South Branch Bear Run Coldwater Conservation Plan

2018

Western Pennsylvania Conservancy

Table of Contents

South Branch Bear Run Coldwater Conservation Plan

Prepared by

Western Pennsylvania Conservancy

water, land, life.

With the support and assistance of

Indiana County Conservation District

Indiana University of Pennsylvania

Ken Sink Chapter of Trout Unlimited

Pennsylvania Fish & Boat Commission

Pennsylvania Game Commission

Susquehanna River Basin Commission

Funding for this project was provided by

Coldwater Heritage Program

on behalf of the PA Department of Conservation and Natural Resources, the PA Fish and Boat Commission, the Foundation for Pennsylvania Watersheds and the PA Council of Trout Unlimited

Introduction and Background

The Bear Run watershed is a 19 square mile watershed located in the northeast corner of Indiana County, Pennsylvania with portions of its headwaters in Jefferson County and the lower watershed, including the confluence with the West Branch of the Susquehanna River, in the town of McGees Mills, Clearfield County (Figure 1). Bear Run is formed primarily by two branches, known as the North Branch and the South Branch. While the North Branch has a robust native brook trout population, the South Branch is impacted by abandoned mine drainage (AMD). The North Branch and its tributaries were evaluated by Western Pennsylvania Conservancy (WPC) in 2006 through the completion of the Northern Bear Run Coldwater Conservation Plan (NBRCCP, 2006), funded by the Coldwater Heritage Partnership (CHP). That plan serves as a key reference in our conservation and restoration efforts in the North Branch of Bear Run. Since the completion of the CHP for Northern Bear Run, significant efforts have been underway to remediate impairments to the South Branch. The completion of a CHP for the South Branch will guide future restoration efforts in the watershed.

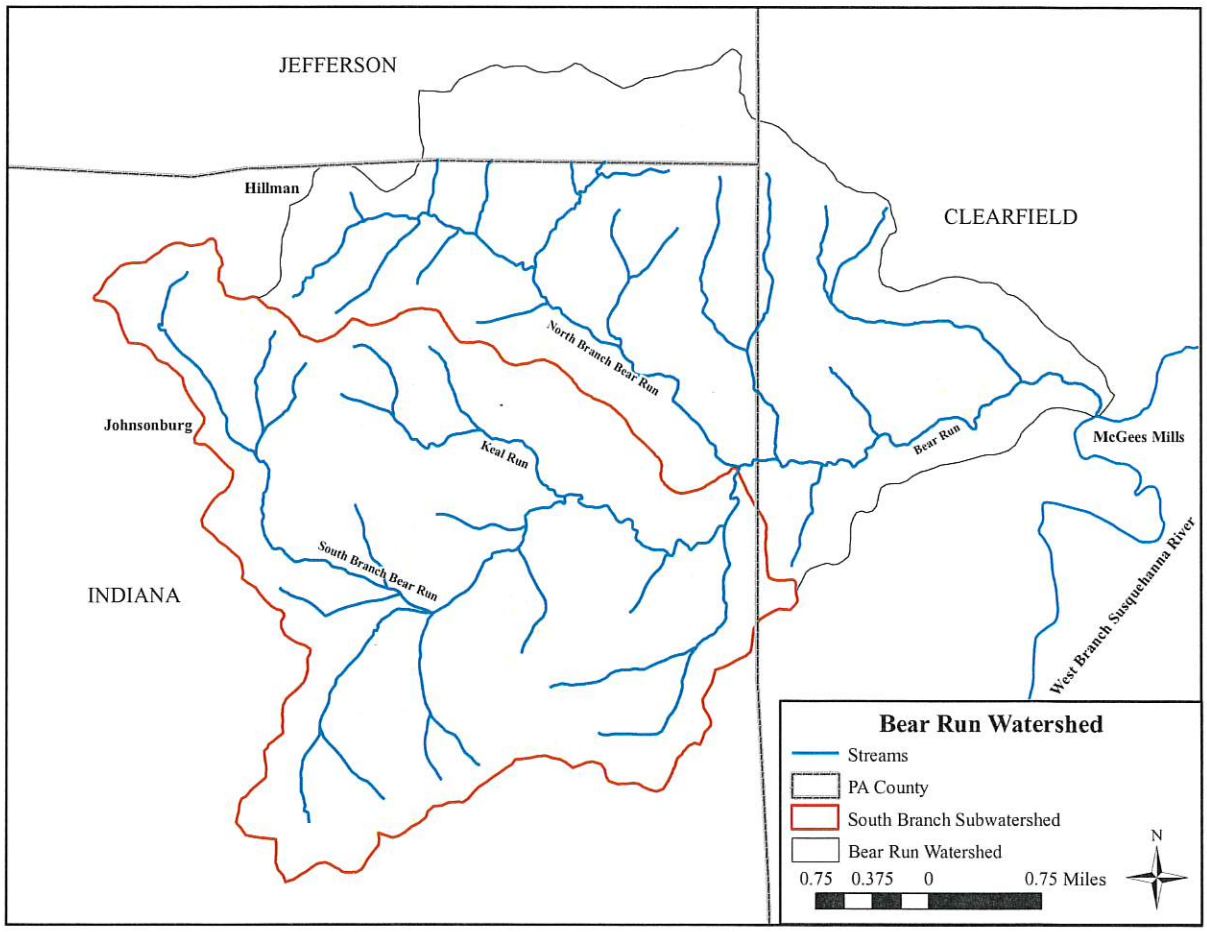

Figure 1 - Bear Run watershed which encompasses three counties in south-western Pennsylvania.

In decades past, the South Branch was considered one of the worst streams in Indiana County in regards to AMD impacts and was completely devoid of fish, per the information submitted by the Indiana County Conservation District (ICCD) to the PA Department of Environmental Protection (DEP) in 2005, as a proposal to assess the non-point source pollution impacts to the Bear Run watershed.

Due to improvements in water quality the South Branch is recovering. Previous restoration plans of the watershed conclude that the streams and tributaries of the South Branch have potential to improve as wild trout streams or develop into new ones, but not enough was known about them at the time. The massive effort needed to complete abandoned mine reclamation has been the primary focus. Now that those solutions have been identified and funding & restoration efforts are being completed, WPC and our partners believe it is an opportune time to focus on other impairments to water quality and aquatic organisms in the Bear Run watershed. The objective of this planning project is to identify additional coldwater and native trout resources in the South Branch Bear Run watershed, including the previously unassessed Bear Run mainstem, identify non-AMD impacts to the aquatic resources and develop a Coldwater Conservation Plan for the South Branch that will, in concert with the Northern Bear Run Plan, guide continued watershed restoration efforts in the entire Bear Run watershed. Plan development has been guided by a coalition of partners including WPC, ICCD, Ken Sink Chapter of Trout Unlimited (KSTU) and the Susquehanna River Basin Commission (SRBC).

Photo 1 - Keal Run is a high quality tributary to the South Branch

Description of the Watershed

The South Branch Bear Run Coldwater Conservation Plan addresses the streams not assessed within the scope of the NBRCCP. This includes 22.2 miles of named and un-named tributaries within the South Branch sub-watershed, as well as the mainstem of Bear Run for a total of 26.7 miles of streams (Figure 2).

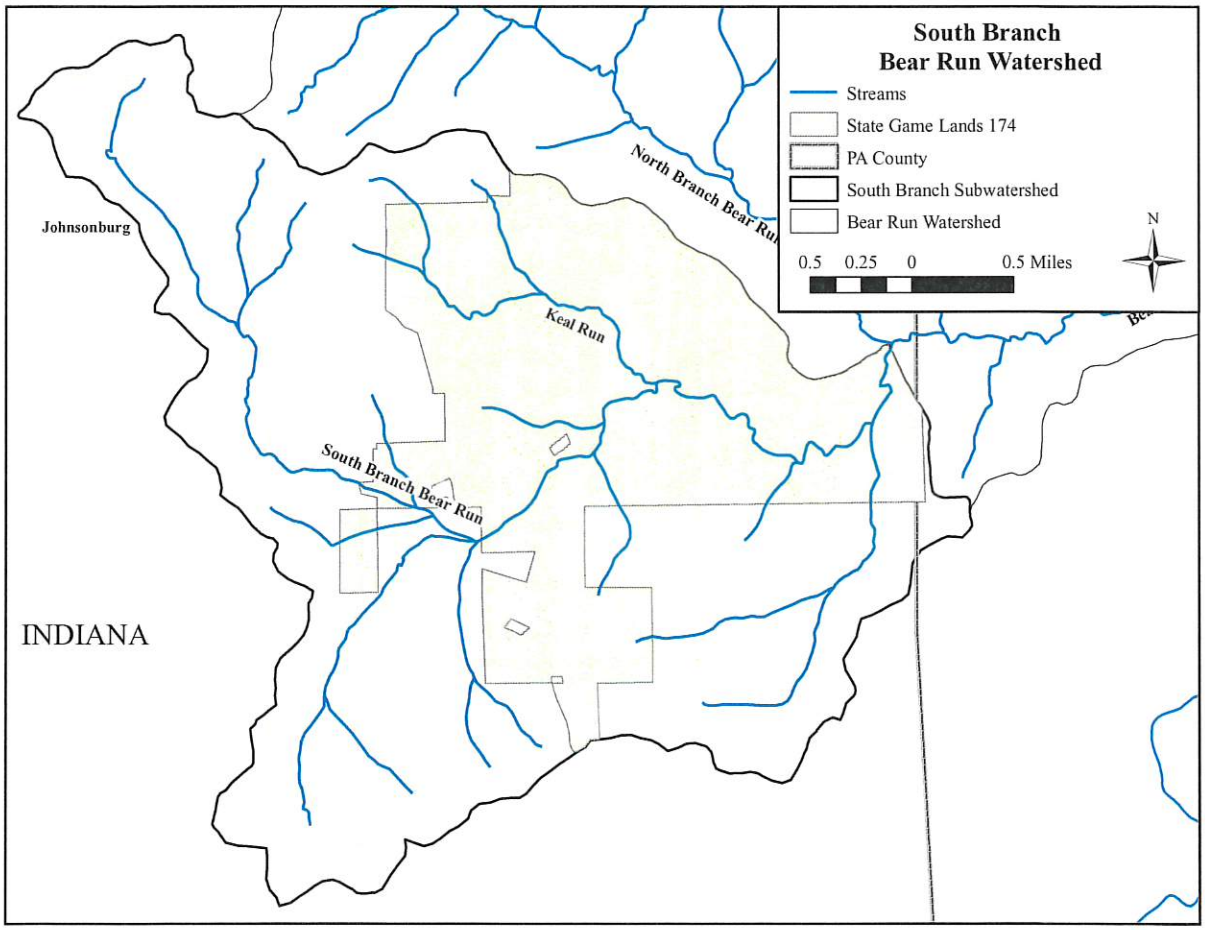

Figure 2 South Branch Bear Run watershed map depicting streams and public lands.

The South Branch subwatershed, at 10 square miles, encompasses slightly more than half of the total area of the Bear Run watershed. Public land managed by the Pennsylvania Game Commission (PGC) covers 3.7 square miles (2,368 acres) in the South Branch watershed. The majority of the watershed is private land which is a mix of land cover, including forest, pasture, row crops, barren lands and low density residential.

State Game Lands (SGL) 174 is comprised of 3,956 acres of mountainous, forested terrain which are drained by approximately nine miles of the South Branch and its tributaries. The Game Commission has been a cooperative partner in restoring the South Branch of Bear Run. Due to its location and size, SGL 174 is host to a number of the abandoned mine restoration sites in the watershed.

Photo 2 State Game Lands 174 encompasses the mainstem of the South Branch

The South Branch of Bear Run is designated as a Cold Water Fishery (CWF) by the PA Code 25, Chapter 93. Per the DEP, Chapter 93 Designated Use definitions, a CWF designated stream is protected 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." The South Branch watershed includes 12.7 miles of stream formerly listed by the DEP as impaired by abandoned mine drainage. The extensive efforts required to address those issues are discussed below and well documented by multiple partner reports and presentations. For more information, refer to the reports authored by SRBC in the citations.


Photo 3 - A wood duck box on the South Branch provides habitat for wildlife

Land Cover

Land cover data quantifies the attributes of what is on the surface of the landscape without specifying what the land is currently being used for. The South Branch watershed is dominated by tree canopy and low vegetation cover types (Figure 3). Land cover percentages in the South Branch watershed aligns closely with the entire Bear Run watershed (Table 1).

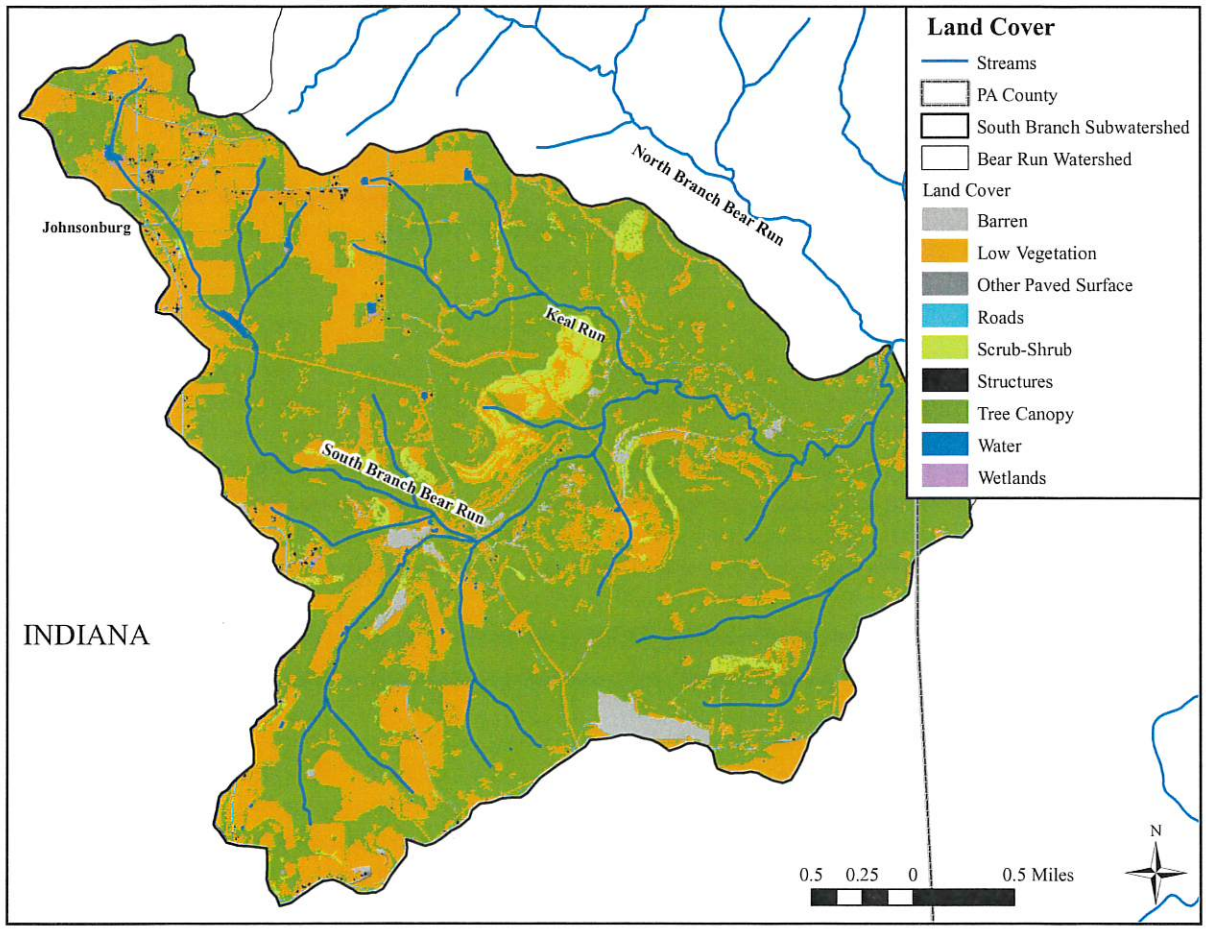

Figure 3 - Land cover of the South Branch Bear Run watershed from 2013.

Table 1 - Land Cover Types - Data Source Chesapeake Conservancy (2016).

Land Cover Type	Percent of South Branch Bear Run Subwatershed	Percent of Bear Run Watershed
Barren	1.38%	1.44%
Low Vegetation	24.93%	25.30%
Other Paved Surface	0.32%	0.62%
Roads	0.55%	0.61%
Scrub-Shrub	2.22%	1.60%
Structures	0.12%	0.13%
Tree Canopy	69.86%	69.64%
Tree Canopy Over Other Paved	0.06%	0.14%
Tree Canopy Over Roads	0.18%	0.17%
Tree Canopy Over Structures	0.02%	0.02%
Water	0.31%	0.30%
Wetlands (emergent)	0.05%	0.03%

In the case of conserving coldwater habitats, two land cover distinctions are most important: abundant tree canopy and a lack of development are crucial. Development would be encompassed by the barren, low vegetation, other paved surface, roads, scrub-shrub and structures land cover categories. These conditions are especially detrimental within the riparian zones and headwater portions of a watershed. GIS analysis found that while the main stem of the South Branch of Bear Run has a riparian buffer that is mostly forested, there are locations where the buffer has been modified by anthropogenic activities. Locations that have been manipulated by human activities are predominantly in the headwaters where agriculture is the prominent land use, and in concentrated residential areas such as Johnsonburg and Hillman. In addition to the agricultural impacts, there are portions of the watershed where abandoned mine lands remain or where reclamation has not generated sufficient overhead tree canopy at this time (Figure 3), limiting riparian buffer width and contributing sediment to the stream

Abandoned Mines

The most obvious characteristic of the South Branch Bear Run watershed is the legacy of abandoned mines across the landscape. Significant funding has been leveraged by conservation partners including the ICCD, Evergreen Conservancy, SRBC and Game Commission.

Abandoned mine treatment & land reclamation projects have been completed in nine phases and range in scale from large area reclamation of coal spoil piles and passive treatment pond installation to the use of active limestone dosing silos at multiple locations (Figure 4). Since 2006, over $2.0 M has been invested in AMD reclamation activities in this watershed, making it one of the most extensive restoration efforts in Indiana County. Funding has been leveraged from a number of sources (Table 2).

Photo 4 - WPC staff and AmeriCorps members tested water quality on a tributary to the South Branch

Table 2 - Mine Reclamation Funding in the Bear Run watershed.

Reclamation Project	Grant Amount	In Kind	Total
Bear Run Assessment	$9,072.00		$9,072.00
EC BR 7 (Phase I)	$11,000.00		$11,000.00
BR 17	$173,000.00	$30,800.00	$203,800.00
BR Renaissance (GG)	$1,432,326.00	$223,006.59	$1,655,332.59
Phase 9 (OSM)	$90,000.00	$66,000.00	$156,000.00
Total	**$1,715,398.00**	**$319,806.59**	**$2,035,204.59**

At this time, it is estimated that approximately 75% of the abandoned mine impairments in the South Branch have been addressed (SRBC, 2013). The issues that remain in the watershed occur primarily in the form of surface mine seeps. Restoration efforts focused in remediating those sources are being developed by SRBC and ICCD and funding for restoration should be pursued. Additionally, a long term monitoring site on the South Branch upstream of its confluence with the North Branch would provide a gauge for continued water quality improvement as currently none exists to track changes in water chemistry.

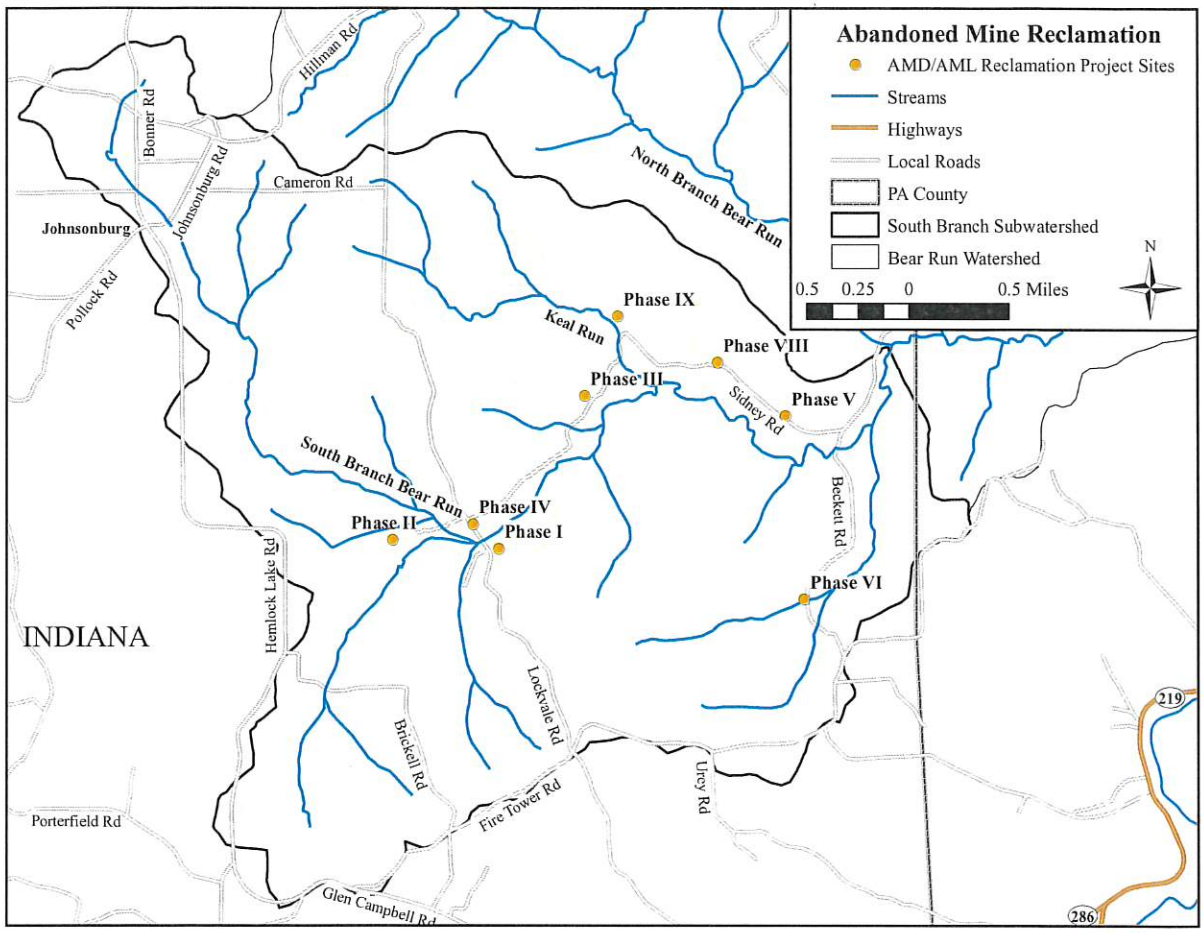

Figure 4 - Nine phases of AMD reclamation work that has greatly improved water quality in the South Branch watershed.

Photo 5 - A limestone dosing silo treating an AMD discharge on the South Branch

Abandoned mine remediation projects implement a number of different water quality improvement practices, each of which have long term operation and maintenance requirements. It's important that funding is planned for and secured to ensure that the significant improvements made throughout the Bear Run watershed do not degrade due to neglect.

The impacts of abandoned mine drainage remain present in the watershed and additional restoration efforts are planned to capture the remaining water quality impairments. Poorly reclaimed surface mines still offer AMD loading in portions of the watershed, particularly draining on the southern side of the South Branch between the Lochvale Bridge and entry of Keal Run. Recently, the PGC and SRBC completed a pilot project (~20 acres) to re-reclaim two sites by amending the soils with high-pH paper mill sludge and attempting to revegetate with a mix of grasses and trees. The success of that approach will be monitored moving forward. In addition, SRBC, ICCD, and PGC submitted a proposal to the Growing Greener Program requesting funds to complete additional forestry reclamation approach (FRA) re-reclamation projects in these areas along the south side of the South Branch. That proposal was not funded due to the elimination of AMD funds to the Chesapeake Bay watershed. However, with a proposal already prepared, it should be submitted to other funding programs for consideration.

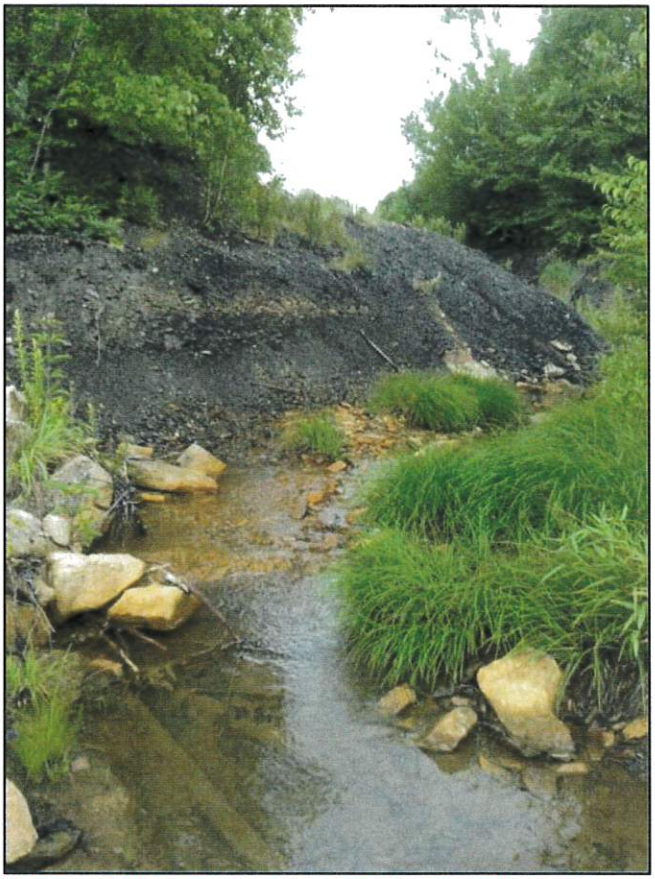

Photo 6 - Coal refuse piles still remain throughout the watershed

Photo 7 - AMD seeps degrade water quality on the South Branch downstream of Lochvale Bridge

Resource Extraction

Resource extraction in the Bear Run watershed is not limited to coal mining . A high density of conventional shallow natural gas wells exists in the watershed, with approximately 16 wells per acre in the entire watershed (Figure 5). Based upon DEP data, there are 144 gas wells in the South Branch watershed, 132 active, 8 inactive and 4 abandoned. Twenty of these wells are within 200 feet of a stream. Additionally there are a number of natural gas transfer pipelines that intersect the streams of the South branch. At the time of this report, there are no unconventional wells in the watershed.

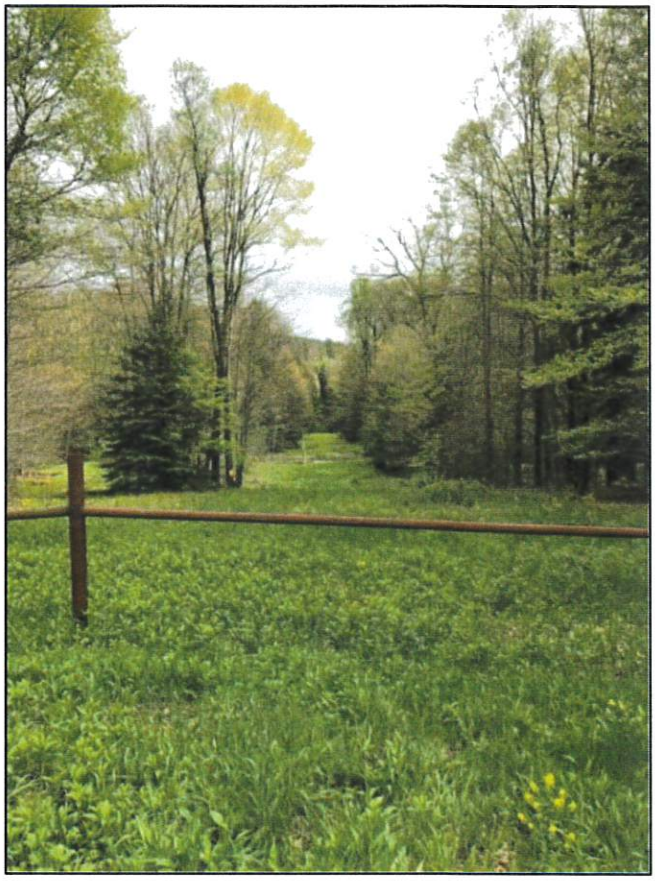

Photo 8 - Natural gas transmission lines intersect the South Branch and its tributaries throughout the watershed

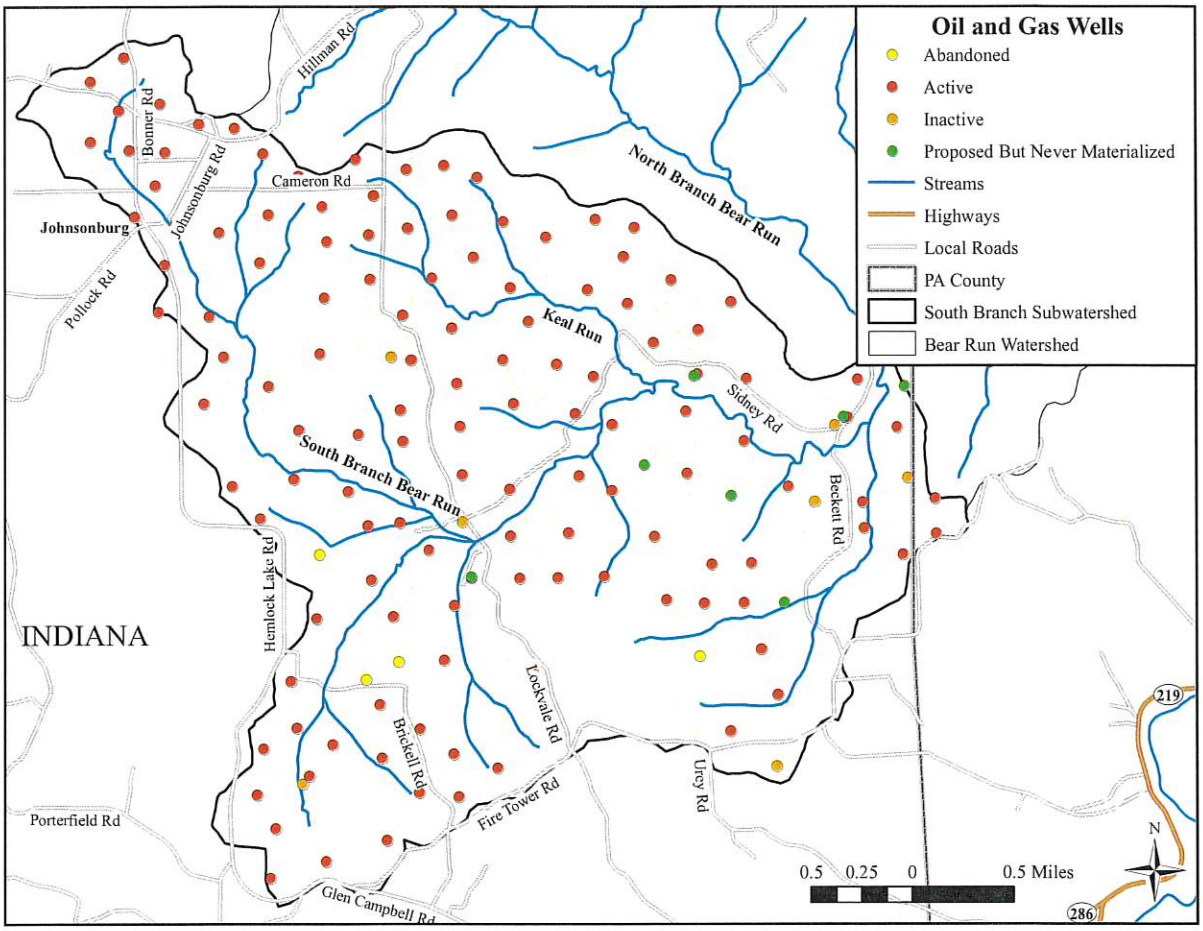

Figure 5 - Shallow gas wells in the Bear Run watershed.

Extraction of minerals in the Bear Run watershed includes surface coal mining, deep coal mining, and several stone quarries. These industries have a direct impact to the landscape from excavation activities but also have associated infrastructure including access roads, stream crossings, pipelines and cleared areas, which can impact water quality and watershed health. There are nine inactive coal mining operations in the South Branch watershed and 17 active coal operations (Figure 6). Impacts associated with these activities include surface mines, discharges, NPDES discharges and post-mining treatment points. Additional information on active mining and abandoned mine reclamation projects can be found in the references below on the SRBC's work in the watershed.

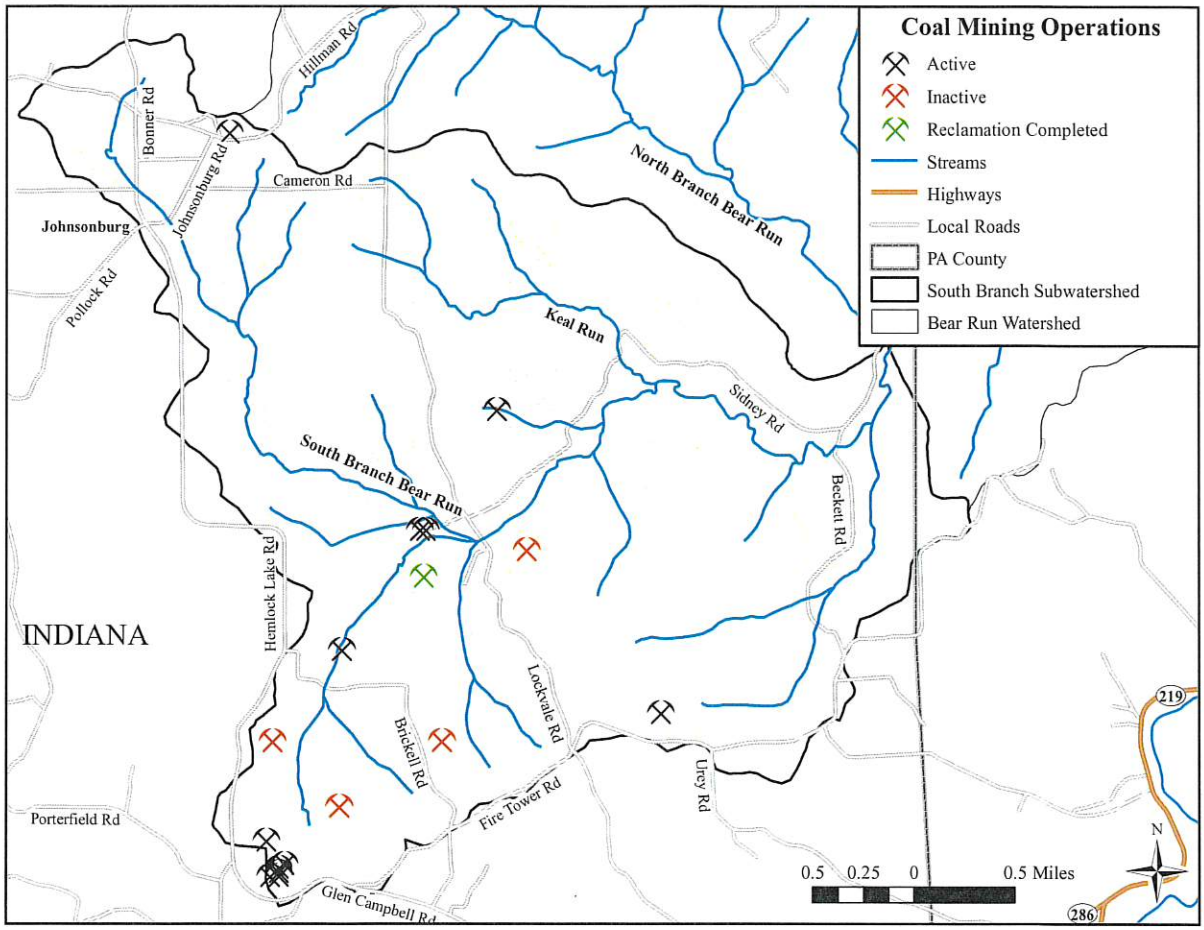

Figure 6 - Coal mining in the Bear Run watershed. The upper reaches of the watershed have been extensively mined since the early 1900's.

Due to the abundant forests throughout the watershed, silviculture remains an active industry. Forestry projects greater than 25 acres require the implementation of an erosion and sediment control plan, which covers access roads, log landings and skid trails as temporary disturbances. There are regulations in place focused on wetland and stream crossing permitting through the PA DEP. The PFBC prohibits any alteration or disturbance of streams and/or fish habitat without proper permitting as well as restricting any input of harmful substances off logging sites.

Dirt & Gravel Roads

The South Branch Bear Run watershed lies in a rural part of Indiana County and many of the roads are township maintained dirt & gravel roads, primarily by Banks Township. In addition, more than 40 miles of access roads throughout the watershed, including private lanes, State Game Lands 174 and oil & gas well service roads add to this mileage. Well designed and maintained dirt and gravel roads can function in reducing overland flow and sediment contributions to streams. Unfortunately, roads that are in poor condition tend to continue degrading until funding is invested to improve them.

Banks Township has applied to and received funding from the ICCD Indiana County Low Volume, Dirt & Gravel Road (LVDGR) Program funding to complete a number of projects within the Bear Run watershed (Table 3). These projects are having a positive impact on reducing sediment inputs from roads; however it's important to note that these projects require regular maintenance to ensure they continue to be a benefit rather than revert to an ongoing issue. The Indiana County LVDGR Program also funds projects focused on to stream crossing improvements as a component of their dirt and gravel road program. Additional projects on the roads maintained by Banks Township will reduce the environmental impacts that infrastructure has throughout the watershed.

Photo 9 - Dirt and gravel road issues are apparent during or immediately following heavy rain events

Table 3 - Dirt and Gravel Road Improvement Projects in the Bear Run watershed 1999-2015.

Project Participant	Contract Date	Road Name	Total Expenditures	Total In-kind	Total Project
Banks Township	4/1/1999	Beckett Road	$9,146.56	$2,300.00	$11,446.56
Banks Township	11/1/2002	Sidney Road	$4,020.95	$2,291.00	$6,311.95
Banks Township	6/1/2003	Beckett Road	$5,507.38	$0.00	$5,507.38
Banks Township	12/1/2003	Harkleroad Road	$696.50	$126.00	$822.50
Banks Township	8/1/2004	Sidney Road	$4,714.10	$6,495.00	$11,209.10
Banks Township	7/1/2005	Sidney Road	$4,943.23	$762.00	$5,705.23
Banks Township	7/1/2006	Beckett Road	$10,810.90	$5,028.00	$15,838.90
Banks Township	7/1/2007	Harkleroad Road	$3,274.16	$4,286.00	$7,560.16
Banks Township	8/1/2008	Sidney Road	$2,448.97	$1,810.00	$4,258.97
Banks Township	3/1/2011	Beckett Road	$2,923.80	$1,221.50	$4,145.30
Banks Township	12/1/2014	Beckett Road	$2,816.86	$756.86	$3,573.72
Banks Township	6/6/2015	Harkleroad Road	$19,238.47	$6,018.00	$25,256.47
		Total	**$70,541.88**	**$31,094.36**	**$101,636.24**

There still remain a number of road segments, both public and private which would benefit from road improvement projects. One area of focus should be SGL 174 access roads and gas well roads. Unfortunately neither of these qualifies for County LVDGR Program funding. Identifying funding opportunities and stakeholders for improving these access roads will be essential for reducing their impacts on aquatic resources found within the South Branch watershed. As a preliminary step, WPC digitized many of the non-public roads from a hardcopy map of the Bear Run watershed (Figure 7). A total of 42 miles of access roads were identified through this process. Not all access roads identified are currently in a state of disrepair but many of them occur within a stream corridor which could have harmful impacts to coldwater systems found in the South Branch watershed.

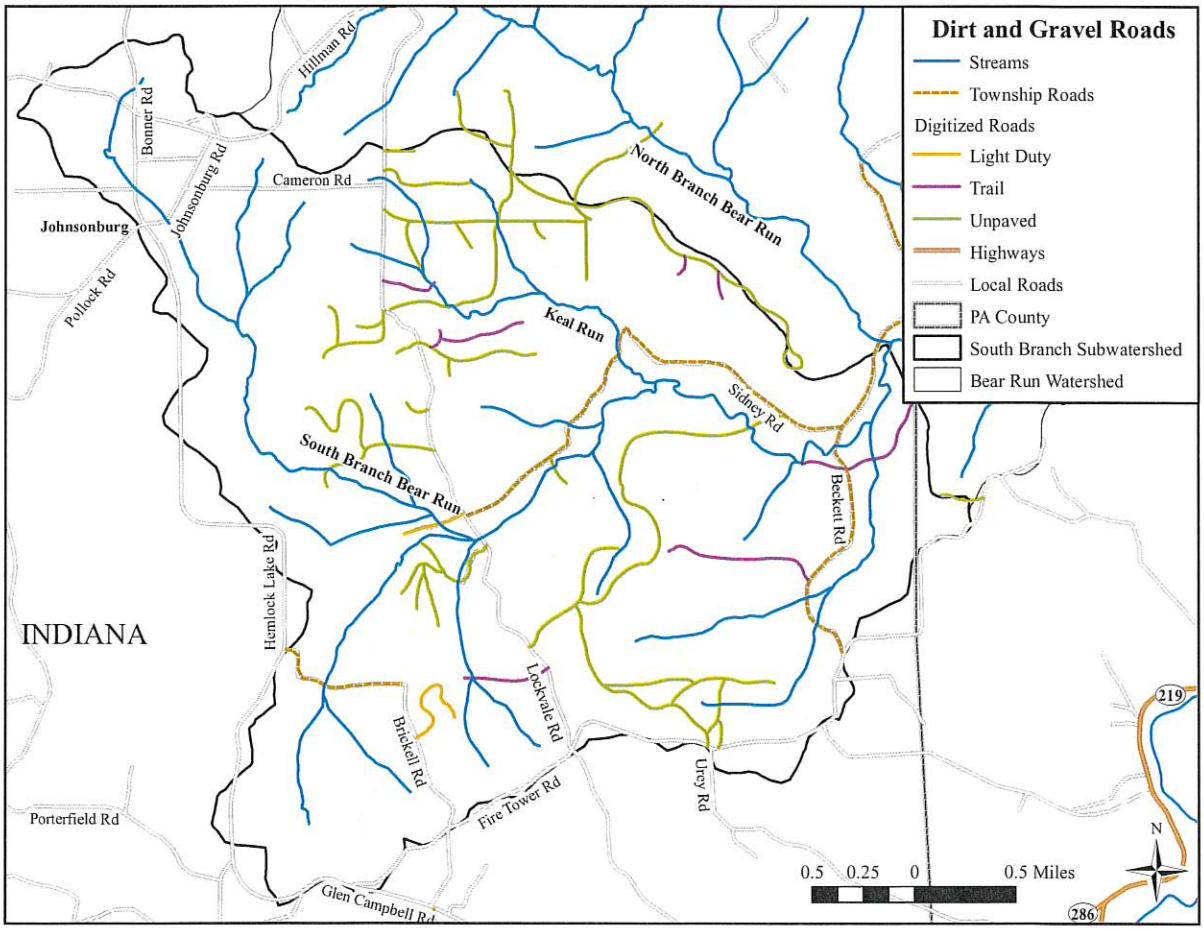

Figure 7 - Digitized access road segments found in the Bear Run watershed. Numerous roads traverse streams and could have impacts to water quality and fish passage.

Sedimentation

Sedimentation from roads, historic mining and upstream land use is likely the primary impairment in the watershed following AMD. Fine sediment and silt can impair macroinvertebrate communities and limit spawning habitat for fish by covering gravel and cobble substrates (Argent, 1999). Sediment can also clog cross pipes and culverts, exacerbating erosion, intensifying dirt & gravel road inputs and decreasing the effectiveness of road-stream crossings for aquatic organism passage. Other likely contributions would be from low density residential, agricultural or timber harvest.

Photo 10 - Logging operations are a potential source of sediment

Sediment can enter the stream system by multiple pathways. In the case of barren land or open fields, overland sheet flow across large swaths of un-vegetated or poorly vegetated land can transport fine sediments. This is worsened on steep hillsides or any soil left bare during/after an agricultural or construction activity. This is visible at locations in the watershed where piles of coal waste remain or where vegetation has been altered or removed. If the flow of water over these surfaces goes unchecked sheet flow can develop into concentrated flow. While these impacts are not as widespread over the landscape, the higher velocities of water and greater intensity of erosive forces can cause equal if not greater sediment scour and transport.

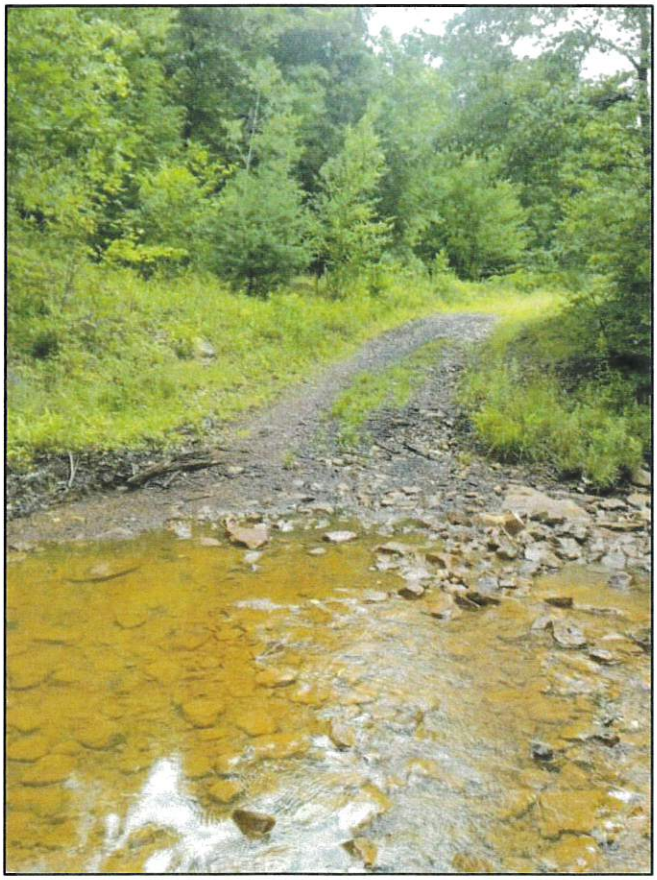

Photo 11 - Access roads and fords often directly impact the streams of the South Branch watershed

Sedimentation sources are not limited to large areas of land. As noted above, the large amount of dirt and gravel roads throughout the watershed also contribute additional sediment load to area streams. Working with partners to identify the road sections and barren lands contributing sediment to the streams and developing a strategic approach to improving them will greatly benefit the South Branch watershed.

Field Work Overview

Field work for this plan was designed to supplement previous and ongoing efforts in the watershed. Methodologies included: visual assessment of instream habitat, temperature monitoring, chemical and water quality sampling, electrofishing, and the assessment of aquatic organism passage conditions throughout the Bear Run watershed.

Visual Assessment

WPC utilized a modified version of the United States Environmental Protection Agency (EPA) Rapid Bioassessment Protocol (RBP) to complete this assessment (EPA, 1999). The protocol evaluates stream segments utilizing ten scored categories addressing the components of instream habitat. Field surveys were completed during the summer months of 2016 & 2017. Visual assessments were completed on the South Branch and any tributaries which were accessible via public land. Twenty-five stream segments were assessed totaling 18.1 miles (Figure 8). Overall scores ranged from 9.6 (Marginal) to 16.7 (Optimal).

Photo 12 - Deep pools and large woody debris comprise good habitat on this section of the South Branch

Visual assessment results characterize the South Branch mainstem with abundant high quality fish habitat, including undercut banks, large woody debris and complex riffle/run/pool sequences which allowed reaches to score in the optimal and sub-optimal categories (Figure 8). Tributaries range in score, from Marginal to Optimal.

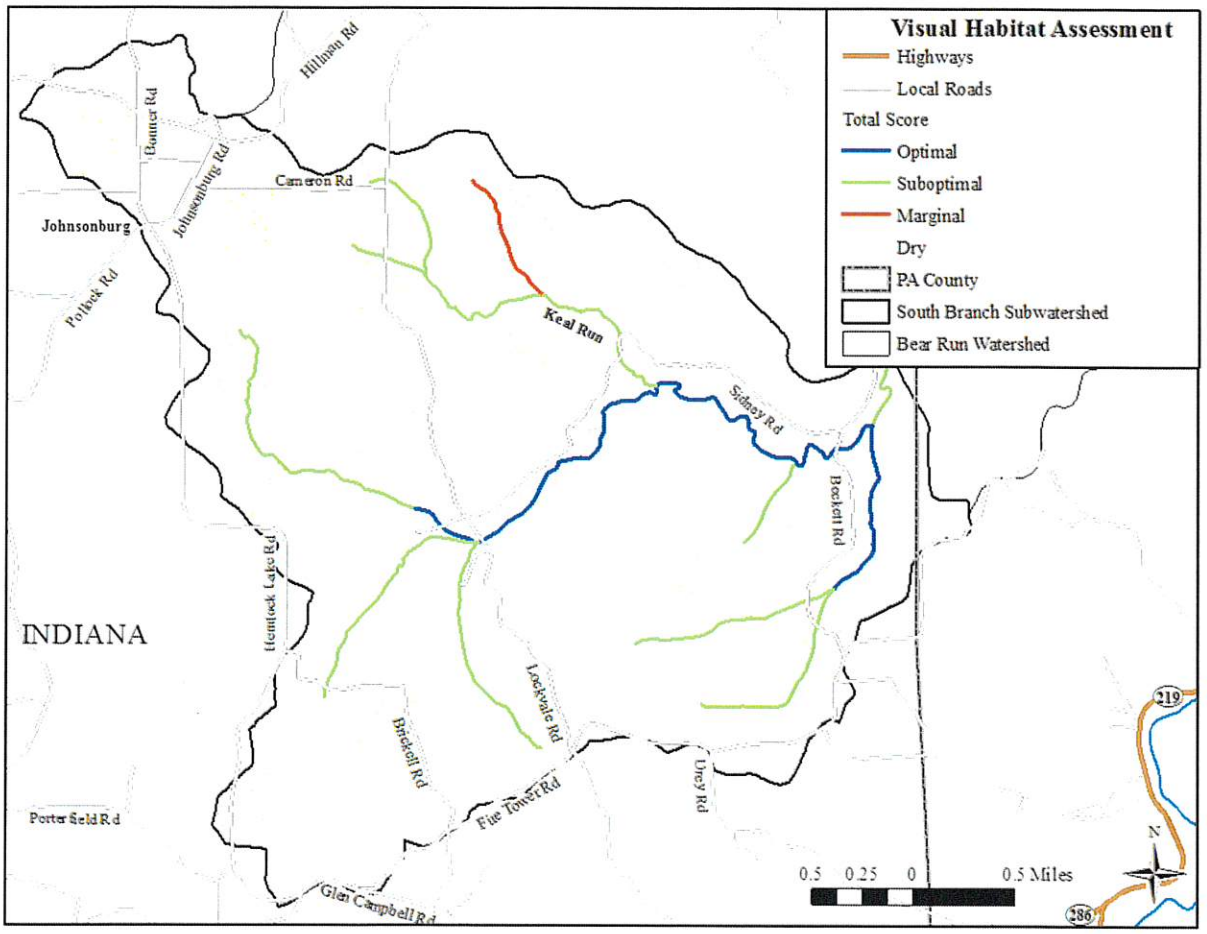

Figure 8 - Visual assessment results from South Branch of Bear Run. All reaches scored in the Optimal and sub-optimal categories except for a tributary to Keal Run.

The majority of segments assessed included a full suite of substrate types including boulder, cobble, gravel and sand. Table 4 displays the results of the visual assessment which allows for the identification of common issues throughout the South Branch watershed. For example, seven segments received scores in the Poor range for sediment deposition, which occurs from large scale movement of sediment, impacting available habitat for numerous aquatic species. Tributaries with notably excessive sedimentation were dominated by mixed sand and silt substrate. These reaches also frequently contained embedded riffles. Embeddedness decreases available habitat for macroinvertebrate and fish (EPA, 1999).

Table 4. Visual assessment scores for the Bear Run watershed 2016 and 2017.

Stream Name	GIS ID	Epifaunal/Cover	Embedded	Depth Regimes	Sediment Dep.	Flow Status	Channel Alter.	Freq. of Riffles	Bank Stability	Veg. Protection	Riparian Width	Total Score
Trib 27036 To Bear Run	7976	18	15	18	16	18	16	18	16	16	14	16.5
Trib 27040 Of South Branch Bear Run	8065	16	16	17	16	15	17	14	16	4	18	14.9
Trib 27039 To South Branch Bear Run	8077	10	16	11	13	14	16	15	14	4	18	13.1
Trib 27049 To South Branch Bear Run	8071	16	16	16	14	18	14	18	12	12	13	14.9
South Branch Bear Run	8019	15	15	16	13	12	19	17	17	12	11	14.7
South Branch Bear Run	8017	16	14	15	16	15	17	18	18	18	19	16.6
Bear Run	8007	17	15	19	14	15	18	13	16	16	18	16.1
South Branch Bear Run	8024	16	16	18	13	14	17	18	18	14	18	16.2
South Branch Bear Run	8021	12	16	13	17	16	19	18	20	18	18	16.7
South Branch Bear Run	8023	16	15	18	13	13	19	17	16	16	16	15.9
South Branch Bear Run	8041	17	17	12	15	15	18	14	18	14	18	15.8
South Branch Bear Run	8049	15	15	17	13	16	17	19	18	18	16	16.4
Trib 27039 To South Branch Bear Run	8059	17	15	18	10	16	16	17	17	12	17	15.5
South Branch Bear Run	8041	17	17	12	15	15	18	14	18	14	18	15.8
South Branch Bear Run	8041	17	17	12	15	15	18	14	18	14	18	15.8
South Branch Bear Run	8038	15	16	10	8	11	15	17	16	14	16	13.8
Trib 27037 Of Bear Run	7975	15	15	18	15	17	17	18	15	14	20	16.4
Trib 27047 To South Branch Bear Run	8070	14	14	13	12	14	6	9	14	11	14	12.1
Trib 27036 To Bear Run	8005	17	18	18	15	17	13	18	15	16	18	16.5
Trib 27042 To South Branch Bear Run	7990	16	16	11	10	13	16	14	16	14	18	14.4
Trib 27043 Of South Branch Bear Run	7994	8	7	7	4	9	14	3	14	14	16	9.6
Trib 27041 To South Branch Bear Run	8052	10	10	14	4	17	18	13	12	16	18	13.2
Trib 27042 To South Branch Bear Run	8014	13	12	18	6	15	13	16	8	2	8	11.1
Trib 27042 To South Branch Bear Run	8000	10	11	14	8	10	12	7	16	16	16	12
Trib 27044 Of South Branch Bear Run	7989	14	14	5	16	12	11	6	13	13	14	11.8

There are four depth regimes whose diversity is characteristic of a healthy stream system and include a mixture of fast & deep, fast & shallow, slow & deep, and slow & shallow reaches (Figure 9). Many mainstem segments and tributaries were lacking in deep water regimes. These deep water regimes play a crucial role in the life history of native brook trout, as larger fish could thrive in these reaches. Low

impact habitat restoration through the implementation of large woody material habitat projects in difficult to access areas would increase channel complexity and encourage the formation of deep pools.

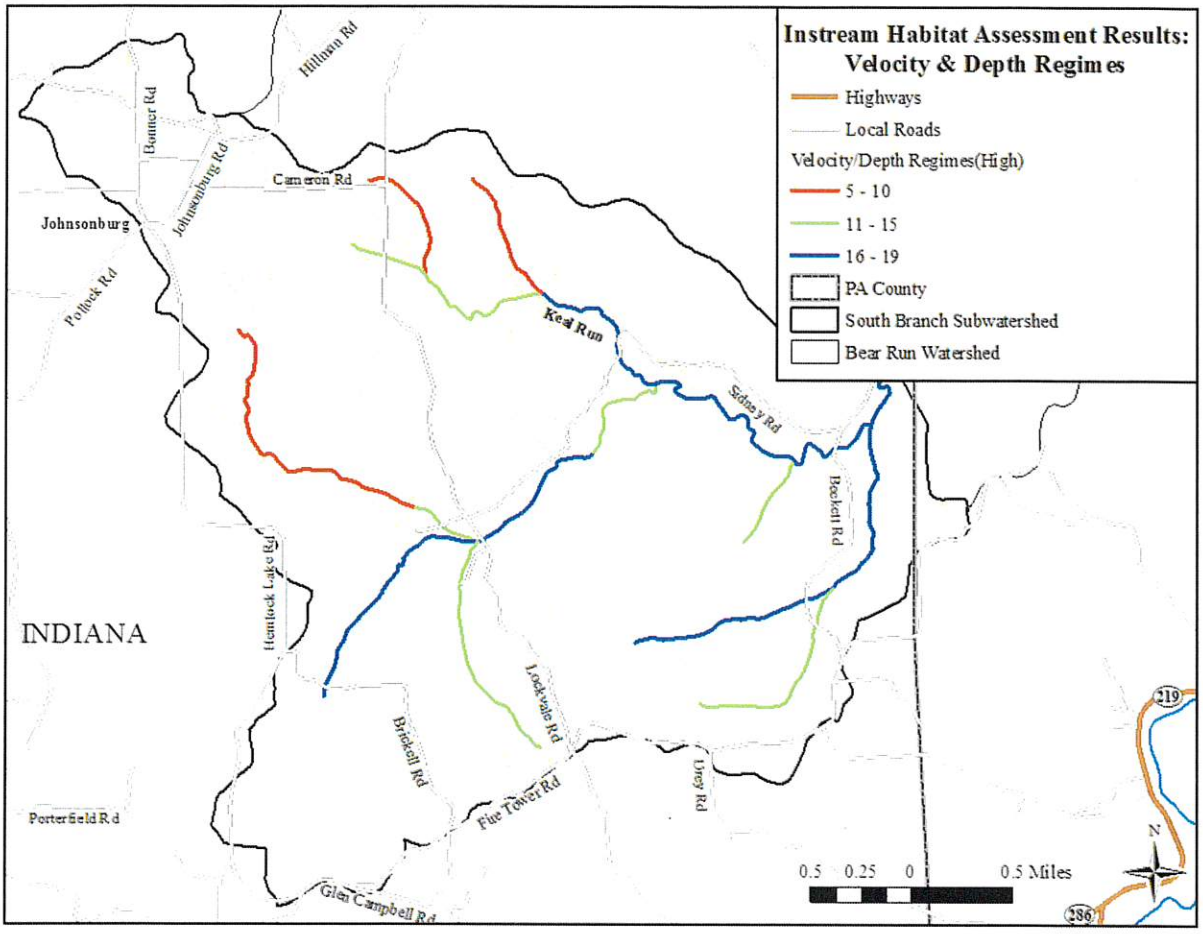

Figure 9 – Reaches of the South Branch displaying the scores for velocity and depth regimes.

The primary sources of water quality impact discovered during the field assessment were AMD and sedimentation (Table 5). As stated in the land cover section above, there are a number of locations where the riparian zones have been degraded. Having these locations identified through the visual assessment will provide WPC and our partners with information for focused outreach towards potential restoration projects (Figure 10). There were stream segments in the headwaters of the South Branch, most prominently within the Keal Run subwatershed where the stream was lower gradient, sinuous and highly impacted by deposited sediments. These are areas where there is frequent interface between dirt & gravel access roads, which may be contributing additional sediment. These reaches are also downstream of agricultural operations in the headwaters.

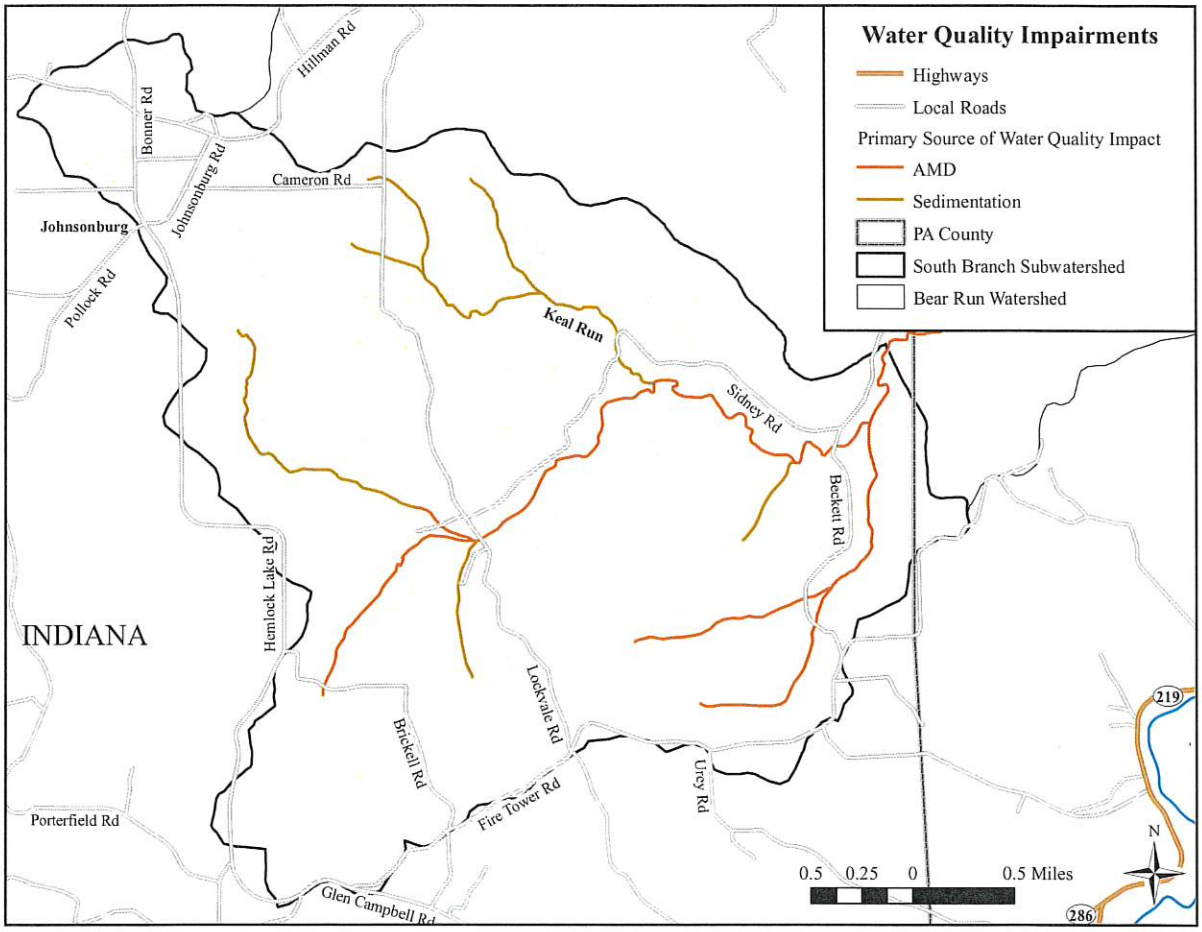

Figure 10 – Reaches of the South Branch impacted by AMD and sedimentation.

Table 5 - Primary impacts identified during the visual assessment of the Bear Run watershed.

Stream Name	GIS ID	Stormwater Inputs	DGR Sediment Contribution	Active Streambank Erosion	Primary Source of Water Quality Impact
Trib 27048 Of South Branch Bear Run	8084	None	None	Minimal	
Trib 27036 To Bear Run	7976	Overland Flow	Moderate	Moderate	AMD
Trib 27040 Of South Branch Bear Run	8065	Road Ditch	Minimal	Minimal	AMD
Trib 27039 To South Branch Bear Run	8077	None	Minimal	Minimal	AMD
Trib 27049 To South Branch Bear Run	8071	None	Minimal	Moderate	AMD
South Branch Bear Run	8019	None	None	Minimal	AMD

Stream Name	GIS ID	Stormwater Inputs	DGR Sediment Contribution	Active Streambank Erosion	Primary Source of Water Quality Impact
South Branch Bear Run	8017	Overland Flow	None	Minimal	AMD
Bear Run	8007	None	None	Minimal	AMD
South Branch Bear Run	8024	Road Ditch	Minimal	Minimal	AMD
South Branch Bear Run	8021	Overland Flow	None	Minimal	AMD
South Branch Bear Run	8023	None	None	Moderate	AMD
South Branch Bear Run	8041	None	None	Minimal	AMD
South Branch Bear Run	8049	Overland Flow	Minimal	Minimal	AMD
Trib 27039 To South Branch Bear Run	8059	Overland Flow	None	Minimal	AMD
South Branch Bear Run	8038	None	Minimal	Moderate	Sedimentation
Trib 27037 Of Bear Run	7975	Overland Flow	Minimal	Minimal	Sedimentation
Trib 27047 To South Branch Bear Run	8070	Overland Flow	Heavy	Moderate	Sedimentation
Trib 27036 To Bear Run	8005	Overland Flow	Minimal	Moderate	Sedimentation
Trib 27042 To South Branch Bear Run	7990	Road Ditch	Moderate	Minimal	Sedimentation
Trib 27043 Of South Branch Bear Run	7994	None	Minimal	Minimal	Sedimentation
Trib 27041 To South Branch Bear Run	8052	None	None	Moderate	Sedimentation
Trib 27042 To South Branch Bear Run	8014	Overland Flow	Moderate	Heavy	Sedimentation
Trib 27042 To South Branch Bear Run	8000	Road Ditch	Minimal	Moderate	Sedimentation
Trib 27044 Of South Branch Bear Run	7989	None	Minimal	Minimal	Sedimentation

In its headwaters, the South Branch of Bear Run and its tributaries have been highly impacted by development associated with the villages of Flora, Johnsonburg and Lochvale (Figure 3). These are also the reaches were agricultural land uses are most concentrated. Farming practices and small clusters of homes have led to channel alteration and severe reductions in the widths of riparian buffers, with some reaches completely lacking in any vegetation other than low grasses. Also of note is the high number of man-made ponds on headwater tributaries of the South Branch watershed.

The overall characterization of the South Branch indicates a watershed with quality habitat in the mainstem and a number of problematic tributaries. It is worth noting that while a number of segments received a Marginal score in one or more category for the visual assessment protocol, there were no segments which were in bad enough condition to merit a Poor score (less than 5). The data collected through this process was used to identify restoration priorities.

Stream Temperature Monitoring

According to the species spotlight from the Eastern Brook Trout Joint Venture (EBTJV, 2018), water temperatures greater than 65 – 70 degrees Fahrenheit (18.3 – 21.1 degrees Celsius) are stressful to brook trout over extended periods of time. Low water levels and high air temperatures can amplify this stress. In an attempt to monitor stream temperatures across the Bear Run watershed, WPC deployed ten HOBO data loggers concentrating on the South Branch and its tributaries but also including one site in the headwaters of the North Branch and one site on the North Branch just before its confluence with the South Branch (Figure 10). These temperature loggers were deployed from April 2017 until October 2017 in order to collect data during the warmest time of year. At the time of deployment, as well as during the monthly site visits to download data off the units, WPC staff collected pH, conductivity, dissolved oxygen and temperature utilizing hand-held field probes (Appendix 1). Data loggers at sites 1, 3, 6, and 9 were located on the mainstem of the South Branch of Bear Run. Sites 4, 5, 7, and 8 were located near the mouths of tributaries to the South Branch. Two additional data loggers (2 and 10) were deployed on the North Branch of Bear Run.

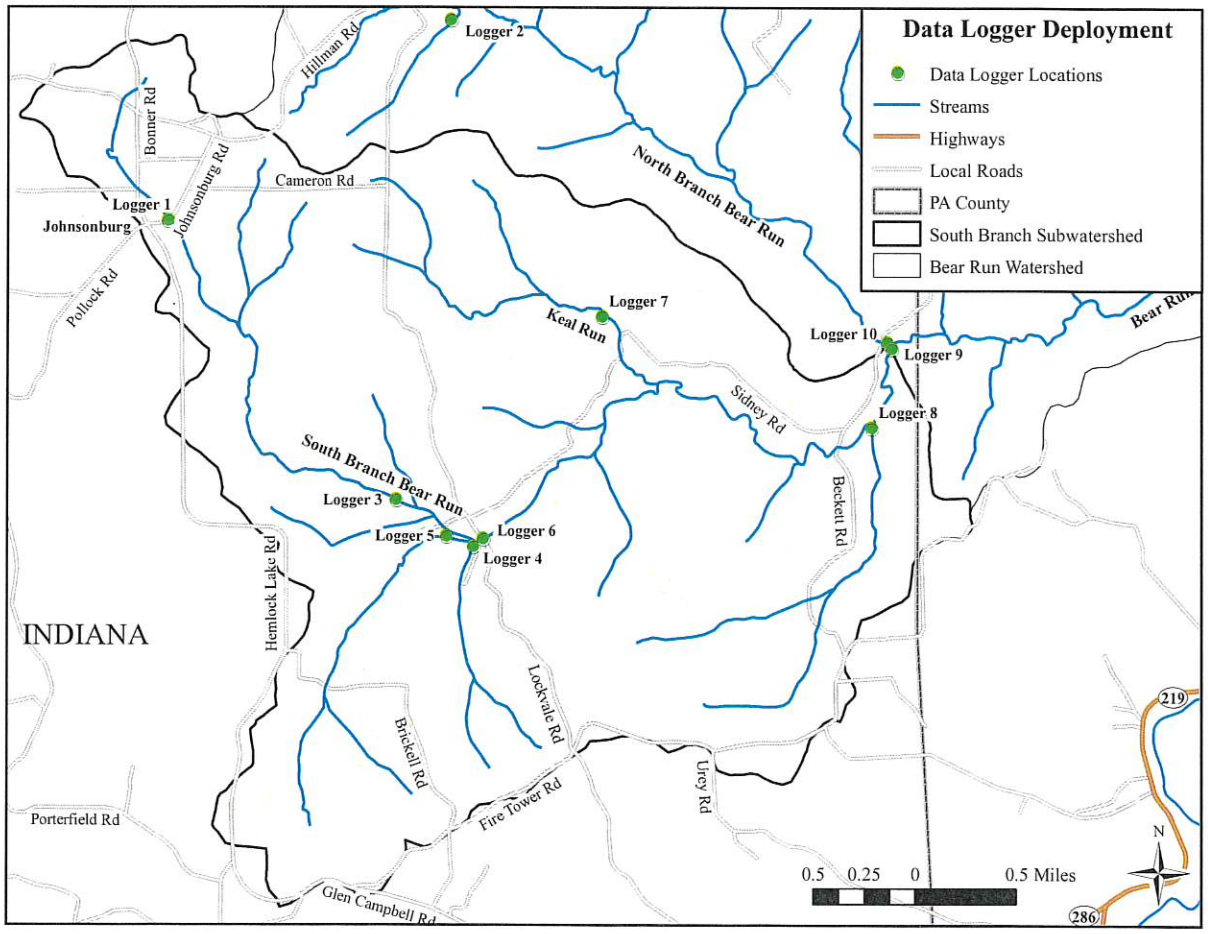

Figure 10- HOBO data logger deployment locations in the Bear Run watershed.

Table 4 shows the four mainstem loggers in order from highest upstream to lowest in the watershed. It is interesting to note that some of the highest water temperatures occur in the headwaters of the South Branch, indicated by the results of logger 1. Logger 3 was the only logger on the mainstem that did not exceed the ideal water temperatures for native brook trout during any of the months in which the data loggers were deployed (Table 6 and Figure 11). Logger 6, which is directly downstream of two tributaries influenced by passive abandoned mine drainage treatment systems (see Loggers 4 & 5 in Table 7), had higher temperatures in the months of July and August.

Table 6 - Mainstem South Branch Bear Run temperature data April – October 2017.

Logger #	April	May	June	July	August	September	October
Logger 1	13.51	12.79	16.46	18.95	18.11	16.13	13.85
Logger 3	12.17	11.98	15.8	18.2	16.43	14.38	12.93
Logger 6	13.09	12.95	17.64	20.76	19.91	17.34	14.59
Logger 9	12.9	12.44	16.22	18.83	17.31	15.22	13.24

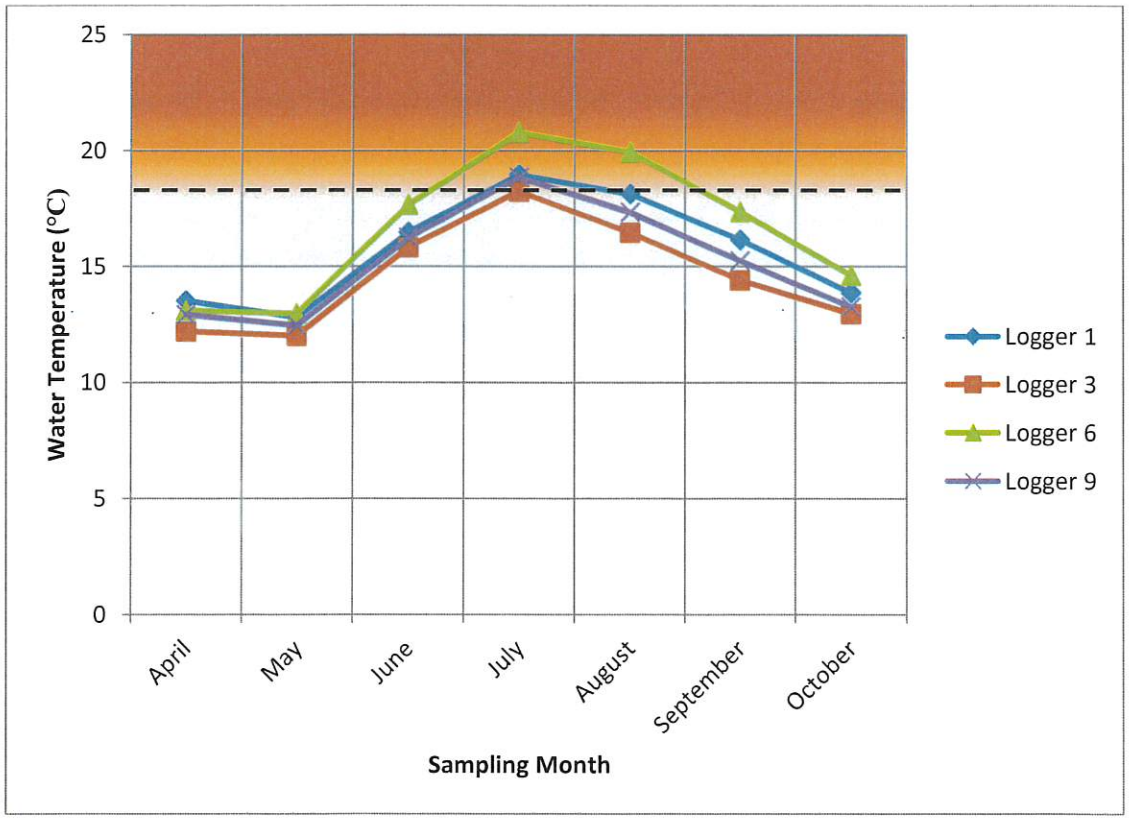

Figure 11 – Mean water temperatures on the mainstem South Branch stations April – October 2017.

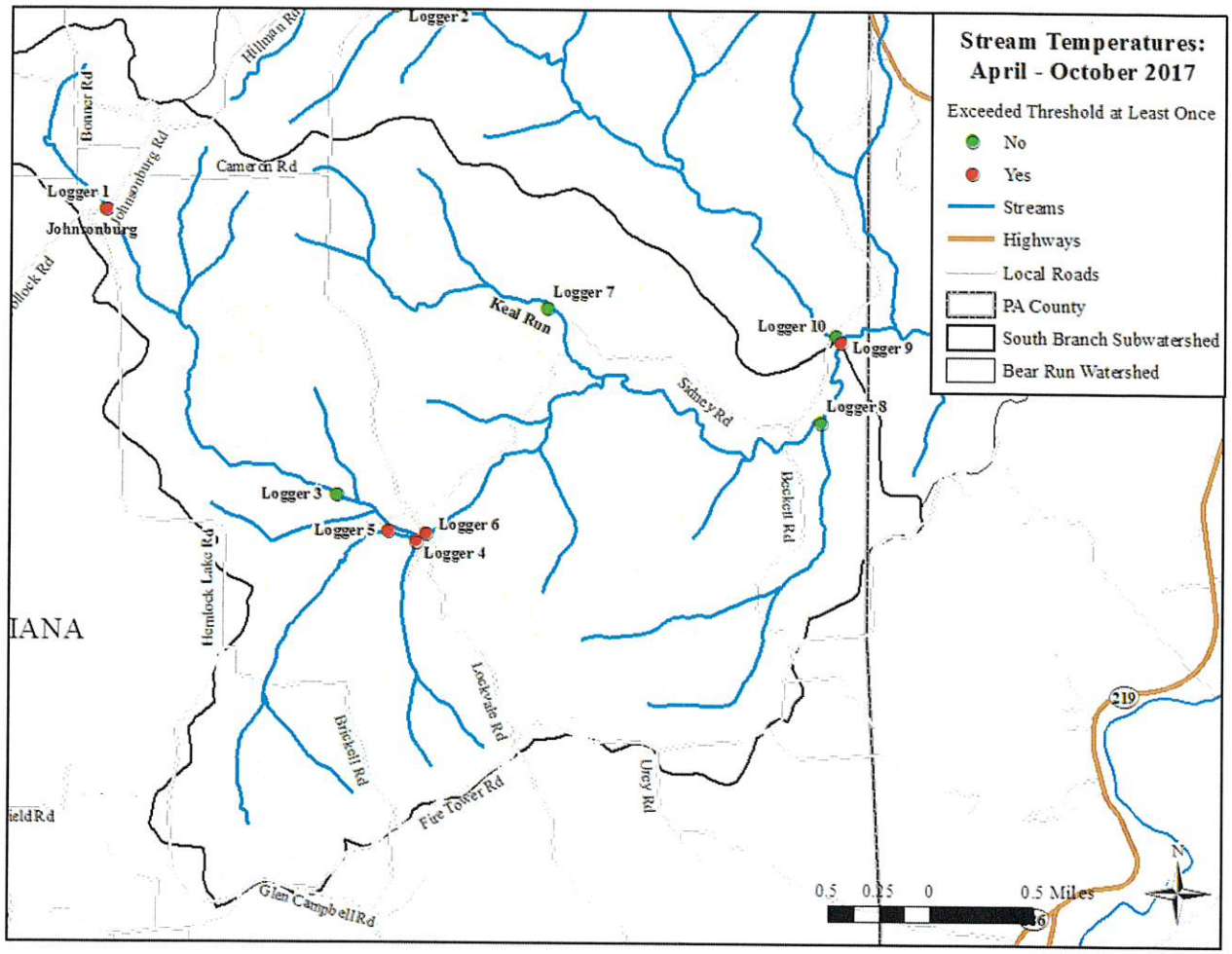

Figure 12 - Data loggers locations which exceeded the preferred water temperature threshold for native brook trout.

Data loggers on tributaries to the South Branch tell two remarkably different stories. Tributaries which were influenced by abandoned mine drainage treatment systems (Loggers 4 & 5) had higher water temperatures during the entire sampling period of April to October (Table 7 and Figure 12). These temperatures were significantly higher in the summer months, exceeding the preferred water temperature threshold for native brook trout (Table 5 and Figure 13).

Table 7 – Tributary water temperature data from the South Branch off Bear Run.

Logger #	April	May	June	July	August	September	October
Logger 4	13.14	12.88	17.41	20.38	19.35	16.52	13.84
Logger 5	13.64	13.5	18.47	21.04	21.23	18.58	15.52
Logger 7	11.8	11.48	14.71	17.58	16.37	14.55	13.24
Logger 8	11.22	11.23	14.87	17.76	16.47	14.53	12.78

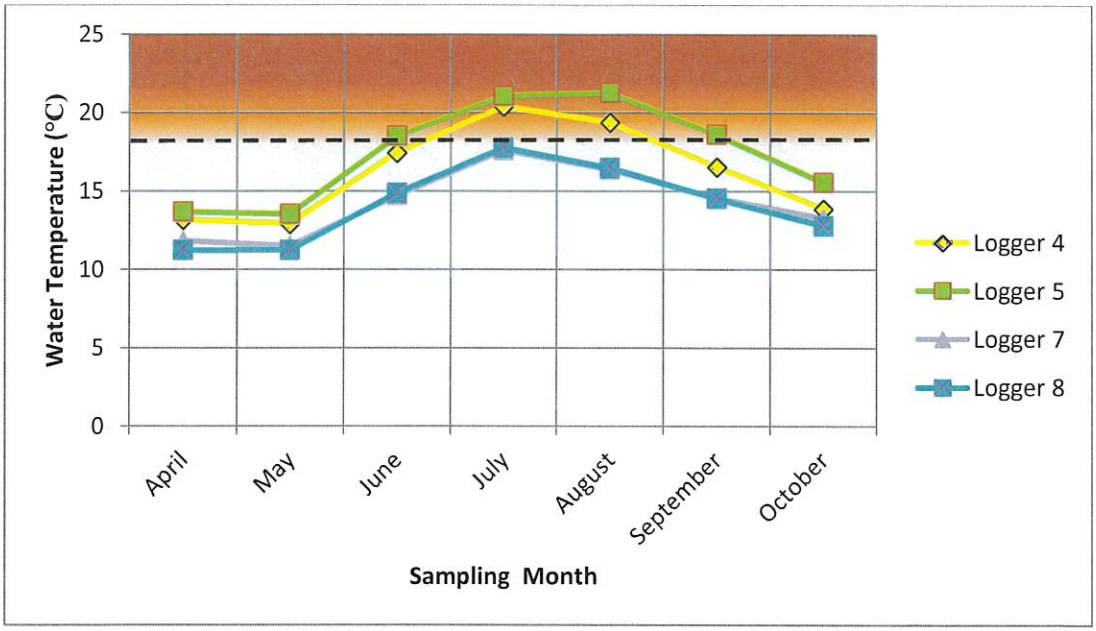

Figure 13 Mean water temperatures on tributaries to the South Branch.

Tributaries often serve as coldwater refugia during the warmer summer months. In cases where tributary water temperatures exceed the temperature limits of suitable habitat, native brook trout may have nowhere to go until cool water temperatures return. Extended periods of high water temperatures can lead to mortality, which can decimate an already isolated population. While the positive impact of AMD restoration of water quality in the South Branch is paramount to the recovery of the watershed, additional investigation into identifying sources and alleviating the high water temperatures in these tributaries is recommended. Perhaps the most encouraging information the water temperature component of this project reveled was the importance of Keal Run (Logger 7) as a coldwater refuge (Figure 14). The mainstem of this subwatershed is almost entirely within SGL 174 and is well forested. It did not exceed the temperature threshold during any of the months of the data logger deployment (Figure 14). Focusing on improving this stream's instream habitat and connectivity could contribute greatly to the ecosystem recovery of the South Branch watershed.

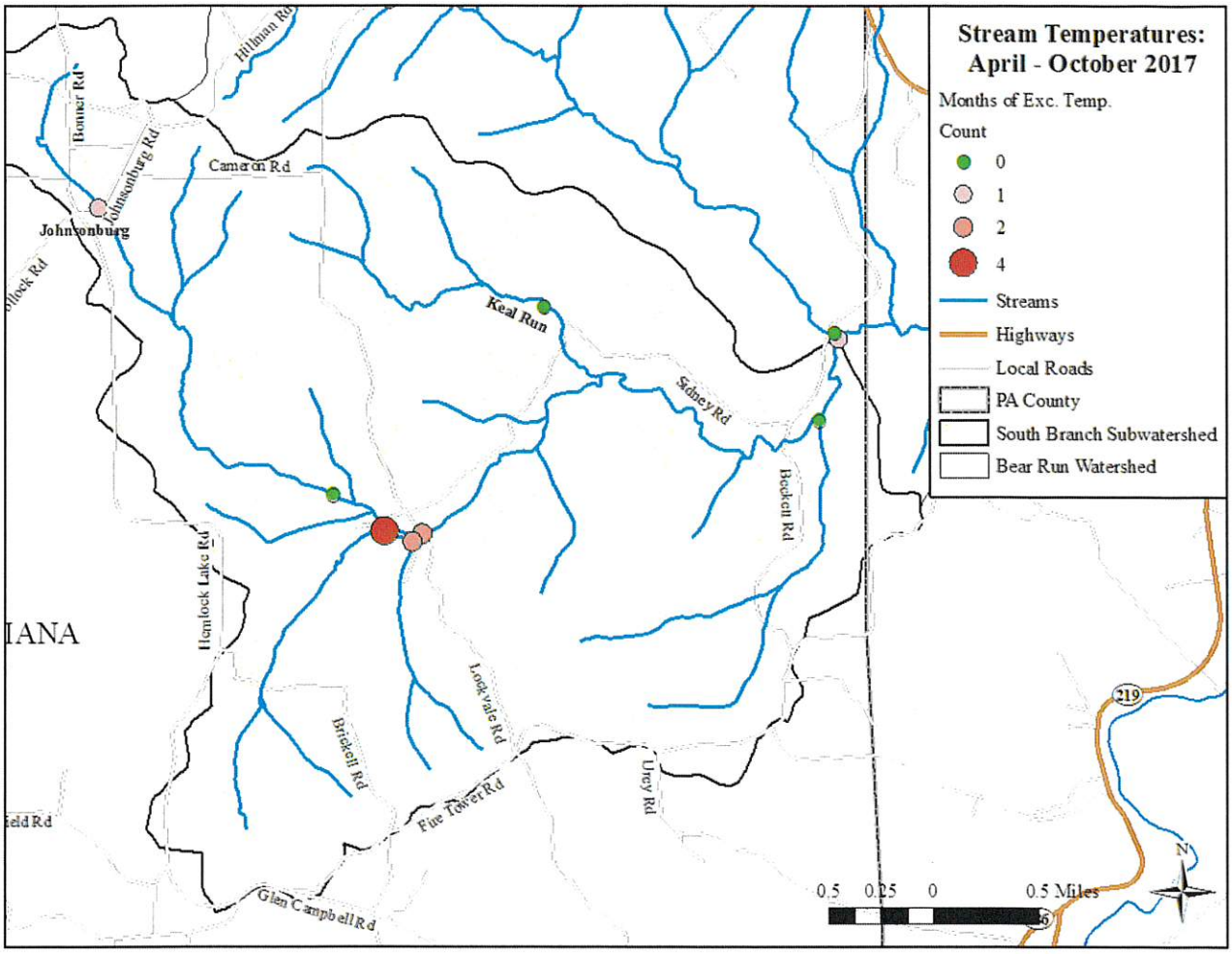

Figure 14 - Data loggers displayed by the number months of high water temperatures during the deployment period.

Chemical Sampling

Watershed wide water quality sampling was last completed in 2015 by the SRBC and DEP to address a petition to delist the South Branch of Bear Run from the Impaired List (Figure 15). This effort was successful and in 2016, approximately six miles of Bear Run were removed from the Impaired List for AMD impacts (PA DEP, 2016). This delisting lead to the PFBC adding additional sections of Bear Run to the Wild Trout Waters list and recommending that the DEP reclassify those sections as HQ-CWF or EV (PFBC, 2017).

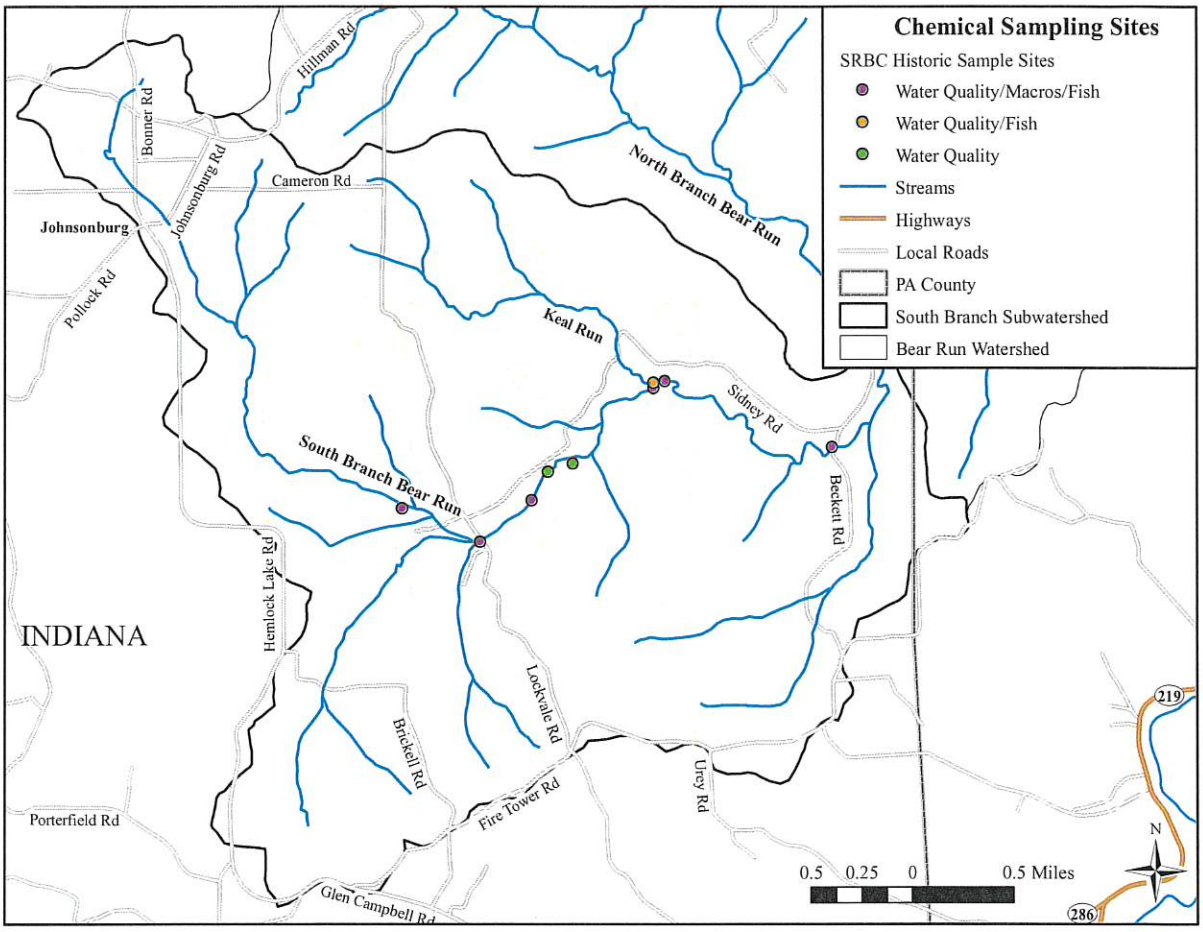

Figure 15 - Historic sampling stations completed by SRBC for biological and water quality sampling efforts.

While visiting the data logger deployment sites WPC staff completed water quality monitoring utilizing hand-held probes. The site numbers correspond with the map of data logger locations (Figure 10). A summary table of the results of that effort is below in Appendix 1.

Electrofishing

During October of 2014, PFBC staff completed electrofishing surveys in the Bear Run watershed to determine whether or not streams contained significant native brook trout biomass to qualify the North Branch and another tributary as Class A wild trout waters. While in the area PFBC staff also completed surveys on the South Branch of Bear Run and Keal Run.

PFBC staff surveyed 353 meters of the South Branch starting at the mouth. Average stream width at this site was 5.1 meters. During the survey they captured native brook trout, blacknose dace and creek chub. Native brook trout size class distributions as well as biomass estimates for South Branch Bear Run (Table 8).

Table 8 - Native brook trout catch and biomass estimates for the South Branch Bear Run.

Size Class	Catch	Estimated Kg/Ha	Estimated Number/Ha	Estimated Number/Km
75	5	0.17	28	14
100	5	0.38	28	14
125	3	0.41	17	8
150	4	0.92	22	11
175	1	0.36	6	3
200	1	0.52	6	3
Total	19	2.76	107	53

PFBC staff also surveyed 185 meters of Keal Run, starting approximately 170 meters downstream of where Sidney Road (T-701) intersects the stream. Average stream width at this site was 2.2 meters. Once again, PFBC captured native brook trout and creek chub, but there were no blacknose dace captured during the course of this survey. Keal Run's catch results and biomass estimates are in Table 9.

Table 9 - Native brook trout catch and biomass estimates for Keal Run.

Size Class	Catch	Estimated Kg/Ha	Estimated Number/Ha	Estimated Number/Km
75	3	0.45	75	16
100	1	0.34	25	5
125	1	0.61	25	5
150	1	1.03	25	5
175	1	1.61	25	5
Total	7	4.04	175	36

WPC staff completed electrofishing surveys at four sites in the South Branch of Bear Run in September 2016 with mixed results. Two of the tributaries were unsuitable for shocking, lacking any significant flow at the time of survey. Two tributaries that were surveyed did contain fish, including blacknose dace and creek chub, but no native brook trout were collected. Field staff noted that good habitat was present; therefore future surveys may show a change in species composition. Possible explanations for the limited number and species of fish collected in 2016 could be the result of little precipitation which could have had some impact on fish occupancy. Resurvey of these tributaries and the addition of some surveys on the mainstem of the South Branch would be good information that should be obtained in the future.

Aquatic Organism Passage Assessment

Recent work by a partnership of state and federal agencies, conservation organizations and academia called the North Atlantic Aquatic Connectivity Cooperative (NAACC) has developed unified protocols for road-stream crossing assessments that can help identify bridges and culverts that are problematic from an aquatic connectivity perspective. This effort is being coordinated online at http://www.streamcontinuity.org which hosts prioritizations, training resources and an online database of surveyed sites.

Stream connectivity is important for all aquatic species but especially important for salmonid species in a number of ways. Access to thermal refuge, spawning habitat, and eliminating genetic isolation of populations are all paramount to maintain native brook trout populations into the future. Poor design of culverts and bridges can negatively affect stream connectivity. Culverts can act as barriers to fish passage in a number of ways. For example, a culvert can be perched above the stream bed causing fish to have to jump large heights. Aquatic organisms have varying levels of mobility and passable culverts are essential for a connected ecosystem. High current velocities often found in culverts that are undersized can make it impossible for organisms to move through them. Water depth within the culvert can be too shallow, or may not provide resting areas for organisms that are migrating upstream. Properly designed and installed culverts also benefit other fish species that are less mobile than trout including blacknose dace and sculpin species.

Aquatic organism passage (AOP) restoration projects throughout the Bear Run watershed will benefit the entire ecosystem. Inadequate culverts, such as the one pictured to the right located on Keal Run, can be found throughout the Bear Run watershed. The example picture here is undersized. This creates a velocity barrier for fish passage as the stream is forced through a pipe that is smaller than the width of stream. This also creates a blowout effect on the outlet side of the culvert which can cause erosion issues on the adjacent streambanks.

Photo 13 - An undersized culvert on Keal Run in need of replacement

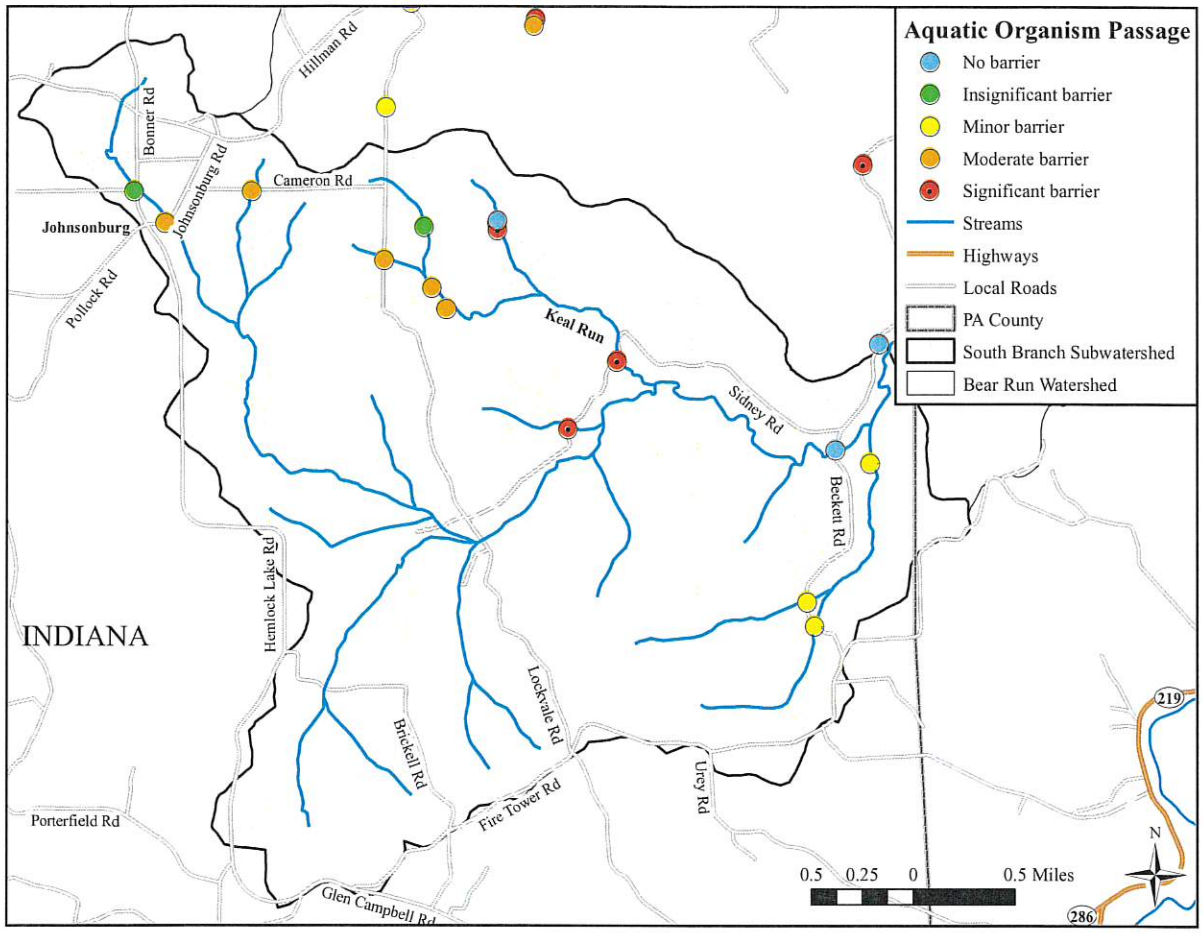

Figure 16 - Aquatic organism passage assessment sites in the South Branch Bear Run watershed.

Table 10 offers an evaluation of culverts assessed during the AOP assessment portion of this project. The NAACC assessment protocol generates two aquatic passability scores. The Coarse filter qualifications are shown in Table 10. Results from the surveys are shown in Table 11.

Table 10 – NAACC Assessment Coarse Filter conditions for aquatic organism passage structures.

Metric	Flow Condition	Crossing Classification		
		Full AOP	Reduced AOP	No AOP
		If all are true	*If any are true*	*If any are true*
Inlet Grade		At Stream Grade	Inlet Drop or Perched	
Outlet Grade		At Stream Grade		Cascade, Free Fall onto Cascade
Outlet Drop to Water Surface		= 0		≥ 1 ft
Outlet Drop to Water Surface/ Outlet Drop to Stream Bottom				> 0.5
Inlet or Outlet Water Depth	Typical-Low	> 0.3 ft		< 0.3 ft w/Outlet Drop to Water Surface > 0
	Moderate	> 0.4 ft		< 0.4 ft w/Outlet Drop to Water Surface > 0
Structure Substrate Matches Stream		Comparable or Contrasting		
Structure Substrate Coverage		100%	< 100%	
Physical Barrier Severity		None	Minor or Moderate	Severe

Table 11 – NAACC evaluation scores for sites in the Bear Run watershed.

Crossing Code	Crossing Type	Coarse Filter Score	Calculated Score	Evaluation	Road	Stream Name
xy4088936078 810684	Culvert	No AOP	0.224	Significant barrier	Harkleroad Road	Murray Run
xy4087130178 839084	Culvert	No AOP	0.224	Significant barrier	Sidney Rd	UNT to South Branch Bear Run
xy4090018878 841265	Culvert	Reduced AOP	0.332	Significant barrier	SGL Access Road	UNT to Bear Run
xy4088539178 845268	Multiple Culvert	Reduced AOP	0.371	Significant barrier	SGL Access Road	Keal Run
xy4087597378 834326	Culvert	No AOP	0.394	Significant barrier	Sidney	Keal Run
xy4088590878 845346	Culvert	Reduced AOP	0.4	Significant barrier	SGL Access Road	Keal Run
xy4087993678 850282	Multiple Culvert	Reduced AOP	0.401	Moderate barrier	SGL Access Road	Keal Run
xy4088349078 856005	Culvert	No AOP	0.5	Moderate barrier	Lochvale Road	UNT to Keal Run
xy4088856978 868239	Culvert	No AOP	0.5	Moderate barrier	Cameron Road	UNT to South Branch Bear Run
xy4088145278 851606	Culvert	No AOP	0.51	Moderate barrier	SGL Access Road	Keal Run
xy4088649078 876469	Culvert	No AOP	0.52	Moderate barrier	Johnsonburg Rd	South Branch Bear Run
xy4090307678 847059	Culvert	Reduced AOP	0.531	Moderate barrier	P N Coal Road	UNT to Bear Run
xy4089975278 841483	Multiple Culvert	No AOP	0.572	Moderate barrier	Railroad	UNT to Bear Run
xy4089425778 855518	Culvert	Reduced AOP	0.632	Minor barrier	Lochvale Road	Bear Run
xy4090157678 852928	Culvert	Reduced AOP	0.643	Minor barrier	Lochvale Road	Bear Run
xy4088183378 804031	Culvert	Reduced AOP	0.728	Minor barrier	SGL Access Road	Murray Run
xy4086837078 810767	Culvert	No AOP	0.743	Minor barrier	SGL Access Road	UNT to South Branch Bear Run
xy4085701478 816348	Culvert	No AOP	0.75	Minor barrier	Beckett Road	UNT South Branch Bear Run
xy4085871278 817007	Culvert	Reduced AOP	0.792	Minor barrier	Beckett Road	UNT South Branch Bear Run
xy4088876978 879305	Multiple Culvert	Reduced AOP	0.828	Insignificant barrier	Walter Long Road	South Branch Bear Run
xy4088575078 852216	Culvert	Reduced AOP	0.858	Insignificant barrier	SGL Access Road	Keal Run
xy4087674978 809658	Bridge Adequate	Full AOP	1	No barrier	Harkleroad Rd	North Branch Bear Run
xy4086936578 813973	Bridge Adequate	Full AOP	1	No barrier	Beckett Rd	South Branch Bear Run
xy4088608378 845343	No Crossing	Full AOP	1	No barrier	SGL Access Road	Keal Run

WPC completed 24 NAACC assessments in the Bear Run watershed in 2017 (Figure 16). Of these stream-road intersections, eleven had reduced aquatic organism passage and ten had no aquatic organism passage based upon the coarse screen algorithm for passage derived by the NAACC workgroup. The more complex calculated score and evaluation resulted in six crossings being significant barriers to AOP, seven were moderate barriers, six were minor barriers, two crossings were insignificant barriers and three crossings were not barriers at all (Table 11). The three crossings which presented full aquatic organism passage and no barrier were either bridges which spanned the full stream channel and streambanks and one location where no culvert was in place. Further exploration of the field data collected via the NAACC database will provide additional details for specific sites.

The results of this assessment will be used to identify and prioritize future culvert replacement projects by WPC, municipalities, the PGC, PFBC, and other stakeholders. Working on a systematic approach to replacing and upgrading these strucures will be essential. Additionally, identifying and assessing stream-crossings that were not included in this project, including private lanes and access roads could provide additional high priority restoration projects. WPC is working with the ICCD to strategically assess culverts in Indiana County's high quality watersheds and including the remaining unsurveyed crossings in the Bear Run watershed is recommended.

Previous and Current Studies/Analysis

Overview

Numerous conservation partners have completed a variety of conservation projects in the Bear Run watershed since 2005. By offering summaries of each completed Plan, readers will be able to determine which resource could hold additional information that is important to a particular reader.

Bear Run Restoration Plan – 2006.

The first effort to identify water quality impairments in the Bear Run watershed was completed in 2006 by ICCD. This plan cataloged the sources and characteristics of AMD sources in the watershed and has been the source for information related to reclaiming and remediating those sources of pollution. To a lesser degree, the plan also gave an overview of other issues in the South Branch, North Branch and the mainstem of Bear Run, providing the start to assessment efforts focused on the next steps to take in the watershed as AMD impairments were being addressed. Even then, the plan recognized similar limiting factors within the Bear Run watershed: sedimentation, riparian encroachment and headwaters land uses as being the next problems to address over ten years ago.

Northern Bear Run Coldwater Conservation Plan – 2006.

In 2006, WPC completed the Northern Bear Run Coldwater Conservation Plan (NBRCCP). This plan was focused primarily on the unimpaired North Branch of Bear Run and to a lesser extent the tributaries of Murray Run, Harkleroad Run and an unnamed tributary which parallels PA Route 36. The plan included visual habitat assessment of the identified streams segments, electrofishing at two locations on the North Branch and macroinvertebrate & chemical sampling at four sites. This effort concluded with the identification that the primary water quality impacts in the northern watershed were resulting from erosion and sedimentation. Management recommendations in that plan outlined a number of primary factors and potential best management practices that should be implemented. In addition, it was recommended that the North Branch of Bear Run be redesignated by the DEP to HQ or EV. In 2006 KSTU petitioned the DEP Environmental Quality Board for that redesignation. Following aquatic macroinvertebrate sampling by DEP in 2009 and fisheries surveys completed by PFBC (discussed in more detail below), this redesignation was formally proposed in 2016 by DEP. The draft Stream Redesignation Evaluation Report states:

> Based on applicable regulatory definitions and requirements of § 93.4(b), the Department has determined that the entire Bear Run basin from its source to confluence with South Branch Bear Run qualifies as HQ based on § 93.4b(a)(2)(ii) (Class A wild trout stream qualifier). In addition, those portions of Bear Run and tributary segments located entirely within SGL 174, with the prerequisite HQ qualifier, also satisfy EV criteria and are being recommended for redesignation to EV based on § 93.4b(b)(1)(iii) (outstanding state resource waters). Those portions of Bear Run upstream of SGL 174 are being recommended for redesignation to HQ-CWF based on §93.4b(a)(2)(ii). This recommendation exceeds the HQ designation sought in the petition (DEP, 2016).

The stream designation change makes the North Branch the only Exceptional Value designated stream in Indiana County. This conservation success is a boon to the North Branch and WPC continues to use the NBRCCP to guide its conservation and restoration efforts in the watershed.

Bear Renaissance Watershed Renaissance Mine Drainage Restoration Project – 2008.

Initiated in 2005 this multiphase project was the result of two assessment and planning efforts focused on AMD restoration in the Bear Run watershed. SRBC completed a total maximum daily load study in 2005. The Indiana County Conservation District completed the Bear Run Restoration Plan in 2006. This plan determined that of the 27 AMD discharge sites in the watershed, there were eight individual sites that were responsible for 72 percent of the AMD loading in Bear Run.

The South Branch of Bear Run was not addressed in the NBRCCP due to the extensive AMD impacts throughout the watershed. However, over the last ten years, Evergreen Conservancy, ICCD and the SRBC have led remediation efforts in the South Branch of Bear Run, to the point that a diversity of fish species are now returning to the stream. Beginning in 2008 a multi-phase strategy utilizing both passive and active treatment methodologies was implemented and has proven successful. As stated in the Bear Run Abandoned Mine Drainage Remediation – Watershed Renaissance Project information sheet "for the first time in possibly a century or more, every (survey) station (Figure 17) in Bear Run contained fish (Clark, 2017)." The final stages of this effort are currently taking place and improvements should continue as the final two phases are constructed and fish continue to recolonize throughout the watershed.

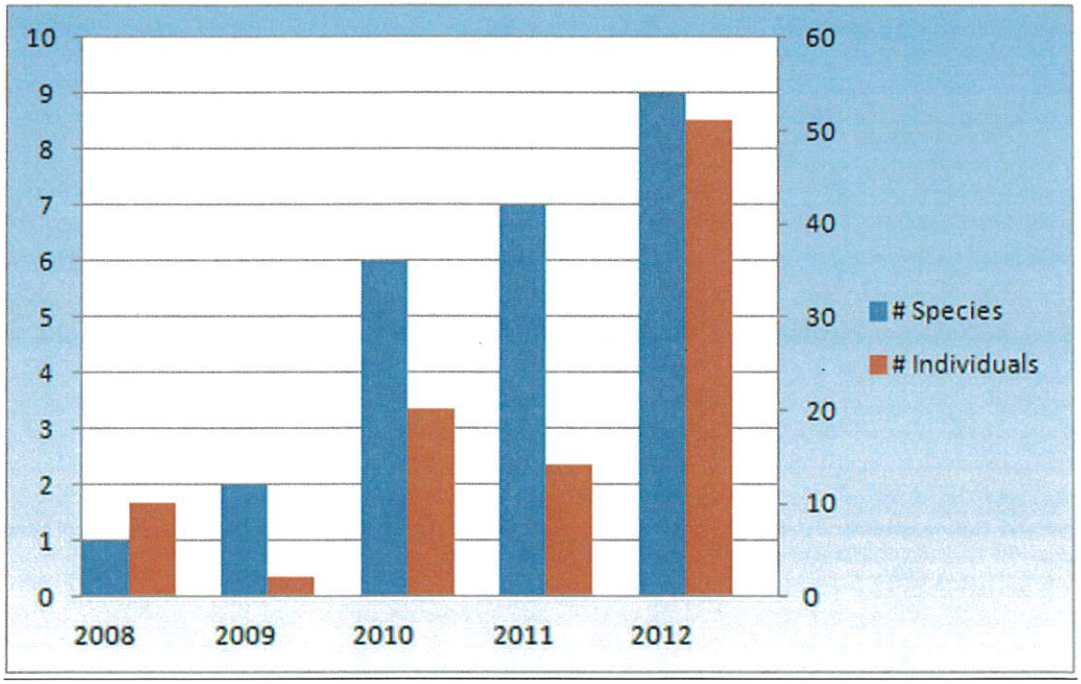

Figure 17 – Fish population improvements over time in the South Branch Bear Run (Figure courtesy SRBC)

Delisting Bear Run - 2016.

Segments of Bear Run were listed by the PA DEP as impaired for pH and metals as early as 1996. DEP with the assistance of SRBC last completed field and laboratory water quality sampling in November of 2015, sampling 13 sites. The impetus for this assessment was to collect data to accompany an application to remove Bear Run from the DEP list of impaired streams. This sampling included field collection of flow (cfs), pH, conductivity (uS), temperature (°C) and dissolved oxygen (mg/l). Bottled samples were collected for laboratory analysis and included the following parameters: pH, conductivity (uS), turbidity

(NTU), alkalinity (mg/l), acidity (mg/l), iron (mg/l), manganese (mg/l), aluminum (mg/l), sulfate (mg/l) and total suspended solids (mg/l). As a result, three segments of Bear Run (ID: 5981, 7018 and 7536) were removed from that list in 2016, totaling 3.1 miles of stream.

Indiana University of Pennsylvania Biology Department – 2017.

The aim of Cassie Graham's Master's thesis is to assess the stages of macroinvertebrate recovery from acid mine drainage (AMD) in the Bear Run Watershed. In 2017, Cassie carried out water chemistry and macroinvertebrate surveys in areas upstream and downstream of the nine treatment systems in the watershed. Data upstream and downstream of treatments are being compared to determine how effectively the treatment systems are improving the water quality, as evidenced by the biodiversity of macroinvertebrates. Furthermore, stages of biological recovery are being assessed by comparing the macroinvertebrate composition in areas where treatment has more recently been installed to areas where treatment has been occurring longer. Since AMD treatments have been implemented in phases over the last nine years, her study will assess the stages of macroinvertebrate recovery across a chronological sequence of stream remediation projects, determining which taxa re-colonize first and how quickly this occurs.

PFBC – 2017.

The PFBC recently completed electrofishing surveys in the Bear Run watershed. Two surveys were completed on Murray Run and the North Branch of Bear Run to determine if they would qualify for Class A wild trout stream status. Those surveys were highly successful and both streams were put forward to the Commissioners for Class A designation. At the time of the writing of this plan, Bear Run has been approved for Class A status. Murray Run is expected to be approved at a future Commissioners meeting.

Unique and Outstanding Values in the Watershed

The Bear Run watershed is host to the only Class A native brook trout population in Indiana County. This resource is providing the native brook trout population for recolonization of the South Branch of Bear Run and its tributaries as water quality continues to improve. The entire system is recovering from decades of abuse from abandoned coal mines and its recovery is a testament to the success and ongoing need for those types of restoration projects. As an important watershed in the headwaters of the West Branch of the Susquehanna River, Bear Run plays a crucial role as a refuge for coldwater species, especially native brook trout.

The Bear Run watershed also encompasses the only Exceptional Value (EV) stream in Indiana County. The other streams in the watershed are classified as Cold Water Fisheries (CWF), with an intention to upgrade those classifications in the future. Long term connectivity between this high quality coldwater resource and the South Branch and its tributaries by ensuring good water quality, adequate fish passage, abundant and accessible high quality fish habitat will be crucial to the health of the Bear Run watershed and ultimately, the West Branch of the Susquehanna River.

Paralleling the South Branch for most of its length through State Game Lands 174 lies an abandoned railroad grade. This grade is in fair condition with the rails pulled up and very few rail ties still in place. While the culverts that allowed the railroad line to traverse the landscape are in poor condition or nonexistent (and likely contributing sediment to the system), an organized effort by an interested organization could develop a multi-use trail that would intersect the watershed. This feature has been mentioned before in the Bear Run Restoration Plan and its sister railroad, which parallels the North Branch and still has the infrastructure in place, was a topic in the Northern Bear Run CCP. Both of these rail lines extend beyond the boundaries of the State Game Lands 174 and as a result working with numerous private landowners may be challenging. Conservation project partners, working with the PGC to move these projects forward, could certainly develop another recreational asset to this watershed.

The South Branch Bear Run watershed is also host to several PA Natural Heritage Program Natural Heritage Areas (NHAs) which offer unique habitats in Indiana County (Figure 18). In the northern portion of the watershed the Johnsonburg NHA encompasses an area of upland forest and fields which support the breeding grounds for an unnamed Species of Concern. This species requires a combination of forested and grassland habitats adjacent to deep mature forest to successfully breed. The Bear Run NHA contains habitat for at least two dragonfly species which rely on high quality, well canopied streams to survive. These species can be impacted by excessive nutrients and sedimentation, and they have habitat requirements similar to native brook trout. It's important to note the ecosystem benefits that clean, coldwater streams can have beyond obvious aquatic species like fish.

Despite its mining legacy, the South Branch watershed also holds a large number of forest patches (Figure 18). These landscape blocks are unfragmented and diverse forest areas identified in WPC's Conservation Blueprint, which is a representation of a selection of important conservation targets for protection and restoration across Pennsylvania developed in 2006.

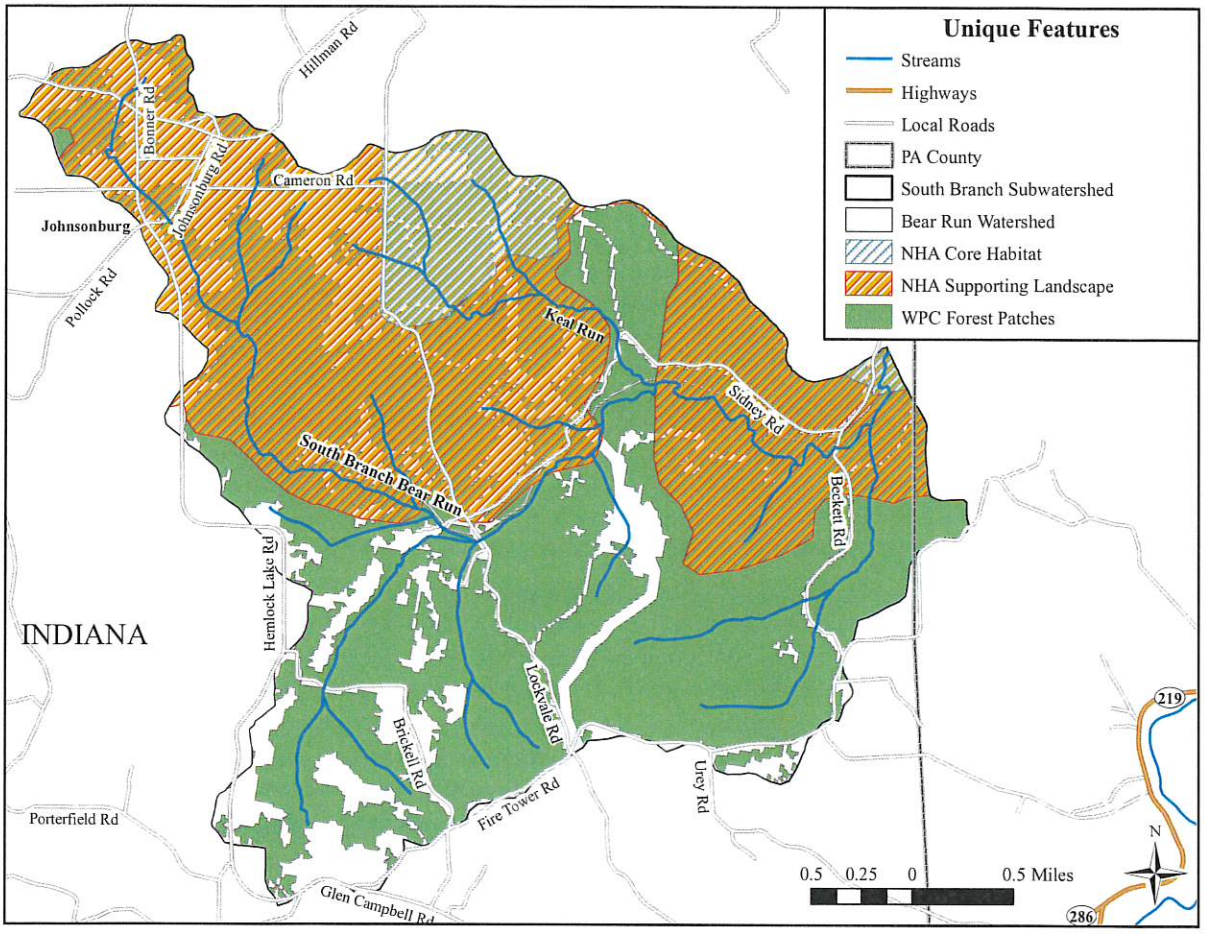

Figure 18 - Forest patches and Natural Heritage Areas identified by WPC's Conservation Blueprint.

Areas of Concern and Potential Conflict

Climate change and its associated impacts are likely to impact native brook trout and their habitat in a number of ways. Warmer temperatures and lower summer flows will increase stream temperatures and reduce habitat suitable for trout (DeWeber, 2015). This is anticipated to reduce native brook trout growth, survival and reproduction rates, and increase stress (DeWeber, 2015). It also opens a window for non-native trout and invasive species to occupy prime habitat that would normally contain native brook trout. More intense storm events could increase the rates of erosion and sedimentation which can significantly alter stream channels. Excessive sedimentation can also reduce the aquatic insect community, fill in spawning gravel with fine sediments and form large bars and blockages which inhibit fish movement (DeWeber, 2015). Higher flows in the winter will scour stream beds but also carry the added impact of destroying trout spawning redds, decreasing reproductive success. This will have an even greater impact on those populations which are on the verge of recovery or decline.

Agricultural practices which alter the stream channel or riparian areas can have negative impacts to aquatic ecosystems. Since this type of land use is most prevalent in the headwaters of the South Branch watershed, impacts such as increased stream temperatures and erosion & sedimentation are carried through the tributaries to the mainstem. Many operators are resistant to changing their methods, especially at a time when operational expenses often outweigh profits. Additionally, they may be averse to working with agencies or accepting government funding. Partnering with non-profit organizations to leverage funding and working with conservation minded operators will be necessary to develop a concerted effort towards implementing agricultural best management practices in the watershed.

Future mining (outside of re-mining and reclamation activities) in the watershed should be fairly limited, however some coal reserves remain which could be tapped for extraction. Awareness and rapid response to mining permit applications which threaten high quality streams or imperil water quality improvements in the South Branch and its tributaries are a must for concerned citizens/organizations.

Currently no unconventional gas wells are sited in the Bear Run watershed, however the abundance of shallow gas wells and pipelines indicate that those resources are present. Vigilance towards expansion of efforts to develop unconventional wells and associated infrastructure (such as water withdrawals, access roads and pipeline construction) should activity increase in the watershed will be imperative.

Recommendations and Next Steps

This Coldwater Conservation Plan has identified a number of areas for partners seeking to implement restoration projects in the South Branch Bear Run watershed. The completion of visual habitat assessment, aquatic organism passage evaluation and temperature monitoring provide valuable information for focusing those efforts. We offer the following recommendations for future potential project implementation:

Project(s)	Issue Addressed	Partners
Instream habitat improvement (including LWD additions)	Focus will be on identified reaches lacking deep pool habitat and minimal natural debris accumulation	ICCD, KSTU, PGC, WPC
Culvert replacement projects	Utilize NAACC evaluation results to strategically replace inadequate culverts	Banks Township, ICCD, KSTU, PGC, WPC
Public dirt and gravel road improvements	Improve dirt and gravel roads and crossings contributing sediment to the streams	Banks Township, ICCD, KSTU, PGC, WPC
Access road improvements	Evaluate access roads and partner with PGC and/or companies maintaining oil & gas wells	ICCD, KSTU, PGC, WPC, private landowners, resource companies
Agricultural Best Management Practices	Work with landowners/operators along the South Branch and its tributaries to implement sediment and nutrient reduction BMPs (including installation of riparian buffers)	ICCD, KSTU, PGC, WPC, private landowners
Abandoned Mine Restoration	Address remaining AMD inputs and debris piles impacting the South Branch watershed	ICCD, KSTU, PGC, SRBC, WPC
Temperature monitoring	Refine and monitor water temperature changes in the South Branch mainstem	ICCD, IUP, KSTU, WPC
Aquatic resource identification & monitoring	Continue to monitor water quality and fisheries of the South Branch, including long term monitoring sites, trout redd surveys and electrofishing surveys of tributaries	Evergreen Conservancy, ICCD, IUP, KSTU, SRBC, WPC

Of significant note is the value of Keal Run as a subwatershed within the South Branch. With the completion of mine reclamation projects, this tributary's period of cool instream temperatures in the summer, abundant habitat and existing native brook trout populations present an opportunity to develop a stronghold for coldwater conservation within the Bear Run watershed. Focused efforts on reducing sedimentation, increasing aquatic connectivity and improving instream and riparian habitat will contribute greatly to the role this stream already plays as a refuge for native brook trout and other aquatic species in the watershed.

Finally, the most important recommendation would be for the partnerships that have led to such dramatic improvements in the South Branch of Bear Run watershed continue to collaborate. This collective of organizations, each of which brings a unique aspect and contribution to the efforts in the watershed, will be the primary driver in long term coldwater projects conservation in the Bear Run watershed.

Photo 14 - A colorful South Branch Bear Run native brook trout.

Summary & Conclusion

The South Branch of Bear Run watershed has been a focus of a number of partnering organizations. Prior to the completion of this Coldwater Conservation Plan, the focus of remediating the effects of abandoned mine drainage throughout the watershed was first and foremost. The information collected for this plan provides a framework for targeted restoration and future projects. Utilizing these existing plans for holistic watershed restoration and incorporating the findings of this plan for the South Branch will enable a solid approach to ensuring the South Branch, and the entire Bear Run watershed, continues to see improved water quality, restored coldwater ecosystems and returning native brook trout populations. Extensive time and funding have been expended in the South Branch of Bear Run watershed. This work could not be completed without a cadre of dedicated agencies, organizations and individuals. It is our hope that this Coldwater Conservation Plan for the watershed will continue to push those efforts into the future.

Appendix 1 – Water Quality Data

SB = South Branch Bear Run stations

NMT = No measurement taken

Site Number	Date	pH	Conductivity	Total Dissolved Solids	Dissolved Oxygen (mgL)	Temp C
SB1	April-17	7.68	195.6	139.0	10.90	8.4
	May-17	7.19	194.3	138.0	NMT	NMT
	June-17	7.56	223.0	158.0	7.73	15.5
	July-17	7.64	227.0	161.0	8.16	19.7
	August-17	7.37	199.2	141.0	7.24	16.8
	September-17	6.95	229.0	163.0	6.86	17.2
	October-17	6.89	284.0	195.0	9.34	8.7
SB3	April-17	7.81	101.6	72.1	11.20	9.6
	May-17	7.35	104.2	74.0	NMT	NMT
	June-17	7.46	118.6	84.1	8.34	16.4
	July-17	6.55	101.0	70.5	9.43	18.0
	August-17	7.14	125.5	89.3	4.35	15.3
	September-17	8.06	109.6	77.9	8.15	14.8
	October-17	7.40	114.2	81.3	10.78	8.0
SB6	April-17	7.41	179.5	128.0	10.50	11.7
	May-17	6.91	224.0	159.0	NMT	NMT
	June-17	6.91	197.6	140.0	8.00	19.0
	July-17	7.52	181.1	128.0	9.28	19.3
	August-17	6.86	241.0	172.0	7.92	20.2
	September-17	7.01	184.8	131.0	8.10	16.3
	October-17	7.13	230.0	140.0	11.39	8.7
SB9	April-17	6.57	202.0	144.0	10.80	11.7
	May-17	7.00	251.0	179.0	NMT	NMT
	June-17	6.32	245.0	174.0	8.53	17.1
	July-17	7.65	233.0	165.0	8.82	17.5
	August-17	6.64	337.0	239.0	8.61	17.5
	September-17	7.29	235.0	167.0	8.55	15.0
	October-17	6.98	309.0	219.0	11.96	7.8

Site Number	Date	pH	Conductivity	Total Dissolved Solids	Dissolved Oxygen (mgL)	Temp C
UNT4	April-17	6.45	229.0	164.0	10.70	11.3
	May-17	5.88	229.0	162.0	NMT	NMT
	June-17	6.89	187.6	133.0	8.01	18.2
	July-17	5.77	162.1	113.0	9.20	18.5
	August-17	5.86	328.0	232.0	7.52	20.0
	September-17	6.62	189.5	134.0	7.81	15.8
	October-17	6.94	229.0	167.0	11.12	8.0
UNT5	April-17	7.36	219.0	156.0	10.40	12.2
	May-17	6.98	248.0	176.0	NMT	NMT
	June-17	7.35	230.0	163.0	7.84	20.2
	July-17	7.48	205.0	146.0	9.01	20.9
	August-17	7.45	231.0	165.0	7.80	21.4
	September-17	6.90	203.0	141.0	8.12	16.9
	October-17	6.94	243.0	172.0	11.33	9.7
KR7	April-17	6.95	52.0	37.0	10.90	11.8
	May-17	6.36	54.9	39.0	NMT	NMT
	June-17	7.78	76.2	54.1	8.42	16.3
	July-17	7.92	78.5	55.7	9.40	17.2
	August-17	6.54	104.6	74.5	5.60	16.8
	September-17	6.52	66.2	46.4	8.28	14.8
	October-17	6.52	71.2	50.3	10.80	8.8
UNT8	April-17	4.93	223.0	158.0	11.50	9.6
	May-17	4.98	237.0	169.0	NMT	NMT
	June-17	4.67	249.0	177.0	8.36	15.9
	July-17	4.48	240.0	168.0	9.60	16.7
	August-17	5.26	316.0	224.0	7.96	16.5
	September-17	5.07	286.0	204.0	8.16	14.2
	October-17	5.45	329.0	234.0	11.29	7.9

References & Citations

Argent, David G. and Patricia A Flebbe. *Fine sediment effects on brook trout eggs in laboratory streams.* Fisheries Research, 1999 253-262.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition.* U.S. Environmental Protection Agency, 1999.

Bear Run - Indiana County; Water Quality Standards Review, Stream Redesignation Evaluation Report. Report. Water Quality Monitoring Section, Division of Water Quality Standards; Bureau of Clean Water, Pennsylvania Department of Environmental Protection. PA DEP, 2016. 1-16.

Bear Run Watershed Renaissance Mine Drainage Restoration Project. Report. Susquehanna River Basin Commission. SRBC, 2013. 1-8

Cotchen, Adam. *Bear Run Watershed AMD Restoration Project.* Presentation. Indiana County Conservation District. ICCD, 2014.

Clark Jr., Thomas. *Bear Run Abandoned Mine Remediation - Watershed Renaissance Project.* Fact Sheet. Susquehanna River Basin Commission. SRBC, 2017. 1-2.

Clark, Jr., Thomas. *Bear Run Restoration Plan.* Report. Indiana County Conservation District. ICCD, 2006, 1–139.

DeWeber, Jefferson T. and Tyler Wagner. *Predicting Brook Trout Occurrence in Stream Reaches throughout their Native Range in the Eastern United States.* Transactions of the American Fisheries Society. I 44, 2015, 11-25.

Eastern Brook Trout Joint Venture. *Species Spotlight – Whitewater to Bluewater.* http://easternbrooktrout.org/groups/whitewater-to-bluewater/species-spotlight/brook-trout-salvelinus-fontinalis accessed 2018.

Indiana County Natural Heritage Inventory. Report. Pennsylvania Natural Heritage Program. PNHP, 2011. 96-98.

North Atlantic Aquatic Connectivity Collaborative. http://www.streamcontinuity.org, accessed 2018.

Northern Bear Run Coldwater Conservation Plan. Report. Western Pennsylvania Conservancy. WPC, 2006. 1-49.

Reclaiming Abandoned Mine Lands Improves Bear Run. Article. United States Environmental Protection Agency, Section 319 Nonpoint Source Program. EPA, 2015. 1-2.

Upper West Branch Susquehanna River (8B) Basin Report. Report. Pennsylvania Fish and Boat Commission, Division of Fisheries Management. PFBC, 2017 1-25.