Briar Creek Watershed

Coldwater Conservation Plan
Columbia County, PA

Prepared by:

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In conjunction with

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Funded by:

Coldwater Heritage Partnership

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ACKNOWLEDGMENTS

Funding for the Coldwater Conservation Plan (CCP) was provided by the Coldwater Heritage Partnership (CHP). The CHP is composed of Pennsylvania Trout Unlimited (PATU), the PA Department of Conservation and Natural Resources (DCNR), and the PA Fish and Boat Commission (PFBC). The CHP grant program is administered by PATU under contract with DCNR, and receives funding assistance from DCNR, PFBC, and the Foundation for Pennsylvania Watersheds.

This CCP was made possible by the hard work, dedication and vision of the Briar Creek Association for Watershed Solutions (BCAWS). BCAWS has worked to gather data in conjunction with the Columbia County Conservation District (CCCD). Other key partners whose help was critical to the CCP completion include Bloomsburg University, Briar Creek Township and North Centre Township (letters of support from each have been received). The CCP was based on 10 sampling sites within the watershed. We thank the private landowners for openly welcoming BCAWS volunteers to monitor the stream at these sites biweekly for a year. We look forward to working with these individuals in the future to improve stream quality in our watershed.

Technical reports and studies providing biological and chemical data for the Briar Creek Watershed (BCW) were also reviewed to support the findings of the CCP, including the Pennsylvania Department of Environmental Protection (DEP), the PFBC, and the Pennsylvania Science Office of The Nature Conservancy (PSONC).

A special note of thanks to Ben Franek, BCAWS Secretary, for the many hours spent to complete this plan. Ben created the mapping, provided geotechnical data, compiled and analyzed the monitoring data for this plan and prepared narrative. Stephanie Singer, watershed specialist for the CCCD, was instrumental in the creation of the CCP. She worked with BCAWS from inception to realize the group's vision, obtain funding, and gather physical and chemical data for the CCP. Nancy Corbin, also a watershed specialist for the CCCD, was instrumental as liaison to state and federal agencies in procuring project reports from past studies in the watershed. She also prepared narrative and spent many hours editing the CCP. Stream monitors were: Mary Jo Gibson, Ruth Bogart, Ray Hosler, Ben Franek, and Stephanie Singer. Contributors to the project include: Clem McIntyre, Tom Clymer, Carol Clymer, and Patti Hosler.

This work is dedicated in memory of

Ray Hosler (1950-2012)

BCAWS Vice-President, Colleague,

Friend

INTRODUCTION AND BACKGROUND

BCAWS was established in April 2007 by concerned residents of the watershed. The mission statement of the organization is: Establishing partnerships to promote awareness and action on a local, state, national and global level with an eye towards preserving the precious and unique resources of Briar Creek, and, by extension, the greater Chesapeake Bay Watershed. BCAWS currently has approximately 25 members.

The goals of BCAWS include promoting watershed awareness, completing watershed assessments, and protecting stream quality. The Coldwater Heritage Partnership Planning grant has allowed BCAWS to work on all aspects of the groups goals. With the funding support of the CHP, BCAWS was able to execute a Briar Creek Watershed Coldwater Conservation Plan to compile what is known about the watershed, identify information gaps that may exist, monitor the streams and propose specific actions to address knowledge gaps and/or identified problems in the watershed. Since the inception of BCAWS, monitoring in the watershed, at the intensity of this effort, has not been conducted. Through the help of volunteers from BCAWS and Bloomsburg University, physical and chemical data were collected along major tributaries to establish a baseline of watershed stream conditions. Once the collection period was complete, the data was examined and compared to rank watershed sites for priority conservation action.

LIMITATIONS

This project was delimited by the number of individuals involved, their relevant expertise with germane work, the extent of funding available for equipment, supplies, etc., the amount of time available for the various tasks, and the availability of pre-existing data and information.

GLOSSARY

BCAWS – Briar Creek Association for Watershed Solutions

CCP – Coldwater Conservation Plan

CHP – Coldwater Heritage Partnership

CWF – Coldwater Fishery

DCNR – Department of Conservation and Natural Resources

DEP – Department of Environmental Protection

EC – Electro Conductivity

EPA – United States Environmental Protection Agency

IBI – Index of Biological Integrity

MCL – Maximum Contaminant Value

PATU – Pennsylvania Trout Unlimited

PFBC – Pennsylvania Fish and Boat Commission

PGC – Pennsylvania Game Commission

PNDI – Pennsylvania Natural Diversity Inventory

PSONC – Pennsylvania Science Office of The Nature Conservancy

Q – Discharge/Flow

TDS – Total Dissolve Solids

TMDL – Total Maximum Daily Load

USFW – United States Fish and Wildlife Service

USGS – United States Geological Survey

Section 1: WATERSHED DESCRIPTION

History

A brief snapshot of the history of human impacts in the watershed was compiled. The initial time period noted is considered pre-1770s. About this time, a local Lenni Lenape aboriginal group inhabited the area. This group developed villages in areas immediately located on the banks of streams in places free of timber above the recognized flood level. Other development by the group included paths or trails, burying grounds, and agriculture and pastureland (Beers and Co., 1915).

Circa the 1770s, West Briar Creek sub-watershed was one of the first areas in Columbia County developed by "settlers" since the land was considered some of the more fertile. Then, in the early 1800s, the first mills in the BCW were built and then powered by water from the branches of Briar Creek (Baillie, Dominguez, & Johnson, 2012). Other industries established included an iron furnace, tannery, and saw and woolen mills (Beers and Co., 1915).

The mid-1800s to mid-1900s saw railroads constructed through the watershed with fisheries ensuing as a pioneer industry. Heavier industry then developed with the manufacture of railroad cars, cars, and military vehicles (Berwick Borough, 2009). To date, persisting activities include agricultural and industrial practices, residential and infrastructure development, and watershed conservation. Robust establishment of the history of human impacts in the watershed before the timeframe noted here remains a challenge because of a lack of documentation (Franek, 2009).

Location

The watershed spans parts of Columbia County and Luzerne County (a small portion of Salem Township) and encompasses approximately thirty-three square miles (~21,000 acres).

BCW is governed locally by six municipalities: Berwick Borough, Briar Creek Borough, Briar Creek Township, North Centre Township, Orange Township, and Salem Township - see Figure 1.1 below.

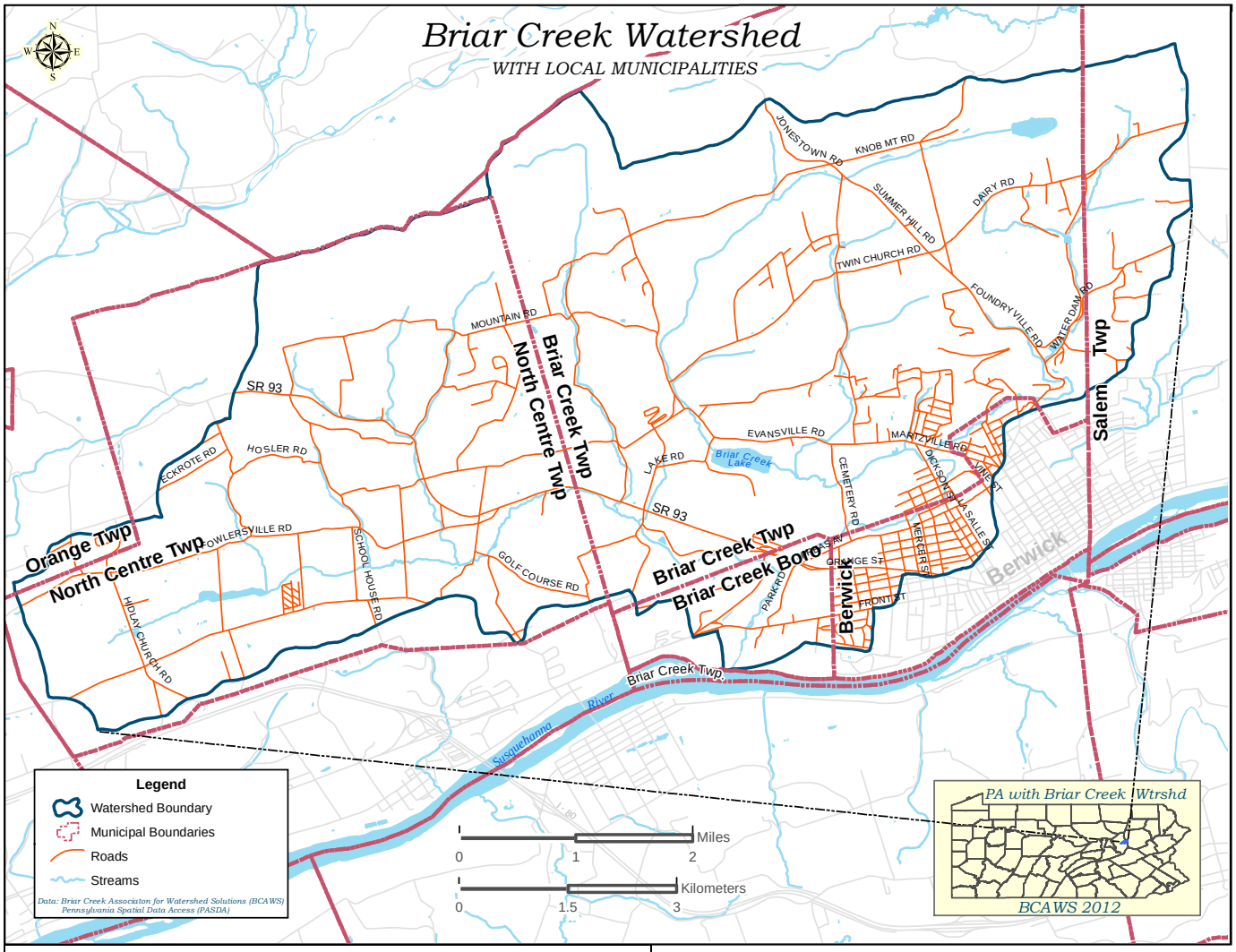

Figure 1.1: Location Map with Local Municipalities

Municipality	Square miles	Square miles in Watershed
Berwick Borough	5.2	1.24
Briar Creek Borough	1.2	1.04
Briar Creek Township	19.3	16.48
North Centre Township	14.6	12.04
Orange Township	12.4	.22
Salem Township	27.7	1.94

Table 1.1: Municipal Area Coverage of the Watershed

Stream Characteristics

Figure 1.2 and Table 1.2 describe the ~44 miles of streams which make up the seven sub-watersheds within the Briar Creek Watershed. Chapter 93 of the Pennsylvania Code establishes water quality standards for surface waters of the Commonwealth.

The standards are developed for water uses which are deemed acceptable and are considered by the Department of Environmental Protection (PA DEP) in implementing its authority under the Clean Streams Law as well as other statutes that authorize protection of surface water quality. All streams within the Briar Creek watershed have been previously classified as Cold Water Fisheries (CWF). Even more, Glen Brook has been listed on the Pennsylvania Fish and Boat Commission (PFBC) class A wild trout list.

PA DEP assesses streams for the Clean Water Act Section 305(b) reports and Section 303(d) listing. Four stream uses are evaluated: aquatic life, fish consumption, potable water supply, and recreation. A stream that does not meet the required criteria for any of the four use categories is considered non-attaining and therefore listed as impaired. Two sections of stream in the Briar Creek watershed are included on DEP's 2012 Integrated Water Quality Monitoring and Assessment Report and require a Total Maximum Daily Load (TMDL). A TMDL is an indicator of how much of an impairment a stream can handle and still meet water quality standards (DEP, 2012a). A section of East Branch Briar Creek is listed as impaired downstream of Briar Creek Lake noting thermal modification and low dissolved oxygen levels (see Figure 1.2). Also, an unnamed tributary (not mapped) to West Branch Briar Creek is listed as impaired due to siltation (DEP, 2012a). Figure 1.2 maps each sub-watershed along with the BCAWS monitoring site locations. Table 1.2 lists numerical details about each sub-watershed. See the Briar Creek Sub-Watershed Findings section for a map, picture, and information regarding each monitoring site.

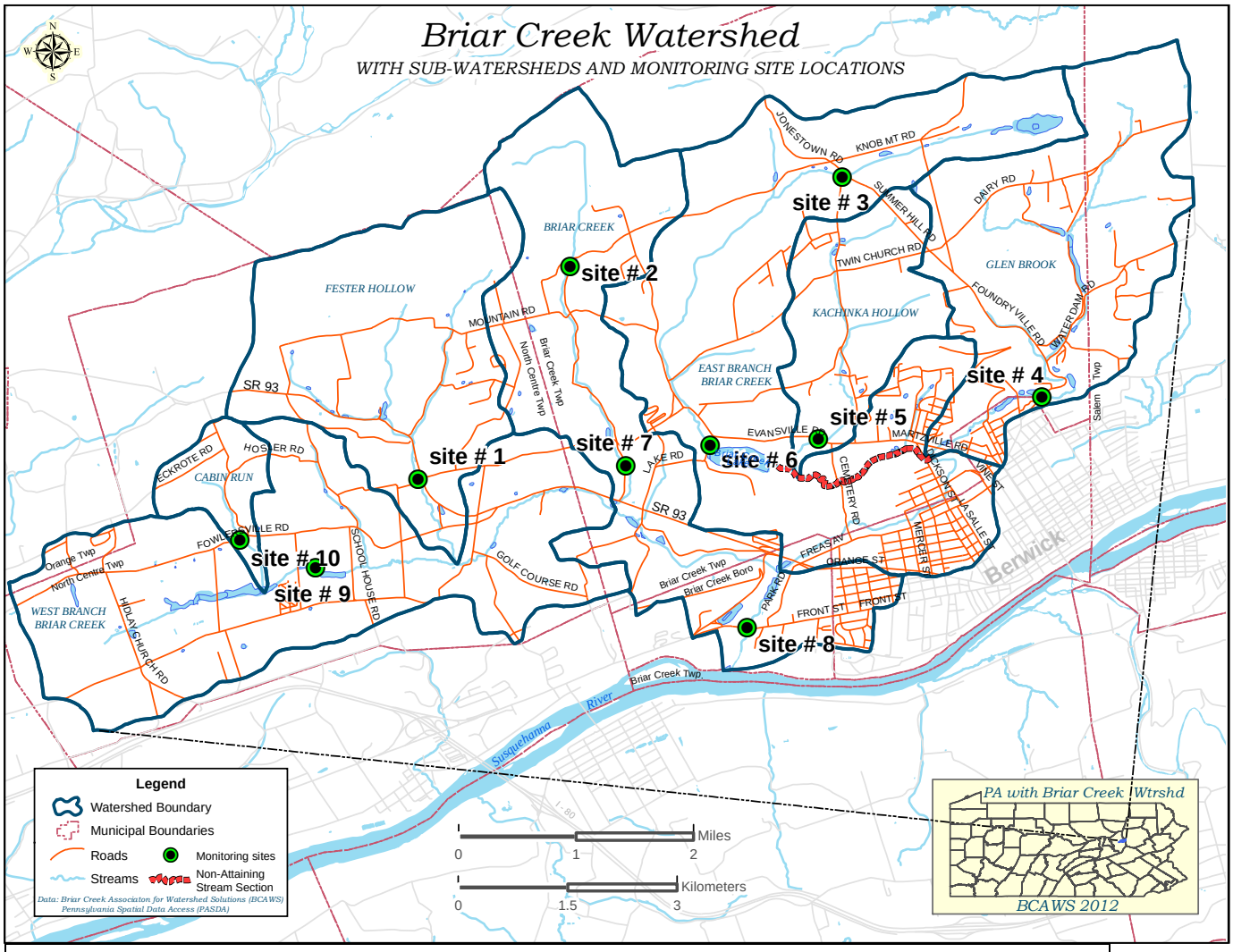

Figure 1.2: Briar Creek Sub-Watersheds and Monitoring Site Locations

Sub-Watershed	Acres	Square Miles	Waterway Length (mi.)
West Branch Briar Creek	4345.6	6.79	6.53
Cabin Run	467.2	.73	1.22
Fester Hollow	2905.6	4.54	5.66
Briar Creek (main	3718.4	5.81	7.77
East Branch Briar Creek	5139.2	8.03	11.95
Kachinka Hollow	1331.2	2.08	3.80
Glen Brook	3174.4	4.96	7.30
Total Watershed	21081.6	32.94	44.23

Table 1.2: Sub-Watershed Descriptions

Climate

Pennsylvania is divided into ten climate regions - BCW is located on the boundary of Climate Region 5, which includes the Columbia County portion of the watershed, and Climate Region 1, which includes the Luzerne County (Salem Township) portion of the watershed (Pennsylvania State Climatologist, 2012).

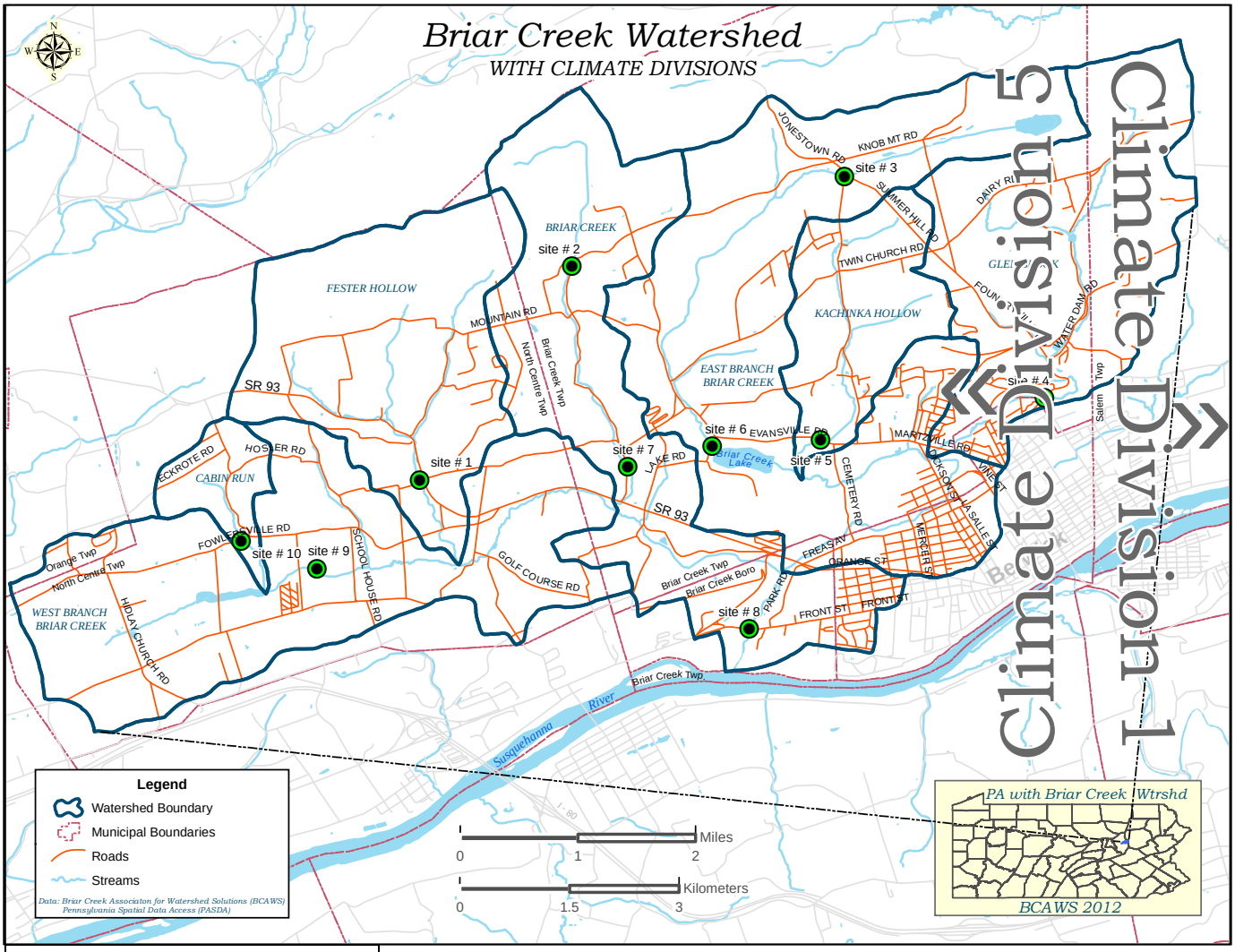

Figure 1.3: Climate Divisions

The climate of the watershed is determined by several factors. At large, mid-latitude and continental influences control the climate. Spatially, topography primarily drives local climate variance. Temporally, the position of the Jet Stream influences climate (Miller, 1995). Changes in climate, whether natural or human caused, will necessitate the need for consideration of resultant influences on water availability throughout the watershed. Coincidentally, individuals at BCAWS meetings have expressed concern regarding potential changes in flood severity stemming from climate shifts.

Statistical exploration of the available climate data was conducted in order to get an idea of whether conditions during the project time frame (September 2011 – October 2012) were average or possibly extreme. Both precipitation and temperature data were utilized from the time period 1899-2010 to establish average values. Table 1.3.1 shows the monthly average precipitation amounts and temperatures for each climate division for the time period 1899-2010. Also shown are exploratory, statistical standardized values (Z Scores) for each month of field-data collection (to be compared to the calculated average for the respective month). The computed Z scores were used to reveal if a particular month's temperature and precipitation amount were either about average or unusual.

It was found that the precipitation varied somewhat for both divisions, but not to the extent to warrant added consideration toward influence on stream discharge. Temperatures varied somewhat more than precipitation. March of 2012 for both climate divisions saw Z scores indicating temperatures beyond two standard deviations from the average for the month. Caution should be exercised when considering water quantity and quality data collected during such a month as well as planning decisions requiring consideration of such data. In general, the farther from the average temperature or precipitation amount observations are, more caution should be exercised.

Division 5												
Monthly Precipitation (inches)												
Time Period	January	February	March	April	May	June	July	August	September	October	November	December
1899-2010	2.64	2.37	3.22	3.24	3.65	3.78	3.67	3.64	3.59	3.17	3.05	2.87
2011-2012	2.85	1.01	1.84	1.82	5.82	3.57	4.07	3.82	4.96	5.79	3.47	3.6
Standardized Score for 2011-2012 Months												
Z Score	.154	-1.144	-1.139	-1.001	1.231	-.116	.320	.107	.662	1.389	.272	.541
Monthly Temperatures (degrees Fahrenheit)												
Time Period	January	February	March	April	May	June	July	August	September	October	November	December
1899-2010	27.81	29.32	38.39	49.49	59.87	68.33	72.69	70.76	63.77	52.38	41.37	31.11
2011-2012	30.9	34.8	48.1	49.7	64.6	68	76.3	71.6	64.3	51.4	45.1	36.3
Standardized Score for 2011-2012 Months												
Z Score	.625	1.302	2.435	.082	1.590	-.144	1.757	.391	.216	-.340	1.229	1.185

Table 1.3: Division 5 Climate Data

Division 1												
Monthly Average Precipitation (inches)												
Time Period	January	February	March	April	May	June	July	August	September	October	November	December
1899-2010	2.94	2.66	3.32	3.63	3.82	4.11	4.21	4.11	3.95	3.71	3.32	3.20
2011-2012	2.56	1.27	2.67	2.14	4.85	2.64	4.45	2.97	4.86	4.92	3.05	3.03
Standardized Score for 2011-2012 Months												
Z Score	-.257	-1.241	-.515	-.988	.589	-.838	.129	-.557	.433	.532	-.176	-.108
Monthly Average Temperatures (degrees Fahrenheit)												
Time Period	January	February	March	April	May	June	July	August	September	October	November	December
1899-2010	23.93	24.78	33.92	45.22	56.13	64.51	69.06	67.20	59.77	49.39	38.47	27.80
2011-2012	27.6	31.9	44.6	45.3	62.2	64	72.3	68.2	60.3	50.6	43	34.2
Standardized Score for 2011-2012 Months												
Z Score	.775	1.676	2.546	.031	2.179	-.227	1.698	.456	.229	.411	1.451	1.585

Table 1.4: Division 1 Climate Data

Geology

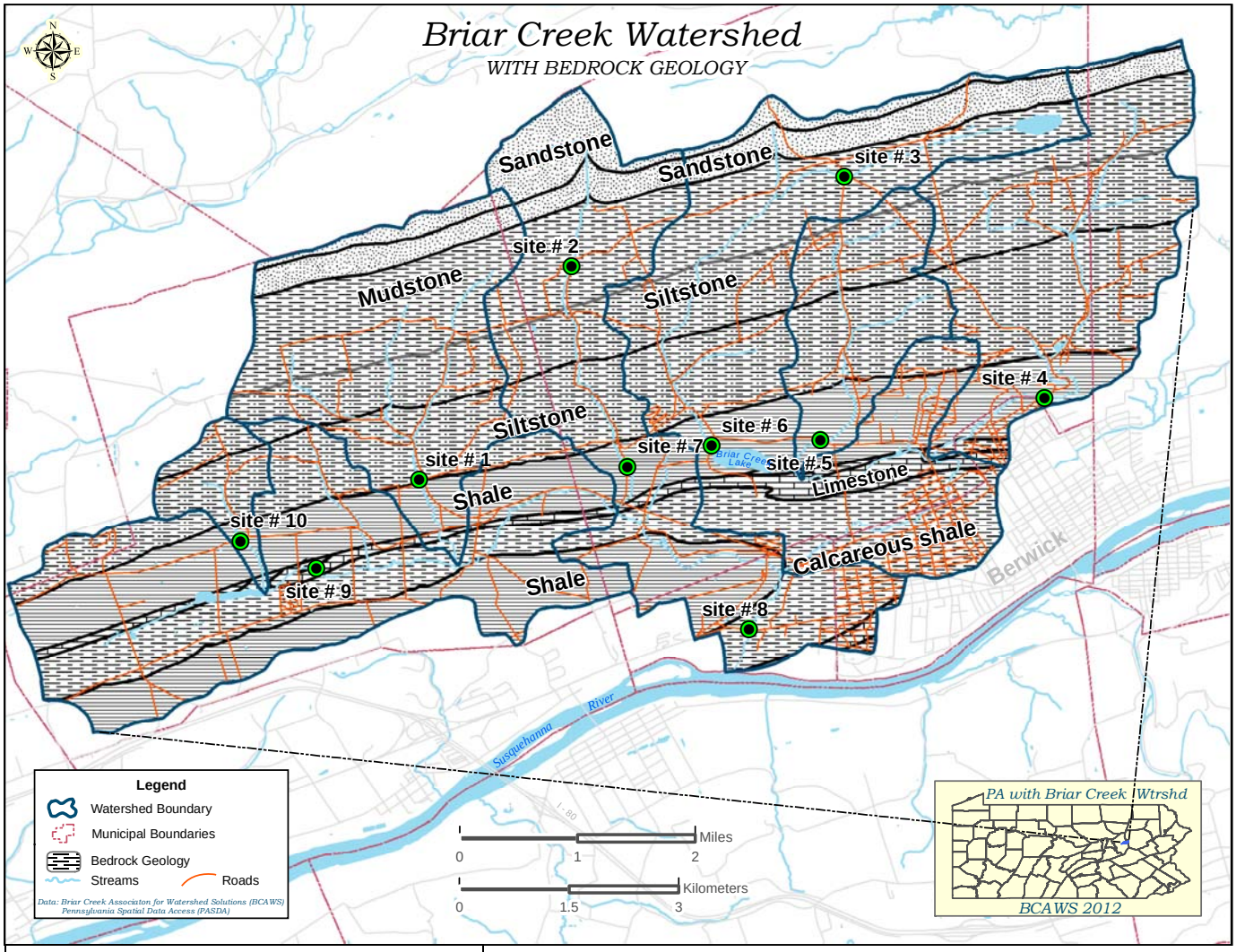

Figure 1.4: General Bedrock Geology

This section is particularly concerned with the environmental characteristics of BCW bedrock (solid rock at/near surface) and surficial geology (unconsolidated materials at/near surface). The bedrock geology of the watershed is comprised primarily of several distinct units having particular characteristics. The same holds true for the surficial geology of the watershed (not mapped). A particular geologic characteristic can contribute to a site being vulnerable to certain activities and should be considered in conservation efforts. Figure 1.4 maps the dominant type of bedrocks found throughout the watershed.

The drainage divide on top of Lee Mountain separates watersheds. BCW lays to the right.

A more detailed consideration of the local geology of each stream monitoring site can be found in Table 1.5. Several terms are used in the geologic description of each site. For surficial geology descriptions: flood susceptibility refers to whether flooding at the site is usual, infiltration capacity refers to how well water will pass into and/or through the earth materials, aquifer potential refers to how well the geology can provide water as a source for usage, and erodibility refers to how easily the land at the site can be worn away. For bedrock geology descriptions (the rock unit as a water source): water quality refers to fitness of the water for consumption, hard/soft generally refers to the ratio of calcium carbonate in the water, and potential concern refers to possible troubles related to usage of the respective rock unit's water (Inners, 1981).

Site	**Surficial Geology** (land material conditions)					**Bedrock Geology** (as ground-water source)			
	Unit Symbol	**Flood Susceptible**	**Infiltration Capacity**	**Aquifer Potential**	**Erodibility**	**Unit Symbol**	**Water Quality**	**Hard /Soft**	**Potential Concern**
1	Qal	Yes	Moderate to High	Low	Easy	Dh	Fair		Iron; Hydrogen Sulfide
2	Qsa	Yes	Moderate to High	Low	Moderate	Dcsc	Good	Soft	
3	Qsa	Yes	Moderate to High	Low	Moderate	Dcsc	Good	Soft	
***4**	Qal	Yes	Moderate to High	Low	Easy	Dmh	Fair	Hard	Iron/Dissolved Solids; Hydrogen Sulfide
5	Qal	Yes	Moderate to High	Low	Easy	Dml	Fair	Hard	Iron/Dissolved Solids; Hydrogen Sulfide
6	Qal	Yes	Moderate to High	Low	Easy	Dml	Fair	Hard	Iron/Dissolved Solids; Hydrogen Sulfide
7	br		Variable	Very Low		Dml	Fair	Hard	Iron/Dissolved Solids; Hydrogen Sulfide
	Qal	Yes	Moderate to High	Low	Easy				
8	Qooa		High	Low to Moderate		Swc	Poor	Hard	High Calcium Sulfate
9	Qal	Yes	Moderate to High	Low	Easy	Do	Good	Hard	
10	Qsa	Yes	Moderate to High	Low	Moderate	Dml	Fair	Hard	Iron/Dissolved Solids; Hydrogen Sulfide

Table 1.5: Site-Select Geologic Properties (after *Inners, 1978; Inners, 1981)

Soils

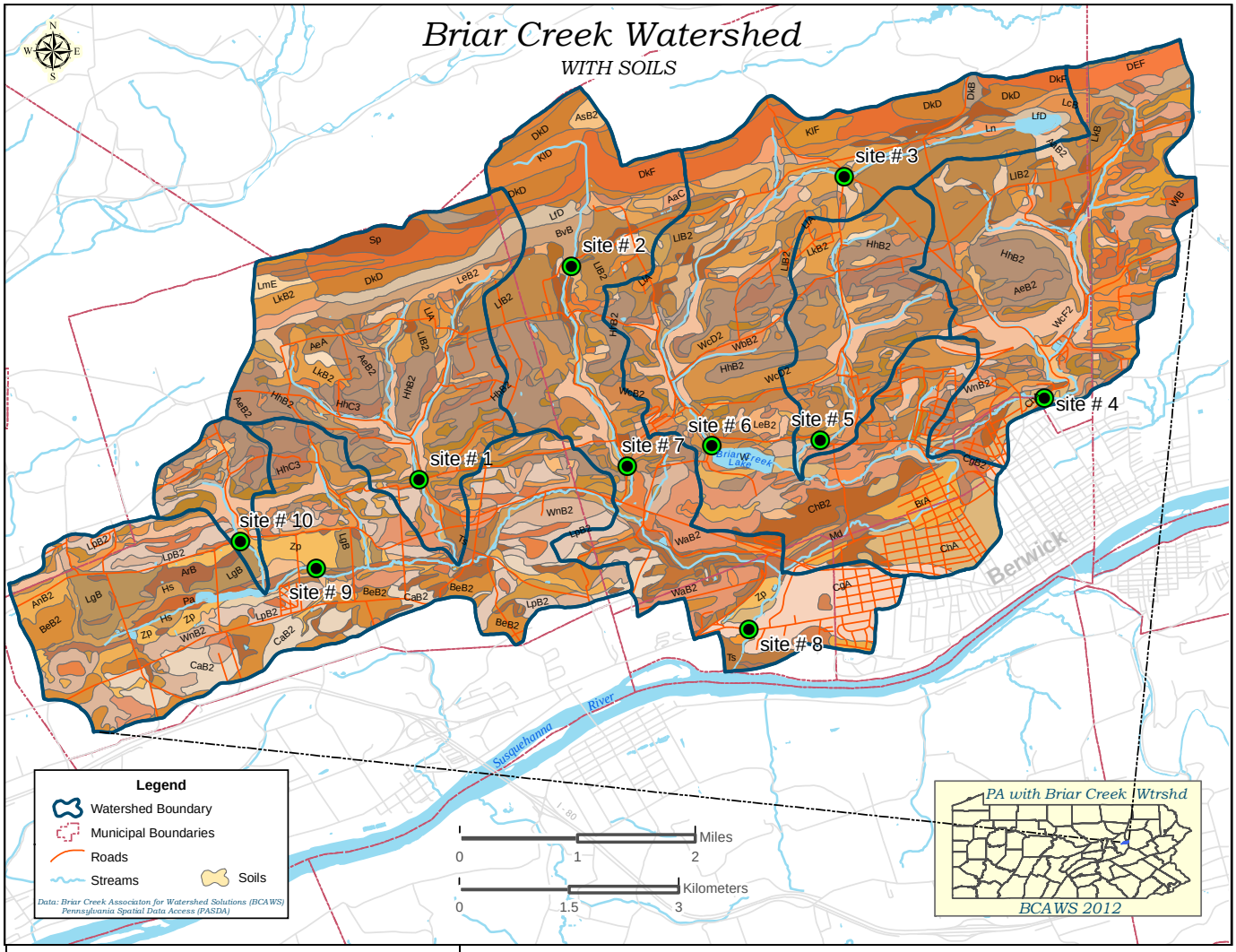

Figure 1.5: Soils with Select Labels

The soils of the watershed are numerous with various characteristics. This section will detail primarily the soil types found at each monitoring location. It should be noted that the monitoring locations were situated in close proximity to soils of varied types. It is not our intention to portray that the soil in the immediate vicinity has sole influence at the local monitoring station. Also, the soil descriptions apply to soils in their unaltered state or not altered by people (Parrish, 1967). Caution should be used when considering the conditions at a site because, for example, liming may have been done to reduce the acidity of the soil or tiling of the surrounding area may have been done to drain water-saturated soils. Such activities change the natural condition of the land.

Sites 1, 6, and 9 have Holly Series - Holly silt loam (Hs) soils (NRCS, 2012). The Hs slopes 0 to 3%, is somewhat poorly/poorly drained and strongly acid, and has moderate moisture holding capacity. The

water table is within two feet of the surface (Parrish, 1967). Site 2 has Buchanan Series – Buchanan very stony loam (BvB) soils (NRCS, 2012). The BvB slopes 0 to 8%, is moderately well and somewhat poorly drained and strongly acid, and has moderate moisture holding capacity. Site 3 has Albrights Series – Albrights gravelly silt loam (AaA) soils (NRCS, 2012). The AaA slopes 0 to 3%, is moderately well or somewhat poorly drained and strongly acid, and has high moisture holding capacity. Site 4 has Chenango Series – Chenango silt loam (ChA) soils (NRCS, 2012). The ChA slopes 0 to 3%, is well drained and strongly acid, and has moderate moisture holding capacity. Site 5 has Watson Series – Watson silt loam (WbB2) soils (NRCS, 2012). The WbB2 slopes 3 to 8%, is moderately well drained and strongly acid, and has high moisture holding capacity. Site 7 has Middlebury Series – Middlebury fine sandy loam (Mb) soils (NRCS, 2012). The Mb slopes 0 to 3%, is moderately well or somewhat poorly drained and acid, and has moderate moisture holding capacity. Site 8 has Chenango Series – Chenango gravelly sandy loam (CgA) soils (Parrish, 1967). The CgA slopes 0 to 3%, is well drained and strongly acid, and has moderate moisture holding capacity. Site 10 has Zipp Series – Zipp silt loam (Zp) soils (NRCS, 2012). The Zp slopes 0 to 3%, is poorly and very poorly drained and medium acid, and has moderate moisture holding capacity.

Biology

Briar Creek Watershed (BCW) provides diverse landscape and habitat for a variety of organisms. Adjacent to many homes and farms, natural habitats include oldfield, hedgerow, forest edge, forest interior, freshwater marsh, riparian, stream, and lake – all depending on high quality water resources. Also, the State Game Lands #55 within the watershed serve as a wildlife bank, providing current and future environmental conditions preferred by many species of birds and plants. Moreover, some of these species have rare distributions and are of special conservation concern (PSONC, 2004, Wilson, et al. 2012, and C. Corbin, Bloomsburg University of Pennsylvania - Biology Professor, personal observation 2010).

The Second Pennsylvania Breeding Bird Atlas (Wilson et al. 2012) lists over ninety bird species that actually *breed* within the watershed. Some of these breeding species, though present in BCW are absent in nearby watersheds (Corbin et al. in prep), are indicators of well-connected stream and riparian ecosystems. These include multiple species of heron, duck, rail, swallow, flycatcher, plover/sandpiper, and one species each of crane and kingfisher. Briar Creek Lake and the surrounding area provide habitat for many species. Bald eagles, a threatened species, have been observed at Briar Creek Lake, along with a variety of water fowl. Sandhill cranes utilize the lake during migration.

In addition to birds, other non-avian species noted by BCAWS volunteers in the last year are testimony to currently healthy aquatic ecosystems. Some pertinent mammals are mink, muskrat, and short-tailed shrew. Many species such as damselflies and mayflies (along with representatives of other aquatic macroinvertebrate orders (PA DEP, 2012b) and fish (Wnuk, 2006) inhabit the watershed. Hence, regionally, this area and its water resources are extremely valuable for its human and non-human stakeholders. With this in mind, BCAWS recognizes that some of the resources need improvement.

To augment habitat at the lake, BCAWS holds workdays to build aquatic habitat structures (see pictures, previous page). For three years, in cooperation with the PFBC, BCAWS volunteers have built submersible structures mimicking natural habitats, which are important for aquatic species such as native fish and turtles. Details of this plan may be accessed at http://www.columbiaccd.org/html/bcaws.html.

A Pennsylvania Natural Diversity Inventory (PNDI) Environmental Review was conducted for all known occurrences of species of concern within the watershed. PNDI reviews help to ensure that future projects will not have a negative ecological impact to noted areas of concern. The review is conducted by DCNR, PFBC, Pennsylvania Game Commission (PGC) and USFW. Findings from these agencies for Briar Creek watershed are summarized in below. Specific project activities within the watershed would need to be submitted for a more in depth review for potential impacts.

- DCNR: Briar Creek watershed was noted as a place of ecological importance. No significant species of concern have been documented. (F. Sechler, Jr., DCNR Environmental Review Specialist, personal communication, 2012).
- PFBC: Except for occasional transient species, no species of special concern are known for the watershed. (C. Urban, PFBC Chief, Natural Diversity Section, personal communication, 2012).
- PGC: Species of concern for the watershed includes the Indiana Bat (*Myotis sodalis*). It's status is endangered on both the federal and state listings. In addition, a portion of State Game Lands #55 is located within the watershed. (O. A. Mowery, PGC – Division of Environmental Planning & Habitat Protection, Bureau of Wildlife Habitat Management, Environmental Planner, personal communication, 2012).
- USFW: Conservation of habitat is encouraged to help protect the Indiana bat (*Myotis sodalis*) which is federally and state listed as endangered. Indiana bats roost and forage in the watershed. (C. Riley, United States Department of the Interior, Fish and Wildlife Service, Field Office Supervisor, personal communication, 2012).

In addition, other biological assessments of the watershed are summarized below:

- PA DEP 2005 Benthic Macroinvertebrate Survey: Issues discussed in the PA DEP's assessment of Briar Creek Basin include thermal pollution in the East Branch of Briar Creek, agricultural influences, fragmented riparian buffers, localized sediment problems, localized stormwater influences and channelization/flow alterations. These are items that BCAWS can work to mitigate through education and promoting best management practices (M. Friday, DEP Biologist, personal communication, 2008).

- PA DEP Benthic Macroinvertebrate Sample Summary: Sampling for benthic macroinvertebrates (organisms without backbones which are visible to the eye without the aid of a microscope living on, under, and around rocks and sediment on the bottoms of lakes, rivers, and streams) was conducted near the mouth of the East Branch Briar Creek. The sampling resulted in an index of biological integrity (IBI) score indicating impairment of the aquatic life use. IBI scores compile several indicators of stream health.

- PFBC Briar Creek Basin (405D) Fisheries Management Report, June, 2006: PFBC documented 28 fish species in the Briar Creek Basin in 2006. Historic work documented 34 species even though more streams were sampled in 2006 (Wnuk, 2006). Habitat degradation and sedimentation may be factors in the reduction, as many of the fish absent in 2006 were species that preferred gravel and rock substrates and were somewhat intolerant of turbidity (Wnuk, 2006). The PFBC study noted that absent fish previously documented in earlier reports included rock bass (*Ambloplites rupestris*), redbreast sunfish (*Lepomis auritus*), satinfin shiner (*Cyprinella anolostans*), common shiner (*Luxilus conrnutus*), and rosy face shiner (*Notropis rubellus*). New fish species to the watershed included common carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), greenside darter (*Etheostoma blennioides*), banded darter (*E. zonale*), and walleye (*Sander vitreus*) (Wnuk, 2006). It was noted that brown trout and sculpins were the most common fish encountered at the sites and that wild trout were present in most of the sections electrofished in the Briar Creek basin. PFBC recommended that Glen Brook be upgraded from Coldwater Fishery to High-Quality Coldwater Fishery based on its support of a Class A mixed wild brook/brown trout population and managed as a Class A wild brook trout water. Their recommendations also included investigating the sources of sedimentation in the Briar Creek Basin and take corrective actions.
- PSONC Columbia County Natural Area Inventories 2004: The report lists Fester Hollow as a significant feature due to its partially forested ravines and hilltops to provide important habitat and ecological diversity (PSONC 2004). It was noted that some of the forested ravines along streams form continuous forested corridors connecting to Knob Mountain. These forested corridors along Briar Creek and the East Branch of Briar Creek are very important in the overall ecology of the watershed. The corridors serve to protect the water quality in the streams as well as form a functional linkage between habitats for species to move along the streams and between blocks of forest (PSONC 2004). Recommendations for the watershed areas include additional forested buffers to minimize the impact of non-point sources of pollution. The report also comments on the ridgetop area in the State Game Lands. It supports exceptional bird diversity for the area, offers a variety of habitat for other fauna, and the wetland areas also have potential to support rare plants (PSONC 2004).

Land Use

Briar Creek watershed is located in the Ridge and Valley Physiographic Province of Pennsylvania, providing rich farm land and unique natural resources (see below).

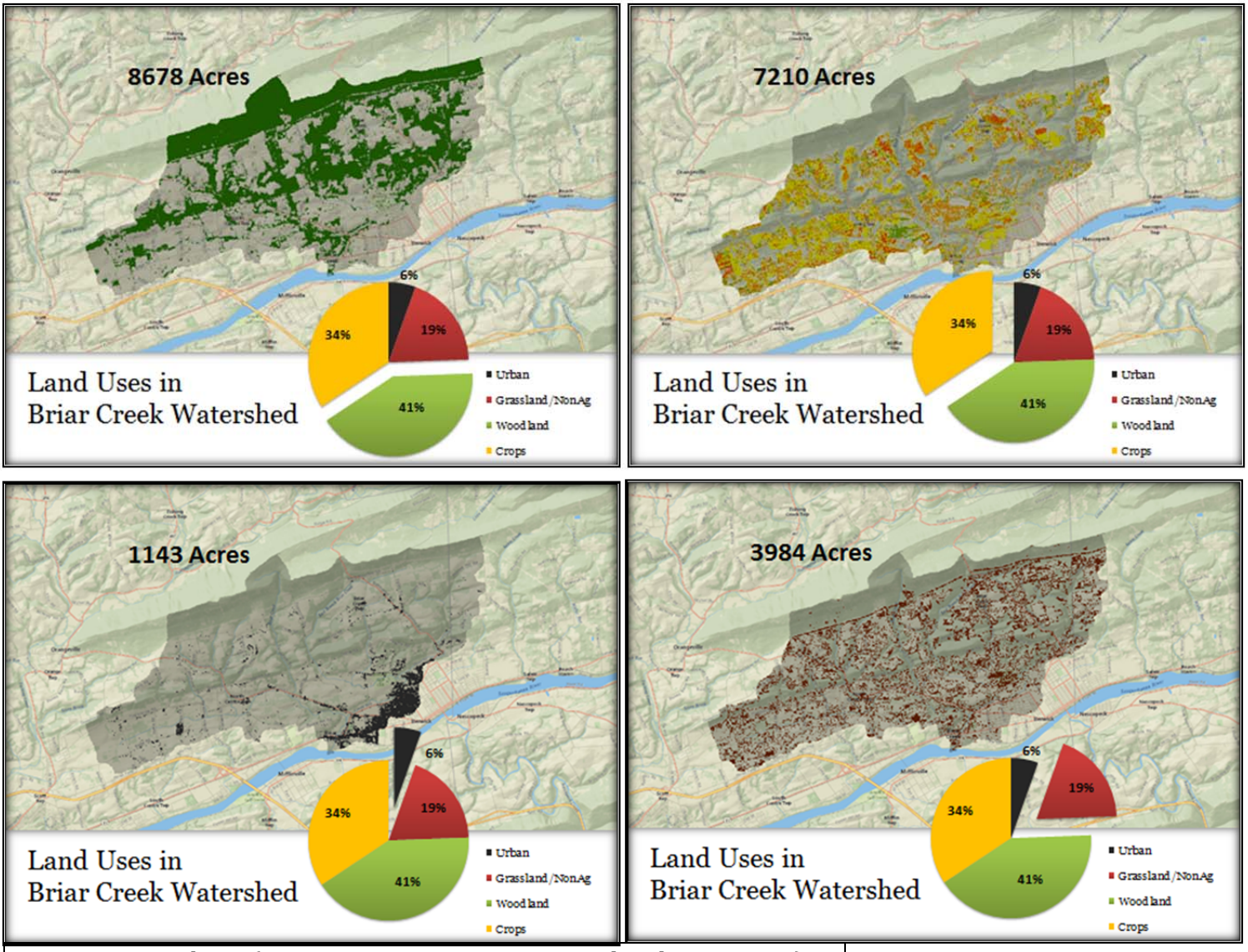

Figure 1.6: Land Use (Maps courtesy J. Prosceno -*used with permission*)

Many of the headwater streams are in forested areas that flow into rural valleys. Land use for the watershed is predominately woodland and agriculture. Forty one percent (8,678 acres) of the watershed is woodland, with Knob Mountain and State Gamelands #55 accounting for much of the land cover. Thirty four percent (7,210 acres) of the watershed is farmed, including cropland, pasture and orchards.

Nineteen percent (3,984 acres) is grassland and non-agricultural. It includes Briar Creek Lake, Briar Creek Park and Ber Vaughan Park. Briar Creek Lake, constructed as a flood control structure, is a centerpiece of watershed activities with a significant amount of the outdoor recreation and water-related interests taking place there. The remaining 6% (1,143) is urban, with approximately 7,000 residents in the Briar Creek

Watershed (Prosceno, 2010). Commercial, light industrial and residential sites are more concentrated in and near Berwick Borough. Much of the area near the mouth of the watershed is developed.

In a comparison to other EPA-rated watersheds of similar size and land use, Briar Creek Watershed has a B rating, which shows that residents in the watershed are working to improve and/or conserve resources in the area.

Sunrise over Briar Creek Township – Looking Northwest

Section 2: METHODOLOGY

BCAWS Site Monitoring and Data Collection Overview

Data collection of the quantitative and qualitative nature of Briar Creek sub-watershed stream-flow took place from September of 2011 to October of 2012. Members of BCAWS assumed sites to monitor on a bi-weekly basis. At least one monitoring site was selected near the lower end/confluence of each sub-watershed; therefore, all sub-watersheds have representation in the compilation of the overall watershed conservation plan. Also, those sites were located on upstream side of roads to minimize the effect of bridges, automobiles, runoff, etc. on water quality and quantity. Land-owner permission was granted for monitoring at each site. The main branch of Briar Creek and East Branch Briar Creek have multiple sampling sites. East Branch Briar Creek, for example, has multiple sampling sites because of Briar Creek Lake, which creates a significant difference in the continuity of the stream system. Funding from the CHP grant was used to purchase the equipment utilized in the monitoring.

Water Quantity

For water quantity, or the volume of water flowing in the stream, open channel discharge (Q) was calculated via the commonly employed, velocity/area method via a USGS Pygmy Current Meter, 6/10 depth wading-rod, and JBS Instruments AquaCalc 5000 field computer combination. In-situ calculations of Q were completed and recorded. To do so, semi-permanent cross sections were established, at the selected sites, with pins at the tops of bank. To obtain an average measurement of Q for the cross-section, a tenth foot, engineer's scale, tape measure was stretched perpendicularly across the stream and measurements were taken at approximately every foot. Major obstructions (e.g. exposed, dry boulders) were taken into account according to equipment manufacturer specification. Activities can lead to diminished water quantity. A baseline of water quantity was established for an entire year and future water quantity can now be compared.

Water Quality

For water quality, temperature, pH, electro conductivity (EC), and total dissolved solids (TDS) were measured at each site, with a Hanna Instruments model 991300 waterproof pH/EC/TDS/Temperature meter. Water pH is a measure to indicate if water is basic or acidic. EC is a measure of how much current will pass through water. Changes in EC indicate a respective change in the amount of ions in the stream water. TDS is a general measure of how much substance is dissolved in water. Changes in levels of water quality parameters, like pH, EC, and TDS, indicate activity in the respective watershed. Activities can lead to diminished water quality. Once a baseline has been established with the noted parameters, future water

quality can be compared. Additionally, the date, time, and weather conditions were noted at the beginning of collection at each site. Of special note is that the meter probe was held in the stream for measurement and not in a container filled with sample water. This was done to eliminate variability in assessment of water quality due to changes in extracted water sample temperature.

Visual Assessment

Stream site visual assessments were conducted primarily through the summer of 2012 during the height of the green-on season in Pennsylvania. The Alliance for Aquatic Resource Monitoring – Visual Assessment Manual was selected by BCAWS members for use for the visual assessments (Alliance for Aquatic Resource Monitoring, 2009). This is an acknowledged version of the United States Department of Agriculture Stream Visual Assessment Protocol. The visual assessment includes a section for an in-situ hand-drawn field reconnaissance map. To be included on this page were indicators for the characteristics of the stream section. The protocol also includes indicators for: channel condition, bank stability, riparian zone, water appearance, nutrient enrichment, fish barriers, in-stream fish cover, embeddedness, invertebrate habitat, canopy cover, sewage, and manure presence. Directions on calculation technique are included with each respective indicator. The various determined scores were then used to attain an overall score for the stream section. Sites attaining score values less than 6.0 were considered "poor," from 6.1 to 7.4 "fair," from 7.5 to 8.9 "good," and greater than 9.0 "excellent." Table 3.2 summarizes the visual assessment scores.

Throughout the data collection period, pictures were taken to provide additional descriptive power to the assessment. Also, pictures, from past BCAWS events as well as from past project work done in the watershed, were included. The current status of the watershed is reinforced through these.

Secondary Data Collection

Existing data germane to the watershed and conservation plan were collected from various sources. As such, the accuracy of this work is in-part subject to the integrity of the data collected. For example, information collected online for mapping geology, soils, etc. may have a margin of error related to boundary positions. This should be recognized when developing subsequent conservation planning.

Section 3: Findings

BCAWS-Conducted Water Quantity and Quality

Site #	Sub-Watershed	Discharge Ft^3/sec (=cfs)			Water Temperature ^{0} F			pH			EC (mS)			TDS (ppm)			No. of samples
		Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.	
1	Fester Hollow	0.75	3.56	34	34.4	54.14	70.7	7.06	7.66	9.17	69	89	351	35	44	169	26
2	Briar Creek	0.06	0.685	39.1	35.96	51.44	64.94	5.52	6.67	7.47	20	27	177	10	14	89	25
3	East Branch Briar Creek	0.4	1.385	10.425	32.18	49.73	71.42	6.78	6.92	7.21	49	70.5	224	25	35.5	113	22
4	Glen Brook	0.58	4.915	60.2	34.88	55.04	72.14	7.06	7.37	7.79	68	96	266	35	49	145	27
5	Kachinka Hollow	0.12	2.325	41.2	34.52	57.02	85.1	6.97	7.66	8.68	88	147	301	44	75	137	27
6	East Branch Briar Creek	0.54	4.645	11.5	32.18	50.18	78.62	7.14	7.565	8.73	1.25	81.5	172	34	43.5	86	22
7	Briar Creek	0.63	4.03	22.1	32	49.28	67.46	6.15	7.45	7.69	23	76	200	12	38	98	21
8	Briar Creek	4.14	18.5	50	32.18	57.56	80.96	7.16	7.7	8.21	101	178	306	50	96	161	27
9	West Branch Briar Creek	0.67	3.2	31.1	35.6	57.38	71.6	6.96	7.87	8.31	117	204	281	58	102	141	26
10	Cabin Run	0.17	0.53	15.7	33.98	55.04	72.32	7.28	7.73	7.9	83	118	211	42	59	106	26

Table 3.1: Water Quantity and Quality

Discharge calculations/values, to date, had not been well-established for the entire Briar Creek Watershed, at least at the sub-watershed geospatial level and temporal level this project produced. The primary data, which the BCAWS team collected, will be used as an initial benchmark for future discharge considerations. Table 3.1 shows minimum, median, and maximum values for each of the four parameters BCAWS collected at each site. It should be noted that climate data should be considered with the discharge values when accounting for variability in water quantity and quality.

General water quality criteria for CWF in PA via PA Code Chapter 93

§ 93.6. General water quality criteria

(a) Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life.

(b) In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances that produce color, tastes, odors, turbidity or settle to form deposits.

Specific water quality criteria for CWF in PA via PA Code Chapter 93

Maximum Temperatures parameter for CWF Stream (PA Code – Chapter 93)		
Month	Day	Temperature ^{0} F
January	1-31	38
February	1-29	38
March	1-31	42
April	1-15	48
April	16-30	52
May	1-15	54
May	16-31	58
June	1-15	60
June	16-30	64
July	1-31	66
August	1-15	66
August	16-30	66
September	1-15	64
September	16-30	60
October	1-15	54
October	16-31	50
November	1-15	46
November	16-30	42
December	1-31	40

The above picture is of the BCAWS team on one of the field-methods training days. Techniques for proper equipment operation, site protocol, and data calculation were covered. Information collected at each site throughout the study included water temperature, TDS, and pH.

Total Dissolved Solids parameter for CWF Stream (Commonwealth of Pennsylvania, 2012): **750 ppm maximum** value; **500 ppm monthly average**.

pH parameter for CWF Stream (Commonwealth of Pennsylvania, 2012): From **6.0 to 9.0** inclusive.

CWF stands for Cold Water Fishes and a stream with CWF designation is appropriate for "maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat" (Commonwealth of Pennsylvania, 2012).

Visual Assessment Scores

Site #	Channel Condition	Bank Stability	Riparian Zone	Water Appearance	Nutrient Enrichment	Fish Barriers	Instream Fish Cover	Embedd-eddness	Canopy Cover	Sewage -if Applicable	Overall Score (Rating)	**Priority Rank**
1	7	7	3	3	3	10	5	3	6	n/a	5.4 Poor	**4**
2	10	10	10	10	10	10	10	10	10	n/a	10 Excellent	**10**
3	5	5	10	8	8	4	10	8	10	n/a	7.8 Good	**8**
4	7	3	3	7	7	10	8	5	10	n/a	7 Fair	**6**
5	3	1	1	7	3	10	2	3	1	n/a	3.4 Poor	**1**
6	3	7	1	7	3	10	1	3	1	n/a	3.7 Poor	**2**
7	10	7	10	7	10	10	5	10	10	10	8.9 Good	**9**
8			1	7	10	1	3	1	1	n/a	3.8 Poor	**3**
9	7	5	7	3	3	10	10	10	9	5	7.1 Fair	**7**
10	3	1	1	7	10	10	5	3	7	5	5.6 Poor	**5**

Table 3.2: Visual Assessment Scores for Briar Creek Watershed Streams

Visual Assessments were used to rank the sites and produce a priority ranking score for each. According to the assessments, the site receiving the lowest overall score rating (site 5) should receive first attention.

Bloomsburg University of Pennsylvania: Geochemical Study

In a contemporaneous study, a Bloomsburg University team Pfister and colleagues sampled and tested water from each of the pre-established BCAWS study sites representing each sub-watershed (Pfister, Venn, & Hallen, 2012). Lab tests were conducted for water: pH, Conductivity, Turbidity, Total Acidity to Phenolphthalein Endpoint, Total Alkalinity to the pH of 4.5, and Dissolved Oxygen. Cations tested included: Calcium, Magnesium, Sodium, and Strontium. Anions tested included: Nitrate, Sulfate, and Bromide. Metals tested (filtered and non-filtered versions) included: Arsenic, Barium, Iron, Lead, and Manganese. Significant results from this study are added to sub-watershed findings - primary focus is on water Maximum Contaminant Level (MCL) standards as established by the U. S. Environmental Protection Agency (EPA).

West Branch Briar Creek

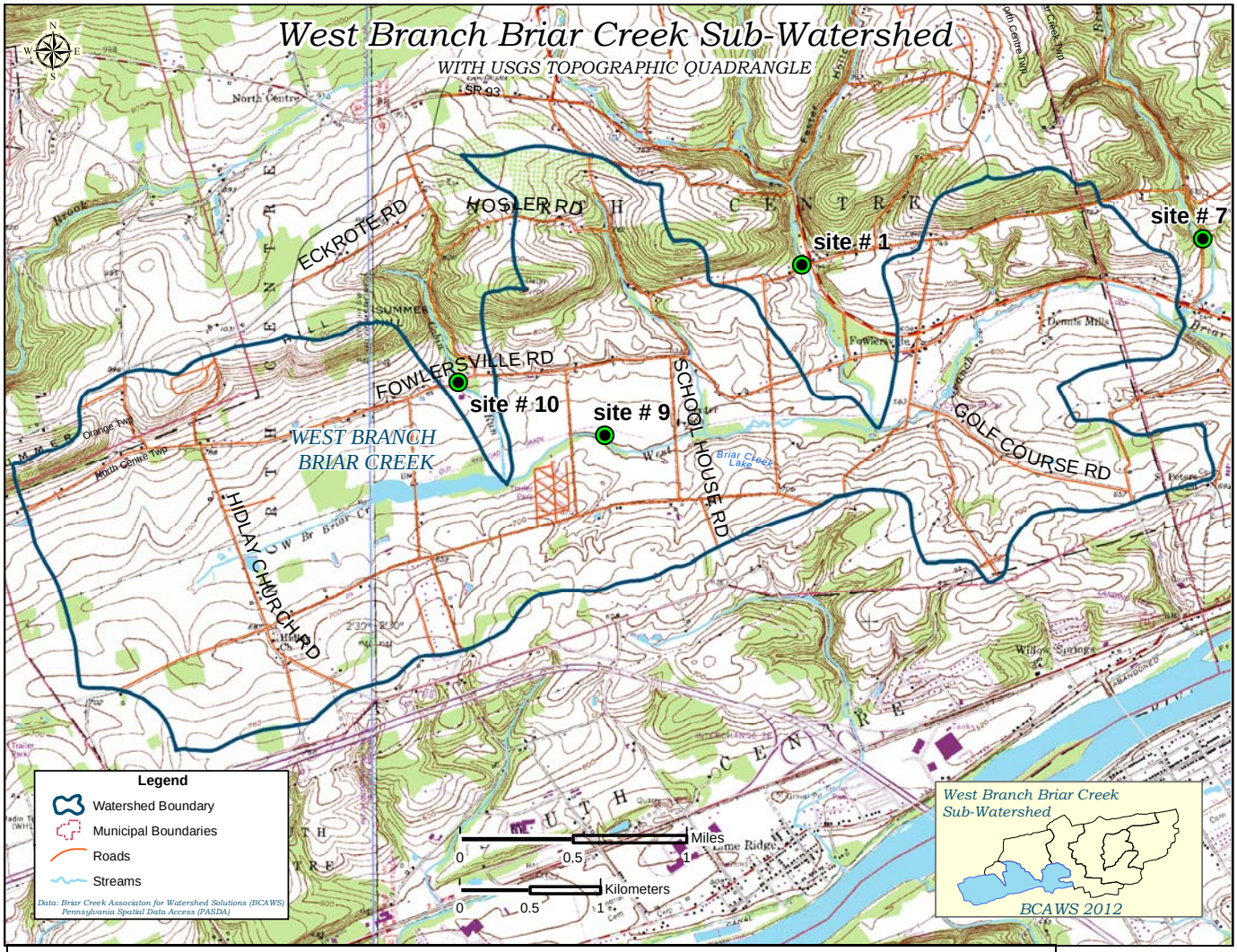

Figure 3.1: West Branch Briar Creek Sub-Watershed

Site # 9: Looking upstream.

Site # 9 Findings:

* Water temperature was higher than acceptable for CWF designation for 18 out of 26 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *fair* (7.1) with water appearance and nutrient enrichment the most impacted of the ten applicable criteria.

* At times, Lead and Nitrate MCL's were exceeded.

Cabin Run

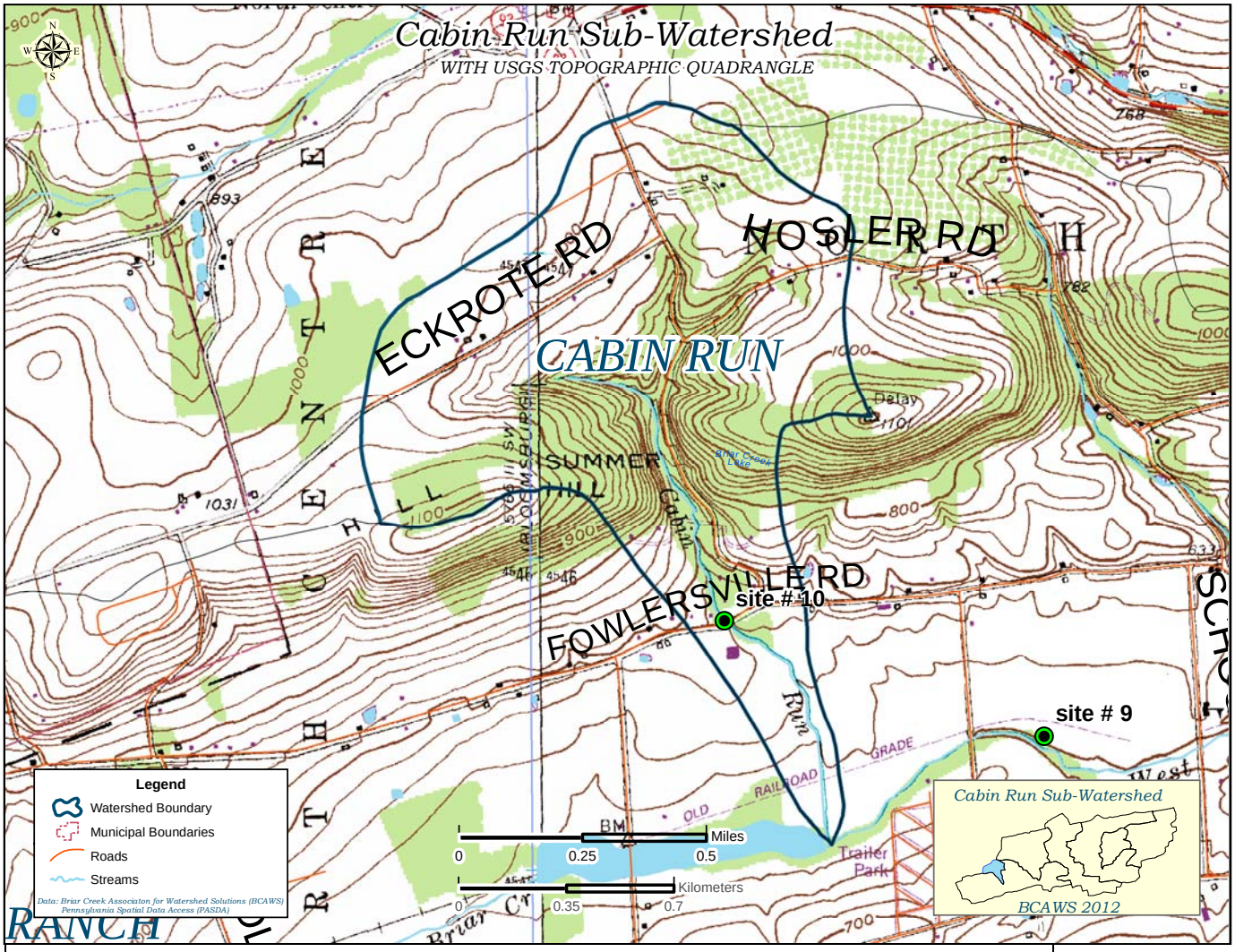

Figure 3.2: Cabin Run Sub-Watershed

Site # 10: Looking upstream from the highway cross-drain.

Site # 10 Findings:

* Water temperature was higher than acceptable for CWF designation for 19 out of 26 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *poor* (5.6) with bank stability and riparian zone the most impacted of the ten applicable criteria.

* At times, Lead and Nitrate MCL's were exceeded.

Fester Hollow

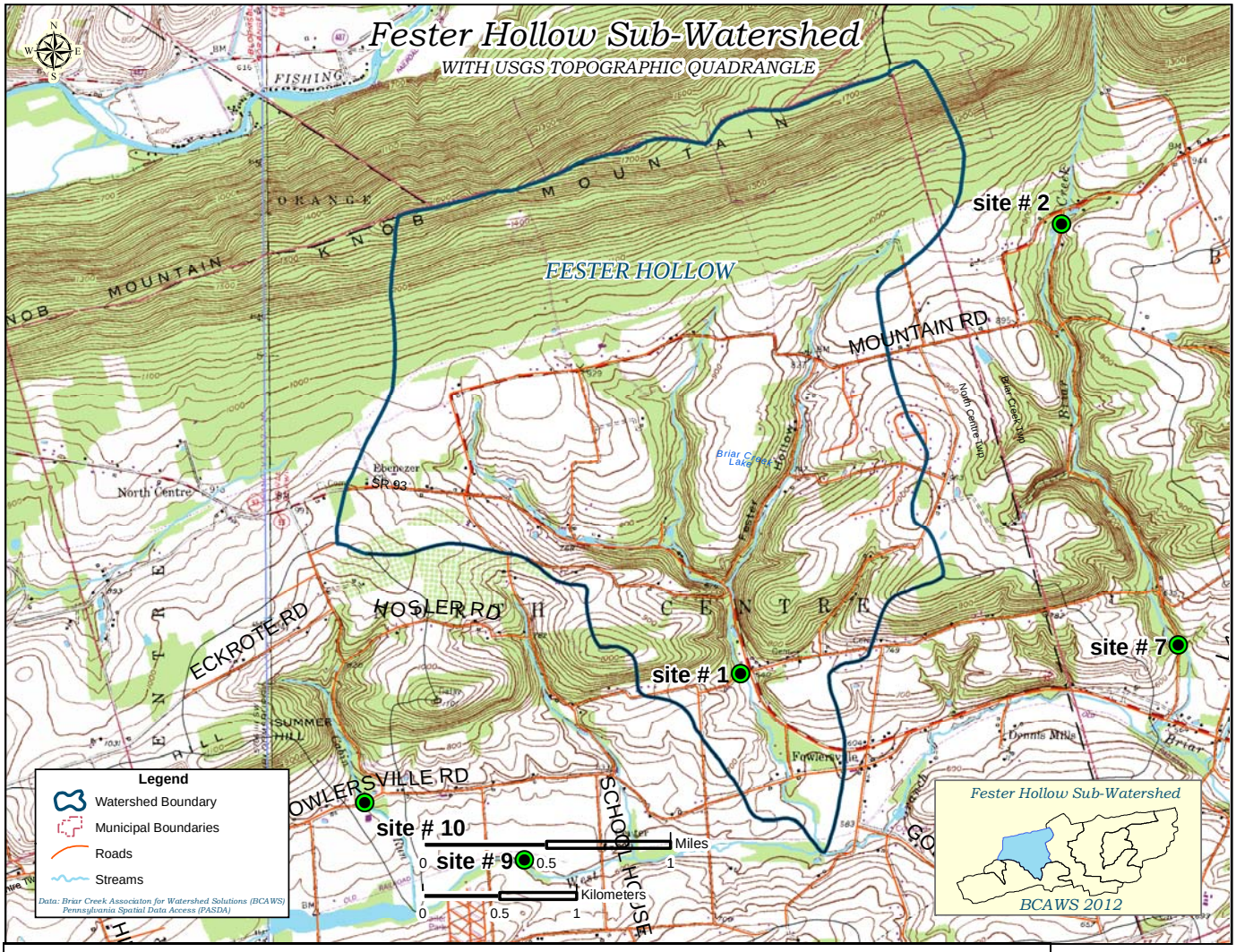

Figure 3.3: Fester Hollow Sub-Watershed

Site #1: Upstream from the bridge.

Site # 1 Findings:

* Water temperature was higher than acceptable for CWF designation for 21 out of 26 samples.

* pH values were within the acceptable range for CWF designation except for one sample - March 17, 2012 (pH 9.17).

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *poor* (5.4) with four out of nine applicable criteria having a score of 3.

*At times, the Nitrate MCL was exceeded.

Briar Creek (main branch)

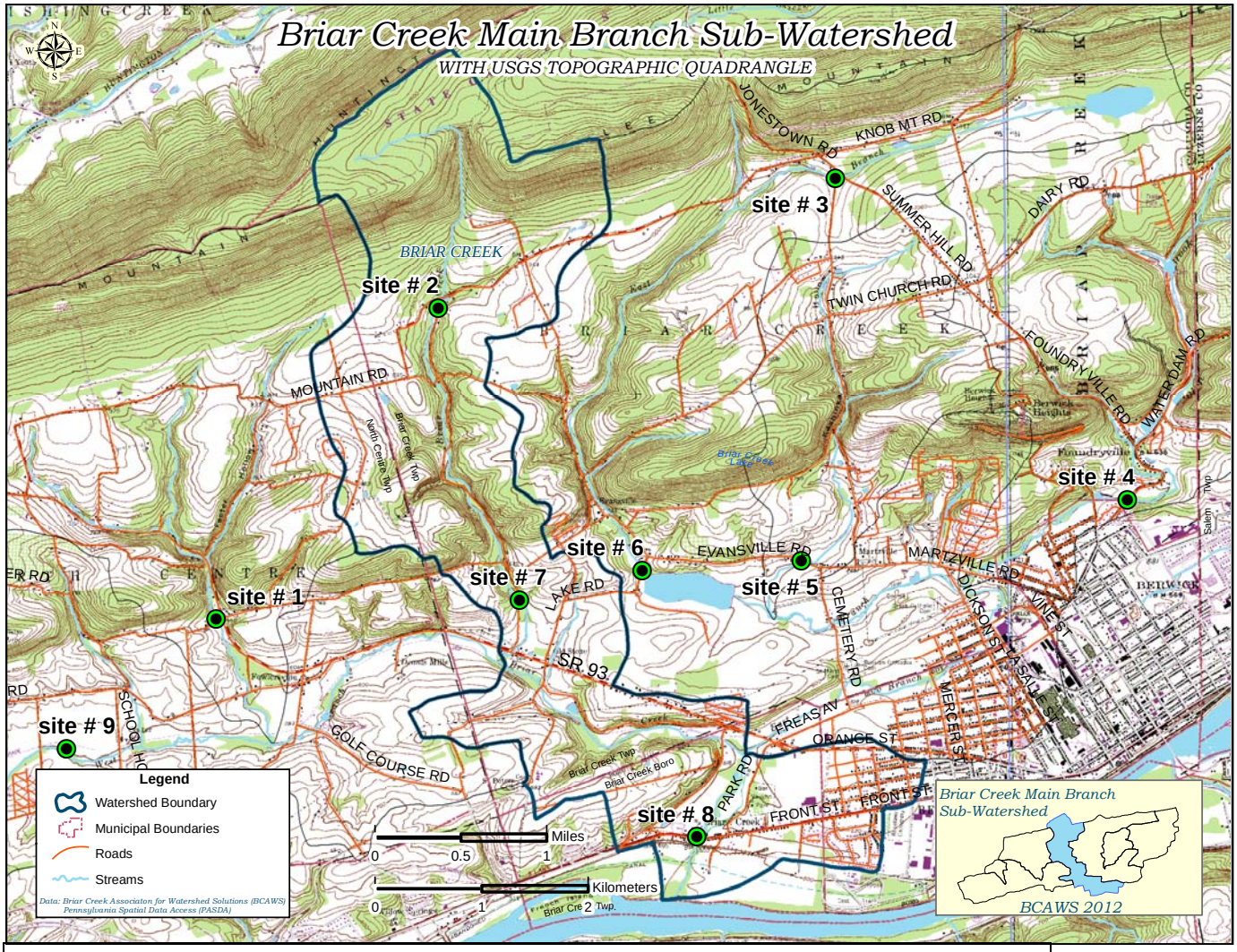

Figure 3.4: Briar Creek (main branch) Sub-Watershed

Site # 7: In winter time

Site # 7 Findings:

* Water temperature was higher than acceptable for CWF designation for 13 out of 21 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *good* (8.9) with in-stream fish cover the most impacted of the ten applicable criteria.

* At times, Lead and Nitrate MCL's were exceeded.

Site # 8 Findings:

* Water temperature was higher than acceptable for CWF designation for 23 out of 27 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score (partial) was *poor* (3.8) with 4 out of 7 applicable criteria with a score of one.

* At times, Lead and Nitrate MCL's were exceeded.

Site # 8 (see page 27): During the Hurricane Irene/Tropical Storm Lee event of 2011. The monitoring site which is usually visible on the upstream side of the bridge is located just beyond the telephone pole.

Site # 2 Findings:

* Water temperature was higher than acceptable for CWF designation for 16 out of 25 samples.

* pH values were within the acceptable range for CWF designation except for one sample – September 29, 2011 (pH 5.52).

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *excellent* (10) with nine applicable scores at 10.

Site # 2 (see page 27): Monitoring took place upstream beyond the bridge abutment.

Site # 3 Findings:

* Water temperature was higher than acceptable for CWF designation for 14 out of 22 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *good* (7.8) with fish barriers the most impacted of the nine applicable criteria.

* At times, Lead and Nitrate MCL's were exceeded.

Site # 3 (see page 29): looking upstream.

East Branch Briar Creek

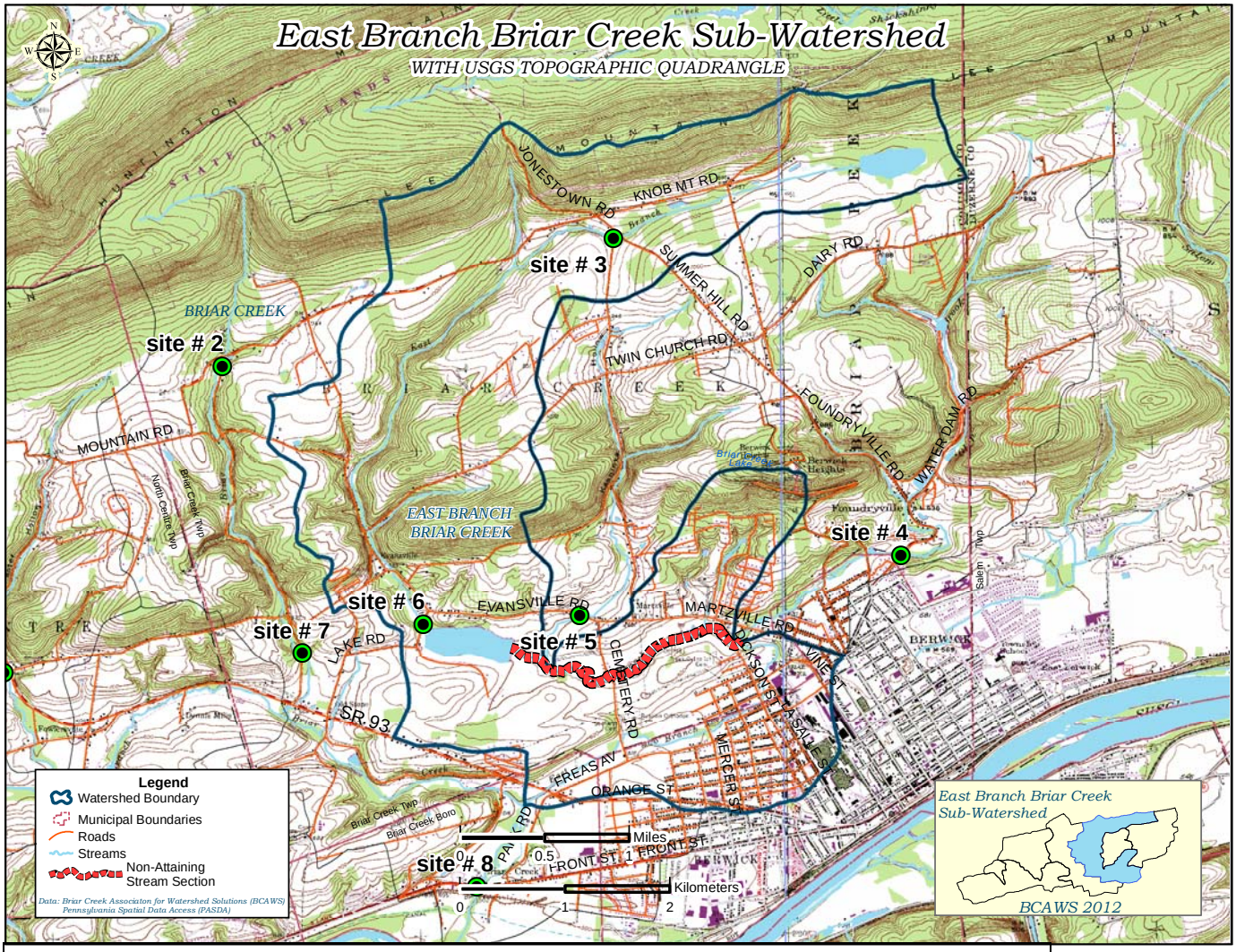

Figure 3.5: East Branch Briar Creek Sub-Watershed

Site # 6: Looking upstream.

Site # 6 Findings:

* Water temperature was higher than acceptable for CWF designation for 20 out of 22 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *poor* (3.7) with 3 out of 9 applicable criteria with a score of one.

* At times, Lead and Nitrate MCL's were exceeded.

Kachinka Hollow

Figure 3.6: Kachinka Hollow Sub-Watershed

Site # 5: Looking upstream during flash-flood conditions.

Site # 5 Findings:

* Water temperature was higher than acceptable for CWF designation for 21 out of 27 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *poor* (3.4) with 7 out of 9 applicable criteria with a score of three or lower.

* At times, Lead and Nitrate MCL's were exceeded.

Glen Brook

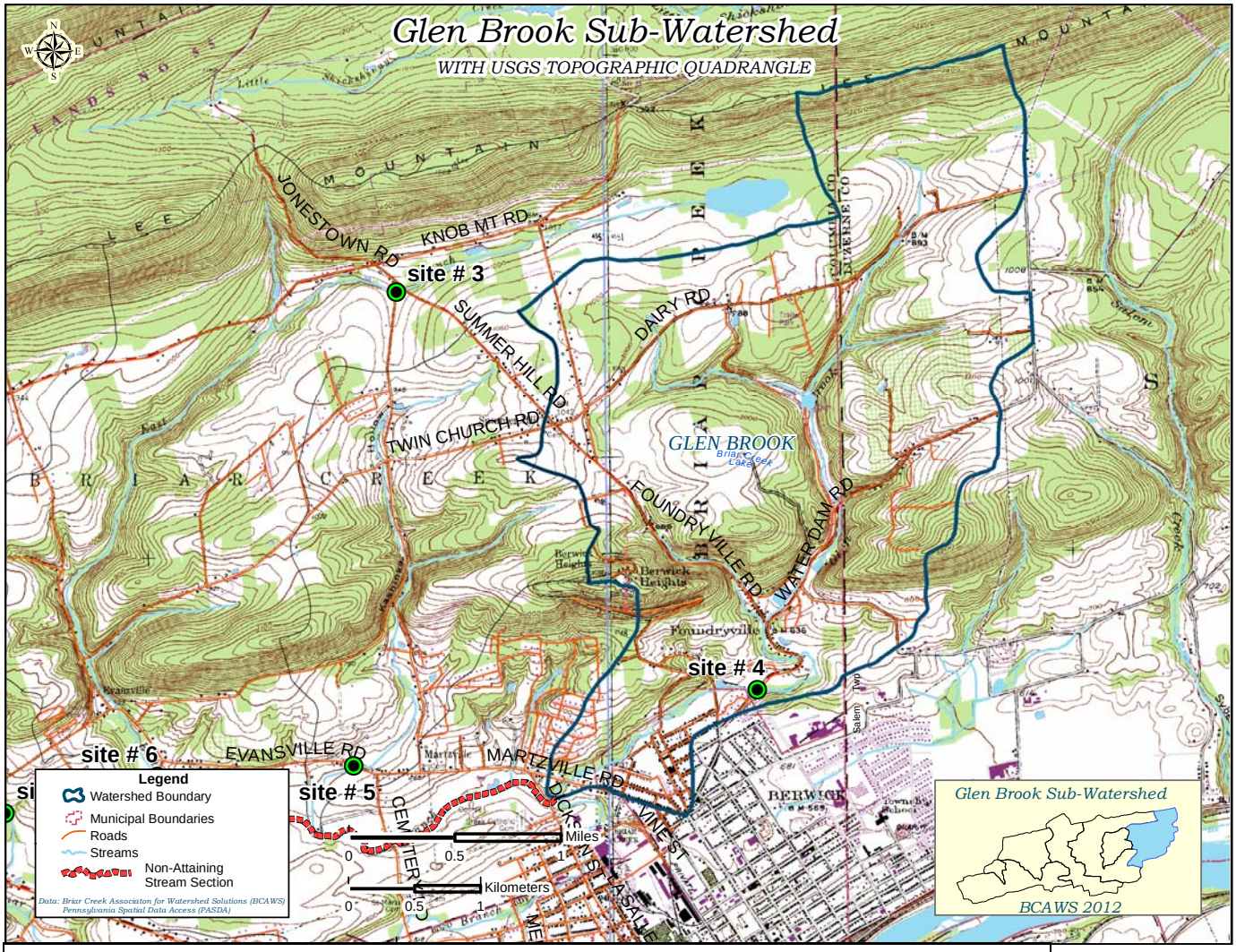

Figure 3.7: Glen Brook Sub-Watershed

Site # 4: looking upstream.

Site # 4 Findings:

* Water temperature was higher than acceptable for CWF designation for 18 out of 27 samples.

* pH values were within the acceptable range for CWF designation.

* EC/TDS values were acceptable as required for CWF designation.

* The visual assessment score was *fair* (7) with bank stability and riparian zone the most impacted of the nine applicable criteria.

* At times, Lead and Nitrate MCL's were exceeded.

Section 4: DISCUSSION AND RECOMMENDATIONS

Discussion

The Briar Creek Watershed is a dynamic area of land that drains into the Susquehanna River at the borough of Berwick. Many of the headwater streams are in forested areas that flow into rural valleys. Land use includes farmland (grain, hay, produce, and orchards), rural populations, and an increasing amount of housing developments. Briar Creek Lake, constructed as a flood control structure, is the centerpiece of the watershed with most of the outdoor recreation and water related interest taking place at the lake. Many residents of the area have enjoyed Briar Creek Lake for fishing, picnicking, and weddings so it has been a natural opportunity to generate interest in the watershed as a whole.

The Briar Creek Watershed Association, formed in 2006, is a small group of dedicated individuals committed to raising awareness of the watershed's issues. The Association provides the public with six education programs every year on local environmental topics such as erosion, pollinators, history, invasive species, and bat biology. In 2011, BCAWS sent a newsletter highlighting goals and accomplishments to the residents in the watershed. They also generate interest by distributing their brochure, appearing at public events such as the Bass Masters Festival, and sitting on local committees such as the Susquehanna Greenway Partnership. Their most successful project has been a multiple year series of workdays to build aquatic habitat structures for Briar Creek Lake. Volunteers for these events have been plentiful due to the physical and fun nature of the project that benefits beloved thought of lake. Still, a major obstacle for the leadership of BCAWS is to generate interest and volunteer support for the watershed wide issues.

Because of land use, sections of the watershed have been degraded. Townships and landowners have struggled with this dilemma and the problems associated with it by using mainly reactive solutions. There are areas of the watershed where land use practices can be altered or improved to contribute to a healthier environment and community. The Coldwater Conservation Plan was necessary to aide in pinpointing these areas and in some cases quantifying the problem. The leadership of BCAWs will use the results of the Coldwater Conservation Plan as a guide to help educate the watershed residents and to prioritize areas for improvement. A key strategy that can mitigate problems documented in the CHP is riparian forest buffer management. Riparian buffers are effective at controlling stream system temperatures, runoff and flooding, point/non-point source pollution, and sedimentation (DEP, 2010) - all of which trouble the BCW.

As the Coldwater Conservation Plan is implemented, BCAWS will continue to use the important strategy of fostering partnerships with local entities. The watershed association has built strong relationships with

townships and will continue to build upon these key alliances. One of the main challenges will be to work with townships on land use planning that will benefit the watershed and ultimately the residents. Because key sensitive areas have been identified within the Coldwater Plan, township officials will be instrumental in implementing best management practices for these areas and most importantly, preventing future problems. This can largely be accomplished by the adoption of land use ordinances which protect streams by requiring riparian buffers and applying the principals of smart growth.

In addition, the strong leadership of BCAWS will continue to seek out others to share this significant responsibility. To add to their strengths, partnering groups and businesses will be invited to have representation on the board to continue to diversify perspectives and ideas. Most importantly, the residents of the watershed will continue to be invited to engage in programs and projects. Educating and engaging the residents will be an important challenge, but will be worth the efforts as more people understand and fully appreciate the beautiful watershed. As each new person becomes aware of their responsibilities, the watershed will eventually become a place where residents hold a respect for the streams that flow through their backyards and will take the necessary steps to protect them for the future.

Recommendations

- As elaborated in the discussion section, use this document as a guiding tool for conservation planning and best management practices for the Briar Creek Watershed and as an aide for neighboring watershed organization conservation planning.
- A key strategy that can mitigate problems documented in the CHP is riparian forest buffer management. Riparian buffers are effective at managing and controlling stream system temperatures, runoff and flooding, point/non-point source pollution, and sedimentation (DEP, 2010) – all which need addressed in the BCW. We recommend conserving intact vital riparian corridors throughout the watershed, identifying fragmented corridors, and where degraded or absent, developing riparian forest buffers.
- Give mitigation priority to stream sections which received a 'poor' visual assessment rank. Then, work toward mitigation of sites which received a 'fair' visual assessment rank. Site five received the lowest visual assessment score and should garner first attention.
- Throughout the entire watershed, work to bring water MCL's down to meet U.S. EPA standards. Per the Bloomsburg Geochemical study, most sites were found to some extent to have elevated contamination levels. Continue monitoring stream water chemistry via project-utilized methods to isolate the source of lead and nitrates and then mitigate.
- Further investigate/monitor the stream-water temperatures. Streams at all ten monitoring sites had maximum temperatures that exceeded the upper threshold for CWF designation. Using the visual assessment rankings, work with land owners to expand canopy cover, and riparian zone areal coverage along the streams. Continue to monitor until recommended conditions are met.
- Further investigate and then mitigate identified impaired stream sections on East Branch Briar Creek and West Branch Briar Creek.
- Investigate the decreasing number of fish species in streams through additional aquatic inventory.
- With climate changes, anticipate and prepare for changes in water availability in the watershed.
- Protect quality areas like the headwaters of the watershed as well as Glen Brook sub-watershed.
- Communicate the findings of this effort to local municipalities and continue to work with them toward watershed conservation. Adopt zoning and land-use ordinance to prevent additional water quantity and quality degradation.
- Continue to communicate with the Commonwealth agencies conducting activities in the watershed.
- Through public meetings, outreach, and sponsored events, continue to engage watershed citizens with BCAWS conservation endeavors.

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