quadrangles:
  - Conestoga Quadrangle
- 1990 Lancaster County Natural Areas Inventory reference: None



Description: Pequea Creek, at its confluence with the Susquehanna River, is hemmed in by steep forested slopes that rise approximately 300 feet from the stream banks to the hill summits. This section of the creek forms the boundary between Conestoga Township to the northwest and Martic Township to the southeast. Most of this area is forested and hilly, with several patches of interior forest. Besides the species of concern located here, the forested areas provide habitat for plants and animals excluded from most other areas of Lancaster County. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor.

Species of Concern Considerations:

- The lobed spleenwort is a small fern that utilizes the shaded rock outcrops as its primary habitat. The viability of existing populations of lobed spleenwort and its rock outcrop habitat may be enhanced by maintaining a forested buffer. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. Additional surveys are recommended to more accurately determine the current extent of this species.
- In Pennsylvania, cranefly orchid can be found mostly in the southeast where it grows in moist deciduous forests and along stream banks. The entire rich, moist, forest environment should be considered potential habitat for this plant. Cranefly orchid populations are threatened by the loss of their rich woodland habitat. These high quality woodlands may also be altered by encroachment of invasive species, over-browsing by deer, and forest fragmentation. Fragmentation of the forest by roads, logging operations and other interior forest disturbances can have a drying effect on the habitat and promote invasive species growth. Maintenance of known populations and preservation of the communities where cranefly orchid grows will be crucial to its survival. Creating buffers around fragmented habitat and removal of invasive species will help to maintain populations and encourage new population growth. The

management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

- Susquehanna trillium, a form of trillium of indistinct taxonomy, is found in great profusion among some of the ravines of the lower Susquehanna River, is also present at this location. This plant has an unclear taxonomic status, as it may represent a form of the declined trillium (*Trillium flexipes*), a white-flowered form of the purple trillium (*Trillium erectum*), or possibly a hybrid between these two species. This taxonomic puzzle needs to be investigated further, but either way, the populations of these trilliums are worthy of conservation action. Conservation of the rich forested habitat should provide the protection needed for this species. Unauthorized collection for wildflower gardens is also a potential threat.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Tuliptree-beech-maple forest
  - Dry oak-heath forest
  - modified successional forest*
  - shrubland*
  - grassland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest

- This Natural Heritage Area contains several forest community types as delineated from aerial photography. Tuliptree-beech-maple hardwood forest dominates most of his area. Dry oak-heath forest occurs on portions of the hillsides. Bottomland in the floodplain of the creek contains a small sycamore (river-birch)-box elder floodplain forest. Hemlock-tuliptree-birch forest occupies the steep slopes at a tight bend in the creek, which is also the primary habitat for both of the species of concern known from this location.
- Two large interior forest patches occur with this area. The creek, and the road on its western shore, separate the two large interior forest blocks. The topography is varied and convoluted, with steep slopes interspersed with relatively flat hill tops.

Ownership: This Natural Heritage Area straddles the boundary between Martic & Conestoga Townships.

- PPL Corporation owns roughly half of the species of concern core habitat. PPL allows public access to these lands.
- There are several primary landowners that own the remaining land within this Natural Heritage Area.
- There are numerous small holdings along the Martic Township side of the Creek, most with cottages, or houses. These houses were likely used as summer cottages in the past and appear to have been converted to full time residences.

Disturbances:

- Historic – Historical aerial photos from 1940 reflect that little has changed in the area in the past 60 years. Houses and cottages occurred along the Martic Township side of the lower reaches of Pequea Creek. A few houses were already present on top of the hill overlooking the Susquehanna River on the Conestoga Township side of the creek with a nearby cultivated field. The utility rights-of-way were already in place.
- Current – There are few disturbances apparent within this area. A campground occurs in the floodplain of the creek. There is a network of ATV/logging trails on top of the hill

overlooking the Susquehanna River in Conestoga Township. A mobile home park exists within the forested landscape to the northeast of the Natural Heritage Area. These features fragment an otherwise intact landscape.

- Exotic Species – Invasive species were not considered an extensive problem during surveys in 1991 and 1994. Invasive species noted during surveys included:
  - Garlic mustard *(Alliaria petiolata)*
  - Japanese honeysuckle (*Lonicera japonica*)
  - Barberry (*Berberis thunbergii*)
  - Ivy-leaved speedwell (*Veronica hederifolia)*

Additional ground surveys should be conducted to determine the current invasive species control needs at this location as the spread of invasive plants has been significant throughout the county.

Conservation Actions:

Overall:

- Approximately half of this area is currently owned by the PPL Corporation, which allows public access to the site. While providing the primary habitat for the populations of cranefly orchid, cliff spleenwort and trillium, the forested landscape also helps to protect water quality of the small streams that drain through this area into Pequea Creek and provides refuge for other forest dependent species.
- Conservation priorities should be to conserve the current forest cover in its current condition, and to improve or expand the amount of forest cover in non-forested areas. The forest cover should be allowed to achieve old-growth characteristics.

Within the Core Habitat:

- Provide for the long-term protection of the species of concern core habitat.
  - The steep, rocky nature of the immediate habitat of the species of concern likely precludes most types of development activity. Road widening or maintenance activities could impact the species of concern at this location. Indiscriminate roadside herbicide use is inappropriate for this location.
  - Approximately half of the species of concern core habitat is owned by PPL Corporation and is currently considered to be of secondary concern for conversion to incompatible uses.
    - First, consider fee-simple acquisition, or conservation easement options with the largest property owners of the core habitat outside of the PPL Corporation property holdings.
    - Second, consider fee-simple acquisition, or conservation easement options with the PPL Corporation property holdings.
- Conserve the intact forest canopy
  - Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way.
- Remove invasive species of plants.
  - Though invasive species are not currently considered an extensive problem at this location that is exactly the reason to take an aggressive approach to invasive species control. It is much easier and more effective to keep a place weed-free than to try and repair a heavily infested habitat.
  - Invasive species management needs to be coordinated by individuals familiar with the native species as well as the invasive species present.
  - Coordinate invasive species management along roadways and within the utility rights-of-way. Spot treating aggressive invasive plants with appropriate herbicides

may be necessary along the utility rights-of-way. Establish native shrubs and herbs under power lines to help prevent recolonization by invasive species.
    - Continual invasive species monitoring and control will be necessary.

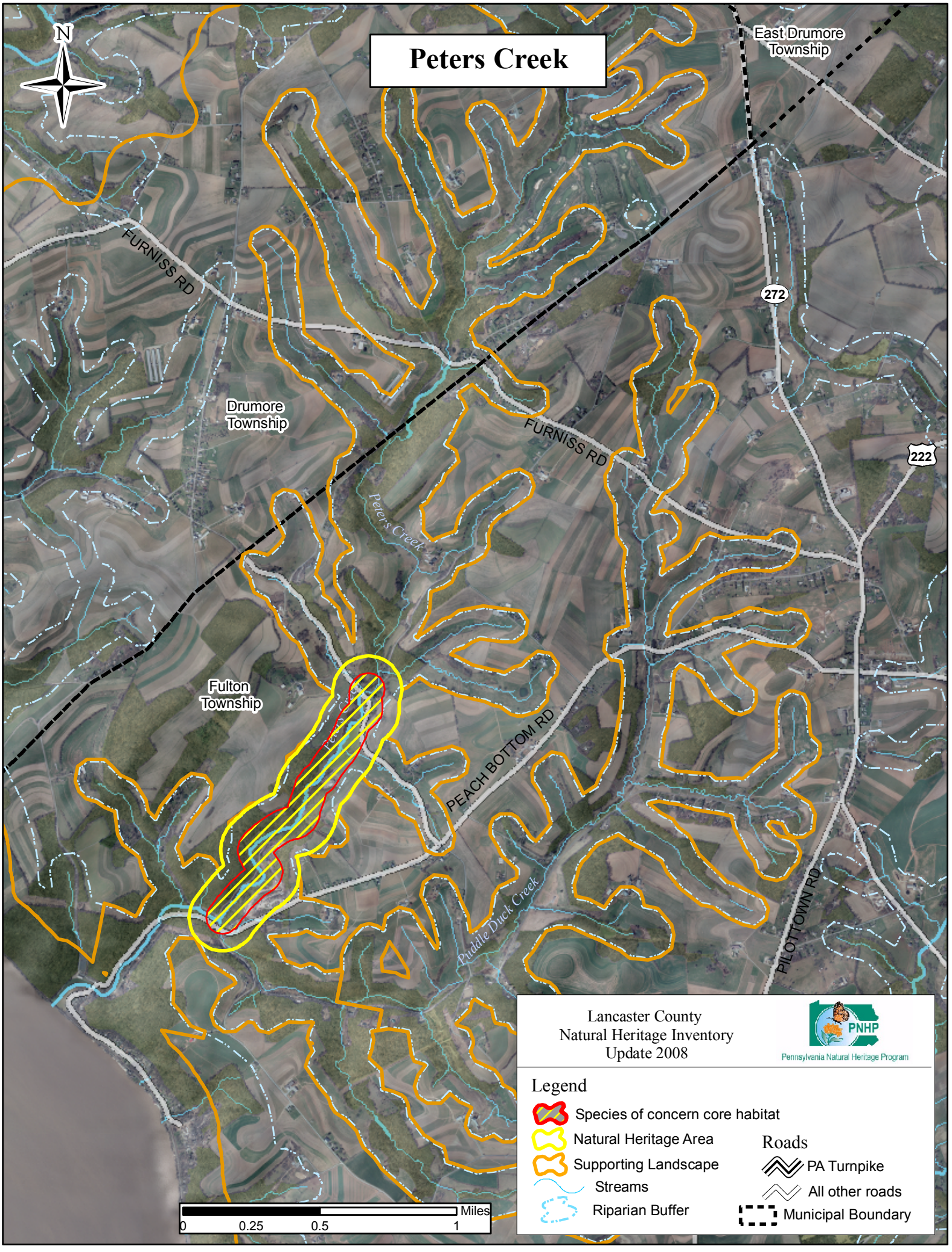
Within the Natural Heritage Area / Supporting Landscape:

- Conservation easements should be sought for adjacent forested and agricultural properties to provide a buffer to this habitat and to help provide connectivity to other nearby Natural Heritage Areas. Additional populations of species of concern could occur on adjacent parcels.
- This Natural Heritage Area was drawn to exclude the most disturbed portions of the adjacent habitat. The utility rights-of-way are currently the primary sources of disturbance within the area. These linear openings fragment the forest habitat, increasing edge to interior forest ratio and reduce the available habitat for forest interior species. They also act as actual barriers to animals that will not venture into open habitats. Despite these disturbances to the forested habitat, these clearings can also provide important habitat for many native species adapted to increased light levels.
    - Care must be taken to distinguish between clearings that are composed of native vs. introduced vegetation and managed accordingly.
    - Forested areas with full canopy cover should be established within the utility rights-of-way in appropriate locations to act as habitat bridges for animals & plants.
        - This will be most easily accommodated in low elevation areas between hills, where power line function will not be affected by a mature tree canopy.
        - Native shrubs and shorter understory trees should be used where the wire height may be impeded by mature canopy trees.
        - Native short shrubs and herbaceous species should be encouraged where wire height is lowest.
- Adjacent forested properties should be acquired or provided with conservation easements to help provide a buffer to this habitat. Additional populations of species of concern could occur on adjacent parcels.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus and tilth.
        - Trees that have fallen over approved trails can be cut through as necessary.
    - Removal of non-native trees will be necessary. The upland habitats at the edges of this preserve are the primary location of non-native trees within this area. Focus tree removal efforts on tree-of-heaven (*Ailanthus altissimus*) and Norway maple (*Acer platanoides*)
- Encourage native tree and shrub recruitment.
    - Reduce the size of the deer herd. Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
    - Deer fencing may be necessary to allow native species recruitment.
    - Native tree and shrub planting may be necessary.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
    - Block access to forested areas by off road vehicles, ATVs, motorcycles and bicycles.
- Additional surveys for species of concern are recommended. Recent surveys for the plant species of concern, harbinger of spring (*Erigenia bulbosa*), have not succeeded in finding this

plant though the habitat is appropriate for this species. Past historical biological surveys have also documented the following species to have occurred in the area:

- Umbrella-tree (*Magnolia tripetala*)
- Rough green snake (*Opheodrys aestivus*)

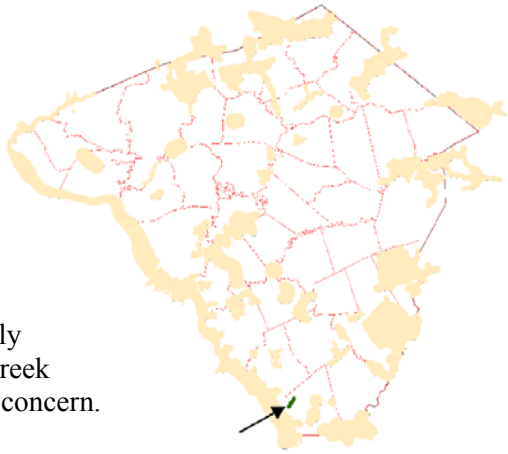
- A campground exists along the eastern edge of the Natural Heritage Area and negatively impacts the natural habitat. The campground should not expand beyond its current footprint. Year-round camping facilities should be discouraged as they tend to develop into permanent dwellings.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
  - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
  - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
  - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
- <u>Potential zoning options for conservation enhancement:</u>
  - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 2/3 of the area.
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be encouraged to conserve this attribute.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
  - Growth within the Township should be discouraged to occur within the core habitat or supporting landscape identified for this area.


Peters Creek
N
East Drumore Township
FURNISS RD
272
Drumore Township
FURNISS RD
222
Peter's Creek
Fulton Township
PEACH BOTTOM RD
Puddle Duck Creek
PILOTTOWN RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Peters Creek – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Elephant's foot (*Elephantopus carolinianus*)	G5	S1	PE	1992-03-22	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Fulton Township
- USGS Quadrangles:
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Peters Creek flows through a partially wooded, partially agricultural landscape. Wet meadows within the floodplain of the creek provide the necessary habitat for elephant's foot, a plant species of concern.

Species of Concern Considerations:
- Elephant's foot grows in open woodlands, woodland borders, and serpentine barrens, often in somewhat disturbed conditions. In Pennsylvania, it represents a southerly species and occurs at a northern border of its range, and has been found in a few southern, particularly southeastern, counties. About 10 populations are currently documented from the state. Since the species may occupy disturbed habitats, active management may be required to create the proper successional stage and ecological conditions for the species to thrive. At this location, elephant's foot is growing along the floodplain of Peters Creek in a wet meadow that may be used as a pasture.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types(*).

The habitat along either side of Peters Creek is dominated by modified successional forest, a characteristic weedy forest type that frequently follows heavy disturbance such as recent agricultural activity or repeated logging. This habitat type is usually dominated by early successional trees and shrubs including many invasive species. Restoration of this habitat type should try to mimic nearby higher quality natural communities in similar topographic and hydrologic settings. Natural Communities identified for this area include:
- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry oak-heath forest
  - Dry oak-mixed hardwood forest
  - modified successional forest*
  - shrubland*
- Palustrine (wetland) communities:

- Sycamore (river birch)-box elder floodplain forest

Ownership:

- A portion of this Natural Heritage Area is owned by PECO Energy Company.
- The remainder is owned by a few large parcel private owners. Future ownership fragmentation may impede future conservation actions. Conservation action within this Natural Heritage Area should be set in motion before ownership fragmentation makes this more difficult

Habitat Disturbances:

- Historic –
  - Most of the area along Peters Creek has been cleared, cultivated and developed for over 200 years. The mosaic of natural communities that once occupied this area was replaced by the agrarian landscape modifications of the European colonists to provide for food, clothing and shelter.
  - Two mill dams occurred on Peters Creek at either end of this Natural Heritage Area. Legacy sediments may have buried the historic floodplain and caused the channelization of the creek.
  - A small road was built along most of the floodplain of Peters Creek.
- Current –
  - About half of this Natural Heritage Area is currently in active agricultural production, while the remainder has reverted to forest cover. However, the active pasturing may help maintain the open habitat preferred by elephant's foot.
  - A quarry or some other industrial use has fragmented the habitat in the southwestern portion of this area. Much of this activity occurs on steep slopes that lead directly to the creek.
- Exotic Species –
  - Invasive species were not documented during past surveys of this area, though they are likely to have a significant presence in this disturbed habitat.

Conservation Actions:

Overall:

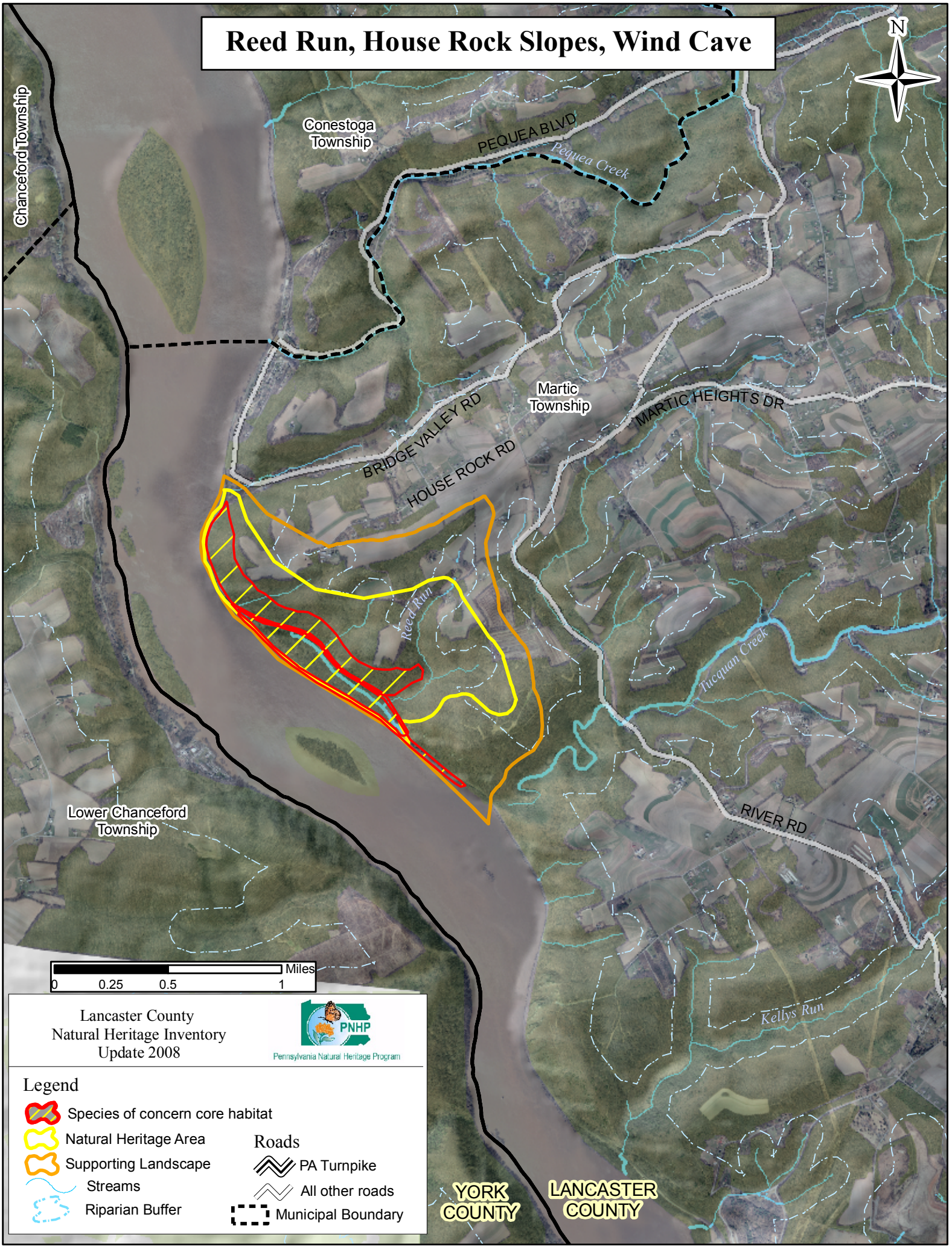
- Prevent the conversion of Peters Creek floodplain or the adjacent steep slopes to inappropriate uses.

Within the Core Habitat:

- Protect natural habitats along the creek floodplain through land acquisition, conservation easements, and riparian restoration initiatives.
- Work with local landowners to help maintain the habitat conditions necessary for this plant species. Active pastures along Peters Creek have helped to maintain the open aspect preferred by elephant's foot. However, stream side fencing should prevent livestock from entering the stream or grazing within the creek's 100 year floodplain. A rotation of annual mowing of different portions of the floodplain habitat can help preserve the open aspect of the floodplain without the severely negative impacts caused by livestock.
- Monitor the quarry/industrial activity in the vicinity of Peters Creek Road and Peach Bottom Road. Implement strategies to prevent sediment, chemical pollution and industrial debris from reaching the creek, or alternately, end the industrial activity along the steep slopes leading to the creek.
- Allow the forests of the steep slopes along the creek to mature with a goal of establishing a mixed age forest of native species with well defined canopy, sub-canopy, shrub and herbaceous layers.

Within the Supporting Landscape:

- Enhance and restore native vegetation along all tributaries to Peters Creek. Encourage native tree and shrub recruitment. Planting additional native species may be necessary. Insist that plants that are introduced into the landscape be native to the county and from local seed source. Strive to mimic the species composition of similar high quality natural communities in nearby locations.
- Remove non-native species. Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
- Riparian buffers:
  - Streams through forested areas should be considered high priority for conservation. The forested riparian corridor helps to regulate the temperature of the stream and creates streamside conditions that contribute to improved water quality and aquatic habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
  - All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement.
    - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain as feasible.
      - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
    - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests.
    - Other narrow waterways within the supporting landscape have been strongly channelized in the intensively cultivated fields and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.


Reed Run, House Rock Slopes, Wind Cave
N
Chanceford Township
Conestoga Township
PEQUEA BLVD
Pequea Creek
Martic Township
MARTIC HEIGHTS DR
BRIDGE VALLEY RD
HOUSE ROCK RD
Reed Run
Tucquan Creek
RIVER RD
Lower Chanceford Township
Kellys Run
YORK COUNTY
LANCASTER COUNTY
Miles
0 0.25 0.5 1
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary

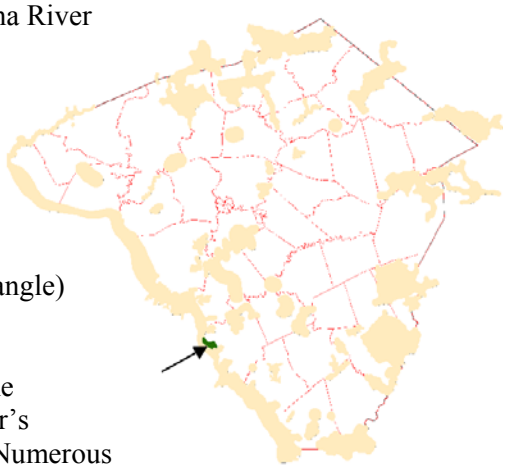
Reed Run, House Rock Slopes, Wind Cave – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Lobed spleenwort (*Asplenium pinnatifidum*)	G4	S3	PR	2006-08-18	CD
Vasey's eupatorium (*Eupatorium godfreyanum*)	G4	S2	TU	2002-09-13	BC
Umbrella magnolia (*Magnolia tripetala*)	G5	S2	PR	2006-08-18	A
Leaf-cup (*Polymnia uvedalia*)	G4G5	SNR	PT	2006-08-18	B
Cranefly orchid (*Tipularia discolor*)	G4G5	S3	PR	2006-08-18	D
Animals:					
Prothonotary Warbler (*Protonotaria citrea*)	G5	S2S3B	CR	2005-06-21	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This Natural Heritage Area occurs along the Susquehanna River south of Pequea Borough.

- Municipalities:
  - Martic Township
- USGS Quadrangles:
  - Conestoga Quadrangle
  - Holtwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "NC514, NC515, SP517, SP506" – (Holtwood Quadrangle)



Description: This Natural Heritage Area, which is entirely within Martic Township, is composed of a variety of habitats including the steep, forested slopes overlooking the Susquehanna River, the river's floodplain and banks, and the richly vegetated Reeds Run ravine. Numerous bedrock outcroppings are exposed along the steep slope from the hill crests to the river. The Conestoga Trail parallels the river shoreline, traversing the slopes past House Rock, which provides a spectacular view of the Susquehanna River. This Natural Heritage Area joins the Tucquan Glen Natural Heritage Area to the south.

Species of Concern Considerations:

Plants:

- The lobed spleenwort is a small fern that utilizes the lightly shaded rock outcrops as its primary habitat. It was documented on boulders in the area near Wind Cave. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. Much more suitable habitat is available for this species among the outcrops overlooking the Susquehanna River. Additional surveys are encouraged.
- This population of Vasey's eupatorium is growing in a narrow band of lower slope along the railroad rights-of-way between Reed Run and Tucquan Creek in dry, schist-derived substrate. This plant is adapted to the disturbed, open conditions created by this railroad and will likely persist in the absence of competition from invasive species. Indiscriminate use of herbicides for

vegetation management is not advisable in this location. This plant will likely respond favorably to the reduction of competition through periodic mowing and targeted spot treatments with herbicides. Maintenance activities should consider their impact on this and other rare plants in the rights-of-way.

- Umbrella magnolia occurs in the moist shaded habitat of Reed Run ravine. The plant is doing very well at this location with successful seedling recruitment into the understory. This population of umbrella magnolia is considered to be one of the few in the state to not have been intentionally planted or escaped from cultivation.
- Leaf-cup typically grows in ravines, moist thickets, and along the banks of streams or rivers. It has a PA legal rarity status of Threatened. At this location, it is found primarily along the railroad rights-of-way and portions of the adjacent floodplain and hillside. Protection of leaf-cup will require maintenance of known populations and preservation of stream and riverbank habitat. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.
- The cranefly orchid is a plant of moist, rich forests. It is usually found individually, with few other specimens in the area. It can be easily overlooked due to its small size and individual nature. It was primarily found in the moist, rich forested habitat of Reed Run. The entire adjacent forest environment should be considered potential habitat for this plant.

Animals:

- Two adult Prothonotary Warblers were observed in late June 2005, hunting and continually returning to the same place, evidently feeding young. The typical nesting period for this bird species is between May 25th and July 20th, so this observation is considered a nesting location for this species. The forested floodplain and associated wetlands along the Susquehanna River is the primary habitat for this species at this location. Because this bird nests in tree cavities, dead trees along the river shore and adjacent wetlands should be left standing to provide nesting habitat.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Forests cover roughly 80% of this Natural Heritage Area, which includes a number of different forest types. There are currently only minor incursions or disturbances to this area. The Natural Heritage Area contains portions of two large interior forest blocks, (~500 acres & ~2000 acres). A primary conservation goal for this area is to conserve this uninterrupted aspect of the forest canopy. Both forest and woodland vegetation types are present in this area. Forests are considered to be areas where the tree canopy is nearly or completely closed with the majority of the tree crowns overlapping, and there is between 60% to 100% tree cover. Woodlands have a much sparser canopy, with between 10% and 60% tree cover. Shrubs may be present in a woodland, but do not dominate the understory. Tuliptree-beech-maple forest and Dry oak-health forest are the primary forest types occurring within this Natural Heritage Area. The other forest/woodland communities occur in much smaller patches.
    - Terrestrial (upland) communities:
        - Tuliptree-beech-maple forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath forest
        - Dry oak-heath woodland
        - Birch (black gum) rocky slope woodland
        - Virginia pine-mixed hardwood shale woodland
        - modified successional forest*
    - Palustrine (wetland) communities:
        - Silver maple floodplain forest

- Sycamore (river birch)-box elder floodplain forest

Ownership:

- Most of Reed Run and other portions of the core habitat are owned by the Lancaster County Conservancy.
- Much of the core habitat for rare species along the Susquehanna River at this location is owned by the PPL Corporation or falls within the Norfolk Southern Railroad rights-of-way.
- The rest of the Natural Heritage Area is owned by three primary private landowners. The Lanco Beagle Club owns nearly 200 acres, which contains part of a significant block of interior forest. There are numerous house lots along Bridge Valley Road and House Rock Road with each containing a small portion of a larger forest block. Ownership fragmentation diminishes the future prospects for preservation of large landscape scale features.

Habitat Disturbances:

- Historic –
  - Aerial photos from 1940 show agricultural fields on the hilltops that are currently forested, so there has been a gain in forest cover since the 1940's.
  - The railroad was already in place by the 1940's.
  - An extensive sandbar can be seen along the shoreline of the Susquehanna River. This sandbar may have been habitat for several plant species currently found in similar habitats in the river floodplain. The seasonal flooding and ice scour that typically occurs along the river has likely eroded this sandbar and deposited it elsewhere along the river's course. This helps to demonstrate the temporary character of land in the floodplain of this dynamic river system.
- Current –
  - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that may regard the railroad as an insurmountable obstacle. The habitat created by the railroad rights-of-way is a product of habitat disturbance. The rights-of-way is a narrow band of exceptional weediness in this otherwise intact landscape. This habitat disturbance has also resulted in habitat creation for two species of concern at this location. The plants leaf-cup and Vasey's eupatorium are plants adapted to disturbed conditions and may disappear from the site in the absence of some form of disturbance.
  - Logging roads and access trails are apparent primarily in the southern portion of the Natural Heritage Area, which fragment the large block of interior forest. Agricultural fields occur on the flatter portions of the hill tops.
  - Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species – Purple loosestrife is primarily restricted to wet habitats. While it is known to occur in many other locations in the county, it currently only occurs along the banks of the Susquehanna River within this Natural Heritage Area. Japanese knotweed currently occupies portions of the river banks and the adjacent floodplain. Japanese knotweed can inhabit much drier habitats and small pioneer populations that show up should be targeted for control measures before they become firmly established. English Ivy occurs within the forested habitat near the Conestoga Trail head on Bridge Valley road. Control of this species should be by pulling, as its waxy coating makes it especially resistant to herbicides. Invasive species control efforts should focus on maintaining the relatively invasive-free conditions of Reed Run.

Control options for invasive plants range from mechanical to chemical (see individual fact sheets). Invasive species of plants at this location include:

- Mile-a-minute (*Polygonum perfoliatum*)
- Wine berry (*Rubus phoenicolasius)*
- Common mugwort (*Artemisia vulgaris*)
- Japanese stilt grass (*Microstegium vimineum*)
- Kudzu (*Pueraria lobata*)
- Japanese honeysuckle (*Lonicera japonica*)
- Tree-of-heaven (*Ailanthus altissima*)
- Princess tree (*Paulownia tomentosa*)
- Japanese knotweed (*Polygonum cuspidatum*)
- Purple loosestrife (*Lythrum salicaria*)
- Multiflora rose (*Rosa multiflora*)
- Bush honeysuckles (*Lonicera morrowii, Lonicera maackii)*
- English ivy (*Hedera helix*)
- Common privet (*Ligustrum vulgare, Ligustrum obtusifolium*)
- Japanese & European barberry (*Berberis thunbergii, Berberis vulgaris*)

Conservation Actions:

Overall:

- Safeguard the quality and expanse of the forested landscape. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect water quality of the small streams that drain through this Natural Heritage Area into the Susquehanna River and provides refuge and habitat for other forest dependent species. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve old-growth characteristics.
- This site should be considered a medium priority for conservation acquisition. If PPL chooses to divest itself of its portion of the property, it should be considered a high priority for conservation acquisition.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat.
    - The steep, rocky nature of the immediate habitat of the species of concern likely precludes most types of development activity. The flatter hilltops, however, could prove tempting building sites. Indiscriminate railroad herbicide use is inappropriate for this location.
    - Much of the priority core habitat within Reed Run is owned by the Lancaster County Conservancy, whose mission statement provides for the continued protection of lands under its ownership. A significant portion of the core habitat along the river slopes is currently owned by PPL Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the current management regime.
        - First, consider fee-simple acquisition, or conservation easement options with the largest property owners of the core habitat outside of the Lancaster County Conservancy and PPL Corporation property holdings. One primary landowner, the Lanco Beagle Club, owns the most significant remaining portion of this core habitat including a section of a large interior forest block.
        - Second, consider fee-simple acquisition, or conservation easement options with the PPL Corporation property holdings to provide long-tem protection for this area.
- Conserve the intact forest canopy.

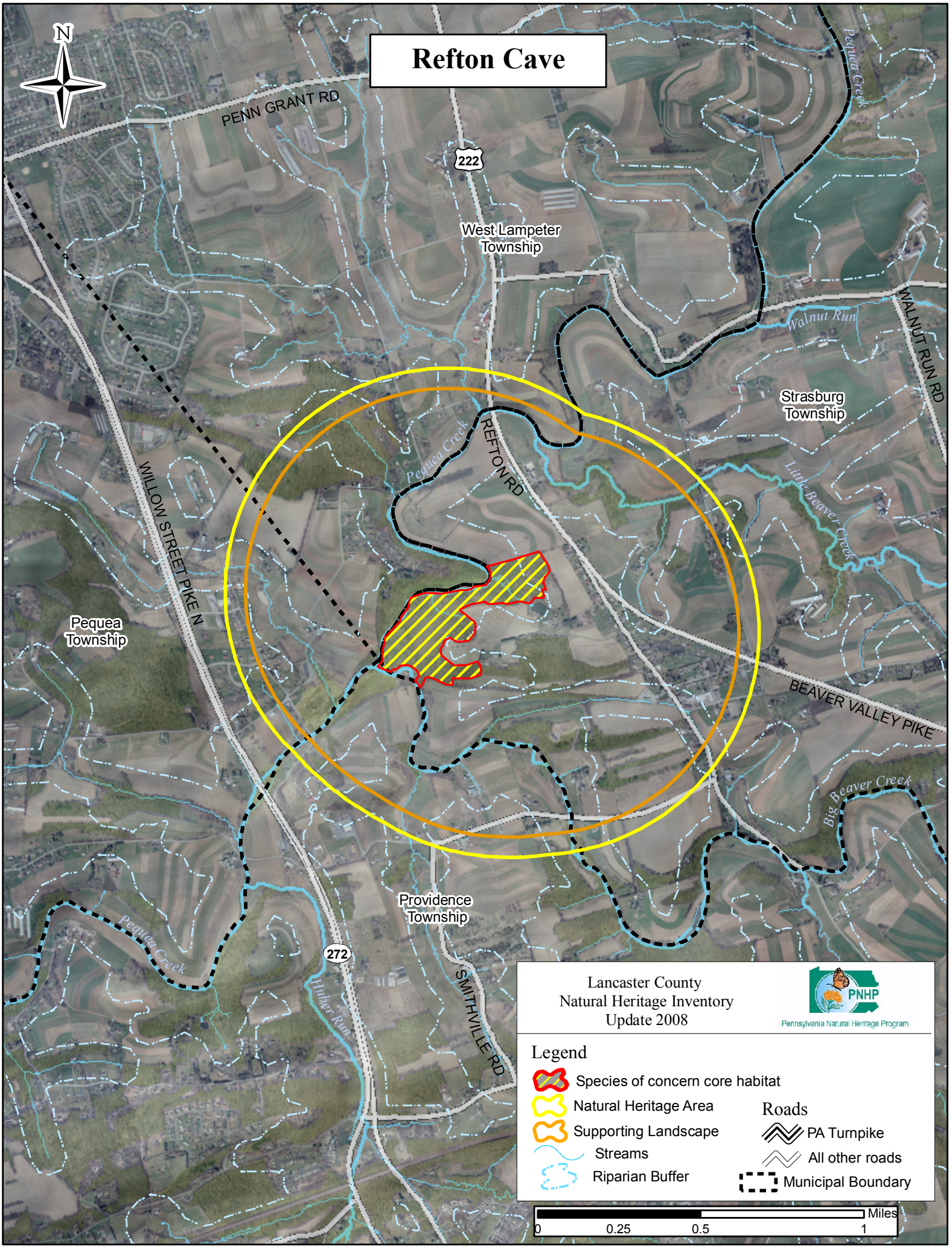
- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.
- Avoid logging activities in this area to allow for the development of old growth conditions.

- Remove invasive species of plants.
  - Invasive species are not currently a significant problem in Reed Run. Though invasive species are not currently considered an extensive problem at this location, this is exactly the reason to take an aggressive approach to invasive species control. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet.
  - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern. Mechanical control, (mowing) is an option that will also require attention to the location and timing of mowing. Early-mid spring season mowing will result in stunted growth for most of the invasive species. Allow the plant species of concern to bloom and set seed before late season mowing takes place.
  - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
  - Continual invasive species monitoring and control will be necessary.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>
The supporting landscape is derived from the adjacent subwatersheds of Reed Run, Brubaker Run and House Rock Run. Activities within these watersheds can have a direct impact on the core habitats and the species of concern it contains. The supporting landscape for this area was drawn to exclude the most disturbed portions of the adjacent habitat, which are primarily active agricultural fields and residential areas.

- Conservation easements should be sought for adjacent forested and agricultural properties to provide a buffer to this habitat and to help provide connectivity to other nearby greenway Natural Heritage Areas. Additional populations of rare species could occur on adjacent parcels.
- The numerous residential lots along Bridge Valley Road and House Rock Road each contain a small portion of a larger forest block. The land owners should be encouraged to cooperate towards conserving the intactness of this large forest block. Conservation easements may be an appropriate tool toward this effort.
- Portions of the Lanco Beagle Club property currently consists of a maze of shrub rows used for dog training. These shrub rows are frequently composed of a tangle of invasive shrubs including multiflora rose, autumn olive and non-native bush honeysuckles and are a prime source of invasive species for the area. Removal of these shrubs and conversion of this habitat back to upland forest will help increase the interior forest in this area and help eliminate a major source of invasive shrub species. This property should be considered a high priority for acquisition or conservation easements within this area.
- Avoid logging in this area.
  - Allow the forest to return to near old-growth conditions.
  - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
    - Trees that have fallen over approved trails can be cut through as necessary.
  - Remove non-native trees and shrubs. The railroad rights-of-way are the primary location of non-native trees and shrubs within this area.

    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Rare species of plants are particularly susceptible to deer herbivory.
- Low quality agricultural fields within the supporting landscape should be encouraged to return to forest to expand the area of interior forest at this location.
- Remove invasive species of plants.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
    - Block access to forested areas by off road vehicles.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the topography and hydrology.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
        - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
        - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.
- Additional surveys for rare species are recommended.
- <u>Potential zoning options for conservation enhancement:</u>
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 80% of the area within the core habitat, ~50% of the Natural Heritage Area and ~30% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this area.


Refton Cave
N
PENN GRANT RD
222
West Lampeter Township
Pequea Creek
Walnut Run
WALNUT RUN RD
Strasburg Township
REFTON RD
Pequea Creek
Little Beaver Creek
WILLOW STREET PIKE N
Pequea Township
BEAVER VALLEY PIKE
Big Beaver Creek
Providence Township
Pequea Creek
272
Huber Run
SMITHVILLE RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
0
0.25
0.5
1
Miles

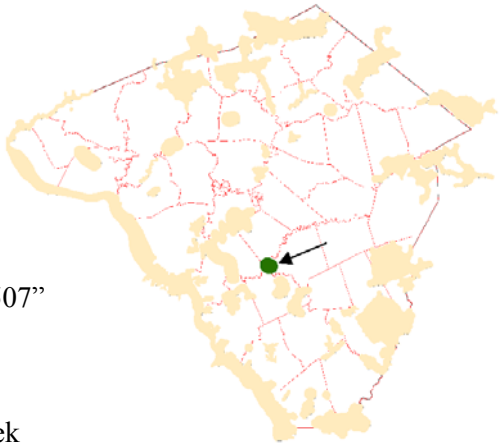
Refton Cave – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Price's Cave Isopod (*Caecidotea pricei*)	G5	S2S3	-	1999-03-11	A
Refton Cave Planarian (*Sphalloplana pricei*)	G2G3	S1	-	1999-03-11	A
Pizzini's Cave Amphipod (*Stygobromus pizzinii*)	G3G4	S1	-	1999-03-11	A
Exemplary Natural Communities					
Solution cave aquatic community	GNR	S3	-	1999-03-11	AB

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This Natural Heritage Area occurs along the Pequea Creek near the town of Refton.

- Municipalities:
  - Pequea Township
  - Providence Township
  - Strasburg Township
  - West Lampeter Township
- USGS Quadrangles:
  - Conestoga Quadrangle
  - Quarryville Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Refton Cave – NC527, SA501, SA502, SA507" (Quarryville Quadrangle)



Description: Refton Cave is a limestone solutional cave with large underground pools of water. The cave is near a bend in Pequea Creek which is joined by Big Beaver Creek and Little Beaver Creek. Several nearby sinkholes likely also lead into the cave system. The surrounding land is primarily agricultural with a mixture of woodlots and newer residential lots. The cave is home to several invertebrate cave species of concern, one of which, Refton cave planarian, is currently considered globally imperiled due to the very few known populations of this species in the world.

Species of Concern Considerations:

- Cave invertebrates: There are several rare cave invertebrates known from the Refton Cave system: Refton cave planarian (a flatworm), Price's cave isopod and Pinzzini's cave amphipod (crustaceans). There are currently very few known locations for Refton cave planarian in the world. Since this is likely the best of the known locations for this animal species globally, Lancaster County has a very high degree of responsibility for its continued existence. The focus of conservation efforts for this species, and the cave habitat as a whole, is the protection of the water quality of the cave. The specific hydrology of underground systems is difficult to determine, but in general, conditions above ground effects the habitat underground. Prevent contamination of the groundwater by preventing agricultural, residential, industrial and roadway runoff from entering the system.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Tuliptree-beech-maple forest
  - Dry oak-mixed hardwood forest
  - Dry oak-heath forest
  - modified successional forest*
  - grassland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest
  - wet meadow*

- The upland forested habitats of the area are dominated by a mixture of tuliptree, beech and red maple, while the areas within and adjacent to the floodplain of Pequea Creek are dominated by sycamore, river birch and box elder. Some of these areas appear to be of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as modified successional forest are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers. Wet meadows and pastures within the floodplain can potentially be restored back to floodplain forest or other open wetland habitats as appropriate to the topography and hydrology.

Ownership:

- Most of the area surrounding Refton Cave is held in larger sized parcels in active agricultural production, though subdivision development has encroached on the area.
- The Lancaster County Conservancy owns a wooded parcel of about 37 acres.

Disturbances:

- Historic –
  - The landscape surrounding Refton Cave was gradually cleared of its original forest cover over 200 years ago and replaced by an intensively cultivated landscape. Aerial photos from the 1940's show that agricultural fields left very little natural habitat remaining. In most areas, fields extended to the banks of Pequea Creek and its tributaries. Erosional gullies can be observed crossing fields leading to the creek.
  - Several forested patches were fixtures of the landscape in 1940 including the parcel currently owned by the Lancaster County Conservancy. The age of this patch of forest may suggest it has utility as a reference natural community for restoration of areas of similar topography and hydrology.
  - Three milldams occurred along Pequea Creek and Big Beaver Creek just outside of this Natural Heritage Area. The legacy sediments that are trapped behind the dams alter the topography of the floodplain and trap stream banks in unnatural channels when they are suddenly breached.
- Current –
  - Forest cover has increased in this area as some agricultural lands were retired, particularly in the immediate vicinity of Refton Cave.
  - In contrast, residential development has increased in the area along Shiprock Road, Route 272 and adjacent to parts of Pequea Creek.
  - Route 272 was built through the area, and a Route 222 bypass around Refton was constructed.

- Much of the Pequea Creek floodplain remains in active agricultural production with little to no vegetated buffer between the banks of the creek and agricultural fields.

- Exotic Species – The exotic species composition and threat to this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall:

- Restore the forested/vegetated floodplain of the Pequea Creek, Little Beaver Creek and the adjacent slopes and uplands to include all the area within 100-meters from the upper edge of the floodplain.
- Protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-dwelling species of concern present at this location.
- Implement an Aquifer Protection Overlay Zone within the supporting landscape for this Natural Heritage Area to help protect ground water resources.

Within the Core Habitat:

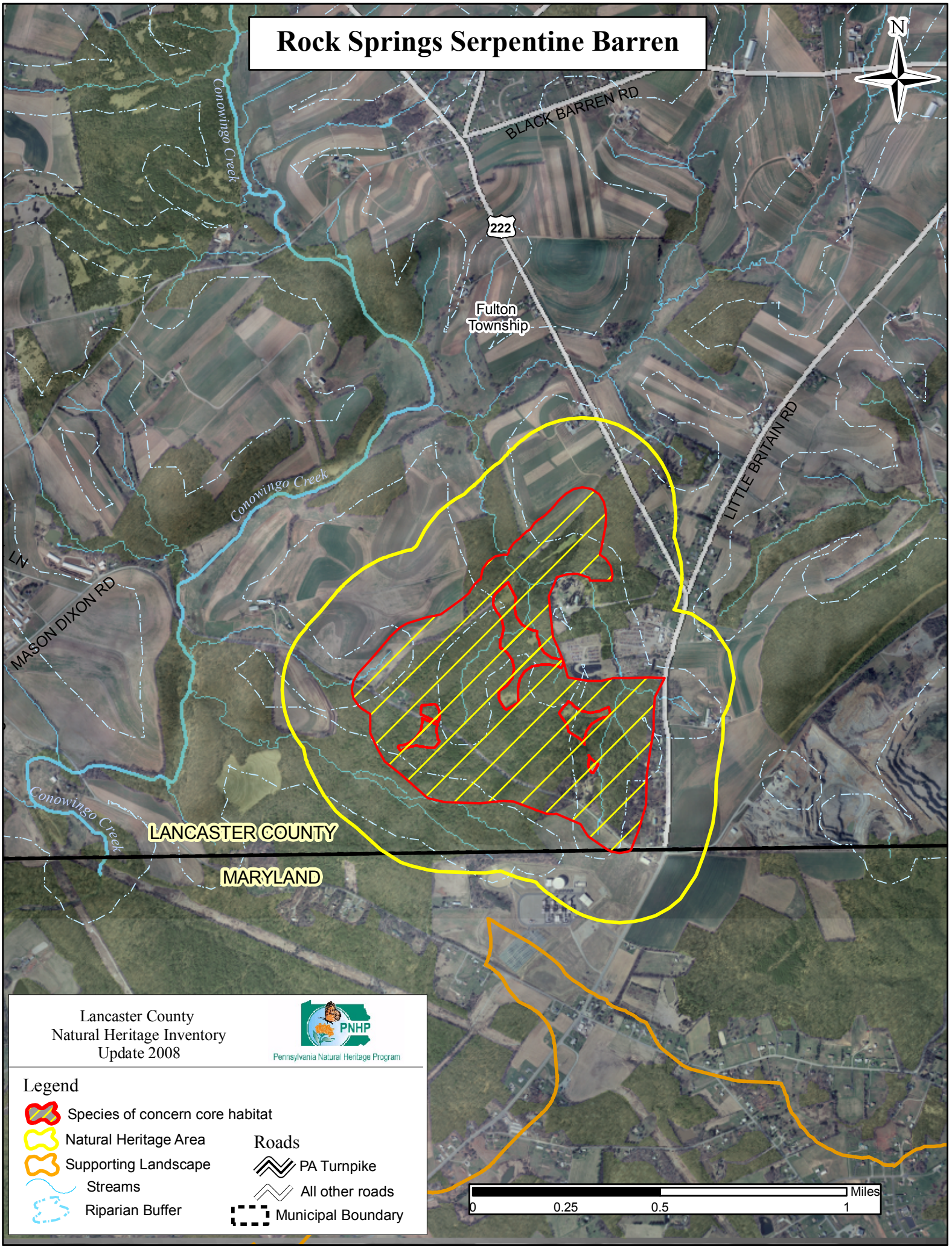
- The subterranean habitat of the cave-dwelling species can be considerably impacted from above ground land use decisions. Storm water runoff through rural and suburban areas can be a significant source of chemical and nutrient pollutants, which can severely impact water quality and the food chain of both surface and subsurface waters. Runoff from agricultural fields typically have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Storm water management measures such as the creation of detention basins or vegetated swales should be implemented to slow and capture water flow in these expanses of cultivated landscapes. Conservation efforts should focus on protecting and improving the quality of the surface and ground water for both the local human community as well as for the habitat for native plants and animals and species of concern.

Within the Supporting Landscape:

- Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution. Sinkholes should be buffered with native vegetation to help slow the flow of water before it enters the sinkhole. Water that is reduced in velocity will drop sediment and other heavy particles as it slows down.
- The long term goal for the area should be to restore mature floodplain forests and the associated upland buffer forests along both shores of Pequea Creek and its tributaries. Ideally, expand the native vegetation along the river corridor to include land within 100 meters of the creek's floodplain. Alternately, the 100 foot riparian buffer can substitute for the 100 meter buffer where development has already eliminated the preferred option. Restoration efforts should be designed to mimic the adjacent natural community type in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Restoration is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Prevent the conversion of agricultural or natural lands adjacent to Pequea Creek, Little Beaver Creek or their tributaries to residential or industrial development. Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way especially along the creek shoreline and any remaining natural habitats. These natural habitats provide a significant filter for runoff entering the creek from the adjacent uplands.
- Potential zoning options for conservation enhancement:

- Implement an Aquifer Protection Overlay Zone or Karst Hazard Overlay Zone within the supporting landscape for this Natural Heritage Area. Refer to the example in the Pequea Township Zoning Ordinance.
- Pequea, Providence, Strassburg and West Lampeter Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Pequea and West Lampeter Townships include the 500-year floodplain in the definition of their floodplain district. Strict enforcement of these regulations will help prevent conversion of the floodplain to unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to prohibit agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils and those within the 100-year floodplain should be encouraged to regenerate into natural habitats.
- Growth within the Township should be discouraged to occur within 100 meters of the 100-year floodplain of Pequea Creek or its tributaries.
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary destruction of natural habitat and prime farmland.

- <u>Potential restoration activities:</u>
    - Historic milldams occurred along water courses in this area. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts.
        - Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.
    - Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat.
        - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
            - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
            - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
            - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.


Rock Springs Serpentine Barren
N
BLACK BARREN RD
Conowingo Creek
222
Fulton Township
LITTLE BRITAIN RD
Conowingo Creek
MASON DIXON RD
Conowingo Creek
LANCASTER COUNTY
MARYLAND
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
0
0.25
0.5
1
Miles

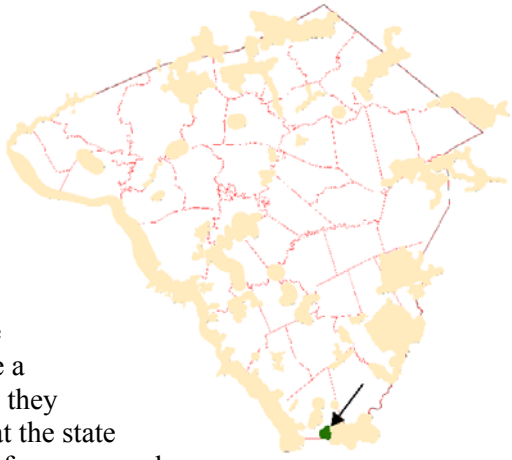
Rock Springs Serpentine Barrens – *Exceptional significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Annual fimbry (*Fimbristylis annua*)	G5	S2	PT	1993-04-05	A
Few flowered nutrush (*Scleria pauciflora*)	G5	S2	PT	1993-04-05	A
Plain ragwort (*Senecio anonymus*)	G5	S2	PR	1993-04-05	A
Prairie dropseed (*Sporobolus heterolepis*)	G5	S1	PE	1986-10-28	D
Serpentine aster (*Symphyotrichum depauperatum*)	G2	S2	PT	1986-10-28	E
Sensitive species of concern[3]	-	-	-	1986-09-09	D
Animals:					
Dot-lined white moth (*Artace cribraria*)	G5	S1	-	2004-07-03	E
A moth (*Panthea sp. 1*)	G4	SU	-	2004-08-27	C
Tolype moth (*Tolype notialis*)	G4G5	S1	-	2004-07-03	E
Southern variable dart moth (*Xestia elimata*)	G5	S2S3	-	2004-08-27	C
A zale moth (*Zale curema*)	G3G4	S1	-	1997-05-14	C
Oblique zale moth (*Zale obliqua*)	G5	S1	-	1998-07-02	C
A zale moth (Zale squamularis)	G4	S2S3	-	2004-07-16	C
A zale moth (*Zale submediana*)	G4	S2	-	1997-05-14	C
Exemplary Natural Communities:					
Eastern serpentine barrens	G2	S2	-	1993-04-05	BC

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Rock Springs Serpentine Barrens

Location: This Natural Heritage Area occurs adjacent to Route 222 at the Pennsylvania / Maryland border.

- Municipalities:
  - Fulton Township
  - Cecil County, Maryland
- USGS Quadrangles:
  - Conowingo Dam Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Rock Springs" – (Conowingo Dam Quadrangle)



Description: Rock Springs is a globally rare serpentine influenced habitat similar to those of nearby New Texas and Goat Hill and is part of the ecologically unique State Line Serpentine Barrens complex. The serpentine habitats are often referred to as grasslands, and they do have a strong representation of warm season grasses and grass-like plants, but they also contain a good diversity of other plant species, many uncommon at the state and global levels. Rock Springs is known to support six plant species of concern and eight animal species of concern, all of which are butterflies & moths that feed on the unique variety of plants present. The serpentine community itself is considered globally imperiled due to the limited occurrences of this habitat type around the world. The suppression of fire and lack of past woody vegetation management had allowed the serpentine herbaceous openings at Rock Springs to succumb to their eventual replacement by woody vegetation to become a more common habitat type. Recent management activities, at first glance, may appear harsh, but the removal of the woody vegetation is an essential step in the restoration of this habitat.

Species of Concern Considerations:

Plants:

- The plant species of concern known to occur at Rock Springs have been found primarily in the strongly serpentine influenced herbaceous openings or within the adjacent thin woodlands. These include annual fimbry, few-flowered nutrush, plain ragwort, prairie dropseed, serpentine aster and a sensitive species of concern. In the past, natural disturbance, such as wild fires, would have helped to keep these areas in an open condition. With the relatively recent suppression of fire, the open areas have gradually closed due to natural succession. Before restoration activities at Rock Springs, the invasion of woody plants was nearly complete, eliminating open habitats for the serpentine adapted species of concern known from this site. An active restoration effort to restore the serpentine openings has been initiated to ensure the continued existence of these habitats and the species they contain.
- Serpentine aster, mentioned above, is only known to occur in the eastern serpentine barrens of Pennsylvania and Maryland. This extremely limited distribution has given this species the status of G2 – globally imperiled. Serpentine aster is typically found in the more open areas of serpentine barrens, suggesting that fire may be needed to weed out woody overgrowth and maintain this preferred habitat.

Animals:

- All of the animal species of concern currently known from New Texas are butterflies & moths (Lepidoptera). Many of these species are limited in distribution in Pennsylvania to serpentine and other grassland habitats, which are often set in a matrix of open oak and pine woodlands. Conservation of these species requires protection of the habitat they use during all stages of their life cycles. Maintaining a mosaic of grassland, oak, and pine areas at serpentine barrens sites and the surrounding area will create a diverse and healthy habitat capable of supporting the rare Lepidoptera listed above. Plantings of native herbaceous food plants and desirable nectar sources may also help increase the existing Lepidoptera populations. Creation of corridors between barrens sites would also encourage movement of species between sites and create more secure populations. Pesticide

application, especially for the control of gypsy moths, can have a devastating effect on populations of Lepidoptera species of concern and should be eliminated in this area.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types.

Most of the species of concern core habitat at Rock Springs has recently been cleared of vegetation. The bare ground is being colonized by early successional plants including many invasive species. Historically, this habitat contained a mosaic of herbaceous openings interspersed with small woodlots, but recent fire prevention and the removal of grazing animals has favored the expansion of wooded habitats at the expense of herbaceous openings. The invasion of serpentine herbaceous openings by woody trees and shrubs can influence the surrounding habitat. As woody vegetation encroaches on the openings, they tend to trap more organic debris and allow deeper soils to accumulate. As deeper soils occur on the site, they allow the area to succeed to more common woodland and forest types. Fire disturbances have maintained these herbaceous openings in the past. Active woody vegetation removal will be necessary to maintain these openings in the absence of fire. Other natural community types occur adjacent to the recently cleared area of Rock Springs include:

- Terrestrial (upland) communities:
  - Red oak-mixed hardwood forest
  - Dry oak-heath forest
  - Pitch pine-mixed oak forest
  - Red cedar-pine serpentine shrubland
  - Serpentine grassland

Ownership:

- The Lancaster County Conservancy owns much of the historic serpentine barrens area and maintains it as a dedicated nature preserve.
- The remainder of this Natural Heritage Area contains a number of private parcels of varying sizes, though the primary habitat is made up of larger parcels. Future ownership fragmentation of this globally rare habitat may impede future conservation actions. Conservation action within this Natural Heritage Area should be set in motion before ownership fragmentation makes this more difficult

Habitat Disturbances:

- Historic –
  - Historically, wildfires likely helped to maintain the open aspect of these habitats. Early accounts record the intentional setting of fire in these habitats by Native Americans to help open the area for greater potential hunting success.
  - Based on aerial photos from the 1940s, much of the serpentine habitat was likely cleared by grazing in the past, while small portions of this area had a cover of trees and shrubs.
  - Most of the surrounding landscape had been cleared of its original forest cover and converted to agricultural production over several centuries.
  - The serpentine habitat was bisected by Mason Dixon Road.
- Current –
  - The lack of fire disturbance had allowed for an almost complete conversion of the serpentine herbaceous openings to a pine-oak forest. A portion of the property owned by the Lancaster County Conservancy has recently been cleared of vegetation as a first step towards restoration of this serpentine habitat.
  - An auto salvage yard with an enormous pile of used tires occupies a portion of the historic serpentine barrens.
  - Some residential development has been occurring at the periphery of the serpentine habitat.

- Exotic Species –
  - The removal of the existing vegetation has created favorable conditions for a number of aggressive invasive plant species especially mile-a-minute, (*Polygonum perfoliatum*) Japanese honeysuckle (*Lonicera japonica*) and Japanese stilt grass (*Microstegium vimineum*).

Conservation Actions:

Overall:

- Conservation of the core habitat, supporting landscape and connecting linkages between this serpentine habitat and those nearby should be considered a high conservation priority in the county.
- The state line serpentine habitats are part of a series of habitat "islands" stretching into Maryland that should be thought of as a single system. Connect these habitats by maintaining natural vegetation along waterways and over serpentine bedrock geology. A surrounding agricultural landscape is suitable for properties adjacent to this Natural Heritage Area.
- Active stewardship of these habitats is necessary. In the absence of natural fire disturbance, or active vegetation removal, these habitats will succeed into woodlands and forests, replacing the globally rare habitat with a more common type.
- Habitat restoration activities should strive to establish a mosaic of habitat types to accommodate the variety of organisms and their diverse habitat preferences. While some of these plants will only thrive in the open on thin soils, or even bare bedrock conditions, others need the limited shelter of scattered trees. Some of the insect species require conifers during part of their life cycle while others need deciduous trees or specific shrubs or wildflower host plants. There is no "one-size-fits-all" management recommendation for this habitat other than to provide for a mosaic of habitat diversity.

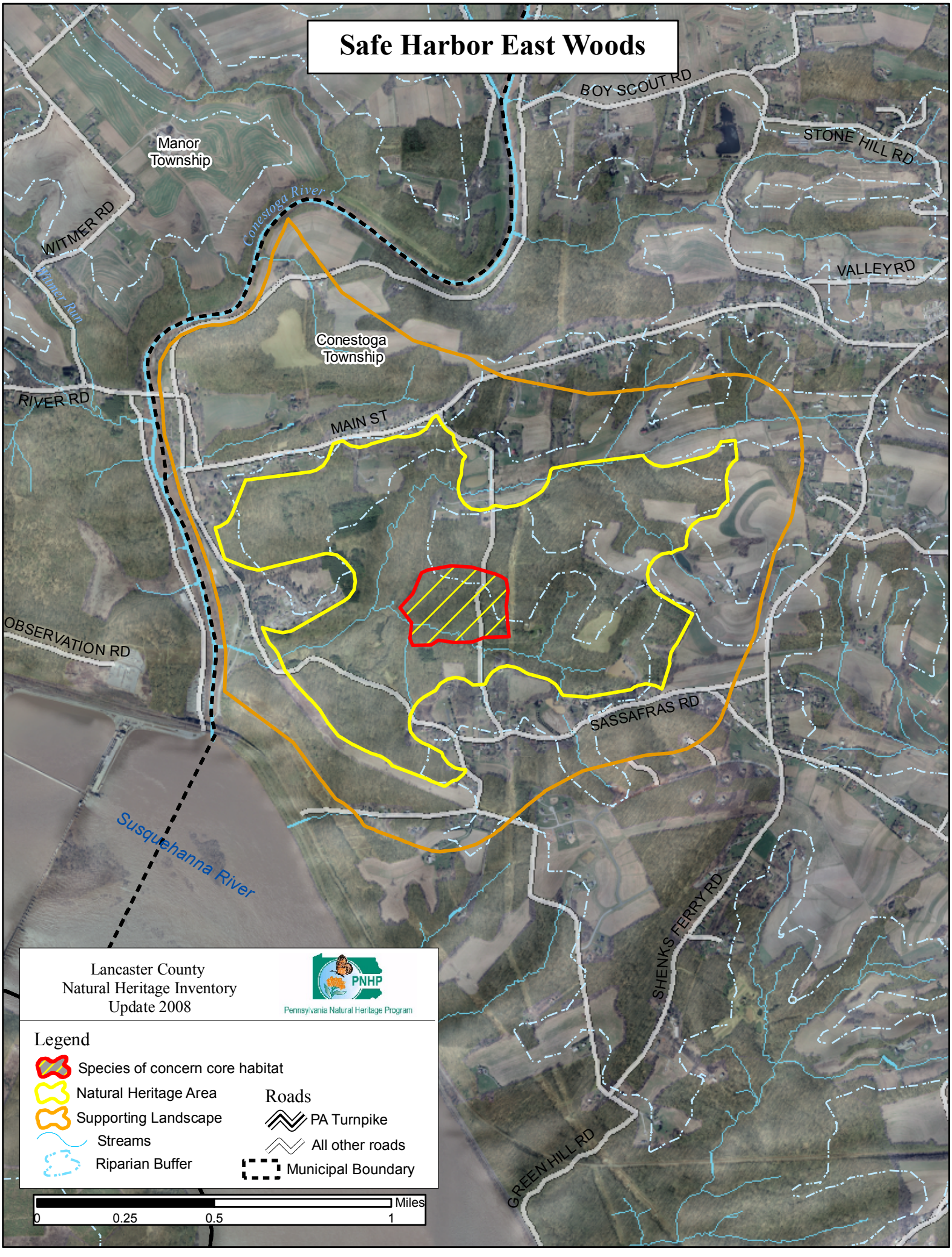
Within the Core Habitat:

- Focus conservation efforts on acquisition of the largest parcels identified as part of the Eastern Serpentine Barrens Natural Community that are not already preserved by the Lancaster County Conservancy. Transfer of development rights, conservation easements and fee simple acquisition are all appropriate tools for securing the conservation status of the parcels with varying ecological significance.
- Since much of the historic serpentine habitat has been cleared of vegetation, a monitoring plan needs to be established to document the changes in vegetation. This will help direct future restoration activities.
- Monitor for invasive species of plants. Invasive plant establishment may be an indicator of deeper soils. Additional soil removal may be necessary to expose the serpentine bedrock.
- Additional parts of the historic serpentine habitat occur on Lancaster County Conservancy property south of Mason Dixon Road. Restoration attempts in this area should strive to establish a mosaic of different habitat types by gradually removing trees on hilltops dominated by junipers and pines especially where the trees are underlain by native warm season grasses or other serpentine indicators. Areas that are dominated by oaks and other hardwoods likely indicate deeper soils and should be left in place to provide habitat diversity.
- The auto salvage operation is not a compatible use with the eventual goal of using prescribed fires to help manage this habitat. At a minimum, the tire pile should be relocated.

Within the Supporting Landscape:

- The plants that characterize these habitats are adapted to the dry, nutrient poor soils and periodic fire events. A priority for the security of these globally rare habitats should be to establish protection for the core habitats as well as to provide for the landscape context in which natural process can be maintained. These systems may be best maintained in an agricultural or rural setting.

- Residential and industrial development near or between these barrens should be strongly discouraged.
- These serpentine habitats occur in isolated patches as the bedrock material, serpentinite, is exposed at the surface of the ground in a scattered fashion much like an archipelago chain of islands. Each habitat has a slightly different species composition, largely due to the slightly different environmental conditions found at each distinct location. The area between and around these habitats should be maintained to provide the necessary buffer to allow prescribed burns to help sustain the mosaic of open habitat once a network of the woody species have been removed. A long range goal for these isolated habitats is to recognize them as a single system and plan for their ecological needs. Connect Rock Springs to New Texas, Goat Hill and Oakryn Barren though natural habitat corridors along streams and over serpentine bedrock geology. Natural habitat corridors between the barrens will help keep the genetic flow between the isolated populations of species in circulation.
- Educate the adjacent landowners on the significance of the globally rare habitat and the need for ongoing management activities.

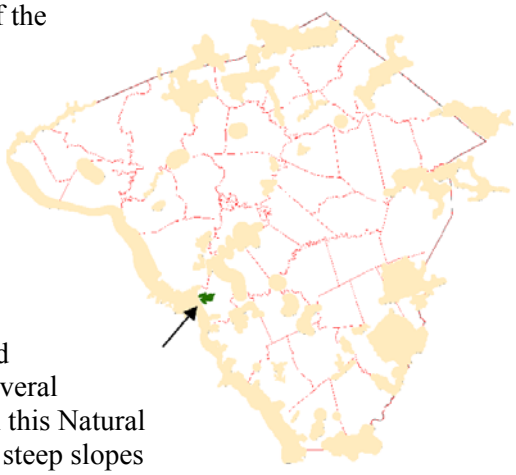

Safe Harbor East Woods
BOY SCOUT RD
STONE HILL RD
VALLEY RD
Manor Township
Conestoga River
WITMER RD
Witmer Run
Conestoga Township
RIVER RD
MAIN ST
OBSERVATION RD
SASSAFRAS RD
Susquehanna River
SHENKS FERRY RD
GREEN HILL RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Safe Harbor East Woods – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	2006-04-10	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This Natural Heritage Area occurs on the south side of the Conestoga River where it empties into the Susquehanna River.



- Municipalities:
  - Conestoga Township
- USGS Quadrangles:
  - Conestoga Quadrangle
  - Safe Harbor Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:

Description:

The area is dominated by a moist, tulip-beech-maple hardwood forest with a rich herbaceous layer along the steep slopes of several unnamed streams. Two large interior forest patches occur with this Natural Heritage Area. The topography is varied and convoluted, with steep slopes interspersed with relatively flat hill tops. The Natural Heritage Area of this site was drawn around the core habitat of the population of puttyroot and the adjacent large forested blocks. Approximately half of the Natural Heritage Area is owned by Safe Harbor Power Company with the Safe Harbor Village bordering the Natural Heritage Area to the west. During spring surveys in 1999 the forest floor was described as carpeted with Dutchman's-breeches (*Dicentra cucullaria*) together with other distinctive spring wildflowers associated with rich woods. The setting is not pristine, as exotic plant species are well established.

Species of Concern Considerations:

- A large population of the plant species of concern puttyroot was last documented at this location in 1999. Puttyroot is a plant of moist, rich forested habitats. These habitats in the state have been diminished by logging and conversion to agricultural, industry and residential uses.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- The Natural Heritage Area for this location was drawn around the core habitat for the puttyroot and the adjacent continuous forested area. Consequently, the Natural Heritage Area is almost entirely forested. The forest type appears dominated by tuliptree-beech-maple forest, with smaller pockets of other forest types including:
  - Terrestrial (upland) communities:
    - Hemlock-tuliptree-birch forest
    - Tuliptree-beech-maple forest
    - Dry oak-mixed hardwood forest

- Dry oak-heath forest
- modified successional forest*

Ownership:

- Approximately half of this area is currently owned by the Safe Harbor Water Power Corporation, which allows public access to the site.
- The PPL Corporation owns smaller parcels along the banks of the Conestoga River as well as utility rights-of-way through the area.
- The remainder of the area is privately owned by numerous landowners in a wide range of parcels sizes.

Habitat Disturbances:

- Historic –
  - Historic aerial photos from 1940 depict the area as largely cleared for agricultural activity, with only a small portion of the area forested.
  - Portions of the site were formerly used as quarry operations. This area has made a very significant recovery from these conditions, as the area now contains patches of interior forest that support puttyroot, which typically occurs in richly forested habitats.
- Current –
  - The site is crossed by a powerline corridor and several smaller roads.
  - The site includes several conifer plantations, home sites and open fields.
  - Past and recent garbage dumping detracts from the otherwise scenic qualities of this area.
  - Hiking trails pass near a few of the puttyroot plants.
  - Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species - Invasive plants are well established, particularly low herbs such as ivy-leaved speedwell (*Veronica hederifolia*), Indian strawberry (*Duchesnea indica*), garlic mustard (*Alliaria petiolata*) and purple dead-nettle (*Lamium purpureum*). Control options for invasive plants range from mechanical to chemical (see individual fact sheets). Invasive species of plants at this location also include:
  - Norway Maple (*Acer platanoides*)
  - Tree of heaven (Ailanthus altissima)
  - Garlic mustard (*Alliaria petiolata*)
  - Barberry (*Berberis thunbergii*)
  - English Ivy (*Hedera helix*)
  - Orange day-lily (*Hemerocallis fulva*)
  - Purple dead-nettle (*Lamium purpureum*)
  - Common privet (*Ligustrum vulgare*)
  - Japanese honeysuckle (*Lonicera japonica*)
  - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
  - Multiflora rose (*Rosa multiflora*)

  High priority for invasive species control at this site should be targeted towards removing small populations of newly established invasive plants. Chemical control of these small patches may be necessary. This could include coordinated volunteer participation and would likely be most effective in summer and fall. Volunteer invasive species removal could be best directed towards woody species removal including barberry, common privet, bush honeysuckle and multiflora rose.

These species are easily identified and young plants can be pulled from the ground under appropriate soil conditions. Larger shrubs can be cut and sprayed with the appropriate herbicides.

Conservation Actions:

Overall:

- Approximately half of this area is currently owned by the Safe Harbor Water Power Corporation, which allows public access to the site. While providing the primary habitat for the populations of puttyroot, the forested landscape also helps to protect water quality of the small streams that drain through this area into the Conestoga River and provides refuge for other forest dependent species. This site should be considered a medium priority for conservation acquisition.

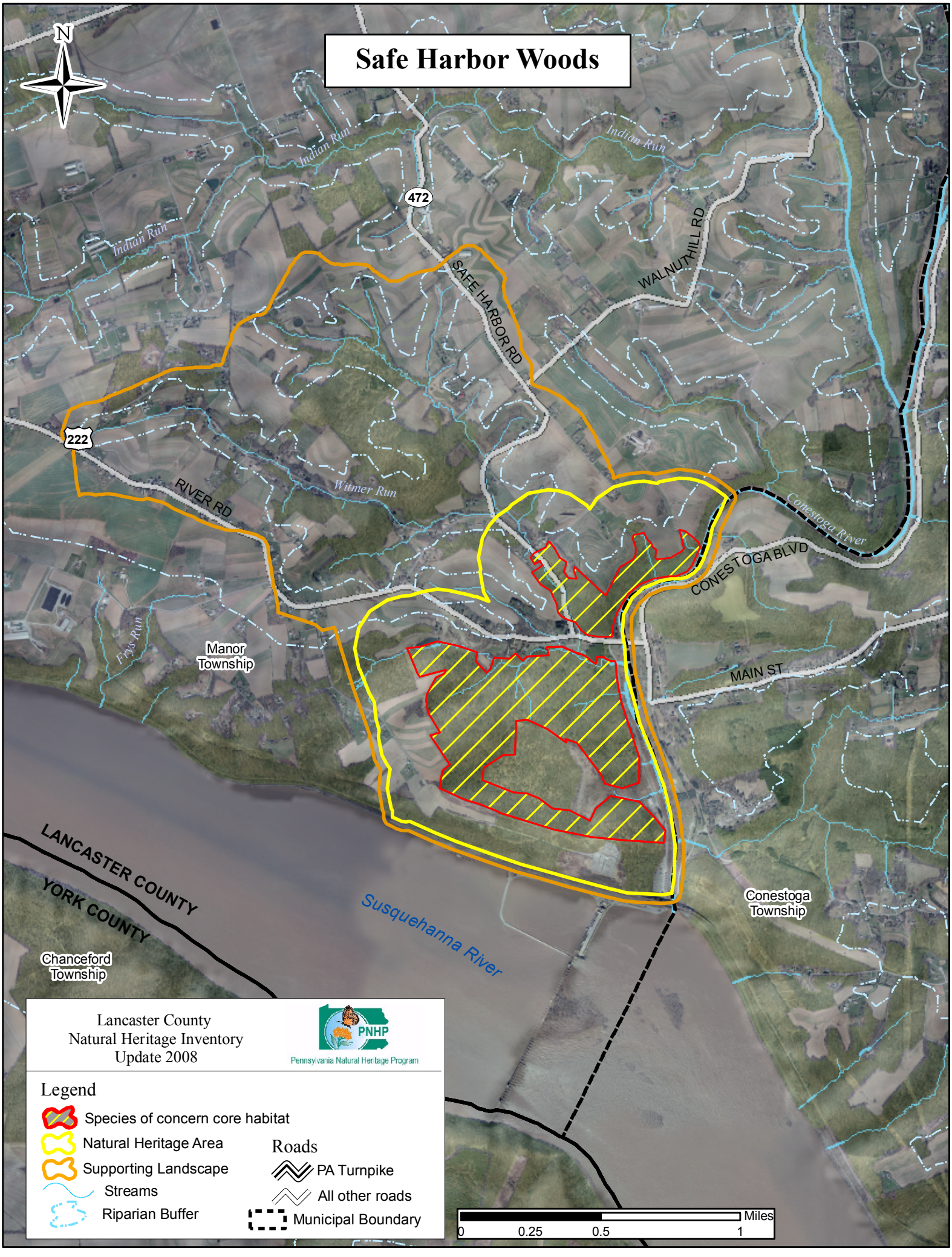
Within the Core Habitat:

- Provide for the long-term protection of the core habitat.
    - Approximately half of the core habitat is owned by the Safe Harbor Water Power Corporation and is currently considered to be of secondary concern for conversion to incompatible uses.
        - First, consider fee-simple acquisition, or conservation easement options with the largest property owners of the core outside of the Safe Harbor Water Power Corporation property holdings.
        - Second, consider fee-simple acquisition, or conservation easement options with the Safe Harbor Water Power Corporation property holdings.
- Remove invasive species of plants.
    - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
    - Coordinate invasive species management within the utility rights-of-way.
    - Continual invasive species monitoring and control is recommended.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
    - Block access to forested areas by off road vehicles, ATVs, motorcycles and bicycles.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus and tilth.
        - Trees that have fallen over approved trails can be cut through as necessary.
        - Improve the forest composition by removing non-native trees and shrubs. The utility rights-of-way and the edges of River Road and Spring Run Road are likely the primary location of non-native trees and shrubs within this area.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Uncommon native species of plants are particularly susceptible to deer herbivory.
- Additional surveys for species of concern are recommended. Recent surveys for the plant species of concern harbinger of spring (*Erigenia bulbosa*) have not succeeded in finding this plant, though the habitat is appropriate for this species. Past historical biological surveys have documented the following species to have occurred in the area. None of these is currently known to occur in the immediate vicinity. Surveys for these species in this and adjacent area may find populations of these species still present in the area.

Within the Natural Heritage Area / Supporting Landscape: The Natural Heritage Area for this location was drawn to exclude the most disturbed portions of the adjacent habitat, which are primarily active agricultural fields and residential areas. The supporting landscape for this area was generated primarily as a 300 meter perimeter around the Natural Heritage Area and is intended to indicate an area that should be maintained as

rural and agriculture to provide a buffer for the Natural Heritage Area and the core habitat it contains. Increased development within this area may result in intensified pressure on the surrounding natural habitat.

- Forested properties should be acquired or provided with conservation easements to help provide a buffer to this habitat. Additional populations of species of concern could occur on adjacent parcels.
    - The small patches of agricultural fields within the area should be encouraged to return to forest to expand the area of interior forest and decrease the amount of edge habitat at this location.
- Consider closing Spring Run Road. This road does not need to be a through road, and could serve the few residences that are here without passing entirely through the habitat. Partial closure of this road would slightly increase the interior forest at this location. The forest would remain fragmented due to the utility rights-of-way paralleling Spring Run Road. Portions of the utility rights-of-way should be allowed to achieve forest canopy closure to improve habitat connectivity within this area.
- Develop a forested corridor between the Natural Heritage Area and points north and south. This could be established as a recreational trail and function as both a recreational opportunity and a wildlife corridor.
    - Main Street to the north of the Natural Heritage Area nearly severs the connection between the Natural Heritage Area and points to the north. Suburban development lines most of the roadway, with few patches of undeveloped land that can contribute to wildlife corridors. Several of the remaining undeveloped parcels represent an opportunity to provide a linkage between the Natural Heritage Area and forest blocks to the north.
    - Similarly, establish and maintain a natural corridor between Safe Harbor East Woods and Shanks Ferry to the south across River Road.
    - The Conestoga Trail passes around this Natural Heritage Area to the east, but currently follows along roadsides in the area and does not serve as a habitat corridor.
- Conservation easements should be sought for forested and agricultural properties to provide a buffer to the Natural Heritage Area and to help provide connectivity to other nearby greenway Natural Heritage Areas. Additional populations of species of concern may occur on adjacent parcels.
- Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
- <u>Potential zoning options for conservation enhancement:</u>
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 35% of the core habitat, ~35% of the Natural Heritage Area and ~25% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this area.


Safe Harbor Woods
N
Indian Run
Indian Run
Indian Run
472
SAFE HARBOR RD
WALNUT HILL RD
222
RIVER RD
Witmer Run
Conestoga River
CONESTOGA BLVD
Frys Run
Manor Township
MAIN ST
LANCASTER COUNTY
YORK COUNTY
Susquehanna River
Conestoga Township
Chanceford Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Safe Harbor Woods – *High significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	1996-04-15	D
Harbinger-of-Spring (*Erigenea bulbosa*)	G5	S2	PT	1996-04-15	CD
Clinton's wood fern (*Dryopteris clintoniana*)	G5	S2	PT	1995-07-07	E
Animals:					
Sensitive species of concern[3]	-	-	-	1991-05-18	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location:

- Municipalities:
  - Conoy Township
  - East Donegal Township
  - West Hempfield Township
  - Marietta Borough
- USGS Quadrangles:
  - Columbia West
  - York Haven
- 1990 Lancaster Natural Areas Inventory reference:
  - "Vinegar Ferry"



Description: This wooded habitat on the west side of the mouth of the Conestoga River contains steep-sided, narrow ravines that feed into the Conestoga River in a topographically convoluted landscape. The habitat is moist and rich, and supports a diverse spring wildflower community. The Natural Heritage Area is bounded to the southwest by the Susquehanna River, where the landscape drops off steeply to the railroad tracks paralleling the river. Exposed bedrock outcrops jut out from the scenic ridgeline and slopes along the river.

Species of Concern Considerations:

Plants:

- A small patch of puttyroot occurs mid-slope in a moist, richly forested ravine. There is more potential habitat for this small, inconspicuous orchid, and additional surveys may reveal the presence of a larger population.
- Harbinger-of-spring occurs in seepy areas and along the banks of a small creek running through the area. The immediate habitat for this species is spongy, and can be easily disturbed by excessive foot traffic.
- Clinton's wood fern was documented on a slope facing Witmer Run, which feeds into the Conestoga River. The population is close to a road and could be vulnerable to roadside maintenance activities.

Animals:

- A sensitive animal species of concern utilizes the steep, dry, southwest-facing wooded slopes along the Susquehanna River. The suitable habitat for this animal species is mapped as occurring from Turkey Hill all the way down to the mouth of the Conestoga River. A dead specimen was found between the two rails of the train tracks along the river. The railroad can be a substantial barrier for small animal movement between upland and lowland habitats. Periodic under track culverts, or other means of mitigating the barrier effect of the tracks, should be integrated into future railroad maintenance plans.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- The rare species core habitat is drawn around the forested portions of the immediate landscape, so this entire habitat is forested. This Natural Heritage Area has roughly 65% forest cover including about 90 acres of interior forest. The supporting landscape also contains significant forested features. The forest appears dominated by modified successional forest, which is an early stage of recovery from past clearing. Other forest communities present include:
    - Terrestiral (upland) communities:
        - Hemlock-tuliptree-birch forest
        - Tuliptree-beech-maple forest
        - Dry oak-heath forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath woodland
        - Virginia pine-mixed hardwood woodland
        - modified successional forest*
        - juniper woodland*
    - Palustrine (wetland) communities:
        - Sycamore (river birch)-box elder floodplain forest

Ownership:

- The PPL Corporation owns nearly 90% of the rare species core habitat and over 50% of the Natural Heritage Area.
- The Norfolk Southern Corporation owns a narrow railroad rights-of-way paralleling the Susquehanna River.
- The remainder of the Natural Heritage Area and almost all of the supporting landscape is privately owned property in a variety of parcel sizes. The largest of these contain the bulk of the forested habitat in the supporting landscape.

Habitat Disturbances:

- Historic –
    - Based on aerial photos from 1940, much of the rare species core habitat appeared to have been logged or cultivated in the recent past, evidenced by the visible remnants of hedgerows and openings.
    - The floodplain at the mouth of Witmer Run where it enters the Conestoga River was cleared for active agriculture in 1940, but has since converted back to forest.
    - Most of the roads, the railroad, utility rights-of-ways and the Safe Harbor power plant were in place by 1940.
- Current –

- There has been much recovery of the forested landscape within the rare species core habitat since 1940. What had been recovering from logging or agriculture in 1940 is now in forest cover. The early successional forest type that dominates these areas is not high quality, owing to its recent disturbance history. It will likely take generations and some active management before the forest begins to resemble the forest it replaced.
- Small lot residential development has increased along River Road and Pittsburg Valley Road.
- Trash dumping was apparent in the forested rare species core habitat.
- Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.

- Exotic Species –
  - Invasive species of plants were listed as a long-term threat to the species of concern and this habitat, but specifics are not available. The railroad and utility rights-of-way, the edges of roads and the transition zone between forested and agricultural landscapes are likely the areas of greatest invasive plant species concentrations. An updated site survey is recommended.

Conservation Actions:

Overall:

- Safeguard the quality and expanse of the forested landscape, especially as it extends into the supporting landscape between the branches of Witmer Run. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect the water quality of the small streams that drain through this area into the Susquehanna River and provides refuge and habitat for other forest dependent species. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve and maintain old-growth characteristics.
- Road maintenance activities can inadvertently destroy the population of Clinton's wood fern. Inform Manor Township road maintenance staff about the presence of sensitive natural features along Safe Harbor Road and River Road in the vicinity of Conestoga River. Create a management plan for the roadside with PHNP or other botanists.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat through conservation easements and fee-simple acquisition.
  - Almost all of the core habitat is currently owned by the PPL Corporation and is presently considered to be of secondary concern for conversion to incompatible uses based on the assumption that the current land use and ownership will remain for the foreseeable future. If PPL chooses to divest itself of the property, it should be considered a medium priority for conservation acquisition.
  - Private property within the core habitat should be considered a priority for conservation easements or acquisition.
- Develop a roadside management plan in coordination with the Manor Township road maintenance staff to provide for safety of the population of Clinton's wood fern at this location.

- Encourage active forest management on woodlands that are labeled as "modified successional forest" to help speed the recovery process of these areas. Reforestation efforts should be designed to mimic the adjacent natural community type by encouraging a similar composition of native trees and shrubs of varying age classes.
    - Remove non-native trees and shrubs while avoiding disturbing native species.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Rare species of plants are particularly susceptible to deer herbivory. Deer fencing may be necessary in areas to protect young trees and shrubs until they become established.
    - Allow the forest to return to near old-growth conditions.
    - Block access to forested areas by off road vehicles, ATVs and other motorized vehicles.

Within the Natural Heritage Area: The Natural Heritage Area for this location is drawn closely around the core habitat.

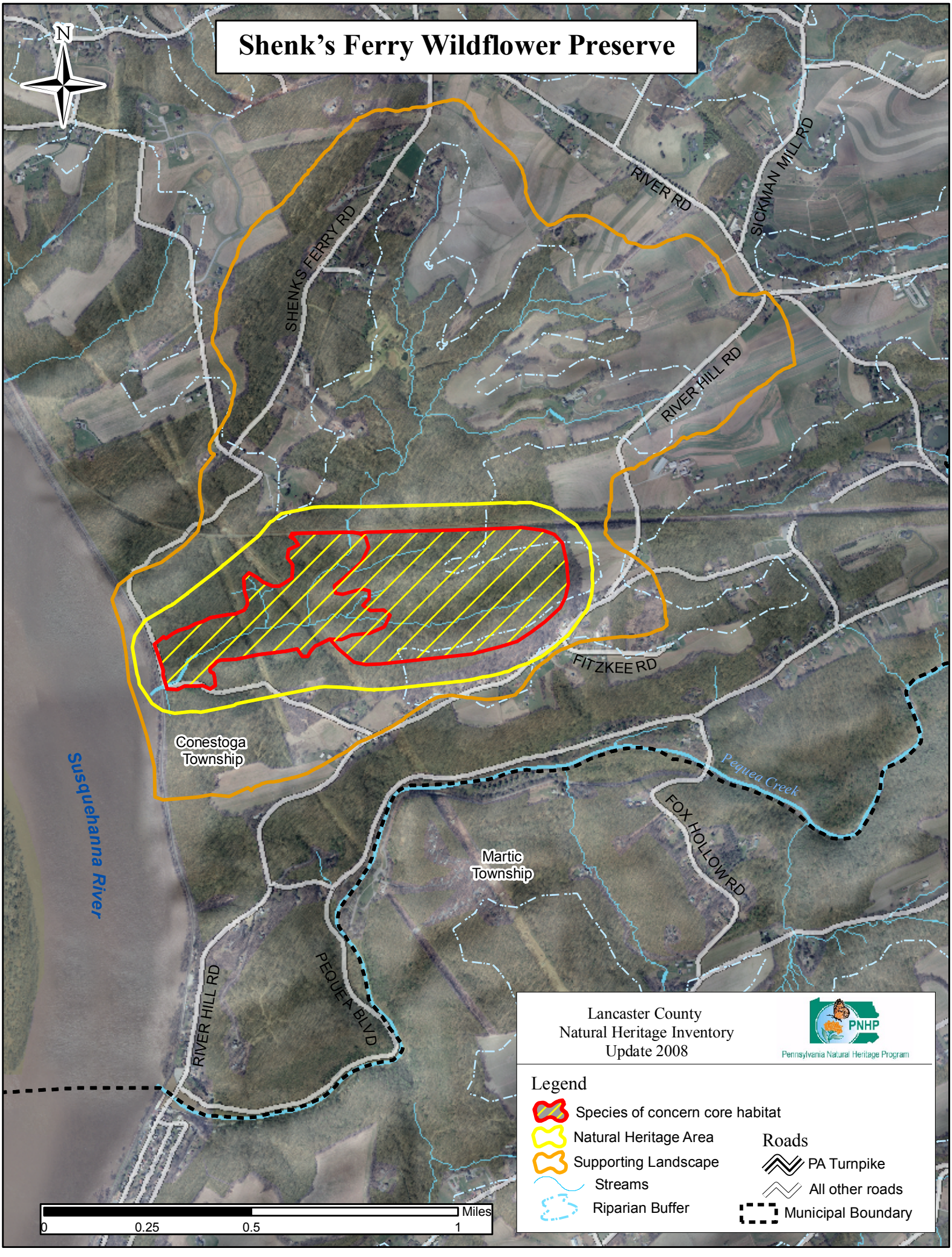
- Parcels currently in agriculture that are of high quality agricultural soils should be considered for agricultural easements to retain this attribute. Poorer quality agricultural soils should be encouraged to regenerate into forest cover to provide a buffer to the core habitat and increase the amount of forest habitat.

Within the Supporting Landscape:

The supporting landscape for this Natural Heritage Area is derived from the Witmer Run Watershed and the adjacent area draining into the Conestoga and Susquehanna Rivers. Activities within the upstream watershed can have a direct impact on the core habitats of the Natural Heritage Area and the species of concern it contains.

- The area between the branches of Witmer Run in the supporting landscape is conspicuously forested including a small patch of interior forest. This area provides a significant habitat corridor, nearly reaching Indian Run to the north. Conservation and expansion of the forested riparian corridor of the Witmer Run branches should be considered a priority for activities within the supporting landscape for this area. Forested zones along creeks help filter runoff from roads, residences and agricultural areas, cleansing the runoff before it enters larger streams and rivers. Forested creek edges also slow runoff, allowing the water to recharge the groundwater. These narrow corridors are highly susceptible to colonization by invasive species of plants. Target pioneer populations of invasive plants for immediate and continued removal, particularly tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose, oriental bittersweet and common privet.
- Conservation easements should be sought for forested and agricultural properties adjacent to the Natural Heritage Area to provide a buffer to this habitat and to help provide connectivity to other nearby greenway Natural Heritage Areas. Additional populations of rare species could occur on adjacent parcels.
- Zoning options for conservation enhancement:
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for approximately 35% of the area within the core habitat, ~30% of the Natural Heritage Area and ~20% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.

    - Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this area.
- Streams through forested areas should be considered high priority for conservation in the habitat. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings. See riparian corridor section for site specific recommendations.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
        - include adjacent wetlands
        - add a buffer equal to the width of the wetland.
        - Slopes over 25% should not count toward the buffer
        - Non-porous surfaces should not be included in the buffer calculation
    - Intermediate forested buffer of 100 feet
    - Minimum forested buffer of 35 feet


Shenk's Ferry Wildflower Preserve
N
SHENKS FERRY RD
RIVER RD
SICKMAN MILL RD
RIVER HILL RD
FITZKEE RD
Conestoga Township
Susquehanna River
Pequea Creek
FOX HOLLOW RD
Martic Township
PEQUEA BLVD
RIVER HILL RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

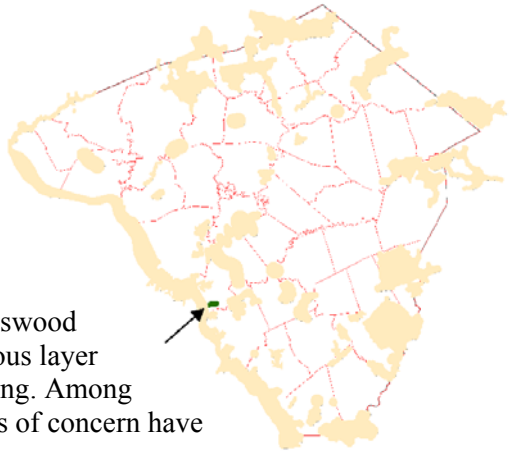
Shenk's Ferry Wildflower Preserve - *high significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	2006-04-10	B
Susquehanna trillium (*Trillium sp.*)	G?	S?	TU	2006-04-10	A

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: Shenk's Ferry is a wooded ravine along the Susquehanna River north of Pequea Borough.

- Municipalities:
  - Conestoga Township
- USGS Quadrangles:
  - Conestoga Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Shenks Ferry Wildflower Preserve: SP511, SP512" – Conestoga Quadrangle.



Description: This site is a deep, forested ravine, which opens into the Susquehanna River. The forest canopy is a tuliptree – beech - maple forest with smaller portions in a sugar maple - basswood forest. The lower slopes support a very rich and diverse herbaceous layer and this area is a popular destination for spring wildflower viewing. Among the rich diversity of spring wildflowers present, two plant species of concern have been documented from this location.

Species of Concern Considerations:

- Puttyroot is a plant of moist, rich forested habitats. These habitats in the state have been substantially diminished by logging and conversion to agricultural, industrial and residential uses.
- The populations of Susquehanna trillium in the lower Susquehanna ravines are plants of uncertain taxonomy, which is to say, the populations of this trillium do not fall neatly into one species characterization. These populations may be hybrids between declined trillium and purple trillium (*Trillium flexipes* and *Trillium erectum*). This taxonomic puzzle needs to be investigated further, but either way, the populations of these trilliums are worthy of conservation action. Conservation of the rich forested habitat should provide the protection needed for this species. Unauthorized collection for wildflower gardens is also a potential threat.
- Other plant species of concern have been reported form here. Additional surveys are needed to document these occurrences.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- The most floristically interesting portion of the area is composed of a sugar maple-basswood forest, while most of the area is dominated by tuliptree-beech-maple forest, with smaller patches of other natural community types scattered as topography, sunlight and available moisture dictate including:
    - Terrestrial (upland) communities:
        - Hemlock-tuliptree-birch forest
        - Tuliptree-beech-maple forest
        - Sugar maple-basswood forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath forest
        - modified successional forest*
    - Palustrine (wetland) communities:
        - Sycamore-(river birch)-box elder floodplain forest

Ownership:

- Approximately one third of the core habitat is owned by PPL
- A smaller, though significant corridor through the northern portion of the core habitat is owned by the Norfolk Southern Rail Corp. The railroad also owns a large parcel north of the rail line.
- There is one large private landowner (100+ acres) that currently owns most of the remaining portion of the core habitat of this site.

Disturbances:

- Historic- Aerial photos from 1940 show that most of the core habitat of this site has been forested since the time the photos were taken, though portions had been cleared for agriculture and powerline transmission corridors. The site is crossed by two powerline corridors, a railroad and several smaller roads. Portions of the site had apparently been converted to conifer plantations.
- Current-
    - The area is a popular passive recreation area, used primarily in the spring to view the wildflowers. Several major trails meander through the area, and other, smaller trails are apparent. Trampling off of the paths is a disturbance to sensitive populations of plants. Off road vehicles including four wheel drive vehicles, ATVs, motorcycles and bicycles have made some inroads into the area.
    - The railroad along the Susquehanna shoreline impedes animal movement from the river to the uplands and visa versa, especially for small animals like turtles and salamanders that would consider the railroad an insurmountable obstacle. Evidence of dumping is apparent near the railroad.
    - Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic species –
    - While the central portion of the ravine is only slightly invaded by exotic species of plants, the weedy species come to dominate the shrub and herbaceous layers towards the margins of the ravine. The powerline corridors,

railroad, roads and trails all contribute to providing habitat conditions favorable to the spread of invasive species of plants. Invasive species of plants known at this location include, but are not likely limited to:

- Tree of heaven: (*Ailanthus altissima*)
- Garlic mustard (*Alliaria petiolata*)
- Barberry (*Berberis thunbergii*)
- Orange day-lily (*Hemerocallis fulva*)
- Common privet (*Ligustrum vulgare*)
- Japanese honeysuckle (*Lonicera japonica*)
- Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
- Lesser celandine (*Ranunculus ficaria.*)
- Multiflora rose (*Rosa multiflora*)

- Invasive plants are especially heavy along the powerline corridors. Control options for invasive plants range from mechanical to chemical (see individual fact sheets).
- High priority for invasive species control at this site should be targeted towards removing small populations of newly established invasive plants, in particular, lesser celandine (*Ranunculus ficaria*). Currently, only small patches of this plant have been observed at this location. Lesser celandine has the potential to severely impact the currently uninvaded riparian corridor of Grub Run. Chemical control of these small patches may be necessary. Other invasive plants are well established at the margins of the preserve and control activities should concentrate on removing invasive plants from the ravine and working towards the more heavily infested edges, pushing back the line of invasion. This could include coordinated volunteer participation and would likely be most effective in summer and fall. Volunteer invasive species removal could be best directed towards woody species removal including barberry, common privet, bush honeysuckle and multiflora rose. These species are easily identified and young plants can be pulled from the ground under appropriate soil conditions. Larger shrubs can be cut and sprayed with the appropriate herbicides.

Conservation Actions:

Overall:

- The Shenks Ferry Wildflower Preserve is currently owned by PPL, who allow public access in a park-like setting. If PPL chooses to divest itself of the property, it should be considered a high priority for conservation acquisition.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat.
  - Approximately one third of the core habitat is owned by PPL. A smaller, though significant corridor through the northern portion of the core habitat is owned by the Norfolk Southern Rail Corp. These parcels are currently considered to be of secondary concern for conversion to incompatible uses, based on the assumption that the current land use and ownership will remain for the foreseeable future.
  - There is one large private landowner that currently owns most of the remaining portion of the core habitat of this site. Fee-simple acquisition or conservation easement options with this landowner should be considered a high priority for

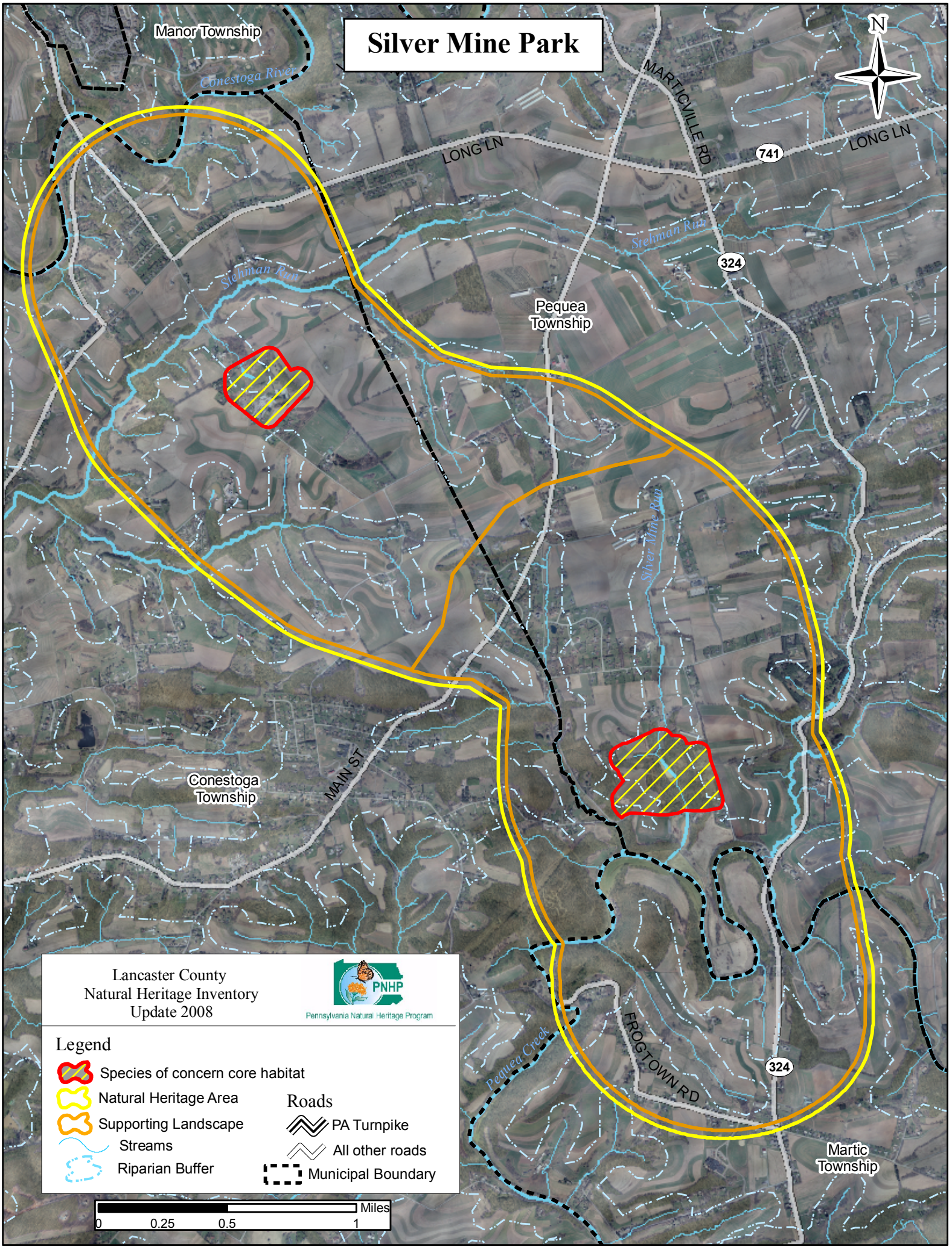
this site. Aerial photos from 1940 indicate that this parcel has remained forested for the last 100 years.

- Remove invasive species of plants.
    - The core habitat is not heavily infested with invasive species of plants, so their removal will be of primary importance to keep the area from becoming degraded by their increase. Focus invasive species removal on lesser celandine (*Ranunculus ficaria*) and pioneer populations of other weed species listed above. Spot treating aggressive invasive plants with appropriate herbicides may be necessary along the power line right of way, particularly Tree-of-heaven (*Ailanthus altissima*), bush honeysuckles (*Lonicera maackii & Lonicera morrowii*) and Japanese honeysuckle (*Lonicera japonica*). Establish native shrubs under power line to help prevent recolonization by invasive species.
    - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
    - Coordinate invasive species management within the powerline right-of-way.
    - Continual invasive species monitoring and removal will be necessary.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
    - Block access to forested areas by off road vehicles, ATVs, motorcycles and bicycles.
    - Parking can be a serious problem during peak season with very little opportunity to turn around at the end of the lane. A turn around area could help alleviate this problem.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus and tilth, and to provide habitat for animals.
        - Trees that have fallen over approved trails can be cut through as necessary.
    - Removal of non-native trees will be necessary.
- Additional surveys for species of concern are recommended.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- Conservation easements should be sought for adjacent forested and agricultural properties to provide a buffer to this habitat and to help provide connectivity to other nearby Natural Heritage Areas. Additional populations of species of concern could occur on adjacent parcels.
- Green Hill Road south of Grub Run is a good candidate for closing to help decrease edge habitat in this area. The dirt lane is seasonally impassible and its improvement will only help to encourage incompatible development of the area. Closure of this dirt road will increase the amount of interior forest in this ecologically significant area.
- Remove invasive species of plants.
- Adjacent forested properties should be acquired or provided with conservation easements to help provide a buffer to this habitat. Additional populations of species of concern could occur on adjacent parcels.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus and tilth.
        - Trees that have fallen over approved trails can be cut through as necessary.

    - Removal of non-native trees will be necessary. The upland habitats at the edges of this preserve are the primary location of non-native trees within this area.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be reforested with native trees and shrubs appropriate to the habitat. Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
    - Ideal forested stream buffers should be 100 meters (~300 feet) in width from the edge of the 100-year floodplain
    - Intermediate forested stream buffer of 100 feet in width from the edge of the 100-year floodplain
    - Minimum forested buffer of 35 feet in width from the edge of the 100-year floodplain
- Additional surveys for species of concern are recommended.
- <u>Potential zoning options for conservation enhancement:</u>
    - Adjacent parcels currently forested should be zoned to conserve this attribute.
    - Adjacent parcels currently in agriculture should be zoned agricultural.
    - Growth within the Township should be discouraged to occur within the core, hub or supporting landscape identified for this area.
    - Growth within the Township should be encouraged to occur within Conestoga Borough.


Silver Mine Park
Manor Township
Conestoga River
LONG LN
MARTICVILLE RD
741
LONG LN
Stehman Run
Stehman Run
324
Pequea Township
Silver Mine Run
Conestoga Township
MAIN ST
Pequea Creek
FROGTOWN RD
324
Martic Township
N
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Silver Mine Park – *High significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Animals:					
Price's cave isopod (*Caecidotea pricei*)	G5	S2S3	-	1995-01-17	AB
Pizzini's cave amphipod (*Stygobromus pizzinii*)	G3G4	S1	-	1995-01-17	B
Sensitive species of concern (A) [3]	-	-	-	2006-07-14	E
Sensitive species of concern (B) [3]	-	-	-	2008	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area roughly parallels the Conestoga / Pequea Township boundary between the Conestoga River and Pequea Creek with Silver Mine Township Park occurring along Pequea Creek.



- Municipalities:
  - Conestoga Township
  - Martic Township
  - Pequea Township
- USGS Quadrangles:
  - Conestoga Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: This Natural Heritage Area is dominated by an agricultural landscape over limestone bedrock. Cave invertebrate species of concern have been documented at two locations where springs exit the ground. One is an actual spring, and the other is a flooded abandoned mine that flows with water during rain events. These cave invertebrates are likely more common among the network of subterranean solutional caves, cracks and fissures that are typical of limestone geology. In addition, a sensitive species of concern uses the fields, pastures and wood edges of the agricultural landscape as its primary habitat.

Species of Concern Considerations:

- Cave invertebrates: There are two rare cave invertebrates known from the karst system beneath the Natural Heritage Area: Price's cave isopod and Pinzzini's cave amphipod (crustaceans). The focus of conservation efforts for these species, and the cave habitat as a whole, is the protection of the water quality of the cave system. The specific hydrology of underground systems is difficult to determine, but in general, conditions above ground effects the habitat underground. Prevent contamination of the groundwater by preventing agricultural, residential, industrial and roadway runoff from entering the karst system.
- Sensitive species of concern (A) requires appropriate nesting structures such as dead trees and open areas for food gathering. Farming operations that employ infrequent mowing can help maintain the habitat for this species.
- Sensitive species of concern (B) occurs in caves in the area. This species is sensitive to even minor disturbance to the water quality and cave environment. Streams and surface runoff enter sinkholes and caves, bypassing natural filtration through soil and sediment. In addition, the porous carbonate bedrock typical of karst topography allows solid and liquid wastes to seep into caves and

groundwater. Deforestation on the surface causes changes in hydrology and increased sedimentation in caves. Alteration of cave entranceways such as vegetation removal and structural changes, such as closure, can affect climatic conditions in the cave, including airflow, temperature, and humidity.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Dry white pine (hemlock)-oak forest
  - Tuliptree-beech-maple forest
  - Dry oak-mixed hardwood forest
  - Dry oak-heath forest
  - modified successional forest*
  - shrubland*
  - grass-shrubland*
  - grassland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest
  - wet meadow*

- Though most of this Natural Heritage Area has long ago been converted to intensive agricultural production, a few fragments of natural habitat remain, primarily along streams. Some of these areas appear to be of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as modified successional forest are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers. Wet meadows and pastures within the floodplain can potentially be restored back to floodplain forest or other open wetland habitats as appropriate to the topography and hydrology.

Ownership:

- Most of the area is held in larger parcels in active agricultural production, though residential subdivision has occurred adjacent to Route 741 and New Danville Pike.
- Pequea Township's Silver Mine Park encompasses roughly 150 acres along Pequea Creek.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture. Aerial photos from the 1940's show that agricultural production left very little natural habitat remaining. In most areas, fields extended to the banks of the small tributaries leading to the Conestoga River and Pequea Creek. Erosional gullies can be observed crossing fields leading to the creek.
  - Several milldams occurred along Pequea Creek, the Conestoga River and on Stehman Run within and adjacent to this Natural Heritage Area. The legacy sediments that are trapped behind the dams alter the topography of the floodplain and trap stream banks in unnatural channels when they are suddenly breached.
- Current –
  - While the amount of forested / natural habitats has slightly increased since 1940 in this area, residential subdivisions have replaced some agricultural fields, particularly along New Danville Pike. Runoff from impervious surfaces around residences can degrade groundwater quality.

- Most of the area remains in active agricultural production and many of the streams have little to no vegetated buffer between the banks of the creek and agricultural fields. Stehman Run, for the most part, has a good vegetated riparian buffer, though in areas it is completely lacking.

o Exotic Species – The exotic species composition and threat to this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall:

- Protect and improve the quality of the groundwater. Water quality improvement will benefit the local human communities as well as the habitat of the cave-dwelling species of concern present at this location.
  - Implement an Aquifer Protection Overlay Zone or Karst Hazard Overlay District within the supporting landscape for this Natural Heritage Area to help protect ground water resources.
  - Restore the forested/vegetated floodplain of all tributaries to the Conestoga River and Pequea Creek.

Within the Core Habitat:

- The subterranean habitat of the cave-dwelling species can be considerably impacted from above ground land use decisions. Storm water runoff through rural and suburban areas can be a significant source of chemical and nutrient pollutants, which can severely impact water quality and the food chain of both surface and subsurface waters. Runoff from agricultural fields typically have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Storm water management measures such as the creation of detention basins or vegetated swales should be implemented to slow and capture water flow in these expanses of cultivated fields before it can enter sinkholes and other direct openings to the groundwater. Conservation efforts should focus on protecting and improving the quality of the surface and ground water for both the local human community as well as for the habitat for native plants and animals and species of concern.
- The low intensity agricultural land use of pastures and hayfields helps to provide suitable habitat for the sensitive species of concern. Land use practices that adversely affect prey species, such as the conversion to development or high-intensity row-crop agriculture, should be avoided within the core habitat. Mowing or light grazing is recommended to maintain grass cover and keep a layer of ground litter, which encourages a healthy prey population. Agricultural zoning is compatible with this Natural Heritage Area.
- Most of Silver Mine Township Park is within the 100-year floodplain of Pequea Creek. These portions of the park could be restored to a functioning floodplain forest and associated wetlands. Nearby sycamore (river birch)-box elder floodplain forests could serve as reference communities for restoration efforts in these floodplain habitats. Emphasis should be on promoting a viable floodplain natural community rather than on expansion of active park facilities and infrastructure. Mowing of the area should be minimized or eliminated with special emphasis on protecting and expanding areas with native vegetation and restoration and protection of the natural condition of the shoreline.

Within the Supporting Landscape:

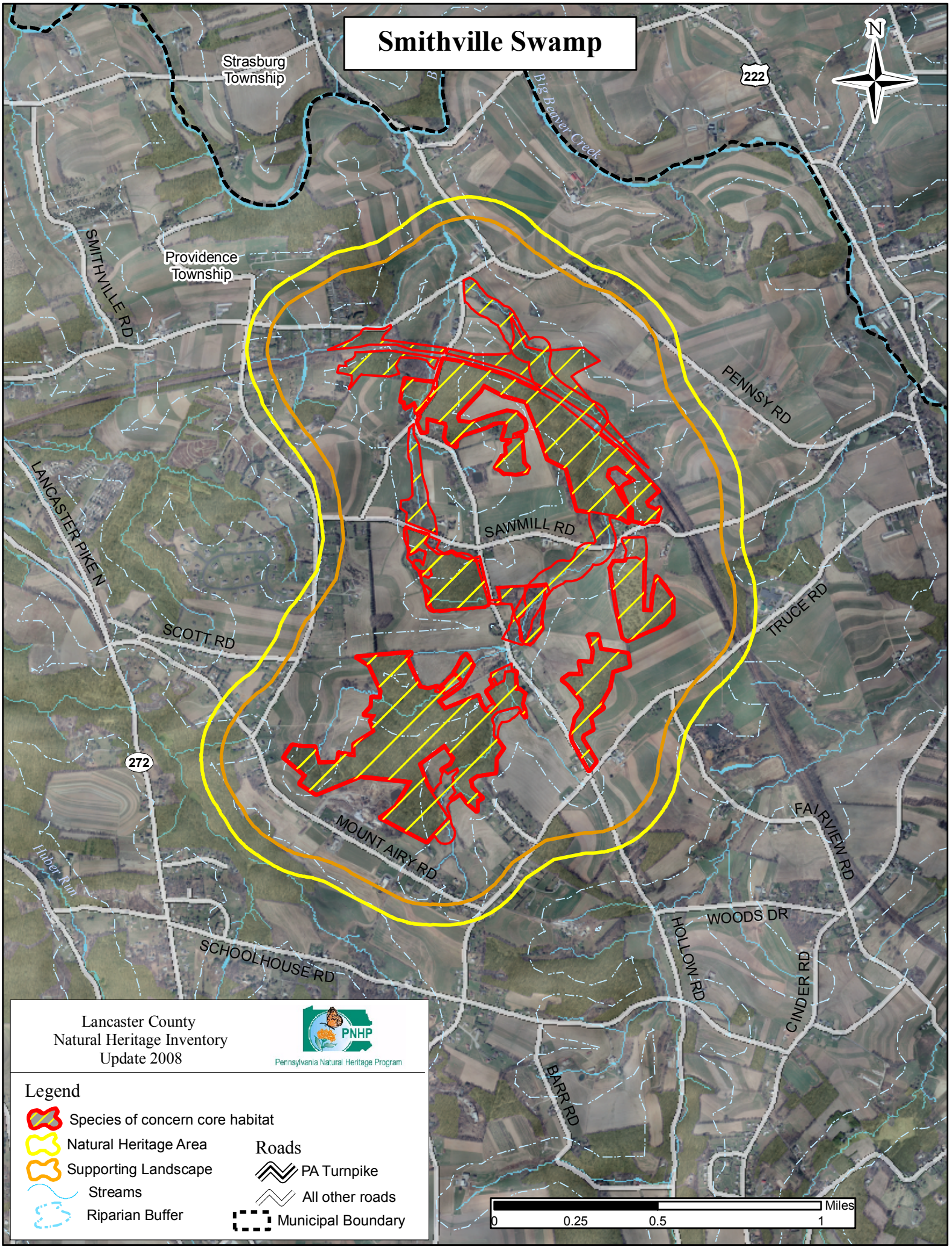
- Pursue conservation easements, transfer of development rights and fee simple acquisition on properties along the Conestoga River and Pequea Creek to help conserve and improve their effectiveness as natural corridors.
- Sinkholes within the area should be considered direct conduits to the groundwater and should be protected from above ground sources of pollution. Sinkholes should be buffered with native

vegetation to help slow the flow of water before it enters the sinkhole. Water that is reduced in velocity will drop sediment and other heavy particles as it slows down.

- The long term goal for the area should be to restore mature floodplain forests and wetland openings as well as the associated upland buffer forests along all tributary streams in the area. Ideally, expand the native vegetation along the tributaries to include land within 100 meters of the creek's floodplain. Alternately, the 100 foot riparian buffer can substitute for the 100 meter buffer where development has already eliminated the preferred option. Restoration efforts should be designed to mimic the adjacent high-quality natural community types in a similar topographic and hydrologic position by recruiting a comparable composition of native trees and shrubs of varying age classes. Restoration is a labor intensive effort that requires long term monitoring and maintenance to avoid infestation by invasive species of plants.
- Prevent the conversion of agricultural or natural lands in the supporting landscape to residential or industrial development. Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way especially along the creek shoreline and any remaining natural habitats. These natural habitats provide a significant filter for runoff entering the creek from the adjacent uplands.
- <u>Potential zoning options for conservation enhancement:</u>
  - Implement an Aquifer Protection Overlay Zone or Karst Hazard Overlay Zone within the supporting landscape for this Natural Heritage Area. Refer to the example in the Pequea Township Zoning Ordinance.
  - Conestoga, Martic and Pequea Townships have zoning ordinances restricting new construction within the 100-year floodplain of all waterways. Pequea Township includes the 500-year floodplain and lands containing alluvial or floodplain soils in the definition of its floodplain district. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat. Most of the smaller tributaries within this Natural Heritage Area don't have a defined 100 year floodplain. A riparian buffer overlay zone could be an appropriate option to provide protection for the water of these smaller streams (see Lancaster Township)
    i. The floodplain regulations for Conestoga Township are weakly written and would permit new construction within the floodplain zone if the structure could be deemed not to be affected by flood waters. This regulation should be updated to reflect the need to protect the floodplain from encroachment from development or any sort.
    - Floodplain regulations in all Townships should be updated to restrict tilling of fields and chemical or nutrient application within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
    - Lancaster Township's floodplain regulation appears to provide for the establishment of a 100-foot forested riparian buffer on all water courses in the Township, but this appears to conflict with a regulation requiring only a 15–foot grass strip between tilled land and water courses (Section 1310.8 A-E). A 100-foot forested riparian buffer along all water courses is a reasonable and achievable goal and would go a long way towards protecting and improving water quality locally as well as regionally, while the 15-foot grass strip will offer a bare minimum of water quality protection.
  - Conestoga Township has a "Conservation District" zoning option that could help contribute toward conservation of ecologically sensitive habitats. It does not allow new construction within this zone except by special exception (Article XII, Section 1202). Strict enforcement of this regulation could provide considerable protection for the intended resources.
- <u>Potential restoration activities:</u>
  - Historic milldams occurred along water courses in this area. An analysis of the legacy sediments these dams trapped and the feasibility to restore the original topography should be conducted prior to replanting efforts near milldams.

- Priorities for restoration of historic floodplain topography should be where the end result would be a functioning wetland habitat.

- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the habitat.
  - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
  - An ideal vegetated stream buffers should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
  - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
  - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.


Smithville Swamp
Strasburg Township
Providence Township
Big Beaver Creek
222
N
SMITHVILLE RD
PENNSY RD
LANCASTER PIKE N
SAWMILL RD
TRUCE RD
SCOTT RD
272
MOUNT AIRY RD
FAIRVIEW RD
Huber Run
WOODS DR
HOLLOW RD
CINDER RD
SCHOOLHOUSE RD
BARR RD
Lancaster County
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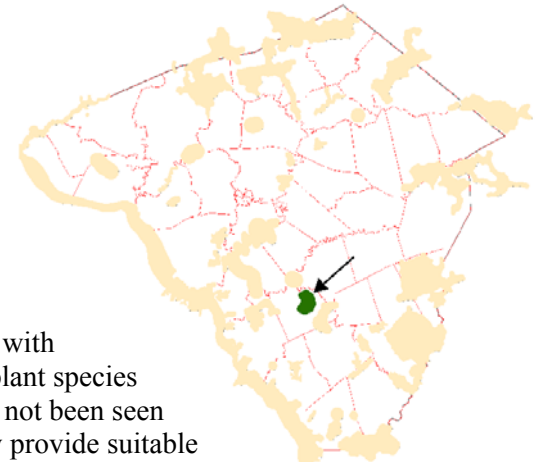
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Smithville Swamp – *High significance*					
Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bull sedge (*Carex bullata*)	G5	S1	PE	1993-06-29	BC
Twig rush (*Cladium mariscoides*)	G5	S2	PE	1993-06-29	D
Rough-leaved aster (*Eurybia radula*)	G5	S2	N	1993-09-10	CD
Quillwort (*Isoetes valida*)	G4?	SU	N	1996-08-24	E
Sweet bay magnolia (*Magnolia virginiana*)	G5	S2	PT	1993-06-29	B

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location:

- Municipalities:
  - Providence Township
- USGS Quadrangles:
  - Quarryville Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:



Description: This Natural Heritage Area consists of various patchy woodlots in an agriculture and residential dominated landscape. An interesting forested and open wetland within this area contains an unusual mix of plants more typically associated with the coastal plain of Delaware and New Jersey. Numerous other plant species of concern were historically documented from this area but have not been seen in recent times. Restoration efforts of these wetland habitats may provide suitable habitat for their return.

Species of Concern Considerations: The viability of all of these wetland plants and their habitats may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. Excessive browsing by deer may be a threat in some locations.

Plants:

- Bull sedge grows in swamps, seepages, boggy wetlands and along streamlets. In Pennsylvania, this species occurs on a western border of its range and has been documented historically in a few eastern counties. Fewer than 5 populations are currently known from the state.
- Twig rush grows in quaking bogs, marshes, fens, and along shorelines of lakes and ponds. In Pennsylvania, it has been documented historically in scattered locations, particularly in the glaciated northwestern and northeastern counties. About 15 populations are currently known in the state. This occurrence of twig rush is particularly interesting because of its distance from other populations of this species in the state.
- Rough-leaved aster grows in wet woods, swamps, seeps, bogs, and along streams. In Pennsylvania, it has been documented historically mostly in the southern counties. About 30 populations are currently known from the state.

- This species of quillwort can be found from Pennsylvania south into Georgia and Mississippi. In Pennsylvania, it has been documented historically in some southern counties, where it grows in low volume streamlets, seepages, impoundments, and other wet places. Fewer than 5 populations are currently known from the state, but more field surveys are needed to determine the range, relative abundance, and ecological requirements of *Isoetes valida*.
- Sweet bay magnolia occurs in wetlands, particularly swamps and seepy woodlands. In Pennsylvania, it represents a southerly species and has been documented in several southeastern counties. About 20 populations, most with few individuals, have been documented in the state. Populations of sweet bay magnolia occurring west of the Coastal Plain in the state have significance for plant geography and possibly for genetic diversity

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

- Much of the natural vegetation is dominated by "modified successional forest" which is typically an early stage of recovery from past disturbance such as intensive logging or agricultural production. Dry oak-heath forests area also frequent in portions of the landscape.
- Of particular concern is the unusual Red maple-magnolia coastal plain palustrine forest, which is considered an isolated remnant of a habitat type more common along the coastal regions of Delaware and New Jersey. These and other communities likely present include:
    - Terrestrial (upland) communities:
        - Tuliptree-beech-maple forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath forest
        - Red maple terrestrial forest
        - modified successional forest*
    - Palustrine (wetland) communities:
        - Red maple-magnolia coastal plain palustrine forest
        - wet meadow*

Ownership: All of this Natural Heritage Area is in private ownership, though the average parcel size is fairly large making broad conservation action possible. Primary conservation acquisition or easement activity should focus on the forested wetland containing the red maple-magnolia coastal plain palustrine forest and an accompanying buffer. Additional conservation activity should focus on the supporting landscape before future parcel fragmentation makes bread conservation action more difficult.

Habitat Disturbances:

- Historic –
    - Past habitat disturbances to this area have been extensive. The landscape surrounding the forested wetlands was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape with scattered woodlots that we see today.
    - A portion of the forested wetland habitat appears to have been dammed or excavated in the past to create an artificial pond.
    - A drainage ditch runs through the wetland in a past attempt to drain the area. The unique community supported by this site is made possible by the site's wetland hydrology. Altering the wetland hydrology of the swamp forest eliminates critical wetland habitat.
    - A railroad passes though the Natural Heritage Area.

- Current –
  - Most of the areas that were forested in 1940 remain forested today, indicating that the areas have some attribute making their conversion to agriculture difficult.
  - Residential development is rapidly replacing agricultural fields in this area, diminishing the potential for significant habitat restoration.
  - The swamp is in close proximity to agricultural fields and is likely exposed to agricultural run-off. Nutrients, chemical compounds and sediments carried in run-off may impact water and habitat quality.
  - Runoff from impervious surfaces associated with suburban development can also significantly affect the water quality in the wetland habitat.
  - Artificial pond creation has flooded some former wetland habitats.
  - Recent selective logging has occurred within portions of the woodlots, though selective canopy removal may help maintain the open wetland conditions favorable for some of the species of concern.
  - Trash and yard waste dumping is apparent in the marsh and along the adjacent road.
- Exotic Species – Past surveys described these habitats as weedy without listing invasive species though common reed (*Phragmites australis*) was noted. Control of this invasive species should occur before it contaminates the entire wetland habitat.

Conservation Actions:

Overall:

- The primary goal should be to acquire the patch of wet woods described as a "Red maple-magnolia coastal plain palustrine forest" and the surrounding "Red maple terrestrial forest" as a dedicated nature preserve.
- Secondarily, other woodlots in the Natural Heritage Area should be considered potential species of concern habitat and connected to form a network of suitable habitat.
- Restore a forested buffer around the wetland habitat to help protect the sensitive wetland habitat from further encroachment

Within the Core Habitat:

- The wetlands of this area should be preserved as a dedicated nature sanctuary.
- Preserve and restore the natural hydrology of the wetland by disabling drainage ditches. Restore and preserve hydrologic connections to other nearby wetland habitats through adjacent streams and seeps.
- Careful selective tree thinning (surgical removal) within the "Red maple-magnolia coastal plain palustrine forest" may improve the habitat for the magnolia and other species of concern found here; however, too much logging would be detrimental to the area.
- The core habitats here are a series of modified, patchy natural areas surrounded by land in agricultural or residential use. Permanent protection of the core habitats, particularly the "Red maple-magnolia coastal plain palustrine forest" should be a high priority.
- Remove invasive species of plants.
  - Invasive plants in the swamp should be targeted for careful eradication.
  - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
  - Continual invasive species monitoring in the swamp will be needed.
- Conduct update surveys of the forested wetlands and the species of concern they contain. Develop a monitoring plan to gauge population trends, natural community health and management success at this location. Additional wet habitats in the vicinity could also contain similar species.

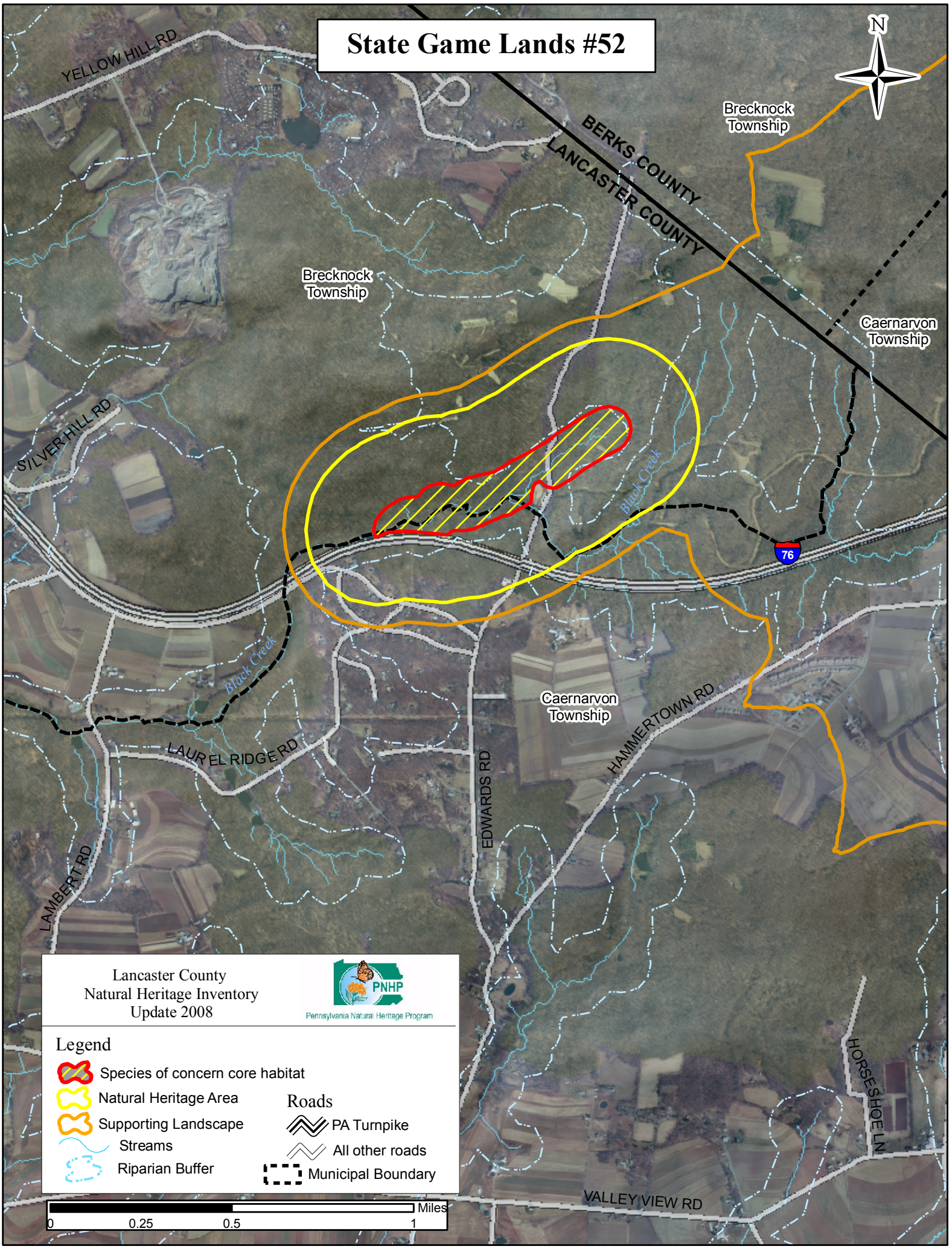
Within the Supporting Landscape:

- Considering the significant potential for this community type to harbor species of concern, efforts should be made to restore other sites in the vicinity that have the potential to support this habitat.
- The nearby Gleissners Swamp Natural Heritage Area has a similar coastal plain natural community. A natural habitat connection through natural corridors such as streams and existing woodlots should be established between these areas to allow for species migration and genetic flow. The agricultural dominated landscape presents an opportunity to reconnect the patchy woodlots within this Natural Heritage Area. An inactive rail line currently joins both habitats and could be used as a potential corridor between the two. An expansion of the natural habitat on either side of the rail line would help improve this potential. The inactive railroad bed could also be suitable for a recreational rail trail conversion between Smithville and Quarryville.
    - Protection of multiple populations of these species could be used to help restore populations between sites and may help to ensure the continued survival of the species of concern.
- A 300 meters protective forested buffer should be established around the core habitat areas. Natural habitat should be expanded at the site to provide additional habitat and buffer and to help connect these isolated communities to help provide a long term viable habitat context for this area.
- Expand and restore natural areas along streams and around core habitat.
    - Allow cropland or pasture adjacent to core habitats to return to forested or natural cover in order to provide a buffer from disturbance.
    - Reforest streamside corridors in appropriate areas. This will expand potential habitat and protect water quality.
        - Careful determination is needed to avoid planting trees in floodplains that contain wet meadows or shrublands. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
- Zoning options for conservation enhancement:
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils or areas with hydric soils should be encouraged to regenerate into natural cover.
    - Growth within the Township should be discouraged within the core and supporting landscape identified for this area.
    - Providence Township has a zoning ordinance restricting construction within the 100-year floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats. Additionally, wetlands should be afforded the same protection as floodplains in zoning ordinances to help protect most of the species of concern core habitat at this location.
- All tributaries in the watershed should be restored to native trees and shrubs to provide an increased buffer from storm water and agricultural runoff, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and streams will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
    - Areas within the floodplain that are currently in agricultural production should be restored to wetlands or floodplain forests.

- Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.

Other plant species of concern historically documented from this habitat or nearby include:

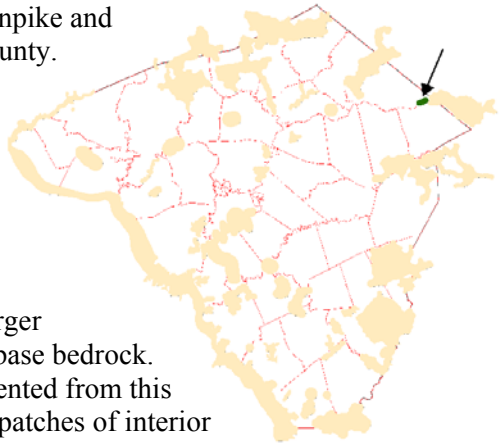
Common name	**Scientific name**	**G-Rank**	**S-Rank**	**Last observed**
Colic-root	*Aletris farinosa*	G5	S1	1862-07-05
Swamp-pink	*Arethusa bulbosa*	G4	S1	1864-06-11
Red Milkweed	*Asclepias rubra*	G4G5	SX	1941-10-04
Variable Sedge	*Carex polymorpha*	G3	S2	1862-07-05
Rough-leaved Aster	*Eurybia radula*	G5	S2	1889-08-19
Soapwort Gentian	*Gentiana saponaria*	G5	S1S2	1941-10-04
Weak Rush	*Juncus debilis*	G5	S3	1868-09-17
Swamp Dog-hobble	*Leucothoe racemosa*	G5	S2S3	1863-05-30
Nuttall's Milkwort	*Polygala nuttallii*	G5	S3	1955-10-28
Sand Blackberry	*Rubus cuneifolius*	G5	S1	1890-07-12
Whip Nutrush	*Scleria triglomerata*	G5	SH	1862-06-18
White Heath Aster	*Symphyotrichum ericoides*	G5	S3	1936-09-12
Possum-haw	*Viburnum nudum*	G5	S1	1938-09-29


State Game Lands #52
N
YELLOW HILL RD
BERKS COUNTY
LANCASTER COUNTY
Brecknock Township
Brecknock Township
Caernarvon Township
SILVER HILL RD
Black Creek
76
Black Creek
Caernarvon Township
HAMMERTOWN RD
LAUREL RIDGE RD
EDWARDS RD
LAMBERT RD
HORSESHOE LN
VALLEY VIEW RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

State Game Lands #52 – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Puttyroot (*Aplectrum hyemale*)	G5	S3	PR	2003-03-27	CD

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location: This Natural Heritage Area occurs between the PA Turnpike and the Lancaster/Berks County line in the northeastern part of the county.

- Municipalities:
  - Brecknock Township
  - Caernarvon Township
- USGS Quadrangles:
  - Morgantown Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: This Natural Heritage Area is a small portion of a larger forested area that contains a moist, rocky deciduous forest on diabase bedrock. A small population of a plant species of concern has been documented from this habitat. The adjacent forested landscape includes relatively large patches of interior forest that connect to the larger forested landscape of northern Lancaster County and western Berks County. Much of the forest understory is dominated by invasive species of shrubs.

Species of Concern Considerations:

- Puttyroot grows in moist woodlands and on forested slopes and streambanks. In Pennsylvania, it has been documented historically particularly in southeastern counties. About 40 populations are currently known from the state. Habitat loss, invasive species, and in some locations, excessive browsing by deer are the primary threats to the known populations of puttyroot. Establish buffers around fragmented forested habitat and remove invasive species to help maintain these populations. Though the documented population at this location is small, much more potential habitat exists throughout the forested landscape. Additional surveys for this and other species of concern are encouraged.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

This forest dominated landscape occurs primarily on diabase bedrock with frequent surface boulders which have made the area unsuitable for farming. The slightly neutral soils derived from the weathering of this stone help support rich plant communities. The potential for additional species of concern and a rich diversity of native plants and animals is high in these diabase bedrock habitats. Unfortunately, though the forests contain many towering groves of native trees, much of the understory is dominated by invasive species of shrubs that limit the resources available for native tree seedling growth. These natural community types were delineated in this area:

- Terrestrial (upland) communities:
  - Tuliptree-beech-maple forest
  - Dry oak-heath forest

        - modified successional forest*
    - Palustrine (wetland) communities:
        - Red maple-mixed shrub palustrine woodland

Ownership: Almost all of this Natural Heritage Area is within State Game Lands #52. South of the turnpike, the habitat is composed of numerous private parcels.

Habitat Disturbances:

- Historical:
    - Historical aerial photos from the 1940s show this and the entire surrounding area as a nearly uninterrupted forested landscape, providing a connected landscape contributing significantly to wildlife habitat and migratory potential. Though logged repeatedly over the past few centuries, this area had very few disturbances evident in 1940.
- Current:
    - Since 1940, the PA Turnpike has split this large forested landscape into smaller parts, reducing interior forest, increasing edge habitat and creating a nearly impenetrable barrier to wildlife movement. The large forested areas south of the turnpike have essentially been isolated from the habitats to the north.
    - South of the turnpike, recent residential development has fragmented the previously intact interior forest. Subdivision of the few remaining large forest patches in the county severely limits the future ability of the habitat to support many forest dependent species.
    - Unimproved access roads to Game Lands and occasional game food plots are the only interruptions to the remaining forested landscape north of the turnpike.
- Exotic species:
    - Much of the forest understory is infested with invasive species of shrubs especially bush honeysuckles, common privet and winged euonymus. These shrubs compete with native tree, shrub and herbaceous regeneration. The future forests depend on recruitment of seedlings into the understory. Removal of these species will require a long-term, labor intensive effort with continual follow-up.
        - Deer exclosure fences have been erected and the invasive shrub understory has been mechanically removed in portions of this Game Lands in an effort to improve forest understory composition. This type of extreme restoration effort will likely be necessary throughout the invasive dominated understory.
        - Invasive species documented include:
            - Norway maple (*Acer platanoides*)
            - Tree-of-heaven (*Ailanthus altissima*)
            - Garlic mustard (*Alliaria petiolata*)
            - Japanese barberry (*Berberis thunbergii*)
            - Autumn olive (*Elaeagnus angustifolia*)
            - Burning bush (*Euonymus alatus)*
            - Common privet (*Ligustrum vulgare*)
            - Japanese honeysuckle (*Lonicera japonica*)
            - Bush honeysuckles (*Lonicera morrowii, Lonicera maackii*)
            - Japanese stiltgrass (*Microstegium vimineum*)
            - Mile-a-minute (*Polygonum perfoliatum*)
            - Multiflora rose (*Rosa multiflora*)

Conservation Actions:

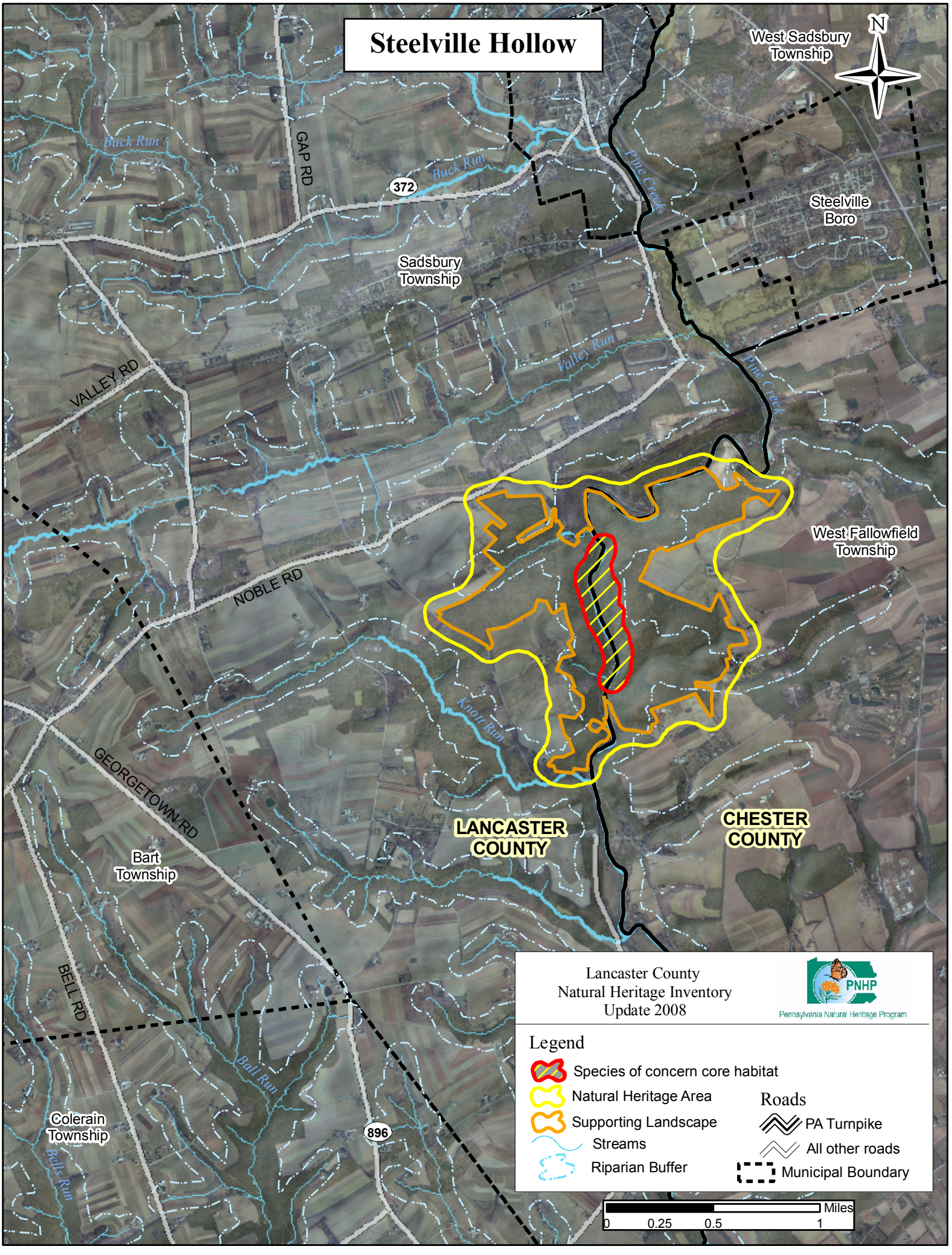
Overall: The primary conservation objective for this area should be to preserve and improve the quality and expanse of the intact forested landscape.

Within the Core Habitat:

- Preserve and improve the quality of the forest habitat. Puttyroot exists primarily in rich, forested landscapes. Avoid additional fragmenting features such as roads, utility rights-of-way and game food plots in the forested habitats. These fragmenting features allow invasive species of plants to colonize forested interior habitats. Many Game Land access roads and food plots in this area are lined with thick tangles of invasive shrubs and vines.
- Remove invasive species of plants.
  - Selective mechanical removal of invasive shrubs within the heavily infested portions of the understory may be necessary to help restore native tree and shrub composition.
  - Target pioneer populations of invasive plants for immediate and continued removal. Focus initial efforts on invasive shrub and vine removal, particularly tree-of-heaven, Norway maple, non-native bush honeysuckles, Japanese honeysuckle, Asiatic bittersweet, multiflora rose, winged euonymus and common privet. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
  - Implement a "Weed Warriors" program to allow citizen involvement in invasive species control on public lands.
  - Continual invasive species monitoring and control will be necessary.
- Decrease the size of the deer herd. Overbrowsing by white-tailed deer is a serious threat to the overall understory plant diversity. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory. Uncommon native plant species such as orchids and other wildflowers are particularly susceptible to eradication due to deer browsing.

Within the Supporting Landscape:

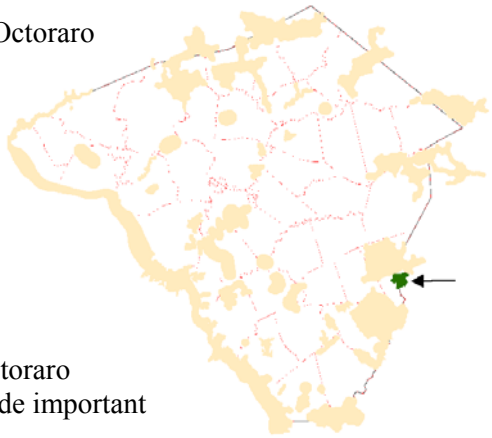
- Establish habitat connections between the north and south sides of the PA Turnpike. This could be achieved by the construction of green underpasses, overpasses and culverts. In the past, this forested habitat acted as part of a primary migratory corridor through the region. Restoration at key locations can help re-establish this function to the landscape.
- Forested properties adjacent to State Game Lands should be acquired or provided with conservation easements to help provide a buffer to this habitat and provide a greater area of protection from development. Subdivision and fragmentation of large forested areas severely degrades its utility to interior forest dependent species, such as many species of neotropical migrant songbirds. Most lands with diabase bedrock have avoided past conversion to agricultural uses. Future development projects should be discouraged within these habitats. Additional populations of species of concern could occur on adjacent forested parcels.
- Improve the quality of forested areas by removing non-native trees, shrubs and vines and encouraging the recruitment of native species into the sub-canopy.
- Zoning options for conservation enhancement:
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.


Steelville Hollow
N
West Sadsbury Township
Buck Run
GAP RD
372
Buck Run
Pine Creek
Steelville Boro
Sadsbury Township
Valley Run
Pine Creek
VALLEY RD
West Fallowfield Township
NOBLE RD
Knott Run
GEORGETOWN RD
LANCASTER COUNTY
CHESTER COUNTY
Bart Township
BELL RD
Ball Run
Colerain Township
896
Bells Run
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Steelville Hollow – *Notable significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bradley's spleenwort (*Asplenium bradleyi*)	G4	S1	PE	1993-05-07	E
Lobed spleenwort (*Asplenium pinnatifidum*)	G4	S3	PR	1993-05-07	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location: This Natural Heritage Area occurs along the West Branch Octoraro Creek at the Lancaster / Chester County boundary.

- Municipalities:
  - Sadsbury Township, (Lancaster County)
  - West Fallowfield Township, (Chester County)
- USGS Quadrangles:
  - Gap Quadrangle
  - Parkesburg Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Steep wooded hillsides border the East Branch of the Octoraro Creek at this site and create a deep stream valley. These slopes provide important habitat for two plant species of concern.

Species of Concern Considerations:

- Bradley's spleenwort is a fern of very limited distribution in Pennsylvania. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. All of the currently known populations of this plant in PA occur on rock outcrops along the Susquehanna River or other scattered locations like this one in Lancaster County. Since a disproportionate share of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large responsibility for its continued existence in the state. The exact location of this species at all locations in the county should be limited to authorized researchers to avoid its extirpation by unauthorized collection. There are numerous outcrops in this area that potentially support additional populations of this species. Additional surveys are recommended to more accurately determine the current extent of this species.
- The lobed spleenwort is a small fern that grows on dry shaded cliffs and rock outcrops, particularly on sandstone and schist. The viability of existing populations of lobed spleenwort and its rock outcrop habitat may be enhanced by establishing a surrounding buffer of forest. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. Additional surveys are recommended to more accurately determine the current extent of this species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

The valley supports several forest types. Sycamore (river birch)-box elder floodplain forest can be found along the creek in flat, lowland areas. The sheer slopes on the eastern side of the creek support a tuliptree-beech-maple forest, while dry-oak heath forest occupies the more moderate slopes of the western bank and much of the surrounding upland. Extensive bedrock outcroppings are exposed along the slopes and shaded by species such as sweet birch (*Betula lenta*), red oak (*Quercus rubra*) and mountain laurel (*Kalmia latifolia*).

Ownership: Ownership of this site is comprised of a number of private landowners and the site is currently unprotected from future land use changes.

Habitat Disturbances:

- The core habitat at this site appears to be mostly undisturbed woodland. Previous logging may have occurred, as the forest is young. Future logging would create a significant disturbance for these species by opening the forest canopy and altering light and humidity levels in the forest. The core habitat is bisected by Creek Road, which runs along the creek. Some of the land within the Natural Heritage Area and most of the surrounding land is in agricultural or residential use. Forest fragmentation or development on these surrounding properties would likely impare the quality of the core habitat. Trails through the forest are a minor disturbance. However, trails can provide the opportunity for more significant disturbances such as trash dumping, damage to understory vegetation, ATV use and the spread of invasive plants

Conservation Actions:

Overall:

- Permanent protection of the forest habitat, particularly in the core, through conservation easements or acquisition should be a priority. Management should focus on limiting disturbance, maintaining an intact forest canopy and expanding forest coverage.

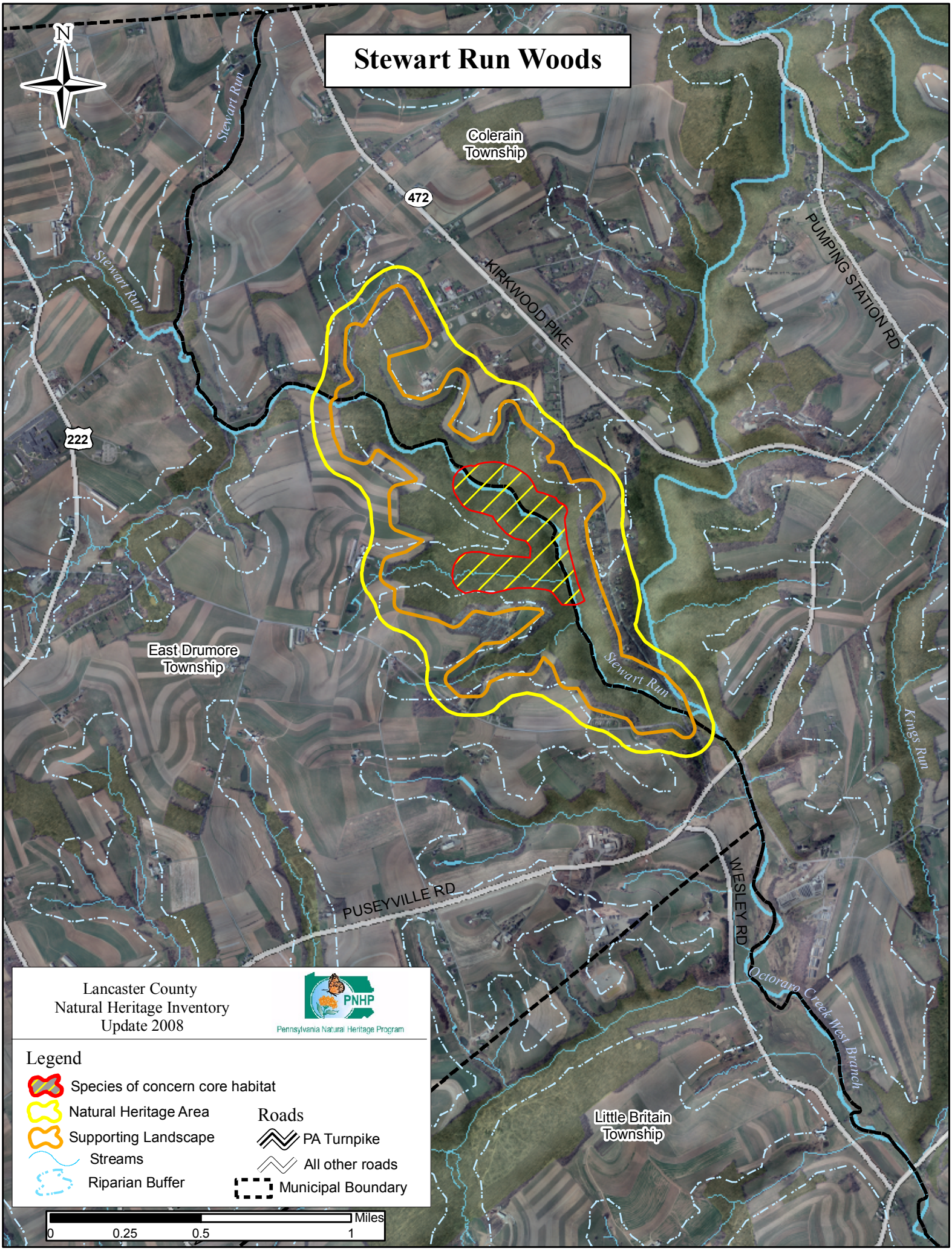
Within the Core Habitat:

- Provide permanent protection of the forested land and limit residential development on properties in the core habitat through acquisition or conservation easements.
  - Easements should include language that maintains limited, passive use of forests and prohibits the construction of numerous or wide trails.
- Preserve the existing intact forest canopy.
  - Avoid additional fragmenting features such as roads, buildings, & utility rights-of-way.
    - Both spleenwort species are sensitive to the changes in light level and humidity that accompany fragmentation and may not persist at this site if the forested land that buffers their habitat is reduced.
  - Avoid logging in this area.
    - Logging in upland areas above the ravine may be particularly detrimental if slash is left upslope of spleenwort populations.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
    - Encourage native tree and shrub recruitment.
  - Creek Road fragments the core habitat. This road should not be widened or expanded in a way that would increase its fragmenting effect.
- Allow agricultural fields immediately adjacent to core habitat to return to forest cover.
  - This will provide an important buffer and enhance habitat quality.
- Remove invasive species of plants.

  - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
- Additional surveys at this site for Bradley's spleenwort, lobed spleenwort and other rare species are recommended.

Within the Supporting Landscape:

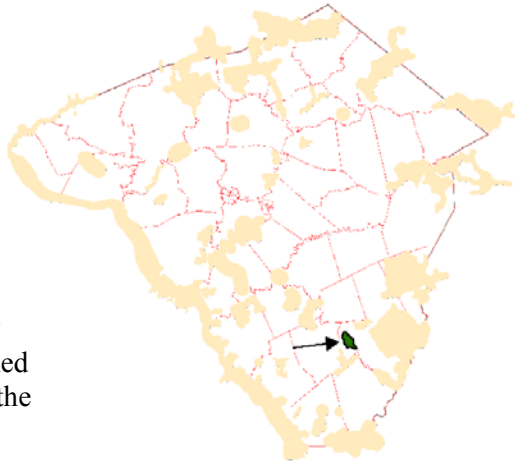
- Permanently protect adjacent forested land through acquisition or conservation easement and reestablish connectivity to other forested sites.
  - These species appear to thrive in large forested blocks. The extent of forest cover in this area should be maintained and expanded as much as possible.
  - Reforesting corridors between this site and the large forested area along the West Branch of Octoraro Creek that contains Stewart Run and Conners Mill Woods would provide a link between several spleenwort populations.
- Efforts should focus on reforesting or expanding existing forested riparian corridors along the East Branch of Octoraro Creek. Areas with steep slopes, such as the ravine north of Homeville, may be excellent candidates for expansion and restoration, as they could provide additional habitat for spleenwort species.
  - It is important to consider each site when reforesting and avoid planting trees or shrubs in floodplains that contain herbaceous wetlands or natural shrubland communities. These habitats should be maintained in an open condition, with tree plantings to occur at the periphery of natural wetland openings. See riparian corridor section for site specific recommendations.
  - This would also serve to protect the water quality of the East Branch of Octoraro Creek.
- Limit water runoff and agricultural erosion from surrounding uplands that may flow through this site.
  - Road salt and agricultural chemicals are carried in runoff and may alter habitat chemistry.
- Zoning options for conservation enhancement:
  - Enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for most of the core habitat and preserve potential habitat in nearby areas.
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
  - Growth within the Township should be discouraged within the core or supporting landscape identified for this area.
- Additional surveys for rare species are recommended.


Stewart Run Woods
N
Stewart Run
Colerain Township
472
KIRKWOOD PIKE
PUMPING STATION RD
Stewart Run
222
East Drumore Township
Stewart Run
Kings Run
PUSEYVILLE RD
WESLEY RD
Octoraro Creek West Branch
Little Britain Township
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Stewart Run Woods – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Lobed spleenwort (*Asplenium pinnatifidum*)	G4	S3	PR	1995-10-17	BC

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks



Location:
- Municipalities:
  - Colerain Township
  - East Drumore Township
- USGS Quadrangles:
  - Wakefield Quadrangle
  - Kirkwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None

Description: Stewart Run flows through this wooded stream valley on its way to the West Branch of the Octoraro Creek. County owned Theodore A. Parker III Natural Area constitutes a large portion of the core habitat at this site.

Species of Concern Considerations:
- The steep ravine slopes in this valley produce a number of bedrock outcrops that provide habitat for lobed spleenwort, a small fern that grows on dry shaded cliffs and rock outcrops, particularly on sandstone and schist. The viability of existing populations of lobed spleenwort and its rock outcrop habitat may be enhanced by establishing a surrounding buffer of forest. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. Additional surveys are recommended to more accurately determine the current extent of this species.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

The valley's lower slopes support a tuliptree-beech-maple forest, while the upper slopes are characterized by a dry oak-heath forest, with species such as mountain laurel (*Kalmia latifolia*), chestnut oak (*Quercus montana*) and sweet birch (*Betula lenta*).

Ownership: County owned Theodore A. Parker III Natural Area constitutes a large portion of the core habitat at this site.

Habitat Disturbances:
- Stewart Run Woods is relatively intact but several disturbances have the potential to impact the quality of this site. The upper portions of the eastern slope support a number of residences along Wesley Road. Disturbances on these lots such as logging or development that increases run-off could alter habitat conditions for lobed spleenwort on the slopes below. Theodore A. Parker III Natural Area is used for passive recreation and contains hiking trails. Trampling vegetation near trails and the

spread of invasive plants along trails is a disturbance. Some invasive plant species occur along the stream bank. Efforts should focus on mechanical or water-safe chemical removal of invasive plants along the stream bank. Invasive species often thrive along forest edges and trails, so limiting new trail construction and minimizing forest fragmentation in this area will help to reduce further spread of invasive species.

Conservation Actions:

Overall:

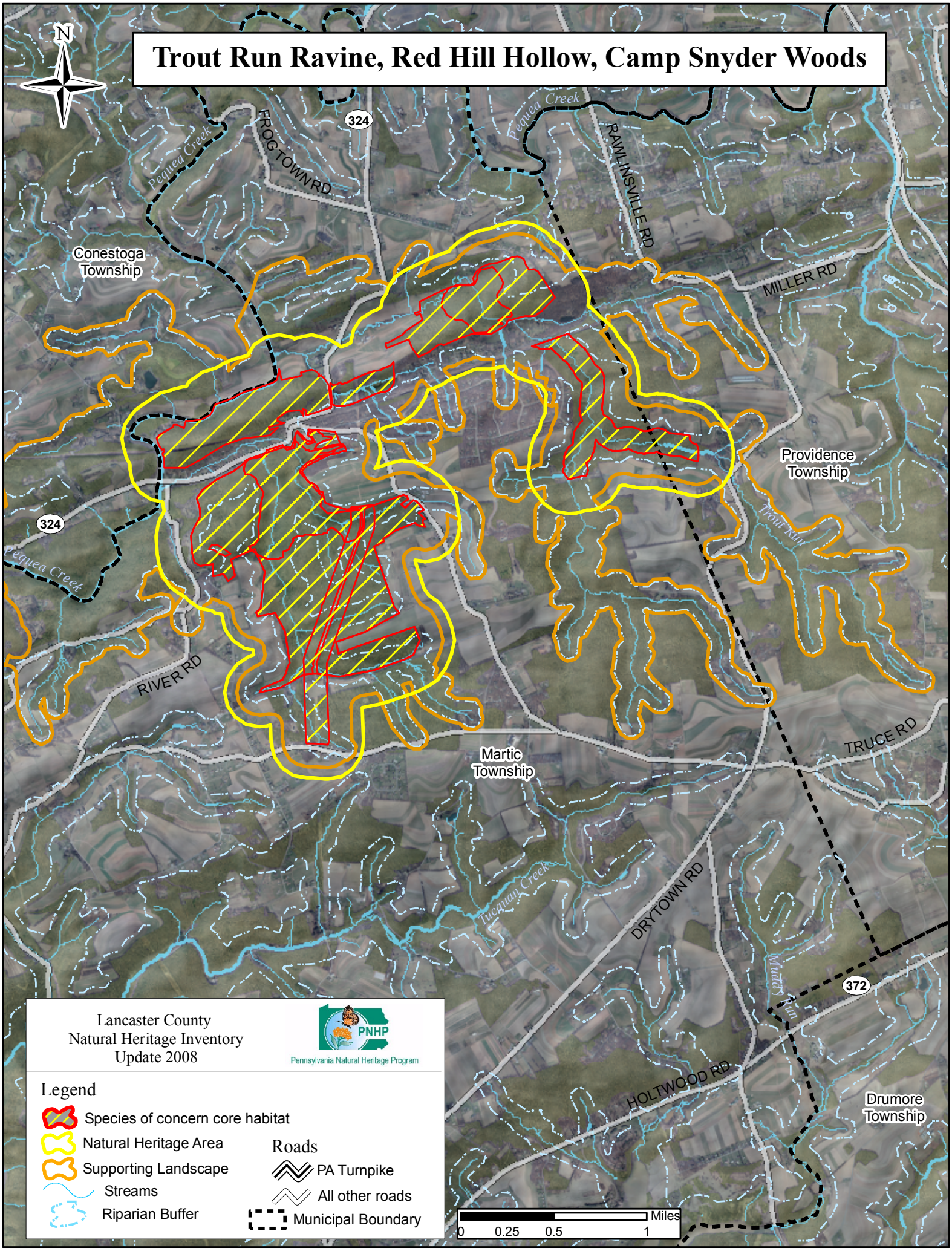
- Theodore A. Parker III Natural Area contributes important protection for most of the core habitat. However, beyond the natural area the site is owned by a number of private landowners and is unprotected. Permanent protection of these remaining lands through conservation easements or acquisition should be a priority. Much of Stewart Run Woods is interior forest and a primary conservation goal for this site is the maintenance of an intact forest canopy throughout the site. An intact forest provides necessary habitat for lobed spleenwort and maintains the quality of Stewart Run.

Within the Core Habitat:

- Permanently protect the forested land on other properties within the core habitat through conservation easement or acquisition.
    - The activities on the residential lots along Wesley Road have significant potential to alter lobed spleenwort habitat quality. If it is not practical to provide these properties with conservation easements, efforts should be made to educate landowners about the impacts of their activities and offer steps that they can take to contribute to maintaining the health of the unique natural area on the slopes below.
- Preserve intact forest canopy.
    - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.
        - Lobed spleenwort is sensitive to the changes in light level and humidity that accompany fragmentation and may not persist if the forest is fragmented or reduced in size.
    - Avoid logging in this area.
        - Lobed spleenwort may be particularly susceptible to logging in areas upslope from its location. Logging or further development in the residential upland areas should be discouraged.
        - Allow the forest to return to near old-growth conditions.
        - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
        - Encourage native tree and shrub recruitment.
- Maintain current management of natural area as a limited use, passive recreation facility.
    - Limit the number of trails available.
    - Discourage more active use of the natural area and prohibit activity on the rocky slopes.
- Remove invasive species of plants.
    - Invasive plants along the stream bank and pioneer populations should be targeted.
    - Invasive species management needs to be coordinated by individuals familiar with the rare species as well as the invasive species present.
    - Invasive species monitoring would be beneficial.
- Additional surveys for lobed spleenwort and other rare species are recommended.

Within the Supporting Landscape:

- Permanently protect and maintain connectivity to adjacent forested land through acquisition or conservation easement.
    - This site is part of a large forested block and connected along wooded floodplains to other tracts of forested land, such as State Game Lands 136 and Conners Mill Woods, which supports another rare *Asplenium* species. These lands may provide additional habitat for lobed spleenwort.
- Non-forested riparian areas should be reforested.
    - This will reconnect the site to other nearby forested areas, provide a corridor for species dispersal, and will help to protect water quality.
    - It is important to consider each site when reforesting and avoid planting trees or shrubs in floodplains that contain herbaceous wetlands or natural shrubland communities. These habitats should be maintained in an open condition, with tree plantings to occur at the periphery of natural wetland openings. See riparian corridor section for site specific recommendations.
- Efforts should be made to limit agricultural erosion and water runoff from surrounding uplands that may flow through lobed spleenwort habitat
    - Road salt and agricultural chemicals are carried in runoff and may alter habitat chemistry.
- Zoning options for conservation enhancement:
    - Enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for some of the remaining core habitat and preserve potential habitat in nearby areas.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks.
    - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
    - Growth within the Township should be discouraged within the core or supporting landscape identified for this area.


Trout Run Ravine, Red Hill Hollow, Camp Snyder Woods
N
Pequea Creek
FROG TOWN RD
324
Pequea Creek
RAWLINSVILLE RD
Conestoga Township
MILLER RD
Providence Township
Trout Run
324
Pequea Creek
RIVER RD
Martic Township
TRUCE RD
Tucquan Creek
DRYTOWN RD
Mill Creek
372
HOLTWOOD RD
Drumore Township
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Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

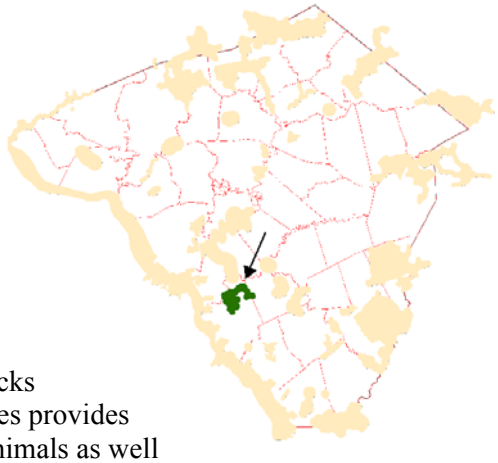
Trout Run Ravine, Red Hill Hollow, Camp Snyder Woods – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bradley's spleenwort (*Asplenium bradleyi*)	G4	S1	PE	1983-06-07	D
Lobed spleenwort (*Asplenium pinnatifidum*)	G4	S3	PR	1995-10-12	C
American holly (*Ilex opaca*)	G5	S2	PT	1995-10-03	D
Southern bog clubmoss (*Lycopodiella appressa*)	G5	S2	PT	1993-06-30	C
Cranefly orchid (*Tipularia discolor*)	G4G5	S3	PR	1990-03-10	B
Sensitive species of concern[3]	-	-	-	1991-09-07	C
Animals:					
Tawny emperor (*Asterocampa clyton*)	G5	S3S4	-	1999-07-13	E
Baltimore checkerspot (*Euphydryas phaeton*)	G4	S2S4	-	1999-07-13	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location:

- Municipalities:
  - Conestoga Township
  - Martic Township
  - Providence Township
- USGS Quadrangles:
  - Conestoga Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "SP502, SP516, SP547" – (Conestoga Quadrangle)



Description: This hilly, forested tributary to Pequea Creek contains impressive rock outcrops, small wetlands and several significant blocks of interior forest. The variety of forest dominated natural communities provides suitable habitats for a large diversity of common native plants and animals as well as for six plant species of concern and two butterfly species of concern. Though recent residential development of the forested habitat has significantly reduced the natural habitat available, there are additional forested patches lying adjacent to this Natural Heritage Area that contribute to this area's overall wildlife value. This area contains Martic Township Park and Lancaster County Conservancy's Haver-Trout Run Nature Preserve.

Species of Concern Considerations:

Plants:

- Bradley's spleenwort is a fern of very limited distribution in Pennsylvania. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. All of the currently known populations of this plant in PA occur in scattered locations in Lancaster County. Since all of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large responsibility for its continued existence in the state. The exact location of this species at all locations in the county should be limited to authorized researchers to avoid its extirpation by unauthorized collection. There are numerous outcrops in this area that should be considered potential habitat for this species. Return surveys in 1995 failed to relocate this population. Additional surveys are recommended to more accurately determine the current extent of this species.
- The lobed spleenwort is a small fern that grows on dry shaded cliffs and rock outcrops, particularly on sandstone and schist. The viability of existing populations and its rock outcrop habitat may be enhanced by maintaining a surrounding buffer of forest. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. Lobed spleenwort is known to occur at several locations on both sides of the railroad line within this Natural Heritage Area. Additional surveys are recommended to more accurately determine the current extent of this species.
- A few scattered American holly trees of varying age occur within this area. Populations of holly in the lower Susquehanna ravines are some of the few to be considered native to the state, and not the result of cultivation, or naturalized from cultivated specimens. Collecting for holiday greens may be the biggest threat for this species at this location.
- Southern bog clubmoss has a mostly coastal distribution from Nova Scotia west and south into Texas and Florida. In Pennsylvania, it occurs mainly in the southeastern counties, where it grows in sandy to peaty seepages, depressions, and damp successional openings. About 12 populations are currently documented from the state. This species can colonize certain types of disturbed ground, such as abandoned quarries and utility rights-of-way, if the proper substrate and moisture conditions are present. Natural succession, invasive species, and the indiscriminate application of herbicide can be threats at these sites. At this location, southern bog clubmoss occurs in seepy areas adjacent to an artificial pond. The pond was likely the site of a naturally swampy habitat before being artificially impounded.
- The cranefly orchid is a plant of moist, rich forests. It is usually found individually, with few other specimens in the area. It can be easily overlooked due to its small size and individual nature. The entire rich, moist, forest environment should be considered potential habitat for this plant. Maintain the native forest canopy and encourage native tree and shrub recruitment into the understory to continue to provide sufficient available habitat for this species.
- A sensitive plant species of concern grows in grasslands, successional openings, serpentine barrens, and dry open woods. Fewer than 5 populations are currently known from the state. These populations are threatened by human-related habitat loss, natural succession, invasive species, and excessive deer browsing. Given the preference of the species for open habitats, active management - such as fire, mowing, or invasive species removal - is often required to maintain the proper successional stage and ecological conditions for the species to thrive.

Animals:

- The Tawny emperor butterfly can be found in thickets, watercourses, ridge tops, woodland edges and clearings, fencerows, and parks where it is closely associated with hackberry trees. Two broods occur in most of this species' range. Mature caterpillars occur in May and June, then again in July and August. Adults occur mostly June through July and August through early September. Since the larvae overwinter in leaf litter, don't rake around hackberry trees to help improve habitat for this species.
- Baltimore checkerspot is a butterfly that had formerly been considered quite scarce and local in damp meadows with stands of turtlehead. It appears to have increased in some areas where larvae feed on

introduced English plantain. The preferred habitat for this species is wet meadows, open floodplains, and less commonly, fields. The larval host plants include turtlehead (*Chelone glabra*), which is favored for oviposition, but plantain (*Plantago*) and yellow foxglove (*Aureolaria = Digitalis*) are also used. Late instar larvae have been documented to accept many additional plants, including honeysuckle, lousewort, and viburnum. The female lays all her eggs in a cluster that may contain as many as 700 eggs. The reddish eggs hatch after about two weeks. The young larvae form a silken nest and feed from within on new turtlehead leaves. The larvae stop feeding in August, but remain within their communal tent, where they spend the winter. With the onset of springtime temperatures, the larvae leave the nest and wander off to feed individually. The diet is appreciably expanded at this point.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not (*).

The forested areas are dominated by tuliptree-beech-birch forest, but also contain sizable areas of dry oak-heath forest and narrow bands of hemlock-tuliptree-birch forest. All of these are suitable reference communities for future restoration efforts to imitate in similar topographic and hydrologic settings.

- Terrestrial (upland) communities:
  - Hemlock-tuliptree-birch forest
  - Tuliptree-beech-birch forest
  - Dry oak-mixed hardwood forest
  - Dry oak-heath forest
  - modified successional forest*
  - shrubland*
  - grass-shrubland*
  - grassland*
- Palustrine (wetland) communities:
  - Sycamore (river birch)-box elder floodplain forest
  - Red maple-mixed shrub palustrine woodland
  - Cattail marsh

Ownership:

- A large portion of the forested area is maintained as a public park by Martic Township.
- Another significant portion of the forested area is owned by the Lancaster County Conservancy, which maintains the area as a nature preserve.
- A portion of the forest is owned by the Boys Club of Lancaster County and used as a camping and outdoor facility.
- Norfolk Southern Railroad Company owns a rights-of-way though the Natural Heritage Area.
- The remainder is in private ownership in variously sized lots. Future ownership fragmentation may impede future conservation actions. Conservation action with the owners of the largest forested habitat parcels should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
  - Though likely repeatedly timbered over the past several centuries, aerial photos from 1940 show the hilly topography almost fully in forest cover. A rail line, a utility rights-of-way and several minor roads were the only fragmenting features in the forested landscape in 1940. Much of the adjacent flatter land had been converted to agricultural purposes. Those

lands left forested were likely too steep, stony, or wet to be easily converted to agricultural uses.
    - Several milldams historically occurred along these tributaries to Pequea Creek.
- Current –
    - Formerly natural small wetlands and seeps along tributaries to Pequea Creek have been dammed and impounded, forming small man-made ponds. This has flooded much of the natural habitat for the southern bog clubmoss and other native wetland species.
    - Recent housing developments have significantly reduced the extent of the forested landscape and fragmented a previously large forest block.
    - Recent and ongoing timbering activities threaten the continuity of the forest canopy and the microhabitat of the two fern species of concern.
    - The powerline right-of-way fragments the forest canopy, but also allows plants to grow that are more adapted to open conditions including a plant species of concern. Indiscriminate herbicide applications along the powerline could eliminate this population.
    - Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.
- Exotic Species –
    - Few invasive species were noted during past field surveys, but the roads, railroad, utility rights-of-way and the transition zone between forested and agricultural landscapes are likely the areas of greatest invasive plant species concentrations. Invasive species noted include the following, though others are likely to be present:
        - Gill-over-the-ground (*Glechoma hederacea*)
        - Japanese honeysuckle (*Lonicera japonica*)
        - Japanese stilt grass (*Microstegium vimineum*)
        - Multiflora rose (*Rosa multiflora*)

Conservation Actions:

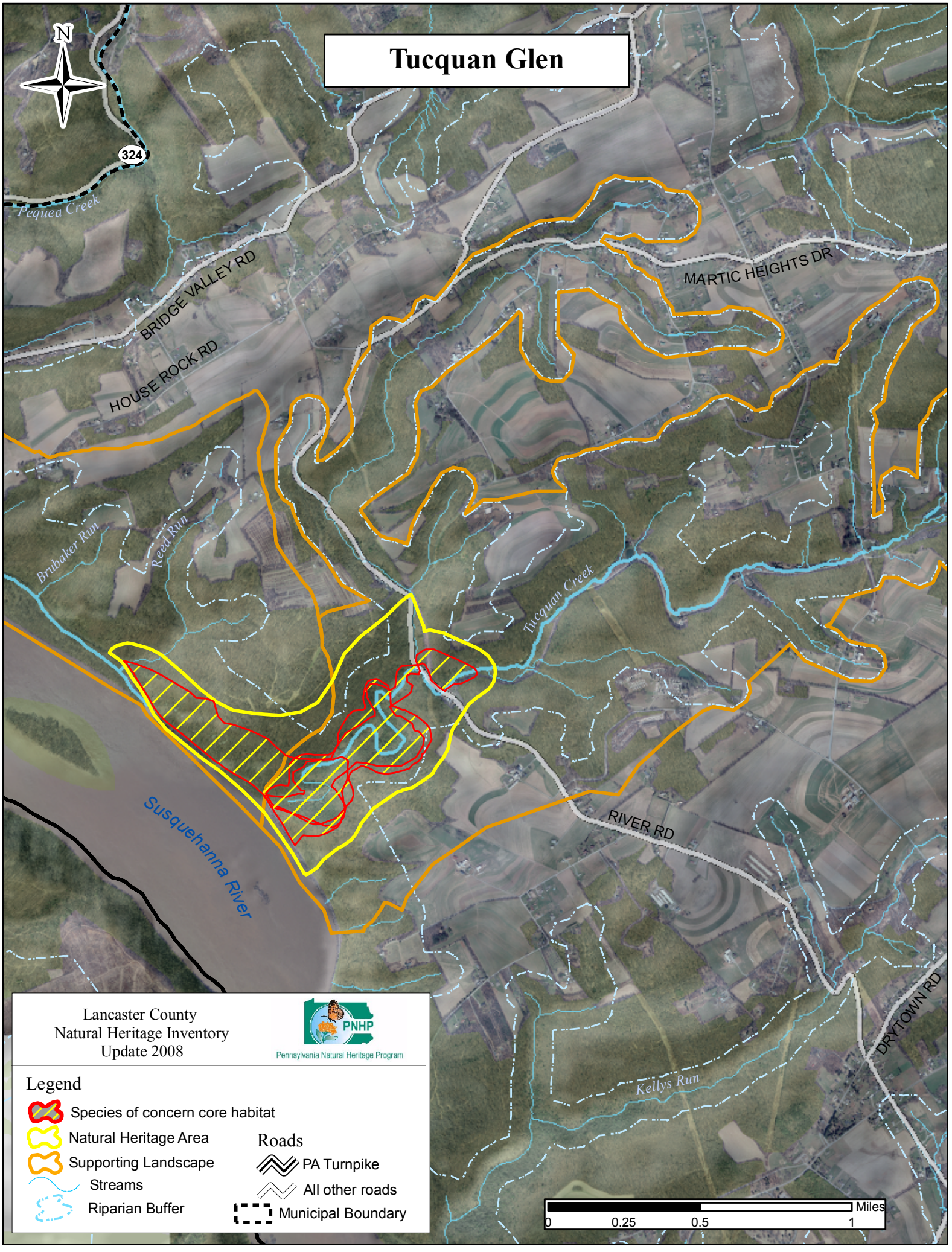
Overall:
- Provide for the long-term protection of the core habitat through conservation easements and fee-simple acquisition.
- Expand the protection of the habitat as a nature sanctuary by Lancaster County Conservancy and/or as an expansion of Martic Township Park. Any future park expansion should emphasize preserving viable natural communities rather than on active park facilities and infrastructure.
- The primary conservation concern for this habitat should be to focus on safeguarding the quality and expanse of the forested landscape. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect water quality of the small streams that drain through this Natural Heritage Area into Pequea Creek and provides refuge and habitat for other forest dependent species. Prevent fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to achieve and maintain old-growth characteristics.

Within the Core Habitat:
- Conserve the intact forest canopy and a healthy native shrub layer.

- Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way. Discourage development of forested habitats.
- Avoid logging in this area.
  - Allow the forest to return to near old-growth conditions.
- Restore the natural hydrology along tributaries to the Pequea Creek. Natural seeps and wetlands have been dammed to create ponds. This wetland habitat modification has drowned former wetland habitats in the area.
- Natural openings along streams and wetlands as well as along the utility corridor help provide habitat for several plant species of concern. Maintain open character of these habitats. Avoid indiscriminate herbicide applications. Rights-of-way managers should consult a botanical expert regarding species of concern and rights-of-way maintenance options.
- Encourage native tree and shrub recruitment.
  - Reduce the size of the deer herd. Plants species of concern are particularly susceptible to deer herbivory. High deer numbers severely increase tree seedling mortality. Without successful tree seedling recruitment, future forest health will be in jeopardy.
  - Remove non-native trees and shrubs. The railroad rights-of-way and forest/agricultural transition zones are likely the primary location of non-native trees and shrubs within this area. Care must be taken to distinguish between native and non-native species of plants. Coordinate invasive species control with those familiar with plant identification.
- Block access to forested areas by off road vehicles, ATVs and other motorized vehicles
- Additional surveys for species of concern are recommended.

<u>Within the Supporting Landscape:</u>.

- Zoning options for conservation enhancement:
  - Enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for most of the core habitat and preserve potential habitat in nearby areas.
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks.
  - Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
  - Growth within the Township should be discouraged within the core or supporting landscape identified for this area.


Tucquan Glen
N
324
Pequea Creek
BRIDGE VALLEY RD
HOUSE ROCK RD
MARTIC HEIGHTS DR
Brubaker Run
Reed Run
Tucquan Creek
Susquehanna River
RIVER RD
DRYTOWN RD
Kellys Run
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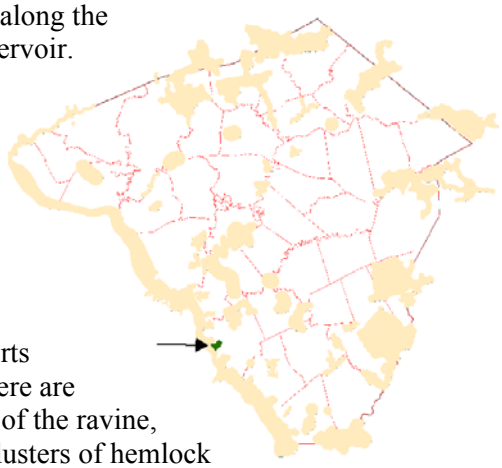
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

Tucquan Glen – *High significance*					
Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Plants:					
Bradley's spleenwort *(Asplenium bradleyi)*	G4	S1	PE	2006-04-12	D
Lobedspleenwort *(Asplenium pinnatifidum)*	G4	S3	PR	2006-04-12	B
Fringe-tree *(Chionanthus virginicus)*	G5	S3	PT	2000-07-10	C
Vasey's eupatorium *(Eupatorium godfreyanum)*	G4	S2	TU	2002-09-13	BC
St. Andrew's-cross *(Hypericum stragulum)*	G5	S2	TU	2002-09-13	BC
Susquehanna trillium (*Trillium sp.*)	G?	S?	TU	2006	E
Appalachian gametophyte fern *(Vittaria appalachiana)*	G4	S2	PT	2005-04-22	B
Exceptional Natural Communities:					
Hemlock-tuliptree-birch forest	GNR	S2	NR	1988-11-04	C

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location: This Natural Heritage Area is a wooded ravine that occurs along the Susquehanna River between Pequea Borough and Muddy Run Reservoir.

- Municipalities:
  - Martic Township
- USGS Quadrangles:
  - Holtwood Quadrangle
- 1990 Lancaster Natural Areas Inventory reference:
  - "Tucquan Glen – NC620" – (Holtwood Quadrangle)



Description: This area contains a narrow, scenically outstanding, forested ravine that ends at the Susquehanna River. The area supports a lush, diverse, relatively undisturbed herbaceous undergrowth. There are frequent rock outcrops of Wissahickon schist in the lower portions of the ravine, especially near the mouth of the stream and high up both slopes. Clusters of hemlock and rhododendron cast pockets of deep shade and provide cool, moist microhabitat conditions along portions of the creek. Six plant species of concern are currently known to occur in this Natural Heritage Area. In addition, the hemlock-tuliptree-birch forest present within the ravine is a high-quality example of this forest community type. The age of the trees suggest nearly old growth conditions. This forested natural landscape functions as an important terrestrial component of the Susquehanna River regional migratory corridor.

Species of concern considerations:

Plants:

- Bradley's spleenwort is a fern of very limited distribution in Pennsylvania. Removal of the forested canopy around rock outcrops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species. All of the currently known populations of this plant in PA occur on rock outcrops along the Susquehanna River or other scattered locations in Lancaster County. Since a disproportionate share of this plant's limited occurrences in PA are in Lancaster County, the County has a proportionally large

responsibility for its continued existence in the state. The exact location of this species at all locations in the county should be limited to authorized researchers to avoid its extirpation by unauthorized collection. There are numerous outcrops in this area that potentially support additional populations of this species. Additional surveys are recommended to more accurately determine the current extent of this species.

- The lobed spleenwort is a small fern that utilizes the lightly shaded rock outcrops as its primary habitat. There are numerous outcrops in this area that potentially support additional populations of this species. Removal of the forested canopy around rock out crops could alter the microhabitat conditions that the fern presently benefits from; therefore, logging operations should not occur within the core habitat for this species.
- Fringe tree at this location is sparsely scattered on the lower and mid-slope portions of the river-facing hill. Though this species is native to nearby portions of the lower Susquehanna River shore, this population is considered suspicious due to its proximity to a former cabin site. It may be the result of cultivation at this location.
- This population of Vasey's eupatorium is growing in a narrow band of lower slope along the railroad rights-of-way between Reed Run and Tucquan Creek in dry, schist-derived substrate. This plant is adapted to the disturbed, open conditions created by this railroad and will likely persist in the absence of competition from invasive species. Indiscriminate use of herbicides for vegetation management is not advisable in this location. This plant will likely respond favorably to the reduction of competition through periodic mowing and targeted spot treatments with herbicides. Maintenance activities should consider their impact on this and other rare plants in the rights-of-way.
- St. Andrew's cross occurs in the disturbed conditions created by the construction and continued maintenance of the railroad paralleling the Susquehanna River. This plant is adapted to the disturbed, open conditions created by this railroad and will likely persist in the absence of competition from invasive species. Indiscriminate use of herbicides for vegetation management is not advisable in this location. This plant will likely respond favorably to the reduction of competition through periodic mowing and targeted spot treatments with herbicides. Maintenance activities should consider their impact on this and other rare plants in the rights-of-way.
- Susquehanna trillium, a form of trillium of indistinct taxonomy, is found in great profusion among some of the ravines of the lower Susquehanna River, is also present at this location. This plant has an unclear taxonomic status, as it may represent a form of the declined trillium (*Trillium flexipes*), a white-flowered form of the purple trillium (*Trillium erectum*), or possibly a hybrid between these two species. This taxonomic puzzle needs to be investigated further, but either way, the populations of these trilliums are worthy of conservation action. Conservation of the rich forested habitat should provide the protection needed for this species. Unauthorized collection for wildflower gardens is also a potential threat.
- The Appalachian gametophyte fern occurs in rock crevices and overhangs with a microhabitat featuring dampness, shade, coolness and competition from only a few mosses. Additional potential habitat occurs among the steep, nearly inaccessible cliffs nearby. Changes in the adjacent tree canopy cover could result in drier, warmer microhabitat conditions, diminishing the habitat available for this species at this location; therefore, logging should be avoided within the core habitat for this species. In addition, the hemlock woolly adelgid, an introduced insect pest on hemlock trees, poses a similar threat by killing hemlock trees, which help provide the cool, moist habitat conditions at this location.

<u>Exceptional Natural Communities:</u>

- The hemlock-tuliptree-birch forest present within the ravine is a high-quality example of this forest community type. The age of the trees suggest nearly old growth conditions. The hemlock component of the forest is in jeopardy due to the infestation of hemlock woolly adelgid and would benefit from timely introduction of verified biological control agents for the pest.

Forest Cover/Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Forests cover almost the entire area of this Natural Heritage Area, with only minimal incursions from residences, roads and utility rights-of-way. An unpaved access road down through the glen breaks up an otherwise intact block of interior forest. Portions of two interior forest blocks are included in this Natural Heritage Area. The cool, moist slopes along Tucquan Creek are dominated by a hemlock-tuliptree-birch forest. On the drier, upper slopes a tuliptree-beech-maple forest dominates. The slopes draining directly into the Susquehanna River are dominated by dry oak-mixed hardwood forest and dry oak-heath forest. A narrow band of sycamore (river birch)-box elder floodplain forest occupies the river floodplain.
    - Terrestrial (upland) communities:
        - Hemlock-tuliptree-birch forest
        - Tuliptree-beech-maple forest
        - Dry oak-mixed hardwood forest
        - Dry oak-heath forest
        - Dry oak-heath woodland
        - modified successional forest*
        - grass-shrubland*
    - Palustrine (wetland) communities:
        - Silver maple floodplain forest
        - Sycamore (river birch)-box elder floodplain forest

Ownership: This Natural Heritage Area is narrowly drawn to focus on the habitat for the seven species of concern found at this location.

- The Lancaster County Conservancy owns approximately 80% of the core species of concern habitat, ~60% of the Natural Heritage Area, and ~35% of the supporting landscape for this area.
- PPL Corporation owns utility rights-of-way across the northeastern portion of the Natural Heritage Area and an additional rights-of-way across the northeastern portion of the supporting landscape.
- The Norfolk Southern Railroad Corporation owns a rights-of way along the shoreline of the Susquehanna River.
- Most of the remaining portions of the Natural Heritage Area and supporting landscape are held in relatively large parcels, which are more constructive towards conservation easements or acquisition transactions than numerous smaller parcels.

Habitat Disturbances:

- Historic –
    - Aerial photos from the 1940's show that very little has changed in Tucquan Glen in the past 65 years. The area, then as now, had a continuous forested canopy with a dense grove of coniferous forest in the steep-sided ravines near the creek's confluence with the Susquehanna River. There appears to have been an increase in coniferous forest cover upstream since the 1940's, perhaps the result of growth since previous lumbering activity.
    - The unpaved road though the glen was already in place and was used as access for several home sites and seasonal cabins that were scattered though the area.
    - Most of the current agricultural fields, residences and the utility and railroad rights-of-way were already in place by the 1940's.
- Current –
    - River Road cuts through the northeastern portion of the Natural Heritage Area.
    - Some lumbering has occurred on the north slope of the ravine, adjacent to the preserve.

- The railroad along the Susquehanna River restricts animal movement between the river, its floodplain and upland habitats.
- The roadways, utility corridors and railroad fragment the otherwise continuously forested habitat and provide access for invasive and edge adapted species to forest interior habitats.
- The seasonal cabins that once occurred in the glen have since been removed from the Lancaster County Conservancy owned property, but these locations remain as outposts for invasive plant species within an otherwise relatively invasive-free habitat.
- Agricultural fields occur on adjacent lands and contribute to the fragmentation of the forested habitat.
- A campground operates on property adjacent to the Lancaster County Conservancy Tucquan Glen Preserve. Currently, little disturbance of the forested habitat appears to have taken place, as the primary campground area occurs on former agricultural land.
- Overbrowsing by white-tailed deer (*Odocoileus virginianus*) is a serious threat to the overall understory plant diversity. An overabundance of deer can create the effect of park-like forests in which the understory and vertical stratification is greatly reduced. Removal of understory species eliminates habitat for some nesting songbirds as well as increases competition between deer and other wildlife due to reduced food sources. Furthermore, deer prefer higher quality food leaving poorer, less diverse species to mature and dominant the overstory.

- Exotic Species – There are a number of invasive plant species established mainly at the edges of the ravine. A large patch of bamboo occurs along a tributary to Tucquan Creek adjacent to River Road. Bamboo is planted as an ornamental, but spreads though aggressive root rhizomes to form dense monocultures. Bamboo does not spread by seed in our climate, but if pieces of root become dislodged from the parent plant, they can establish new colonies. English ivy persists at old cottage sites and represents a serious threat to this special habitat. This weed should be hand-pulled and burned or hauled out of the site. An insect pest on hemlock trees, the hemlock woolly adelgid, which was accidentally introduced from Asia, and has killed numerous hemlock trees in the glen. Additional information on this insect pest can be obtained from the PA Bureau of Forestry web site at < http://www.dcnr.state.pa.us/forestry/woollyadelgid/index.aspx >. If this insect pest succeeds in decimating the hemlock population at this location, it could have a dramatic affect of the microclimate of the glen, creating a drier and warmer environment. The list below represents those invasive plants noted in past field surveys. Additional surveys will likely reveal more recent additions such as Japanese stilt grass (*Microstegium vimineum*) and tree-of-heaven (*Ailanthus altissima*).
  - Bamboo (*Pseudosasa japonica*)
  - Garlic mustard (*Alliaria petiolata*)
  - Day lily (*Hemerocallis fulva)*
  - English ivy (*Hedera helix*)
  - Gill-over-the-ground (*Glechoma hederacea*)
  - Multiflora rose (*Rosa multiflora*)
  - Barberry (*Berberis thunbergii*)
  - Japanese honeysuckle (*Lonicera japonica*)

Conservation Actions:

Overall:

- Safeguard the quality and expanse of the forested landscape. While providing the primary habitat for the populations of species of concern, the forested landscape also helps to protect water quality of the small streams that drain through this area into the Susquehanna River and provides refuge and habitat for other forest dependent species. This forested natural landscape also functions as an important terrestrial component of the Susquehanna River regional migratory corridor. Prevent

fragmentation and incursions into the forested landscape. Suppress the establishment and spread of invasive species of plants. Encourage the regeneration of native trees, shrubs and herbaceous layers. The forest cover should be allowed to maintain old-growth characteristics.

- This site should be considered a moderate priority for conservation acquisition, since much of the vulnerable habitat is already under the protection of the Lancaster County Conservancy.

Within the Core Habitat:

- Provide for the long-term protection of the core habitat.
  - Much of the priority core habitat within Tucquan Glen, including both sides of the lower portions of the creek, is owned by the Lancaster County Conservancy, whose mission statement provides for the continued protection of lands under its ownership.
  - On the adjacent private property, the steep, rocky nature of the immediate habitat of the species of concern likely prevents most types of development activity. The flatter hilltops, however, could prove tempting building sites. Logging of the adjacent slopes is a potential concern.
    - Consider fee-simple acquisition, or conservation easement options with the largest property owners of the core habitat outside of the Lancaster County Conservancy. Focus conservation actions on properties bordering Tucquan Creek just southwest of River Road in order to provide protection for the entire Tucquan Glen.
    - Second, consider fee-simple acquisition, or conservation easement options with the owner of the southwestern portion of the Natural Heritage Area. This parcel contains portions of the species of concern core habitat and parts of a block of interior forest.
- Conserve the intact forest canopy.
  - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.
  - Consider closing the unimproved roadway that extends through the center of Tucquan Glen. Closure of this road will help expand the interior forest component of this landscape by joining two interior forest blocks separated by this fragmenting feature.
  - Provide biological controls to reduce the damage to hemlock trees from the introduced pest – hemlock woolly adelgid.
  - Avoid logging activities in this area to develop and maintain old growth conditions.
- Remove invasive species of plants.
  - Invasive species are not currently a primary detriment to Tucquan Glen, which is an excellent reason to take an aggressive approach to invasive species control. It is much easier and more effective to keep a place invasive-free than to try and repair a heavily infested habitat.
    - Target pioneer populations of invasive plants for immediate and continued removal, particularly English ivy, tree-of-heaven, non-native bush honeysuckles, Japanese honeysuckle, multiflora rose and common privet.
  - Invasive species are a significant feature of the railroad rights-of-way. However, indiscriminate use of herbicides as rights-of-way defoliants is not acceptable. A smarter, more selective use of chemical controls is required in these areas that contain both invasive species and species of concern. Mechanical control, (mowing) is an option that will also require attention to the location and timing of mowing. Early-mid spring season mowing will result in stunted growth for most of the invasive species. Allow the plant species of concern to bloom and set seed before late season mowing takes place.
  - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
  - Continual invasive species monitoring and control will be necessary.

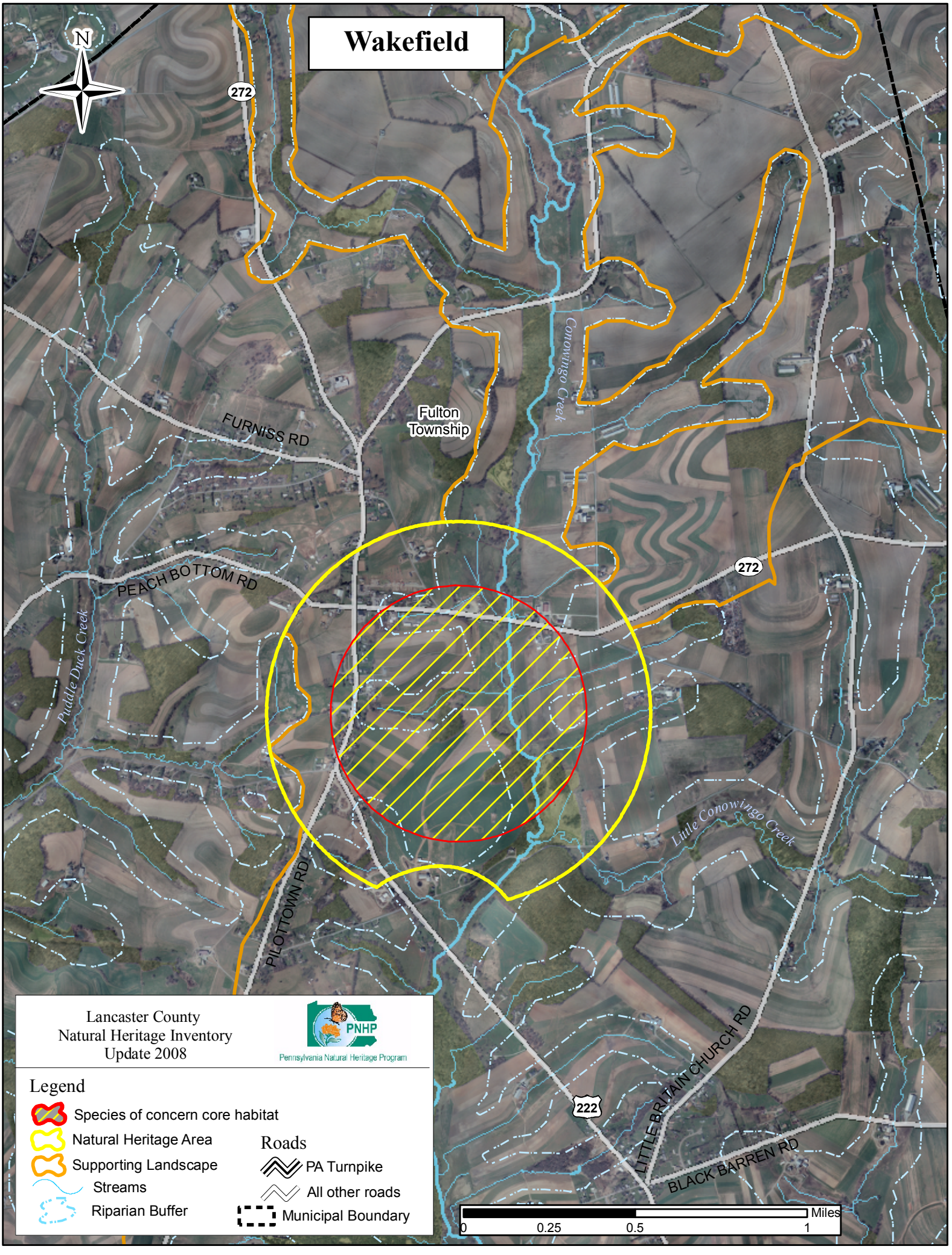
Within the Natural Heritage Area / Supporting Landscape:

Tucquan Glen

The supporting landscape for this Natural Heritage Area is derived from a portion of the Tucquan Creek watershed that contains prominent interior forest blocks. Activities within this portion of the watershed can have a direct impact on the core habitats of the Natural Heritage Area and the species of concern it contains.

- Adjacent forested properties should be acquired or provided with conservation easements to help provide a buffer to this habitat and to help provide connectivity to other nearby Natural Heritage Areas. Additional populations of species of concern may occur on adjacent parcels.
- The campground adjacent to the Lancaster County Conservancy preserve is on land that was formerly agricultural fields. Some portions of the adjacent forest are being utilized as campground expansion. Rather than carve up the forest for campground expansion, consider reforesting adjacent former agricultural lands to provide additional campground lots.
- Agricultural fields within the Natural Heritage Area should be encouraged to return to forest to expand the area of interior forest at this location.
- Remove invasive species of plants.
- Avoid logging in this area.
    - Allow the forest to return to near old-growth conditions.
    - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
        - Trees that have fallen over approved trails can be cut through as necessary.
    - Improve the forest composition by removing non-native trees and shrubs. The railroad rights-of-way and the edges of River Road are the primary location of non-native trees and shrubs within this area.
    - Encourage native tree and shrub recruitment.
        - Reduce the size of the deer herd. Uncommon native species of plants are particularly susceptible to deer herbivory. High deer numbers severely increase tree seedling mortality. Without successful tree seedling recruitment, future forest health will be in jeopardy.
- High levels of public activity are potentially detrimental to the habitat, so only passive recreation should be allowed to occur.
    - Block access to forested areas by off road vehicles, ATVs, motorcycles and bicycles.
- Streams through forested areas should be considered high priority for conservation. Streams through non-forested areas should be restored with native trees, shrubs and wetland plants as appropriate to the topography and hydrology.
    - Careful determination is needed to avoid planting trees in floodplains that should remain as herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings.
        - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
        - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
        - A minimum vegetated buffer should be at least 35 feet in width from the edge of the 100-year floodplain.
- Additional surveys for species of concern are recommended.
- <u>Potential zoning options for conservation enhancement</u>:
    - Strict enforcement of regulations restricting building activity on slopes greater than 25% will provide protection for almost all of the area within the core habitat, ~90% of the Natural Heritage Area and ~40% of the supporting landscape.
    - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks. Adjacent parcels currently forested should be zoned to conserve this attribute.

- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into forest cover.
- Growth within the Township should be discouraged to occur within the core, Natural Heritage Area or supporting landscape identified for this area.


Wakefield
N
272
FURNISS RD
Fulton Township
Conowingo Creek
PEACH BOTTOM RD
272
Puddle Duck Creek
Little Conowingo Creek
PILOTTOWN RD
222
LITTLE BRITAIN CHURCH RD
BLACK BARREN RD
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
0
0.25
0.5
1
Miles

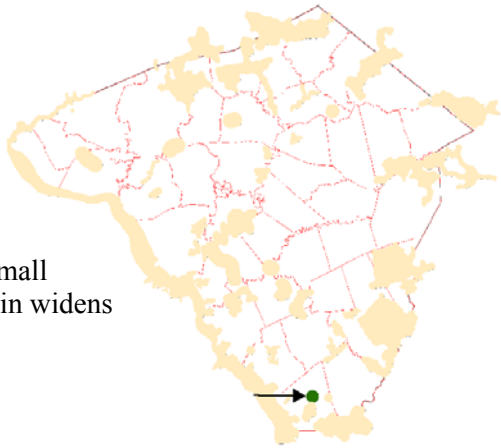
Wakefield – *Notable significance*

Species of Concern:	PNHP Rank[1]		State Status[1]	Last Observed (y-m-d)	Quality[2]
	Global	State			
Animals:					
Sensitive species of concern[3]	G5	S2B	PT	2002	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area occurs along the Conowingo Creek just south of Wakefield Borough.

- Municipalities:
  - Fulton Township
- USGS Quadrangles:
  - Wakefield Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: The Conowingo Creek in this Natural Heritage Area passes though a landscape dominated by agricultural activities. Small patches of forest occur along its banks and in places, the floodplain widens into wet meadow habitats.

Species of concern considerations:

Animals:

- The core habitat for this sensitive species of concern is both the wider streams in the area and the adjacent upland forest. This sensitive species of concern requires abundant food source in the creeks and breeding areas in the adjacent upland forest. This can be achieved by preserving and improving the water quality of the area and by protecting and expanding the natural vegetation buffer along all streams and tributaries.

Forest Cover / Natural Communities: The plant community types depicted are approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and otherwise describe general land cover types (*).

- Only small fragments of natural habitat remain in this area. Most of these narrow strips of forest are highly impacted by edge effects and are considered "modified successional forest". Some of these remnants appear to be of higher quality, and could potentially be used as reference habitats for the long-term goal of restoring large sections of the riparian corridor within the watershed. Those identified as modified successional forest are likely in need of additional restoration measures to remove infestations of invasive species of plants and restore native tree, shrub and herb layers. Wet meadows and pastures within the floodplain can potentially be restored back to floodplain forest or other open wetland habitats as appropriate.
  - Terrestrial (upland) communities:
    - Tuliptree-beech-maple forest
    - Dry oak-heath forest
    - modified successional forest*
    - shrubland*

- Palustrine (wetland) communities:
  - Red maple-black gum palustrine forest
  - Red maple-mixed shrub palustrine woodland
  - Tussock sedge marsh
  - wet meadow*

Ownership:
- Most of the suitable habitat for the species of concern is held in large agricultural parcels. Ownership fragmentation along the Conowingo River may impede future conservation actions.
- PECO Energy Company owns a utility rights-of-way through this Natural Heritage Area.

Habitat Disturbances:
- Historic –
  - The landscape surrounding this Natural Heritage Area was gradually cleared of its original forest cover over 200 years ago and replaced by the intensively cultivated landscape that we see today. Several small patches of forest have remained a fixture of the landscape since 1940 based on aerial photos taken during the era. The long term preservation of these habitat fragments may be responsible for the existence of the species of concern at this location.
  - Several historic milldams occurred along the Conowingo Creek in the vicinity of this Natural Heritage Area. The legacy sediments that are trapped behind the dams alter the topography of the floodplain and trap stream banks in unnatural channels when they are suddenly breached.
- Current –
  - Large expanses of cultivated fields dominate the landscape with little interruption from any natural habitat.
  - Little natural habitat remains in the area except for an intermittent narrow band of trees along the Conowingo Creek. Restoration of wide, vegetated/forested stream buffers should be a priority for the entire watershed.
- Exotic Species –
  - The exotic species composition and threat to this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

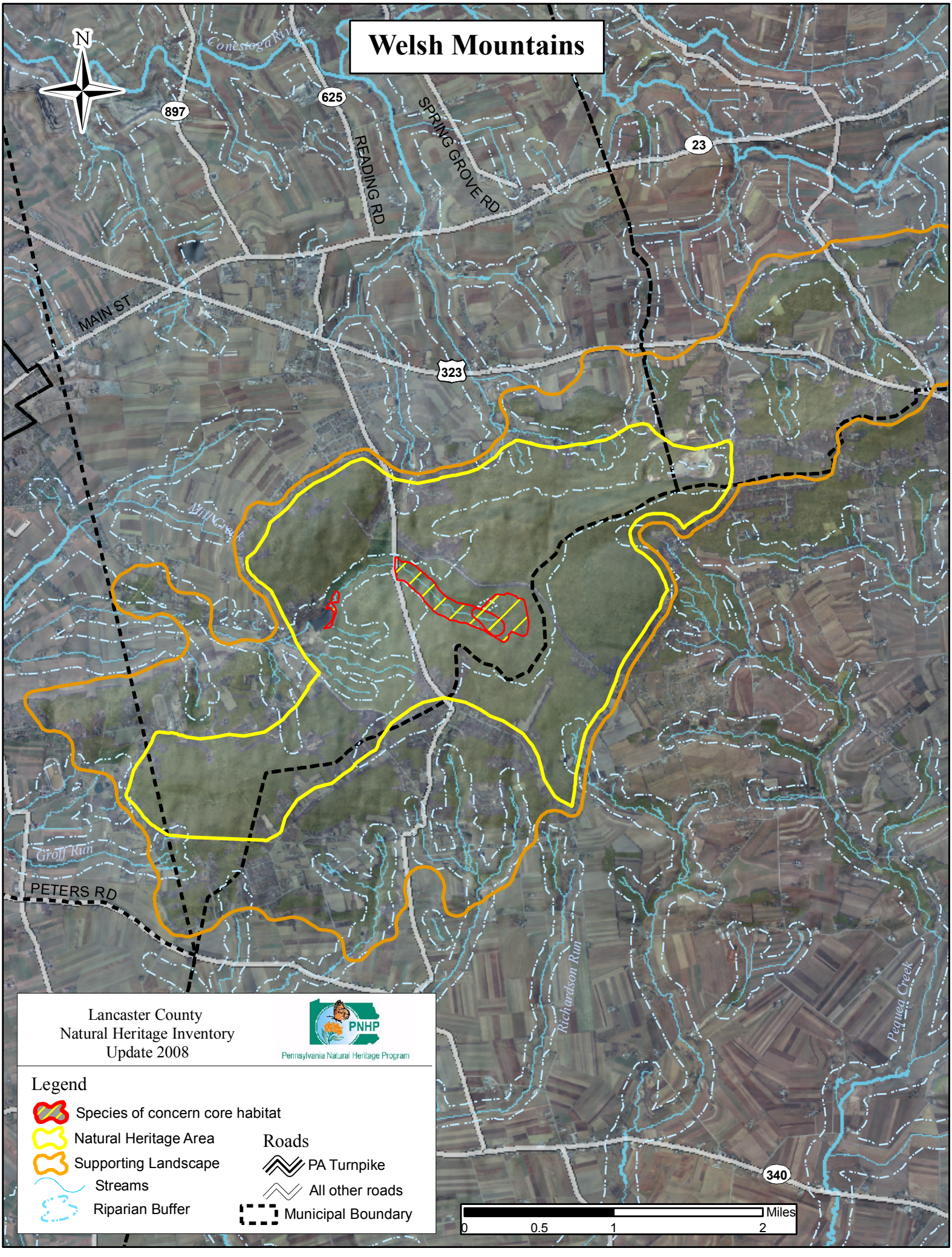
Overall: The riparian streamside forests need to be restored all along Conowingo Creek and its tributaries.

Within the Core Habitat:
- Prevent the conversion of agricultural or natural lands adjacent to Conowingo Creek, or its tributaries to residential or industrial development.
- Protect and expand the natural vegetation along the creek floodplain and adjacent upland. Implement the conservation / restoration of a wide strip of native vegetation as a terrestrial habitat corridor along the creek floodplain. Riparian corridors of all stream tributaries to the Conowingo Creek in this area need additional restoration measures. Avoid building, replacing or expanding dams on waterways.
- Restoration of vegetated stream buffers along Conowingo Creek and its tributaries will help increase the quality of the habitat and food source for the species of concern while improving water conditions for the Conowingo Creek, the Susquehanna River and the Chesapeake Bay.
- The habitat of the stream-dependent species can be considerably impacted from nearby land use decisions. Use of herbicides, pesticides and fertilizers in agricultural production may have a significant impact on the water quality at this location. Conservation efforts should focus on protecting and improving the quality of the surface water for both the local human community as well as for the habitat for the sensitive species of concern. The rainwater

runoff from the agricultural fields and pastures should be considered a potential source of significant surface water contamination. Runoff from these sources have significantly higher levels of sediment, nutrients, pesticides, herbicides and other pollutants than runoff filtered through a natural habitat. Stormwater management measures such as the creation of detention basins or vegetated swales should be implemented to break up the uninterrupted expanses of cultivated ground in these large agricultural landscapes.

Within the Natural Heritage Area/Supporting Landscape:

- All of the conservation actions for the core habitat also apply to the supporting landscape.
- The intensively cultivated adjacent landscape offers little natural habitat for native species of plants and animals. Portions of the area, particularly along the floodplain of the Conestoga River should be restored to native trees and shrubs to provide an increased buffer for storm water and agricultural runoff filtration, and to provide habitat diversity for a wider range of native plants and animals. Expansion of native vegetation along the creeks and water courses in the area will also provide greater connectivity between and among the adjacent natural habitats, providing a corridor for animal and plant movement within this portion of the county.
- Fulton Township zoning ordinances currently restrict new development within the floodplain of all waterways. Strict enforcement of these regulations will help prevent conversion of the floodplain to many unsuitable uses and help protect most of the species of concern core habitat.
    - Floodplain regulations should be updated to restrict agricultural activities within the 100-year floodplain as well. Chemical, nutrient and sediment runoff into waterways from agricultural sources can be significantly reduced by returning seasonally flooded areas to natural habitats.
- Other narrow waterways in the supporting landscape have been strongly channelized and the lack of vegetated riparian buffers provides little, if any, protection from agricultural runoff.
        - An ideal vegetated stream buffer should be at least 100 meters (~300 feet) in width from the edge of the 100-year floodplain.
        - An intermediate vegetated stream buffer should be at least 100 feet in width from the edge of the 100-year floodplain.
        - A minimum vegetated buffer should me at least 35 feet in width from the edge of the 100-year floodplain.
    - Take into account the presence of legacy sediments at historic milldam locations and appropriately restore the historic floodplain.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built-out.
- Growth should be encouraged to occur clustered in close proximity to existing infrastructure to avoid unnecessary destruction of natural habitat and prime farmland.

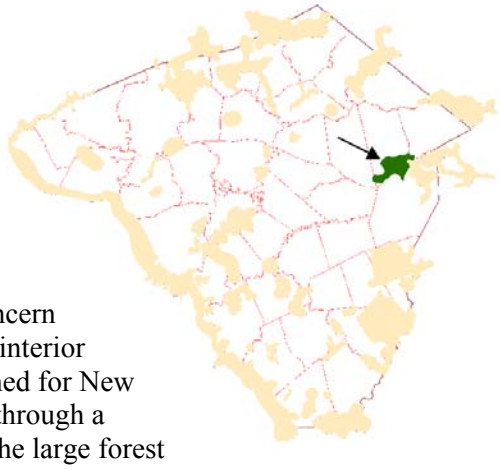

Welsh Mountains
N
Conestoga River
897
625
READING RD
SPRING GROVE RD
23
MAIN ST
323
Mill Creek
Groff Run
PETERS RD
Richardson Run
Pequea Creek
340
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.5
1
2

Welsh Mountains – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Colic-root (*Aletris farinosa*)	G5	S1	PE	2001-08-15	D
Bushy bluestem (*Andropogon glomeratus*)	G5	S3	PR	1994-08-13	C
Netted chainfern (*Woodwardia areolata*)	G5	S2	PT	1996-05-31	D

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks

Location:
- Municipalities:
  - East Earl Township
  - Salisbury Township
- USGS Quadrangles:
  - Honeybrook Quadrangle
  - New Holland Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: This Natural Heritage Area includes the species of concern core habitat, supporting landscape and the adjacent large blocks of interior forest referred to as the Welsh Mountains that surround the watershed for New Holland Reservoir. Several streams originate in the area and flow through a predominantly dry-oak heath forest on their way to the reservoir. The large forest dominated landscape at this site should be considered one of the primary natural corridors of the county. It provides both a habitat refuge for local native species as well as a large enough habitat to be considered part of a regional corridor connecting with habitats into Chester and Berks Counties.

Species of Concern Considerations:

Plants:
- Colic-root grows in a variety of habitats, including clearings and openings, thickets, open woods, serpentine barrens, and wetlands, especially on sandy or peaty substrates. At this location colic-root occurs in drier clearings near the stream headwaters. Fewer than 10 populations, mostly with few individuals, are currently known from the state, primarily in the southeastern counties. The remaining populations of colic-root in the state are threatened by human-related habitat loss, natural succession, invasive species, and collection by gardeners and herbal medicine enthusiasts. Given the preference of the species for open habitats, active management - such as fire, mowing, or invasive species removal - is often required to maintain the proper successional stage at sites where it grows.
- Bushy bluestem grows in a variety of damp to wet open places, clearings, and sometimes in human-created disturbed ground. At this location, it occurs in open, wet meadows around the reservoir itself. About 15 populations are currently known from the state, particularly in the southern counties. The populations of bushy bluestem in the state are threatened by human-related habitat loss, natural succession, invasive species, and the indiscriminate spraying of herbicides. Given the preference of the species for open habitats, active management – such as fire, mowing, or invasive species removal is often required to maintain the proper successional stage at sites where it grows.
- Netted chainfern grows in swamps, seepages, wet woods, boggy wetlands and along the margins of streamlets. At this location, it occurs along the moist woods adjacent to the creek. About 30

populations are currently known from the state in scattered counties, particularly in the Delaware River drainage. The viability of populations of netted chainfern and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

- This Natural Heritage Area is dominated by one of the largest contiguously forested areas of the county referred to as the Welsh Mountains. The habitat is relatively homogenous for its size, consisting primarily of dry oak-heath forest, dry oak-mixed hardwoods forest with smaller patches of modified successional forest with scattered conifer plantations.

Ownership:

- New Holland Borough Authority owns much of the Natural Heritage Area and all three core habitats. This land should be retained by the borough and maintained in its current use as forested land for watershed protection.
- Lancaster County Money Rocks Park occurs within the Natural Heritage Area and protects a significant portion of an interior forest block.

Habitat Disturbances:

- Historic –
  - The area has remained forested, likely due to its difficulty for conversion to agricultural uses.
  - Several roads cut through the otherwise unbroken forest, creating smaller forested blocks from a large forested block. Interior forest is decreased by road and utility right-of-way fragmentation of the landscape. Forested habitat within 100 meters of a non-forested land use is considered edge habitat.
  - The small stream flowing out of the Welsh Hills has been dammed to create the New Holland Reservoir.
- Current –
  - Most of this site is maintained as relatively undisturbed forest. However, several roads and numerous residences fragment the canopy. There are also a number of trails throughout the site used for off-road vehicles and horseback riding. Creating numerous, wide trails disturbs vegetation, fragments the forest canopy and facilitates the spread of invasive plants. Trails also provide an opportunity for dumping trash, and trash can be found in the core habitat.
  - Clearings and areas easily accessed by trails are particularly susceptible to trash dumping.
  - Some forms of disturbance also serve to create habitat at this site. The clearings used by colic-root are a remnant of past disturbance. Without future disturbance this community will transition back into forest with the continued growth of woody plants.
- Exotic Species – The core habitat for colic-root contains numerous invasive plant species including well established populations of mile-a-minute (*Polygonum perfoliatum*) and multiflora rose (*Rosa multiflora*).

Conservation Actions:

Overall:

- Permanent protection through conservation easement of the core habitats would be appropriate. Management of lands should focus on maintaining the large intact forest canopy and expanding the small habitats that support colic-root and bushy bluestem.

Within the Core Habitat:

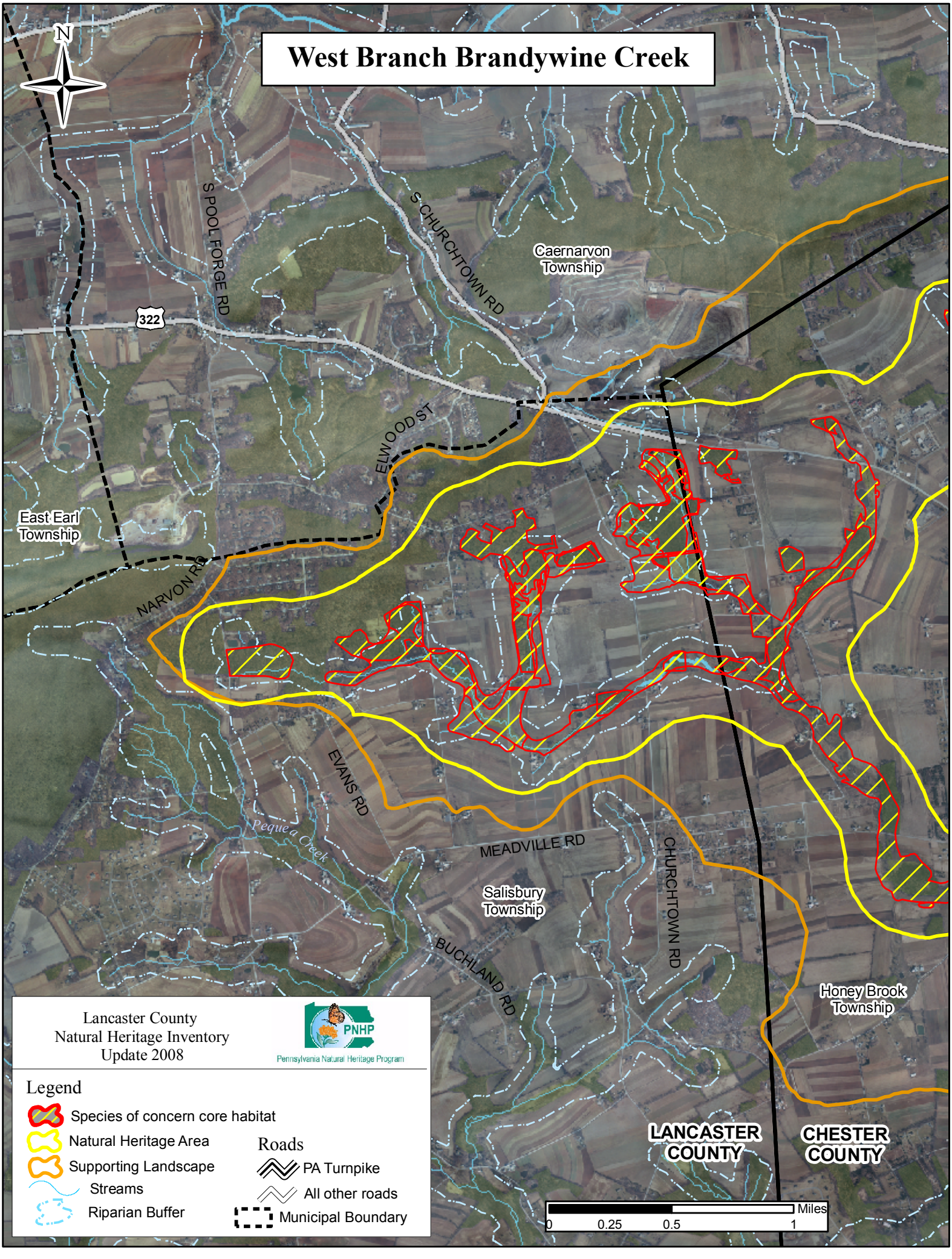
- Maintain current ownership and use of lands as an important water quality buffer for New Holland Reservoir.
  - Permanently protect core habitats with a conservation easement. Conservation easement should include provisions that protect the specific habitat required by species of concern.
- Preserve intact forest canopy.
  - Avoid additional fragmenting features such as roads, buildings, and utility rights-of-way.
  - Avoid logging in areas with existing intact forest canopy, particularly along streams.
    - Leave fallen trees in place to help build soil nutrients, humus, tilth and animal microhabitats.
    - Encourage native tree and shrub recruitment.
- Close wide trails that fragment the canopy.
  - Prohibit the use of ATVs on trails.
  - Encourage only passive recreation uses of the forest by the public.
  - Remove trash from core habitats.
- Initiate an infrequent disturbance regime to maintain and expand clearings used by colic-root. Consideration should be given when implementing disturbance that colic-root plants are not damaged in the process.
- Lowland, wet meadow areas along the banks of the reservoir could be expanded by removal of some of the surrounding pine plantation.
- Remove invasive species of plants.
  - Large stands of mile-a-minute and exotic plants in the clearings should be targeted.
  - Invasive species management needs to be coordinated by individuals familiar with the species of concern as well as the invasive species present.
  - Invasive species monitoring of the clearings will be necessary.

<u>Within the Natural Heritage Area / Supporting Landscape:</u>

- This site is part of one of the most contiguous tracts of forest in the county and forested land extends well beyond the Natural Heritage Area. Establishing permanent protection and maintaining connectivity to adjacent forested land is important in that it provides a large extent of interior forest and additional habitat for many species.
- This Natural Heritage Area is near Red Hill Swale, another site that houses several species of concern including bushy bluestem. Much of the land between the two sites is forested and connection between the habitats should be maintained.
- Reforest stream corridors.
  - Moist, riparian corridors at this site provide habitat for netted chainfern. Reforesting other stream corridors in the supporting landscape may contribute additional habitat for this species.
  - Careful determination is needed to avoid planting trees in floodplains that contain herbaceous wetland habitats. These habitats should be maintained in their current open condition, with tree plantings to occur at the periphery of natural wetland openings. See riparian corridor section for site specific recommendations.
- Additional surveys for species of concern are recommended.
- <u>Potential zoning options for conservation enhancement:</u>
  - Zoning regulations should discourage further fragmentation of contiguous or interior forest blocks.
    - Salisbury Township has zoned this area as Open Space Conservation (RR-OSC), which is very compatible with maintaining the long range integrity with this forested landscape.
    - East Earl Township has zoned this area Rural Residential (RR-RR) which will lead to the eventual subdivision and fragmentation of this large block of interior forest. Zoning within this Natural Heritage Area should be updated to Open

Space Conservation (RR-OSC) to reflect the significance of the unfragmented forests of this natural habitat for the county and the region.

- Growth within the Township should be discouraged within the core habitat, supporting landscape or Natural Heritage Area identified for this location.


West Branch Brandywine Creek
N
S POOL FORGE RD
S CHURCHTOWN RD
322
Caernarvon Township
ELWOOD ST
East Earl Township
NARVON RD
EVANS RD
Pequea Creek
MEADVILLE RD
Salisbury Township
CHURCHTOWN RD
BUCHLAND RD
Honey Brook Township
LANCASTER COUNTY
CHESTER COUNTY
Lancaster County
Natural Heritage Inventory
Update 2008
PNHP
Pennsylvania Natural Heritage Program
Legend
Species of concern core habitat
Natural Heritage Area
Supporting Landscape
Streams
Riparian Buffer
Roads
PA Turnpike
All other roads
Municipal Boundary
Miles
0
0.25
0.5
1

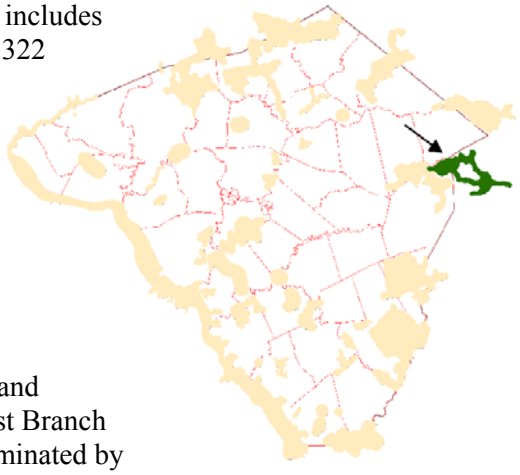
West Branch Brandywine Creek – *High significance*

Species of Concern:	PNHP Rank[1] Global	PNHP Rank[1] State	State Status[1]	Last Observed (y-m-d)	Quality[2]
Plants:					
Bushy bluestem (*Andropogon glomeratus*)	G5	S3	PR	1993-05-18	C
Sweet bay magnolia (*Magnolia virginiana*)	G5	S2	PT	1993-05-18	C
Swamp lousewort (*Pedicularis lanceolata*)	G5	S1S2	PE	1994-09-12	BC
Animals:					
Sensitive species of concern [3]	-	-	-	2001	E

[1] Please refer to Appendix IV for an explanation of PNHP ranks and legal status
[2] Please refer to Appendix V for an explanation of quality ranks
[3] This species is not named at the request of the agency overseeing its protection

Location: This Natural Heritage Area is primarily in Chester County, but includes a portion of the West Branch Brandywine Creek watershed near Route 322 in Salisbury Township.

- Municipalities:
  1. Salisbury Township, (Lancaster County)
  2. Honey Brook Township, (Chester County)
- USGS Quadrangles:
  - Honey Brook Quadrangle
  - Wagontown Quadrangle
- 1990 Lancaster Natural Areas Inventory reference: None



Description: Several tributaries originate in this area and their springs and rich bottomlands support a cluster of wetland communities. The West Branch Brandywine Creek watershed is in a landscape that has long been dominated by agricultural activities. The relatively flat topography of the valley, while being conducive to agriculture, also allows water to pool in low lying areas, creating wetlands of varying types. Historically, wetlands likely existed at most locations where water exits the ground at a spring. Most of these wetlands were drained or dammed to create fields or farm ponds for agricultural production in past centuries, but some remain or have recovered from a cessation of these activities. These wetland fragments should be considered the backbone for a restoration of this habitat type in the West Branch Brandywine Creek watershed.

Species of Concern Considerations: Open sites are characterized by wet meadows or tussock sedge marshes that provide habitat for three plant species of concern and one animal species of concern.

- Bushy bluestem grows in a variety of damp to wet open places, clearings, and sometimes in human-created disturbed ground. Bushy bluestem ranges across the continent in the southern states. About 15 populations are currently known from Pennsylvania, particularly in the southern counties. Given the preference of the species for open habitats, active management – such as fire, mowing, or invasive species removal – is often required to maintain the proper successional stage at sites where it grows.
- Sweet bay magnolia is a southerly species that has been documented in several southeastern counties. It occurs in wetlands, particularly swamps and seepy woodlands. The viability of populations of sweet bay magnolia and its habitat type will be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. Excessive deer browse may be

threat in some locations. This and other populations of sweet bay magnolia occurring west of the Coastal Plain in the state have significance for plant geography and possibly for genetic diversity.

- Swamp lousewort grows in calcareous wetlands, including boggy meadows, marshes, swamps, and fens. About 10 populations of swamp lousewort are currently known in Pennsylvania, where it occurs mostly in the southern and northwestern counties. The known occurrences of swamp lousewort and its habitat type will be enhanced by creating buffers around its habitat, removal of invasive species, and protection of wetland hydrology. Excessive deer browsing may be a threat in some locations.
- The sensitive species of concern inhabiting these shallow wetlands require specific plant communities with a matrix of open canopied habitats. The reestablishment of the marshes at this site would recreate suitable habitat for this species.
- In addition to the species of concern currently found at this site, several plant species of concern were historically documented from this area. Red milkweed (*Asclepias rubra*), sand blackberry (*Rubus cuneifolius*), Scirpus-like rush (*Juncus scirpoides*), and rough-leaved aster (*Eurybia radula*) had been documented in this area.

Forest Cover / Natural Communities: The plant community types depicted are only approximations delineated from 2005 aerial photography interpretation and were followed up with minimal selective ground-truthing. Community types follow "Terrestrial & Palustrine Plant Communities of Pennsylvania" (Fike 1999) where appropriate, and describe general land cover types where they are not.

Forested habitats here include red maple-black gum palustrine forest, red maple-mixed shrub palustrine woodland, and red maple-magnolia coastal plain palustrine forest, which is characterized by the presence of sweet bay magnolia (*Magnolia virginiana*). Moist clearings in a tuliptree-beech-maple forest provide habitat for bushy bluestem (*Andropogon glomeratus*).

Ownership: This entire Natural Heritage Area within Lancaster County appears to be in private ownership. Much of the area of the sub-watershed is in large agricultural parcels including most of the area considered to be of highest ecological significance. Future ownership fragmentation along the banks of the many branches of the West Branch Brandywine Creek may impede future conservation actions. Conservation action along the creek corridor should be set in motion before ownership fragmentation makes this process more difficult.

Habitat Disturbances:

- Historic –
  - The landscape within this Natural Heritage Area was cleared of its original forest cover over several centuries to accommodate the expansion of intensive agriculture. Only small isolated pockets of natural vegetation remained to provide habitat for native plants and animals.
- Current –
  - Some of the open wetlands are used for pasture and are subject to partial drainage. The site's natural hydrology is an important component of its wetland habitats and drainage or alteration of hydrology is detrimental. Grazing in pasture areas also disturbs vegetation patterns and compacts soil.
  - Many of the wetland communities are adjacent to agricultural fields and likely exposed to agricultural run-off. Chemical compounds and sediments carried in run-off may impact water and habitat quality.
  - Logging is a disturbance that impacts the upland forests. Logging creates or accentuates the clearings utilized by bushy bluestem. Without sustained disturbance to maintain those openings, bushy bluestem will be out-competed through the encroachment of woody plants. If logging is moderate and used to maintain clearings, it may have a beneficial effect on the bushy bluestem population.
  - The core habitats are adjacent to residential areas and several outbuildings exist within the core habitat.
- Exotic Species –

- The exotic species composition and threat to this location is unknown, though narrow corridors in unnatural surroundings are frequently dominated by invasive species of plants.

Conservation Actions:

Overall:

- Maintain this Natural Heritage Area as a wetland complex, composed of multiple types of wetlands. Habitat modification by beavers could help to improve the integrity of this Natural Heritage Area, by reestablishing the matrix of open canopied wetland complexes. At this point, if beavers would expand into this system, they should be left to modify and restore some of the open habitats that previously existed at this site. Beaver numbers are on the rise in Pennsylvania, and it is very possible that they could be documented here in the near future if they don't already exist.

Within the Core Habitat:

- Long term goals of this Natural Heritage Area should be to reestablish the slow moving marsh systems that dominated this area before modern agricultural practices worked to minimize the areas of lands considered un-cultivatable. Conversion of these wet meadows to drier lands that are more suitable for row crops, involved channelizing these systems to improve drainage and rapidly direct water downstream. Prior to this hydrological modification, light farming and grazing practices were compatible with the species of concern found at this site.
- Permanently protect natural areas and wetlands on properties within the core habitat through conservation easement or acquisition.
  - Conservation easements should include provisions that protect the specific habitat required by species of concern.
- All of the species of concern that have been lost from this Natural Heritage Area would benefit from the habitat restoration under the management recommendations provided below. Some key general activities that should be considered within this area include:
  - Further fragmentation of this Natural Heritage Area should be avoided, and where necessary, should be conducted with the continuity of the wetland systems in mind. This may require that road crossings involve bridge systems that would preserve the wide sluggish waters associated with marshes and slow flowing waterways.
  - Light grazing with pastoral animals can be an effective tool to maintain these soggy meadows in their preferred condition. Once the open habitat within the historic floodplain has been restored, light grazing, often considered compatible with high financial yield organic meat and dairy production, could be an effective tool to maintaining the habitat for all wet meadow species.
  - Ironically, the conversion of wetlands for production of row crops limited the consistent water supplies used for irrigation, livestock watering, and farm fire protection. To compensate for the loss of wetlands, farm ponds were created to provide a consistent supply of water for farming uses. Many of these farm ponds were built where drainage was poor, often on top of existing springs, seeps, and other natural wetlands. These natural wetlands were replaced with highly modified deep, steep sided ponds, which serve little to no use for wildlife. Creation of additional farm ponds should be discouraged to maintain the existing hydrology within the Natural Heritage Area. Additionally, as the existing farm ponds deteriorate and are in need of maintenance, the removal of such ponds should be explored, in order to recreate the natural flows of the landscape.
  - Because most of the species of concern noted from this site rely upon open canopied habitats, programs that support establishment of riparian buffers with trees, such as CREP, should be avoided in areas close to the streams. Instead, these programs may be better suited beyond the historic floodplain of the drainages delineated within in this Natural Heritage Area.

    - Legacy sediment removal may be explored, but must be done with caution to avoid direct harm to the species of concern noted from this Natural Heritage Area.
- In addition to the above general recommendations for the entire Natural Heritage Area are these recommendations for specific sections of the West Branch Brandywine Creek watershed::
    - Improvement of, or creation of road crossings should be done with wildlife corridors in mind.
    - Establishment of forested riparian buffers should avoid any existing springs, seeps, and wet meadows that may exist along the stream.
    - Existing wet meadows should not be modified (i.e. dammed, farmed or planted in trees).

Within the Natural Heritage Area / Supporting Landscape:

- There are a number of other small streams in this headwaters area that could provide additional habitat for species of concern.
    - Efforts should be made to restore the natural communities of riparian corridors in this area.
    - Provide a natural buffer between agricultural lands and streams.
- There are multiple landowners, mainly farmers, that own the property within this Natural Heritage Area. Pursue conservation easements, fee simple acquisition and other programs that may restore the wetlands on properties along the West Branch Brandywine Creek to help conserve and improve its effectiveness as a natural corridor.
- Avoid subdivision of large parcels as this would likely impede broad conservation initiatives. Agricultural zoning is compatible with this Natural Heritage Area.
- Adjacent parcels currently in agriculture that are of high quality agricultural soils should be zoned agricultural and considered fully built out. Poorer quality agricultural soils should be encouraged to regenerate into natural vegetation cover.
- Growth within the Township should be discouraged to occur within the core or supporting landscape identified for this location.
- Reestablishment of the wide floodplain and wet meadows would serve as an effective buffer to flooding that may occur downstream.
- This Natural Heritage Area is near the New Holland Reservoir site, which also contains several species of concern including bushy bluestem. Much of the land between the two sites is forested and this habitat connectivity should be maintained.
- Additional surveys for species of concern are recommended.

Glossary

Alluvium – material such as sand, silt, or clay that is deposited on land by streams.
Anthropogenic – human caused.
ATV – all-terrain-vehicle.
Bedrock - The solid rock that underlies loose material, such as soil, sand, clay, or gravel.
Bt (Bacillus thuringiensis) – an insecticide, which is produced by the fermentation of a bacterium (Bt), used to control many caterpillar-type pests (e.g., gypsy moth).
Bog – a nutrient poor, acidic peatland that receives water primarily from direct rainfall with little or no input from groundwater or runoff; vegetation consists primarily of peat moss and ericaceous shrubs.
Calcareous- composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.
Canopy – the layer formed by the tallest vegetation.
Circumneutral – pH between 5.5 and 7.
Co-dominant – where several species together comprise the dominant layer (see "dominant" below).
Community – an assemblage of plant or animal populations sharing a common environment and interacting with each other and the physical environment.
DCNR – Pennsylvania Department of Conservation and Natural Resources.
DEP – Pennsylvania Department of Environmental Protection.
Diabase – a dark gray igneous rock. The chemical composition of diabase may support unusual plant communities.
Dimilin – a commercially produced, restricted-use insecticide containing diflubenzuron as the active ingredient. Diflubenzuron, which has been used as a method to control gypsy moth, interferes with chitin production during the early stages of certain insects (DCNR, Division of Pest Management).
Dominant – the species (usually plant) exerting the greatest influence on a given community either by numerical dominance or influence on microclimate, soils, and other species.
Ecosystem - an ecological community together with its environment, functioning as a unit.
Element – all-inclusive term for species of special concern and exemplary natural communities.
Handbook (Shertzer 1992).
Exotic – non-native; used to describe plant or animal species that were introduced by humans; examples include Japanese honeysuckle, purple loosestrife and grass carp; exotics present a problem because they may out-compete native species.
Extant – currently in existence.
Extirpated – loss of a species from part of its natural range; also referred to as “localized extinction”.
Floodplain – low-lying land generally along streams or rivers that receives periodic flooding.
Forb – non-grass herbaceous plant such as goldenrod.
Graminoid – grass or grass-like plant such as a sedge or a rush.
Ground cover – low shrubs, herbs, and mosses that are found at or close to the ground surface.
Herptile – a reptile or amphibian
Herpetofauna – the group of reptiles and amphibians found in a particular region
Hibernacula – a location where animals hibernate.
Hibernation – the period of winter inactivity during which time normal physiological processes are reduced and a significant decrease in body temperature occurs. In Pennsylvania, true hibernation is shown by woodchucks, jumping mice, and bats.
High-Quality Coldwater Fisheries (HQ-CWF) – DEP designation (PA Code, Chapter 93) for a stream or watershed that has excellent quality waters and environmental or other features that require special water quality protection.
Hydrology – water system of an area including both surface water and ground water.
Igneous - formed by solidification from a molten state. Used of rocks.
Invasives – plants or animals that tend to spread and alter the overall makeup and character of sites. These invasions are either due to the introduction of an exotic species, or due to natural succession. The introduction of invasives can often cause the breakdown of the natural community.
Karst—a landscape of characteristic landforms (sinkholes) and subsurface features (caves, sinking streams, limestone springs) produced primarily as a result of solution of the underlying bedrock
Lepidoptera – moths and butterflies.

Listed species – species that is monitored and considered to be of concern by PNHP.
Matrix – the form of land use or habitat that surrounds a focal patch of habitat.
Mesic – moist, not saturated.
Native – describes species that occurred in Pennsylvania or in the area in which they are found prior to European settlement; not introduced by human activities.
Natural Area – State Forest Natural Areas, which are specific management units designated by DCNR Bureau of Forestry.
Natural Heritage Area – as used in this study, an area with either an exemplary natural community or species of special concern
Neo-tropical - referring to the tropical locations in the new world; Mexico, Caribbean Islands, and Central and parts of Northern South America.
Non-point – refers to diffuse sources of pollution such as storm water runoff contaminated with oil or pesticides.
Odonates – dragonflies and damselflies.
Palustrine - describes wetlands; areas intermediate between aquatic and terrestrial habitats, supporting predominately hydrophytic vegetation, where conditions are at least periodically wet enough during the growing season to produce anaerobic soil conditions and thereby influence plant growth.
Peat – partially decomposed remains of plant material in which at least some of the plant parts are still distinguishable.
PNHP – the Pennsylvania Natural Heritage Program
POSCIP – Plant of Special Concern in Pennsylvania.
Potential Natural Area – used by Western Pennsylvania Conservancy to denote an area that may have desirable environmental characteristics to support rare species or exemplary natural communities, but which needs a field survey to confirm; a preliminary category given to sites prior to field survey (see METHODS section).
Prescribed burning – burning under controlled conditions; needed to maintain communities such as limestone glades and pitch pine barrens.
Riparian – streamside.
Rookery - the breeding ground of certain birds or animals, such as herons, penguins, and seals.
ROW – rights-of-way: strip of land occupied or intended to be occupied by a street, crosswalk, railroad, electric transmission line, oil or gas pipeline, water main, sanitary or storm sewer line, or other special use.
Sedge - grasslike herbaceous plant of the family Cyperaceae, especially members of the genus Carex.
Seeps – where water flows from the ground in a diffuse pattern and saturates the soil; lush herbaceous vegetation often grows in these wet areas.
Shrub - a perennial, woody plant that differs from a tree in its short stature (less than five meters in height) and typically multi-growth form.
Soil association – a group of soils that are geographically associated in a characteristic repeating pattern and defined and delineated as a single unit.
Soil series – groups of soils that have vertical profiles that are almost the same, that is, with horizons (layers) that are similar in composition, thickness, and arrangement.
Subcanopy - in a forest community, the tops and branches of the small trees and tall shrubs that form a distinct layer beneath the high tree canopy and above the shrub layer (if present).
Swamp - a wooded wetland, intermittently or permanently flooded
Succession – natural process of vegetation change through time; over time, the plant species of a site will change in composition and structure as light and soil conditions change (e.g., a field that is left alone may, over time, be taken over by shrubs, then small trees and eventually a woodland).
Understory – layer of shrubs and small trees between the herbaceous layer and the canopy.
Upland - sites with well-drained dry to mesic soils.
Wetlands - areas intermediate between aquatic and terrestrial habitats; characterized by a predominance of hydrophytes, where conditions are at least periodically wet enough, during the growing season, to produce anaerobic soil conditions and thereby influence plant growth.
WPC – the Western Pennsylvania Conservancy
Vernal – occurring in the spring.
Xeric – extremely dry or droughty.

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APPENDICES

APPENDIX I: PNHP PROGRAM RANKS, AND STATE AND FEDERAL STATUS

PNHP GLOBAL ELEMENT RANKS

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Bachman's Warbler).

GNR = Not ranked at the global level. Applies to natural communities that have been designated at the state level but not yet reviewed globally.

GU = Possibly in peril range wide but status uncertain; need more information.

GX = Believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered.

PNHP STATE ELEMENT RANKS

S1 = Critically imperiled in state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in state (on the order of 21 to 100 occurrences).

S4 = Apparently secure in state, with many occurrences.

S5 = Demonstrably secure in state and essentially ineradicable under present conditions.

SA = Accidental in state, including species which only sporadically breed in the state.

SE = An exotic established in state; may be native elsewhere in North America (e.g., house finch).

SH = Of historical occurrence in the state with the expectation that it may be rediscovered.

SN = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in the state.

SR = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.

SRF = Reported falsely (in error) from the state but this error persisting in the literature.

SU = Possibly in peril in state but status uncertain; need more information.

SX = Apparently extirpated from the state.

APPENDIX I (continued)

STATE STATUS-NATIVE PLANT SPECIES

Legislative Authority: Title 25, Chapter 82, Conservation of Native Wild Plants, amended June 18, 1993, Pennsylvania Department of Environmental Resources.

PE - Pennsylvania Endangered - Plant species which are in danger of extinction throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained or if the species is greatly exploited by man. This classification shall also include any populations of plant species that have been classified as Pennsylvania Extirpated, but which subsequently are found to exist in this Commonwealth.

PT - Pennsylvania Threatened - Plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent further decline in this Commonwealth, or if the species is greatly exploited by man.

PR - Pennsylvania Rare - Plant species that are uncommon within this Commonwealth. All species of native wild plants classified as Disjunct, Endemic, Limit of Range and Restricted are included within the Pennsylvania Rare classification.

PX - Pennsylvania Extirpated - Plant species believed by the Department to be extinct within this Commonwealth. These plant species may or may not be in existence outside this Commonwealth. If plant species classified as Pennsylvania Extirpated are found to exist, the species automatically will be considered to be classified as Pennsylvania Endangered.

PV - Pennsylvania Vulnerable - Plant species which are in danger of population decline within Pennsylvania because of their beauty, economic value, use as a cultivar, or other factors which indicate that persons may seek to remove these species from their native habitats.

TU - Tentatively Undetermined - Plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.

N - None - Plant species which are believed to be endangered, rare, or threatened, but which are being considered by the required regulatory review processes for future listing

APPENDIX I (continued)

STATE STATUS-ANIMALS

The following state statuses are used by the Pennsylvania Game Commission for (1990, Title 34, Chapter 133 pertaining to wild birds and mammals) and by the Pennsylvania Fish and Boat Commission (1991, Title 30, Chapter 75 pertaining to fish, amphibians, reptiles and aquatic organisms):

PE - Pennsylvania Endangered

Game Commission - Species in imminent danger of extinction or extirpation throughout their range in Pennsylvania if the deleterious factors affecting them continue to operate. These are: 1) species whose numbers have already been reduced to a critically low level or whose habitat has been so drastically reduced or degraded that immediate action is required to prevent their extirpation from the Commonwealth; or 2) species whose extreme rarity or peripherality places them in potential danger of precipitous declines or sudden extirpation throughout their range in Pennsylvania; or 3) species that have been classified as "Pennsylvania Extirpated", but which are subsequently found to exist in Pennsylvania as long as the above conditions 1 or 2 are met; or 4) species determined to be "Endangered" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87 Stat. 884), as amended.

Fish and Boat Commission - Endangered Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or the Native Endangered Species list published in the Federal Register; or, (2) declared by the Executive Director (PaFC) to be threatened with extinction and appear on the Pennsylvania Endangered Species List published in the Pennsylvania Bulletin.

PT - Pennsylvania Threatened

Game Commission - Species that may become endangered within the foreseeable future throughout their range in Pennsylvania unless the causal factors affecting the organism are abated. These are: 1) species whose populations within the Commonwealth are decreasing or have been heavily depleted by adverse factors and while not actually endangered, are still in critical condition; or 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that have been identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe decline throughout their range in Pennsylvania; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public law 93-205 (87-Stat. 884), as amended, that are not listed as "Pennsylvania Endangered".

Fish and Boat Commission - Threatened Species are all species and subspecies: (1) declared by the Secretary of the United States Department of the Interior to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on a Threatened Species List published in the Federal Register; or, (2) have been declared by the Executive Director (PaFC) to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Pennsylvania Threatened Species List published in the Pennsylvania Bulletin.

APPENDIX I (continued)

FEDERAL STATUS

U.S. FISH AND WILDLIFE SERVICE CATEGORIES OF ENDANGERED AND THREATENED PLANTS AND ANIMALS

The following definitions are extracted from the September 27, 1985 U.S. Fish and Wildlife Service notice in the Federal Register:

LE - Listed Endangered - Taxa in danger of extinction throughout all or a significant portion of their ranges.

LT - Listed Threatened - Taxa that are likely to become endangered within the foreseeable future through all or a significant portion of their ranges.

PE - Proposed Endangered - Taxa proposed to be formally listed as endangered.

PT - Proposed Threatened - Taxa proposed to be formally listed as threatened.

C1 - Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.

C2 - Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support the immediate preparation of rules.

C3 - Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three categories, depending on the reason(s) for removal from consideration.

3A--Taxa for which the Service has persuasive evidence of extinction.

3B--Names that, on the basis of current taxonomic understanding, usually as represented in published revisions and monographs, do not represent taxa meeting the Act's definition of "species".

3C--Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

N - Taxa not currently listed by the U.S. Fish and Wildlife Service

APPENDIX II: PENNSYLVANIA ELEMENT OCCURRENCE QUALITY RANKS

Quality Rank*	Explanation
A	Excellent occurrence: all A-rank occurrences of an element merit quick, strong protection. An A-rank community is nearly undisturbed by humans or has nearly recovered from early human disturbance; further distinguished by being an extensive, well-buffered occurrence. An A-rank population of a sensitive species is large in area and number of individuals, stable, if not growing, shows good reproduction, and exists in natural habitat.
B	Good occurrence: protection of the occurrence is important to the survival of the element in Pennsylvania, especially if very few or no A-rank occurrences exist. A B-rank community is still recovering from early disturbance or recent light disturbance, or is nearly undisturbed but is less than A-rank because of significantly smaller size, poorer buffer, etc. A B-rank population of a sensitive species is at least stable, in a minimally disturbed habitat, and of moderate size and number.
C	Fair occurrence: protection of the occurrence helps conserve the diversity of a region's or County's biota and is important to statewide conservation if no higher-ranked occurrences exist. A C-rank community is in an early stage of recovery from disturbance, or its structure and composition have been altered such that the original vegetation of the site will never rejuvenate, yet with management and time partial restoration of the community is possible. A C-rank population of a sensitive species is in a clearly disturbed habitat, small in size and/or number, and possibly declining.
D	Small occurrence: protection of the occurrence may be worthwhile for historical reasons or only if no higher ranked occurrences exist. A D-rank community is severely disturbed, its structure and composition been greatly altered, and recovery to original conditions, despite management and time, essentially will not take place. A D-rank population of a sensitive species is very small with a high likelihood of dying out or being destroyed, and exists in a highly disturbed and vulnerable habitat.
E	Verified as extant, but has not been given a rank; additional information needed to evaluate quality.

* Intermediate ranks may also be assigned.

APPENDIX III: FIELD SURVEY FORM

PLANT & ANIMAL SPECIES OF SPECIAL CONCERN REPORT
(PLEASE INCLUDE A MAP – SEE MAPPING INSTRUCTIONS)

SPECIES NAME:	**SURVEYOR(S):** (*Please include your address & phone #)*
DATE OF VISIT:	**TIME SPENT AT SITE:**
USGS QUADRANGLE:	
SITE NAME AND DIRECTIONS TO SITE:	**GPS Coordinates**: Latitude:_____ Longitude:_____ **DATUM** (e.g. NAD27, NAD83)_____

OWNER INFORMATION:
- **Public Land:** give tract name:_____
- **Private Land:** Please fill out landowner info below. **NOTE**: We cannot accept data collected on private land if you didn't have permission!

Landowner Name:	Address:
Phone Number:	City / State / Zipcode:

- Landowner aware of the species of special concern? **YES____ NO____**
- Landowner aware that data are submitted to PA Natural Diversity Inventory? **YES____ NO____**
- Landowners are welcome to call the PNDI-East office in Middletown at (717) 948-3962 for more information.
- **IF A SPECIMEN WAS COLLECTED**: Please ask for the landowner's signature **for permission to save the specimen in a museum**: Landowner Signature:_____ Date:_____
- WHERE IS THE SPECIMEN BEING HELD_____

HABITAT DESCRIPTION: Give a general description of the site. You might include other plant/animal species at site, substrate/soils, topography, land use, weather, etc. If revisiting a site, indicate any obvious changes to the habitat.

DISTURBANCES/THREATS: Include human and/or natural disturbances and threats to the species at this site.

SPECIES DATA: Fill out as much of the following as you can - include anything else you feel is of importance.

♣Give general description of what you saw (*i.e.: found scat, heard song, animal crossing road, found plant in bog..*)

♣Count or estimate the number of plants / animals you observed & estimate the size of the area they occupy.

♣Age and condition of individual(s) (*i.e.: fresh adult butterfly; healthy mature plants - 50% flowering and with immature fruit...*)

♣Behavior (*animals*) (*i.e.: nectaring insect, breeding birds, turtle basking...*)

♣If revisiting this site, compare the heath and size of the population to previous visits.

♣Confidence level on Identification: ID Positive ID Somewhat Uncertain ID Unknown

♣Voucher specimen or photo taken? (*Please include if possible*)

♣Additional information:

APPENDIX IV: COMMUNITY CLASSIFICATION

LANCASTER COUNTY NATURAL COMMUNITY DEFINITIONS

Quality Rankings:
Patches of potential natural habitat were ranked from 3 (highest) to 0 (lowest) based on interpretation of 2005 aerial Ortho photos and ground truthing of representative habitat blocks.
Each distinctive community patch was given a community type name.

Rank:
3 - Natural Communities identified as Fike (1999) Natural Communities.
2 - Fike type Natural Communities modified with negative attributes in the comments field, such as "looks weedy", "highgraded", or "may be modified successional forest".
Ranks of 1 & 0 were assigned to other habitat types as described below.

Community names beginning with a <u>C</u>apital letter are Fike (1999) natural community types:

- Example: "Hemlock (white pine)-northern hardwood forest", "Silver maple floodplain forest". (Fike addresses primarily mature forest types or late successional "natural" community types rather than highly human-modified types)

Any habitat patches with <u>all lower case letters</u> are essentially cover types without a community type associated with it.

- Example: "modified successional forest", "conifer plantation"

Other designations:

2 - stream course-open flowing water body large enough to distinguish within another polygon

2 - shrub wetland-area of wetland dominated by shrubs but not a type described in the Fike classification; probably dominated by weedy species

2 - shrub-emergent wetland – mixed wetland type but not described in the Fike classification; probably dominated by weedy species

1 - grass/conifer plantation – conifer plantation that has been thinned or trees have more space between them and grasses and forbs are evident

1 - conifer plantation – any plantation within a larger polygon or contiguous with a larger area/polygon that is obviously planted to conifers or appears to be planted. This may include some nurseries or Christmas tree farms

1 - grass-shrubland – grass and shrubs appear co-dominant, disturbance type often under powerlines

1 - juniper woodland - red cedar dominate, abandoned field usually

1 - juniper-grass woodland – red cedar and grasses appear to be co-dominant, abandoned field or transmission line

1 - juniper-hardwood forest - trees mature enough to call "forest" but probably abandoned field

1 - juniper-hardwood woodland- area co-dominated by red cedar and hardwood species, abandoned field or transmission line right-of-way

1 - juniper-mixed shrub woodland - codominated by red cedar and shrubs (likely invasive species), abandoned field or transmission line

1 - modified successional forest - any early-successional forest or woodland that appears to be dominated by exotic plant species such as multiflora rose or a variety of honeysuckles in the understory or black locust, tree-of-heaven in the overstory

1, 3 - open water - ponds or streams that are large enough to delineate. Ponds may be natural (oxbows) (3); or artificial/manmade and either dammed or dug (1)

1 - pasture – grassland that is used for grazing animals

1 - shrubland – area dominated by shrubs; most appear to be exotics like multflora rose or perhaps various raspberries or blackberry. These areas often are abandoned fields or transmission line right-of-ways

1 - wet meadow - wetland that appears to be dominated by invasive species or disturbed in some other way rather than the Fike "Wet Meadow"

0 - bare soil – usually the result of human-caused disturbance and may be the result of scraping/earth-moving or deposition

0 - communications tower-disturbance that was not easily removed from polygon

0 - quarry – mining operation for stone or gravel with open pit and surrounding disturbance

0 - residential – one or more houses with lawns and outbuildings

0 - park – obvious recreation area within larger core area

0 - fencerow/agriculture–narrow shrubby or treed border between agricultural fields

0 - golf course

0 - grassland - upland area dominated by graminoid species. These may be lawns, meadows, pasture or hayed fields but not easily called one or another

0 - grassland/hayfield/agriculture, grassland where mowing is evident on the imagery (these areas may be cultivated at times)

0 - nursery/plantation – obvious rows of shrubs or trees but not a conifer plantation

0 - industrial - area of buildings or other disturbance associated with industry

APPENDIX V: CLASSIFICATION OF NATURAL COMMUNITIES IN PENNSYLVANIA

Terrestrial & Palustrine Plant Communities of Pennsylvania (Fike 1999) is the most current community classification system for Pennsylvania's palustrine and terrestrial plant communities. This report was developed by the Pennsylvania Natural Heritage Program to update and refine Smith's 1991 report *Classification of natural communities in Pennsylvania (draft),* the first effort dedicated specifically to the classification of natural communities in the state. Work is ongoing to improve the current classification system. Future editions may define new community types or alter currently defined types. Aquatic communities (lakes, streams, and rivers), communities where vegetation is absent or not a definitive characteristic (caves, scree slopes), and communities resulting from extensive human disturbance (old agricultural fields, manmade wetlands, etc.), are not addressed in this classification. Until more extensive work can be completed to define these types of communities and incorporate them into a single statewide framework, the County Natural Heritage Inventory reports will provisionally refer to features of ecological interest that fall outside the Fike 1999 system using categories described in Smith 1991.

Community Ranks

As with species that are of concern, ranks have been assigned to rate the rarity of each natural community type identified for Pennsylvania. Appendix VI lists criteria for global and state ranks. In most cases, the global extent of these communities has yet to be fully evaluated, and no global rarity rank has been assigned. Work is ongoing to refine these ranks and to further develop the ranking system to rate the relative quality of communities within a type.

Community Name (Fike 1999)	**State Rank**
Terrestrial Forests	
CONIFEROUS TERRESTRIAL FORESTS:	
Hemlock (white pine) forest	S4
CONIFER – BROADLEAF TERRESTRIAL FORESTS	
Serpentine pitch pine - oak forest	S1
Serpentine Virginia pine - oak forest	S1
Pitch pine - mixed oak forest	S4
Virginia pine - mixed hardwood forest	S5
Dry white pine (hemlock) - oak forest	S4
Hemlock (white pine) -northern hardwood forest	S5
Hemlock (white pine) - red oak - mixed hardwood forest	S4
Hemlock - tuliptree - birch forest	S4
Rich hemlock - mesic hardwoods forest	S2S3
BROADLEAF TERRESTRIAL FORESTS	
Dry oak-heath forest	S4S5
Dry oak-mixed hardwood forest	S3
Red oak - mixed hardwood forest	S5
Northern hardwood forest	S4
Black cherry - northern hardwood forest	S4
Tuliptree- beech -maple forest	S4
Sugar maple - basswood	S4
Mixed mesophytic forest	S1S2
Sweet gum - oak coastal plain forest	S1
Red maple (terrestrial) forest	S5
Black-gum Ridgetop Forest	S3
Aspen/gray (paper) birch forest	S3 NOT TRACKED
Palustrine Forests	
CONIFEROUS PALUSTRINE FORESTS	
Black spruce - tamarack peatland forest	S3
Red spruce palustrine forest	S3
Hemlock palustrine forest	S3
CONIFER – BROADLEAF PALUSTRINE FORESTS	

Community Name (Fike 1999)	**State Rank**
Hemlock - mixed hardwood palustrine forest	S3S4
Red spruce - mixed hardwood palustrine forest	S3
BROADLEAF PALUSTRINE FORESTS	
Bottomland oak - hardwood palustrine forest	S2
Red maple - black-gum palustrine forest	S3S4
Red maple - black ash palustrine forest	S2S3
Red maple - magnolia Coastal Plain palustrine forest	S1
Great Lakes Region lakeplain palustrine forest	S1
Sycamore - (river birch) - box-elder floodplain forest	S3
Silver maple floodplain forest	S3
Red maple - elm - willow floodplain swamp	S2
Terrestrial Woodlands	
CONIFEROUS WOODLANDS	
Pitch pine - heath woodland	S2
Pitch pine - scrub oak woodland	S2S3
Red spruce rocky summit	S1
Pitch pine - rhodora - scrub oak woodland	S1
CONIFER – BROADLEAF TERRESTRIAL WOODLANDS	
Pitch pine - mixed hardwood woodland	S2S3
Virginia pine - mixed hardwood shale woodland	S2
Red-cedar - mixed hardwood rich shale woodland	S1S2
BROADLEAF – TERRESTRIAL WOODLANDS	
Dry oak - heath woodland	S3
Birch (black-gum) rocky slope woodland	S2
Yellow oak - redbud woodland	S2
Great Lakes Region scarp woodland	S1S2
Great Lakes Region bayberry - cottonwood community	S1
Palustrine Woodlands	
CONIFEROUS PALUSTRINE WOODLANDS	
Pitch pine - leatherleaf palustrine woodland	S1
Black spruce - tamarack palustrine woodland	S2
Red spruce palustrine woodland	S2S3
BROADLEAF PALUSTRINE WOODLANDS	
Red maple - highbush blueberry palustrine woodland	S4
Red maple - sedge palustrine woodland	S4
Red maple - mixed shrub palustrine woodland	S4
Terrestrial Shrublands	
CONIFEROUS TERRESTRIAL SHRUBLANDS	
Red-cedar - prickly pear shale shrubland	S2
Red-cedar - pine serpentine shrubland	S1
CONIFER – BROADLEAF TERRESTRIAL SHRUBLANDS	
Red-cedar - redbud shrubland	S2
BROADLEAF TERRESTRIAL SHRUBLANDS	
Low heath shrubland	S1
Low heath - mountain ash shrubland	S2
Scrub oak shrubland	S3
Rhodora - mixed heath - scrub oak shrubland	S1
Palustrine Shrublands	
BROADLEAF PALUSTRINE SHRUBLANDS	
Buttonbush wetland	S4

Community Name (Fike 1999)	**State Rank**
Alder - ninebark wetland	S3
Alder - sphagnum wetland	S4
Highbush blueberry - meadow-sweet wetland	S5
Highbush blueberry - sphagnum wetland	S5
Leatherleaf - sedge wetland	S3
Leatherleaf - bog rosemary peatland	S2
Leatherleaf -cranberry peatland	S2S3
Water-willow (Decodon verticillatus) shrub wetland	S3
River birch - sycamore floodplain scrub	S4
Black willow scrub/shrub wetland	S4
Poison sumac - red-cedar - bayberry fen	S1
Buckthorn - sedge (Carex interior) - golden ragwort fen	S1
Great Lakes Region scarp seep	S1
Great Lakes Region bayberry - mixed shrub palustrine shrubland	S1
Terrestrial Herbaceous Openings	
Little bluestem - Pennsylvania sedge opening	S2
Side-oats gramma calcareous grassland	S1
Calcareous opening/cliff	S2
Serpentine grassland	S1
Serpentine gravel forb community	S1
Great Lakes Region dry sandplain	S1
Great Lakes Region sparsely vegetated beach	S1
Herbaceous Wetlands	
PERSISTENT EMERGENT WETLANDS	
Bluejoint - reed canary grass marsh	S5
Cattail marsh	S5
Tussock sedge marsh	S3
Mixed forb marsh	S3
Herbaceous vernal pool	S3S4
Wet meadow	S5 NOT TRACKED
Bulrush marsh	S3
Great Lakes Region palustrine sandplain	S1
Prairie sedge - spotted joe-pye-weed marsh	S1S2
Open sedge (Carex stricta, C. prairea, C. lacustris) fen	S1
Golden saxifrage - sedge rich seep	S2
Skunk cabbage - golden saxifrage forest seep	S4S5
Serpentine seepage wetland	S1
Golden saxifrage - Pennsylvania bitter-cress spring run	S3S4
Sphagnum - beaked rush peatland	S3
Many fruited sedge - bladderwort peatland	S2
Water-willow (Justicia americana)- smartweed riverbed community	S4
Riverside ice scour community	S1S2
Big bluestem - Indian grass river grassland	S3
NON-PERSISTENT EMERGENT WETLANDS	
Pickerel-weed - arrow-arum - arrowhead wetland	S4
Spatterdock - water lily wetland	S4

Community Complexes

ACIDIC GLACIAL PEATLAND COMPLEX

GREAT LAKES REGION SCARP COMPLEX

ERIE LAKESHORE BEACH - DUNE - SANDPLAIN COMPLEX

MESIC TILL BARRENS COMPLEX
SERPENTINE BARRENS COMPLEX
RIDGETOP ACIDIC BARRENS COMPLEX
RIVER BED - BANK - FLOODPLAIN COMPLEX

Community Name (**Smith 1991**)	**State Rank**
SUBTERRANEAN COMMUNITIES	
Solution Cave Terrestrial Community	S3
Solution Cave Aquatic Community	S3
Tectonic Cave Community	S3S4
Talus Cave Community	S2S4
DISTURBED COMMUNITIES	
Bare Soil	N/A
Meadow/Pastureland	N/A
Cultivated Land	N/A
Successional Field	N/A
Young Miscellaneous Forest	N/A
Conifer Plantation	N/A
ESTUARINE COMMUNITIES:	
Deepwater Subtidal Community	S1
Shallow-Water Subtidal Community	S1
Freshwater Intertidal Mudflat	S1
Freshwater Intertidal Marsh	S1
RIVERINE COMMUNITIES:	
Low-Gradient Ephemeral/Intermittent Creek	S5
Low-Gradient Clearwater Creek	S3S4
Low-Gradient Clearwater River	S2S3
Low-Gradient Brownwater Creek	S2S3
Medium-Gradient Ephemeral/Intermittent Creek	S5
Medium-Gradient Clearwater Creek	S3
Medium-Gradient Clearwater River	S?
Medium-Gradient Brownwater Creek	S3
High-Gradient Ephemeral /Intermittent Creek	S5
High-Gradient Clearwater Creek	S3
High-Gradient Clearwater River	S?
High-Gradient Brownwater Creek	S?
Waterfall and Plungepool	S3S4
Spring Community	S1S2
Spring Run Community	S1S2
LACUSTRINE COMMUNITIES:	
Glacial Lake	S1
Nonglacial Lake	S2
Artificial Lake	N/A
Natural Pond	S2S3
Artificial Pond	N/A
Stable Natural Pool	S?
Ephemeral/Fluctuating Natural Pool	S1
Artificial Pool	N/A
Ephemeral/Fluctuating Limestone Sinkhole	S1

APPENDIX VI : PA NOXIOUS WEED AND AQUATIC NUISANCE SPECIES LISTS

Legal Reference: Pennsylvania Noxious Weed Control List

IT IS ILLEGAL TO PROPAGATE, SELL OR TRANSPORT THE FOLLOWING WEEDS IN THE COMMONWEALTH

1. **Cannabis sativa**, commonly known as Marijuana
2. **Cirsium arvense**, commonly known as Canadian thistle
3. **Rosa multiflora**, commonly known as Multiflora rose
4. **Sorghum halepense**, commonly known as Johnson grass
5. **Polygonum perfoliatum**, commonly known as Mile-a-minute
6. **Pueraria lobata**, commonly known as Kudzu-vine
7. **Cirsium vulgare**, commonly known as Bull or Spear Thistle
8. **Carduus nutans**, commonly known as Musk or Nodding Thistle
9. **Sorghum bicolor**, commonly known as Shattercane
10. **Datura stramonium**, commonly known as Jimsonweed
11. **Lythrum salicaria**, commonly known as Purple Loosestrife, including all cultivars
12. **Heracleum mantegazzianum**, commonly known as Giant Hogweed
13. **Galega officinalis**, commonly known as Goatsrue

(Amended November 18, 2000)

- The first four weeds were included in the Pennsylvania Noxious Weed Control Act in 1982-74.
- Weeds numbered 5-10 were added by regulations on May 20, 1989.
- Purple loosestrife was added by regulations on April 12, 1997.
- Purple loosestrife cultivars, Giant hogweed and Goatsrue were added by regulations on November 18, 2000.

http://www.agriculture.state.pa.us >noxious weed law, accessed April 18, 2007

Pennsylvania Fish and Boat Commission Regulations

Aquatic Nuisance Species (ANS)



Aquatic nuisance species are aquatic animals and plants that have been introduced into waterways in which they do not live naturally. They have harmful effects on the natural resources in these ecosystems and the human uses of these resources.

Some of the least-wanted ANS in Pennsylvania are European ruffe, sea lamprey, hydrilla, spiny water flea, purple loosestrife, Eurasian watermilfoil, Asian clam, and red-eared slider (turtle). In 2004, Northern snakehead were first found in Pennsylvania waters.

It's not always "foreign invaders" that are the problem. White perch and flathead catfish are other examples of species that have turned up where they don't belong. While native to some PA watersheds, they have been introduced to other areas.

Aquatic species banned in Pennsylvania (sale, barter, possession or transportation)

Bighead carp (*Hypophtalmichtys nobilis*)
Black carp (*Mylopharyngodon piceus)*
European rudd (*Scardinius erythropthalmus*)
Quagga mussel (*Dreissena bugensis*)
Snakehead (all species)
Round goby (*Neogobius melanostomus*)
Ruffe (*Gymnocephalus cernuus*)
Rusty crayfish (*Orconectes rusticus*)
Silver carp (*Hypophtalmichtys molitrix*)
Tubenose goby (*Proterothinus marmoratus*)
Zebra mussel (*Dreissena polymorpha*)

DEFINITIONS

- ***Biodiversity*** -- The variety of species, their genetic makeup, and the natural communities in which they occur.
- ***Introduced species*** -- A species living outside of its natural geographic range. Can be deliberately or accidentally introduced or brought into the new ecosystem. Also called *exotic*, *non-native*, *nuisance or invasive species*.
- ***Invasive*** -- Spreading or taking over. Invasive species often take over or dominate a habitat.
- ***Native*** -- An animal or plant originating in a region or geographic range. For example, brook trout are native to Pennsylvania.

STOP the spread of ANS

- When retrieving your boat for the day, check the boat, motor and trailer for weeds and other things "tagging along."
- Wash your boat's hull with hot water or with a high-pressure spray.
- Drain livewells, bilges and other compartments.
- Drain all standing water from your boat.
- Don't dump leftover bait into the water you're fishing, unless you collected the bait there.

http://sites.state.pa.us/PA_Exec/Fish_Boat/ans.htm, accessed April 18, 2007.

APPENDIX VII: SUSTAINABLE FORESTRY INFORMATION SOURCES

The ***Pennsylvania Forest Stewardship Program*** is a voluntary program that assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. Participation in the program is open to private landowners who own between 5 and 1,000 acres of forestland. Visit **http://www.cas.psu.edu/docs/CASDEPT/FOREST/Stewardship/1page.html** for more information or contact:

Jim Finley, Assistant Director for Extension
The Pennsylvania State University
School of Forest Resources
7 Ferguson Building
University Park, PA 16802
814- 863-0401; E-mail: fj4@psu.edu

The ***Forest Land Enhancement Program*** complements the Forest Stewardship Program by providing landowners with cost-share dollars to implement their management plans and follow-up technical assistance to encourage the achievement of their long-term forest management goals. For more information, contact:

Jim Stiehler, Forest Stewardship Coordinator
DCNR - Bureau of Forestry
6th Floor, Rachel Carson State Office Building
P.O. Box 8552
Harrisburg, PA 17105-8552
717-787-4777

The ***Forest Legacy Program*** acts to purchase conservation easements or title from willing private landowners. In this program, federal funding is administered through the state Bureau of Forestry to foster protection and continued use of forested lands that are threatened with conversion to non-forest uses. Emphasis is given to lands of regional or national significance. For more information, go to http://www.fs.fed.us/spf/coop/programs/loa/flep.shtml or contact:

Gene Odato, Chief, Rural & Community Forestry Station
DCNR – Bureau of Forestry
6th Floor, Rachel Carson State Office Building
P.O. Box 8552
Harrisburg, PA 17105-8552
717-787-6460; E-mail: godato@state.pa.us

The ***Sustainable Forestry Initiative*** (SFI) program is a voluntary, industry-driven effort developed to ensure that future generations will have the same abundant, healthy, and productive resources we enjoy today. Created in 1995 by the American Forest and Paper Association (the national trade organization representing the United States forest products industry), SFI is a program of comprehensive forestry and conservation practices. Through the SFI of PA program, landowners receive the information they need to enhance their ability to make good forest management decisions, and loggers learn safer, more productive skills and proper environmental practices. For more information, go to http://www.sfiofpa.org/ or contact:

SFI® of PA
315 S. Allen Street, Suite 418
State College, PA 16801
814-867-9299 or 888- 734-9366; E-mail: sfi@penn.com

The ***Forest Stewardship Volunteer Initiative Project*** has an excellent Web site providing general information and links to publications on sustainable forestry.
http://vip.cas.psu.edu/index.html

APPENDIX VIII: PLANTS, ANIMALS AND NATURAL COMMUNITIES OF SPECIAL CONCERN IN LANCASTER COUNTY

Common Name	*Scientific Name*	GRANK	SRANK
Birds			
Great Blue Heron	*Ardea herodias*	G5	S3S4B,S4N
Long-eared Owl	*Asio otus*	G5	S2B,S2S3N
Bald Eagle	*Haliaeetus leucocephalus*	G5	S2B
Yellow-crowned Night-heron	*Nyctanassa violacea*	G5	S1B
Black-crowned Night-heron	*Nycticorax nycticorax*	G5	S2S3B
Osprey	*Pandion haliaetus*	G5	S2B
Prothonotary Warbler	*Protonotaria citrea*	G5	S2S3B
Virginia Rail	*Rallus limicola*	G5	S3B
Barn-owl	*Tyto alba*	G5	S3B,S3N
Reptiles			
Broadhead Skink	*Eumeces laticeps*	G5	S1
Bog Turtle	*Glyptemys muhlenbergii*	G3	S2
Rough Green Snake	*Opheodrys aestivus*	G5	S1
Red-bellied Turtle	*Pseudemys rubriventris*	G5	S2
Invertebrates			
Cave Invertebrates			
Price's Cave Isopod	*Caecidotea pricei*	G5	S2S3
Refton Cave Planarian	*Sphalloplana pricei*	G2G3	S1
Pizzini's Cave Amphipod	*Stygobromus pizzinii*	G3G4	S1
Butterflies			
Common Roadside-skipper	*Amblyscirtes vialis*	G5	S2S4
Falcate Orangetip	*Anthocharis midea*	G4G5	S3
Dusted Skipper	*Atrytonopsis hianna*	G4G5	S2S3
Juniper Hairstreak	*Callophrys gryneus*	G5	S2S4
Frosted Elfin	*Callophrys irus*	G3	S1S2
Red-banded Hairstreak	*Calycopis cecrops*	G5	S4
Mottled Duskywing	*Erynnis martialis*	G3G4	SH
Leonard's Skipper	*Hesperia leonardus*	G4	S3S4
Cobweb Skipper	*Hesperia metea*	G4G5	S2S3
Bronze Copper	*Lycaena hyllus*	G5	SU
Moths			
Spiny Oakworm Moth	*Anisota stigma*	G5	S1S2
A Geometer Moth	*Apodrepanulatrix liberaria*	G4	S3
Dot-lined White Moth	*Artace cribraria*	G5	S1
Tawny Emperor	*Asterocampa clyton*	G5	S3S4
Packard's Lichen Moth	*Cisthene packardii*	G5	S1S3
Lead Colored Lichen Moth	*Cisthene plumbea*	G5	S1
Regal Moth	*Citheronia regalis*	G4G5	SU
Pure Lichen Moth	*Crambidia pura*	G4	SU
A Moth	*Elaphria cornutinis*	G5	SU
Broad-lined Erastria Moth	*Erastria coloraria*	G4	S1
Barrens Buckmoth	*Hemileuca maia*	G5	S1S2
A Moth	*Idaea eremiata*	G4	S1
A Wave Moth	*Idaea violacearia*	G4	S1
Black-waved Flannel Moth	*Lagoa crispata*	G5	S1
Footpath Sallow Moth	*Metaxaglaea semitaria*	G5	S2
A Moth	*Panthea sp. 1*	G4	SU
A Moth	*Papaipema pterisii*	G5	SNR
A Moth	*Parahypenodes quadralis*	G4	SU

A Moth	*Renia sp. 1 nr. discoloralis*	G4	S1?
A Noctuid Moth	*Richia acclivis*	G4G5	S1S2
A Moth	*Sutyna privata teltowa*	G5T4	S1
Tolype Moth	*Tolype notialis*	G4G5	S1
Southern Variable Dart Moth	*Xestia elimata*	G5	S2S3
A Zale Moth	*Zale curema*	G3G4	S1
Oblique Zale Moth	*Zale obliqua*	G5	S1
A Moth	*Zale squamularis*	G4	S2S3
A Zale Moth	*Zale submediana*	G4	S2
Pine Barrens Zanclognatha	*Zanclognatha martha*	G4	S1S2
Dragonflies			
Russet-tipped Clubtail	*Stylurus plagiatus*	G5	S1
Freshwater Mussels			
Triangle Floater	*Alasmidonta undulata*	G4	S3S4
Elktoe	*Alasmidonta marginata*	G4	S4
Yellow Lampmussel	*Lampsilis cariosa*	G3G4	S3S4
Eastern Lampmussel	*Lampsilis radiata*	G5	S1
Green Floater	*Lasmigona subviridis*	G3	S2
Plants			
Colic-root	*Aletris farinosa*	G5	S1
Scarlet Ammannia	*Ammannia coccinea*	G5	S2
Bushy Bluestem	*Andropogon glomeratus*	G5	S3
Puttyroot	*Aplectrum hyemale*	G5	S3
Arrow-feathered Three Awned	*Aristida purpurascens*	G5	S2
Bradley's Spleenwort	*Asplenium bradleyi*	G4	S1
Lobed Spleenwort	*Asplenium pinnatifidum*	G4	S3
Aster-like Boltonia	*Boltonia asteroides*	G5	S1
Bull Sedge	*Carex bullata*	G5	S1
Mead's Sedge	*Carex meadii*	G4G5	S1
Sedge	*Carex shortiana*	G5	S3
A Sedge	*Carex tetanica*	G4G5	S2
Serpentine Chickweed	*Cerastium arvense var. villosissimum*	G5T1Q	S1
Wild Oat	*Chasmanthium latifolium*	G5	S1
Fringe-tree	*Chionanthus virginicus*	G5	S3
Maryland Golden-aster	*Chrysopsis mariana*	G5	S1
Twig Rush	*Cladium mariscoides*	G5	S2
Smooth Swallow-wort	*Cynanchum laeve*	G5	SU
Reflexed Flatsedge	*Cyperus refractus*	G5	S1
Nuttalls' Tick-trefoil	*Desmodium nuttallii*	G5	S2
Jeweled Shooting-star	*Dodecatheon radicatum*	GNR	S2
Clinton's Wood Fern	*Dryopteris clintoniana*	G5	S2
Flat-stemmed Spike-rush	*Eleocharis compressa*	G4	S1
Elephant's Foot	*Elephantopus carolinianus*	G5	S1
Ellisia	*Ellisia nyctelea*	G5	S2
Harbinger-of-spring	*Erigenia bulbosa*	G5	S2
Vasey's Eupatorium	*Eupatorium godfreyanum*	G4	S2
Glade Spurge	*Euphorbia purpurea*	G3	S1
Rough-leaved Aster	*Eurybia radula*	G5	S2
Annual Fimbry	*Fimbristylis annua*	G5	S2
Striped Gentian	*Gentiana villosa*	G4	S1
Bicknell’s Hoary Rockrose	*Helianthemum bicknellii*	G5	S1
St Andrew's-cross	*Hypericum stragulum*	G5	S2
American Holly	*Ilex opaca*	G5	S2
Quillwort	*Isoetes valida*	G4?	SU

Forked Rush	*Juncus dichotomus*	G5	S1
Torrey's Rush	*Juncus torreyi*	G5	S2
Swamp Dog-hobble	*Leucothoe racemosa*	G5	S2S3
Grooved Yellow Flax	*Linum sulcatum*	G5	S1
Common Hemicarpa	*Lipocarpha micrantha*	G5	S1
Upright Primrose-willow	*Ludwigia decurrens*	G5	S1
False Loosestrife Seedbox	*Ludwigia polycarpa*	G4	S1
Southern Bog Clubmoss	*Lycopodiella appressa*	G5	S2
Umbrella Magnolia	*Magnolia tripetala*	G5	S2
Sweet Bay Magnolia	*Magnolia virginiana*	G5	S2
Oblique Milkvine	*Matelea obliqua*	G4?	S1
Three-flowered Melic-grass	*Melica nitens*	G5	S2
Prickly-pear Cactus	*Opuntia humifusa*	G5	S3
Stiff Cowbane	*Oxypolis rigidior*	G5	S2
Shining Panic-grass	*Panicum lucidum*	GNR	S1
Swamp Lousewort	*Pedicularis lanceolata*	G5	S1S2
Round-leaved Fame-flower	*Phemeranthus teretifolius*	G4	S2
Carolina Leaf-flower	*Phyllanthus caroliniensis*	G5	S1
Yellow-fringed Orchid	*Platanthera ciliaris*	G5	S2
Bog Bluegrass	*Poa paludigena*	G3	S3
Leaf-cup	*Polymnia uvedalia*	G4G5	SNR
Tooth-cup	*Rotala ramosior*	G5	S3
Limestone Petunia	*Ruellia strepens*	G4G5	S2
River Bulrush	*Schoenoplectus fluviatilis*	G5	S3
Few Flowered Nutrush	*Scleria pauciflora*	G5	S2
Plain Ragwort	*Senecio anonymus*	G5	S2
Sida	*Sida hermaphrodita*	G3	S2
Sticky Golden-rod	*Solidago simplex ssp. randii var. racemosa*	G5T3?	S1
Prairie Dropseed	*Sporobolus heterolepis*	G5	S1
Serpentine Aster	*Symphyotrichum depauperatum*	G2	S2
Cranefly Orchid	*Tipularia discolor*	G4G5	S3
Nodding Trillium	*Trillium cernuum*	G5	S3
Susquehanna Trillium	*Trillium sp.*	G5	S2
Eastern Gamma-grass	*Tripsacum dactyloides*	G5	S1
Tawny Ironweed	*Vernonia glauca*	G5	S1
Possum-haw	*Viburnum nudum*	G5	S1
Appalachian Gametophyte Fern	*Vittaria appalachiana*	G4	S2
Netted Chainfern	*Woodwardia areolata*	G5	S2
Exemplary Natural Communities			
Eastern Serpentine Barrens	*Eastern serpentine barrens*	G2	S2
Mesic Central Forest	*Mesic central forest*	GNR	S2
Northern Appalachian Acidic Cliff Community	*Northern appalachian acidic cliff community*	G5	S5
Riverside Outcrop Community	*Riverside outcrop community*	GNR	S1S2
Solution Cave Aquatic Community	*Solution cave aquatic community*	GNR	S3

APPENDIX IX: SELECTED FACT SHEETS FOR SPECIES OF CONCERN IN LANCASTER COUNTY

Colic-root
Aletris farinosa

Description
Colic-root is a perennial herb that grows from 1½ to 3 feet (0.5-1 m) in height. The leaves are narrow, lance-shaped, ca 2 to 7 inches (5-18 cm) long, parallel veined, and mostly clustered at the base of the plant. The flowers, appearing from May to July, are relatively and numerous on the middle and upper part of the stem. The individual flowers are whitish, ¼ to 3/8 inch (6-10 mm) long, with six petal-like lobes that have a rough texture, and which persist after blooming time and enclose the capsular fruit.

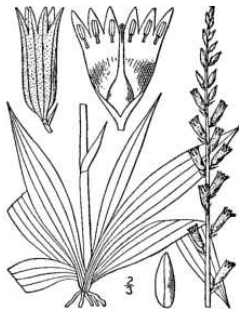
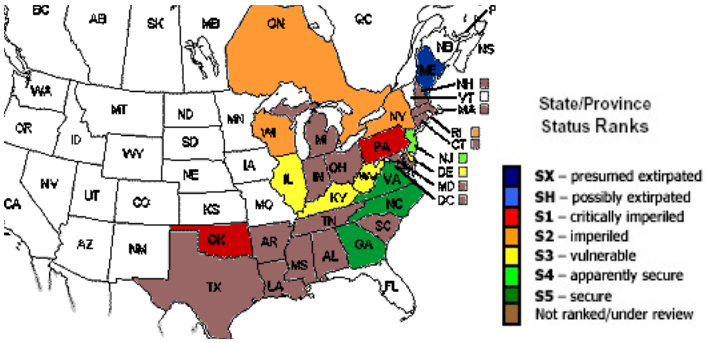


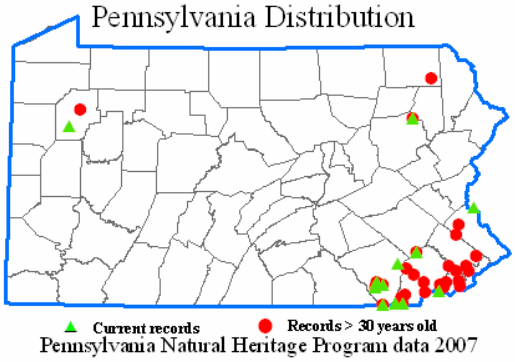
Photo source: USDA-NRCS PLANTS Database

Distribution & Habitat
Colic-root has a wide range in eastern North America, from Maine west into Wisconsin and south into Texas and the Gulf Coast states. In Pennsylvania, it occurs primarily in the southeastern counties. The species grows in a variety of habitats, including clearings and openings, thickets, open woods, serpentine barrens, and wetlands, especially on sandy or peaty substrates.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers colic-root to be a species of special concern, based on the very few occurrences that have been recently confirmed and its apparent decline in numbers from historical levels. It has a PA legal rarity status of Undetermined, but has been assigned a suggested rarity status of Endangered by PABS. Fewer than 10 populations, mostly with few individuals, are currently known from the state.



Conservation Considerations
The remaining populations of colic-root in the state are threatened by human-related habitat loss, natural succession, invasive species, and collection by gardeners and herbal medicine enthusiasts. Given the preference of the species for open habitats, active management - such as fire, mowing, or invasive species removal - is often required to maintain the proper successional stage at sites where it grows.

NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

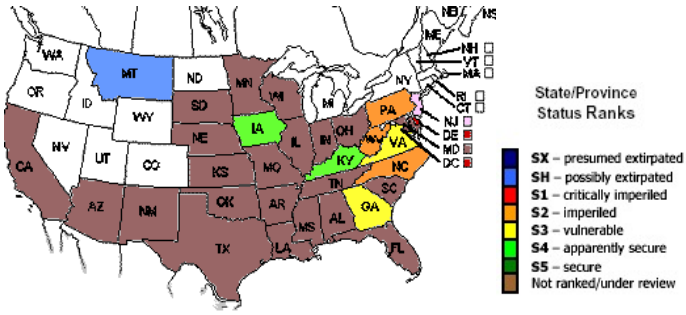
Scarlet Ammannia
Ammannia coccinea

Description
Scarlet ammannia is an erect or spreading, sometimes branched, annual herb with stems to 2 feet high. The leaves are opposite, stalkless, lance-shaped or linear, to 2½ inches long, and pointed at the tip. The flowers, appearing from July to September, occur in small clusters that are subtended by the upper leaves. The individual flowers are small and inconspicuous, and have 4 deep-pink petals. The fruit is a many-seeded capsule.


Photo source: R. Harrison Wiegand

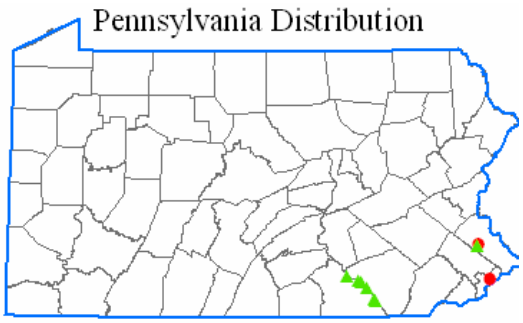
Distribution & Habitat
Scarlet ammannia has a wide range in North America. In Pennsylvania, it has been documented historically mostly in the southeastern counties, particularly along the lower Susquehanna River. Scarlet ammannia grows in various damp to wet habitats, especially on the shorelines of rivers, streams, and ponds, and may also be found in human-created disturbances that simulate natural habitats.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers scarlet ammannia to be a species of special concern, based on the few occurrences that have been recently confirmed. It has a PA legal rarity status of Endangered and has been assigned a suggested rarity status of Threatened by PABS. Fewer than 10 populations, mostly along the lower Susquehanna River, are currently known from the state.

Conservation Considerations
The viability of populations of scarlet ammannia and its habitat depends on maintaining the natural hydrology and natural condition of the shoreline and islands of the Susquehanna River. This species appears well-adapted to the seasonal fluctuations in water levels, especially the lower water levels of summer and fall when the plant is flowering and fruiting. Invasive species represent a threat to scarlet ammannia and its shoreline habitat.



NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.B. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

Bushy Bluestem
Andropogon glomeratus

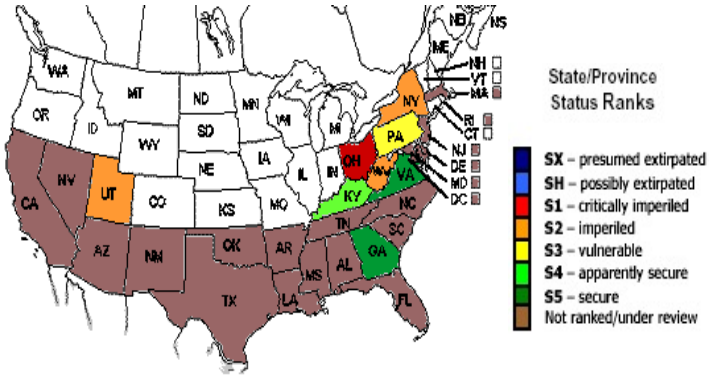
Description
Bushy bluestem is an erect, tufted perennial grass that may grow to 3 feet (1 m) tall. The leaves have narrow, elongate blades approximately 3/8 of an inch (3-6 mm) wide, and tend to turn copper to orange in the fall. The individual flowers are minute and are grouped in small spikelets that are surrounded by fluffy, gray-white bristles. Numerous groupings of the spikelets are aggregated together to form a bushy terminal cluster, which give the plant its name.



Photo source: PNHP

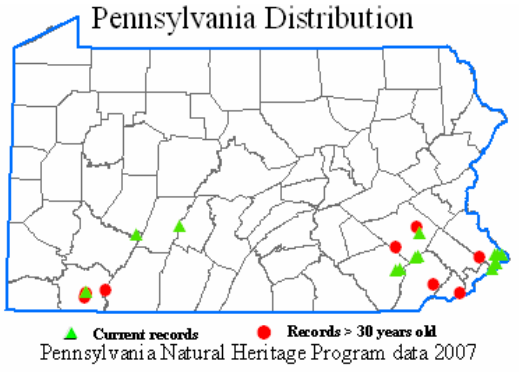
Distribution & Habitat
Bushy bluestem has a range across the continent in the southern states, with an extension northeastward into southern New England. In Pennsylvania, it has been documented historically in scattered locations, particularly in the southern counties. The bushy bluestem grows in a variety of damp to wet open places, clearings, and sometimes in human-created disturbed ground.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers bushy bluestem to be a species of special concern, based on the few occurrences that have been recently confirmed. It has a PA legal rarity status of Undetermined and has been assigned a suggested rarity status of Rare by PABS. About 15 populations are currently known from the state.

Conservation Considerations
The populations of bushy bluestem in the state are threatened by human-related habitat loss, natural succession, invasive species, and the indiscriminate spraying of herbicides. Given the preference of the species for open habitats, active management – such as fire, mowing, or invasive species removal – is often required to maintain the proper successional stage at sites where it grows.



NatureServe conservation status ranks
G5 – Globally secure; **S3** – Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Puttyroot
Aplectrum hyemale

Description
Puttyroot is a perennial herbaceous plant, arising from a roundish rootstock containing a mucilaginous substance that gives the plant its name. Each rootstock produces a single leaf at ground level in autumn. The leaf, which is easily recognized by its elliptical shape, wrinkled texture and whitish veins, remains evergreen over the winter, withers in late spring, and is replaced by a new leaf in autumn. The flowers, appearing in May and June, are clustered at the top of an erect leafless stalk that may reach 2 feet (6 dm) in height. The individual flowers are variously marked with purple, brown, white, and yellow. The fruit is a capsule that hangs downward and often persists over the winter.

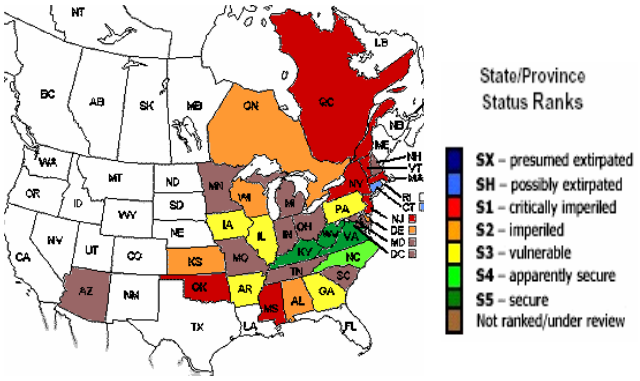

Photo source: Jack Ray and Sally Ray (PNHP)

Distribution & Habitat
Puttyroot has a range from southern New England south and west into Arizona and the Gulf Coast states. In Pennsylvania, it has been documented historically

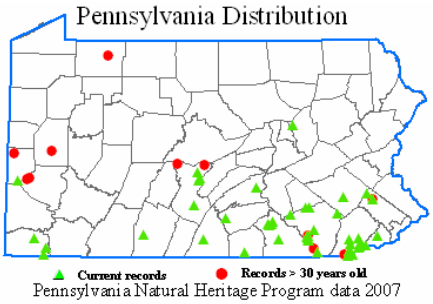
in numerous southern, particularly southeastern, counties. It grows in moist woodlands and on forested slopes and streambanks.



North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers puttyroot to be a species of special concern, based on the relatively few occurrences that have been recently documented. It has a PA legal rarity status and a PABS suggested rarity status of Rare. About 40 populations are currently known from the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The known populations of puttyroot have threats from habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

NatureServe conservation status ranks
G5 – Secure globally; S3– Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Arrow-feather, Three-awn
Aristida purpurascens

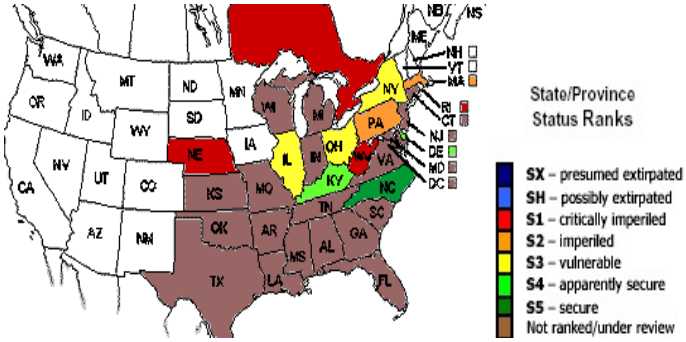
Description
Arrow-feather is a slender perennial grass that grows from 16 to 30 inches (4-7 dm) high. The leaves are linear, elongate, less than 1/8 inch (1-2 mm) wide and 4 inches (10 cm) long. The individual flowers are in spikelets, with their most conspicuous feature being 3 hair-like projections, or awns, that are ½ to 1 inch (1.5 to 2.5 cm) long, protrude from the top of the spikelet, and are oriented more-or-less perpendicular to the spikelet. The overall cluster of spikelets, located on the middle and upper stem, has a bristly appearance due to these awns.



Photo source: PNHP

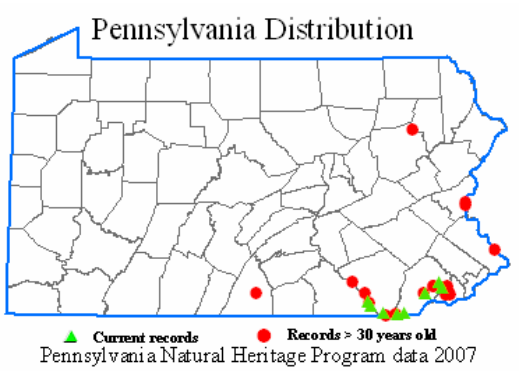
Distribution & Habitat
Arrow-feather has a range in eastern North America, from Ontario east into New England, and south into Texas and Florida. In Pennsylvania, it has been documented historically primarily in the southeastern counties. The species grows in dry to seasonally dry, open, rocky places, especially on serpentine barrens.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers arrow-feather to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. Fewer than 10 populations are currently known from the state.

Conservation Considerations
The populations of this species in the state are mainly on serpentine barrens and the seasonally scoured riverbed and shoreline rock outcrops along the lower Susquehanna River. The viability of the species on serpentine will require maintaining early successional, grassland conditions and controlling invasive species. The riverine populations will require maintaining the natural hydrology of the Susquehanna River, with its seasonal fluctuations in water levels, as well as retaining the natural conditions of the shorelines and islands.



NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania.

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

PNHP
Pennsylvania Natural Heritage Program

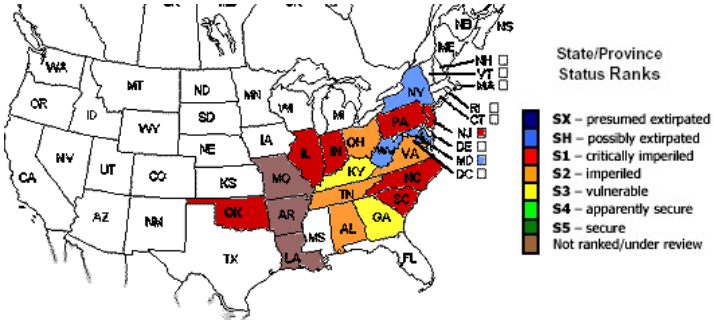
Bradley's Spleenwort
Asplenium bradleyi

Description
Bradley's spleenwort is a small fern growing on rocks. The leaves are generally lance-shaped, 1 to 4 (8) inch (2-17 cm) long, and divided into 5 to 15 pairs of leaflets, or pinnae. The pinnae are roughly triangular in shape and have toothed or lobed margins. Pinnae are largest at the base of the stem and gradually decrease in size as they approach the top of the stem. The lower half of the leaf stem is maroon-colored and the upper half is green. As in most ferns, the spores are produced on the underside of the leaves.


Photo source: PNHP

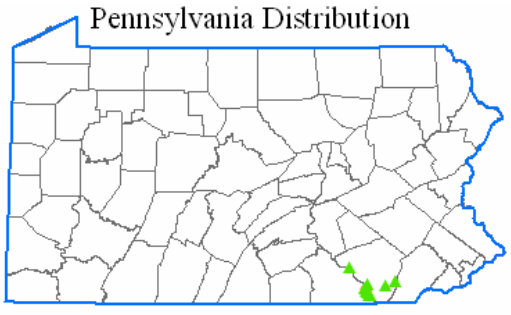
Distribution & Habitat
Bradley's spleenwort has a range from New York south and west into Georgia and Okalahoma. In Pennsylvania, it is near the northeastern end of its range, and has been documented historically in a few southeastern counties. It grows on dry shaded cliffs and rock outcrops, particularly on sandstone and schist.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Bradley's spleenwort to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It has a PA legal rarity status of Threatened and has been assigned a suggested rarity status of Endangered by PABS. Fewer than 10 populations, all with few individuals, are currently known from the state.

Conservation Considerations
Because of its small populations in the state, Bradley's spleenwort is vulnerable even without such threats as indiscriminate spraying of herbicide, quarrying, invasive species, and forest fragmentation. The viability of existing populations and the rock outcrop habitat may be enhanced by establishing a surrounding buffer of forest.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks
G4 – Apparently secure globally; **S1** – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Lobed Spleenwort
Asplenium pinnatifidum

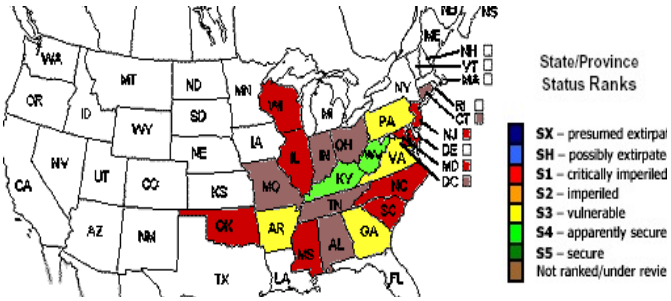
Description
Lobed spleenwort is a small fern that grows from a short rhizome. The leaves, narrowly triangular in shape and tapering to an elongated tip, may be up to 7 inches (17 cm) long but are often much shorter. The leaf margins have a lobed outline, with the lobes tending to get deeper near the base of the leaf. The leaf stem is mostly green, but maroon at the base. As in most ferns, the spores are produced on the underside of the leaves.



Photo source: PNHP

Distribution & Habitat
Lobed spleenwort has a range from New Jersey west into Wisconsin, and south into Georgia and Oklahoma. In Pennsylvania, it has been documented historically at scattered locations in the southern counties. It grows on dry shaded cliffs and rock outcrops, particularly on sandstone and schist.

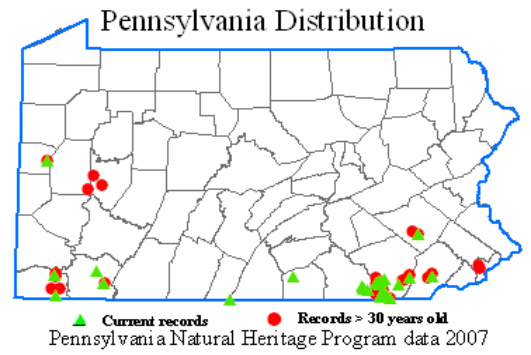
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers lobed spleenwort to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Rare by PABS. About two dozen populations, mostly with few individuals, are currently known.

Conservation Considerations
This species and its habitat have threats such as indiscriminate spraying of herbicide, quarrying, invasive species, and forest fragmentation. The viability of existing populations and the rock outcrop habitat may be enhanced by establishing a surrounding buffer of forest.

NatureServe conservation status ranks
G4 – Apparently secure globally;
S3 – Vulnerable in Pennsylvania.



Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

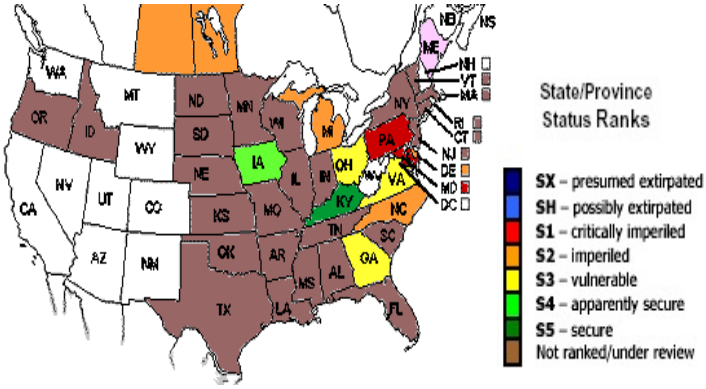
Aster-like Boltonia
Boltonia asteroides

Description
Aster-like boltonia is a perennial herb with a hairless, often branched, stem that can grow to about 3 feet (1 m) tall. The leaves are alternately arranged, untoothed, hairless, broadly linear to lance-shaped, up to 6 inches (15 cm) long, and tend to get smaller in size going up the stem. The flowers, appearing from July to October, consist of daisy-like flowering heads about 1/2 inch (ca 12 mm) wide with surrounding white or pinkish ray florets.


Photo source: Rocky Gleason, PNHP

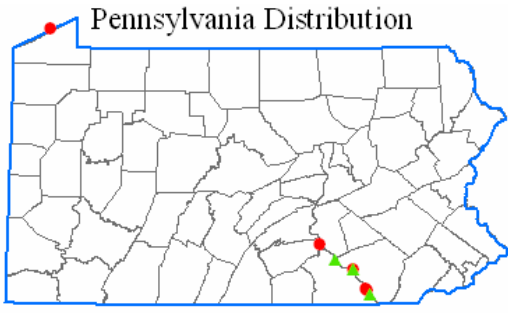
Distribution & Habitat
Aster-like boltonia has a wide range in eastern and midwestern North America. In Pennsylvania, it has been documented historically along the lower Susquehanna River and also in Erie County. This species grows in open wet places, in Pennsylvania particularly on open rocky shores and exposed river bed outcrops, especially where annual scouring takes place.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers the aster-like boltonia to be a species of special concern, based on the very few occurrences that have been recently confirmed and its very specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Only a few populations along the lower Susquehanna River are currently known.

Co nservation Considerations
The viability of populations of aster-like boltonia and its habitat depends on maintaining the natural hydrology and natural condition of the shoreline and islands of the lower Susquehanna River. The species appears well-adapted to the seasonal fluctuations in water levels, especially the lower water levels of summer and fall when the plant is flowering and fruiting. Invasive species represent a threat to this species and its habitat.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks
G5 – Globally secure; **S1** – Critically imperiled in Pennsylvania.

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Bull Sedge
Carex bullata

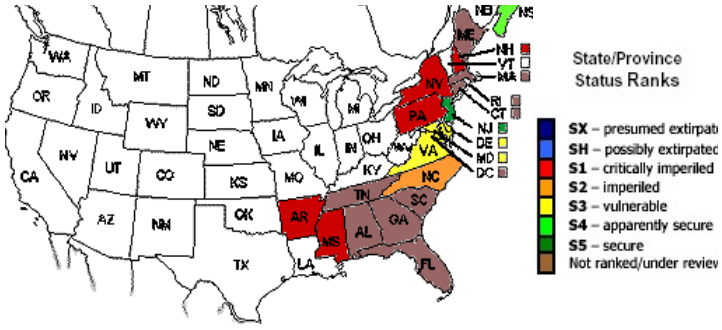
Description
Bull sedge is a grass-like plant that forms colonies. The aerial stems are triangular in cross-section, purple-tinged near the base, and stand 1to 3¼ feet (3-10 dm) tall. The leaves have linear, elongated blades that are smooth, light green, and about 1/8 inch (2-4 mm) wide. The flowers are unisexual, grouped in 1 to 3 male spikes at the top of the stem and 1or 2 bur-like female spikes below. The female spike consist of individual inflated sac-like structures, or perigynia, which are about 3/8 inch (6 to 10 mm) long, arranged around the spike into 8 to 12 vertical rows, and contain the triangular fruit.



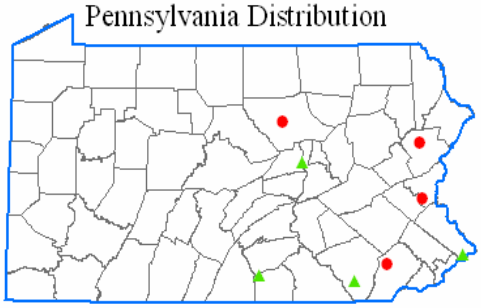
Photo source: PNHP

Distribution & Habitat
Bull sedge has a distribution centered mainly on the coastal plain from Newfoundland south and west into Arkansas. In Pennsylvania, this species occurs on a western border of its range and has been documented historically in a few eastern counties. It grows in swamps, seepages, boggy wetlands and along streamlets.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers bull sedge to be a species of special concern, based on the very few occurrences that have been recently confirmed and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 5 populations are currently known from the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The viability of populations of bull sedge and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

PNHP
Pennsylvania Natural Heritage Program

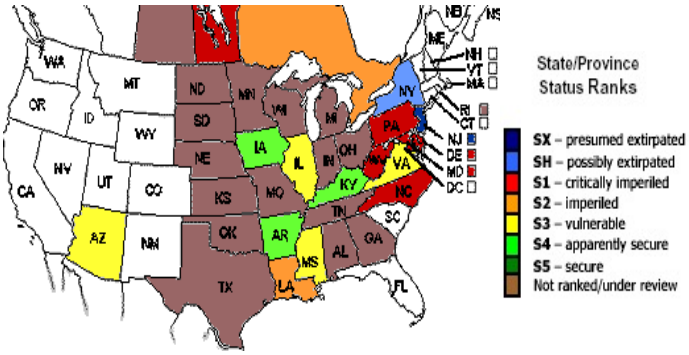
Mead's Sedge
Carex meadii

Description
Mead's sedge is a grass-like perennial herb with a 3-sided stem that reaches 6 to 24 inches (1.5-6 dm) in height. The leaves are linear, flat, up to ¼ inch (6 mm) wide, and arise from brownish sheaths found on the lower portions of the stem. The individual flowers are minute and unisexual, with the male flowers grouped in a club-shaped spike at the top of the stem and female flowers grouped below in 1 to 3 cylindrical spikes. The female spikes support 8 to 30 sac-like structures, or perigynia, which enclose the 3-sided fruit. The fruits mature in late spring and summer.


Photo source: John Kunsman (PNHP)

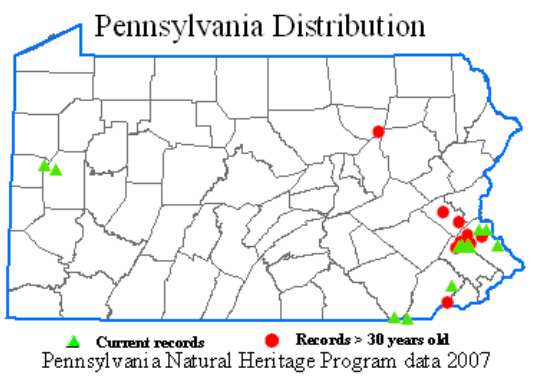
Distribution & Habitat
Mead's sedge has a range throughout most of eastern and midwestern North America. In Pennsylvania, it has been documented historically in scattered counties. It grows in damp or seasonally wet meadows, grasslands, and marshes, particularly on serpentine or diabase substrates.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Mead's sedge to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It has a PA legal rarity status of Undetermined and has been assigned a suggested rarity status of Endangered by PABS. Fewer than 15 populations are currently known from the state.

Conservation Considerations
The viability of populations of this species and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology around wetlands. Active management – such as fire, mowing, or invasive species removal – may be required to maintain the proper successional stage at sites where it grows.



NatureServe conservation status ranks
G4G5 – Apparently globally secure;
S1 – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Short's Sedge
Carex shortiana

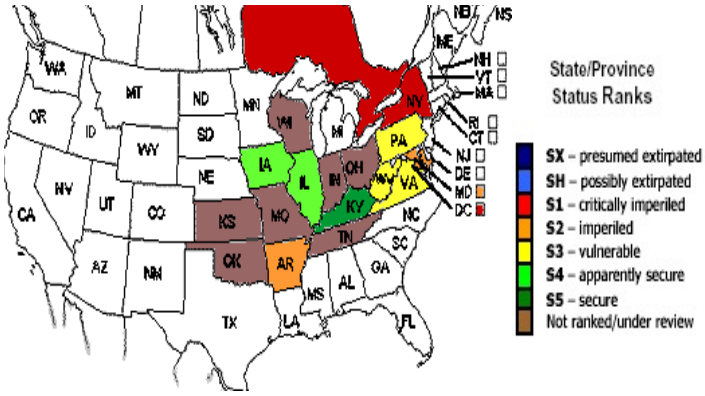
Description
Carex shortiana is a tufted perennial grass-like plant from 8 to 35 inches (2-9 dm) in height, with 3-sided stems, particularly near the base. The leaves are up to 12 inches (30 cm) long and ⅓ inch (1 cm) wide. The flowers are held in densely packed, cylindrical spikes that become dark brown as they mature. Clusters of 3 to 6 spikes are produced at the top of each flowering stem. The lower spikes usually contain all female flowers while the upper spikes have female flowers at the top and male flowers below.



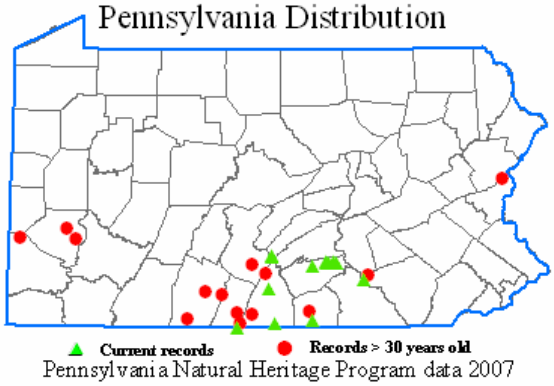
Photo source: John Kunsman (PNHP)

Distribution & Habitat
Short's sedge can be found from Ontario and New York south and west to Virginia and Oklahoma. In Pennsylvania, the occurrences are mostly in the southern half of the state. It grows in wet meadows, bottomlands, swamps, or in moist woods, especially on calcareous substrate.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Short's sedge to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and the wetland habitat. It has a PA legal rarity status of Undetermined and has been assigned a suggested rarity status of Rare by PABS.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
Creating buffers around wetlands, controlling invasive species, and protecting of wetland hydrology will help to maintain occurrences of Short's sedge.

NatureServe conservation status ranks
G5 – Globally secure; S3– Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Fringe-tree
Chionanthus virginicus

Description

The fringe-tree is a deciduous shrub or small tree that can grow up to 30 feet (10 m) tall, but is usually much smaller in Pennsylvania. The leaves are oppositely arranged, oval to elliptic in shape, usually 3 to 8 inches (8-15 cm) long and 1½ to 3 inches (3-8 cm) wide, and have untoothed margins. The white flowers, which appear in May, are grouped in clusters. The flowers have four petal-like lobes, which are elongate, narrow, and have a fringed appearance. Flowers of this species are unisexual, with male and female flowers being produced on separate plants, so only female plants produce the dark blue, one-seeded fruit that matures in the fall.



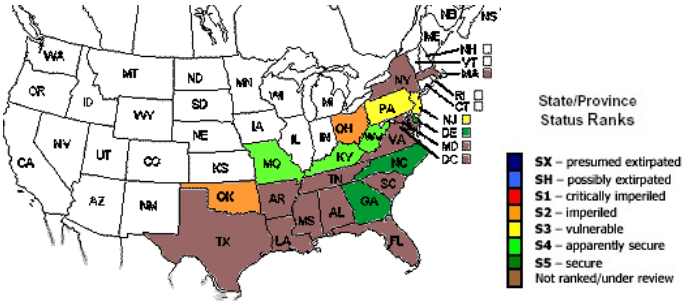
Photo Source: PNHP

Distribution & Habitat

The fringe-tree has a distribution from New York and Massachusetts south into Florida and west into Texas. In Pennsylvania, it is near the northern border of its range, and has been documented historically from numerous southern counties. The species grows in moist woods and along streams, and is also cultivated as an ornamental.

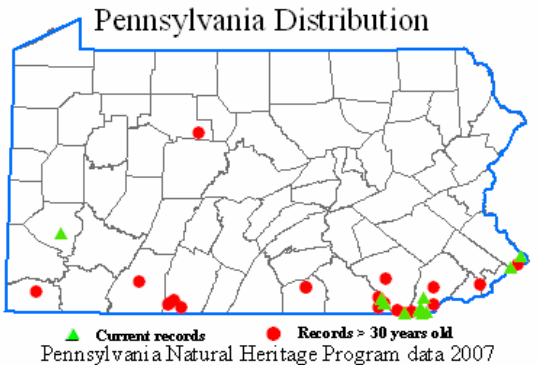
North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status

The PA Biological Survey (PABS) considers fringe-tree to be a species of special concern, based on the relatively few occurrences that have been recently confirmed. It does not have a PA legal status, but has been assigned a suggested rarity status of Threatened by PABS. About 12 populations are currently known in the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations

This species may have declined in abundance from historical levels due to loss of its woodland habitat, invasive species, and excessive deer browsing. The viability of existing populations of fringe-tree and its habitat may be enhanced by creating buffers around fragmented forests and controlling invasive species.

NatureServe conservation status ranks
G5 – Globally secure; **S3** – Vulnerable in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

PNHP
Pennsylvania Natural Heritage Program

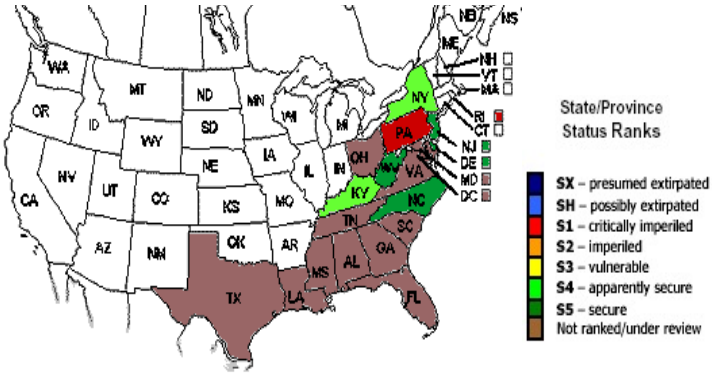
Maryland Golden-aster
Chrysopsis mariana

Description
Maryland golden-aster is a perennial herb that that grows from 1 to 2½ feet (3-8 dm) tall. The stem is hairy when young but becomes more-or-less hairless later. The leaves are lance-shaped to elliptic, hairy at least when young, and tend to decrease in size up the stem. The yellow flowers, appearing from July to October, occur in flowering heads that are about 1inch (2.5 cm) wide. The base of each flower-head is surrounded by sticky green bracts.


Photo source: R. Harrison Wiegand

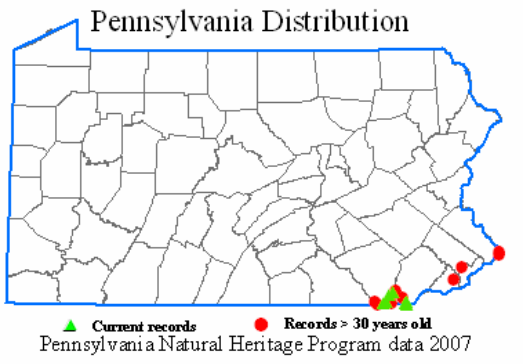
Distribution & Habitat
Maryland golden-aster has a range from New York west and south into Texas and Florida. In Pennsylvania, it is near a northern border of its range, and has been documented historically in a few southeastern counties. It grows in woodland borders, successional openings, open woods, and serpentine barrens.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Maryland golden-aster to be a species of special concern, based on the few occurrences that have been recently confirmed. It has a PA legal rarity status of Threatened and has been assigned a suggested rarity status of Endangered by PABS. About 10 populations are currently known in the state.

Conservation Considerations
Existing populations of Maryland golden-aster are threatened by natural succession, invasive species, and the indiscriminate application of herbicide. Given the preference of the species for relatively open habitats, active management – such as fire, mowing, or invasive species removal – is often required to maintain the proper successional stage at sites where it grows.



NatureServe conservation status ranks
G5 – Globally secure; **S1** – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

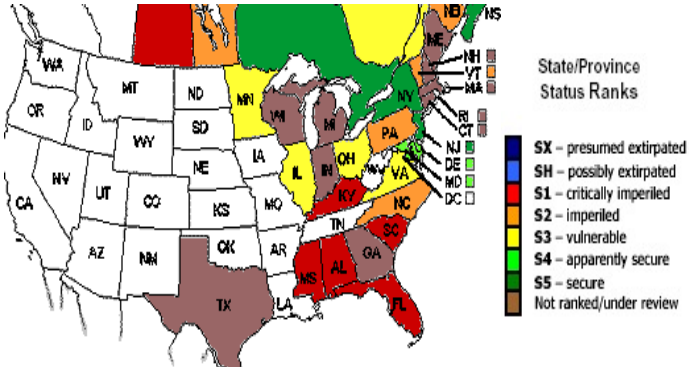
Twig-rush
Cladium mariscoides

Description
Twig-rush is a perennial grass-like herb with upright stems that grow to 40 inches (1 m) tall. The leaves are linear, rough along the edges, and about 1/8 inch (3 mm) wide. The individual flowers, appearing in summer, are minute and are grouped in small, brown spikelets that are covered by spirally arranged scales. The spikelets are grouped into ¼ inch (6 mm) heads which are displayed in a narrow cluster. The fruits are about 1/8 inch (3 mm) long and acorn-shaped.

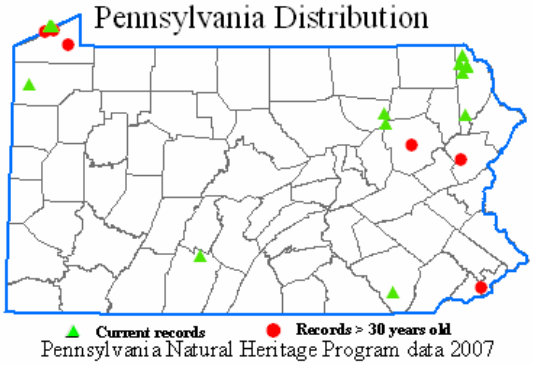

Photo source: Lopez

Distribution & Habitat
Twig-rush has a range from eastern and central Canada south into Texas and the Gulf states. In Pennsylvania, it has been documented historically in scattered locations, particularly in the glaciated northwestern and northeastern counties. It grows in quaking bogs, marshes, fens, and along shorelines of lakes and ponds.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers twig- rush to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 15 populations are currently known in the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The viability of populations of twig-rush and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

NatureServe conservation status ranks
G5 – Globally secure; S2 –Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Smooth Swallow-wort
Cynanchum laeve

Description

Smooth swallow-wort is a perennial twining vine that may grow 10 to 13 feet (3-4 meters) long. This species is a member of the milkweed family plants produces a white, milky sap if bruised. The leaves are oppositely arranged, long-stalked, broadly heart-shaped, and have long-pointed tips. The flowers, appearing from July to August, are grouped in rounded clusters that emerge from the leaf axils. Each cluster contains about 30 creamy white flowers, each of which is about ¼ inch (5 mm) wide and has 5 narrow lobes. The fruit is pod-like and contains hairy seeds.



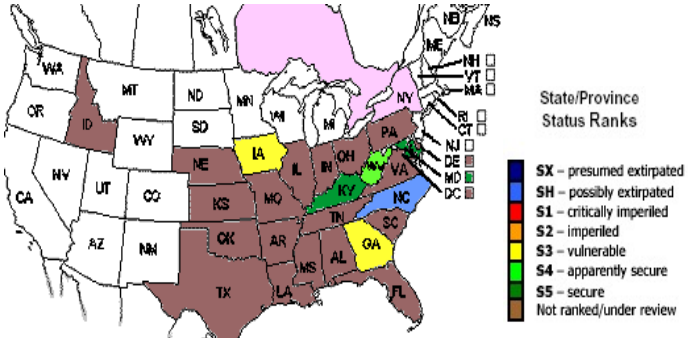
Photo source: R. Harrison Wiegand

Distribution & Habitat

Smooth swallow-wort has a range in much of eastern and midwestern North America. In Pennsylvania, it reaches a northern border of its natural range, and has been documented historically in a few southeastern counties. It grows naturally on scoured riverbanks and riverbed rock outcrops in the Susquehanna River, and sometimes in disturbed ground.

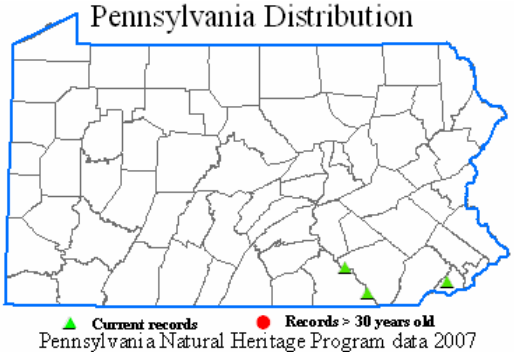
North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status

The PA Biological Survey (PABS) considers smooth swallow-wort to be a species of special concern, based on the few occurrences that have been recently confirmed in natural habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 5 populations are currently known from the state.



Conservation Considerations

The viability of populations of smooth swallow-wort and its habitat depends on maintaining the natural hydrology and natural condition of the shoreline and islands of the lower Susquehanna River. The species appears well-adapted to the seasonal fluctuations in water levels, especially the lower water levels of summer and fall when the plant is flowering and fruiting. Invasive species represent a threat to this species and its habitat. Occurrences of this species in disturbed habitats are not considered to be of conservation concern.

NatureServe conservation status ranks

G5 – Globally secure; **SU** – Not ranked/under review in Pennsylvania.

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Reflexed Flatsedge
Cyperus refractus

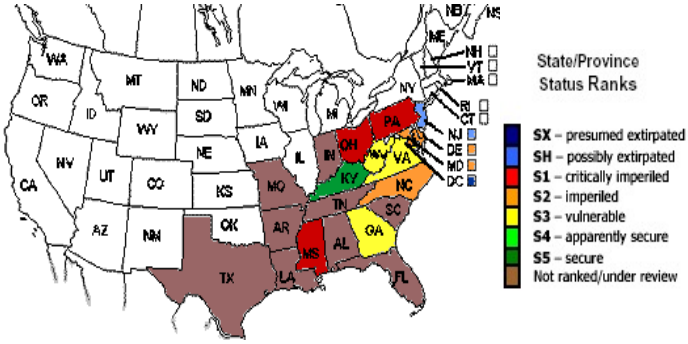
Description
Reflexed flatsedge is a perennial herb with a triangular stem that grows from 1 to 2½ feet (3-8 dm) tall. The leaves are linear, V-shaped or flat, hairless, and up to 1/3 inch (8 mm) wide. The flowers, appearing from July to August, are grouped in loose, open spikes made up of 15 or more spikelets. Most of the spikelets extend horizontally or upward in a bottlebrush-like appearance, which helps to distinguish this species from similar species that have more downward-oriented spikelets. The spikelets are up to about 1 inch (2.5 cm) long and covered by several overlapping scales, which enclosed the small (1/8 inch, or 3 mm) fruits.



Photo Source: PNHP

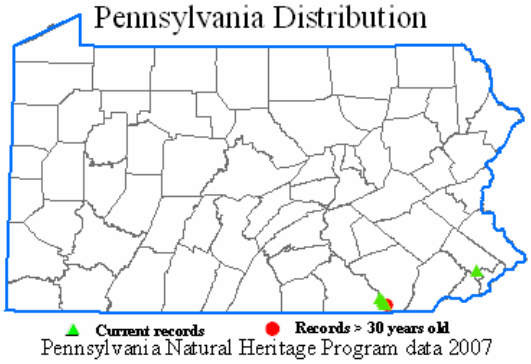
Distribution & Habitat
The reflexed flatsedge has a distribution from southern Pennsylvania south and west into Florida and Texas. In Pennsylvania, this species reaches a northern border of its known range and has been documented historically in a few southeastern counties. It grows on sandy shorelines and scoured river islands in the Susquehanna River, and elsewhere in dry woods.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers reflexed flatsedge to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 5 populations are currently known from the state.

Conservation Considerations
The viability of the riverine populations of reflexed flatsedge and its habitat will require maintaining the natural hydrology of the Susquehanna River, with its seasonal fluctuations in water levels, as well as retaining the natural conditions of the shorelines and islands. In upland sites, given the preference of the species for relatively open habitats, active management – such as fire, mowing, or invasive species removal – may be required to maintain the proper successional stage.



NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Tufted Hairgrass
Deschampsia cespitosa

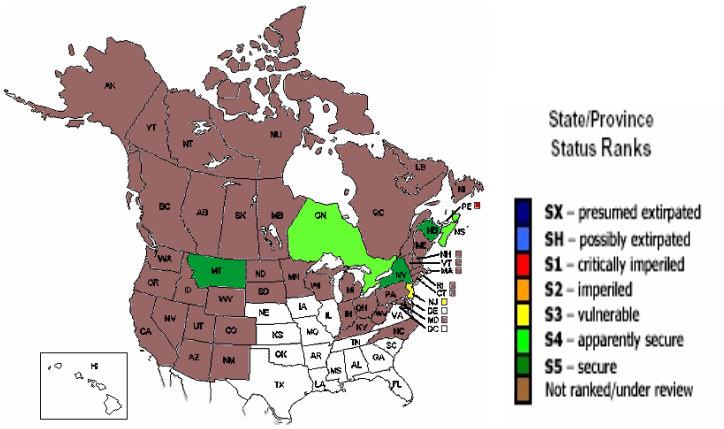
Description
Tufted hairgrass is a perennial grass that grows to 4 feet (about 12 dm) in height. The leaves are arranged alternately, linear in shape, elongate, narrow (1-5 mm in width), and tend to be clumped at the base of the plant in a tufted manner. The tiny individual flowers, appearing in May and June, are grouped in pairs in spikelets that are 2.5 to 5.5 mm in length and are scattered in an open branched terminal grouping that stands above the leaves. The spikelets are often tinged with purple.



Photo source: PNHP

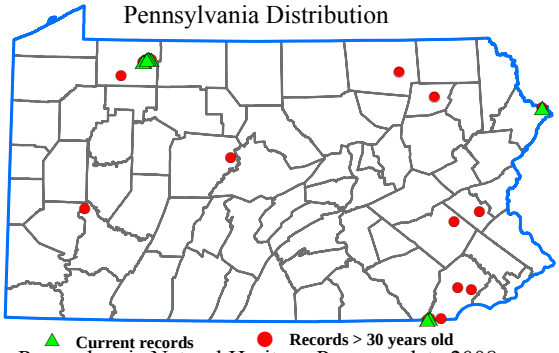
Distribution & Habitat
Tufted hairgrass has a wide range across the northern part of North America. In Pennsylvania, it has been documented historically in several widely scattered, particularly eastern, counties. It grows in various habitats, including serpentine barrens, riverbed scours, marshes, damp openings, and along streams.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers tufted hairgrass to be a species of special concern, based on the few occurrences that have been recently confirmed. It does not have a PA legal rarity status, but has been assigned a PABS suggested rarity status of Undetermined. About 10 populations are currently known from the state.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

Conservation Considerations
The viability of the populations on serpentine barrens will require maintaining early successional, grassland conditions and controlling invasive species. Active management, such as the use of fire, scraping the substrate, or mowing, may be needed to create the proper successional stage and ecological conditions for this species to thrive. The riverine populations of tufted hairgrass will require maintaining the natural hydrology of the stream, with its seasonal fluctuations in water levels, as well as retaining the natural conditions of the shorelines and islands. Invasive species may be a threat in some locations. The viability of populations in wetlands may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

NatureServe conservation status ranks
G5 – Secure globally; S3 – Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Clinton's Wood Fern
Dryopteris clintoniana

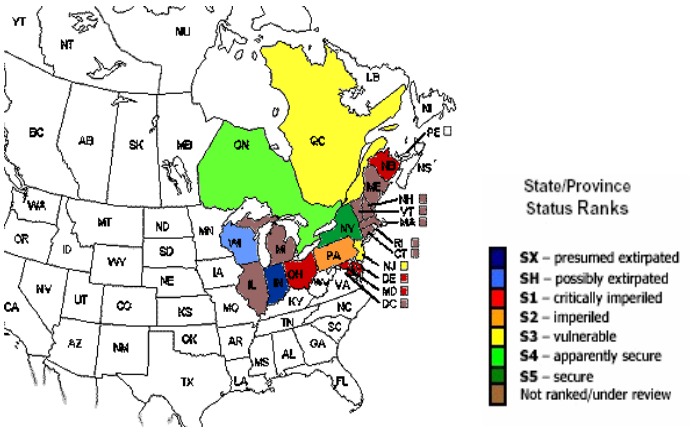
Description
Clinton's wood fern grows from 1½ to 3 feet (4.5-10 dm) tall. Fertile fronds, which have the reproductive spores on the underside, are deciduous and erect. Sterile fronds are smaller, evergreen, and mostly prostrate on the ground. The leaves are divided into leaflets, or pinnae, which are themselves lobed or toothed. The lowest pinnae are triangular in shape and about twice as long as wide. The fertile pinnae are not turned at an angle to the plane of the overall leaf, unlike the more common crested wood fern (*Dryopteris cristata*).



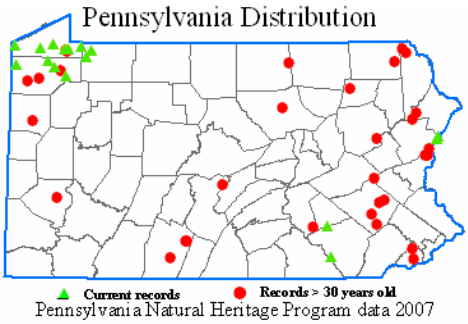
Photo source USDA-NRCS PLANTS Database

Distribution & Habitat
Clinton's wood fern has a range from eastern Canada south to the Middle Atlantic States and the Great Lakes states. In Pennsylvania, it has been documented historically in numerous widespread counties. It grows in swampy woodlands.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Clinton's wood fern to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Threatened by PABS. About 15 populations, mostly of them in the northwestern region, are currently known from the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The viability of the known populations of Clinton's wood fern and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania.

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

Clinton's Wood Fern
Dryopteris clintoniana

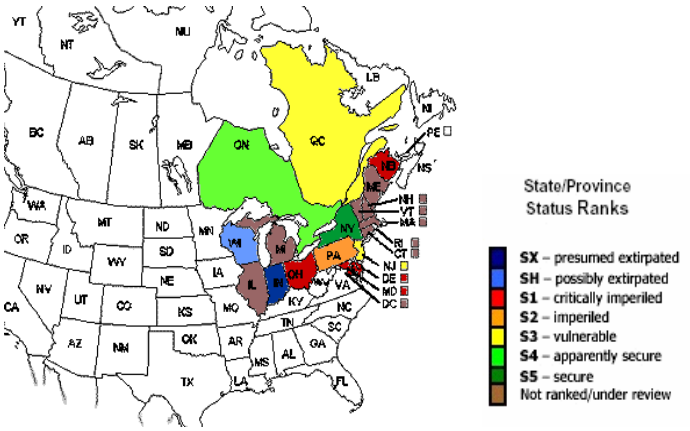
Description
Clinton's wood fern grows from 1½ to 3 feet (4.5-10 dm) tall. Fertile fronds, which have the reproductive spores on the underside, are deciduous and erect. Sterile fronds are smaller, evergreen, and mostly prostrate on the ground. The leaves are divided into leaflets, or pinnae, which are themselves lobed or toothed. The lowest pinnae are triangular in shape and about twice as long as wide. The fertile pinnae are not turned at an angle to the plane of the overall leaf, unlike the more common crested wood fern (*Dryopteris cristata*).



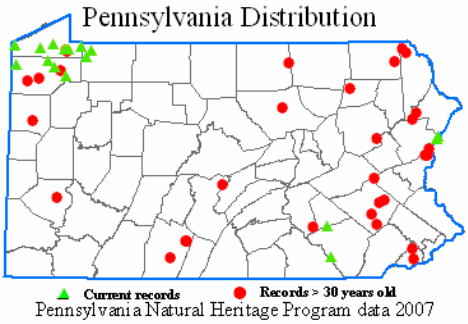
Photo source USDA-NRCS PLANTS Database

Distribution & Habitat
Clinton's wood fern has a range from eastern Canada south to the Middle Atlantic States and the Great Lakes states. In Pennsylvania, it has been documented historically in numerous widespread counties. It grows in swampy woodlands.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Clinton's wood fern to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Threatened by PABS. About 15 populations, mostly of them in the northwestern region, are currently known from the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The viability of the known populations of Clinton's wood fern and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands.

NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania.

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

Flat-stemmed Spike-rush
Eleocharis compressa

Description
Flat-stemmed spike-rush is an upright perennial herb that grows from 6 inches to 2½ feet (1.6-8 dm) tall, and forms colonies because of its underground stems. The aerial stems, which have a compressed or flattened appearance, make up most of the plant since the leaves are reduced to sheaths at the base of the stem. The minute flowers are held in a single spikelet, up to ½ inch (13 mm) long, which is located at the top of the stem. The tiny fruits mature in summer and fall and are about 1/16 inch (about 1 mm) long.

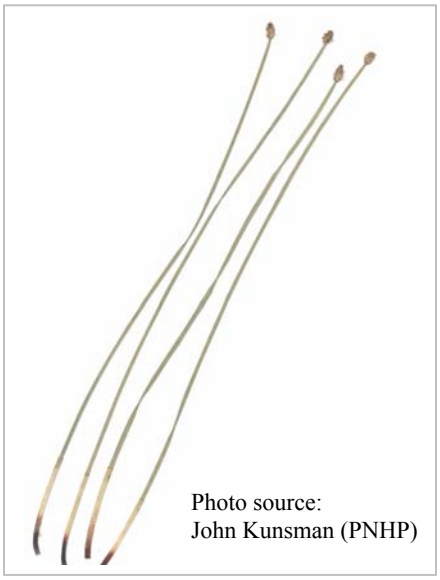
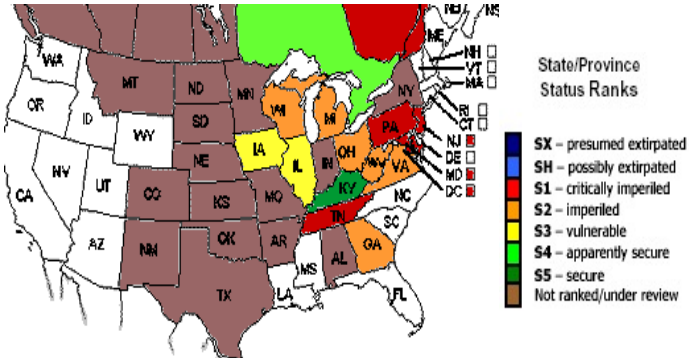


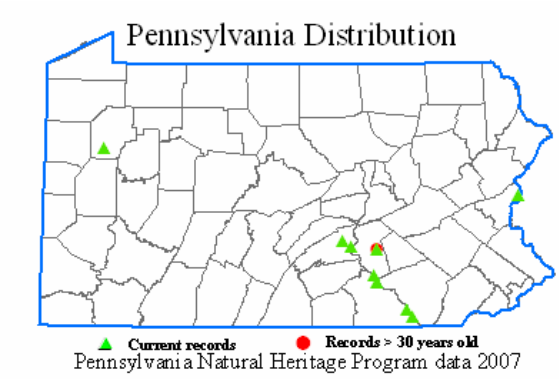
Photo source:
John Kunsman (PNHP)

Distribution & Habitat
Flat-stemmed spike-rush has a large range through much of North America. In Pennsylvania, it has been documented historically in scattered counties, especially along the lower Susquehanna River. It grows on river shorelines and riverbed rock outcrops, which are subject to annual scouring.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers flat-stemmed spike-rush to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 10 populations are currently known from the state.



Conservation Considerations
Flat-stemmed spike-rush appears to be restricted to riverine habitats in Pennsylvania. The viability of the known populations will require maintaining the natural hydrology of the rivers, with the seasonal fluctuations and scouring, as well as retaining the natural conditions of the shorelines, riverbed outcrops, and islands. Invasive species may be a threat at some locations.

NatureServe conservation status ranks
G4 – Apparently globally secure; S1 – Critically imperiled in Pennsylvania

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Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed May 10, 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Elephant's Foot
Elephantopus carolinianus

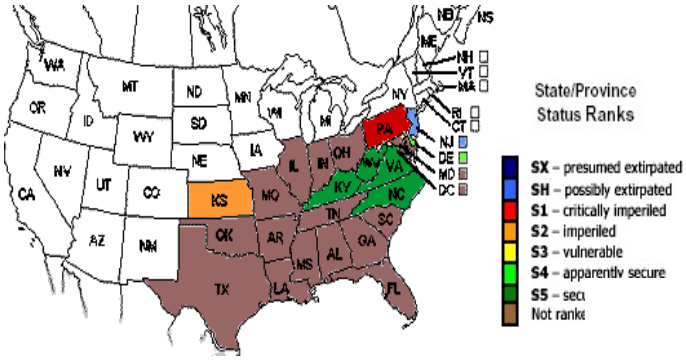
Description
Elephant's foot is a perennial herb with a variably hairy stem that may grow to 3 feet (ca 1 m) tall. The leaves are arranged alternately, broadly elliptic in shape, shallowly toothed on the margin, hairy below, and to 10 inches (25 cm) long. The small, whitish or purplish individual flowers are grouped in flower heads, each of which is subtended by several leaf-like bracts that give the plant one of its distinctive features.



Photo Source: R Harrison Wiegand

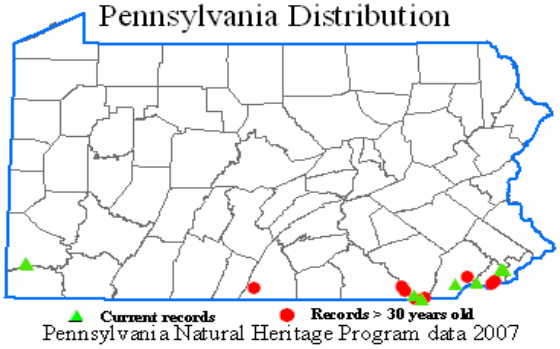
Distribution & Habitat
Elephant's foot has a range from Pennsylvania west into Kansas and south into Texas and Florida. In Pennsylvania, it represents a southerly species and occurs at a northern border of its range, and has been found in a few southern, particularly southeastern, counties. It grows in open woodlands, woodland borders, and serpentine barrens, often in somewhat disturbed conditions.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers elephant's foot to be a species of special concern, based on the few occurrences that have been recently confirmed and its limited state range. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. About 10 populations are currently documented from the state.

Conservation Considerations
Populations of elephant's-foot are threatened by human-related habitat loss, natural succession, and invasive species. Since the species may occupy disturbed habitats, active management may be required to create the proper successional stage and ecological conditions for the species to thrive. Deer browsing may be a problem in some locations.



NatureServe conservation status ranks
G5 – Globally secure; **S1** – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

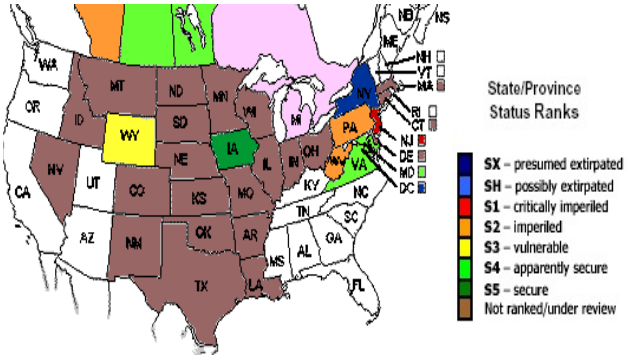
Ellisia; Waterpod
Ellisia nyctelea

Description
Ellisia is a spring annual herb that grows 4 to 16 inches (1-4 dm) tall. Its stems are light green or light purple and usually hairy along their length. The leaves tend to be oppositely arranged on the lower stem and alternately arranged on the upper stem. The hairy leaves are up to 4 inches (10 cm) long and deeply dissected into toothed lobes.
The flowers appear in April and May and grow individually from the upper leaf axils. The ¼ inch (6.5 mm) flowers are whitish-blue and have 5 petal-like lobes that are fused near the base to form a bell shaped flower. The sepals are united near the base and persist on the usually 4-seeded, capsule-like fruit.


Photo source: Tony Davis (PNHP)

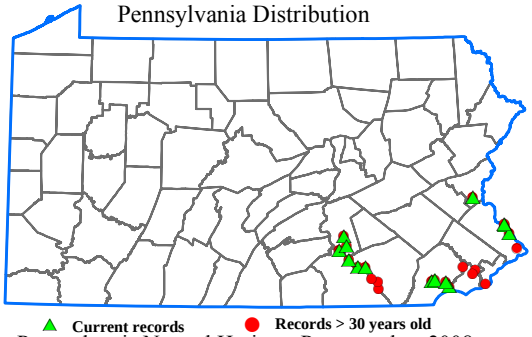
Distribution & Habitat
Ellisia occurs throughout much of the United States, but is apparently absent from northern New England, the Southeast, and the West Coast. In Pennsylvania, it grows on damp, shady stream banks with rich alluvial soils and sometimes in disturbed ground.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers ellisia to be a species of special concern, based on the relatively few occurrences that have been recently confirmed. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. The rich shady stream banks that ellisia depends upon are highly influenced by flooding events. Alteration of the natural flood cycle, dam building, increased erosion, and clearing of floodplain forests all affect the quality of suitable habitat. Populations are also threatened by loss of habitat from development and displacement by invasive plants.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

Conservation Considerations
Protection of ellisia will require maintenance of known populations and preservation of rich, shaded stream bank communities. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.

NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Harbinger-of-spring
Erigenia bulbosa

Description

Harbinger-of-spring is a delicate perennial herb with a weak, hairless stem that may grow up to 6 inches (15 cm) in height. The hairless leaves are subdivided into numerous linear or narrowly oblong leaflets. This species represents one of the earliest-blooming wildflowers in Pennsylvania, with the flowers generally appearing from March into early April. The tiny individual flowers occur in small clusters at the end of a long stalk. Each flower has 5 white petals that are only about 1/8 of an inch (3-4 mm) in length, and contrast noticeably with the blackish anthers. The tiny fruit breaks into 2 sections at maturity. The leaves and stem usually die back to the ground in June.



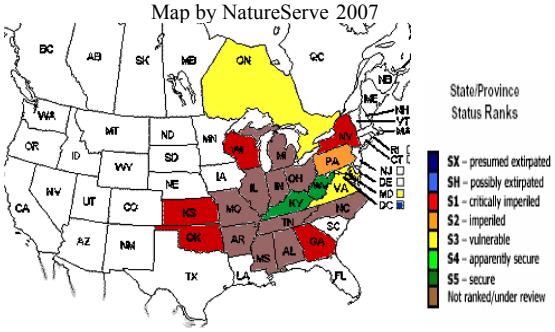
Photo source: John Kunsman (PNHP)

Distribution & Habitat

Harbinger-of-spring has a range from southern Canada south into the Great Lakes states and the Middle Atlantic states. In Pennsylvania, it has been documented historically in several western and southeastern counties. It grows on wooded slopes, floodplain forests, and in rich woodlands.

North American State/Province Conservation Status

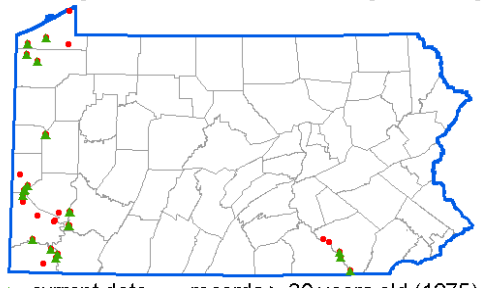
Map by NatureServe 2007



Current State Status

The PA Biological Survey considers harbinger-of-spring to be a species of special concern, based on the relatively few occurrences that have been recently documented. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 40 populations are currently known from the state.

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2005

Conservation Considerations

The known populations of harbinger-of-spring have threats from habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

NatureServe conservation status ranks

G5 – Secure globally; S2– Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

White Trout-lily
Erythronium albidum

Description

White trout-lily is a perennial herb, producing a stem 4 to 6 inches (10-15 cm) tall. The leaves are basal and paired, usually spotted or mottled, elliptic or lance-shaped and up to 6 inches (15 cm) long. The white (sometimes slightly tinged with blue or pink) flowers are produced singly at the end of long stalks in late April and early May. The flowers nod downward and have white 6 petals/sepals that curve strongly upward.



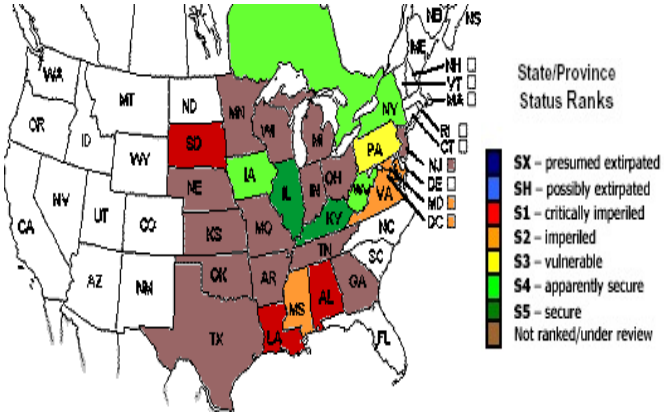
Photo Source: PNHP

Distribution & Habitat

White trout-lily has a distribution from Ontario and New York south into Texas and the Gulf Coast states. In Pennsylvania, the occurrences are rather widespread throughout the state, particularly along the major rivers and streams. The species grows in bottomlands, floodplains, and lower slopes, especially on limestone substrates.

North American State/Province Conservation Status

Map by NatureServe 2007

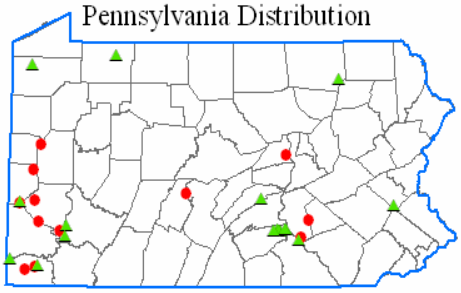


Current State Status

The PA Biological Survey (PABS) considers white trout-lily to be a species of special concern, based on the relatively few occurrences that have been recently confirmed. It does not have a PA legal status, but has been assigned a suggested rarity status of Undetermined by PABS. meaning that more information is needed before a more definitive rarity status can be designated.

Conservation Considerations

More field surveys are needed to determine the range, abundance, and ecological requirements of the white trout-lily before a more definitive conservation status, if needed, can be assigned.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks

G5 – Globally secure; S3 – Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Vasey's Eupatorium
Eupatorium godfreyanum

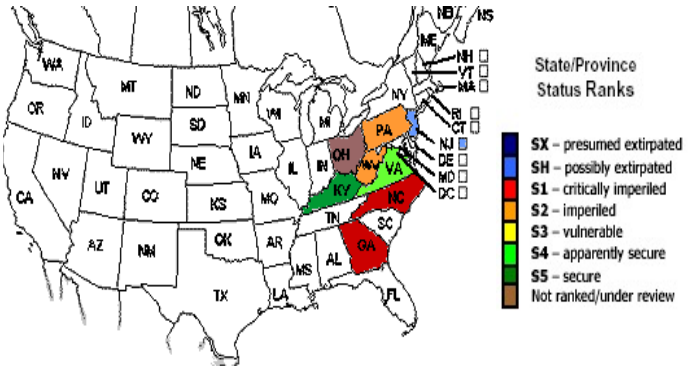
Description
Vasey's Eupatorium is a perennial herb with hairy stems that may grow from 2 to 5 feet (6-15 dm) high. The leaves are oppositely arranged, generally lance-shaped, 3 to 4½ inches (7-11 cm) long, toothed on the margin, pointed at the tip, and attach directly to the stem without a stalk. The flowers, appearing from August to October, are grouped into small flower heads and are arranged in branched, open clusters at the top of stems.



Photo source: PNHP

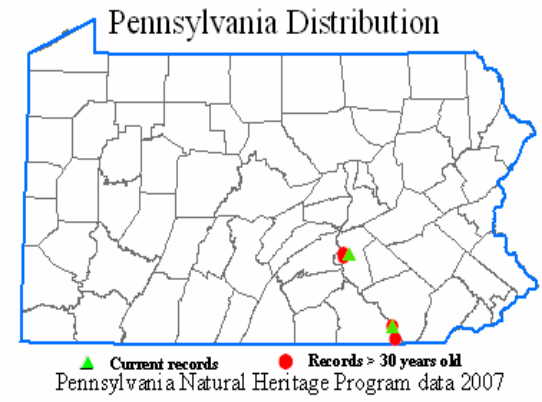
Distribution & Habitat
Vasey's eupatorium has a range mostly in the Appalachian Mountains from Pennsylvania and Ohio south into Georgia. In Pennsylvania, it has been documented historically in a few eastern counties, particularly those bordering the Susquehanna River. It grows on dry slopes, woodland borders, and clearings.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Vasey's eupatorium to be a species of special concern, based on the few occurrences that have been recently confirmed. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Undetermined by PABS. Only a few occurrences have been documented in the state.

Conservation Considerations
Populations of Vasey's eupatorium have threats from natural succession, invasive species, and the indiscriminate application of herbicide. Given the preference of the species for open habitats, active management - fire, mowing, or invasive species removal - may be required in order to create the proper successional stage and ecological requirements for the species to thrive.



NatureServe conservation status ranks
G4 – Apparently secure globally; **S2** – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Glade Spurge
Euphorbia purpurea

Description
Glade spurge is a perennial herb with a hairless stem that may grow up to 3 feet (ca 1 m) in height. A milky sap is present in the stem and leaves. The leaves are alternately arranged, lance-shaped to narrowly oblong, hairless, untoothed on the margin, and 2 to 4 inches (5-10 cm) in length. The flowers, appearing in May or June, are arranged in flat-topped clusters that are subtended by leaf-like bracts that are much shorter and broader than the stem leaves. The fruit is a warty-surfaced capsule that contains 3 smooth seeds.

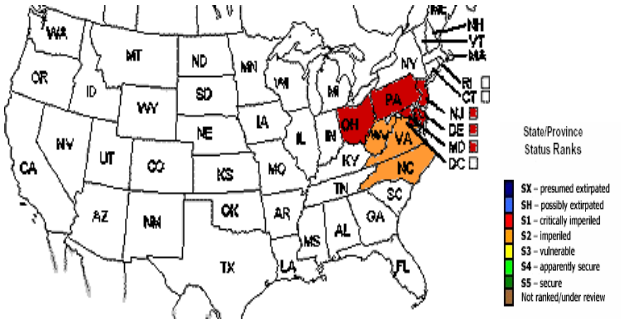


Photo source: R. Harrison Wiegand

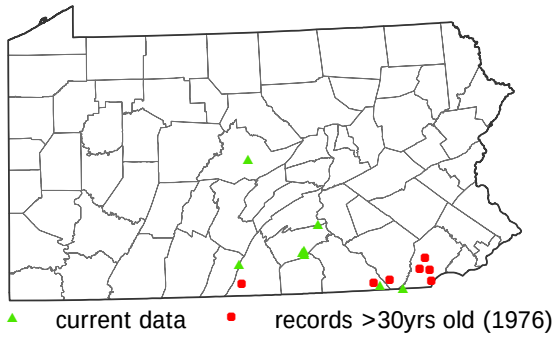
Distribution & Habitat
Glade spurge has a relatively small range from New Jersey into Ohio, and south into North Carolina. In Pennsylvania, it has been documented historically in some southcentral and southeastern counties. It grows in seepages, swamps, bottomlands and on streambanks.

North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status
The PA Biological Survey considers glade spurge to be a species of special concern, based on the relatively few occurrences that have been recently documented, small global range, and wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 10 populations, most of them with only a few individuals, are currently known from the state.



Pennsylvania Natural Heritage Program Data 2006

Conservation Considerations
The viability of the known populations of glade spurge and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands This species may be impacted by excessive browsing by deer in some locations.

NatureServe conservation status ranks
G3 – Vulnerable globally; S1– Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

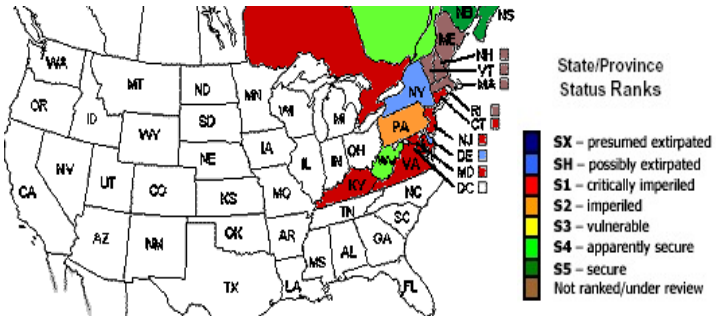
Rough-leaved Aster
Eurybia radula

Description
Rough-leaved aster is a perennial herb with a stem that can grow up to 3 feet (1 m) tall. The leaves are alternate, lance-shaped, strongly veined, toothed on the margin, rough to the touch, stalkless, and up to 4½ inches (11.5 cm) long. The flowers, appearing from August to October, are arranged in a small cluster of daisy-like flower heads at the top of the stem. Each flower head contains many yellow disk florets that are surrounded by 15-40 purple to white ray florets.

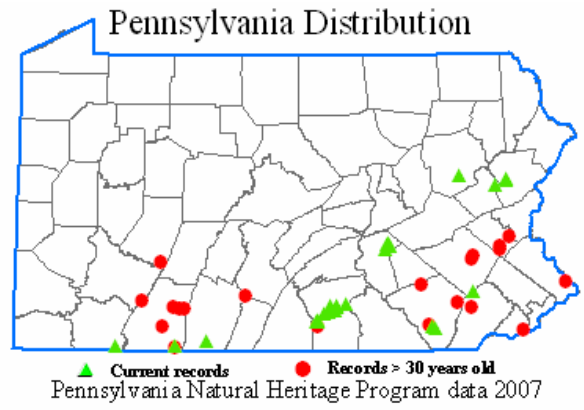

Photo source: John Kunsman (PNHP)

Distribution & Habitat
Rough-leaved aster has a range from eastern Canada south into Kentucky and Virginia. In Pennsylvania, it has been documented historically mostly in the southern counties. It grows in wet woods, swamps, seeps, bogs, and along streams.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers rough-leaved aster to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Threatened by PABS. About 30 populations are currently known from the s



Conservation Considerations
The viability of known populations of rough-leaved aster and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. Excessive browsing by deer may be a threat in some locations.

NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

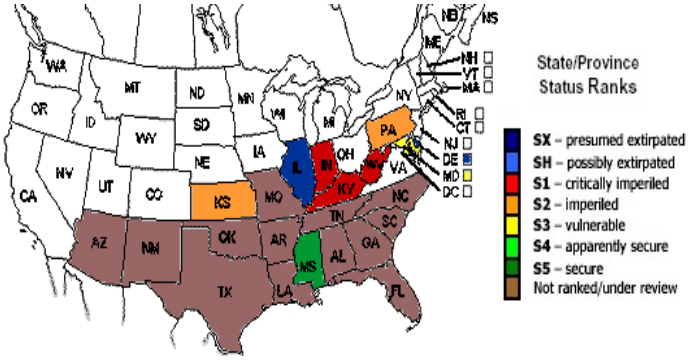
Annual Fimbry
Fimbristylis annua

Description
Annual fimbry is an annual graminoid herb that usually is less than 6 inches (15 cm) in height. The plants grow in tufted clumps and have thin, wiry stems that emerge from slender roots. The leaves are relatively few, less than 1/10 inch (3 mm) wide, have flat or inrolled edges, and occur mostly at the base of the plant. The flowers, appearing from July to October, are minute and are grouped in brown, egg-shaped spikelets. Up to 10 spikelets are clustered at the top of each stem, with the spikelets seeming to emerge from one point on the stem. The mature fruits are about 1/16 inch (1-1.5 mm) long.

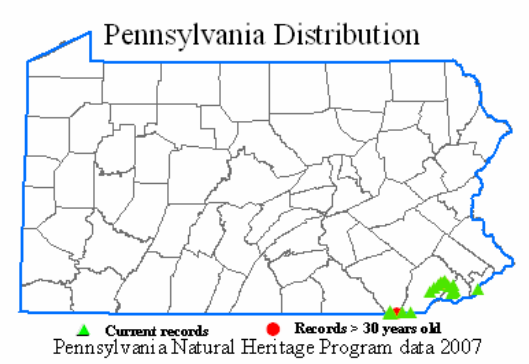

Photo source: PNHP

Distribution & Habitat
Annual fimbry has a wide range in the southern states, with an extension to the northeast into Pennsylvania. In Pennsylvania, it is at a northern border of its range, and has been documented historically in a few southeastern counties. It grows in damp depressions or seasonal seepages on serpentine barrens.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers annual fimbry to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat on serpentine barrens. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 12 populations are currently known from the state.



Conservation Considerations
The viability of populations of annual fimbry and its serpentine habitat will require maintaining early successional conditions and natural hydrology patterns, and controlling invasive species. Active management, through the use of fire, scraping, or mowing, may be needed to create the proper successional stage and ecological conditions for this species to thrive.

NatureServe conservation status ranks
G5 – Globally secure; S2 – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Striped Gentian
Gentiana villosa

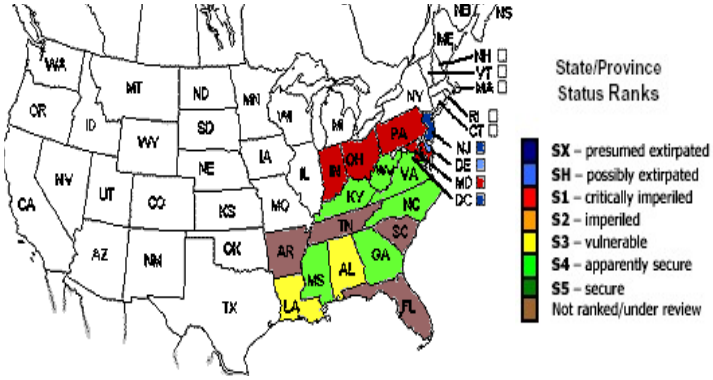
Description
Striped gentian is a perennial herb that usually grows from 8 to 24 inches (2-6 dm) tall. The leaves are oppositely arranged, untoothed on the margin, hairless or nearly so, elliptic to widest above the middle, and 1 to 4 inches (2.5 -10 cm) long. The flowers, appearing in September and October, occur in dense clusters at the top of the stem. The petals are whitish-green (often tinged with purple), 1 to 2 inches (2.5-5.5 cm) long, and are fused for most of their length into a sac-like structure. The fruit is a many-seeded capsule.



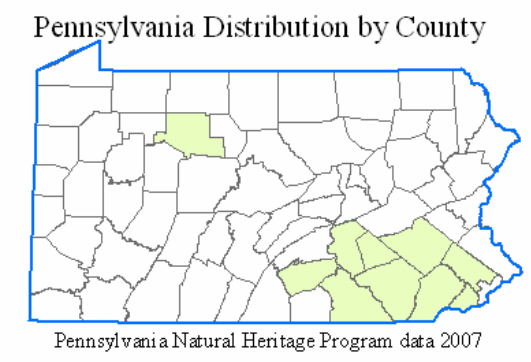
Photo source: R. Harrison Wiegand

Distribution & Habitat
Striped gentian has a range from New Jersey west into Indiana, and south into the Gulf Coast states. In Pennsylvania, it occurs at a northern border of its range, and has been documented historically mostly in the southeastern counties. It grows in grasslands, successional openings, serpentine barrens, and dry open woods.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers striped gentian to be a species of special concern, based on the very few occurrences that have been recently confirmed and the specialized habitat. It has a PA legal rarity status of Undetermined and has been assigned a suggested rarity status of Endangered by PABS. Fewer than 5 populations are currently known from the state.



Conservation Considerations
The populations of striped gentian in the state are threatened by human-related habitat loss, natural succession, invasive species, and excessive deer browsing. Given the preference of the species for open habitats, active management - such as fire, mowing, or invasive species removal - is often required to maintain the proper successional stage and ecological conditions for the species to thrive.

NatureServe conservation status ranks
G4– Apparently globally secure; **S1** –Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Bicknell's Hoary Rockrose
Helianthemum bicknellii

Description

Bicknell's hoary rockrose is a perennial herb with a slender hairy stem that may grow to 18 inches (about 5 dm) in height, but is often much shorter. The leaves are alternately arranged, linear to narrowly elliptic in shape, hairy, up to 1 inch (2.5 cm) in length, and stalkless or nearly so. The small flowers, appearing in June and July, have 5 yellow petals that are about 3/8 inch (8-12 mm) in length. These flowers are clustered in the axils of the leaves on the upper part of the stem, as are flowers produced later in the season that remain closed and do not have expanded petals, but do produce fruits. The fruit is a capsule containing brownish seeds that have net-like surface markings.



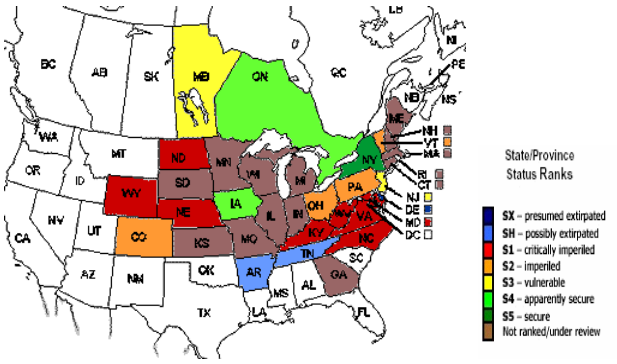
Photo source: PNHP

Distribution & Habitat

Bicknell's hoary rockrose has a distribution from Maine west into Manitoba, and south into Florida and Texas. In Pennsylvania, this species has been documented historically in numerous widespread counties. It grows in open, rocky places that are at least seasonally dry, such as riverbed scours, exposed banks and slopes, upland woods, bedrock outcrops, and serpentine barrens.

North American State/Province Conservation Status

Map by NatureServe 2007



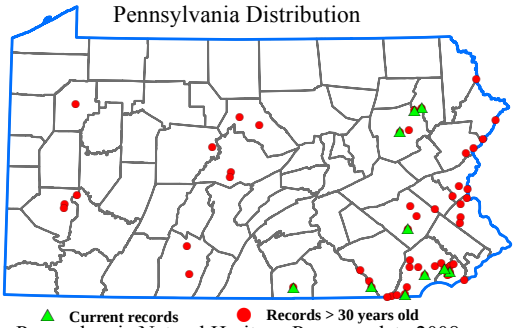
Current State Status

The PA Biological Survey (PABS) considers Bicknell's hoary rockrose to be a species of special concern, based on the few occurrences that have been recently confirmed and the specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 10 populations are currently known from the state.

Conservation Considerations

The upland populations of Bicknell's hoary rockrose have threats from habitat loss, natural succession, invasive species, and quarrying. Because of the preference of the species for relatively open habitats, active management, such as fire, mowing, or invasive species removal, may be required to maintain the proper successional stage and ecological conditions for the species to thrive. The viability of the riverine populations will require maintaining the natural hydrology of the Susquehanna River, with its seasonal fluctuations in water levels, as well as retaining the natural conditions of the shorelines and islands.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks

G5 – Secure globally; S1 – Critically imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.

Pennsylvania Natural Heritage Program

St. Andrew's Cross
Hypericum stragulum

Description

St. Andrew's cross is a low-growing, deciduous shrub with erect stems up to 12 inches (30 cm) tall. The leaves are oppositely arranged, ¾ to 1 inch (2-3 cm) long, untoothed on the margin, oval or lance-shaped and usually widest above the middle, rounded at the tip and tapered toward the base. The flowers, appearing in July and August, are bright yellow and have 4 narrow petals, which are about ⅓ inch (9 mm) long and configured in a cross-like pattern, and are subtended by 2 green sepals. The fruit is a many-seeded capsule.



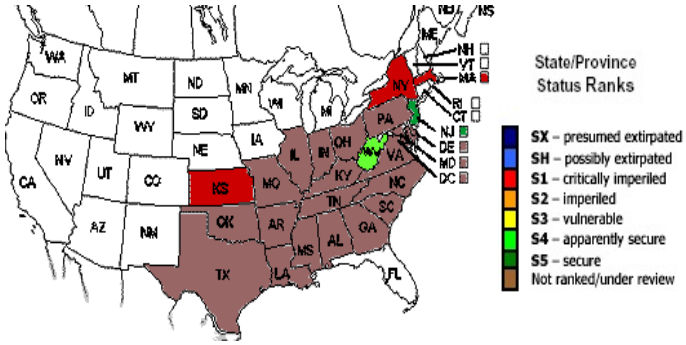
Photo source: John Kunsman (PNHP)

Distribution & Habitat

St. Andrew's cross occurs from New York and Massachusetts south into Georgia and west into Kansas and Texas. In Pennsylvania, this species occurs near the northern end of its range, and has been found in several southern, particularly southeastern, counties. It grows in dryish, open places, such as grasslands, successional clearings, thickets, open woods, and serpentine barrens.

North American State/Province Conservation Status

Map by NatureServe 2007

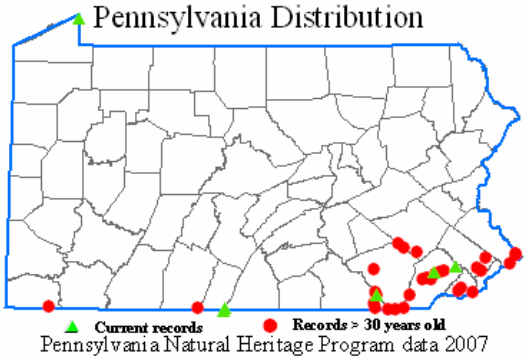


Current State Status

The PA Biological Survey (PABS) considers St. Andrew's cross to be a species of special concern, based on the few occurrences that have been recently confirmed. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Undetermined by PABS. About 10 populations are currently known from the state.

Conservation Considerations

The populations of St Andrew's cross in the state are threatened by human-related habitat loss, natural succession, invasive species, and indiscriminate application of herbicides. Given the preference of the species for open habitats, active management - such as fire, mowing, or invasive species removal - is often required to maintain the proper successional stage and ecological conditions for the species to thrive.



NatureServe conservation status ranks

G5 – Globally secure; **S2** – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

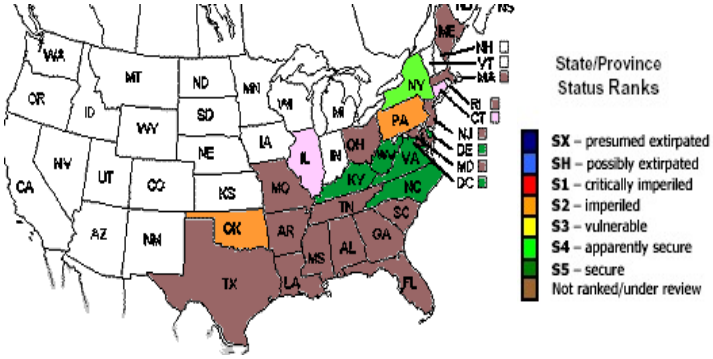
American Holly
Ilex opaca

Description
American holly is an evergreen shrub or small tree that grows to 50 feet (15 meters) in height. It can be easily recognized in any season by its alternately arranged, thickish, evergreen leaves that have a sharp spine at the tip and additional spines along the margin. The flowers, appearing in May and June, are unisexual, so that the familiar berry-like fruit, red at maturity, can be found only on female plants.

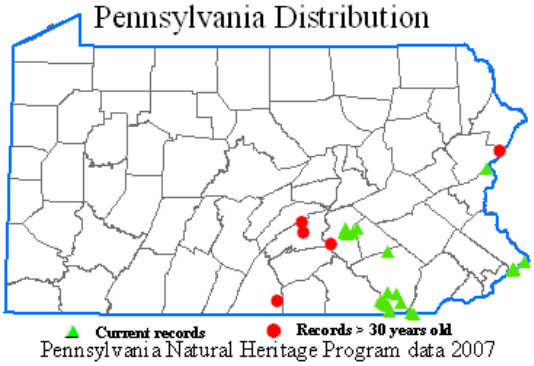

Photo source: John Kunsman (PNHP)

Distribution & Habitat
American holly has a distribution from coastal New England south and west into Florida and Texas. In Pennsylvania, it is near the northern end of its range, and occurs mostly in the southeastern counties. The species grows on wooded slopes and streambanks. It has also been grown as an ornamental, particularly in the southeastern counties, and may escape locally to woodlots, thickets, and fencerows.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers American holly to be a species of special concern, based on the relatively few native occurrences that have been recently confirmed. The species has a PA legal rarity status and a PABS suggested rarity status of Threatened.



Conservation Considerations
The conservation of American holly in Pennsylvania has concentrated on protecting populations that are believed to be indigenous and that represent native genotypes. Occurrences of the species that have resulted from escapes from plantings are of uncertain genetic origin and are considered to be of much lower conservation significance. As a woodland species, proper forest management and control of invasive species are important for the long term viability of American holly. Gathering of the branches of wild trees for winter decoration should be discouraged.

NatureServe conservation status ranks
G5 – Globally secure; **S2** – Imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

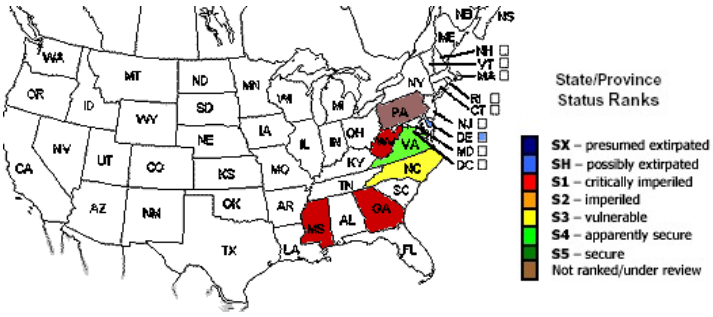
Quillwort
Isoetes valida

Description
Quillworts as a group are mostly aquatic or semi-aquatic herbs that are considered to be relatives of ferns. Their tufted growth habit and elongate, slender leaves superficially resemble certain flowering plants, particularly rushes or grasses. Quillworts reproduce by spores, which are microscopic in size and grouped together at the spoon-like base of certain leaves. The species of quillworts, some of which are common in Pennsylvania, are difficult to distinguish and require detailed examination of the spores. The species highlighted here, *Isoetes valida*, differs from related species by its relatively small, irregularly ridged spores.

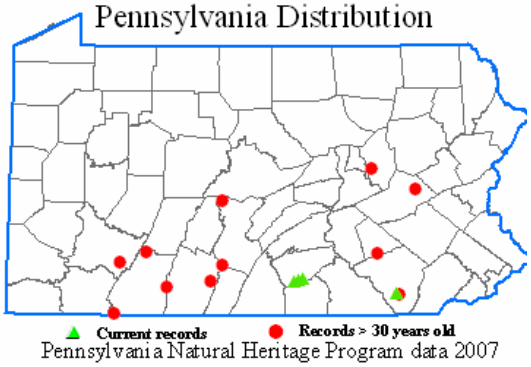

Photo Source: PNHP

Distribution & Habitat
This species of quillwort can be found from Pennsylvania south into Georgia and Mississippi. In Pennsylvania, it has been documented historically in some southern counties, where it grows in low volume streamlets, seepages, impoundments, and other wet places.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers this species of quillwort to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Undetermined by PABS. Fewer than 5 populations are currently known from the state, but more field surveys are needed.



Conservation Considerations
The viability of populations of this species of quillwort and its habitat may be enhanced by creating buffers around wetlands, controlling of invasive species, and protecting the natural hydrology surrounding wetlands. More field surveys are needed to determine the range, relative abundance, and ecological requirements of *Isoetes valida*.

NatureServe conservation status ranks
G4 –Apparently globally secure; SU – Not ranked/under review in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- Washington State Department of Ecology. 2007. An Aquatic Plant Identification Manual [web application]. Available at http://www.ecy.wa.gov/programs/wq/plants/plantid2/. Accessed April 17, 2007.

Forked Rush
Juncus dichotomus

Description
Forked rush is a perennial herb with rounded, slender stems that may be from 1 and 3 feet (3-9 dm) tall. The leaves are elongate, about 1/16 inch (2 mm) wide, rounded in cross-section and indented or channeled near the top, and only about ⅓ to ½ as long as the length of the stem. The flowers, appearing in late spring and summer, are grouped in an open branched cluster at the top of the stem... Flowers have 6 pointed petals and sepals that average about 3/16 inch (5 mm) long. The petals and sepals remain around the fruit, a brownish, many-seeded capsule, as it ripens.

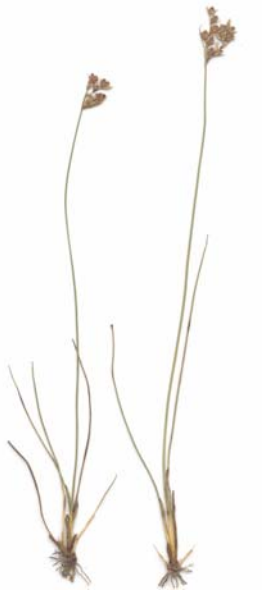
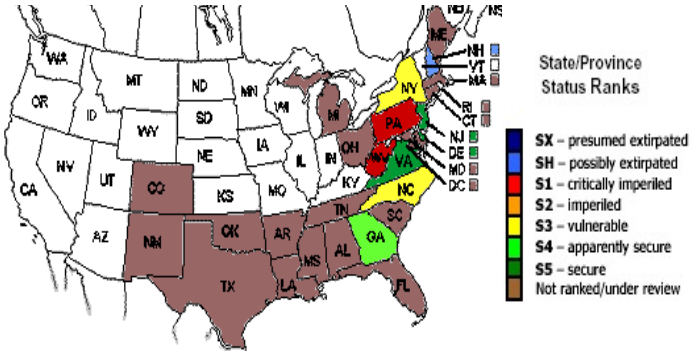


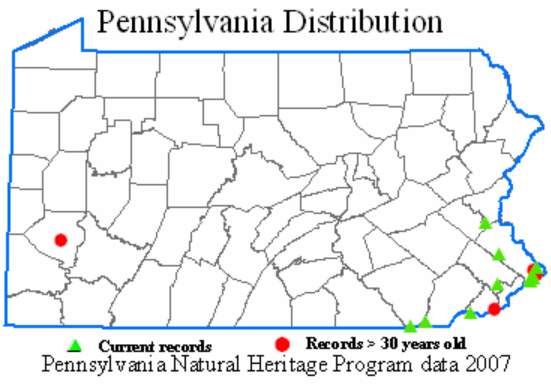
Photo source: John Kunsman (PNHP)

Distribution & Habitat
Forked rush has a range mostly near the coastal from Maine south into Florida and west into the southwestern states. In Pennsylvania, it has been documented historically in some southern, particularly southeastern, counties. It grows in moist to damp old fields, openings, clearings, and open woods.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers forked rush to be a species of special concern, based on the few occurrences that have been recently confirmed. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. About 15 populations are currently known from the state.



Conservation Considerations
The viability of populations of this species and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology around wetlands. Active management – such as fire, mowing, or invasive species removal – may be required to maintain the proper successional stage at sites where it grows.

NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

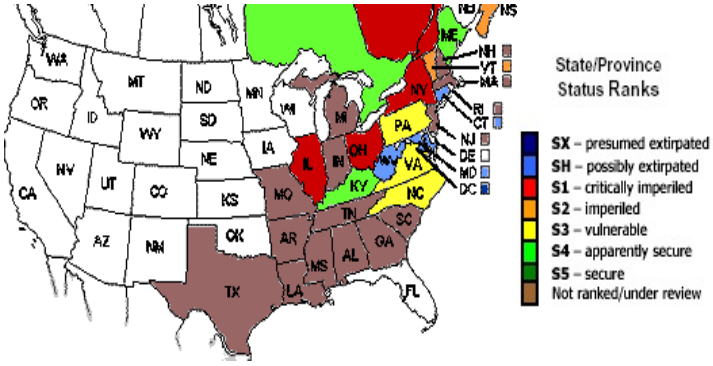
Downy Lettuce
Lactuca hirsuta

Description
The downy lettuce is an annual or biennial herb with milky sap. The slightly to densely hairy stem can reach 8 feet (2.5 m) in height. The leaves are arranged alternately on the stem and variable in shape and length, but tend to have toothed, pinnate lobes. The flowers are individually tiny and are grouped in yellow flower heads that are 5/8 to 7/8 inch (15 to 22 mm) long at maturity. The individual fruits have a slender "beak" at the top, somewhat similar to dandelions. The flower heads and fruits of downy lettuce are slightly larger than a very similar and much more common species of wild lettuce, *Lactuca canadensis*.


Photo source: John Kunsman (PNHP)

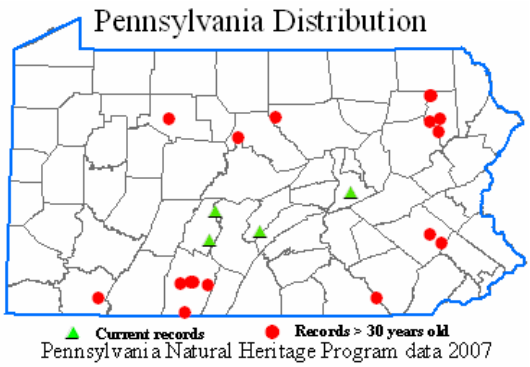
Distribution & Habitat
The downy lettuce has a distribution from Canada south and west into Georgia and Texas. In Pennsylvania, it has been found scattered throughout the state. The species grows in open woods, clearings, thickets, powerline and pipeline rights-of-way, and ridgetops.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers downy lettuce to be a species of special concern, based on the relatively few occurrences that have been recently confirmed. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Undetermined by PABS. meaning that more information is needed before a more definitive rarity status can be designated

Conservation Considerations
More field surveys are needed to determine the range, abundance, and ecological requirements of downy lettuce before a more definitive conservation status, if any, can be assigned. Based on current data, it appears to be a short-lived, early successional species that may have a very limited viability at a given occurrence, even under optimal conditions.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks
G5 – Globally secure; S3 – Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Swamp Dog-hobble
Leucothoe racemosa

Description

Swamp dog-hobble is a deciduous shrub or small tree that may grow up to 9 feet (3 m) in height. The leaves are alternately arranged, sharply toothed on the margin, egg-shaped to elliptic, pointed at the tip, usually more-or-less hairy on the veins below, and typically 1 to 3 inches (3-8 cm) in length. The white flowers, appearing in May or June, are grouped in slender, elongate clusters, with all the flowers tending to point to the same side. The individual flowers, about 3/8 inch (7-9 mm) in length, have a tubular or bell shape. The fruit is a globe-shaped, many-seeded capsule.



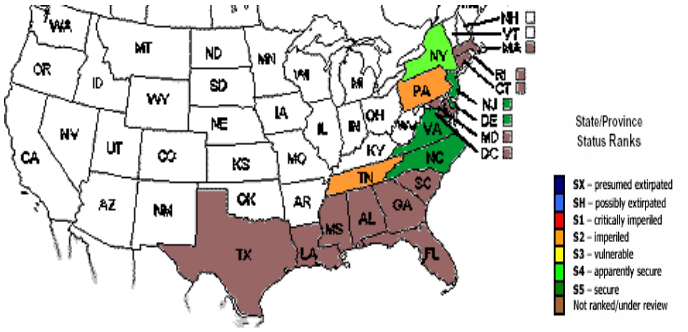
Photo source: PNHP

Distribution & Habitat

Swamp dog-hobble has a mostly coastal range from New York west and south into Texas and Florida. In Pennsylvania, it represents a southerly species and has been documented historically in numerous southeastern counties. It grows in wetlands, particularly swamps, wet thickets, and the margins of ponds and streams.

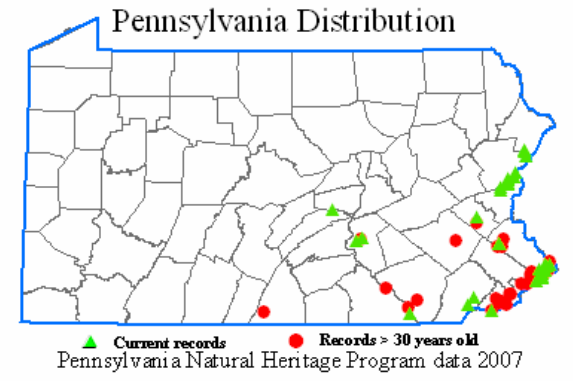
North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status

The PA Biological Survey considers swamp dog-hobble to be a species of special concern, based on the relatively few occurrences that have been recently documented and the wetland habitat. It has a PA legal rarity status of Undetermined and a PABS suggested rarity status of Threatened. About 30 populations are known from the state.



Conservation Considerations

The viability of known populations of swamp dog-hobble and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural
hydrology surrounding wetlands

NatureServe conservation status ranks

G5 – Secure globally; S2– Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

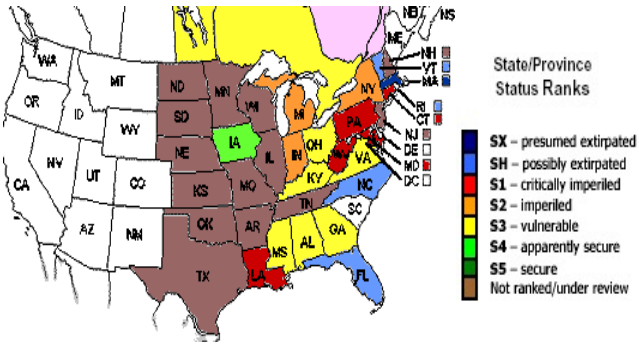
Grooved Yellow Flax
Linum sulcatum

Description
Grooved yellow flax is an erect annual herb that grows up to 2½ feet (75 cm) tall. The common name refers to its grooved stems which are purplish near the base. The leaves grow alternately along the stem. They are linear to oblong, have smooth margins, and attach directly to the stem without a petiole. There are two distinctive blackish glands on the stem near the base of each leaf. The flowers are yellow, have 5 smooth petals, and are roughly ½ inch (1-2 cm) wide. They are held in loose clusters near the top of the stem and bloom from May to September.


Photo source: R. Harrison Wiegand

Distribution & Habitat
Grooved yellow flax has a range throughout eastern North America. In Pennsylvania, it occurs in the central and eastern counties. It grows in dry openings and barrens, especially on limestone and serpentine substrates.

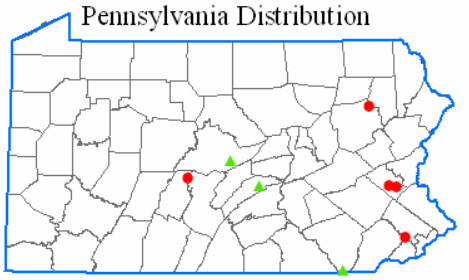
North American State/Province Conservation Status
Map by NatureServe 2007



Current Stat e Status
The PA Biological Survey (PABS) considers the grooved yellow flax to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and the very specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered.

Groved yellow flax populations are threatened by habitat loss and succession. Over time, the open nature of the habitats required by this species may be lost due to encroachment by woody and invasive species. Other potential hazards include trampling, incompatible land management, and habitat fragmentation, which limits seed dispersal.

Conservation Considerations
Maintenance of known populations and preservation of the sandy barrens communities where grooved yellow flax grows will be crucial to its survival. Removal of overgrowth and invasive species with the integration of fire regimes, when appropriate, will help to preserve the open nature of the sites. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.



NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Common Hemicarpa
Lipocarpha micrantha

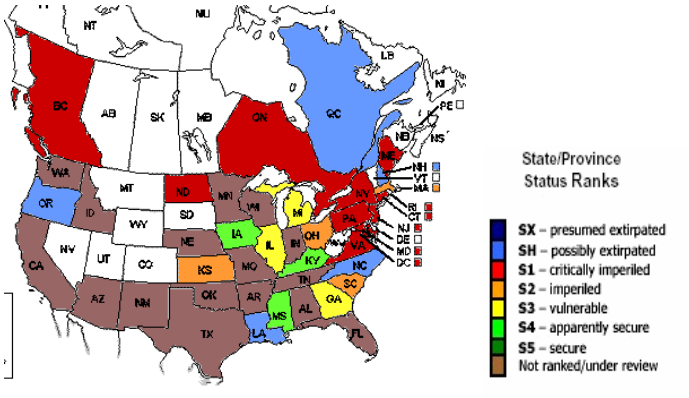
Description
Common hemicarpa is a tiny annual herb that may grow to 4 inches (10 cm) in height, but often is less than 1 inch. It has a tufted appearance with very narrow, hair-like leaves. The minute flowers, appearing from July to September, are grouped in compact clusters that are ¼ inch or less in length. Each cluster is subtended by hair-like bracts that well exceed the length of the cluster.



Photo source: USDA-NRCS PLANTS Database

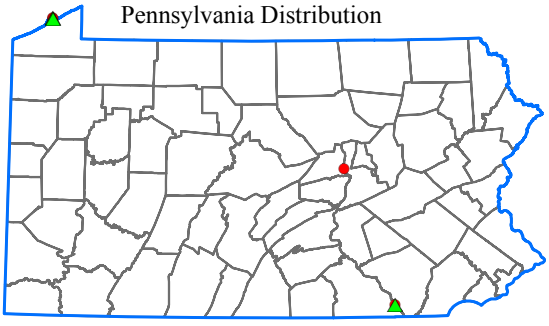
Distribution & Habitat
Common hemicarpa has a distribution throughout most of North America. In Pennsylvania, it has been documented historically only in a few widely scattered counties. It grows on sandy shorelines along Lake Erie and in scoured river beds and shores of the Susquehanna River in the eastern part of the state.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers common hemicarpa to be a species of special concern, based on the few occurrences that have been recently confirmed and the specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 5 populations are known from the state.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

Conservation Considerations
The viability of the known populations of common hemicarpa and its habitat will require maintaining the natural seasonal hydrologic fluctuations of the Susquehanna River and Lake Erie, as well as retaining the natural conditions of the shorelines and islands. Invasive species may be a threat in some locations.

NatureServe conservation status ranks
G5 – Secure globally; S1 – Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

Upright Primrose Willow
Ludwigia decurrens

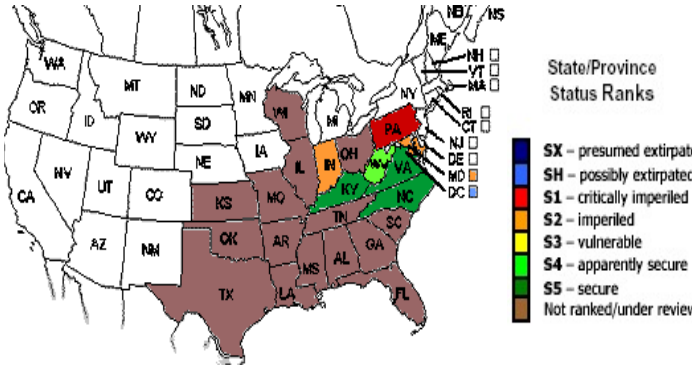
Description
Upright primrose willow is an annual herb with hairless, square stems that may grow up to 6½ feet (2 meters) tall. The leaves are alternately arranged, lance-shaped or linear, and the margins are untoothed. The leaf bases extend downward along the stem and create a raised line or "wing." The flowers, appearing from July to September, are about one inch (2.5 cm) in width and have 4 yellow petals and 8 stamens. The fruit is a many-seeded capsule that is more-or-less four-sided. Despite its common name, the plant is not a true willow but a member of the evening-primrose family.



Photo source: USDA-NRCS PLANTS Database

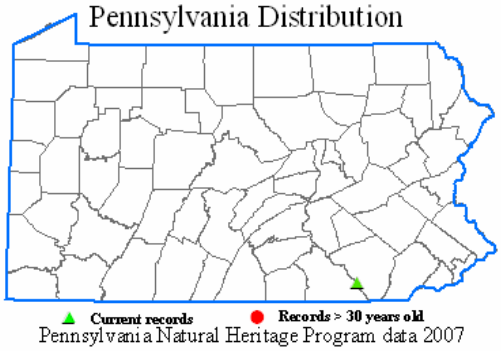
Distribution & Habitat
Upright primrose willow has a range from southeastern Pennsylvania west into Wisconsin and south into Florida and Texas. In Pennsylvania, it reaches the known northern limit of its range and has been found only in Lancaster County, where it inhabits shoreline areas of the Susquehanna River.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers upright primrose willow to be a species of special concern, based on the single occurrence that has been confirmed, its very small state range, and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. At present, it is only known from Lancaster County.

Conservation Considerations
Upright primrose willow is a southerly species that appears to be expanding its range to the north. It was first documented in Pennsylvania in 1987 and may become more frequent in the state in the future. The viability of the single known occurrence can be enhanced by maintaining the natural seasonal fluctuations in the water levels and the natural condition of the shoreline and islands of the Susquehanna River. Invasive species represent a threat to its habitat.



NatureServe conservation status ranks
G5 – Globally secure S1 – Critically imperiled in Pennsylvania

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Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

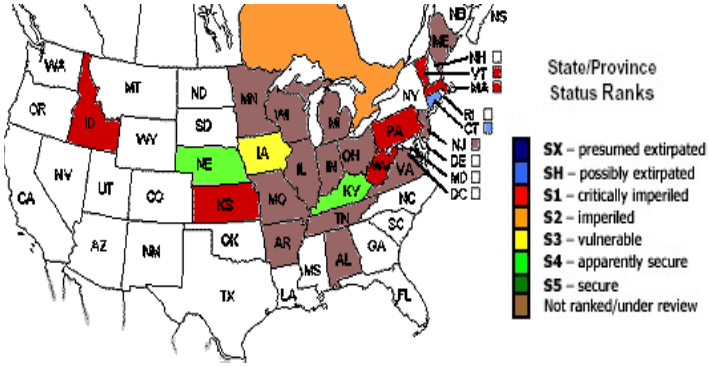
False Loosestrife Seedbox
Ludwigia polycarpa

Description
False loosestrife seedbox is a perennial herb with erect or trailing, four-sided stems that can grow up to 40 inches (1 meter) long. The leaves are alternately arranged, lance-shaped or linear, untoothed on the margins, stalkless, and up to 5 inches (12 cm) long. The flowers, appearing from July to September, occur in the leaf axils. The petals are absent or minute. The most distinctive feature of the plant is the 4-sided capsular fruit, which has 4 sepal lobes at its summit and 2 narrow leaf-like bracts at its base.


Photo source: Tom Smith (PNHP)

Distribution & Habitat
The false loosestrife seedbox has a distribution centered in midwestern North America. In Pennsylvania, it appears to be at an eastern border of its range and has been found in a few counties along the Susquehanna River. It grows on shorelines and in wet depressions and marshes.

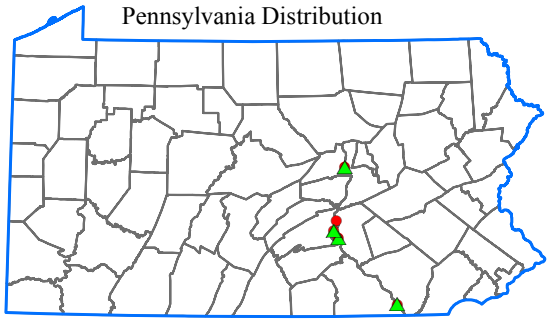
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers false loosestrife seedbox to be a species of special concern, based on the very few occurrences that have been recently confirmed, its restricted state range, and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Only a few populations are currently known from the state.

Conservation Considerations
The populations of false loosestrife seedbox currently known from the state are located either in or in close proximity to the Susquehanna River. The viability of the species and its habitat can be enhanced by maintaining the natural seasonal fluctuations in the water level of the river and the natural conditions of its shoreline and islands. Threats to the species include natural succession and invasive species.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks
G4 – Apparently globally secure; S1 – Critically imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

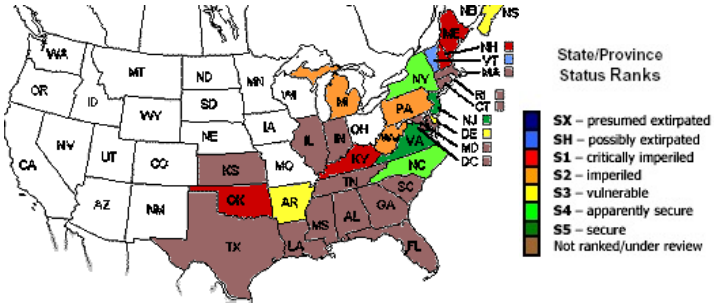
Southern Bog Clubmoss
Lycopodiella appressa

Description
Southern bog clubmoss is a perennial with leafy, creeping, horizontal stems that occasionally produce erect fertile stems. The fertile stems grow up to 16 inches (40 cm) tall. The leaves are scale-like, with at least a few teeth on the margins, and are pressed flat against the stem in an upward direction and cover the entire length of the stem. The species does not have flowers, fruits or seeds, but produces spores in a club-like structure, called a strobilus, located at the top of each fertile stem. The strobilus in this species makes up less than 1/3 of the total height of the fertile stem.


Photo source: John Kunsman (PNHP)

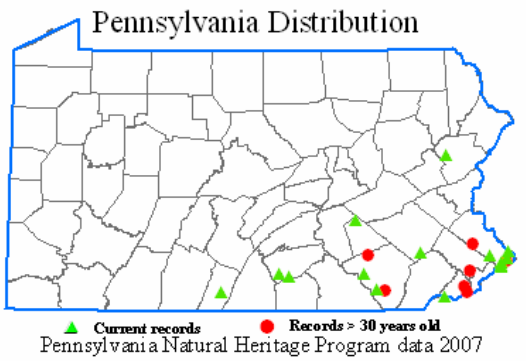
Distribution & Habitat
Southern bog clubmoss has a mostly coastal distribution from Nova Scotia west and south into Texas and Florida. In Pennsylvania, it occurs mainly in the southeastern counties, where it grows in sandy to peaty seepages, depressions, and damp successional openings.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers southern bog clubmoss to be a species of special concern, based on the few occurrences that have been recently confirmed and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 12 populations are currently documented from the state.

Conservation Considerations
The viability of known populations of southern bog clubmoss and its habitat type can be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. This species can colonize certain types of disturbed ground, such as abandoned quarries and utility rights-of-way, if the proper substrate and moisture conditions are present. Natural succession, invasive species, and the indiscriminate application of herbicide can be threats at these sites.



NatureServe conservation status ranks
G5 – Globally secure; S2 – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

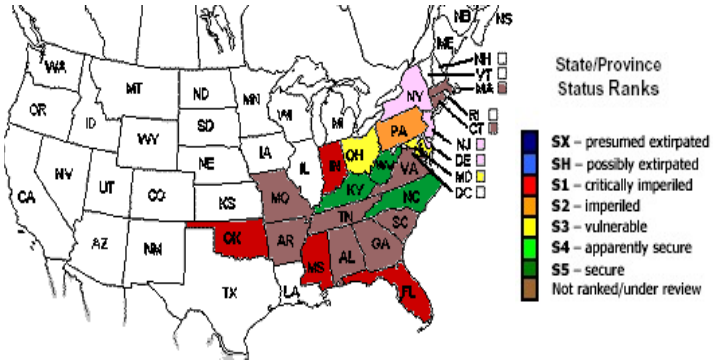
Umbrella Magnolia
Magnolia tripetala

Description
Umbrella magnolia is a small deciduous tree that often has several trunks and grows up to 33 feet (10 meters) tall. The leaves are alternate, untoothed on the margin, conspicuously large (to 24 inches, or 60 cm long), oval to oblong in shape, and usually clustered at the ends of the stout branchlets. The flowers, appearing in May, have large, showy, white petals that are up to 5½ inches (14 cm) long. The fruits are aggregated in a 3 to 5 inch (7-12 cm) cone-like structure, with the enclosed seeds having an orange or red outer covering.

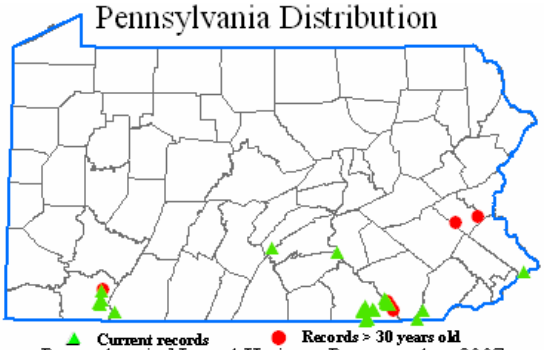

Photo Source: PNHP

Distribution & Habitat
Umbrella magnolia has a range from Pennsylvania west and south into Oklahoma and the Gulf Coast states. In Pennsylvania, it reaches a northern border of its natural range, and has been documented in several southern counties. It grows on rich wooded slopes, wooded streambanks, and in moist ravines. The species has also been cultivated in locations (e.g., the Philadelphia area) that are believed to be outside its natural range in the state, and has escaped from these plantings to woodlands.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers umbrella magnolia to be a species of special concern, based on the few occurrences that have been recently confirmed. It has a PA legal rarity status of Threatened and a PABS suggested rarity status of Rare. About 25 occurrences have been documented in the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
Maintenance of natural populations of umbrella magnolia and its habitat type will be enhanced by creating buffers around fragmented woodland habitat and controlling invasive species. Populations of umbrella magnolia that have resulted from escapes from cultivation are not considered to be of conservation significance.

NatureServe conservation status ranks
G5 – Globally secure; S2 – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

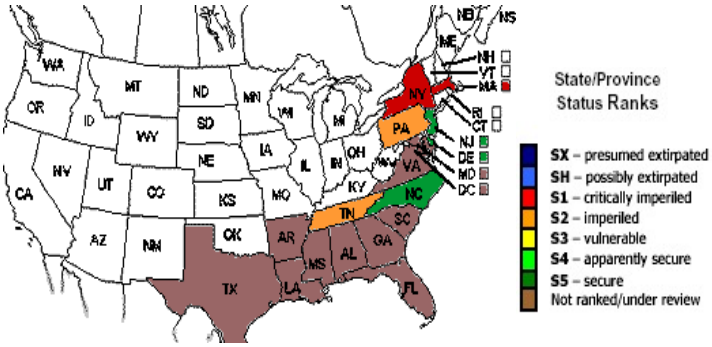
Sweet Bay Magnolia
Magnolia virginiana

Description
Sweet bay magnolia is a semi-evergreen tree that is often multistemmed and may grow to 65 feet (20 meters) tall, but in Pennsylvania is usually much smaller. The leaves are alternately arranged, thickish in texture, untoothed on the margin, noticeably whitish on the lower surface, elliptic in shape, and from 3 to 5 inches (7.5-13 cm) long. The fragrant white flowers, appearing in May and June, are relatively large and showy, approximately 2 to 3 inches (5-7.5 cm) wide. The fruit is a 2 inch (5 cm) cone-like structure containing seeds that have a red or orange outer covering.


Photo source: R. Harrison Wiegand

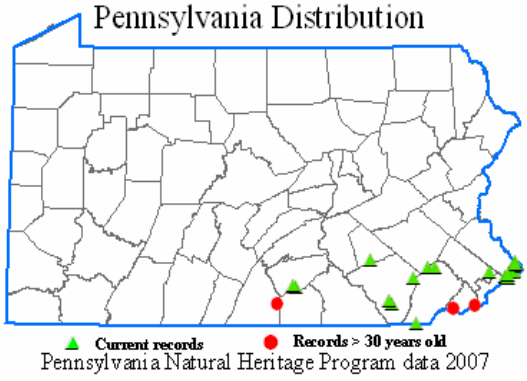
Distribution & Habitat
Sweet bay magnolia has a coastal range from southern New England west and south into Texas and Florida. In Pennsylvania, it represents a southerly species and has been documented in several southeastern counties. It occurs in wetlands, particularly swamps and seepy woodlands.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers sweet bay magnolia to be a species of special concern, based on the few occurrences that have been recently confirmed, its limited state range, and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 20 populations, most with few individuals, have been documented in the state.

Conservation Considerations:
The viability of populations of sweet bay magnolia and its habitat type will be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. Excessive deer browse may be threat in some locations. Populations of sweet bay magnolia occurring west of the Coastal Plain in the state have significance for plant geography and possibly for genetic diversity.



NatureServe conservation status ranks
G5 – Globally secure; S2 – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Three-flowered Melic-grass
Melica nitens

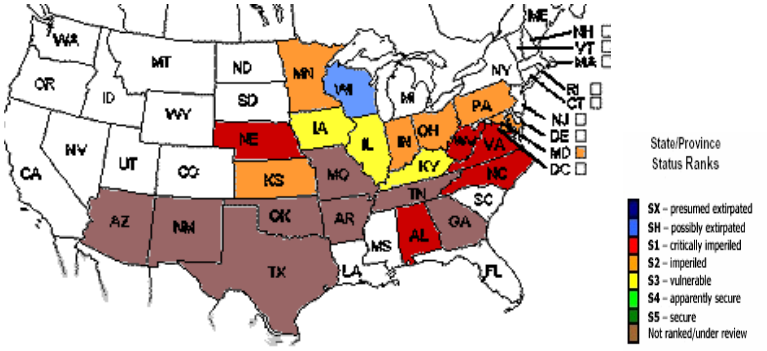
Description
Three-flowered melic-grass is a perennial grass that grows from 1½ to 4 feet (5-12 dm) in height. The leaves are alternately arranged, linear, flattened, elongate, 4 to 8 inches (10-20 cm) in length and about 3/8 inch (5-12 mm) in width. The flowers, appearing from late May into July, are grouped in spikelets that are scattered in a branched terminal cluster. The individual spikelets are 3/8 to ½ inch (9-12 mm) in length, contain usually 3 flowers, and tend to hang downward when mature.



Photo source: PNHP

Distribution & Habitat
Three-flowered melic-grass has a distribution from southern Pennsylvania south and west into Florida and Texas. In Pennsylvania, this species reaches a northern border of its known range and has been documented historically in a few southern counties. It grows on cliffs, rock outcrops, rocky slopes and shores, and dry woods.

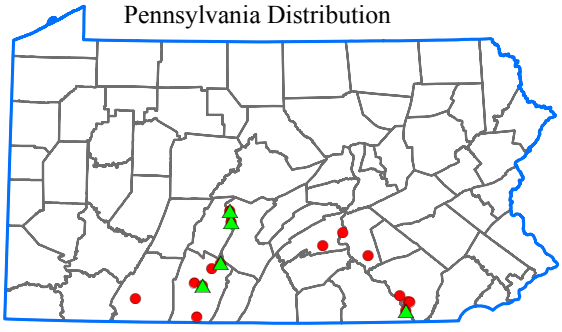
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers three-flowered melic-grass to be a species of special concern, based on the few occurrences that have been recently confirmed. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 5 populations are currently known from the state.

Conservation Considerations
The known populations of three-flowered melic-grass have threats from natural succession, invasive species, and the indiscriminate application of herbicide. Because of the preference of the species for relatively open habitats, active management, such as fire, mowing, or invasive species removal, may be required to maintain the proper successional stage and ecological conditions for the species to thrive.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks
G5 – Secure globally; S2 – Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Prickly-pear Cactus
Opuntia humifusa

Description

Prickly-pear cactus is a perennial herb forming mats or clumps. The stems are shaped into fleshy, flattened pads that are up to 4 inches (10 cm) long and 2½ inches (6 cm) wide. The pads should be touched with caution because of the presence of minute barbed hairs that are very irritating when lodged in the skin. The leaves are reduced to spines, which may not be present on a given plant. The very attractive flowers, appearing in June and July, are bright yellow and up to 3 inches (8 cm) wide. The fruit is fleshy, vase-shaped, red or purple at maturity, and attached along the margins of the pads.



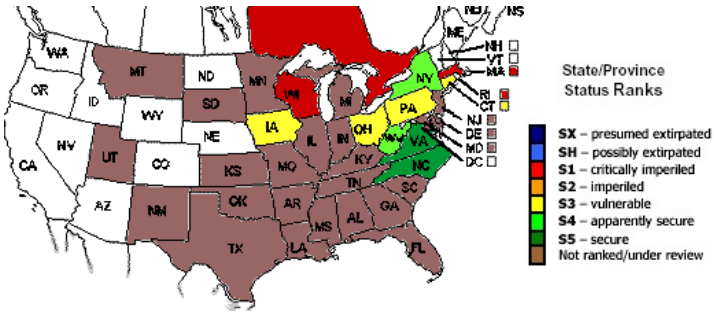
Photo source: John Kunsman (PNHP)

Distribution & Habitat

Prickly-pear cactus has a wide range in eastern and midwestern North America. In Pennsylvania, it occurs scattered primarily in the southern counties, growing on dry, open, rocky ground, such as on shale barrens, slopes, and cliffs. It is also cultivated and may escape locally from these plantings.

North American State/Province Conservation Status

Map by NatureServe 2007



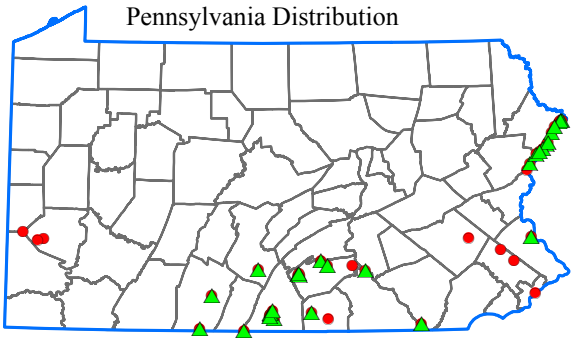
Current State Status

The PA Biological Survey (PABS) considers prickly-pear cactus to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Rare. About 30 occurrences are currently documented from the state.

Conservation Considerations

Occurrences of prickly-pear cactus and its habitat type are threatened by human-related habitat loss, natural succession, invasive species, quarrying, and the collection of wild plants by gardeners. Because of the preference of the species for sunny conditions, active management – such as fire or invasive species removal - may be required to maintain the proper successional stage and ecological conditions. Escapes from cultivation are not considered to be of conservation significance.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks

G5 – Globally secure; S3 – Vulnerable in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

Golden Club
Orontium aquaticum

Description

Golden club is an aquatic perennial that often grows in standing water, with its leaves and flowering stems extending above the water line. This species belongs to the same family as Jack-in-the-pulpit and grows up to 18 inches (46 cm) tall. The leaves are oblong to elliptic, dark green, and velvety. The leaves are up to 12 inches (30 cm) long and repel water so that they always appear dry. The flowers are yellow and bloom from April to May. The tiny flowers are carried on the golden-yellow tip of club-shaped flowering stems. These swollen flowering stems are white directly below the flowers.



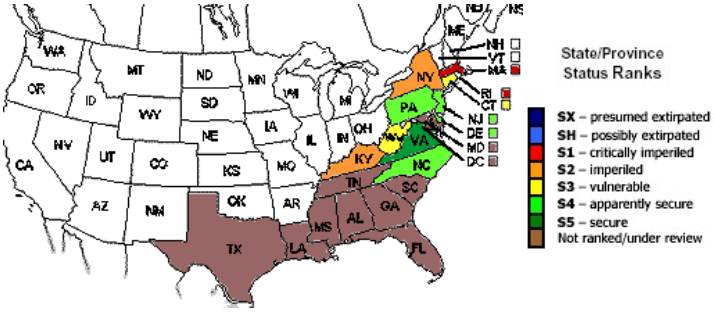
Photo source: Sally Ray (PNHP)

Distribution & Habitat

Golden club occurs from New York and Massachusetts south to Florida and west to Texas. In Pennsylvania, it can be found in lakes, ponds, oxbow floodplains, and wet shores where it grows rooted in the muck beneath the water.

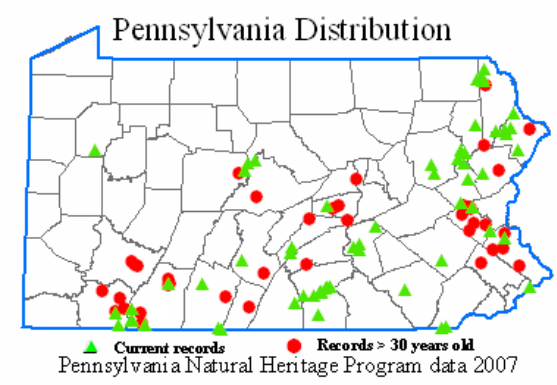
North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status

The PA Biological Survey (PABS) has assigned the golden club to the Watch list. Populations can be negatively impacted by poor water quality, deer and waterfowl browsing, conversion of land for development, and accompanying hydrologic changes. This species has disappeared from many sites in southeast Pennsylvania.



Conservation Considerations

Maintenance of known populations of golden club and protection of its wetland communities will be crucial to its survival. Creating buffers around its habitat, removal of invasive species, and protection of wetland hydrology will help to maintain populations and encourage new population growth. The management of known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

NatureServe conservation status ranks

G5 – Globally secure; S4 – Apparently secure in Pennsylvania

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.

Pennsylvania Natural Heritage Program. 2007.

Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.

- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia

PNHP
Pennsylvania Natural Heritage Program

Swamp Lousewort
Pedicularis lanceolata

Description
Swamp lousewort is a perennial herb that may grow from 1 to 3 feet (3-9 dm) tall. The leaves are oppositely arranged on the lower stem and alternately arranged on the upper stem, oblong to lance-shaped, variably lobed or toothed on the margins, and up to 4 inches (10 cm) long. The flowers, appearing in August and September, occur in a terminal cluster. The petals are partially fused into a tube-like shape, yellowish, and about 1 inch (2.5 cm) long. The fruit consists of a many-seeded capsule

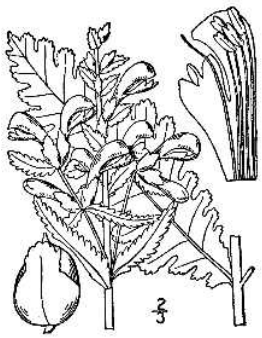
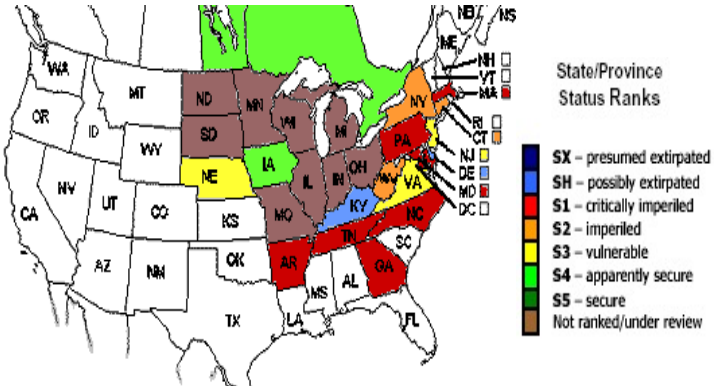


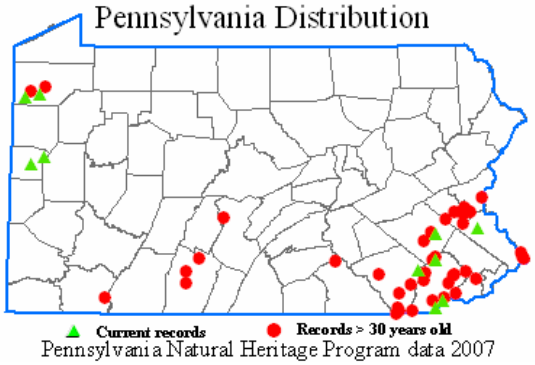
Photo source: USDA-NRCS PLANTS Database

Distribution & Habitat
Swamp lousewort has a range from southern New England west into the Dakotas and south into Arkansas and Georgia. In Pennsylvania, it occurs mostly in the southern and northwestern counties, where it grows in calcareous wetlands, including boggy meadows, marshes, swamps, and fens.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers swamp lousewort to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Endangered by PABS. About 10 populations of swamp lousewort are currently known in the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The known occurrences of swamp lousewort and its habitat type will be enhanced by creating buffers around its habitat, removal of invasive species, and protection of wetland hydrology. Excessive deer browsing may be a threat in some locations.

NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

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References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

PNHP
Pennsylvania Natural Heritage Program

Swamp Lousewort
Pedicularis lanceolata

Description
Swamp lousewort is a perennial herb that may grow from 1 to 3 feet (3-9 dm) tall. The leaves are oppositely arranged on the lower stem and alternately arranged on the upper stem, oblong to lance-shaped, variably lobed or toothed on the margins, and up to 4 inches (10 cm) long. The flowers, appearing in August and September, occur in a terminal cluster. The petals are partially fused into a tube-like shape, yellowish, and about 1 inch (2.5 cm) long. The fruit consists of a many-seeded capsule

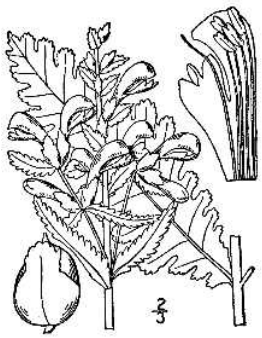
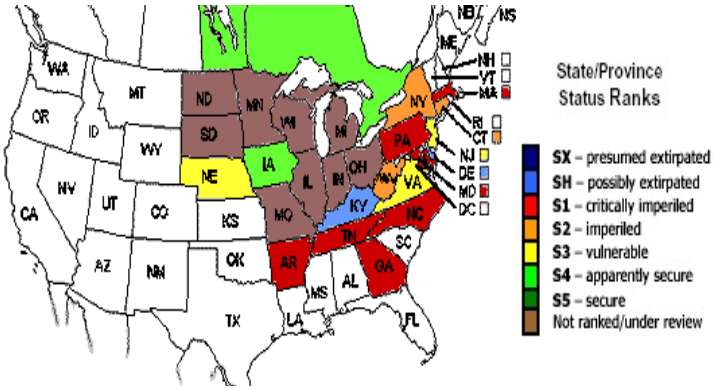


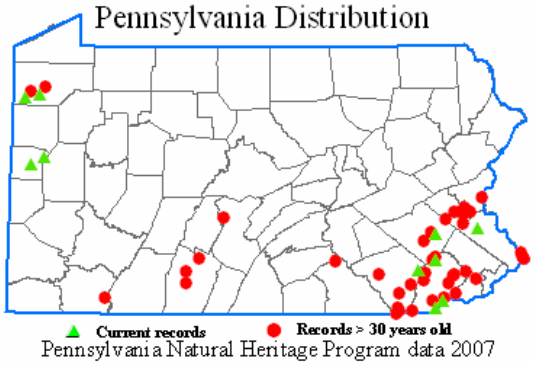
Photo source: USDA-NRCS PLANTS Database

Distribution & Habitat
Swamp lousewort has a range from southern New England west into the Dakotas and south into Arkansas and Georgia. In Pennsylvania, it occurs mostly in the southern and northwestern counties, where it grows in calcareous wetlands, including boggy meadows, marshes, swamps, and fens.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers swamp lousewort to be a species of special concern, based on the few occurrences that have been recently confirmed and its specialized wetland habitat. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Endangered by PABS. About 10 populations of swamp lousewort are currently known in the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations
The known occurrences of swamp lousewort and its habitat type will be enhanced by creating buffers around its habitat, removal of invasive species, and protection of wetland hydrology. Excessive deer browsing may be a threat in some locations.

NatureServe conservation status ranks
G5 – Globally secure; S1 – Critically imperiled in Pennsylvania

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References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

PNHP
Pennsylvania Natural Heritage Program

Carolina Leaf-flower
Phyllanthus caroliniensis

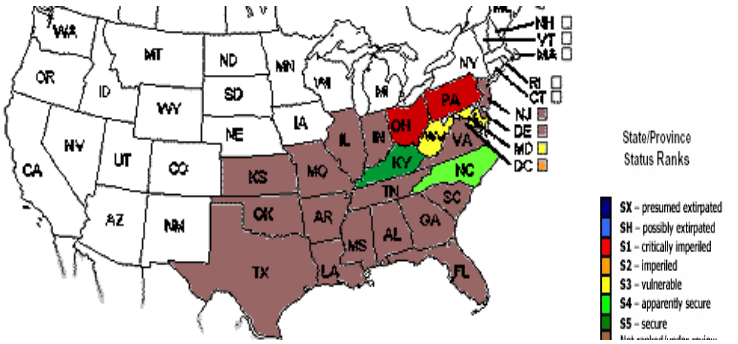
Description
Carolina leaf-flower is an erect, sometimes branched, annual herb that may grow to 2 feet (6 dm) in height, but is often much shorter. The leaves are alternately arranged, stalkless, untoothed on the margin, oblong to elliptic in shape, and less than 1 inch (1-2 cm) in length. The tiny flowers, appearing from July to September, occur in the axils of the upper leaves. The fruit is a dry capsule that is about 1/8 inch (1-2 mm) in thickness.



Photo source: Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database

Distribution & Habitat
Carolina leaf-flower has a range from New Jersey west into Missouri, and south into the Gulf Coast states. In Pennsylvania, it represents a southerly species and has been documented historically in a few southeastern counties, particularly along the lower Susquehanna River. It grows in various damp to wet open habitats, especially on the shorelines of rivers, streams, and ponds, and may also be found in human-created disturbances that simulate natural habitats.

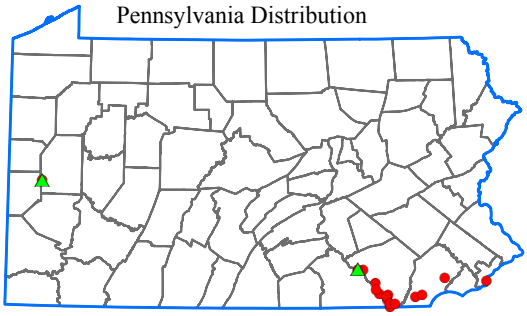
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers Carolina leaf-flower to be a species of special concern, based on the few occurrences that have been recently confirmed and the wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 5 populations, mostly along the lower Susquehanna River, are known from the state.

Conservation Considerations
The viability of populations of Carolina leaf-flower and its habitat depends on maintaining the natural hydrology and natural condition of the shoreline and islands of the Susquehanna River. This species appears well-adapted to the seasonal fluctuations in water levels, especially the lower water levels of summer and fall when the plant is flowering and fruiting. Invasive species represent a threat to this species and its habitat.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks
G5 – Secure globally; **S1** – Critically imperiled in Pennsylvania

PNHP
Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.B. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database / USDA NRCS. 1995. *Northeast wetland flora: Field office guide to plant species*. Northeast National Technical Center, Chester.

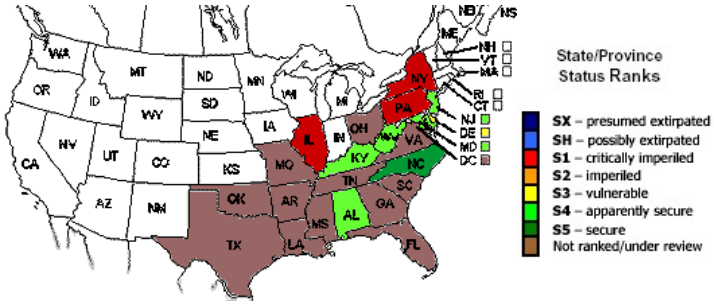
Shortleaf Pine; Yellow Pine
Pinus echinata

Description
Shortleaf pine is an evergreen coniferous tree that may grow 80 to 100 feet (25-30 meters) tall, often with much of the trunk free of lateral dead branches. The bark is reddish-brown and forms scaly plates. The leaves are evergreen, needle-like, in bundles of 2 or occasionally 3, from 2 to 5 inches (5-12 cm) long, relatively slender, and tend to be straight or only slightly twisted. The cones are narrowly egg-shaped, 1½ to 2½ inches (4-6 cm) long, and made up of thin scales that are spirally arranged and have a thickened tip with a short, sharp spine. The cones may persist on the tree for several years.


Photo source: John Kunsman (PNHP)

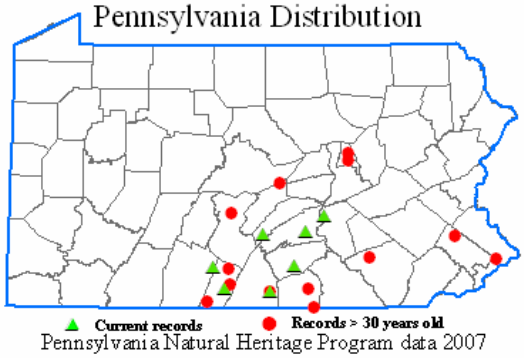
Distribution & Habitat
Shortleaf pine has a distribution from New York south and west into Florida and Texas. In Pennsylvania, where it reaches a northern border of its range, the occurrences are primarily in the southcentral counties. It grows mainly in well drained upland woods and slopes.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers shortleaf pine to be a species of special concern, based on the relatively few occurrences that have been recently confirmed. It does not have a PA legal rarity status, but has been assigned a suggested rarity status of Undetermined by PABS. meaning that more information is needed before a more definitive rarity status can be designated.

Conservation Considerations
More field surveys are needed to determine the range, abundance, and ecological requirements of shortleaf pine. Based on current data, the long-term viability of occurrences will probably require special management, such as prescribed fire, since the species is very intolerant of shade and early successional conditions are necessary for establishment of seedlings.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks
G5 – Globally secure
S1S2 – Critically imperiled in Pennsylvania

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

Bog Bluegrass
Poa paludigena

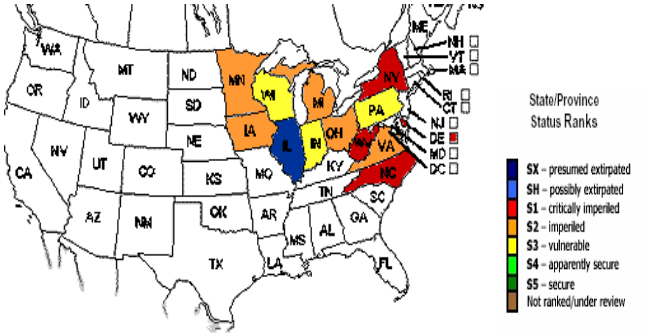
Description
This delicate grass has a very slender stem, which often reclines on other vegetation or the substrate, and may grow from 1/2 to 2 feet (1.7-7 dm) in length. The leaves are alternately arranged, narrow, elongate, 1/12 of an inch (2 mm) wide, and up to 4 inches (10 cm) long. The flowers, appearing from mid May to early June, are aggregated in small spikelets that are individually less than ¼ inch (3-5 mm) long. The spikelets are remotely scattered in a terminal cluster, with the slender branches of the cluster, especially the lower ones, stiffly spreading and/or bent downward as the fruits become mature.



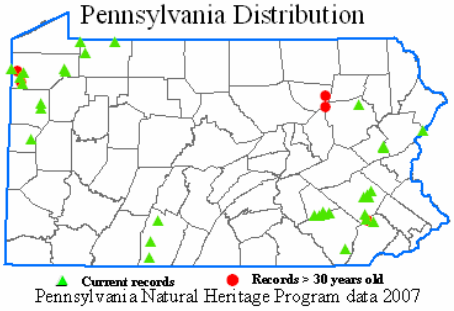
Photo source: John Kunsman (PNHP)

Distribution & Habitat
Bog bluegrass has a range primarily in the Great Lakes states and mid Atlantic states, from New York south into North Carolina and west into Minnesota and Iowa. In Pennsylvania, it has been documented historically in numerous widely scattered counties. It grows in swamps, seepy woods, and along spring-fed streamlets.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers bog bluegrass to be a species of special concern, based on the few occurrences that have been recently confirmed and its very specialized wetland habitat. It has a PA legal rarity status of Threatened and a PABS suggested rarity status of Rare. About 30 populations are currently known from the state.



Conservation Considerations
The viability of populations of bog blue-grass and its habitat may be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the natural hydrology surrounding wetlands. The areas supporting populations should be managed in a way that ensures the continuation of excellent water quality and neutral or calcareous water chemistry.

NatureServe conservation status rank
G3 – Globally vulnerable; S3 – Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

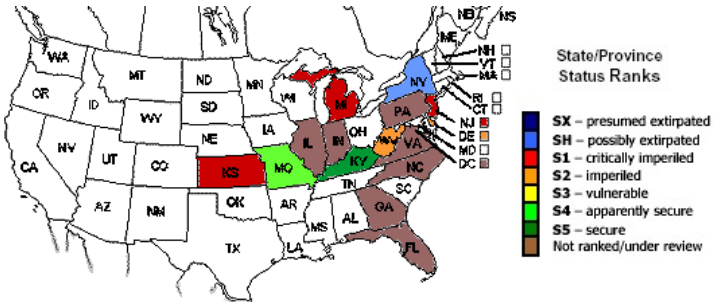
Leaf-cup
Polymnia uvedalia

Description
Leaf-cup is a coarse perennial herb that can reach up to 6½ feet (2 meters) in height. A member of the aster family, this species produces flower heads that look similar to small sunflowers. The leaves a quite large, up to 16 inches (4 dm), and are rough to the touch. The deeply lobed and coarsely toothed leaves have been said to resemble a bear's paw in outline. Leaves are arranged in opposite pairs along the stem. The flower heads are composed of a brownish-yellow center surrounded by 7-13 bright yellow rays. The 2 inch (5 cm) flower heads are produced in leafy, branching clusters at the top of the stems and bloom from July to September.


Photo Source: Rocky Gleason (PNHP)

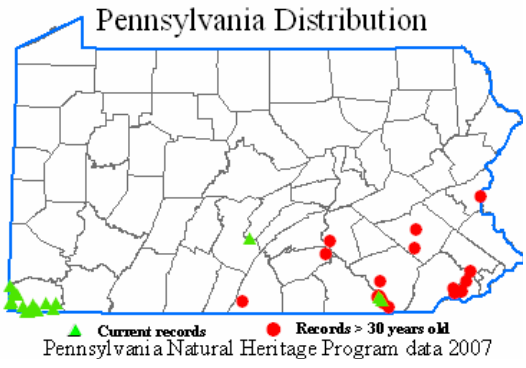
Distribution & Habitat
Leaf-cup is occurs from New York south to Florida and west as far as Kansas. In Pennsylvania, it grows in ravines, moist thickets, and along the banks of streams or rivers.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers the leaf-cup to be a species of special concern, based on the relatively few occurrences that have been confirmed and the localized distribution. It has been assigned a rarity status of Threatened.

Conservation Considerations
Protection of leaf-cup will require maintenance of known populations and preservation of stream and riverbank habitat. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.



NatureServe conservation status ranks
G4G5 – Apparently globally secure; SNR – Not ranked in Pennsylvania

PNHP
Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

Southern Red Oak
Quercus falcata

Description
Southern red oak is a deciduous tree that may grow to 80 feet (25 meters) in height. The bark is gray and furrowed. The leaves are alternately arranged, broadly "U" shaped at the base, densely and permanently hairy on the undersurface, and with 3 to 7 bristle-tipped lobes that tend to have relatively few secondary lobes or teeth. The flowers, appearing from late April to May, are unisexual, with female flowers occurring singly or in pairs and male flowers arranged in much more conspicuous clusters of long, drooping catkins. The fruit is an acorn averaging about 1/2 inch (1.0-1.5 cm) in length, and is covered about ⅓ of its length by a scaly saucer-like cup.



Photo source: PNHP

Distribution & Habitat
Southern red oak has a distribution from New York south and west into Texas and Florida. In Pennsylvania, it represents a southerly species and has been documented historically in a few southeastern counties. The species grows in well-drained woods, thickets, serpentine barrens, and dry slopes.

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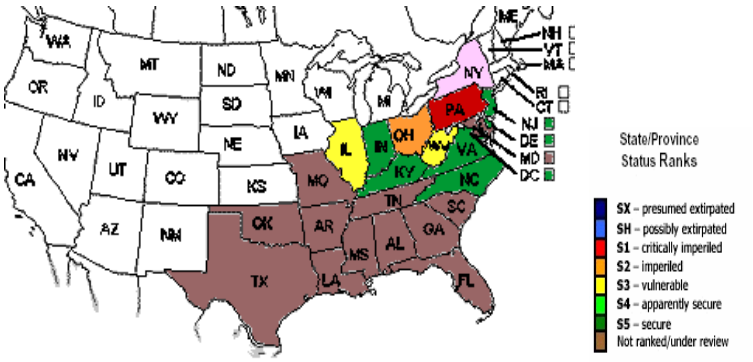
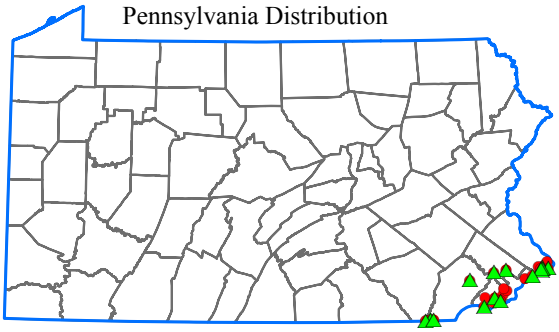
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers southern red oak to be a species of special concern, based on the relatively few occurrences that have been confirmed and the small state range. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 15 populations are known from the state.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

Conservation Considerations
The known populations of southern red oak are threatened by habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

NatureServe conservation status ranks
G5 – Secure globally; S1 – Critically imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T. A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

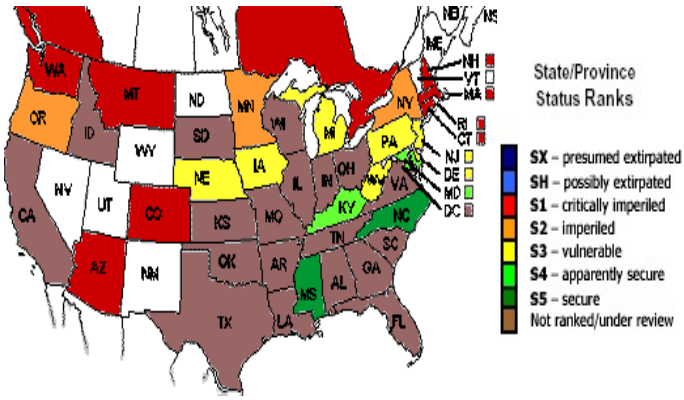
Toothcup
Rotala ramosior

Description
Toothcup is a small annual herb that has smooth stems that may grow up 12 inches (30 cm) in height, but in some cases may be less than 1 inch. The leaves are oppositely arranged, stalkless, averaging about 1 inch (2.5 cm) long, untoothed, generally elliptic in shape with a rounded tip and tapering base. The flowers, appearing from July to September, are located in the leaf axils. Each flower has 4 light pink or whitish petals, which tend to fall off early. The fruit is a many-seeded capsule that is about 3/16 inch (3-5 mm) long and usually becomes red in color as it matures.


Photo source: R. Harrison Wiegand

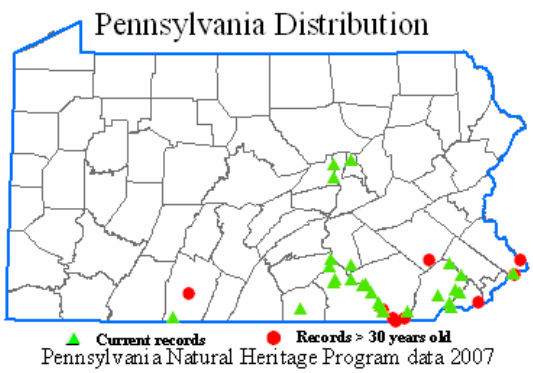
Distribution & Habitat
Toothcup has a very wide range in North America. In Pennsylvania, it has been documented historically in numerous southern counties, particularly along the Susquehanna River. It grows on exposed shorelines, stream margins, streambed outcrops, and other damp, open places.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers toothcup to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Rare. About 30 populations are currently known from the state.

Conservation Considerations
The populations of toothcup that occur along streams and rivers can be enhanced by maintaining the natural seasonal fluctuations in the water level of the stream and the natural conditions of its shoreline. Despite its somewhat narrow habitat requirements, this species appears to be fairly successful in reproducing itself and colonizing new areas. Invasive species may be a threat in some locations.



NatureServe conservation status ranks
G5 – Globally secure; S3 – Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania, Philadelphia.

Limestone Petunia
Ruellia strepens

Description

Limestone petunia is a perennial herb with hairy-lined stems that can reach 40 inches (1 m) in height. The leaves are oppositely arranged, oval to lance-shaped, variable on the margin and in hairiness, and up to 6 inches (15 cm) long and 2½ inches (6 cm) wide. The flowers, appearing from late June through late July, occur singly or in small clusters in the leaf axils. The blue to purple petals are 1 to 2 inches (3-5 cm) long, with a tube-like base and 5 spreading lobes above. The fruit is a hairless capsule with many seeds.



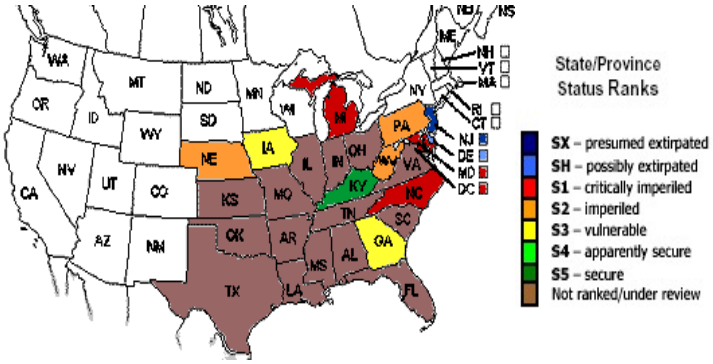
Photo source: R. Harrison Wiegand

Distribution & Habitat

Limestone petunia has a range from New Jersey west into Nebraska, and south into Texas and the Gulf Coast states. In Pennsylvania, it has been documented historically in numerous southern counties. It grows on wooded hillsides, floodplains, and streambanks, especially on calcareous substrates.

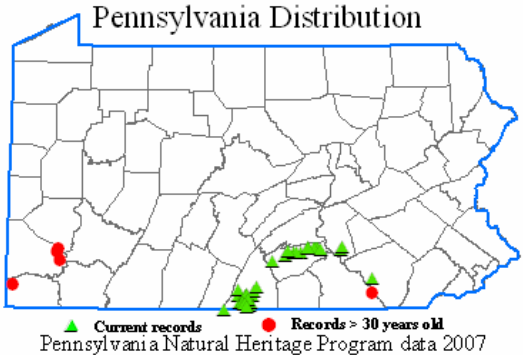
North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status

The PA Biological Survey (PABS) considers limestone petunia to be a species of special concern, based on the relatively few occurrences that have been recently confirmed. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 35 populations are currently known from the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations

The viability of populations of limestone petunia and its habitat can be enhanced by maintaining forested conditions on floodplains and streambanks. Invasive species and quarrying represent threats at some locations.

NatureServe conservation status ranks

G4G5 – Apparently globally secure; S2 – Imperiled in Pennsylvania

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Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

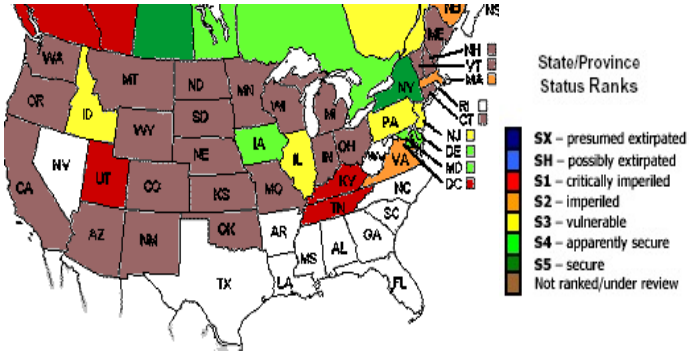
River Bulrush
Schoenoplectus fluviatilis

Description
River bulrush is a perennial herb that forms colonies from underground stems. The triangular aerial stems are robust and may grow from 2½ to 6½ feet (0.7-2 m) in height. The leaves are alternately arranged, grass-like, elongate, averaging about 3/8 inch (1 cm) wide, and somewhat V-shaped in cross-section. The flowers, appearing from June to August, are grouped in ½ to 1½ inch (1.5-4 cm) spikelets. The spikelets are grouped in a branching cluster at the top of the stem that is subtended by several spreading, leaf-like bracts. The individual fruits are about 3/16 inch (3.5-5 mm) long.


Photo source: PNHP

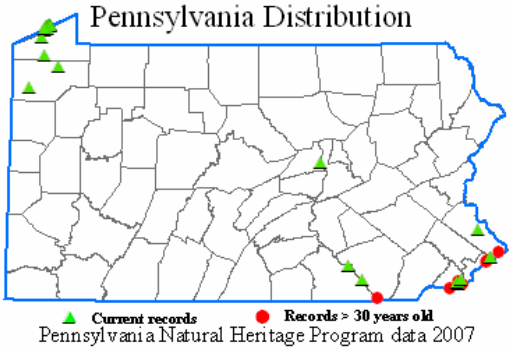
Distribution & Habitat
River bulrush has a very broad range with the exception of the southeastern states, across North America. In Pennsylvania, it has been documented historically in the northwestern and southeastern counties. It grows on the shorelines of rivers and streams, and also in marshes and other wet places.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers river bulrush to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Rare. About 30 populations are currently known from the state.

Conservation Considerations
The viability of the riverine populations of river bulrush may be enhanced by maintaining the water quality and natural hydrology of the streams, with their seasonal fluctuations and scouring, as well as retaining natural conditions along the shoreline areas. For non-riverine populations, establishing buffers and protecting the hydrology around wetlands are necessary. Invasive species represent a threat to the habitat of river bulrush.



NatureServe conservation status ranks
G5 – Globally secure; S3– Vulnerable in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Few-flowered Nutrush
Scleria pauciflora

Description

Few-flowered nutrush is a perennial herb with triangular, tufted stems that grow from 8 to 20 inches (2-5 dm). The leaves are alternately arranged, linear, elongate, variably hairy, and up to 1/10 inch (3 mm) wide. The flowers, appearing from June to September, are minute, unisexual, and are grouped in clustered spikelets at the top of the stem. The fruits are less than 1/8 inch (1-2.5 mm) long, but have a curious appearance in being hard and white (similar to a piece of bone or tooth), globe-shaped with a short-pointed tip, warty on the surface, and having a basal "platform" of 6 tuber-like structures.



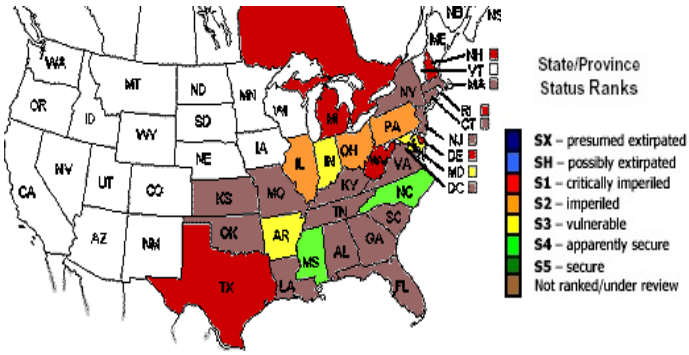
Photo source: Rocky Gleason (PNHP)

Distribution & Habitat

Few flowered nutrush has a range from southern Canada south into Texas and the Gulf Coast states. In Pennsylvania, it has been documented historically mostly in the southeastern counties, where it grows on serpentine barrens.

North American State/Province Conservation Status

Map by NatureServe 2007

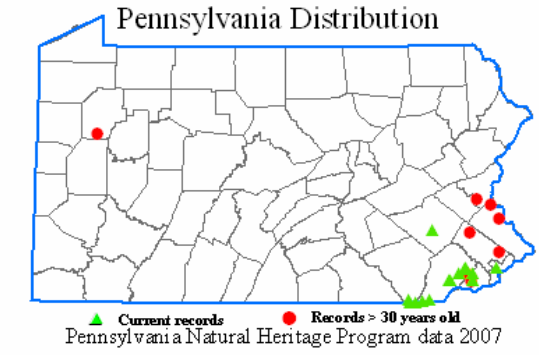


Current State Status

The PA Biological Survey (PABS) considers few-flowered nutrush to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and its specialized serpentine habitat. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. About 15 populations are currently known from the state.

Conservation Considerations

The viability of populations of few-flowered nutrush and its serpentine habitat will require maintaining early successional conditions and controlling invasive species. Active management, through the use of fire, scraping the substrate, or mowing, may be needed to create the proper successional stage and ecological conditions for this species to thrive. Quarrying and habitat loss are threats in some locations.



NatureServe conservation status ranks

G5 – Globally secure; S2– Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

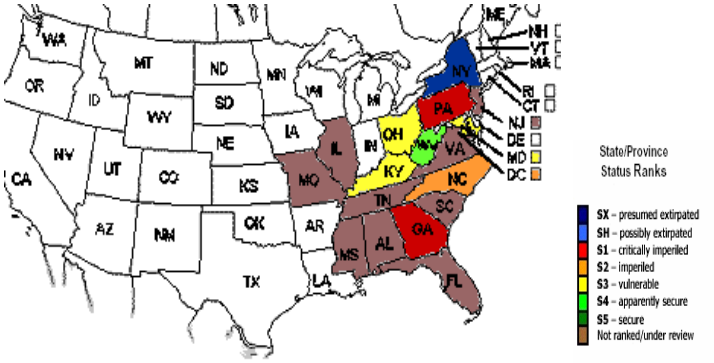
Showy Skullcap
Scutellaria serrata

Description
Showy skullcap is a perennial herb that grows up to 2 feet (6 dm) in height. The leaves are oppositely arranged with a well developed stalk, toothed on the margin, more-or-less hairless, broadly lance-shaped to egg-shaped, pointed at the tip, and 2 to 4 inches (5-10 cm) in length. The blue flowers, appearing in May and June, are arranged in pairs at the top of the stem. The individual petals are fused into a tube-like structure that is about 1 inch (2.5 cm) in length. The common name refers to the cap-like appendage that is present on the calyx of the flower. Although a member of the mint family, this species does not have the characteristic odor often found in that family.


Photo source: Sally Ray (PNHP)

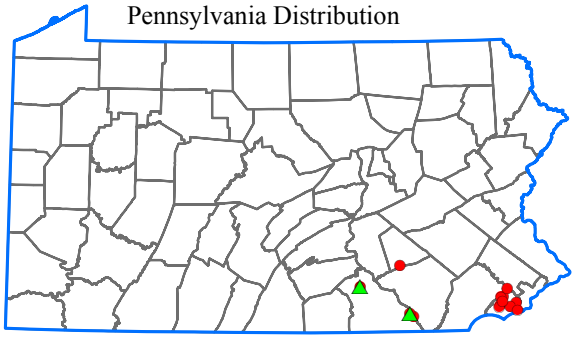
Distribution & Habitat
Showy skullcap has a range from New York south and west into Florida and Missouri. In Pennsylvania, it has been documented historically in a few southeastern counties. It grows in moist woods and on floodplains and rich slopes.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers showy skullcap to be a species of special concern, based on the relatively few occurrences that have been recently documented and small state range. It has a PA legal rarity status of Extirpated, but has been assigned a suggested rarity status of Endangered by PABS. Fewer than 5 populations are currently known from the state.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

Conservation Considerations
The known populations of showy skullcap have threats from habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations. This species is very attractive in flower and may be subjected to picking or digging by gardeners.

NatureServe conservation status ranks
G5 – Globally secure; S1– Critically imperiled in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

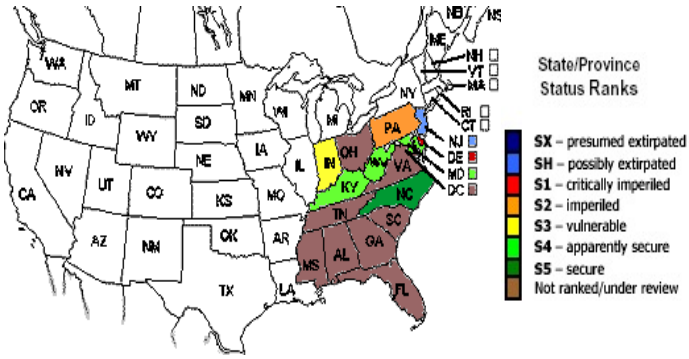
Plain Ragwort
Senecio anonymus

Description
Plain ragwort is a perennial member of the aster family that bears numerous yellow, aster-like flower heads. between 1 and 2¾ feet (3-8 dm) tall and are densely wooly at the base. The leaves grow from the base of the plant as well as along the stems. Basal leaves are toothed, lance-shaped to elliptic, and taper at their base to a petiole. Stem leaves are smaller, deeply dissected, and may attach without a petiole. The flowers are displayed in terminal, flat-topped clusters of 20 to 100 flower heads. Individual flower-heads are about ½ to ¾ inch (13-20 mm) wide and have a yellow central disk surrounded by 8 to 15 yellow rays.


Photo source: PNHP

Distribution & Habitat
Plain ragwort can be found from New Jersey and Pennsylvania south to Florida and west to Indiana through Mississippi. In Pennsylvania this species is most commonly found growing in serpentine barrens and in dry,
open woods.

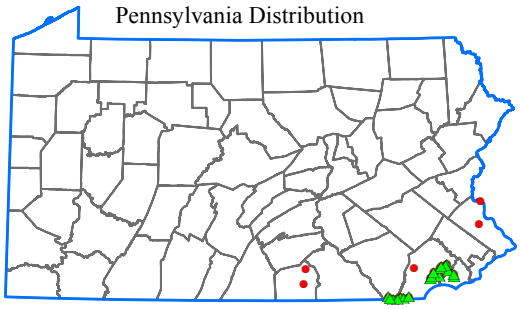
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey (PABS) considers plain ragwort to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and its serpentine habitat. It has a PA legal rarity status and a PABS suggested rarity status of Rare. About xx populations are currently known from the state.

Conservation Considerations
The viability of populations of plain ragwort and its serpentine habitat will require maintaining early successional conditions and controlling invasive species. Active management, through the use of fire, scraping the substrate, or mowing, may be needed to create the proper successional stage and ecological conditions for this species to thrive. Quarrying and habitat loss are threats in some locations.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks
G5 – Globally secure; S2– Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

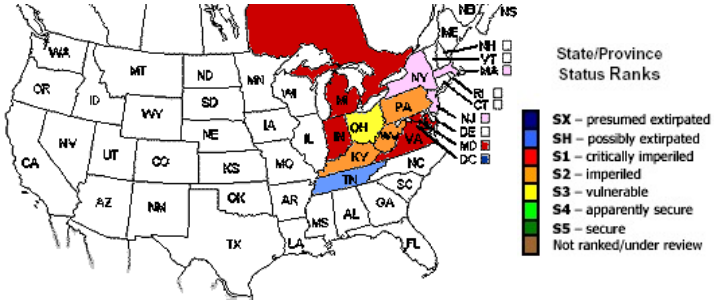
Sida; Virginia-mallow
Sida hermaphrodita

Description
Sida is a large perennial herb that grows 3 to 10 feet (1-3 meters) tall. Its stems are hairy when young but become smooth with age. The leaves grow alternately on the stem and resemble long-pointed maple leaves. They usually have 3 to 7 irregularly toothed lobes, with the middle lobe being the longest. The white flowers, which bloom from July to October, are arranged in stalked clusters that grow from the upper stem leaf axils. Each flower has 5 petals that are each about ⅓ inch (8 mm) long.

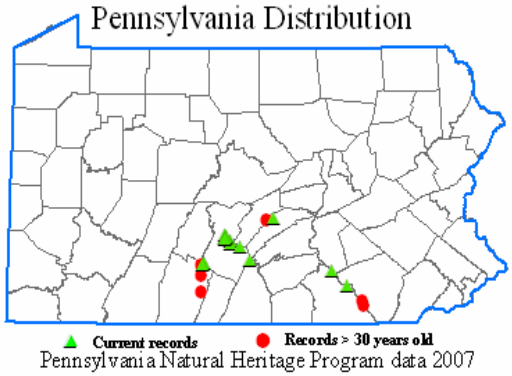

Photo source: John Kunsman (PNHP)

Distribution & Habitat
Sida has a rather localized distribution in midwestern and mid-Atlantic portions of eastern North America. In Pennsylvania, the occurrences are restricted to the Juniata River and lower Susquehanna River watersheds. The species grows on streambanks and bottomlands, as well as disturbed places like roadsides and railroad grades that are in proximity to the stream corridors.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers sida to be a species of special concern, based on the relatively few occurrences that have been confirmed and the localized distribution in the state, as well as rarity throughout its global range. It has been assigned a rarity status of Threatened.



Conservation Considerations
Maintenance of known populations and preservation of the unique habitat where sida thrives will be crucial to its survival. Removal of encroaching invasive species along river corridors and the establishment of buffers surrounding known sites will help to improve habitat quality. Recognition and protection of populations along roadsides and in other unprotected areas will also be important.

NatureServe conservation status ranks
G3 – Globally vulnerable; S2 – Imperiled in Pennsylvania

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and W.M. Klein, Jr. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. American Philosophical Society, Philadelphia.
- Rhoads, A.F. and T.A.Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. University of Pennsylvania Press, Philadelphia.

PNHP
Pennsylvania Natural Heritage Program

Sticky Goldenrod
Solidago simplex ssp. *randii* var. *racemosa*

Description


Photo source: Tom Smith (PNHP)

Sticky goldenrod is a perennial herb that reaches up to 3 feet (9 dm) in height. Its upright stems are mostly smooth but become hairy near the top. The leaves are oblong to egg-shaped, widest above the middle, and taper toward the base. Most leaves are basal and the leaves that do grow on the stem are progressively reduced as they ascend the stem.

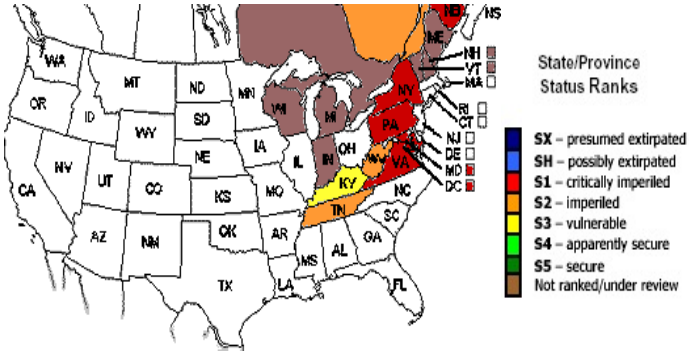
The flowers are displayed from August to September in cylindrical clusters of many small flower heads. The flower clusters vary in form. They may be dense and wand-shaped or have an open, branched appearance. Each small flower head has a yellow central disk surrounded by 7 to 10 yellow rays.

Distribution & Habitat

Sticky goldenrod's range extends in the U. S. from Maine south to Virginia and west as far as Michigan and Tennessee. In Pennsylvania this species occurs in river scours, rock crevices or shores along the Lower Susquehanna River.

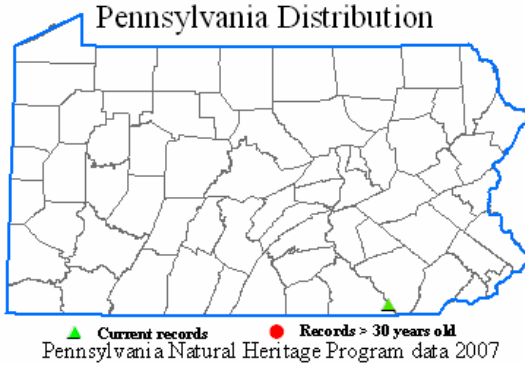
North American State/Province Conservation Status

Map by NatureServe 2007



Current State Status

Throughout the range of this species, habitat loss, land conversion for development and displacement by invasive species have all played a part in its decline. Sticky goldenrod grows along riverbanks where it is susceptible to increased erosion caused by excess run-off, removal of riparian forests, and ATV use.



Conservation Considerations

Protection of sticky goldenrod will require maintenance of known populations and preservation of the riverside communities that support the species. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.

NatureServe conservation status ranks

G5T3 – Globally vulnerable; S1– Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

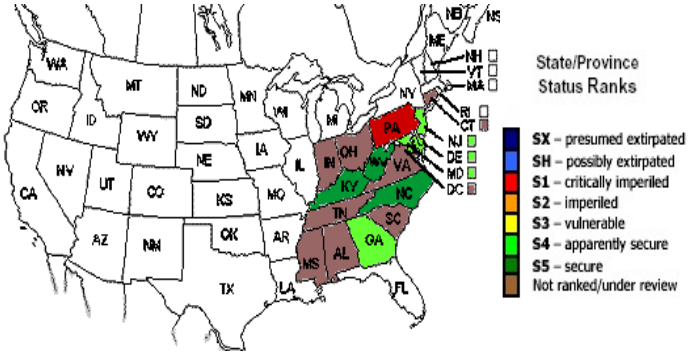
Slender Goldenrod
Solidago speciosa var. *erecta*

Description
Slender goldenrod is an upright, perennial herb that can grow up to 5 feet (1.5 meters) tall with stems that are smooth near the base but coarsely hairy along the flowering portion. The leaves grow alternately along the stem and become substantially reduced as they climb the stem. Leaves are elliptical, ¼ to ¾ inch (5-20 mm) wide, and have a thick, firm texture.
The flowers are displayed from August to October in narrow clusters containing many small flower heads. The flower clusters are spike-like, with compact, ascending branches. Each flower head is about ¼ inch (6 mm) wide and has a yellow central disk surrounded by 5-9 yellow rays.

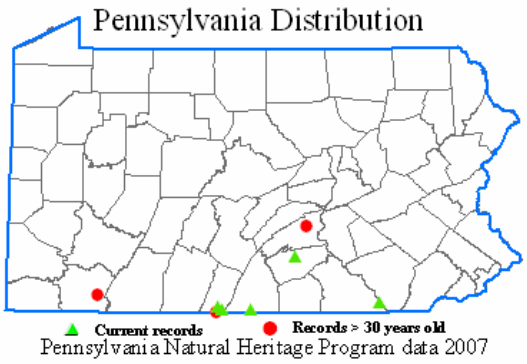

Photo source: R. Harrison Wiegand

Distribution & Habitat
Slender goldenrod can be found from Connecticut south to Georgia and west to Indiana through Mississippi. In Pennsylvania, it grows on dry, acidic, shaly river or road banks.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
This species is threatened by habitat loss through land conversion and habitat succession. The river and road banks where slender goldenrod can be found often have an open nature and may need to be maintained by disturbance, such as fire, flooding, or mowing. Over time, if these disturbances are minimized, the open habitats may become overgrown by woody or invasive species.



Conservation Considerations
Protection of slender goldenrod will require maintenance of known populations and preservation of the communities on which they are dependent. This may include sustaining appropriate hydrology, removal of invasive plants, and establishment of buffers that can moderate the effects of scouring events and run-off. Management of the known sites requires long term monitoring of populations.

NatureServe conservation status ranks
G5 – Globally secure; S1– Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

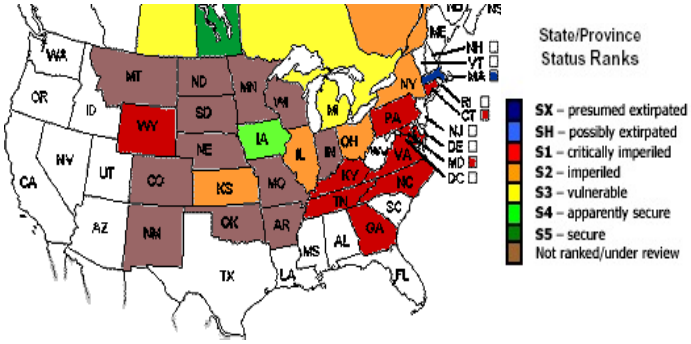
Prairie Dropseed
Sporobolus heterolepis

Description
Prairie dropseed is a perennial grass that grows in dense clumps that produces many fine, drooping leaves. Its flowering stems usually reach 16 to 40 inches (4-10 dm) in height. The leaves are 5 to 14 inches (12-35 cm) long and up to 1/10 inch (2.5 mm) wide. The blades usually have in-rolled edges and are slightly rough to the touch. The flowers can be found singly in small spikelets. The spikelets are reddish to lead-colored and are held in long, narrowly pyramidal, branched clusters. *Heterolepis* means "different scales" and refers to the two scales, or glumes, at the base of each spikelet that are unequal in length.


Photo source: (PNHP)

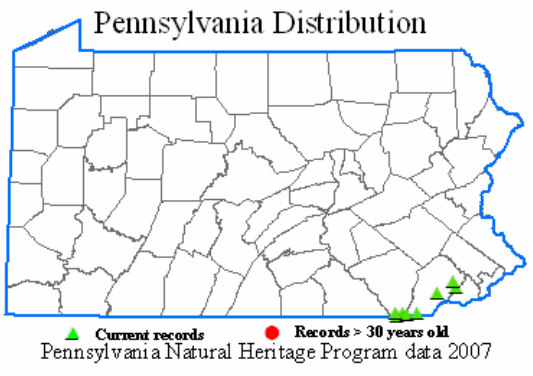
Distribution & Habitat
Prairie dropseed occurs in the U. S. from New York south to Georgia and west to Montana through New Mexico. In Pennsylvania, it can be found growing in serpentine barrens from Lancaster and Chester Counties.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
This species thrives in serpentine barrens, which is a globally rare plant community that is well represented in southeastern Pennsylvania. Land conversion for development, dumping, and fragmentation have degraded the quality of some these rare habitats. In addition, the open nature of the habitats required by prairie dropseed is in some cases threatened by the encroachment of woody or invasive plants.

Conservation Considerations
Maintenance of known populations and preservation of the rare communities, such as serpentine barrens, where plain ragwort grows will be crucial to its survival. Removal of overgrowth and invasive species with the integration of fire regimes, when appropriate, will help to preserve the integrity of the sites. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.



NatureServe conservation status ranks
G5 – Globally secure; S1– Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

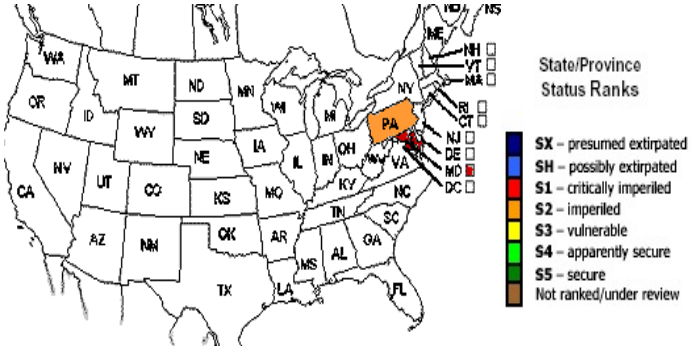
Serpentine Aster
Symphyotrichum depauperatum

Description
Serpentine aster is a perennial herb that grows in spreading clumps. Its smooth, wiry flowering stems are erect or reclining and reach up to 16 inches (4 dm) in length. The leaves are produced from the base of the plant as an over-wintering basal rosette. Basal leaves are oblong to egg-shaped and up to 1½ inches (4 cm) long. Leaves also grow alternately along the stem but are narrow and often pressed flat against the stem. The flowers are held at the top of flowering stems in open, branched clusters that contain many flower heads. The small, daisy-like flower heads have a yellow disk surrounded by 7 to 14 white rays. Flowers are displayed from August through October.


Photo source: John Kunsman (PNHP)

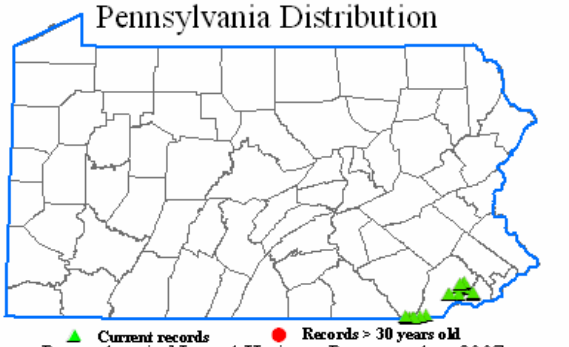
Distribution & Habitat
Serpentine aster is endemic to the eastern serpentine barrens that occur in Pennsylvania and Maryland. This extremely limited distribution has given this species the status of G2 – globally imperiled. Populations in open areas of the serpentine barrens in Lancaster, Chester and Delaware Counties represent a stronghold of the species.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
Serpentine aster occurs in a limited portion of the eastern serpentine barrens, which are a globally rare plant community. This habitat is threatened by land conversion for development, dumping, ATV use and road widening. Serpentine aster is typically found in the more open areas of serpentine barrens, suggesting that fire may be needed to weed out woody overgrowth and maintain this preferred habitat.

Conservation Considerations
Maintenance of known populations and preservation of the serpentine barrens where serpentine aster grows will be crucial to its survival. Removal of overgrowth and invasive species with the integration of fire regimes, when appropriate, will help to preserve the integrity of the sites. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.



NatureServe conservation status ranks
G2 – Globally imperiled; S2– Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- eFloras. 2007. Flora of North America [web application]. Available at http://www.efloras.org/flora_page.aspx?flora_id=1. Accessed May 7, 2007.
- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer. Accessed May 7, 2007.
- Rhoads, Ann and T. Block. 2000. The Plants of Pennsylvania: An Illustrated Manual. Philadelphia: Univ. of PA Press. 180.

Cranefly Orchid
Tipularia discolor

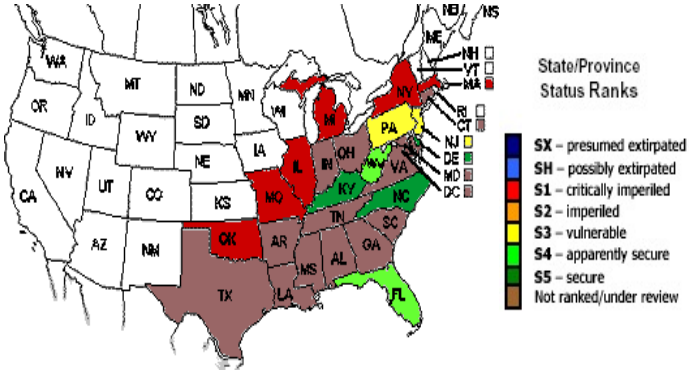
Description
Cranefly orchid is an upright perennial herb. Its single flowering stem grows from a swollen, bulb-like base and reaches 8 to 20 inches (2-5 dm) in height. The leaves are broadly oval and parallel veined. The leaf undersides are purple, while the upper surfaces are green and may have raised purple spots. Each plant has a solitary basal leaf that is only present in the fall and winter. The flowers are greenish-purple and consist of 3 petals and 3 sepals. A long spur extends from the back of the flower. Flowers are held along the upper potions of the flowering stem and bloom from July through August.


Photo source: John Kunsman (PNHP)

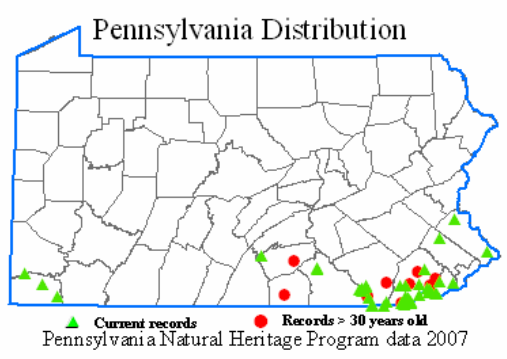

Photo source: Sally Ray (PNHP)

Distribution & Habitat
Cranefly orchid occurs from New York and Massachusetts south to Florida, west to Michigan, and southwest to Texas. In Pennsylvania, it can be found mostly in the southeast where it grows in moist deciduous forests and along stream banks.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
Cranefly orchid populations are threatened by the loss of their rich woodland habitat. These high quality woodlands may also be altered by encroachment of invasive species, over-browsing by deer, and fragmentation. Fragmentation can have a drying effect on the habitat and promote invasive species growth.



Conservation Considerations
Maintenance of known populations and preservation of the communities where cranefly orchid grows will be crucial to its survival. Creating buffers around fragmented habitat and removal of invasive species will help to maintain populations and encourage new population growth. The management of the known sites requires long term monitoring of populations. Potential sites for restoration should be evaluated.

NatureServe conservation status ranks
G4G5 – Apparently secure globally; S3– Vulnerable in Pennsylvania

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References

- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

Nodding Trillium
Trillium cernuum

Description
Nodding trillium is a perennial herb that grows up to 16 inches (4 dm) tall. The leaves occur in a whorl of 3, with the leaf blades being stalkless or nearly so, oval to diamond-shaped, 2 to 6 inches (5-15 cm) long, and hairless. The single flower has a drooping stalk and hangs below the leaves. Each 1 to 1½ inch (2.5-4 cm) flower has 3 white to pinkish petals backed by 3 alternating green sepals. The petals curve strongly upward toward the bottom of the leaves. The blooming time is in April and May.

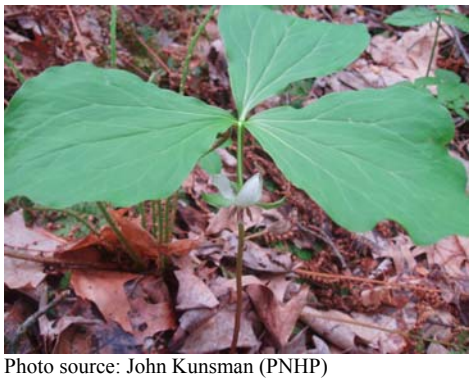
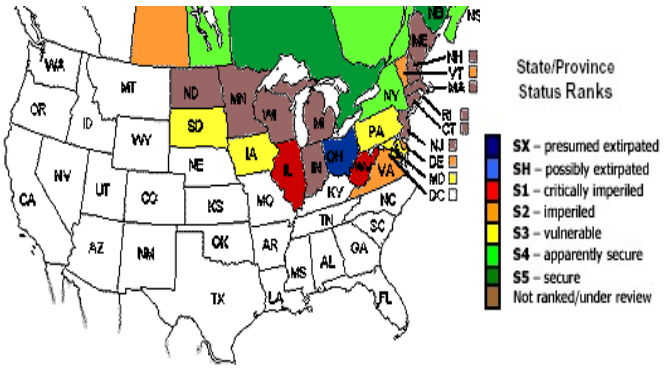


Photo source: John Kunsman (PNHP)

Distribution & Habitat
Nodding trillium can be found in the U. S. from Maine south to Virginia and west to North and South Dakota. In Pennsylvania, it occurs mostly in the southeastern counties, where it grows in rich, moist woods.

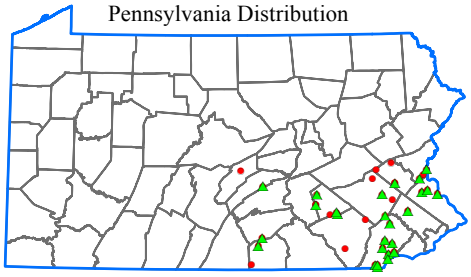
North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers nodding trillium to be a species of special concern, based on the relatively few occurrences that have been recently documented. It does not have a PA legal rarity status, but has been assigned a PABS suggested rarity status of Undetermined. Fewer than 10 populations, habitat loss, land conversion for development, and displacement by invasive species have all played a part in the decline of nodding trillium populations. Many of the remaining rich, moist forests in southeastern and south-central Pennsylvania have become increasingly fragmented, which further degrades habitat quality. Over-abundant deer populations have also contributed to reduced nodding trillium numbers.

Conservation Considerations
Maintenance of known populations and preservation of the communities where nodding trillium grows will be crucial to its survival. Creating buffers around fragmented habitat and removal of invasive species will help to maintain populations and encourage new population growth. The management of the known sites requires long term monitoring of populations.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

NatureServe conservation status ranks
G5 – Globally secure; S3– Vulnerable in Pennsylvania

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

Susquehanna Trillium
Trillium sp.

Description

Susquehanna trillium is a perennial herb that grows up to 16 inches (4 dm) in height. The leaves occur in a single whorl of 3, with the blades being stalkless or nearly so, veiny, oval to diamond-shaped, hairless, pointed at the tip, and 2 to 6 inches (5-15 cm) long. The single flower, appearing from mid April to mid May, has a long arching stalk. The petals are white (to pink), 2 1/2 to 4 1/2 inches (6-11.5 cm) in length, curve backward, and are subtended by 3 alternating green sepals. The fruit, classified as a berry, has several seeds. This plant has an unclear taxonomic status, as it may represent a form of the declined trillium (*Trillium flexipes*), a white-flowered form of the purple trillium (*Trillium erectum*), or possibly a hybrid between these two species.



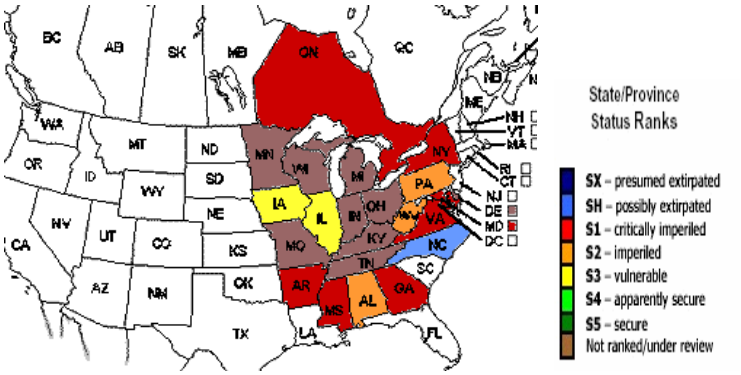
Photo source: John Kunsman (PNHP)

Distribution & Habitat

In Pennsylvania, this plant has been documented historically in a few counties, especially Lancaster and York, along the lower Susquehanna River. It grows on wooded slopes and in rich woodlands and moist ravines.

North American State/Province Conservation Status

Map by NatureServe 2007



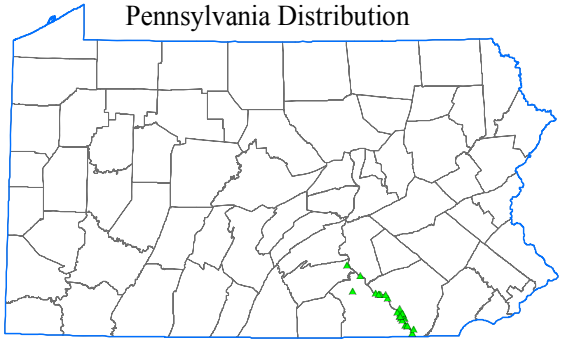
Current State Status

The PA Biological Survey has not assigned a rarity status to the Susquehanna trillium. The declined trillium (*Trillium flexipes*), to which the Susquehanna trillium may be referable, is considered a species of special concern with a PA legal rarity status and a PABS suggested rarity status of Undetermined. .

Conservation Considerations

Additional field surveys and taxonomic studies will be required to determine the identity, range, and conservation status of the Susquehanna trillium. Current populations have threats from habitat loss, invasive species, and in some locations, excessive browsing by deer. Establishing buffers around fragmented forested habitat and removal of invasive species will help to maintain populations.

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks

GU – Unrankable; SU– Unrankable

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program

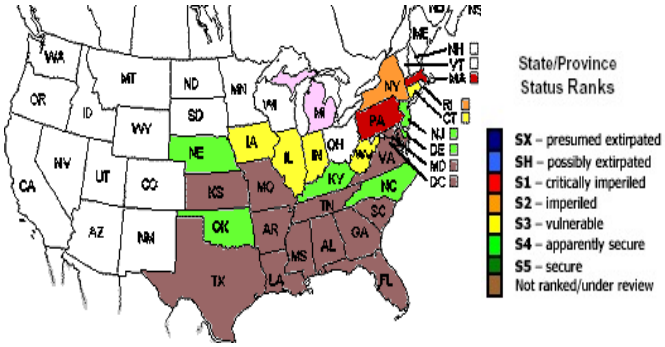
Eastern Gamma-grass
Tripsacum dactyloides

Description
Eastern gamma-grass is a tall perennial grass that usually stands 4 to 8 feet (12-24 dm) tall, often forming conspicuous clumps. The leaves are flat, linear, and up to 1¼ inches (3 cm) wide and 12 to 30 inches (3-7.5 dm) long. The flowers, appearing from July to October, are arranged in 1 to 4 thick spikes that emerge from the top of the stem. The individual flowers are unisexual, with male flowers located at the top of the spike and the female flowers being embedded in swollen stem segments at the base of the spike.


Photo source: PNHP

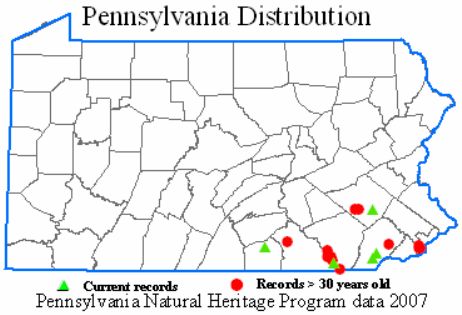
Distribution & Habitat
Eastern gamma-grass has a distribution from southern New England west into Nebraska, and south into Florida and Texas. In Pennsylvania, it represents a southerly species, and has been documented historically in some of the southeastern counties. It grows in damp to wet places in openings, streambanks, islands in the Susquehanna River, and sometimes in disturbed ground.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers eastern gamma-grass to be a species of special concern, based on the relatively few occurrences that have been recently documented and its wetland habitat. It has a PA legal rarity status of Undetermined and a PABS suggested rarity status of Endangered. With fewer than 10 populations in PA, eastern gamma-grass is vulnerable to habitat loss and changes in hydrology that might influence habitat quality, such as damming or draining rivers and increased groundwater use. Conversion of floodplain forests, browsing by deer, and encroachment by invasive plants may degrade the quality of existing habitat. Nutrient enriched run-off from surrounding land can affect the water chemistry to which this species is sensitive.

Conservation Considerations
Conservation of eastern gamma-grass will depend upon the protection of existing populations and maintenance of its required habitat. This may include removing invasive plants and creating buffers to help moderate the effects of run-off and flooding. Sustaining appropriate water levels will also be important for maintaining high quality habitats.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks
G5 – Globally secure; S1– Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Tawny Ironweed
Vernonia glauca

Description

Tawny ironweed is a perennial herb that may grow to 5 feet (15 dm) in height. The leaves are alternately-arranged, narrowly egg-shaped to oblong in shape, noticeably paler below, with short-pointed tips and bases that taper to a short petiole. The flowers, which appear from July to October, are purplish and are grouped into dense flowering heads, which are clustered at the top of the stem in a branched, flat or round-topped grouping. This species has lighter-colored bristles at the top of its fruits than does the much more common species *Vernonia noveboracensis*.



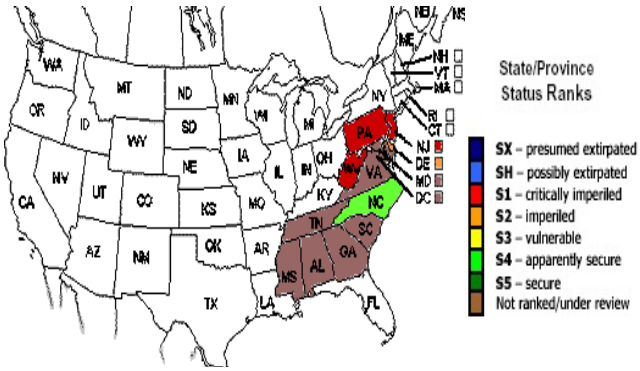
Photo source: (PNHP)

Distribution & Habitat

Tawny ironweed occurs from Pennsylvania and New Jersey south and west into Louisiana and Georgia. In Pennsylvania, it reaches a northern limit of its range and has been documented in a few southeastern counties. It grows in successional clearings, dry fields, and upland forests.

North American State/Province Conservation Status

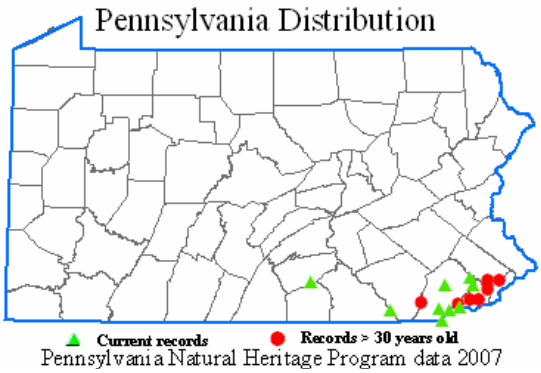
Map by NatureServe 2007



Current State Status

The PA Biological Survey considers tawny ironweed to be a species of special concern because of the few occurrences that have been recently confirmed. It has a PA legal rarity status and a PABS suggested rarity status of Endangered.

Fewer than 10 populations are currently known from the state.



Pennsylvania Natural Heritage Program data 2007

Conservation Considerations

The currently-known populations of tawny ironweed in the state are threatened by human-related habitat loss, natural succession, invasive species, and the indiscriminate spraying of herbicides. Given the preference of the species for open habitats, active management is usually required to maintain the proper successional stage.

NatureServe conservation status ranks

G5 – Globally secure; S1– Critically imperiled in Pennsylvania

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Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.
- USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 20.

Possum-haw
Viburnum nudum

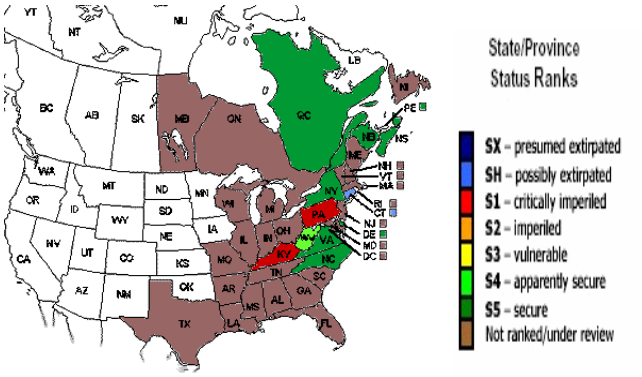
Description
Possum-haw is a deciduous shrub or small tree that grows up to 12 feet (ca 4 m) tall. The leaves are oppositely-arranged, shiny above, toothed or untoothed on the margin, oblong to elliptic in shape, and typically 3 to 5 inches (8-13 cm) long. The flowers, which appear in May or June, are arranged in flat-topped clusters. The small individual flowers have white petals with 5 regular lobes. The fruits at maturity are dark blue-black and berry-like, with a single seed.



Photo source: PNHP

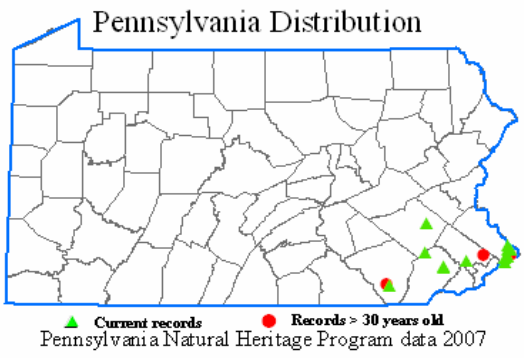
Distribution & Habitat
Possum-haw has a mostly coastal range from New York west and south into Texas and Florida. In Pennsylvania, it represents a southerly species and has been documented in a few southeastern counties. It grows in wetlands, particularly swamps, wet thickets, and the margins of ponds.

North American State/Province Conservation Status
Map by NatureServe 2007



Current State Status
The PA Biological Survey considers possum-haw to be a species of special concern, based on the relatively few occurrences that have been recently documented and its wetland habitat. It has a PA legal rarity status and a PABS suggested rarity status of Endangered. Fewer than 10 populations, most of them with only a few individuals, are known from the state.

Conservation Considerations
The viability of known populations of possum-haw and its habitat would be enhanced by creating buffers around wetlands, controlling invasive species, and protecting the hydrology of the wetland and its surroundings. This species may be impacted by deer browsing in some locations.



NatureServe conservation status ranks
G5 – Globally secure; S1– Critically imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Appalachian Gametophyte Fern
Vittaria appalachiana

Description

Appalachian gametophyte fern is a unique type of fern that lacks true leaves, stems, and roots. Individual plants are only about 1/8 inch (3 mm) long, but may grow in mat-like colonies that can be several inches or more. This species greatly resembles a liverwort or moss, and often grows in association with those plants. The fern reproduces itself by producing tiny, bud-like structures (gemmae) that are able to give rise to new individuals.

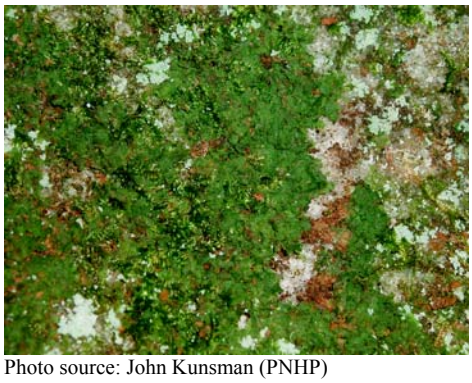


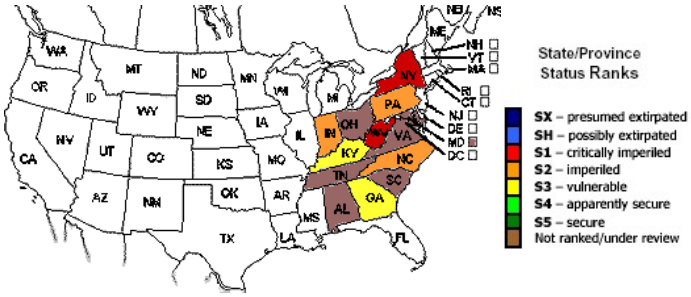
Photo source: John Kunsman (PNHP)

Distribution & Habitat

Appalachian gametophyte fern has a range in the Appalachian Mountains region from New York west and south into Indiana, Alabama and Georgia. In Pennsylvania, this species has been documented in scattered locations, especially in the mountainous counties. It grows on cool, damp, shaded rock outcrops and cliffs, particularly on sandstone, in forested areas.

North American State/Province Conservation Status

Map by NatureServe 2007

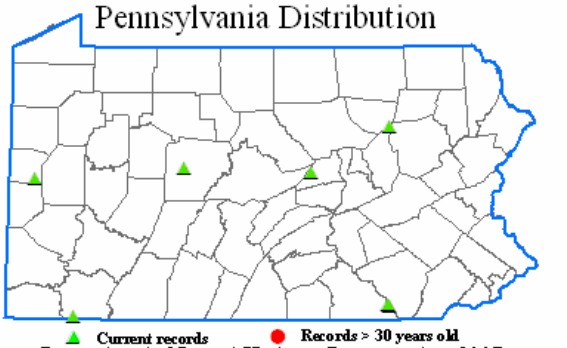


Current State Status

The PA Biological Survey (PABS) considers Appalachian gametophyte fern to be a species of special concern, based on the few occurrences that have been recently confirmed and its extremely specialized habitat. It has a PA legal rarity status and a PABS suggested rarity status of Threatened. Because of its minute size, this fern may be more frequent than the current records suggest.

Conservation Considerations

The viability of the known populations of Appalachian gametophyte fern and its habitat can be enhanced by maintaining a buffer of forest immediately surrounding the rock outcrop that supports the population. Since hemlock (*Tsuga canadensis*) is often a major constituent of the forest at populations of this fern, the loss of hemlock due to the hemlock woolly adelgid (*Adelges tsugae*) represents a threat.



Pennsylvania Natural Heritage Program data 2007

NatureServe conservation status ranks

G4 – Apparently globally secure; S2– Imperiled in Pennsylvania

Pennsylvania Natural Heritage Program

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

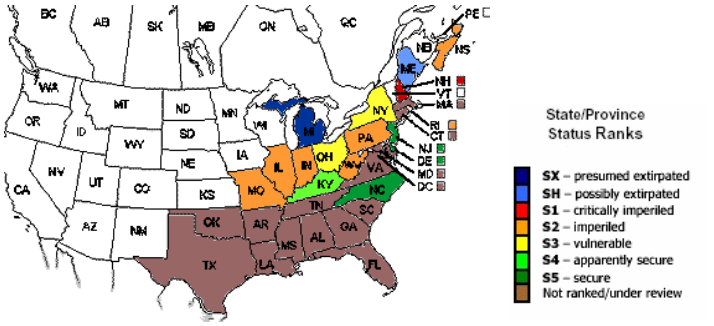
Netted Chainfern
Woodwardia areolata

Description
Netted chainfern grows from 1½ to 2½ feet (5-8 dm) in height, and may form small colonies due to the presence of creeping underground stems. The leaves are easily distinguishable into vegetative and fertile types. The vegetative leaves have a typical fern-like appearance, being green, flattened, and divided into 7 to 12 very deep lobes (or distinct leaflets on the lower part of the leaf) that are not further subdivided into smaller lobes. The leaf veins are conspicuous and have a net-like or chain-like arrangement, as the common name implies. The fertile leaves of netted chainfern are dark colored, much narrower, not flattened and leaf-like, and have spore-producing structures on their underside. The vegetative leaf of this species resembles the leaf of the sensitive fern (*Onoclea sensibilis*), a common species in Pennsylvania, but the lobes in netted chainfern tend to be alternately arranged along the leaf stalk while the lobes of sensitive fern tend to be oppositely arranged.


Photo source: Andrew Strassman (PNHP)

Distribution & Habitat
Netted chainfern has a distribution centered mainly on the Atlantic coastal plain from Nova Scotia south and west into Texas and Florida. In Pennsylvania, the species has been documented historically in scattered counties, particularly in the Delaware River drainage. It grows in swamps, seepages, wet woods, boggy wetlands and along the margins of streamlets.

North American State/Province Conservation Status
Map by NatureServe 2007

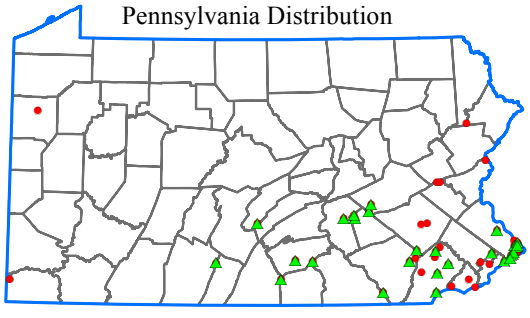


Current State Status
The PA Biological Survey (PABS) considers netted chainfern to be a species of special concern, based on the relatively few occurrences that have been recently confirmed and the wetland habitat. It has no PA legal rarity status, but has been assigned a suggested rarity status of Threatened by PABS. About 30 populations are currently known from the state.

Conservation Considerations
The viability of populations of netted chainfern and its habitat may be enhanced by establishing buffers around wetlands, controlling invasive species, and protecting the natural hydrology
surrounding wetlands.

NatureServe conservation status ranks
G5 – Secure globally; S2 – Imperiled in Pennsylvania

Pennsylvania Distribution



Pennsylvania Natural Heritage Program data 2008

References

- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available at http://www.natureserve.org/explorer.
- Pennsylvania Natural Heritage Program. 2007.
- Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. 2nd edition. University of Pennsylvania Press, Philadelphia.

Pennsylvania Natural Heritage Program