



A Water Resources Plan for the First State National Monument

Shyanne E. Miller

McNair Post-Baccalaureate Achievement Program, Department of Entomology and Wildlife Ecology
University of Delaware

Objective

The Brandywine-Piedmont Watershed is located in southeastern Pennsylvania and northern Delaware provides approximately 500,000 residents of Chester County, Pennsylvania ,and New Castle County, Delaware with their water supply. In 2013 President Barack Obama declared that a large tract of land within the Brandywine Creek watershed be designated as part of the newly established First State National Monument. During summer 2014 the Nature Conservancy of Delaware and University of Delaware Water Resources Agency conducted field studies to prepare a watershed plan for the Piedmont tributaries that flow west toward the Brandywine Creek within the boundaries of the First State National Monument(Figure 1). The summer field work included collection of data on water quality, environmental habitat, and stream geomorphology in the region. These datasets were used to assess the overall environmental quality of the streams which flow into the First State National Monument and to develop a land management plan designed to protect and restore these scenic watersheds that flow through the Brandywine Creek State Park (Delaware Division of Parks and Recreation) and the newly designated First State National Monument at Woodlawn (National Park Service).

Study Area

Sub-Watersheds of Interest

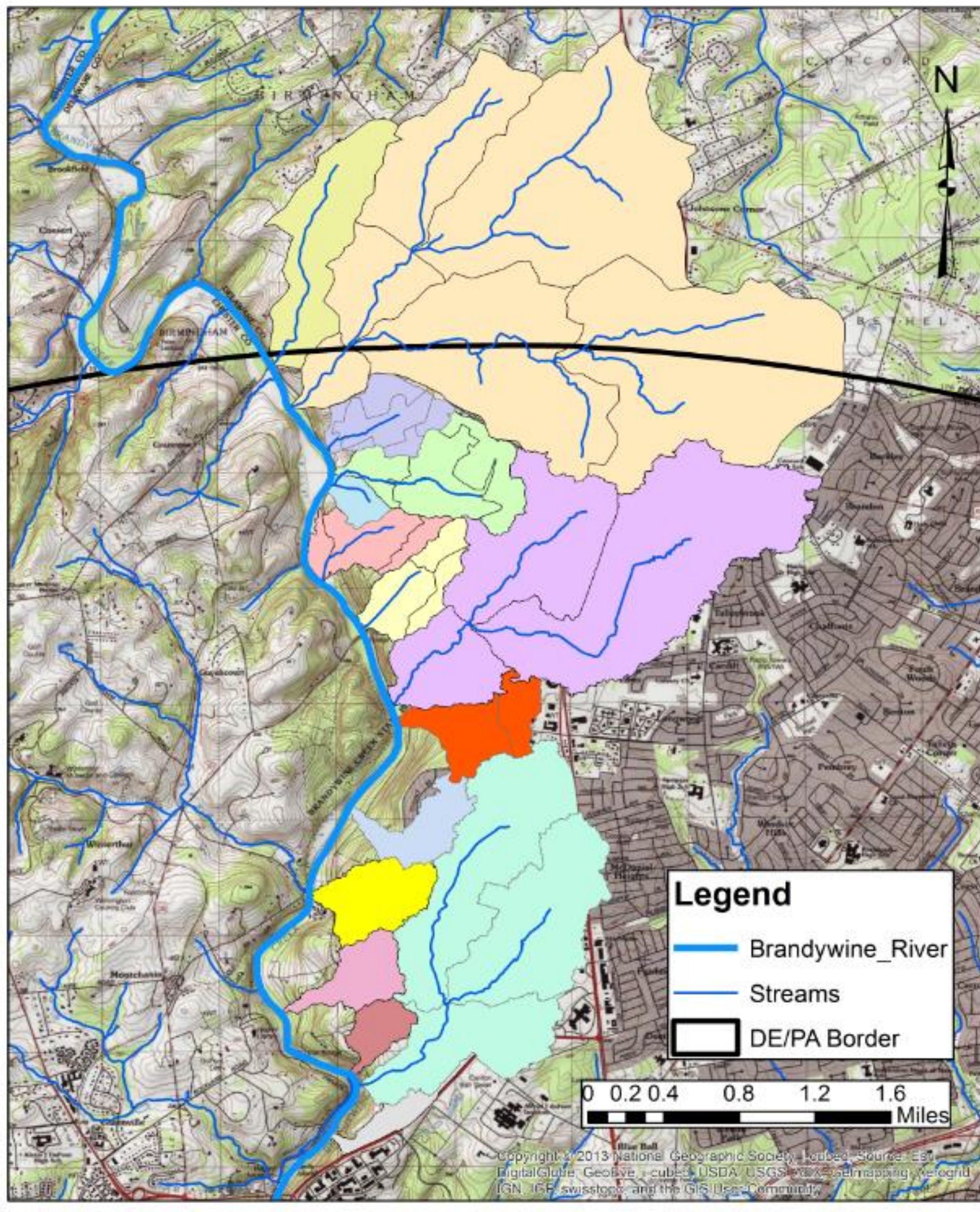


Figure 1. Map of Brandywine Creek tributaries.

Methods

Environmental assessments within the study region were completed using the following methodologies:

1. Obtain stream cross-sections.
2. Assess streams according to the EPA rapid stream bioassessment technique.
3. Measure macroinvertebrate density.
4. Obtain water quality samples.
5. Classify tributaries according to the Rosgen stream geomorphology method.

Results

The EPA Biohabitat Assessment for Beaver Creek South Fork Middle Tributary (Table 1) indicated that seven out of ten parameters had a scoring of optimal. This included parameters such as epifaunal substrate, pool variability, sediment deposition, and channel alteration. Channel sinuosity had a suboptimal rating while right bank stability had a marginal rating. The overall rating for Beaver Creek South Fork Tributary was optimal, with characteristics resembling approximately 90% of reference stream conditions.

The Rosgen Classification for Beaver Creek South Fork Middle Tributary (Table 2) indicated that the stream was entrenched with a very low width to depth ratio. The tributary had low sinuosity and a classification of A3. The A3 stream type predicts that there is high erosion potential and poor recovery potential.

Results elude to a high quality stream overall (Table 1) with a stream type A3 (Table 2). The EPA assessment total score was 169 out of Delaware’s highest score for a reference stream 190. The high erosion potential and poor recovery potential are indicators of a sensitive stream.

Table 1. EPA Biohabitat Assessment Beaver Creek South Fork Middle Tributary Station 8+00		
Epifaunal Substrate	20	Optimal
Pool Substrate	18	Optimal
Pool Variability	18	Optimal
Sediment Deposition	16	Optimal
Channel Flow Status	16	Optimal
Channel Alteration	20	Optimal
Channel Sinuosity	13	Suboptimal
Bank Stability Left	7	Optimal
Bank Stability Right	5	Marginal
Vegetative Left	9	Optimal
Vegetative Right	7	Optimal
Riparian Zone Left	10	Optimal
Riparian Zone Right	10	Optimal
Total Score	169 (optimal)	88.9% (% of Del. Reference)

Table 2. Rosgen Classification Beaver Creek South Fork Middle Tributary Station 8+00	
Single/Multiple	single
Bank Width	26
Floodprone Width	8
Entrenchment Ratio	0.3 (Entrenched)
Bank Width	26
Channel Depth	4
W/D ratio	6.5 (very low)
Channel Length	200
Straight Distance	185
Sinuosity	1.08 (low)
Slope	0.020
Channel Material	Sand/gravel
Classification	A3
Erosion Potential	high
Recovery Potential	Very poor

Beaver Creek Watershed Topography

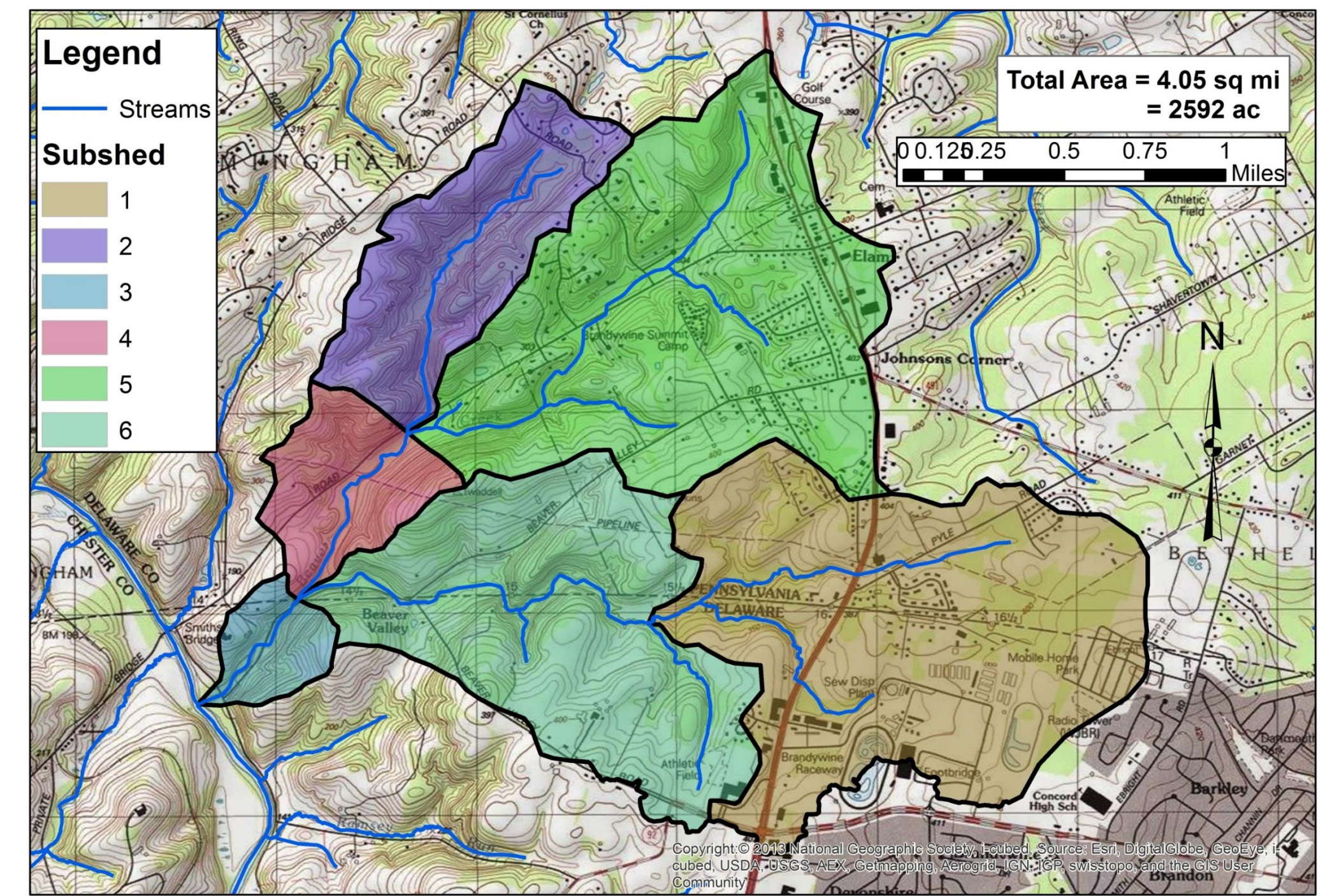


Figure 2. Map of Beaver Creek tributaries.

Discussion and Broader Impacts

Results indicated that the habitat and stream health of the Beaver Creek South Fork Middle tributary was relatively high. It is likely that this high quality can be attributed to the fact that the area was relatively undeveloped, consisting predominantly of woodlands and minimal residential development. Despite the overall high EPA ratings there were some low scoring observation sites in the area. Low scores in these locations were clearly due to anthropogenic disturbances, specifically manmade channel alterations, pipes, and bridges. There were also noticeable points of erosion and undercutting of some sections of banks along the tributaries. It is possible that this can be rectified through restoration practices. It is expected that the water quality samples will show some traces of pollution because the tributaries flow through agricultural areas. Using the information gathered in the field work, our next steps aim to create a report documenting the current status of the Brandywine Watershed. Within the report we will include sites recommended for restoration. Because the area is within the designated First State National Monument, we hope that it will be a national point of interest for visitors.



Figure 3. Interns conducting cross-sections in Beaver Creek.

Literature Cited

1. Rosgen, D.L., 1994. A Classification of Natural Rivers. Wildland Hydrology. 169-199.
2. Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling, 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish. Second Edition. EPA 841-B-99-002. Washington, DC.
3. United States Department of Agriculture, 2007. Rosgen Stream Classification Techniques-Supplemental Materials.

Acknowledgements

Special thanks to Asia Dowtin (UD geography doctoral student), University of Delaware’s Water Resources Agency, Nature Conservancy of Delaware, National Parks Service, and the McNair Scholars Program.