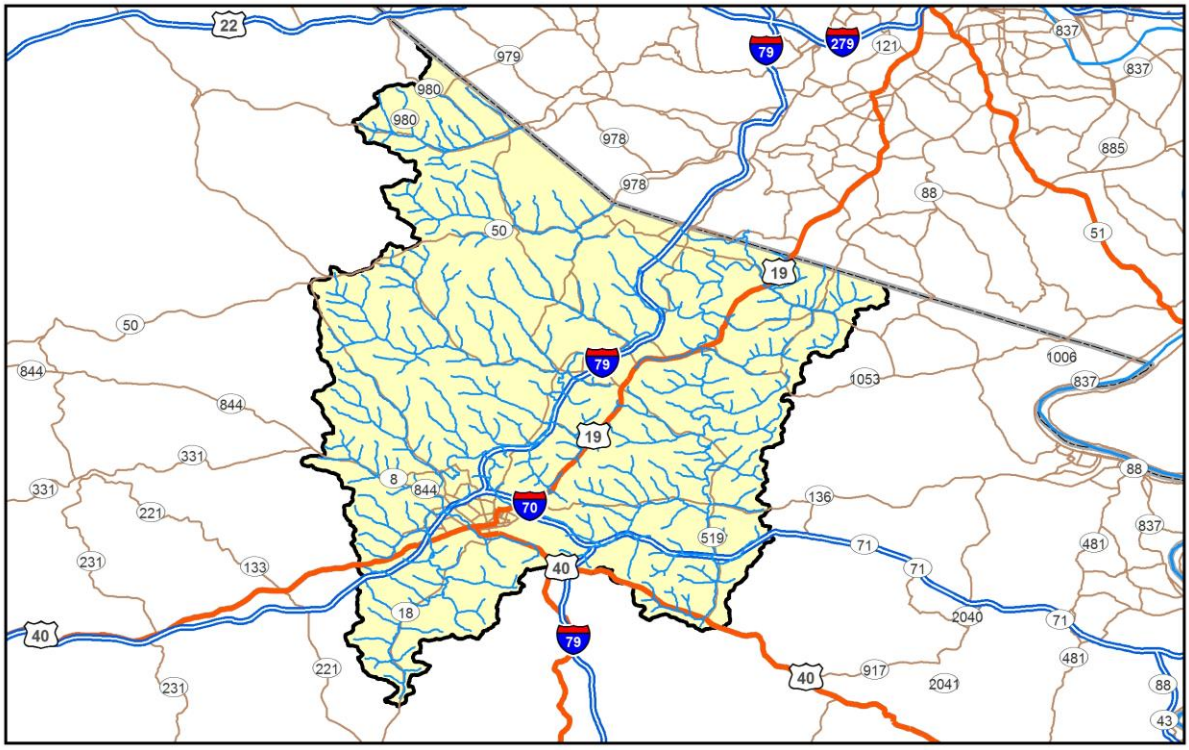
Upper Chartiers Creek Watershed Management Plan



Process and Criteria for Determining Threats to Watershed Resources for the Chartiers Creek Watershed Association
Washington County, Pennsylvania

Western Pennsylvania Conservancy
water, land, life.

Foundation for Pennsylvania Watersheds

Table of Contents

List of Figures

1. Watershed Group Evaluation

Background

Chartiers Creek Watershed Association (ChCWA) was formed in 1999 to study the natural resources in the upper portion of the watershed (Fig. 1). They work to promote local interest in the watershed; develop a program to maintain and improve the water resources of the watershed; restore problematic locations in the watershed; and to identify programs that can help the watershed financially, technically, and scientifically. A River Conservation Plan was written for the watershed in 2002 and ChCWA has focused on implementing this plan. They have completed a number of projects to date focusing on educational displays and demonstrations, restoration of Canonsburg Lake, several dump clean-ups, working with several Girl & Boy Scout troops, and water quality monitoring. The group has an active website that they use to inform members about important events and upcoming meetings. The content on the website is updated regularly and the group also utilizes constant contact to track website traffic.

We met with the Chartiers Creek Watershed Association on March 10, 2010 to introduce the assistance program, explain the types of technical assistance available, get a better understanding of their goals and expectations, and develop initial contacts. A round-table discussion about concerns in the watershed and potential projects generated the following concerns:

- Limiting sprawl
- Conserving wetlands
- Birds and biodiversity
- Core forests
- Stormwater management (5 people mentioned)
- NPS pollution
- Outreach and education
- Concrete plans to achievable goals at municipal level
- Riparian buffers
- BMPs (agricultural)
- Stream monitoring and volunteer monitoring
- Update RCP
- Numerous failing on-lot septic systems (4 people mentioned)
- Flooding
- American Water Company (donated wetland area)
- County stormwater plan is being written
- Protect Little Chartiers Creek
- Look into visual assessments
- Possible cleanup partnering with PA Cleanways

Ascertain Groups' Interest in and Capacity to Implement Strategies

Based on the main objectives of this project, WPC will recommend that the group focus on several highly visible projects that could increase membership in ChCWA. In addition, the group should focus on just a couple of objectives, such as stormwater management and erosion and sedimentation. Group members also emphasized the need for their water quality monitoring database to be updated. ChCWA is a motivated and caring group of like-minded people. They are very passionate about the watershed and its resources and know it very well. Based on eight months of interaction with this group we feel confident in their ability to tackle a number of well thought out projects in the years to come.

2. Identification of Aquatic Resource Values, Current Condition, and Threats

a. Compilation of Existing Data

i. High Quality and Exceptional Value Waterways (DEP)

1. There are only a few reaches within the watershed that are classified as High Quality by DEP (Fig. 2.). The Little Chartiers Creek watershed is the largest of these and it should be investigated thoroughly for possible land and water conservation projects.

ii. Threatened and Endangered Species Information (Natural Heritage Inventory)

1. Four biologically diverse areas (BDA) are located within the watershed. All have significant plant species associated with them (Fig. 3).

iii. Aquatic Community Classification (WPC)

1. Chartiers Creek watershed contains only minimally important habitat according to the Aquatic Community Classification. There are no significant community types for macroinvertebrates.

2. Three significant communities are present for fish species in the Chartiers Creek watershed (Fig. 4). Fish communities are found within a section of Little Chartiers Creek that contains an Ohio River warmwater community (ex. greenside darter and northern hogsucker). Chartiers Creek above Miller Run and Robinson Run both contain the Ohio River coolwater community (ex. blacknose dace and creek chubs).

iv. Current Condition and Threats Within the Watershed

1. In an effort to understand and quantify the types of threats and current condition of the Chartiers Creek watershed WPC GIS staff utilized data from a variety of sources including Pennsylvania Department of Environmental Protection (DEP), Pennsylvania Fish

and Boat Commission (PFBC), Pennsylvania Spatial Data Access (PASDA), and the Washington County Public Safety Department (Parcel data).

v. 303(d) List of Impaired Waterways (DEP)
    1. Most of the 181 square-mile Chartiers Creek watershed has been identified by DEP as having some form of anthropogenic impairment (Fig. 5). A total of 381.79 miles of streams flow in this watershed with 306.43 miles or (80.26%) of the flowing waters being listed as impaired for one of their designated uses. The largest impacts stem from agriculture (23.55%); habitat modification (14.29%); and abandoned mine drainage (10.54%).

vi. Potential Point Source Pollution Including AMD (DEP)
    1. Point source pollution in Chartiers Creek watershed is also a significant problem. There are large portions of the watershed that are impaired by AMD and at least one location that has been impacted by Molycorp (Fig. 6).

    2. The Chartiers Creek watershed has been a focal area for significant Oil and Gas exploration activity related to the Marcellus shale formation. As of July 2010, 27 Marcellus shale well permits have been granted for natural gas extraction within the watershed (Fig. 7). The majority of the well locations have been in the western portion of the watershed which is an area that historically was dominated by forested areas, especially in the riparian corridor analysis. In addition to the permitted pad locations, 17 locations have been permitted by DEP to be used as water withdrawal sources (Fig. 8). As would be expected based on permitted well sites, almost all locations for water withdrawal are in the western portion of the watershed.

vii. Landcover-Related Metrics (WPC)
    1. In an attempt to quantify landuse characteristics within the Chartiers Creek watershed we examined landuse data from PASDA. The three major landuse types that were analyzed at the subwatershed level include forested areas (Fig. 9), agricultural areas (Fig. 10), and developed areas (Fig. 11). Common themes identified from landuse data are that the upper northeast portion of the watershed is the most developed portion of the watershed. Forested lands dominate the south eastern portion of the watershed and agricultural lands are most commonly found in the north western portion of the watershed.

    2. In addition to the large scale GIS analysis, we also were concerned with what was occurring within the riparian areas of all waterways

within the Chartiers Creek watershed. A 150 foot boundary was placed on both sides of all streams that captured landuse data within the riparian corridor of 300 feet. Locations that had a relatively high percentage of forested riparian areas (Fig. 12) tended to have much fewer impairments. We also examined riparian agriculture (Fig. 13) and developed riparian areas (Fig. 14) and these locations overlapped once again with the impaired waters found in (Fig. 5). The results from this analysis further elucidated the importance between forested areas and watershed impairments because locations that have little forested cover often have minimal buffering capabilities for pollutants.

viii. Active River Area Analysis
   1. WPC staff reviewed several portions of the Active River Analysis document that TNC released in July 2010. Based on the small scale nature of this project (only one watershed) versus the multi-state geographic extent of the active river area analysis, this project would not benefit from a detailed analysis utilizing the program.

b. Major Threat Identification
   i. Based on extensive GIS analysis that was completed for this project there are a significant number of threats to this watershed. Some threats are too large to be effectively addressed by a watershed group [Combined Sewer Overflow (CSO) and some AMD projects] but other impairments are ideal projects to be tackled by ChCWA, such as agricultural and habitat modification. WPC recommends that the group focuses on parcel level projects including streambank fencing and other agricultural projects because they yield results rather quickly for improving water quality and can be completed for reasonable amounts of money. This can be achieved by using the GIS data that we compiled and coupled with the parcel data to identify farmers to work with. Meeting and talking with farmers in conjunction with the Conservation District has worked very well for WPC and we would recommend this type of collaboration for ChCWA.

c. Information From Completed Assessments or Conservation Plans
   i. There has been very limited assessment work completed in this watershed. A small visual assessment of the Catfish Creek subwatershed was completed by Skelly and Loy, Inc. in 2006. As a result of this project, three flood storage projects have been identified and are projected to cost $2,086,000. As of August 2010, two of the restoration sites are no longer possible because landowners are not committing to the projects.

   ii. The river conservation plan that was completed in 2003 has a wealth of information and projects that ChCWA could be working on to improve the aquatic ecosystems of the watershed. Most recommendations found in the

plan are not specific enough to generate useful projects for the watershed organization other than additional planning documents.

iii. If there are funds available in the future we would recommend that ChCWA apply for funding from a pertinent grant source to complete a visual assessment of the Little Chartiers Creek watershed.

d. Data Analysis and Map Production
   i. As a result of this project WPC has created 17 different maps to help ChCWA determine locations for further prioritization and restoration project location. All maps have been given to the watershed group for future use and have also been given to theWashington County Watershed Specialist.

e. Identification of Data Gaps
   i. The Little Chartiers Creek subwatershed is the most un-impaired subwatershed found within the Chartiers Creek watershed. This section holds the most important opportunities for watershed conservation work and land conservation. The ability to conserve land in this subwatershed should be further investigated by ChCWA. A detailed watershed assessment would be helpful to determine current watershed conditions. We completed a more detailed GIS analysis of the Little Chartiers Creek subwatershed by observing trends in a riparian corridor of 150 feet on either side of all streams. This was completed in an attempt to document two types of projects; land protection opportunities and stream restoration projects. Locations that contain intact forested riparian corridors would make excellent land conservation properties due to the small amount of forested locations left in the watershed (Fig. 15). By next examining the agricultural riparian corridor we were able to quantify locations that may be in need of agricultural BMP work, such as streambank stabilization, barnyard stabilization and streambank fencing (Fig. 16). Locations that tend to have the highest percentage of agricultural land use in the riparian corridor almost certainly have erosion and sedimentation issues as well. A third, albeit more challenging issue in this subwatershed is the developed riparian corridor (Fig. 17). These locations often input large flows during storm events due to impervious surfaces and un-checked development. Location such as these could benefit from increased flood storage capacity and reconfigured parking lot drainage in commercial settings to rain barrels around more residential locations.

3. **Stakeholder Meeting** – Chartiers Creek Watershed Association is holding a watershed association and partners public meeting in October 2010 to learn more about what other groups in Washington County are doing. Topics of discussion will include small presentations about what other groups are doing in their watersheds and how all groups can collaborate on projects.

4. Draft Watershed Management Plan Developed

a. Threat Identification (Sources) and Ranking

i. Feasibility of success by group – Major threats to the Chartiers Creek watershed include impairments arising from agriculture, habitat modification, and abandoned mine drainage. The most feasible threat for ChCWA to tackle would be erosion and sedimentation issues. By working with the Washington County Conservation District, USDA- National Resources Conservation Service, and other regional non-profits like WPC, ChCWA can begin working with local farmers to change farming practices and install streambank fencing and other agricultural BMPs. The second most manageable issue in the watershed would be habitat modification, which could be worked on jointly with the Pennsylvania Fish and Boat Commission's habitat biologists. Utilizing experienced contractors, numerous streambank stabilization projects can be completed, which will result in more habitat for a myriad of aquatic species and stable, non eroding streambanks.

ii. Overall impact on the watershed – There are many sections of the Chartiers Creek watershed that are in need of some form of restoration work. Many of the streams examined for this project could greatly benefit from on-the-ground conservation practices that will ultimately aid in the long-term recovery of Chartiers Creek watershed, which will benefit water quality in southwestern Pennsylvania by not inputting excessive sedimentation into the Ohio River.

iii. Available funding – Funding is available from a wide variety of sources for stream restoration projects. By working with the Washington County Conservation District and the USDA-NRCS staff, ChCWA can put projects on the ground utilizing a variety of funding that is available for local farmers, which include the Environmental Quality Incentive Program (EQIP) and Wildlife Habitat Incentive Program. (WHIP). Additionally, the Conservation Reserve Enhancement Program (CREP) can be utilized to take marginal lands out of production and pay the farmer to do so. There are several public and private funding sources available that support this type of much-needed work. Private sources include private foundations, such as the Richard King Mellon Foundation, The Foundation for Pennsylvania Watersheds, Dominion Foundation, and many others. Public sources include Growing Greener, and several EPA and USDA programs.

iv. Available partners – In the Commonwealth of Pennsylvania there are a host of different non-government conservation groups (Pheasants Forever, Ducks Unlimited, Trout Unlimited, and Izaak Walton League of America); state (Conservation District and DEP) and federal agencies (EPA, USDA, and U.S. Army Corps of Engineers) to aid in the restoration

of aquatic resources. In addition to these partners other non-profit conservation groups including Western Pennsylvania Conservancy, American Rivers, and The Nature Conservancy, are often available to help in the installation of conservation projects. There are also several area high schools and universities within the watershed or in close proximity.

v. Impact on regional conservation – The importance of a more natural Chartiers Creek watershed is deeply important to a variety of species that are found within its watershed and downstream in the Ohio River. If erosion and sedimentation inputs can be reduced in the Chartiers Creek watershed, it could benefit macroinvertebrate and mussel populations in the Ohio River. In addition, Chartiers Creek watershed could act as a model for other small watershed groups to follow in their implementation of numerous agricultural BMPs to improve regional water quality.

b. Strategies to Address Threats – Threats have been primarily identified with various Geographic Information Systems (GIS) applications for this management plan. Previous work that ChCWA has completed, including bacteriological sampling, has been incorporated into this GIS system. In addition, WPC staff members spent time with several members of ChCWA to tour locations that could be used for restoration projects. Restoration efforts should focus on Little Chartiers Creek watershed primarily due to its lower level of impact. Other projects of opportunity should be completed anywhere feasible in the watershed.

c. Desired Outcomes – If the actions found within this management plan are followed, sedimentation and erosion potential should be greatly decreased in the Chartiers Creek watershed. By working with local conservation partners and leveraging funding, numerous projects can be completed with modest financial resources. All projects should benefit many different types of organisms including fish and macroinvertebrate populations, birds, and other small mammal species.

d. Success Measurements and Monitoring Approach – Monitoring is an important aspect of any restoration project. The ability to have a before and after data set makes success measurements much easier to describe. Monitoring can be as intensive or minimal as time and personnel allow. At a minimum, WPC recommends macroinvertebrate data be collected for a season (Fall or Spring) before the project is constructed. Post construction monitoring should be conducted in the same season that the pre-construction monitoring occurred due to changes in macroinvertebrate life cycles. Water quality monitoring should include base flow conditions as well as high water events in an attempt to determine minimum and maximum conditions. Parameters to monitor should include several standard measurements like pH, dissolved oxygen, total dissolved solids, conductivity, and turbidity. Certain types of projects will also monitor less commonly measured parameters, such as phosphate and nitrogen for agricultural BMPs, total acidity, total manganese and total aluminum for mine drainage specific projects.

5. **Implementation** – Projects can begin in the Chartiers Creek watershed whenever the ChCWA feels that they have all the necessary resources and information in place for a good restoration project at hand. A monitoring plan should be in place well before construction starts. Projects that require permitting (all streambank stabilization projects need General Permits from DEP) should be started months in advance of the actual construction dates. Streambank stabilization projects should be completed with the help of Pennsylvania Fish and Boat Commission habitat biologists through the Technical Assistance Program (TAP) by contacting Dave Keller at (814)-359-5158 or dakeller@state.pa.us or Dave Houser at (814)-359-5219 or dhouser@state.pa.us for lake projects. A database of projects should be kept that contains all relevant restoration information including monitoring, budgeting, volunteer logs for tracking match purposes, donated materials and equipment, or any other pertinent information.

6. **Plan Evaluation and Evolution** – This plan was developed to aid ChCWA in getting new information about their watershed and to aid in the process of getting conservation projects on the ground. As with any plan, new information will become available and it should be included in this document. Land use patterns can change and new maps will need to be made in the coming years. This initial plan was conducted after just one year of close interaction with ChCWA, and will be further developed and focused over the next year. Continued scientific technical assistance will be provided by WPC in the coming years to help with plan implementation.

Figure 1.

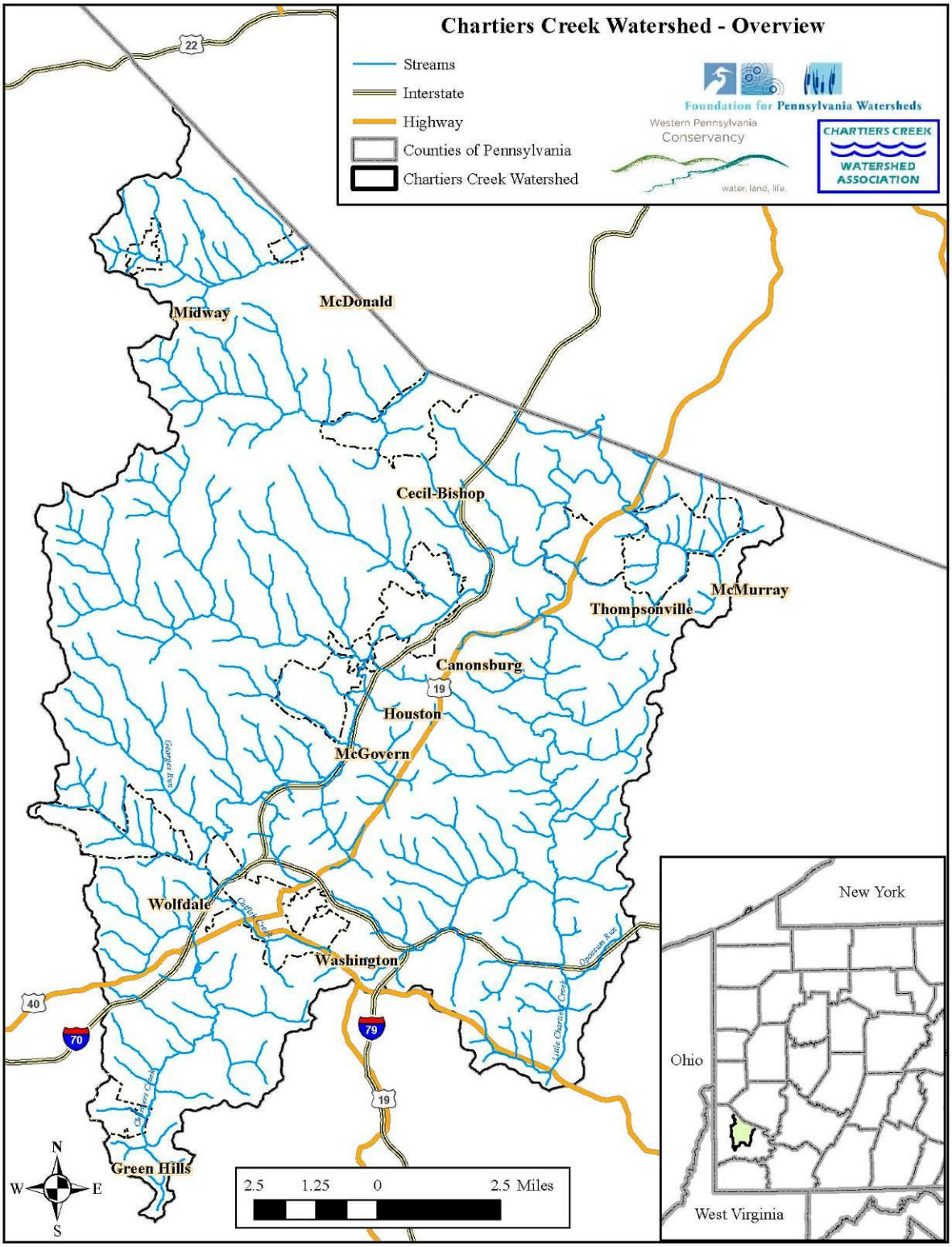

Chartiers Creek Watershed - Overview
Streams
Interstate
Highway
Counties of Pennsylvania
Chartiers Creek Watershed
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION
Midway
McDonald
Cecil-Bishop
McMurray
Thompsonville
Canonsburg
Houston
McGovern
Wolfdale
Washington
Green Hills
22
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
New York
Ohio
West Virginia

Figure 2.

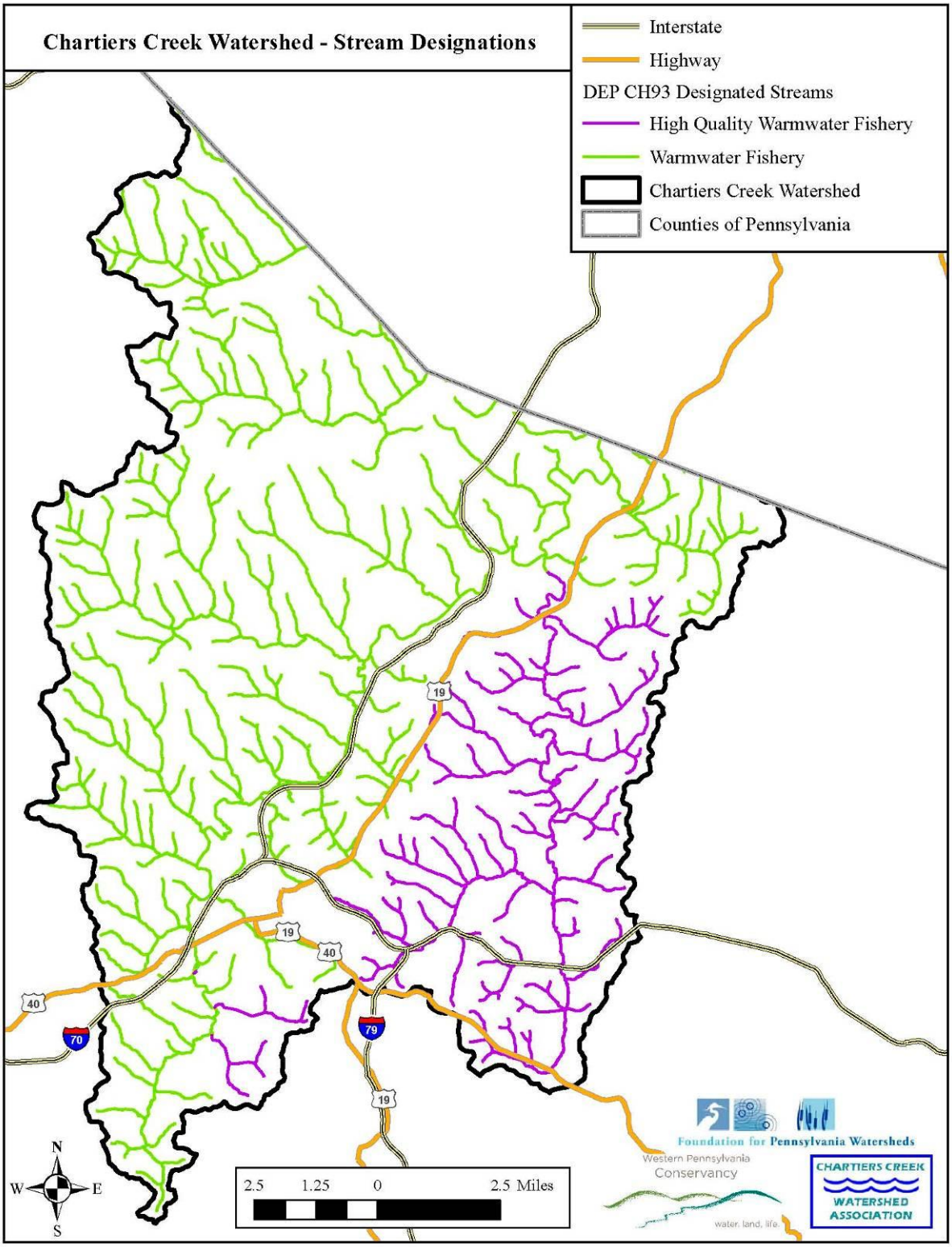

Chartiers Creek Watershed - Stream Designations
Interstate
Highway
DEP CH93 Designated Streams
High Quality Warmwater Fishery
Warmwater Fishery
Chartiers Creek Watershed
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 3.

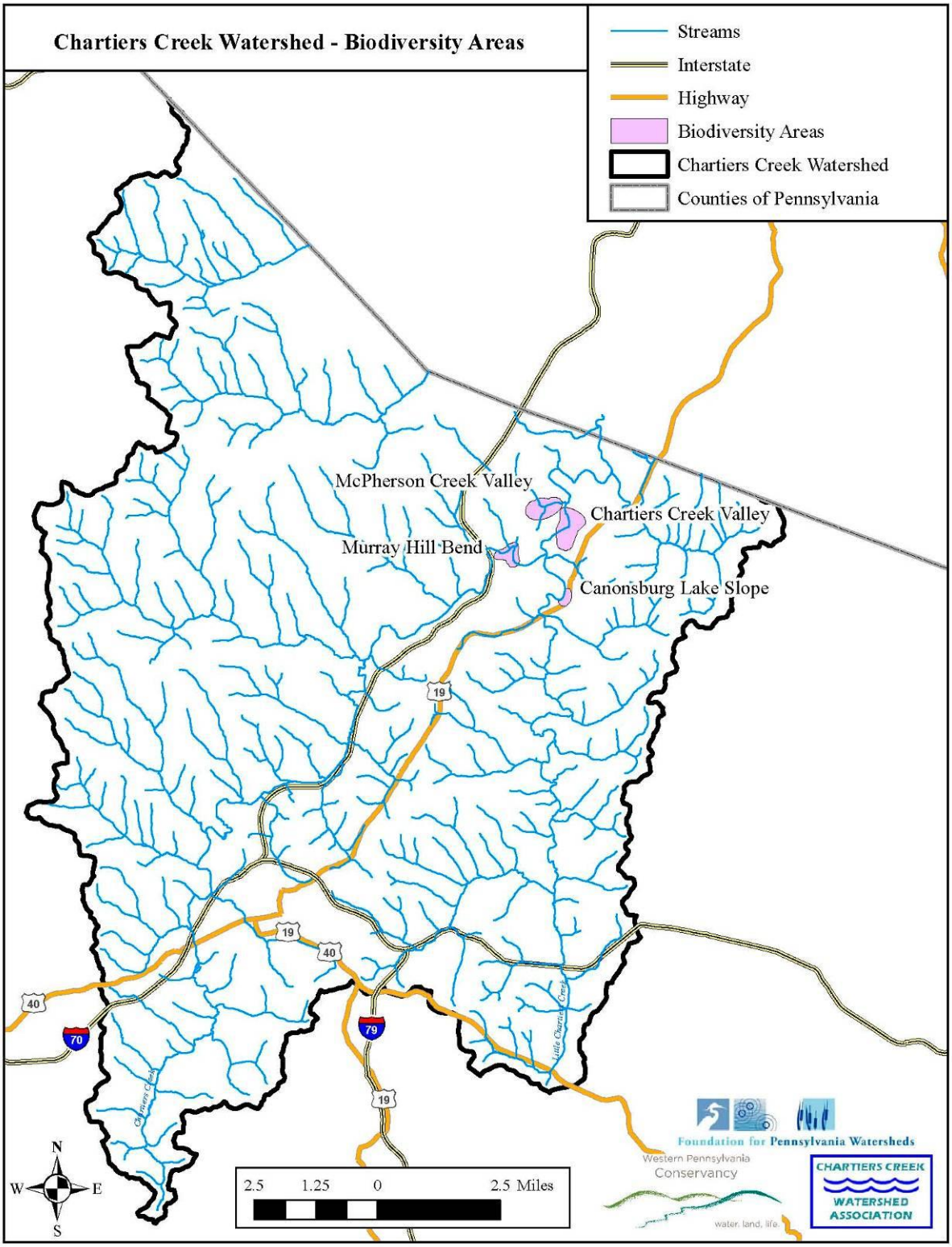

Chartiers Creek Watershed - Biodiversity Areas
Streams
Interstate
Highway
Biodiversity Areas
Chartiers Creek Watershed
Counties of Pennsylvania
McPherson Creek Valley
Chartiers Creek Valley
Murray Hill Bend
Canonsburg Lake Slope
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 4.

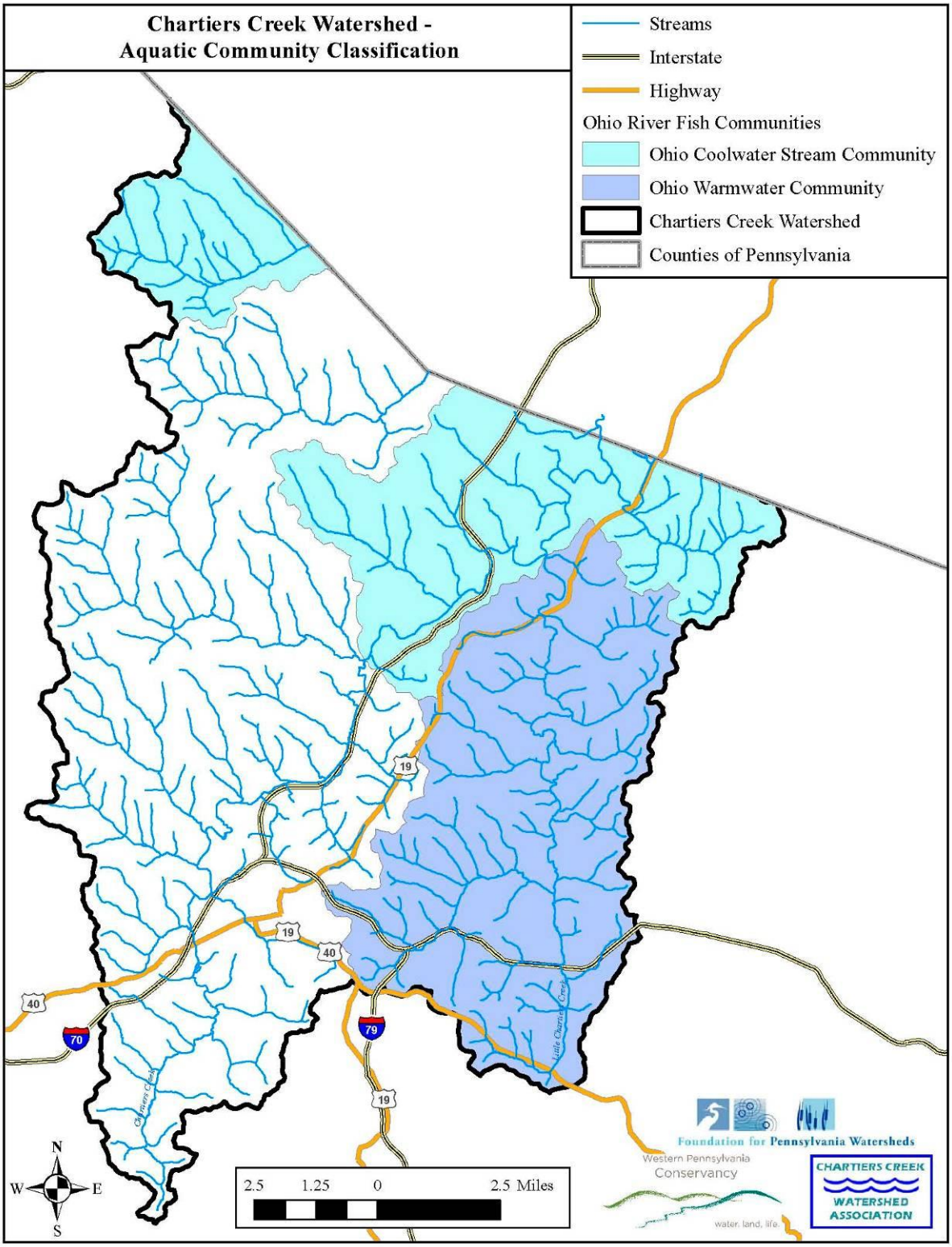

Chartiers Creek Watershed -
Aquatic Community Classification
Streams
Interstate
Highway
Ohio River Fish Communities
Ohio Coolwater Stream Community
Ohio Warmwater Community
Chartiers Creek Watershed
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK
WATERSHED
ASSOCIATION

Figure 5.

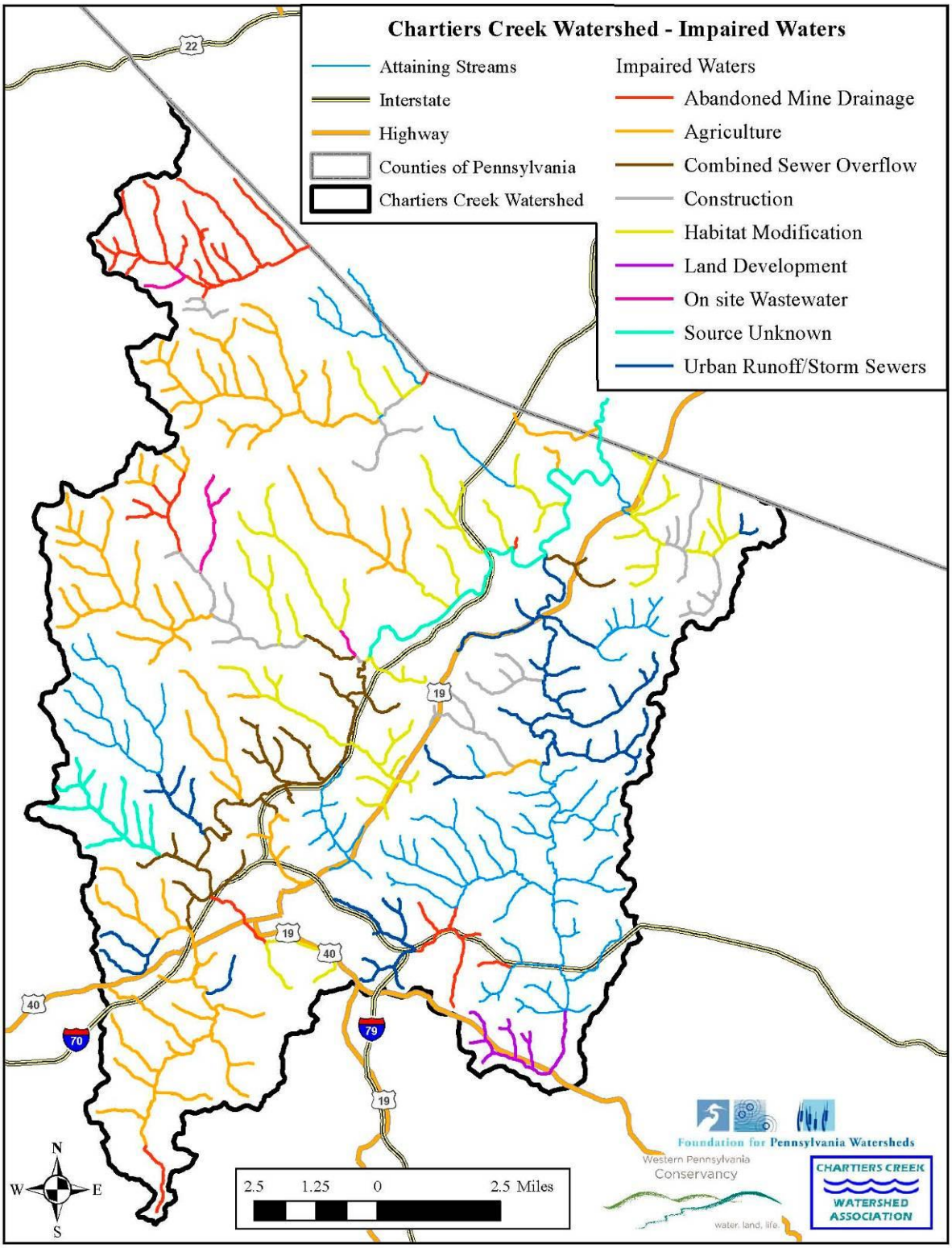

Chartiers Creek Watershed - Impaired Waters
Attaining Streams
Interstate
Highway
Counties of Pennsylvania
Chartiers Creek Watershed
Impaired Waters
Abandoned Mine Drainage
Agriculture
Combined Sewer Overflow
Construction
Habitat Modification
Land Development
On site Wastewater
Source Unknown
Urban Runoff/Storm Sewers
22
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 6.

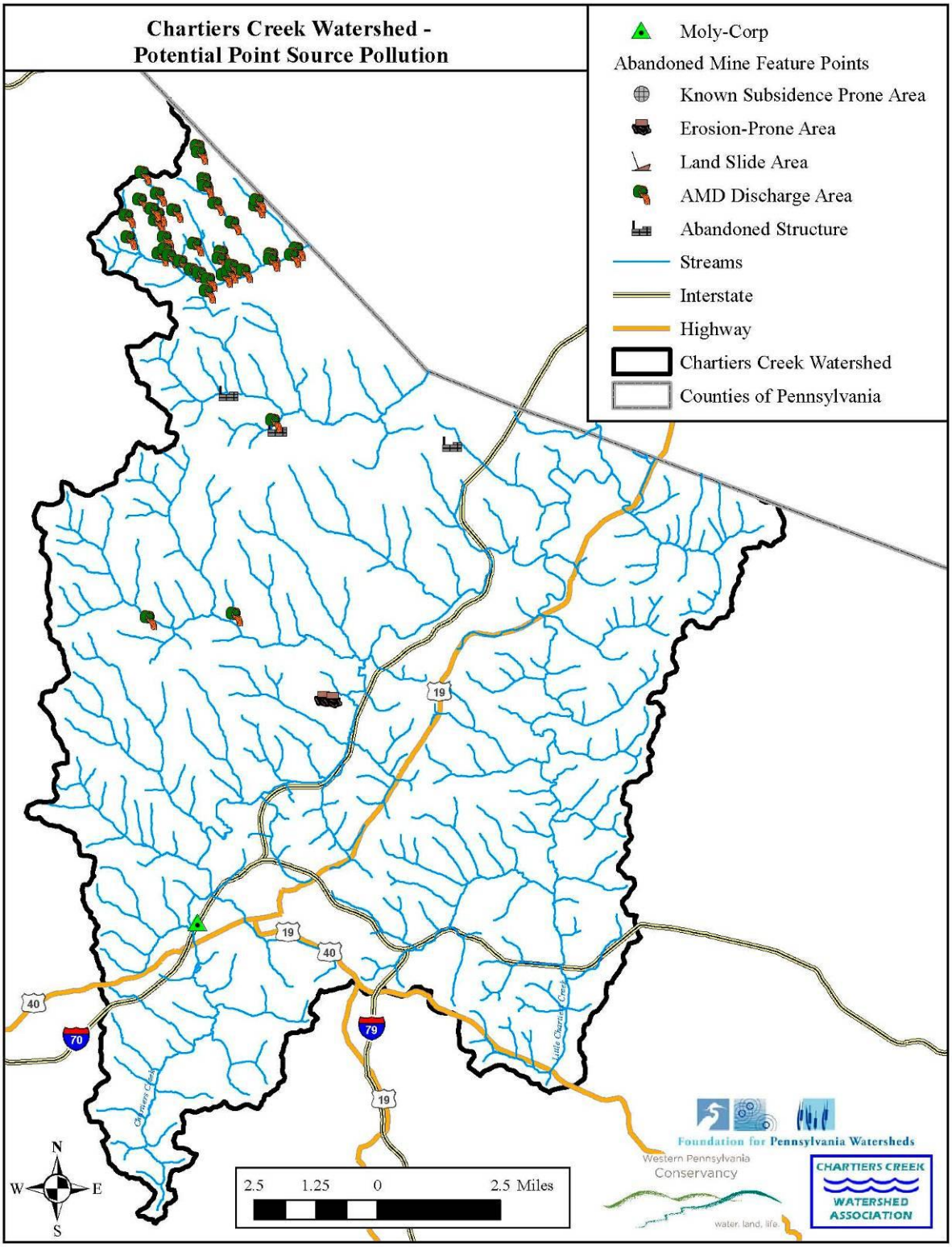

Chartiers Creek Watershed -
Potential Point Source Pollution
Moly-Corp
Abandoned Mine Feature Points
Known Subsidence Prone Area
Erosion-Prone Area
Land Slide Area
AMD Discharge Area
Abandoned Structure
Streams
Interstate
Highway
Chartiers Creek Watershed
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 7.

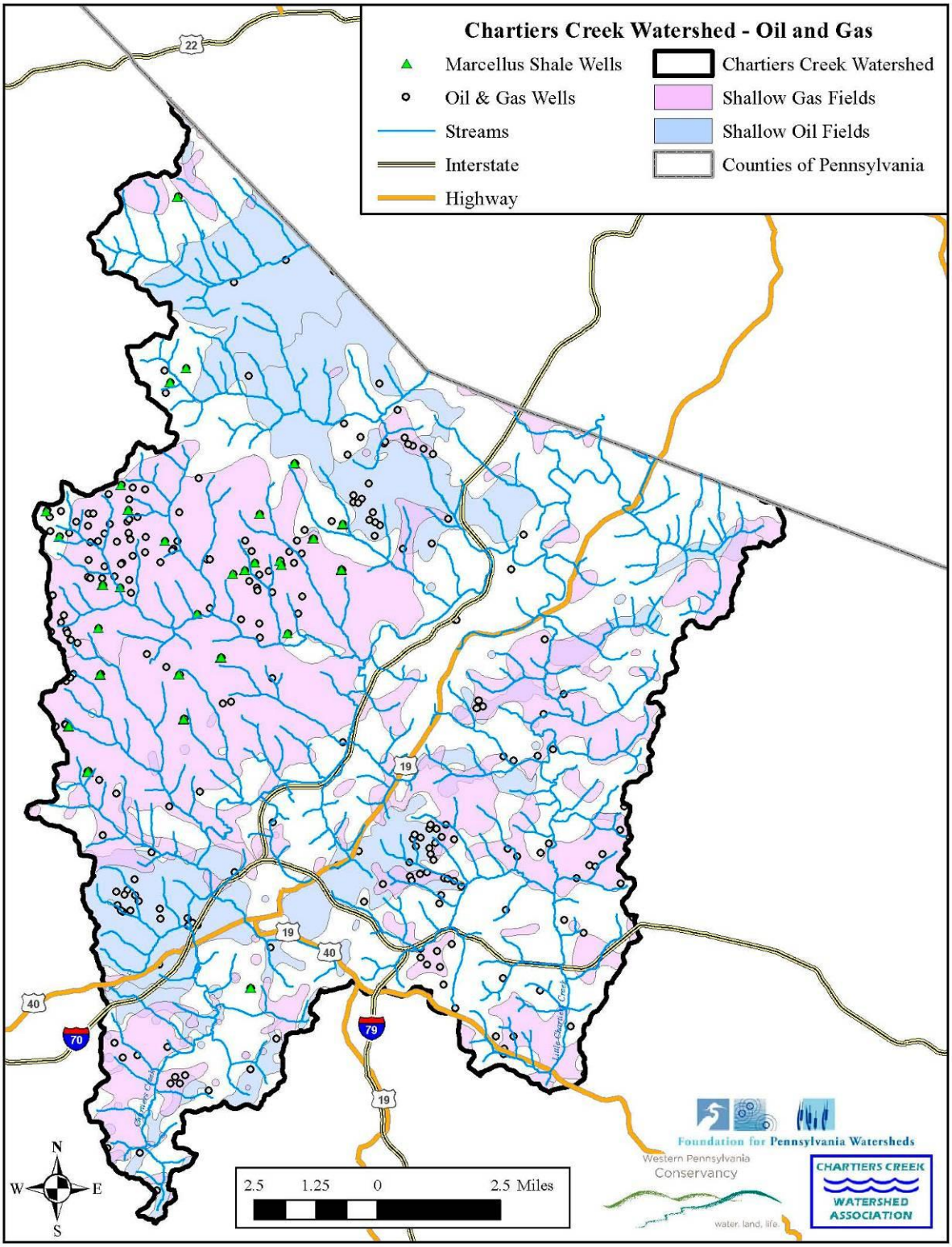

Chartiers Creek Watershed - Oil and Gas
Marcellus Shale Wells
Oil & Gas Wells
Streams
Interstate
Highway
Chartiers Creek Watershed
Shallow Gas Fields
Shallow Oil Fields
Counties of Pennsylvania
22
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 8.

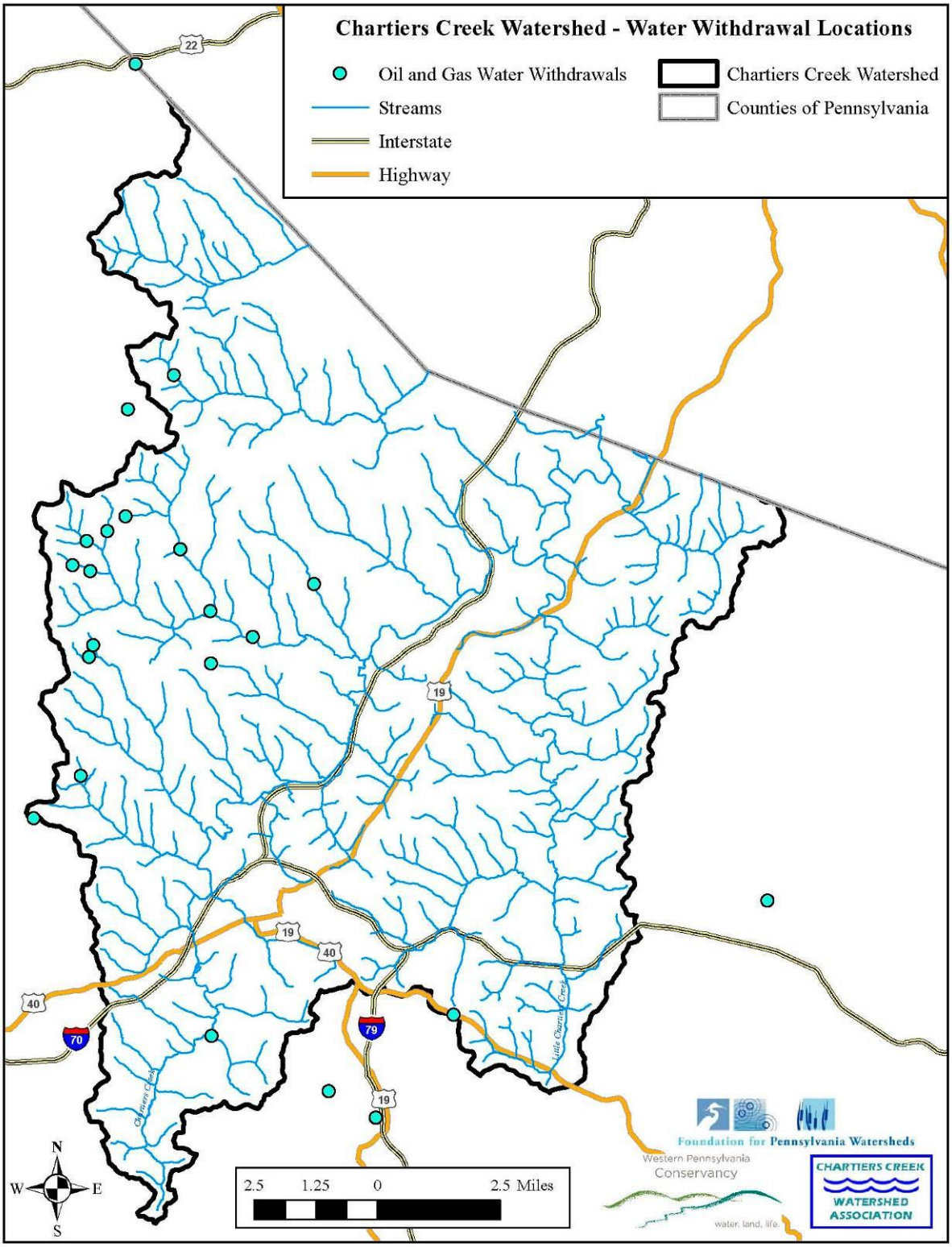

Chartiers Creek Watershed - Water Withdrawal Locations
Oil and Gas Water Withdrawals
Streams
Interstate
Highway
Chartiers Creek Watershed
Counties of Pennsylvania
22
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 9.

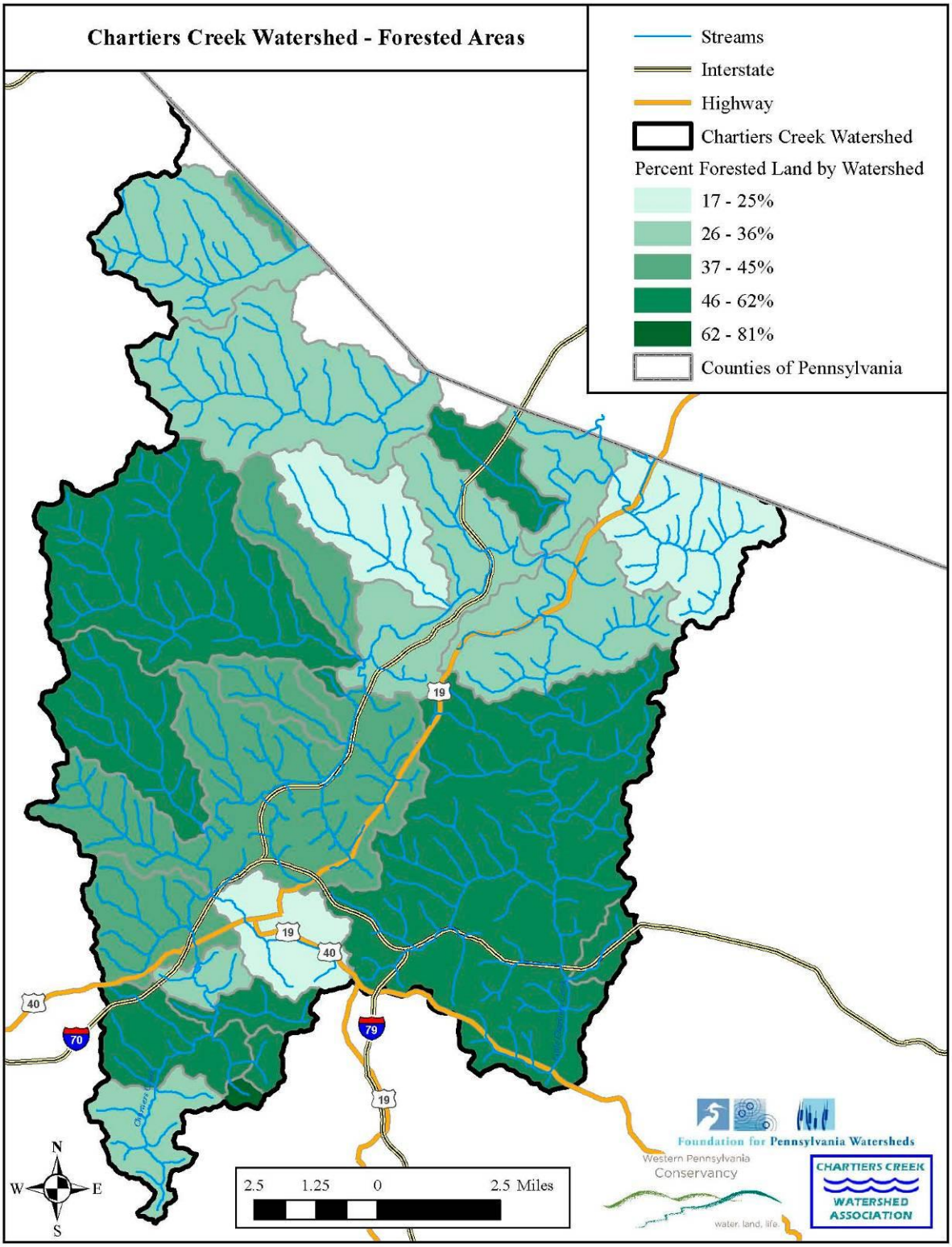

Chartiers Creek Watershed - Forested Areas
Streams
Interstate
Highway
Chartiers Creek Watershed
Percent Forested Land by Watershed
17 - 25%
26 - 36%
37 - 45%
46 - 62%
62 - 81%
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 10.

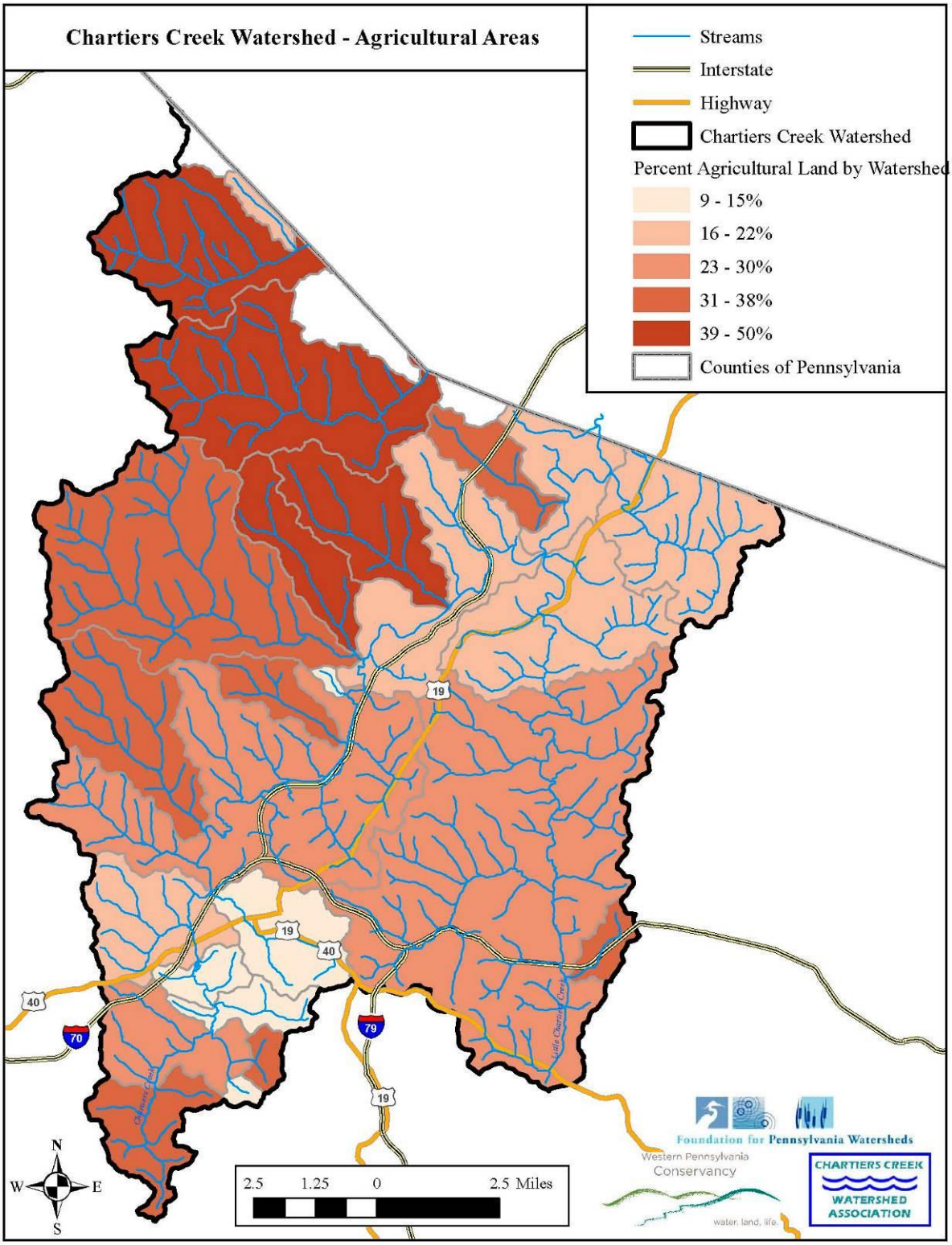

Chartiers Creek Watershed - Agricultural Areas
Streams
Interstate
Highway
Chartiers Creek Watershed
Percent Agricultural Land by Watershed
9 - 15%
16 - 22%
23 - 30%
31 - 38%
39 - 50%
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 11.

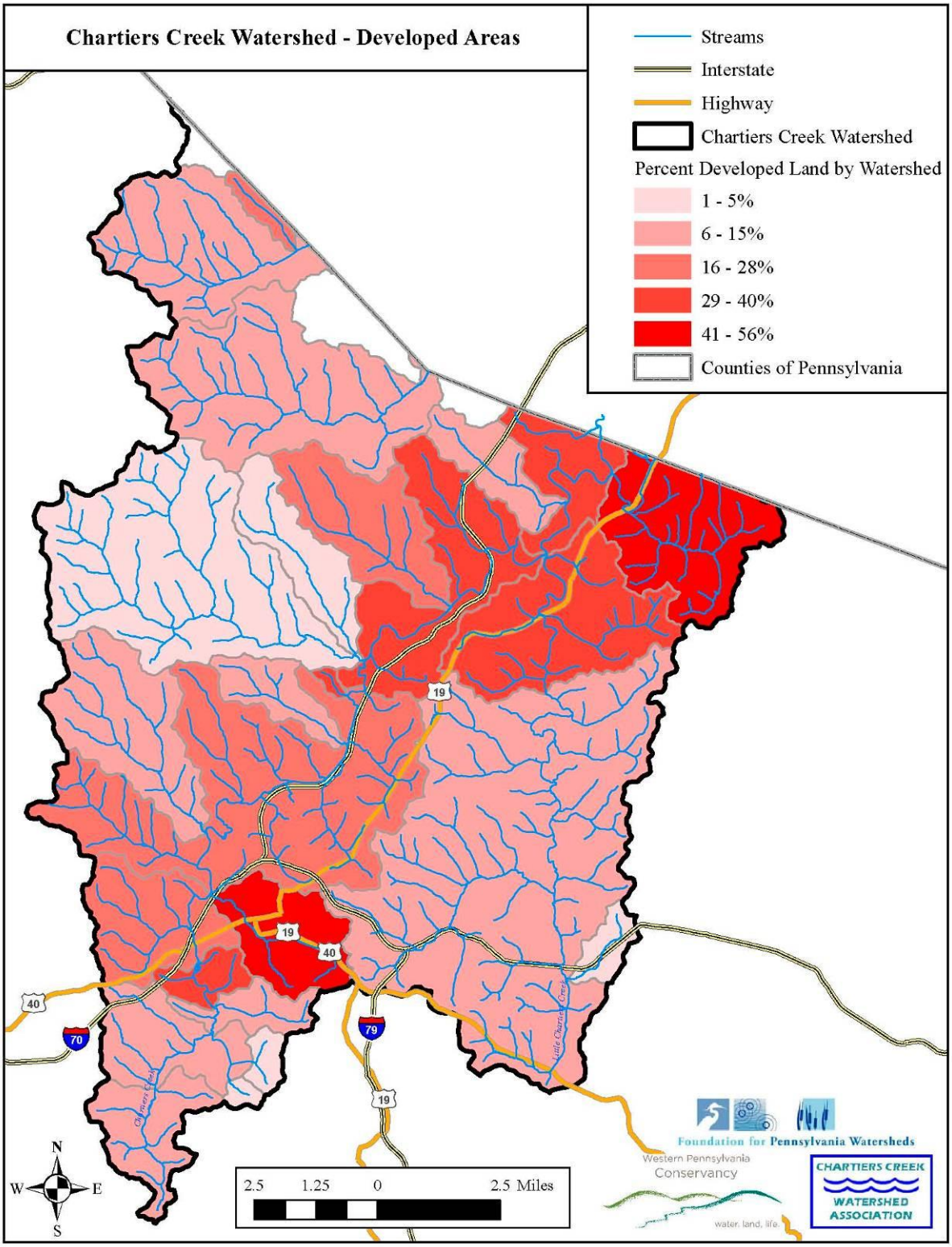

Chartiers Creek Watershed - Developed Areas
Streams
Interstate
Highway
Chartiers Creek Watershed
Percent Developed Land by Watershed
1 - 5%
6 - 15%
16 - 28%
29 - 40%
41 - 56%
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 12.

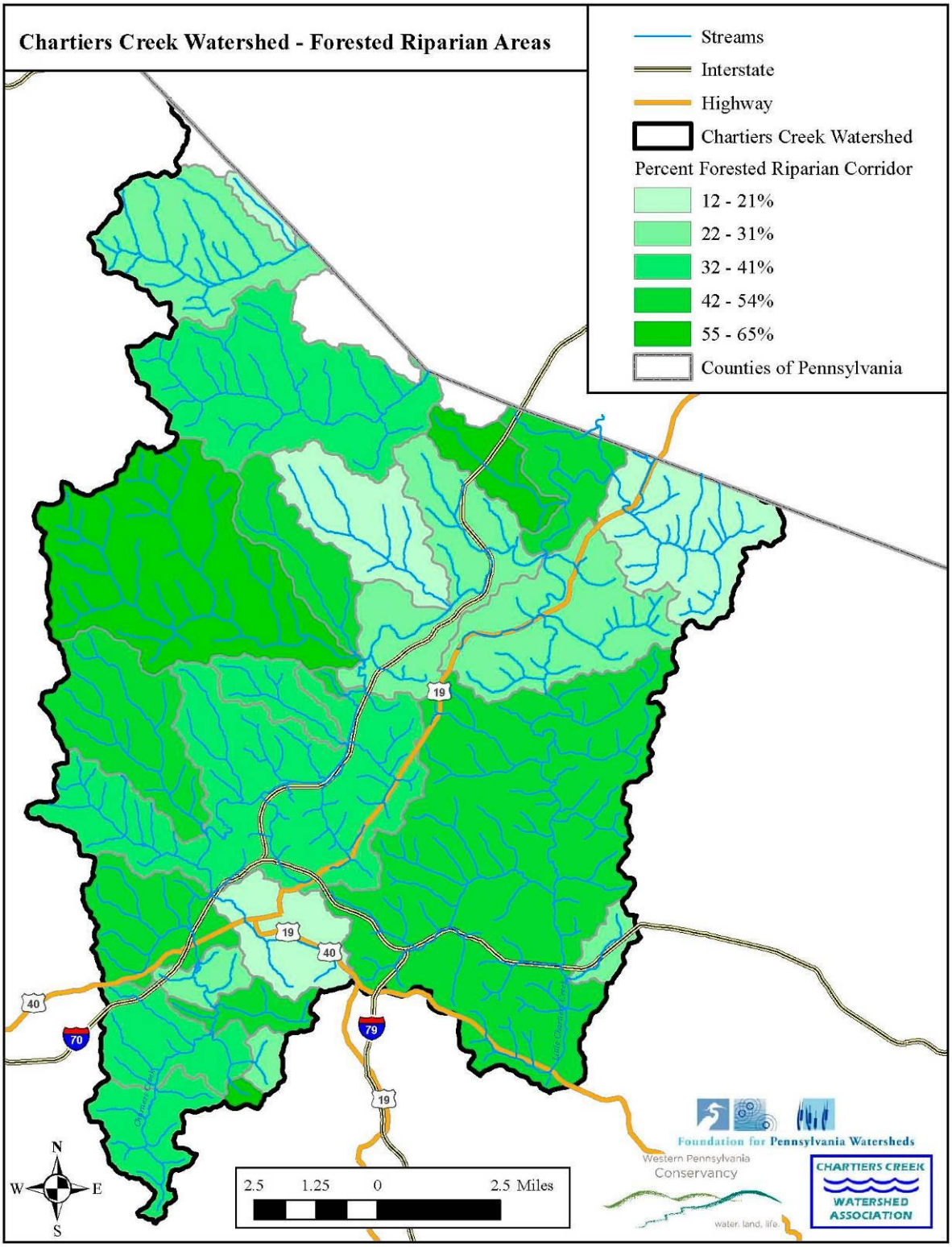

Chartiers Creek Watershed - Forested Riparian Areas
Streams
Interstate
Highway
Chartiers Creek Watershed
Percent Forested Riparian Corridor
12 - 21%
22 - 31%
32 - 41%
42 - 54%
55 - 65%
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 13.

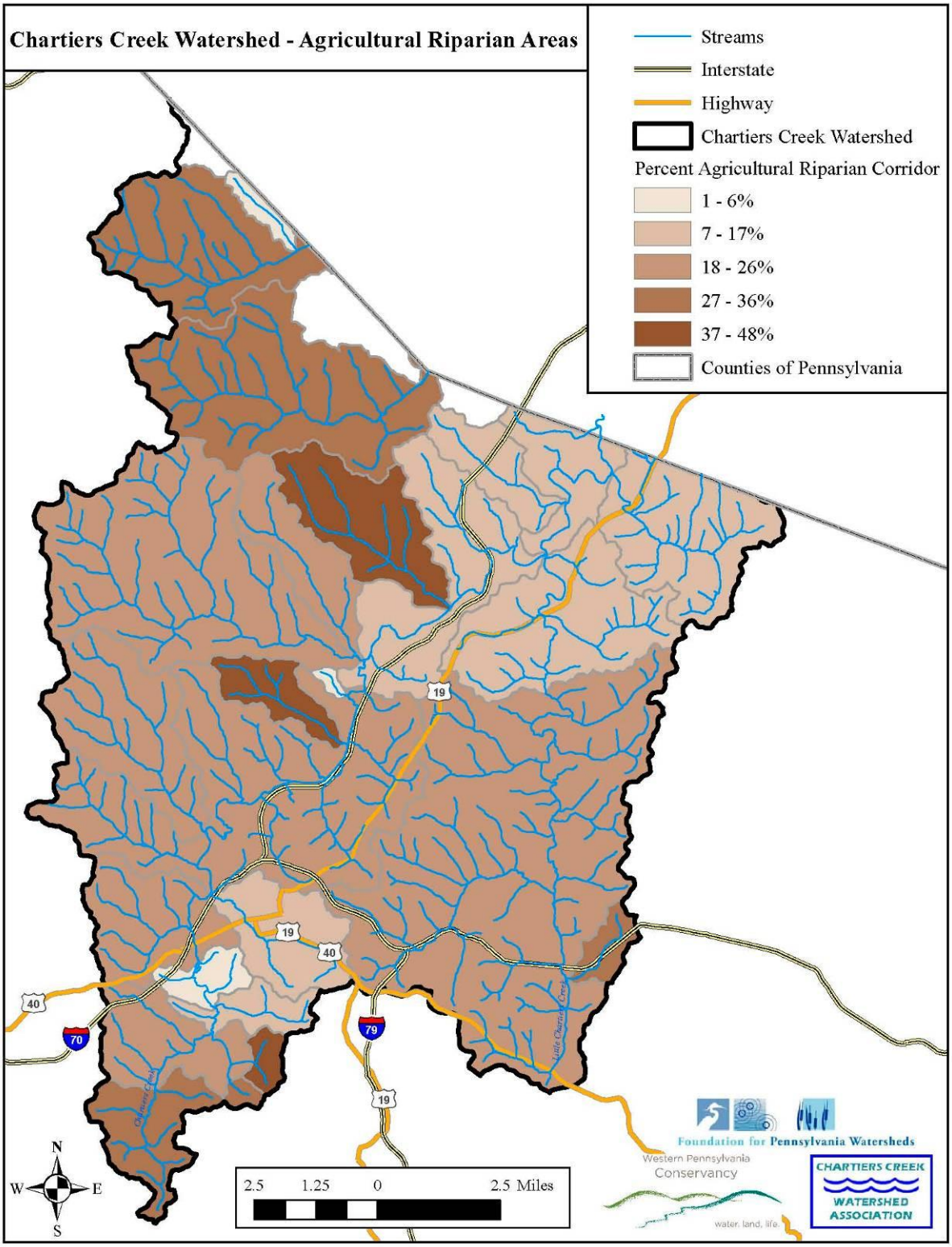

Chartiers Creek Watershed - Agricultural Riparian Areas
Streams
Interstate
Highway
Chartiers Creek Watershed
Percent Agricultural Riparian Corridor
1 - 6%
7 - 17%
18 - 26%
27 - 36%
37 - 48%
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 14.

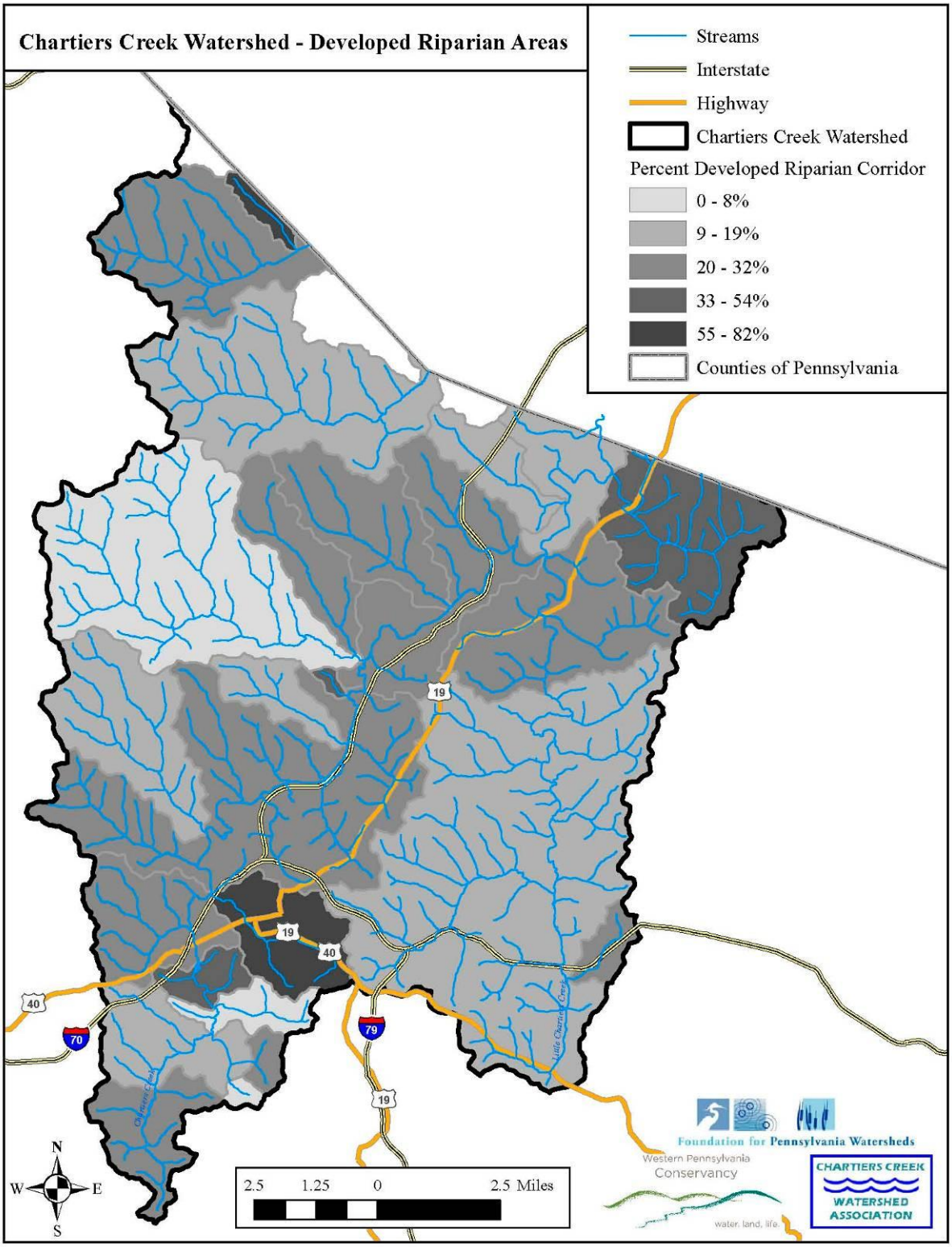

Chartiers Creek Watershed - Developed Riparian Areas
Streams
Interstate
Highway
Chartiers Creek Watershed
Percent Developed Riparian Corridor
0 - 8%
9 - 19%
20 - 32%
33 - 54%
55 - 82%
Counties of Pennsylvania
19
40
70
79
N
W
E
S
2.5 1.25 0 2.5 Miles
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water. land. life.
CHARTIERS CREEK WATERSHED ASSOCIATION

Figure 15.

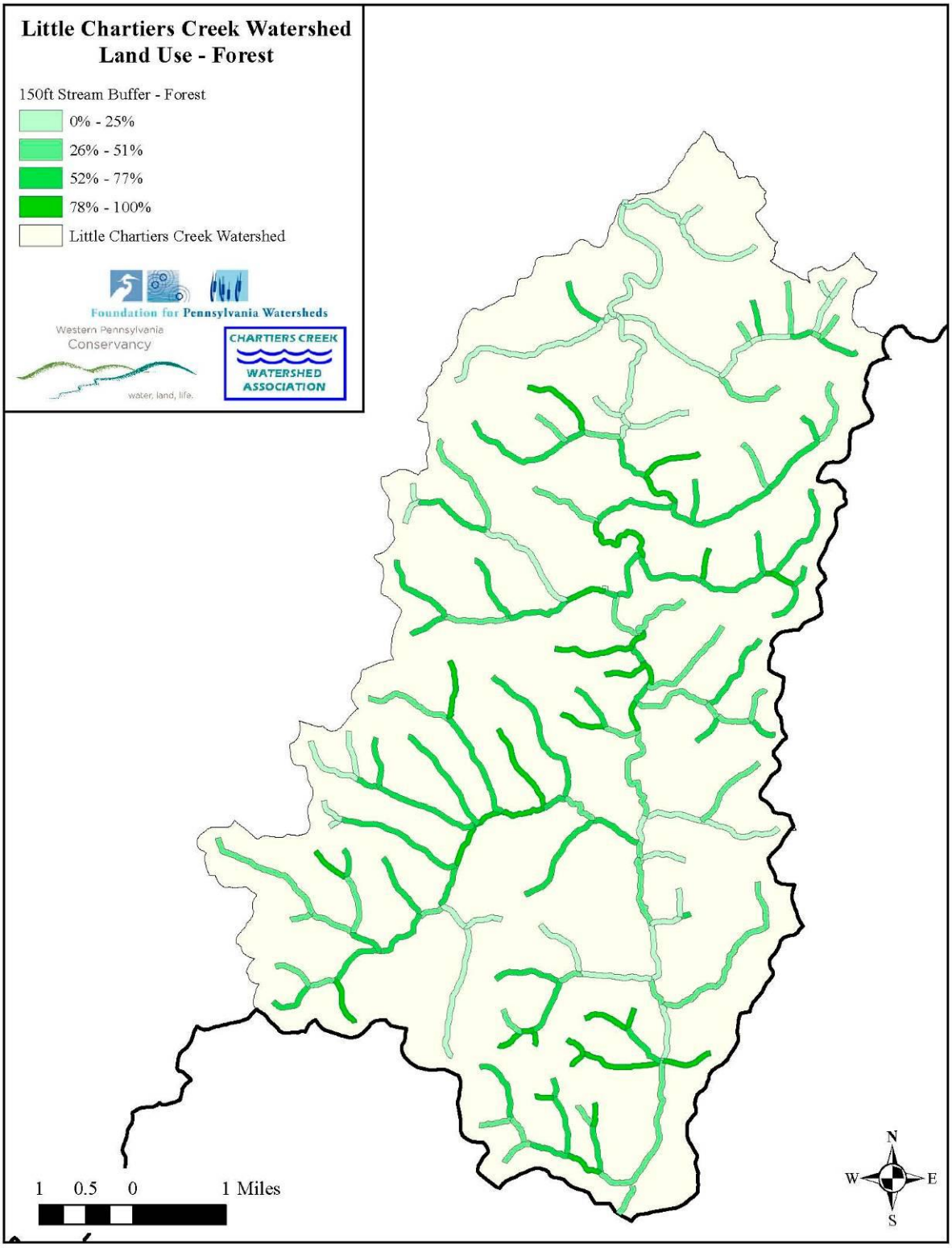

Little Chartiers Creek Watershed
Land Use - Forest
150ft Stream Buffer - Forest
0% - 25%
26% - 51%
52% - 77%
78% - 100%
Little Chartiers Creek Watershed
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water, land, life.
CHARTIERS CREEK WATERSHED ASSOCIATION
1 0.5 0 1 Miles
N
W
E
S

Figure 16.

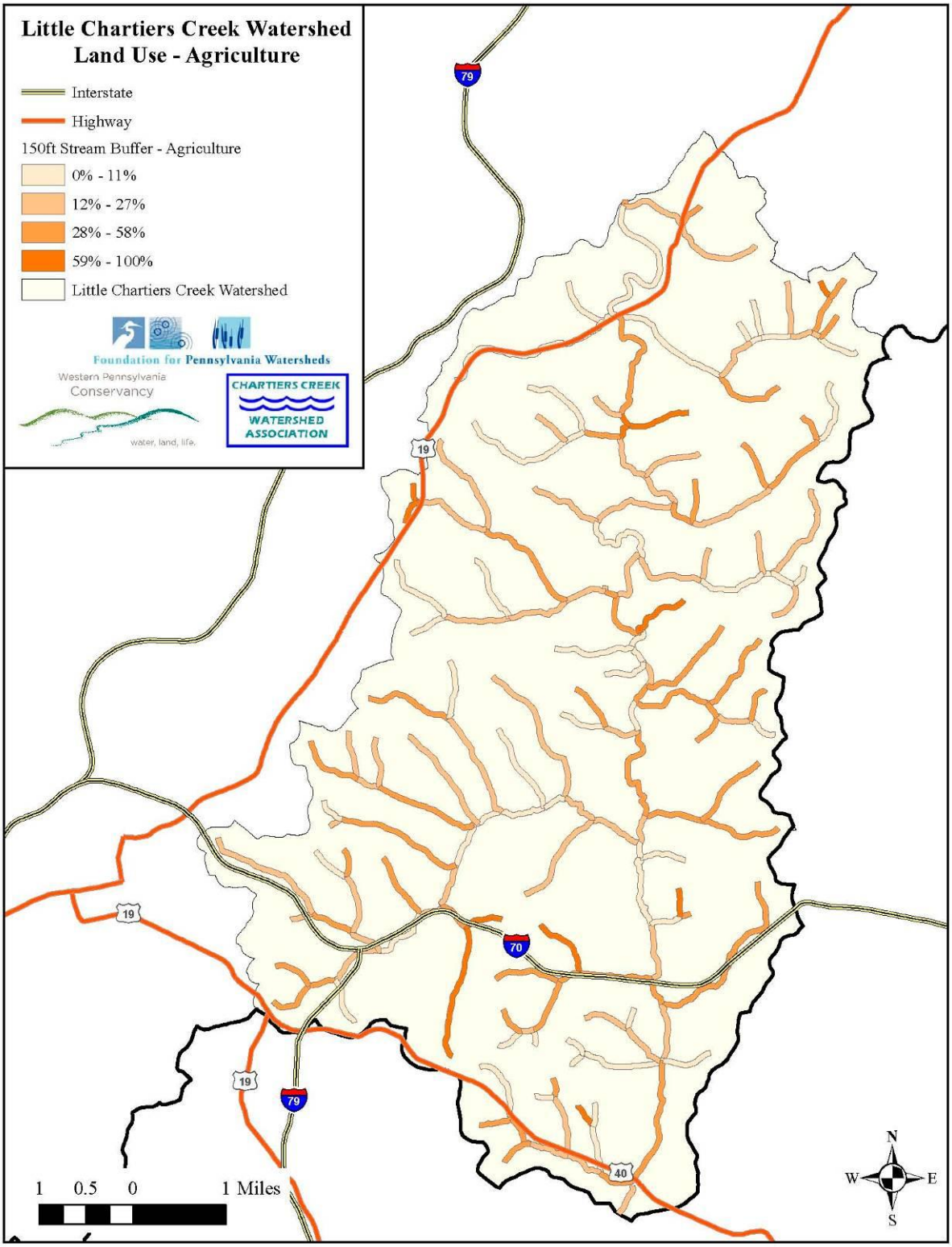
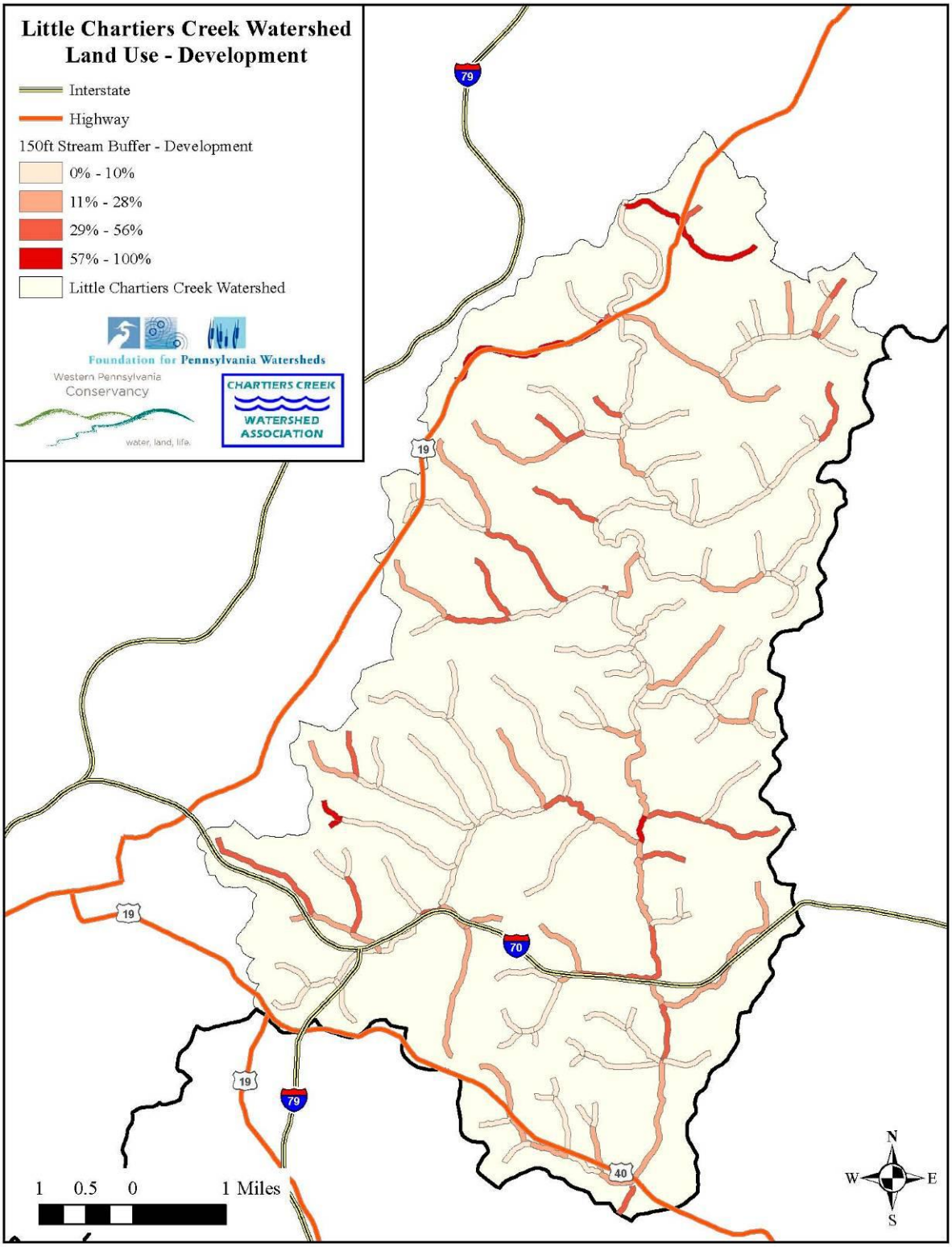

Little Chartiers Creek Watershed
Land Use - Agriculture
Interstate
Highway
150ft Stream Buffer - Agriculture
0% - 11%
12% - 27%
28% - 58%
59% - 100%
Little Chartiers Creek Watershed
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water, land, life.
CHARTIERS CREEK WATERSHED ASSOCIATION
79
19
70
40
1 0.5 0 1 Miles
N
W
E
S

Figure 17.


Little Chartiers Creek Watershed
Land Use - Development
Interstate
Highway
150ft Stream Buffer - Development
0% - 10%
11% - 28%
29% - 56%
57% - 100%
Little Chartiers Creek Watershed
Foundation for Pennsylvania Watersheds
Western Pennsylvania Conservancy
water, land, life.
CHARTIERS CREEK WATERSHED ASSOCIATION
79
19
70
40
1 0.5 0 1 Miles
N
W
E
S