Solomon Creek Coldwater Conservation Plan

Prepared by the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR)

"Among the numerous streams that rush from the mountain into the bosom of the majestic Susquehanna, the beautiful cascade of Solomon's Creek is well calculated to gratify the ardent admirer of the works of Nature. Surrounded with dark hemlocks, the rocks stained with moss and partially covered with laurel and other evergreens, it forms one of the finest scenes for the pencil of the painter. Dashing, foaming and working its tempestuous way down the mountain's side, it here precipitates itself, in the most romantic and picturesque manner, over a ledge of rocks into a natural basin; from which, winding beneath overhanging rocks, it passes through a narrow, perpendicular fissure which runs in a rapid and winding course to the river."

J. Cist, c. 1809

COLDWATER HERITAGE PARTNERSHIP

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The EPCAMR Staff and Volunteers:

Robert E. Hughes-Executive Director-EPCAMR

Michael A. Hewitt-Program Manager-EPCAMR

Justyna Sacharzewska & Kelsey Biondo- EPCAMR Watershed Education & Outreach Interns

Sarah-Jane Gerstman-EPCAMR Watershed Education & Outreach Intern-Wilkes University

Zachary Yodis & Dan Gilbert-EPCAMR Watershed Education & Outreach Interns- King's College

Maria Schmakov & John A. Karpien (EDSI, Inc.)- EPCAMR Community Service Volunteers

Steve Konrad- Amateur Historian Volunteer

Ed Mount Joy- Urban Explorer/Photographer/Volunteer

Ryan Lawrence-King's College EPCAMR Community Service Volunteer

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Dawson A. Hughes-Greater Nanticoke Area School District, Elementary Center Student Volunteer-6th gr.

Samantha Kutskel-**PA Trout, Coldwater Heritage Partnership**-*Program Coordinator*

PA Department of Conservation & Natural Resources

Foundation for PA Watersheds

PA Council of Trout Unlimited

Bud Cook-**The Nature Conservancy**

Tom Venesky- **Times Leader**- *Columnist*

Karen Gower-**Bear Creek Nature Camp**

Bill Williams, Jerry Capral-**PA Game Commission**

Amy Wolfe- **Trout Unlimited-Eastern PA Abandoned Mine Program**

Shawn M. Rummel, Ph.D. - Field & Research Coordinator, Eastern Abandoned Mine PG, **Trout Unlimited**

Melissa Tesauro – Intern, Eastern Abandoned Mine Program, **Trout Unlimited**

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Mike Dziak-**Earth Conservancy**-*President &CEO;* Jackie Dickman, Rick Ruggierio-**Earth Conservancy**

Ray Clarke-**Huber Breaker Preservation Society**-*Chairman of the Board & Treasurer*

Janet Sweeney-**Pennsylvania Environmental Council**-NE Regional Office-*Project Manager*

Dale W. Freudenberger-**Delaware & Lehigh National Heritage Corridor**-*Anthracite Region Coordinator*

Tom Clark-**Susquehanna River Basin Commission**-*AMD Susquehanna River Basin-wide Coordinator*

Aaron Stredny-**Luzerne Conservation District**-Watershed Specialist

Nicholas P. Lylo-**PA Department of Conservation and Natural Resources-Bureau of Forestry**-
Lackawanna Forest District-*District Forester*

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Chapter One: Introduction and Project Background

Solomon Creek Cold Water Conservation Plan (CHP) Purpose

The purpose of the Coldwater Heritage Partnership (CHP) is to provide leadership, coordination, technical assistance, and funding support for the evaluation, conservation, and protection of PA's coldwater streams. PA has over 83,000 miles of streams and 25% of them considered High Quality or Exceptional Value coldwater fisheries. Of that, less than 2% are designated as highly productive waters that contain naturally reproducing Wild Trout (Class A Streams). The CHP's primary focus is to foster protection and improvement of these streams or streams that have that potential.

The Coldwater Heritage Partnership, through the Coldwater Conservation Grant Program, awarded a **$6000** grant to EPCAMR. The grant was made possible through funding from the PA Department of Conservation & Natural Resources, the PA Fish & Boat Commission, the Foundation for PA Watersheds, and PA Council of Trout Unlimited. All of these organizations have supported data collection, analysis, conservation planning and watershed implementation project development for trout fisheries based on the assessment of representative sampled streams across PA.

The funds were used to pay EPCAMR Staff costs for planning activities, conducting the stream walks, water quality monitoring, biological and habitat assessments, travel, supplies, printing costs, postage, mailings, phone, meeting space rental, outreach materials, reference materials, and other related services to develop the Solomon Creek Coldwater Conservation Plan. EPCAMR assures that the funds were expended in accordance with ***OMB Circular A-21*** (http://www.whitehouse.gov/omb/circulars_a021_2004) and a full report of expenditures by budget category was provided at the end of the project. EPCAMR has also provided in-kind contributions, such as volunteer time, EPCAMR interns and other community service volunteer time, donated services, and other donated field equipment and use of our Geographic Information System (GIS) Technical Assistance Center that directly tied into the development of the Solomon Creek Coldwater Conservation Plan.

Coldwater Conservation Planning Grants

In addition to providing information and technical assistance, the CHP administers a grant program to develop Coldwater Conservation Plans for the purpose of conserving and protecting PA's coldwater streams. Coldwater Conservation Plans are useful in building local awareness and support for the long-term stewardship of coldwater streams and their surrounding watersheds. The plans are meant to identify potential problems and opportunities for stream conservation, habitat improvements, and may often lead to more detailed watershed studies or implementation projects, ultimately improving the health of the coldwater ecosystems. The Coldwater Conservation Plans help the community leaders of the selected watersheds to identify potential impacts, threats, problems, and opportunities to our coldwater streams. Ultimately, the Coldwater Conservation Plans allow community leaders to formulate a plan of action for proposed conservation and protection strategies while building community awareness and support for the conservation of our coldwater streams.

The Solomon Creek Cold Water Conservation Plan was initiated in the Summer of 2011, continued through the Fall of 2011, and field reconnaissance was completed during the late Spring of 2012 by two full-time EPCAMR Staff and several trained and EPCAMR certified AMD & Water Quality Monitoring volunteers, King's College interns, and two elementary school students. In the Summer 2012, follow up work was also conducted by the EPCAMR Staff and a two-day electro-shocking survey on 12 selected sites within the Solomon Creek Watershed and completed by Trout Unlimited's Eastern Abandoned Mine Program, at the request of EPCAMR, under a Abandoned Mine Drainage (AMD) Technical Assistance Grant (TAG). The request was approved by Amy Wolfe-Trout Unlimited's Eastern Abandoned Mine Program Director and under the supervision of Shawn M. Rummel, Ph.D. - Field & Research Coordinator, Eastern Abandoned Mine Program and Field Intern Melissa Tesauro. The field reconnaissance was very ambitious and worth the time spent in the field to see the beauty and the beasts that the watershed had to offer.

Robert E. Hughes, EPCAMR Executive Director, has authored the narrative portion of this Solomon Creek Cold Water Conservation Plan, with Michael A. Hewitt, EPCAMR Program Manager, completing the majority of the geographic information system mapping (GIS), data management, data analysis, and relational database attribute completion, with assistance from Justyna Sacharzewska, EPCAMR Watershed Education & Outreach Intern. The majority of the stream walk surveys into each of the headwater tributaries, unnamed tributaries, higher order named streams, and the main stem of Solomon Creek, were conducted and assessed by Dan Gilbert and Zach Yodis-King's College student interns with EPCAMR, Ryan Lawrence-student and EPCAMR Community Service volunteer, and Robert E. Hughes. Michael A. Hewitt, Justyna Sacharzewska, John A. Karpien, Paige Karpien, Ricky Ruggerio, and Dawson A. Hughes also completed other smaller stream sections within the Solomon Creek watershed.

Kelsey Biondo, EPCAMR Watershed Outreach Specialist Intern assisted during the Summer 2012 on the electro-shocking survey. Bob Kent, an EPCAMR community service volunteer and donor to EPCAMR, also assisted on one day of our electroshocking survey in the headwater portions of the Solomon Creek, where he was very familiar with the terrain due to his avid fly fishing activities in these tributaries. Sarah-Jane Gerstman, EPCAMR Watershed Outreach & Education Intern from Wilkes University assisted with the preparation of the macro-invertebrate worksheets, visual habitat assessment sheets, water quality and other data management elements of the Solomon Creek Coldwater Conservation Plan. EPCAMR believes it has shown how significant use of partnerships can lead to a Coldwater Conservation Plan that will ultimately produce priorities and strategies that will produce positive implementation projects and recommendations for the Solomon Creek Watershed and its fisheries.

EPCAMR's recent efforts have resulted in the most comprehensive narrative and pictorial report on the natural resources of the Solomon Creek watershed. Our work is based on research from various secondary data sources, historical research, historical mine mapping, master plans, open space and greenway plans, land use plans, economic redevelopment plans, GIS analyses, and preliminary results from EPCAMR's original exhaustive environmental water quality, visual habitat assessment, fishery survey, and biological macro-invertebrate sampling data.

In addition to EPCAMR's data, other sources of water quality data from the Susquehanna River Basin Commission's ***Total Maximum Daily Load (TMDL) Report*** (http://www.epa.gov/reg3wapd/tmdl/pa_tmdl/SolomonCreek/SolomonCreekAL_DR.pdf) for the Solomon Creek watershed was cited to complement EPCAMR's data collection. An in-depth analysis of the TMDL Report for Solomon Creek will not be covered directly in the Plan; however, it is included in **Appendix A**.

EPCAMR's report contains a thorough inventory of the natural resources of the watershed—surface water and groundwater, geology, hydrogeology, ecology, and biota—as well as detailed information on the culture, history, demographics, and economy of communities within the watershed. The report also provides an overview of past environmental management, reclamation activities by the Earth Conservancy, US Army Corps of Engineers, Northampton Fuels Generating Company, EPCAMR, the Huber Breaker Preservation Society, and the PA Department of Environmental Protections' Bureau of Abandoned Mine Reclamation, and other assessments performed in the Solomon Creek watershed.

EPCAMR's environmental sampling program targeted **46** stream segments as an exploratory study of streams in the Solomon Creek watershed. **33** of those stream segments were sampled for macro invertebrates. EPCAMR staff has walked nearly all of the unnamed tributaries within the Solomon Creek watershed. Each tributary drains to other unnamed or named tributaries and higher order named stream designations downstream to the main stem of Solomon Creek, eventually reaching the mouth at the Susquehanna River below the Wyoming Valley Levee Pumping Station in Hanover Township, south of the Wyoming Valley Sanitary Authority.

Another **12** fish sampling locations were electroshocked and surveyed for absence/presence of fish species in the late Summer, early Fall 2012, following our August 10, 2011 Request for Technical Assistance from PA Trout Unlimited. Dr. Shawn Rummell and his Field Intern Melissa Tesauro, assisted EPCAMR Staff, the Luzerne Conservation District Watershed Specialist-Aaron Stredny, and volunteers with this fieldwork on September 27th and 28th, 2012. PA Trout Unlimited provided EPCAMR with the results of our collective fishery survey to include as **Appendix B** to this Coldwater Conservation Plan to assist with our future recommendations on what implementation projects and recommendations for improvements to the fishery habitat in the Solomon Creek watershed.

Because of the electroshocking fish survey, new insights were revealed about how far the trout are migrating along Solomon Creek towards the mouth of the Susquehanna River. The survey will also answer some questions posed by regional PA Fish & Boat Commission Aquatic Biologists. They pondered whether or not trout have remained isolated above the abandoned mine land areas and those reaches polluted by abandoned mine drainage (AMD) in the lower reaches of the watershed, such as the AMD seepage in Carey’s Patch, the Inman AMD borehole, the Huber AMD seepage located on Jim Doran’s property, Solomon Creek AMD Boreholes in South Wilkes-Barre, and where the Buttonwood/Nottingham Shaft AMD discharges into the main stem of Solomon Creek in Hanover Township, in Buttonwood. The electro-shocking survey helped EPCAMR to identify which tributaries and stream sections within the watershed either are meeting their original designations or if there is a need to request that they be changed.

Some lengths of streams and unnamed tributaries were actually lost to the local underground mine pool complexes throughout the watershed, in what are called “losing reaches” of streams, which consequently, exacerbated the abandoned mine drainage (AMD) impacts that were found in the lower portions of the watershed that will be discussed further in the narrative report. Other lengths of streams and unnamed tributaries encountered showed blockages, woody debris dams, check dams, historic concrete dams, flood debris dams, failing septic systems, pipe runoff, stormwater pipe runoff, coal ash cinder sedimentation, raw sewage discharges directly into Solomon Creek, and massive sedimentation deposits of gravel bars, point bars, and pools filled with sand sized particles of sediments at numerous locations throughout the watershed.

EPCAMR and the Coldwater Heritage Partnership (CHP)

The Eastern PA Coalition for Abandoned Mine Reclamation staff and volunteers conducted the Solomon Creek Cold Water Conservation Plan. EPCAMR was assisted by multiple State Agencies, including the PA Fish & Boat Commission, PA Game Commission, PA Department of Conservation and Natural Resources, PA Trout Unlimited, support from other regional non-profit environmental organizations, field technicians, engineers, and King's College and Wilkes University student interns. The combined effort and collaborative coalition partnership resulted in the development and completion of the Solomon Creek Coldwater Conservation Plan.

The grant that awarded was accompanied by endorsements from the Appalachian Coal Country Team (ACCT), a national partner with EPCAMR and an initiative and of the Office of Surface Mining and AmeriCorps Volunteers in Service to America (VISTA), the Appalachian Regional Commission (ARC), the Environmental Protection Agency's (EPA) Office of Wetlands, Oceans, & Watersheds (OWOW), the Park Foundation, the Norcross Wildlife Foundation, the Kettering Foundation, the Earth Conservancy (EC), a not-for-profit corporation that supports conservation and land revitalization in the Wyoming Valley-Luzerne County, the Huber Breaker Preservation Society (HBPS), the Delaware & Lehigh National Heritage Corridor, Inc.(D&LNHC), and the Pennsylvania Environmental Council's (PEC) NE Office.

The main objective of the Solomon Creek Coldwater Conservation Plan is ***to provide a foundation for the management of the coldwater stream ecosystems in the Solomon Creek watershed***, located in the Wyoming Valley, Luzerne County, PA. The Plan compiled available information on designated Solomon Creek sub watersheds having documented, anecdotal, actual visual identification, Quality Assured/Quality Controlled (QA/QC) stream monitoring of flora and fauna, and or electro fishing of **12** stream segments to identify the abundance of naturally reproducing native brook trout populations. Other fish species within the watershed were surveyed as well to determine transition zones of the various types of fisheries contained within the watershed and to serve as a way to possibly remove stream segments from the Federal List of Impaired Waters. Section 303(d) of the Clean Water Act requires states to list all impaired waters not supporting use, even after appropriate and required water pollution control technologies have been applied.

Trout Waters Classifications

Streams with Pennsylvania Department of Environmental Protection (PA DEP) special protection status in the watershed were selected for study, including streams designated by the PA DEP as containing naturally reproducing trout populations, preferably Class A Wild Trout streams or streams with high potential to become Class A (www.fish.state.pa.us/waters_trout.htm). Other designations include, Approved Trout Waters, Special Regulation Areas, Wilderness Trout Streams, High Quality Coldwater Fisheries (HQ-CWF) and Exceptional Value Coldwater Fisheries (EV-CWF). A link to Geographic Information System (GIS) data layers can be found on the PA Spatial Data Access (PASDA) Clearinghouse site (http://www.pasda.psu.edu).

Approved Trout Waters

These waters have significant portions that are open to public fishing and are stocked with trout by the PA Fish and Boat Commission.

Class A Wild Trout Streams

These are streams that support a population of wild (natural reproduction) trout of sufficient size and abundance to support a long-term and rewarding sport fishery or streams being considered for wild trout designation. The PA Fish and Boat Commission do not stock these streams. ***2.6 miles*** within the Solomon Creek Watershed from the headwater flowing from Solomon Gap downstream to Pine Creek have this designation as a native brook trout fishery. This area can be found on the Wilkes-Barre East and West USGS Topographic Quadrangle Maps in Hanover Township, Laurel Run Borough, and Bear Creek Township, Luzerne County, PA northeast of Solomon Gap, perpendicular to State Route 309, and to the east of Pine Run Road, along Haystack Mountain.

Special Regulation Areas

These are areas where waters that have tackle, harvest or other restrictions. There are a number of different regulation categories. Generally, these waters can be fished year-round. There are ***none*** of these areas in the Solomon Creek Watershed.

Stream Sections that Support Natural Reproduction of Trout

These are stream sections supporting naturally reproducing populations of trout. A wild trout stream section is a *biological designation* that does not determine how it is managed; therefore, the PA Fish and Boat Commission may also stock these streams with hatchery trout. These sections can also be considered for wild trout designation. Pine Creek, a major tributary to Solomon Creek from its headwaters down to the mouth of Solomon Creek (***Lower Latitude Limit: 41.196945, Lower Limit Longitude: -75.89447***) has this designation. Another section of Solomon Creek (***Lower Latitude Limit: 41.23444, Lower Limit Longitude: -75.91664***) main stem from its headwaters down to Division Street in the City of Wilkes-Barre, also has this designation.

Wilderness Trout Streams

Wilderness trout stream management is based upon the provision of a wild trout fishing experience in a remote, natural and unspoiled environment where man's disruptive activities are minimized. Established in 1969, this option was designed to protect and promote native (brook trout) fisheries, the ecological requirements necessary for natural reproduction of trout and wilderness aesthetics. The superior quality of these watersheds is considered an important part of the overall angling experience on wilderness trout streams. Therefore, all stream sections included in this program qualify for the Exceptional Value (EV) special protected water use classification, which represents the highest protection status provided by the PA Department of Environmental Protection (PA DEP). There are **no** planned designations or areas considered for this category in the Solomon Creek watershed.

The PA Code: Title 25, Chapter 93: Drainage List K (Section 93.9k) Susquehanna River Basin

The designated Water Uses and Water Quality Criteria for the stream segments within the Solomon Creek Watershed from the ***Chapter 93 Water Quality Standards*** are listed below. With respect to hydrological order, the numbers appearing on the left-hand column of the drainage lists represent stream entries to aid in identifying hydrological order: 1 identifies the most downstream hydrologic order; 2 is tributary to 1; 3 is tributary to 2, and so on and so forth.

CWF	***Cold Water Fishes***—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.
MF	***Migratory Fishes***—Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which move to or from flowing waters to complete their life cycle in other waters.

2—Solomon Creek	Basin, Source to Pine Creek	Luzerne	HQ-CWF, MF
3—Pine Creek	Basin	Luzerne	CWF, MF
2—Solomon Creek	Basin, Pine Creek to Mouth	Luzerne	CWF, MF

To qualify as a High Quality (HQ) or Exceptional Value (EV) Water, a stream has to meet several criteria spelled out in the PA Code (http://www.pacode.com/secure/data/025/chapter93/s93.4b.html). EPCAMR has added additional stream segments to the total stream miles within the Solomon Creek watershed that are not drawn on the PA DEP's "smallshed's GIS Layer, last updated in 2012. These additional miles were walked and surveyed during our stream walk assessments throughout the watershed.

4.11 miles of additional streams that were not on the Chapter 93 survey list were surveyed, stream walked, discovered and added to this report. **Table 2-1** lists and **Figure 4-5** shows their location.

EPCAMR Sampling & Monitoring Design for the Solomon Creek Coldwater Conservation Plan

The sampling design for the Solomon Creek Cold Water Conservation Plan was intended to yield data for a general condition assessment of the quality of the streams in the Solomon Creek watershed. The results of the sampling was to be used for future improved fishery habitat potential, trout stream restoration, public and private accessibility availability, and improvement of water quality from impairments caused by woody debris blockages, severe streambank erosion, sedimentation, illegal dumping, suspected illicit wildcat sewer discharges, storm water discharge areas, and several abandoned mine drainage (AMD) discharges and stream channel restoration improvement recommendations.

EPCAMR's Quality Assurance and Quality Control involved several indicators. Data were collected on **6** stream condition indicators: **Visual Stream Habitat Assessment scores**, **EPA Rapid Bioassessment Protocol (RPB)** (http://water.epa.gov/scitech/monitoring/rsl/bioassessment/index.cfm), **benthic macro invertebrate sampling**, **stream temperature**, **fish community surveys** (electroshocking) conducted by PA Trout Unlimited, under an AMD Technical Assistance Grant (TU AMD TAG), a **complete photo-essay** of each tributary from their headwaters to confluence with other headwaters or higher orders streams, and water quality sampling at various seasonal flow conditions for various chemical parameters related to acidification due, primarily believed to be correlated with acid rain deposition, flooding, and abandoned mine drainage. Many of the headwater first order streams were found to be infertile due to the local geology and the lack of calcareous rock formations that might otherwise provide additional alkaline addition to the tributaries, however, a few higher order tributaries did contain native brook trout populations and other fish species further downstream when confluences with additional higher ordered stream segments were combined. These sections are discussed further in the report where EPCAMR was surprised to find the abundance of native brook trout in the aforementioned sections.

Benthic MacroInveterbrate Community Sampling Methods

Benthic macro invertebrates were assessed according to the EPA Rapid Bioassessment Protocol for Benthic Macro invertebrates as described in the **EPA Volunteer Stream Monitoring Methods Manual** (EPA, 1997) (available from http://www.epa.gov/volunteer/stream/stream.pdf) at **33** sample sites within the watershed. The surveys were completed at various dates throughout the past year. Specific dates of samples are listed respective of their stream under the stream by stream analysis. http://www.envco.info/d-net-506.html; http://www.dynamicaqua.com/streamsampling.html

Sampling was conducted within a riffle, an area of one square meter was surveyed using a 3' square kick net with a mesh size of approximately 500 microns. One or more members of the EPCAMR Staff or volunteers held the kick net in place while other team members overturned rocks upstream of the net to dislodge macro invertebrates. The team members kicked the rocky bottom for 5 minutes as well as used their hands to collect as many aquatic insects and allow them to be carried into the net by the current. Once collections were completed, macro invertebrates were sorted, counted, and identified.

Most of the existing historical environmental reports and assessments for streams in the Solomon Creek watershed focused on the remediation and restoration of abandoned mine drainage (AMD) impacted sections within the watershed. In addition, and complementary to these efforts, EPCAMR's Solomon Creek Coldwater Conservation Plan focuses on the less impacted, high-quality streams in the watershed, with the goal being to highlight the exceptional water resources still abundant in a watershed heavily impacted by historical mining activities and ways to improve the overall stream health and biological integrity and diversity of the watershed.

However, as the reader reviews each of the sections of streams and tributaries that are included in the Chapter 4 photo-essays, one will find EPCAMR comments in the captions of those reaches that in addition to describing the section briefly, will recommend a particular course of action that should be taken in the near future as a part of an implementation project, stream bank restoration project, trout habitat improvement project, stream-side cleanup, illegal dump site cleanup, woody debris removal, tire removal project, or floodplain management project, pending funding availability.

EPCAMR Community Planning Process

EPCAMR's original plan for community involvement was to hold several meetings within the Solomon Creek watershed once the initial thorough stream walks, water quality, and biological assessments were completed. Following the initial announcement of the grant, the EPCAMR Executive Director instead decided to call community leaders personally, from each of the municipalities located within the Solomon Creek Watershed after sending out an initial e-mail correspondence detailing the scope of work and for the project and our willingness to keep an open line of communications with each of the municipalities.

EPCAMR informed each of them about the grant award, explained the goals of the plan completion, and notified them to let their local police departments know that our EPCAMR Staff, Interns, and Community Service Volunteers, would be walking in waders, wearing orange vests or EPCAMR Staff shirts, backpacking, and conducting field stream surveys at some point throughout the year within their communities to conduct the thorough assessment.

EPCAMR Staff also took the time and opportunity to stop and talk to dozens of residents, business owners, and homeowners that were met along our travels in the watershed to explain to them what the purpose of our stream walks were for and why we were conducting the assessment within the Solomon Creek watershed. Many of those landowners, business leaders, and homeowners were interested in our final product and some were even willing to provide volunteer services and permission to access their property for future restoration efforts, should any funding become available.

EPCAMR Staff directed the people that we encountered to look EPCAMR up on ***FaceBook*** (www.FaceBook.com/EPCAMR) and online at (www.epcamr.org) to stay up to date on each of the sections that we were assessing. EPCAMR Staff had put up albums of our daily stream walks throughout the watershed for people to view at their leisure through a virtual experience without having to walk the streams themselves and took full advantage of the social media available to us to reach a wider audience in the Solomon Creek watershed.

EPCAMR Staff and volunteers wear safety orange EPCAMR Staff shirts while surveying and monitoring the streams in the field, as well as had our EPCAMR Scientific Collector's Permit and Fishing Licenses with a Trout Stamp, purchased from the PA Fish and Boat Commission. Our EPCAMR Staff shirts sure came in handy during hunting season. Our next step was to gather any existing natural resource materials, reference documents, existing plans, historical reports, and historic mine maps of the watershed.

A Solomon Creek Conservation Plan draft public meeting was held in the November 30, 2012. Comments were taken at that time from the public and residents who live in the watershed once they had a chance to hear EPCAMR's overview presentation, view pictures of the entire watershed and read over the draft plan. Plans were mailed on CD to all **9** municipalities within the watershed that have been supportive of the development of the Solomon Creek Coldwater Conservation Plan for comment.

EPCAMR believes that the Final Solomon Creek Coldwater Conservation Plan will be an excellent tool and resource that municipal road departments, zoning offices, and Planning Commissions can use. During the public meeting, EPCAMR incorporated comments and followed up with any questions or concerns that residents or the public had about the draft plan in order to revise it and create the Final Solomon Creek Coldwater Conservation Plan.

Chapter Two: Description of the Watershed

Topography and Geology of the Northern Anthracite Coal Fields

The **18.2** square mile Solomon Creek watershed is located within the Northern Anthracite Coal Field and the Anthracite Valley Section and includes **26.66** miles of streams (***See Table 2-1***). The Solomon Creek watershed is situated within the Anthracite Valley Section of the Ridge and Valley Province, where **17** mineable seams of Anthracite coal can be mined. The elevation of the Solomon Creek watershed ranges from approximately **2148'** in the southeastern portion of the headwaters of Solomon Creek on top of Haystack Mountain, near the radio towers to approximately **560'** at the western outlet of the watershed in Hanover Township, near Lynnwood, and just south of the Wyoming Valley Sanitary Authority, in the floodplain of the Susquehanna River, on the river side of the Wyoming Valley Levee System. Solomon Creek is approximately **8.5** miles long. Solomon Creek currently has **3** officially named tributaries listed in the "PA Gazetteer of Streams" (PA DER, 1989): Pine Creek, Sugar Notch Run, and Spring Run. The watershed can be found on the ***USGS 7.5" Wilkes-Barre East*** and ***Wilkes-Barre West*** Topographic Quadrangles Maps.

Table 2-1 List of Chapter 93 and Unlisted Stream Miles by Sub watershed

Sub Watershed	Chapter 93 Stream Miles	Unlisted Stream Miles	Total Stream Miles
Solomon Creek (Mouth)	4.60	2.82	7.42
Spring Run	2.48	0.45	2.93
Sugar Notch Run	3.46	0.00	3.46
Pine Creek	7.68	0.00	7.68
Solomon Creek (Headwaters)	4.33	0.84	5.17
All Solomon Creek Watershed	22.55	4.11	26.66

The watershed is located within Luzerne County in Northeastern Pennsylvania and covers **9** municipalities, including Ashley Borough, the City of Wilkes-Barre, Hanover Township, Wilkes-Barre Township, Laurel Run Borough, Bear Creek Township, Fairview Township, Rice Township, and Sugar Notch Borough. The majority of the watershed lies in Hanover Township, Ashley Borough, Laurel Run Borough, and Wilkes-Barre Township (***See Figure 2-1***).

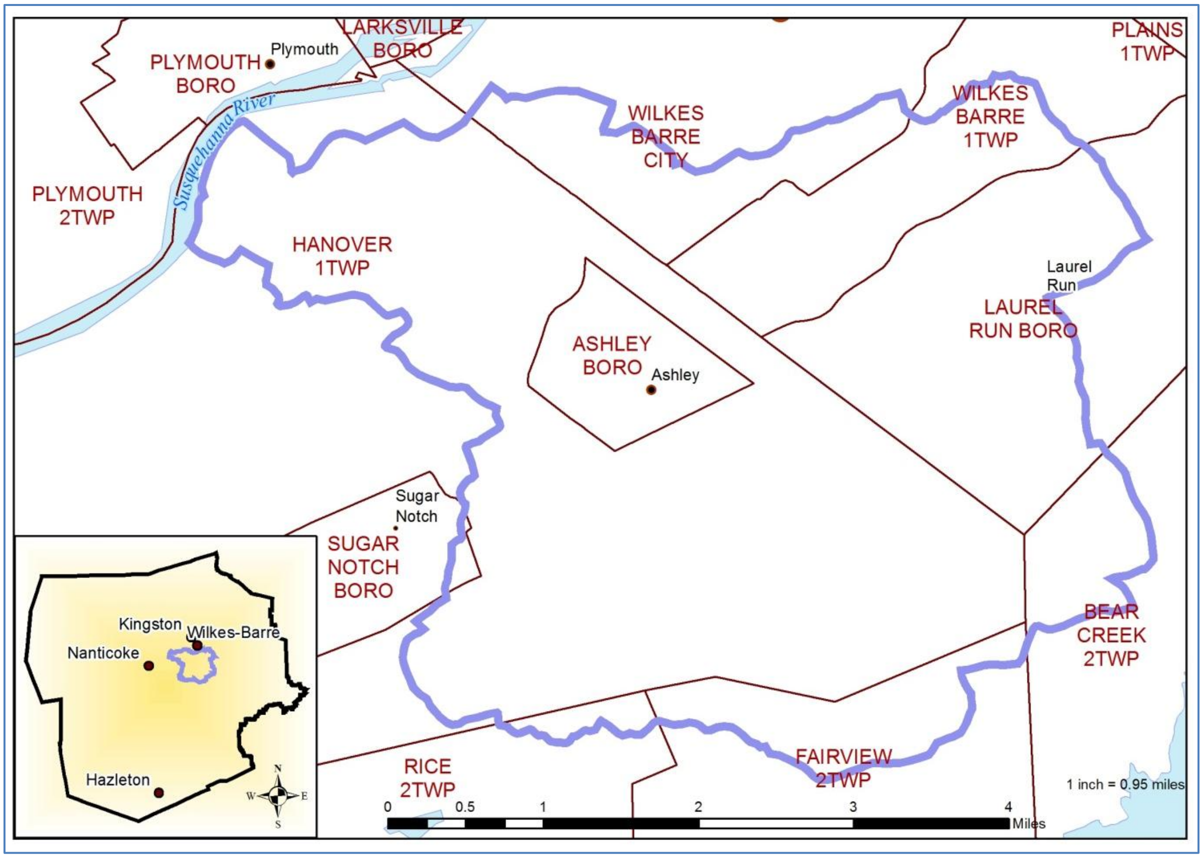
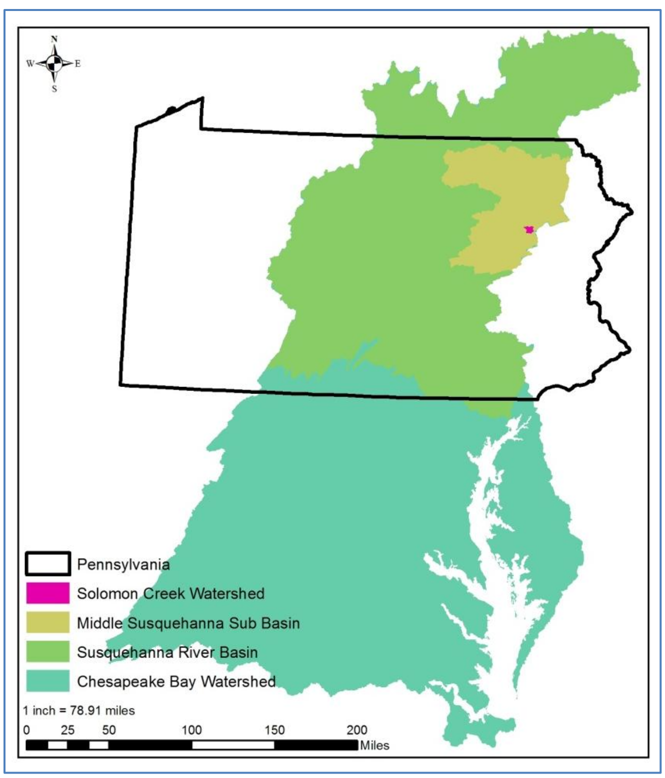


Figure 2-1 (Above) Municipal Boundaries in the Solomon Creek Watershed



The Solomon Creek watershed drains to the Susquehanna River, which drains into the Chesapeake Bay. (***See Figure 2-2***). The Susquehanna River Basin makes up half of the greater Chesapeake Bay watershed that spans **64,000** square miles across **6** states and the District of Columbia (Penn State University, 1996). An estimated **11,562** acres lies within the Solomon Creek watershed.

Figure 2-2 (Left) Location of the Solomon Creek Watershed within the Chesapeake Bay Watershed

The Commonwealth of PA owns a portion of the land in the Solomon Creek watershed that is public land managed as State Game Land and State Forest Land (***See Figure 2-3***). State Game Land 207 is located in the southwestern portion of the watershed and covers about **6.7%** of the watershed and **779** acres. The Pennsylvania Game Commission (***Figure 2-4***) manages the State Game Lands 207. In Wilkes-Barre Township, several contiguous tracts of the Lackawanna State Forest Land are located in the northeastern portion make up about **12.6%** of the watershed and **1463** acres. One tract is located in the Spring Run sub watershed to the west of State Route 309 that is also a part of the Lackawanna State Forest tract. The Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry manage the State Forest Lands. The Earth Conservancy is estimated to hold almost as much land as State Forests and is typically placed in the PA Game Commission Cooperative.

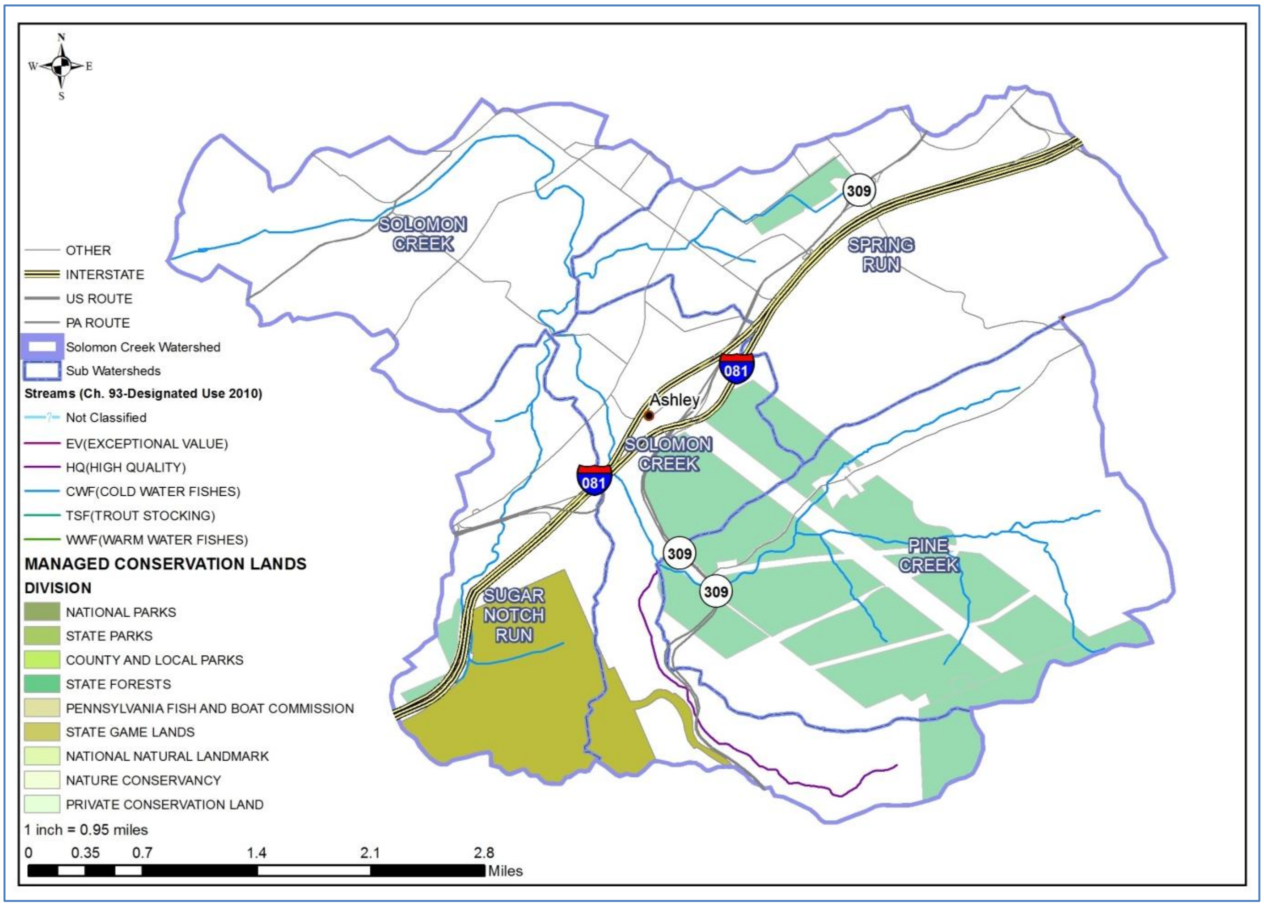


Figure 2-3 Overview Map of the Solomon Creek Watershed

Details on the PA State Game Lands #207 maintained by the PA Game Commission

Location:	Mountain Top, PA
Address:	Heslop Road and Brown Street
Description:	Conservation Land
Access:	Limited pull-off parking areas on Heslop Road, off PA Route 309 on the old railroad grade (Brown Street)
Watershed:	Upper Susquehanna Watershed, Solomon Creek sub-watershed
Boundaries:	North: Interstate 81 and Sugar Notch
South:	Boyle Pond, Beaver Dam Swamp, and Pole Bridge Swamp areas
East:	Haystack Mountain
West:	Interstate 81
Landscape Character:	Wooded Penobscot Mountain. Access is limited to fire roads, trails, and non-motorized vehicles. Wooded ridge top steeply sloping to wetlands and ponds created by glaciers.
Size:	2,073.50 Acres Total (1,430 Acres in Rice Township)
Level of Maintenance:	Low

Facilities (Existing):

(1) Unimproved road
(1) Old rail road grade trail
(2) Designated nature trails
(3) Water bodies (lakes/ponds)
Hunting and trapping areas
(Unimproved Road Access Area, West)

Soils:

ASF - Arnot Rock outcrop complex, steep 25+% slopes, very dark brown flaggy silt loam, loose stones with boulders covering 3-40% of surface, rock outcrops common, has rapid runoff, and natural fertility is low. Depth to bedrock 1 foot, depth to high water table >3 feet, suitable for woodland, wildlife habitat and esthetic uses due to steep slopes

ArD – Arnot Rock outcrop complex, 8-25%, very dark brown flaggy silt loam, loose stones with boulders covering up to 30% of surface, medium runoff, natural fertility is low. Depth to bedrock 1½ feet, depth to high water table >3 feet, suitable for woodland, wildlife habitat, and esthetic uses due to steep slopes restrictions.

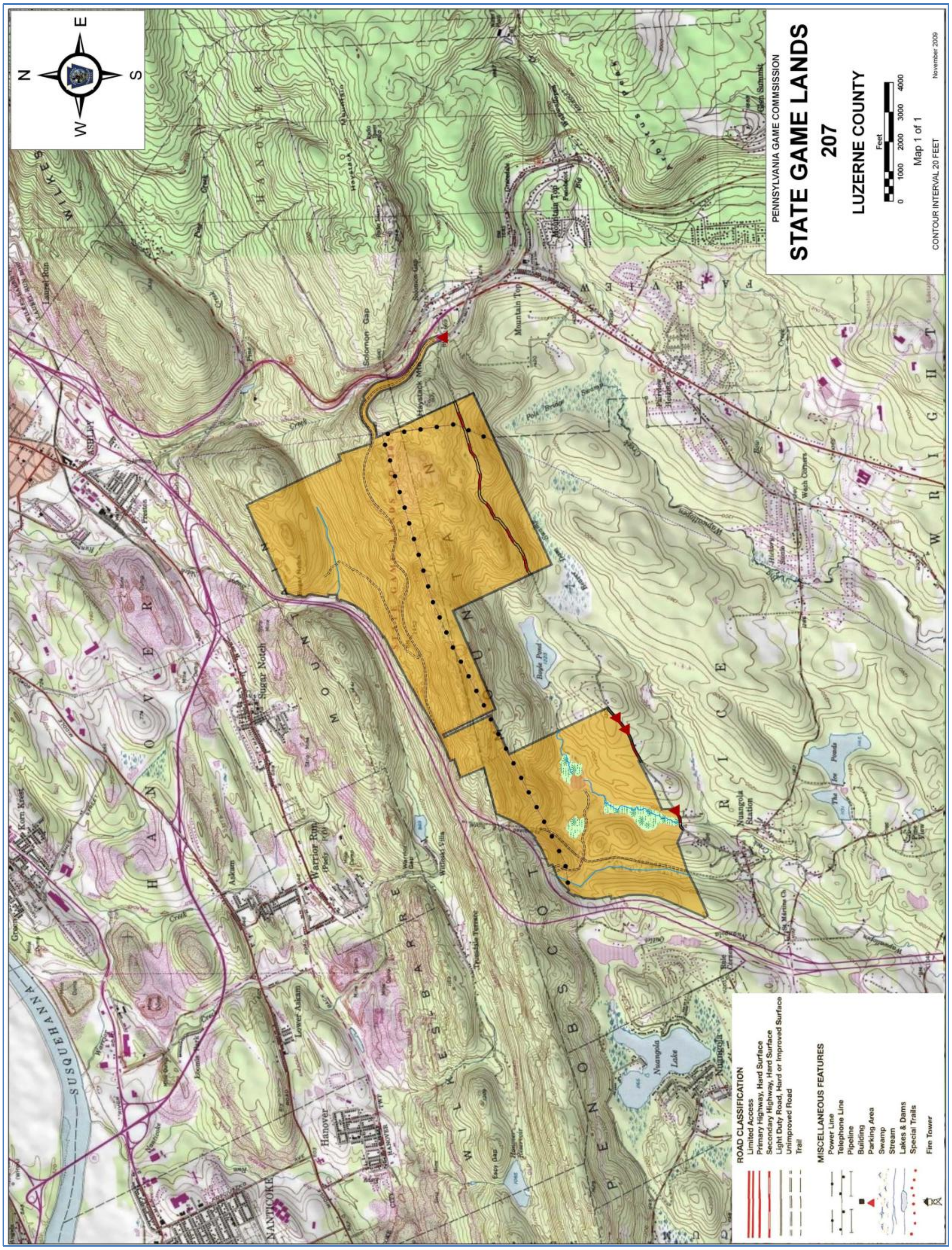


Figure 2-4 PA State Game Lands 207

The birth of Pennsylvania Coals (anthracite and bituminous) are time equivalent at about 250-400 million years ago, but the Anthracite coals are higher rank due to being subjected to higher temperature and pressure (i.e. metamorphism) during the mountain building episodes of the Ridge and Valley Ridge Physiographic Province (***See Figure 2-5***).

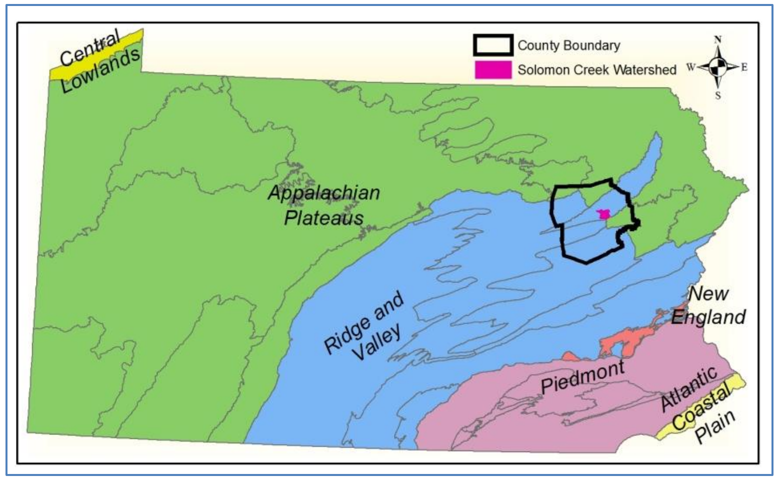


Figure 2-5 Location of the Solomon Creek Watershed within the Ridge and Valley Province

The Solomon Creek Watershed is situated within the Anthracite Valley Section of the Ridge and Valley Province (***Figure 2-6***).

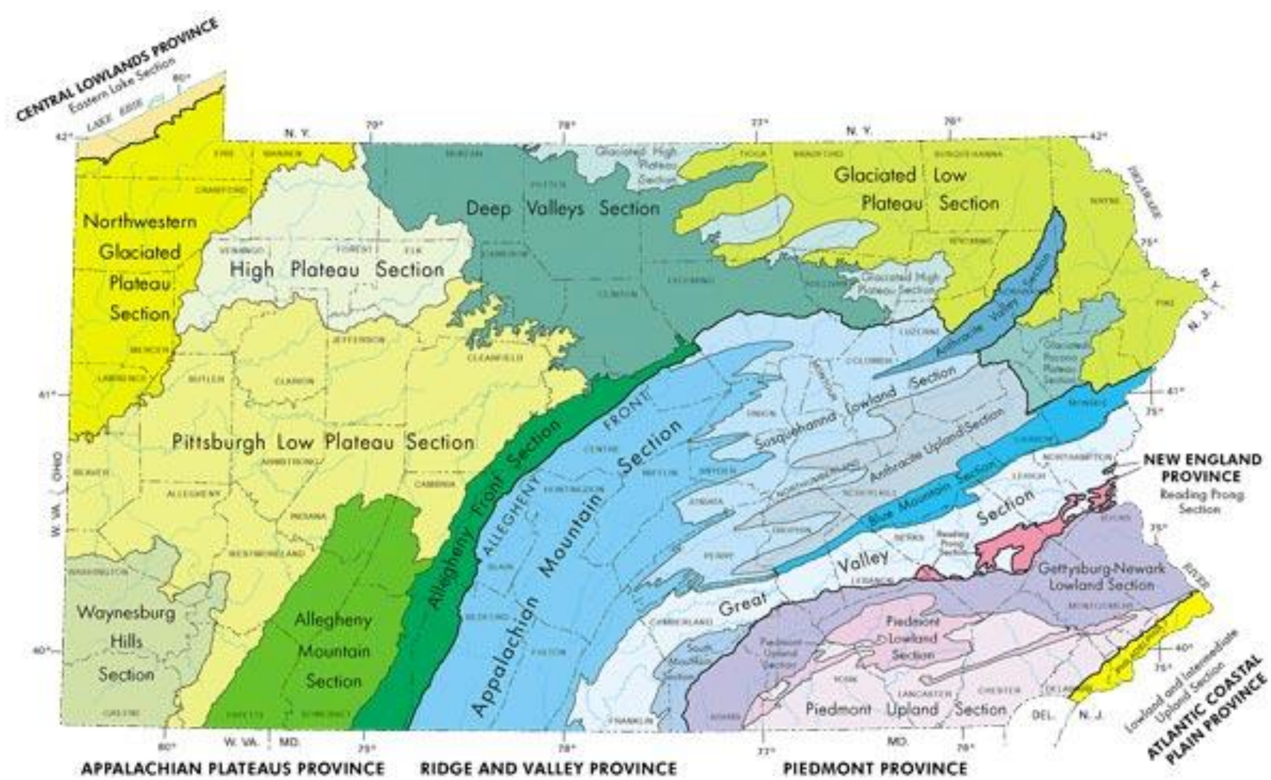


Figure 2-6 The Physiographic Provinces and Sections of PA (PA DCNR, 2011)

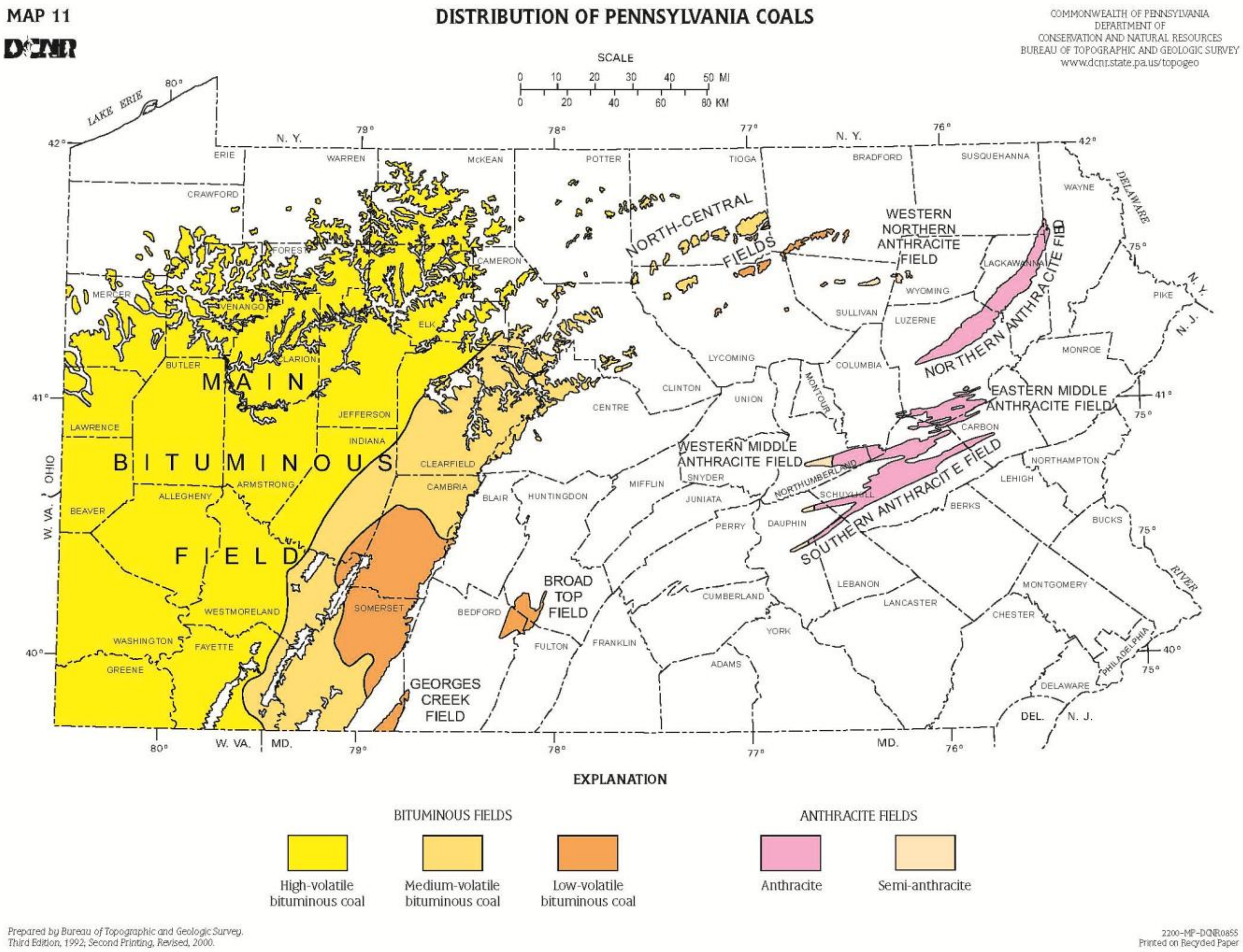


Figure 2-7 PA Distribution of Coal Fields (PA DCNR, 2011)

The geologic structure of the **4** main Coal Fields of the Anthracite Coal Region as shown on (***Figure 2-8****)* consist of one or more deep, steep-sided synclinal basins. Coal veins exhibiting dip in excess of 60 degrees have been measured in some of the Anthracite Coal Fields while others have been completely overturned and fold back on themselves. About **40** coal beds can be found, somewhat thicker than those in the Bituminous Region. Underground mining was the main extractive method when significant mining started in the 1820's, but open-pit mining expanded in the 1970's, and by the 1990's, nearly all production was by surface strip mining. The estimated reserve recoverable by conventional mining methods is **1.505** million tons (The Geology of PA, 1999). Material deposition of pre-historic swamps, flora, fauna, and peat beds were deposited that eventually transformed to Anthracite coal. This occurred during the Carboniferous Geologic Period. At that time, most of PA was a flat, hot, moist plain covered with steaming swamps thick with tall trees and wide spreading ferns. The Anthracite Coal Region is located in the Anthracite Valley Section, portions of the Susquehanna Lowland Section, Anthracite Upland Section, and portions of the Blue Mountain Section, of the Ridge and Valley Physiographic Province.

The Anthracite Coal Region of eastern Pennsylvania occupies portions of 7 counties **(See Figure 2-8)**. The Anthracite Coal Fields extend 50 miles east to west and 100 miles north to south covering around 484 square miles. About 7 billion tons of coal have been taken from the eastern PA Anthracite Fields since 1769, and an estimated three times that amount remains in the ground. This Anthracite mining industry is small today and may never revive. The remaining coal is deep underground, under water, and very expensive to extract (Van Diver, 1990).

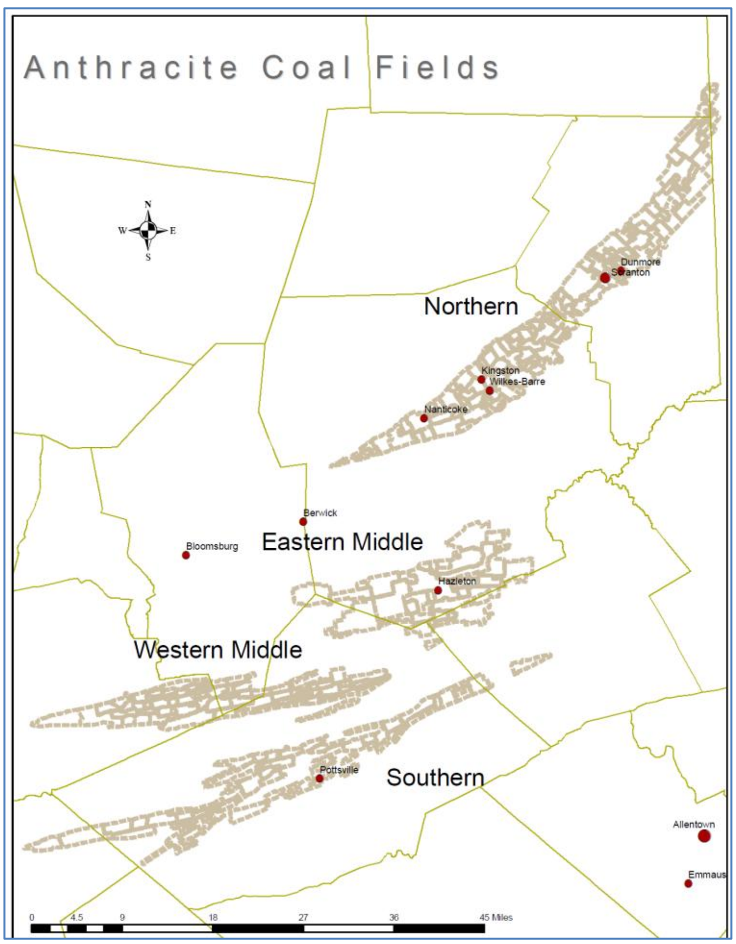


Figure 2-8 The Four Anthracite Coal Fields (Hughes & Hewitt, 2012)

Between Mile Marker 161 and 163 Mile Marker along I-81, the north and southbound lanes separate widely, along opposite sides of Penobscot Mountain, which consists of the Pocono Formation. This is the northern limb of the Berwick Anticline, which is also the southern limb of the Lackawanna Syncline. The southbound lane traverses the dip slope of the ridge where Pocono beds slope 30-50 degrees toward the highway and are prone to sliding. The next lower ridge, is Wilkes-Barre Mountain, along Sugar Notch, within the Solomon Creek watershed. Here one can see red shales, sandstones, and siltstones of the Mauch Chunk Formation and beyond the notch, Pottsville beds. All beds dip north into the Lackawanna Valley. Strip mines are prominent from the Interstate. Coal companies worked the seams in the Llewellyn beds in the center of the Wyoming Valley and in the Pottsville Formation up the sides of the Valley (Van Diver, 1990).

The Northern Anthracite Coal Field is divided into two major "canoe-shaped" basins, the Lackawanna Basin in the northeastern half, and the Wyoming Basin, where Solomon Creek is located, in the southwestern half (***See Figure 2-8***). The valley has irregular to linear hills and is enclosed by steep sloped mountain rims (PA DCNR, 2000). The hydrogeology of the Lackawanna Basin is described in (Hollowell, 1975) and the hydrogeology and movement of subsurface water through rocks and the effect of moving water on rocks, including their erosion of the Wyoming Basin is described in (Hollowell, 1974). These two ***Water Resources Reports of the Pennsylvania Geologic Survey***, prepared in cooperation with the then PA Department of Environmental Resources and the Branch of Environmental Affairs-Wilkes-Barre Field Office, United States Bureau of Mines provided much valuable information on the mine water resources of the Northern Field. The two reports also included detailed information on the underground mine pool complexes and hydrogeology associated within the Solomon Creek watershed.

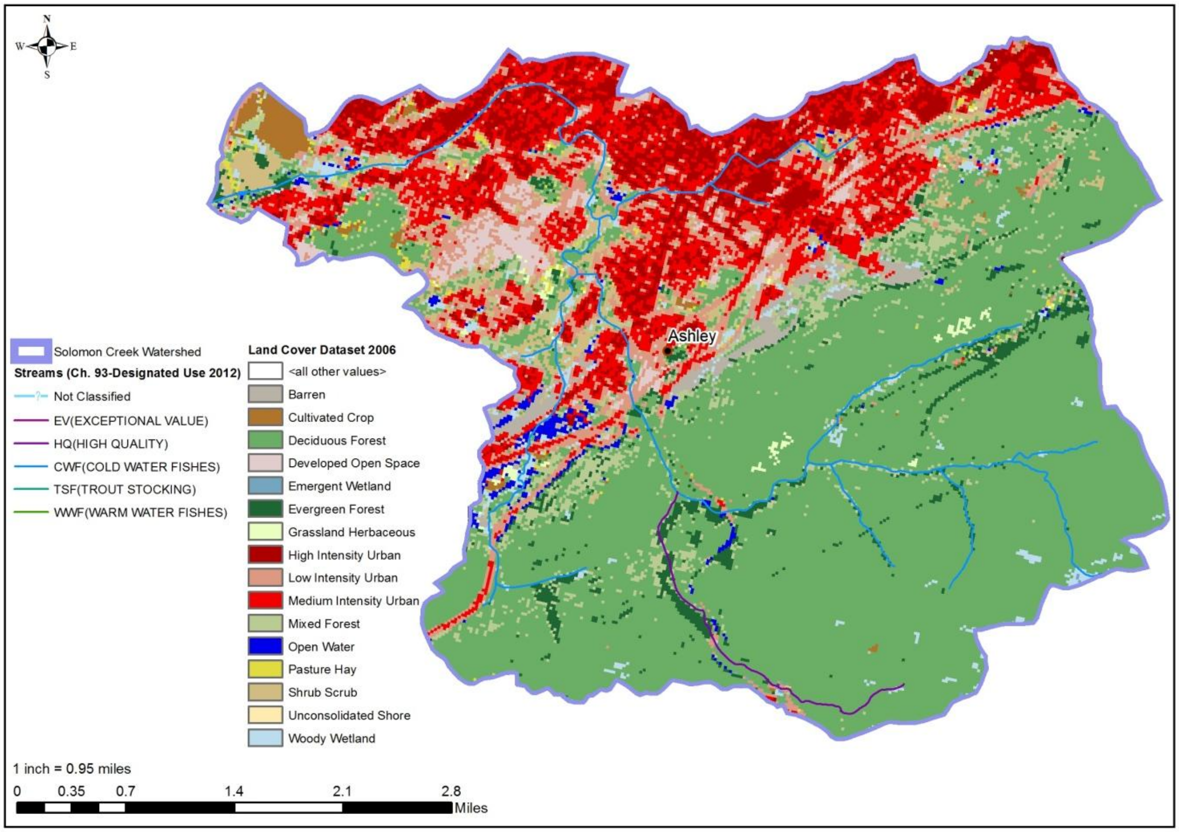


Figure 2-9 Land Cover Map of the Solomon Creek Watershed (Penn State University, 2006)

Table 2-2 Comparison of Land Uses of the Solomon Creek Watershed and the TMDL Reference Watershed.

Landuses	Solomon Creek (acres)	Abraham Creek (acres)
Hay/Pasture	509	1,527
Cropland	336	1,391
Forest	6,748	5,651
Wetland	77	25
Quarry	215	25
Coal Mines	64	12
Turf Grass	22	3
Unpaved Road		7
Transition	492	237
Low Intensity Development	1,839	1,774
High Intensity Development	1,174	180
Total	11,475	10,833

The Solomon Creek watershed is more than **50%** deciduous forest with some evergreen forest riparian corridors, woody wetlands, shrub scrub, and mixed forest in the majority of the headwaters streams, including eastern Hemlock, White Pines, White Oaks, Birches, Quaking Aspens, and Green Ash. Another **45%** is High Intensity Urban, mostly in the City of Wilkes-Barre, with a mix of Medium and Low Intensity Urban development in the borough of Ashley, and the townships of Hanover and

Wilkes-Barre. A small portion, less than **5%**, is cultivated crop down along the mouth in the floodplain areas of the Susquehanna River in the western portion of the watershed (***See Figure 2-9 & Table 2-2***).

Much of the watershed's headwaters reflects the rugged terrain and glacial deposition from the last Wisconsonian glacial episode that encounters the rigid Mauch Chunk formation that intersects Interstate I-81 near Sugar Notch Run's headwater first order tributaries and form State Route 309 north through the Solomon's Gap on the main stem of Solomon Creek. This area lies among the rolling mountains on the western end of the Pocono Plateau. The Catskill and Pocono Formations have infertile sandstones that dominate and quartzite conglomerates are throughout the headwater streams that results in soils with low pH and relatively infertile stream water quality characteristics. Sevon (1969b), Epstein and others (1974), designated the dominant gray and olive gray rocks in Northeastern PA as components of the Pocono Formation. The Spechty Kopf Formation includes both of these groups of rocks and is dominantly sandstone. However, siltstone, shale, conglomerate, polymictic daimictite, pebbly mudstone, laminate, and Anthracite coals are other components. The sandstone, siltstone, and shale are mostly medium gray to olive gray. Most of the sandstones are trough cross-bedded, but some planar bedding is present. The Spechty Kopf is separated from the underlying Catskill Formation by a disconformity, and it may be separated from the overlying Pocono Formation by a disconformity as well (Wood and others, 1969; Epstein and others, 1974; Edmunds and others 1979). There are no alkaline limestone seams within the geology of the Solomon Creek watershed. Along the northern edge of the mountains lie a narrow band of shales and sandstones of the Mauch Chunk Formation.

The further down the watershed, as one enters the Spring Run sub-watershed to the north and the Sugar Notch Run sub-watershed to the southwest, one encounters the limits of the Anthracite Coal measures that were surface mined and deep mined historically in the Llewellyn Formation. It is in these areas that past mining has altered the flow and direction of the stream channels entirely. The Llewellyn Formation includes all rocks in the Anthracite Region above the base of the Buck Mountain coal vein (Red Ash). Conglomerates and sandstones dominate.

Areas where Anthracite coal seams have outcropped to the surface were mined sometimes leaving cropfalls several hundred feet deep into the underground mine workings, particularly along the northeast side of I-81 running from Wilkes-Barre Township, west of Laurel Run Borough, all the way south, to Ashley and Sugar Notch Borough, in the Sugar Notch Run sub-watershed, just above the Hanover Youth Recreational Sports Complex on Preston Road. Many of these vertical cropfalls were backfilled and reclaimed during the reclamation and construction of the Hanover Youth Recreational Sports Complex by the Earth Conservancy. The further down in the watershed one goes, they will encounter beneath the roads and streets within the watershed alluvial soils that run across the entire Wyoming Valley's floodplain areas.

As will be discussed, several tributaries have been severely impacted by past mining practices. Under the Wyoming Valley floor are rocks of the Pottsville Formation and post-Pottsville Formations, which consist of shale, sandstone, conglomerates, and all of the minable anthracite seams. The Pottsville Formation is approximately 50-60% cobble and pebble conglomerate and conglomerate sandstone, 25-40% sandstone, and 10-20% finer clastics and coal. Most of the Formation consists of fining-upward alluvial cycles. Pottsville rocks are mostly light gray to black. The Pottsville is entirely non-marine (The Geology of PA, 1999).

Population in the Solomon Creek Watershed

Luzerne County has approximately **320, 918** people from almost every nationality and background from around the country. Population had been decreasing since the 2000 US Census by 2.7% between 1990 and 2000. In 2010, Luzerne County's population has increased slightly from the **318,564** in 2000. While it is expected that an increase in population of 25% is expected in the Scranton-Wilkes-Barre-Hazleton Metropolitan Statistical Area (MSA) based on a transition in the regional economy from the industrial to the service sector, it is expected to have little impact on the population of the older floodplain communities located within the Solomon Creek watershed. People may move into the older stock homes and some redevelopment will occur where newer subdivisions are created, however they tend to be out of the floodplain and in other communities that are not as built out.

There is no direct population data for the Solomon Creek watershed from the 1990 US Census, but estimates based on the number of residential structures in the flood plain (**928**) and the average number of persons per household (**4.6**) as reported by the 2000 US Census, it can be reasonable to infer that there are about **4,269** residents living within the watershed. The watershed also registers a very high proportion of residents over the age of 65.

Baseline and Socio Economic Conditions of the Solomon Creek watershed is in the ***Solomon Creek Flood Protection Project Feasibility Report*** (Borton-Lawson Engineering, June 2004) attached in **Appendix C.** Another great resource published by the Institute for Public Policy & Economic Development, the ***Lackawanna & Luzerne County Indicators Report*** (IPPED, May 2011) details reliable research based on best practices to make smart decisions related to county-wide interests and impacts as defined by impacting a significant portion of the local population. This report in **Appendix D** as a digital document file that is included on the DVD.

Water Resources Background

The following section provides an overview of surface water quality regulations in Pennsylvania, then reviews the major impacts and influences on water quality in Solomon Creek watershed and recent regulatory actions affecting streams in Solomon Creek. Further information is provided on the hydrologic characteristics of the watershed and the impacts of past mining activities, abandoned mine drainage (AMD), flooding, and acid deposition from rainfall and dry deposition—including sections on the relevant water quality parameters and pollutant loading and seasonal effects. These sections are meant to serve as background for a discussion of the surface water sampling results presented in the streams assessment section. Following the sections on water quality are a background of fisheries management in Pennsylvania and a description of the coldwater fisheries in the Solomon Creek watershed, specifically the trout streams in the watershed. Also included is a section on the effects of acid deposition and flash flooding on trout.

Pennsylvania Surface Water Quality Regulations

In compliance with the federal Clean Water Act of 1972 and through the state enabling legislation Clean Streams Law of 1937, Pennsylvania law regulates surface water quality under Title 25 of the Pennsylvania Code, Chapter 93, Water Quality Standards. Within this section, water bodies, including lakes, rivers, and streams are assigned designated uses by the Pennsylvania Department of Environmental Protection (PA DEP) based on their water resource use by humans and their biological and physical characteristics as habitat for aquatic organisms.

In Pennsylvania, these designated uses are categorized as ***Aquatic Life Use***, ***Water Supply***, and ***Recreational Use***. These designated uses form the basis upon which water quality criteria are developed. Streams are then evaluated to determine whether their water quality are within the relevant criteria (in attainment and meeting a designated use), or whether they violate the criteria (impaired, not attaining, and not meeting a designated use).

All streams that would naturally contain living organisms qualify for an ***Aquatic Life Use*** designation as the most basic designated use. Designations under Aquatic Life Use are based on the type of fish habitat the stream can support such as ***Cold Water Fishery***, ***Warm Water Fishery***, or a stream habitat that is ***Trout Stocked***. Under ***Water Supply***, there are sub-designations that include *Potable*, *Industrial*, or *Livestock Water Supply*. Designations under ***Recreational Use*** include *Boating* and *Fishing* and *Scenic designations* (**PA DEP 25 Pa. Code § 93.3.***).*

Once designated, actions that affect water quality, such as permitting discharges, require that the uses, and level of water quality necessary to protect that use, be maintained and protected by the PA DEP (**PA DEP 25 Pa. Code § 93.4c.***).* In turn, if a discharge permit is requested, before the permit is issued the PA DEP takes into consideration the designated protected use of the stream to determine if the discharge will alter the stream quality.

The purpose of these designations is to establish baseline water quality standards that are to be maintained in the face of multiple possible pollution discharges. Under the Federal Clean Water Act of 1972, point source discharges into waters of the United States are illegal without a National Pollutant Discharge Elimination System (NPDES) permit (**33 U.S.C. §§ 1342**). Based on stream designations, related water quality standards are taken into account when issuing point source discharge permits. Furthermore, these water quality standards are used in efforts to restore impacted streams in the TMDL process discussed below.

In keeping with Pennsylvania Code and Section 303 of the Clean Water Act of 1972, once streams have a designated use, the PA DEP is required to monitor water quality and establish an inventory of streams either attaining or not attaining their designated use. From this inventory, streams out of attainment are listed on an ***Impaired Streams List*** known as the ***303(d) List*** (based on Section 303 of the Clean Water Act). Pollutant loads that are impacting the stream are then re-evaluated and reduced loads are required based on calculations that will allow for the stream to return to its designated use. This numerical reduction of a pollutant load is known as the *total maximum daily load* (*TMDL*). Once the 303(d) List of Impaired Waters and TMDLs have been prepared, Pennsylvania must submit this information to the EPA and include reasonable assurance that the reduced load allocations will be met (**33 U.S.C. §§ 1313**).

A working plan for how the PA DEP will achieve this and other requirements under the Clean Water Act is known as the *Continuing Planning Process* (*CPP*) and must be established and maintained by all states which have primacy (the authority from the EPA to develop their own water quality regulations in accordance with federal mandates). However, the EPA administrator in Region III, Philadelphia, is responsible for periodically reviewing and approving the adequacy of the state's CPP which ensures that states fulfill the requirements of the Clean Water Act ***(*§ 303e**). These plans can include environmental actions that could lead to the improvement of the water quality through activities and recommendations that are suggested in this Solomon Creek Coldwater Conservation Plan by EPCAMR, the public, and our partners.

Pennsylvania DEP applies **Exceptional Value (EV**) or **High Quality** (**HQ**) special protection status to water bodies having outstanding water quality or other characteristics, which allow them to meet certain qualifying factors. The EV or HQ designation is added to the original designated use of the stream (***CWF***, ***WWF***, ***Trout Stocked***) to make, for example, an EV-CWF designation. Further protection through increased attention in management and permitting is afforded for an EV or HQ stream to ensure that the stream's quality is not degraded due to human actions.

The designation of Exceptional Value (EV) to a stream affords the greatest protection, and the High Quality (HQ) status is afforded to streams at the next highest level of quality, or streams of outstanding but somewhat lesser quality. This is one good reason for private property owners who live along stream segments within the Solomon Creek watershed to allow EPCAMR to conduct the stream assessments to further protect the streams adjacent to or that flow through their property. EV streams must have a score of at least 92% of an ideal reference stream, and HQ-streams must score at least 83%, according to PA DEP biological streams assessment. Class A Trout Streams, those streams with very high wild trout biomass as determined by the PA Fish and Boat Commission, also qualify for EV or HQ protection as described in the Fisheries Resources section of this Plan.

Exceptional Value protection is not always simply a reflection of the ecological condition or water quality of a stream. Special protection designation is also a management tool that can be afforded to streams through public policy decisions, regardless of biological assessments. For instance, all PA Fish and Boat Commission-designated ***Wilderness Trout Streams*** (*listed at* http://fishandboat.com/trout_repro.pdf) are automatically considered for HQ and EV status by the PA DEP as a result of a 1969 legislative act designed to protect trout streams in respectively pristine, undeveloped, roadless areas in Pennsylvania. In addition, all streams that flow through state or federally protected natural or wilderness areas are afforded EV protection, regardless of their quality. Unfortunately, there are **no** Wilderness Trout Streams in the Solomon Creek Watershed.

Streams qualify for these special protections for a variety of different reasons. Generally, a stream may be designated EV or HQ if determined through state agency evaluations to have excellent water chemistry, biology, or the ability to support naturally reproducing wild trout populations (**PA DEP 25 Pa. Code § 93.4b**). The chemistry qualifier is based on meeting the state water quality criteria for at least 99% of the time for at least one year of data for various parameters, including dissolved oxygen, temperature, pH, and others. *(See* http://www.pacode.com/secure/data/025/chapter93/s93.4b.html). The biology qualifier is based on the PA DEP's integrated benthic macro invertebrate scoring, which integrates five different benthic macro invertebrate metrics. Samples are collected and identified according to the EPA's modified Rapid Bioassessment Protocol (*Barbour et al., 1999*) and the following metrics are calculated for a subsample of the collection: ***Taxa Richness***; ***modified EPT Index***; ***modified Hilsenhoff Biotic Index*** (HBI) ; ***Percent Dominant Taxon*** (PDT) ; and ***Percent mayflies***.

Taxa Richness is the total number of taxa (genera or species) present in the sample.

Modified EPT Index is the total number of individuals in pollution-intolerant Orders Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddis fly) relative to the total number of individuals in the sample with pollution-tolerant EPT Orders, scores above five, excluded.

Modified Hilsenhoff Biotic Index (***HBI***) values range from 0 to 10, with higher values indicating greater tolerance or poorer conditions.

Percent Dominant Taxon (***PDT***) is the proportion of individuals in the dominant taxon to the total number of organisms in the sample. A sample site with an intolerant PDT indicates a higher-quality site than one with a tolerant PDT.

Percent mayfly is the proportion of individuals in the Orders Ephemeroptera to the total number of organisms in the sample.

Although specific criteria do exist for EV and HQ protection, streams are evaluated on a case by case basis to determine whether they deserve EV or HQ protection—subjective professional judgment of agency scientists as well as objective sampling data are used in the evaluation. The PA DEP ultimately has the discretion to determine the relevant attributes to be considered in granting EV or HQ protection.

Case-specific ecological or recreational values as well as agency management objectives can all come into play during the evaluation and redesignation process. EPCAMR assures the reader that our sampling data used in the development of the Solomon Creek Coldwater Conservation Plan were objective and unbiased.

Once a stream has qualified for a special protection designation and is listed in the Pennsylvania Code, it is protected in that PA DEP regulation does not permit uses along the stream that would lead to any degradation of the stream quality. These so-called anti-degradation designations additionally protect water quality through the discharge permitting process by requiring the evaluation of non-discharge alternatives, using the best pollutant control technologies, or showing that discharges will maintain and protect the existing water quality (**PA DEP 25 Pa. Code § 93.4c.**). A stream with HQ-CWF designation would be regulated to ensure that water quality stays within the criteria for a Cold Water Fishery and does not diminish as a result of impacts from nearby human activity.

In this way, the management of fisheries and surface water quality regulation are integrated. The water quality criteria are set according to the designated use of a stream as aquatic habitat for trout, and regulations ensure that those water quality criteria are met so that the stream's water is kept within the conditions tolerable for trout.

Hydrologic Characteristics

Solomon Creek begins near a reservoir east of Solomon Gap that flows in a northwesterly direction along its main stem through Solomon Gap, near Mountain Top, PA along Lehigh Street, under the railroad grade, and then beneath N. Mountain Road, otherwise known as State Route 309. Solomon Creek then flows along the old Ashley Plane, parallel to State Route 309 Northbound, thorough some heavily forested areas before joining up with the Pine Creek sub-watershed that flows in a westerly direction from Hanover Township, off of Haystack Mountain, parallel to Pine Run Road, until it meets up with Solomon Creek just above the Pine Run Reservoir before heading west into Ashley Borough behind Bentley's. Solomon Creek then reaches Ashley Borough, along S. Main Street and parallel to the old Ashley Planes, along Plane Street. Yet another sub-watershed tributary, Sugar Notch Run, flows in a northeasterly direction from above the Interstate I-81 Southbound lanes, north towards the Hanover Township Youth Recreational Complex, off S. Preston Road, and then along South Main Street at the end of town, behind the Preston Hose Company, over towards the abandoned pump house that fed the Huber Coal Breaker, and then under the rail road grade towards Carey's Patch, before combining with the main stem of Solomon Creek, along Ashley Street, near the Ashley Fire Hall.

At the same location, just upstream of where Sugar Notch Run comes in, Spring Run, yet another sub-watershed that flows periodically, (only when storm flows or heavy rainfalls occur) from the far eastern portion of the watershed that flows down from Laurel Run, Georgetown, and Wilkes-Barre Township, near Highland Park Boulevard. Much of the surface water is lost to vertical crop falls that parallel Interstate I-81 Northbound, along business State Route 309, and in previously abandoned strip mining pits that are now stormwater basins for businesses and industries along Highland Park Boulevard. Stormwater and stream flows that enter these areas eventually reach the underground mine workings and flow towards the South Wilkes-Barre Boreholes, behind the San Souci Highway, just east of St. W. Mary's Road, where abandoned mine drainage is spewing forth into Solomon Creek from this discharge point all the way to the Susquehanna River. A recent measurement by the EPCAMR Staff with a Swoffer Flow meter back on May 21, 2012, measured a flow of **18,000** gallons per minute from the three boreholes.

Solomon Creek makes its way through Buttonwood and picks up additional loadings of abandoned mine drainage contamination from the Buttonwood Shaft, just north of Breaker Road, that conveys mine pool water from the west side of the Wyoming Valley over to the east side to drain into Solomon Creek, before making its way in a westerly direction towards the Wyoming Valley Levee Flood Control Station, just south of the Wyoming Valley Sanitary Authority, where it's confluence with the Susquehanna River is located. A recent measurement by the EPCAMR Staff with a Swoffer Flow meter back on May 21, 2012, measured a flow of **8,900** gallons per minute from the Buttonwood shaft. Historical flow data is attached in the **Appendix E** compiled by the Susquehanna River Basin Commission that shows a mix of data parameters that have been collected since the mid 1960s through 2004, including periodic flow measurements.

The ephemeral stream channel then flows west towards E. Northampton Street, through some abandoned coal lands and then on to S. Empire Street confined to a trapezoidal concrete channel down to the intersection with Moyallen Street, before making its way through the Mayflower section of Wilkes-Barre, along Stanton Street, meandering parallel to New Frederick Street, beneath Blackman Street, where it picks up another first order unnamed tributary that flows down from the ridge behind Allan's Scrap Yard, and between Corgan's Industry, parallel to Allan's Road and Johnson Street. Much of this landscape is also historically abandoned mine lands. This unnamed tributary then crosses business Route 309 and flows in a westerly direction towards the confluence with Spring Run near the intersection with Blackman Street and New Frederick Street. Spring Run then meanders back to Ashley Borough, crossing McLean Street, under Hazle Street, along Spruce and Gilligan Street, continuing in a westerly direction towards W. Liberty Street, until it comes to the confluence with yet another ephemeral tributary locally known as Sulfur Run.

Sulfur Run begins around the intersection between Hazleton Street and Old Ashley Road. Much of the water flows down through highway drainage pipes and culverts between Interstate I-81 and business State Route 309. Sulfur Run then flows in a northwesterly direction behind the Ashley Little League Fields, towards E. Newport Street, and then over towards Conyngham Street before flowing under the rail road grade, across S. Main Street, along Manhattan Street, through St. Leo's park lot and then on to a buried culvert system in Ashley Borough, a gabion basket channel section, a railroad tie channel section culvert along W. Hartford Street, and through one home's basement along Ashley Street before coming to the confluence with the main stem of Solomon Creek behind Ashley Auto. Spring Run is yet another sub-watershed that rarely has a base flow condition due to the headwater streams being lost to areas where past mining practices were extensive in the Laurel Run area, Georgetown area, and Wilkes-Barre area, along S. Empire Street.

Another smaller unnamed tributary flows from St. Mary's Road towards Lee Park, locally named the Lee Park tributary by the EPCAMR Staff, flows along Lee Park Avenue west towards Keith Street, before entering the main stem of Solomon Creek, along the Sans Souci Highway, just a few hundred feet above where the Solomon Creek AMD boreholes enter into the main stem. Much of this headwater tributary area is captured in stormwater pipes that bring in under the St. Mary's Cemetery, and directs it towards another abandoned mine drainage seep, known as the Inman borehole discharge that is located just northeast of the Countrywood Estates along S. Main Street. The mine discharge and piped unnamed tributary that flows under the St. Mary's Cemetery combine in a stormwater culvert at a dip along S. Main Street, before being piped over around a housing development over towards behind Boland Avenue, in Lee Park, where it flows parallel to Boland Avenue before coming into confluence with the Lee Park tributary. These tributaries of Solomon Creek are first through third order perennial and ephemeral streams. Currently, there are **no** operable USGS Stream flow gauges working in the watershed.

The historic low flow readings of the Solomon Creek for the only period of record that could be found from 1941-1988 showed the following based on a gage that was historically located along the Division Street Bridge #3, in South Wilkes-Barre (**Reference Gage #01537500**) and monitored by the US Geological Survey for the PA Department of Environmental Protection (***See Figure 2-10***). The gage was operable from January 1940 through September 1990 that has provided some historical flow data within the watershed for nearly 50 years, however it doesn't capture the last 22 years worth of stream flows and the changes to the stream channel since that time, including some major flooding episodes.

Low-Flow Statistics for Pennsylvania Streams

Developed by the U.S. Geological Survey for the Pennsylvania Department of Environmental Protection

Pennsylvania Low-Flow Statistics - Query Results

LOW-FLOW STATISTICS

[All flow statistics in cubic feet per second (ft^3/s)]

Mouse over or click on table headings to view definition of statistic

STREAM NAME: Solomon Creek **GAGE OR BRIDGE SITE:** gage **REFERENCE GAGE:**[1] 01537500	**COUNTY:** Luzerne **USGS QUAD:** Wilkes-Barre West **STATION NAME:** Solomon Creek at Wilkes-Barre, PA	**LATITUDE:** 411339 **LONGITUDE:** 755417 **DRAINAGE AREA (sq. mi.):** 15.7

Entire Period of Record [2]	$Q_{1,10}$	$Q_{7,10}$	$Q_{30,10}$	MEAN	MEDIAN	HARMONIC MEAN
1941-88	0.21	0.38	0.54	18.9	11.4	3.32

FLOW DURATION TABLE (Probability of Exceedance)										
P5	P10	P20	P30	P40	P50	P60	P70	P80	P90	P95
56.1	40.2	27.8	20.2	15.0	11.4	8.40	6.40	4.50	2.40	1.20

1 Reference Gage indicates which USGS gage was used in the computation of lowflow statistics for the specified locations
2 Period of Record for climatic year, April 1 through March 31
3 Period of record refers to pre-regulation conditions
4 Period of record refers to post-regulation conditions
*** Statistic not computed due to insufficient data

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Figure 2-10 Low Flow Statistics for PA Streams: Solomon Creek Gage

Sub watersheds of Solomon Creek were broken down into **3** major sub-basins and **2** portions of the Main Stem of Solomon Creek (Upper and Lower) (***Figure 2-11***). They are the ***Sugar Notch Run*** sub watershed, ***Pine Creek*** sub watershed, and the ***Spring Run*** sub watershed. There is only one section of stream in the Solomon Creek watershed that is under special protection in the Upper portion of the Main Stem of Solomon Creek that has a High Quality stream designation (***See Figure 2-11***). The remainder of the streams and tributaries in the Solomon Creek watershed are all designated as Cold Water Fisheries.

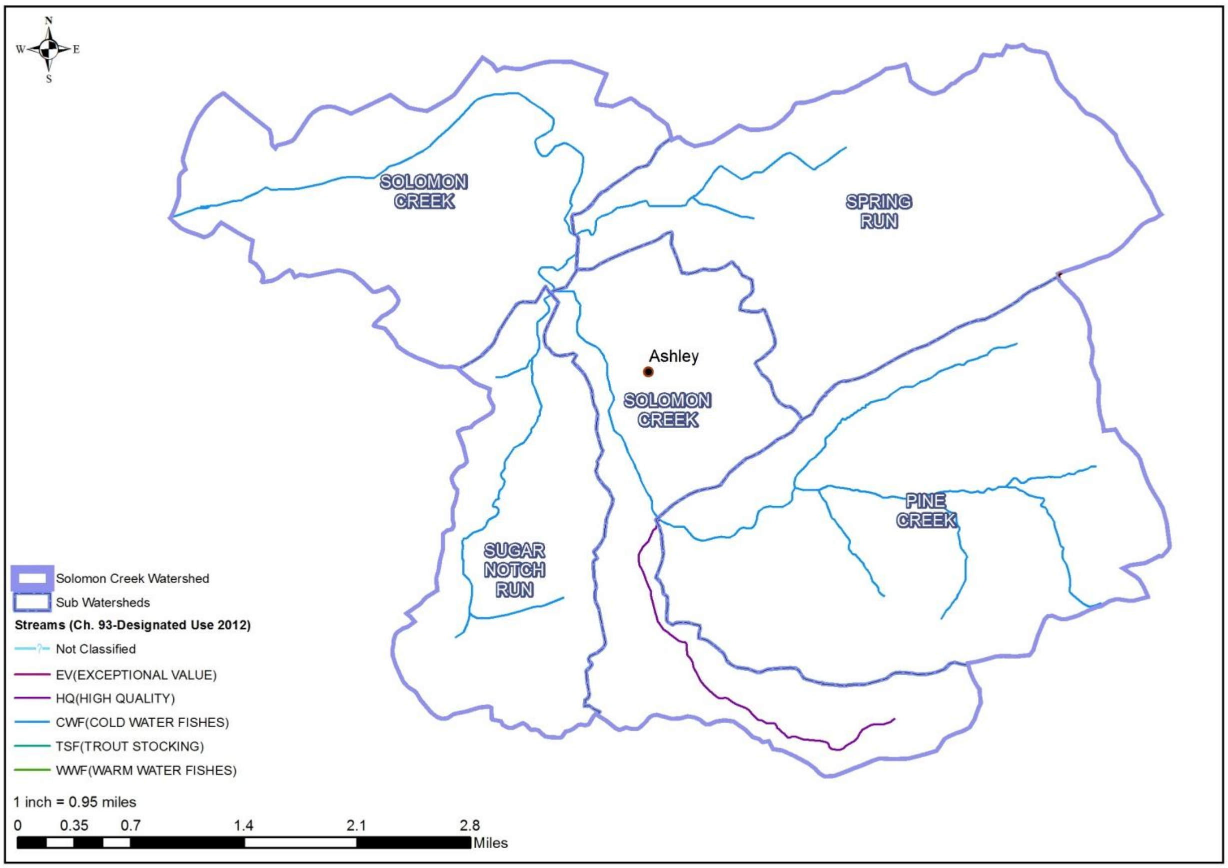


Figure 2-11 Streams under Special Protection and Sub basins of the Solomon Creek Watershed

There are, however, many stream segments that are either not meeting the PA DEP 303(d)/305(b) Designated Use Attaining and Non-Attaining uses (***See Figure 2-12 and Table 2-3***). The entire Spring Run and Sugar Notch Run sub watersheds are designated as Impaired by AMD and other mining related categories, such as metals, pH, stream channel modification, siltation, and flow alteration. There are also segments listed as having urban runoff/storm sewers for their impairment.

Conversely, there are **1.84** miles of headwater streams in Sugar Notch Run subwatershed, upstream of Rte 309, that showed good water quality and fingerling trout when last assessed and could be removed from this list (***See Figure 2-12 and Table 2-3***). EPCAMR will be recommending this course of action to the PA Department of Environmental Protection for further review.

Table 2-3 Solomon Creek Watershed Integrated List of Non-Attaining Stream Segments (PA DEP, 2012)

Stream Name	Stream Reach Code	Miles	Date Created	Stream Use Assessment	Attaning Use?	Source / Cause (Stacked High to Low)
Solomon Creek	2050107000445	3.561	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - Siltation ; Abandoned Mine Drainage - Flow Alterations ; Abandoned Mine Drainage - pH
Solomon Creek	2050107000445	0.036	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - Siltation ; Abandoned Mine Drainage - Flow Alterations ; Abandoned Mine Drainage - pH
Solomon Creek	2050107000445	0.254	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - Siltation ; Abandoned Mine Drainage - Flow Alterations ; Abandoned Mine Drainage - pH
Spring Run	2050107001045	1.194	7/18/2001	Aquatic Life	Impaired	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - Siltation ; Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Spring Run Trib	2050107002885	0.412	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Spring Run	2050107001045	0.878	7/18/2001	Aquatic Life	Impaired	Abandoned Mine Drainage - Metals ; Abandoned Mine Drainage - Siltation ; Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Sugar Notch Run	2050107001041	1.88	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Sugar Notch Run	2050107001041	0.507	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Sugar Notch Run Trib	2050107013065	0.268	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Sugar Notch Run	2050107001041	0.615	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations
Sugar Notch Run Trib	2050107002979	0.188	7/18/2001	Aquatic Life	Impaired	Urban Runoff/Storm Sewers - Flow Alterations ; Abandoned Mine Drainage - Flow Alterations

9.79 Total Stream Miles Impaired in the Solomon Creek Watershed.

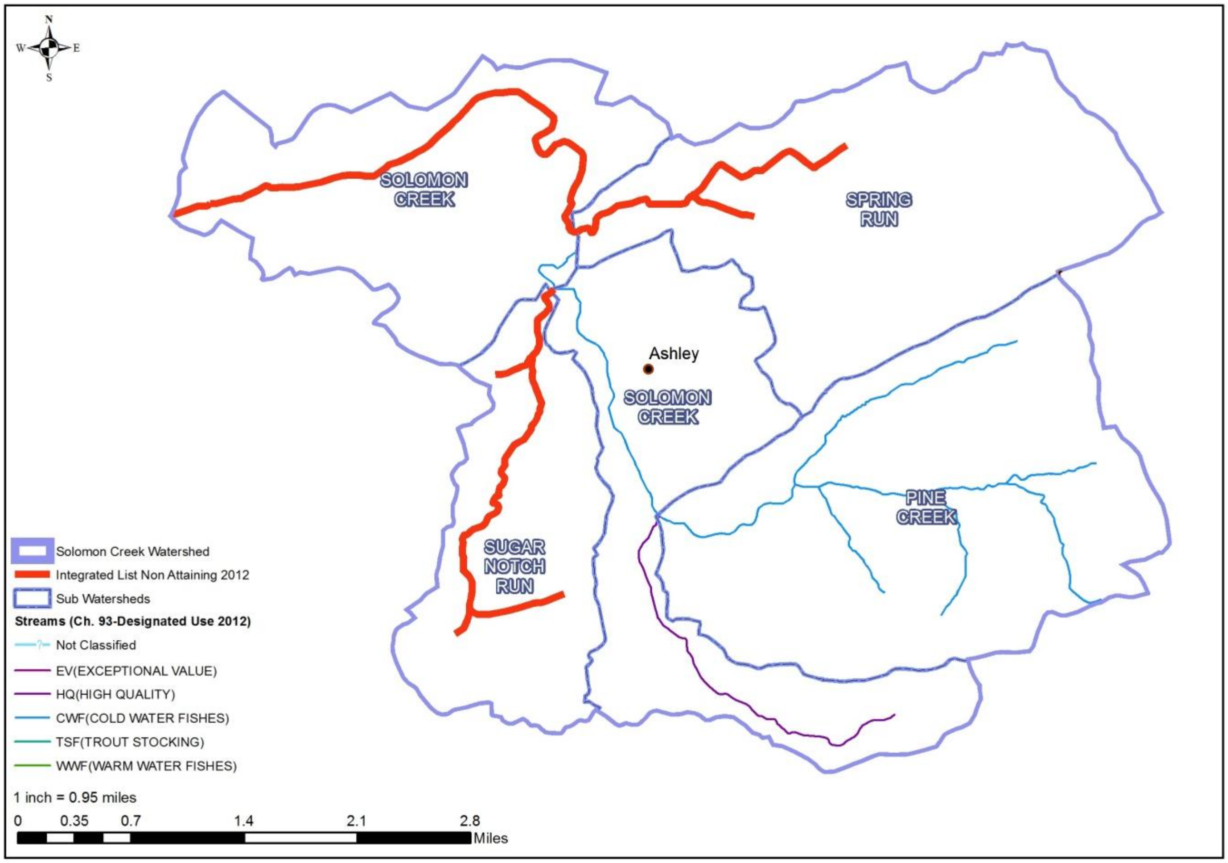


Figure 2-12 Integrated List of Waters: Designated Use Attainment from the PA DEP (formerly 303d/305b)

Impacts on Water Quality in the Solomon Creek Watershed

Abandoned Mine Lands (AML) and Reclamation

In light of the framework by which Pennsylvania protects and maintains water quality, the Solomon Creek watershed has characteristics that are of significant value. There are also other characteristics that are in need of more immediate attention. Abandoned mine land features on the surface within the watershed such as crop falls, abandoned stripping pits converted into storm water detention basins, unconsolidated stream channels that have been moved from their original channel configuration and location during mining, undersized stormwater drainage pipes, and flow loss points located along the bottom rock bedding planes of previously mined out areas, tend to contribute greatly to the impacts of both the headwater tributaries and the main stem of Solomon Creek. Historically, boreholes and shafts were intentionally drilled adjacent to the streams to relieve the pressure in underground mines that flows like underground rivers in vast underground mine complexes beneath the Wyoming Valley watershed and drains mine drainage discharges at strategic locations located throughout the Solomon Creek watershed.

Abandoned mine drainage (AMD) caused by historical past coal mining practices and stormwater are two of the major water quality impacts in the lower portions of the watershed. Together, these impacts result in many of the streams in Solomon Creek being either chronically polluted by metals and low pH or polluted by metals and low pH temporarily during typical heavy rainfall, Spring flows, and snowmelt events.

The Solomon Creek watershed is in some respects, represents a little piece of the water resources of Appalachian Pennsylvania as a whole; many exceptionally clean and productive waters interspersed by a minority of extremely degraded, nearly lifeless, streams impacted by resource extraction industries. Of the more than **83,000** miles of streams in all of Pennsylvania, about **25% (21,000 mi)** are protected as either High Quality or Exceptional Value Coldwater Fisheries. Similarly, all of the roughly **27** miles of streams in Solomon Creek watershed are designated Coldwater Fisheries (CWF), and about **15%** (**4** miles) have High Quality (HQ) protection (***Figure 2-12***).

Currently, about **85% (23** stream miles**)** of the total stream miles in the Solomon Creek watershed are designated Aquatic Life Use Coldwater Fisheries (***Figure 2-12***). About **10** stream miles are impaired and not attaining their designated Aquatic Life Use as Coldwater Fisheries, including **4** miles of the main stem of Solomon Creek itself. The main source of impairment listed comes from abandoned mine drainage, pH, flow modification, stream alteration caused by past mining activity, urban waters/storm sewers and influences of hydrogeology of the underground mine pools beneath the Wyoming Valley (**Figure 2-13**).

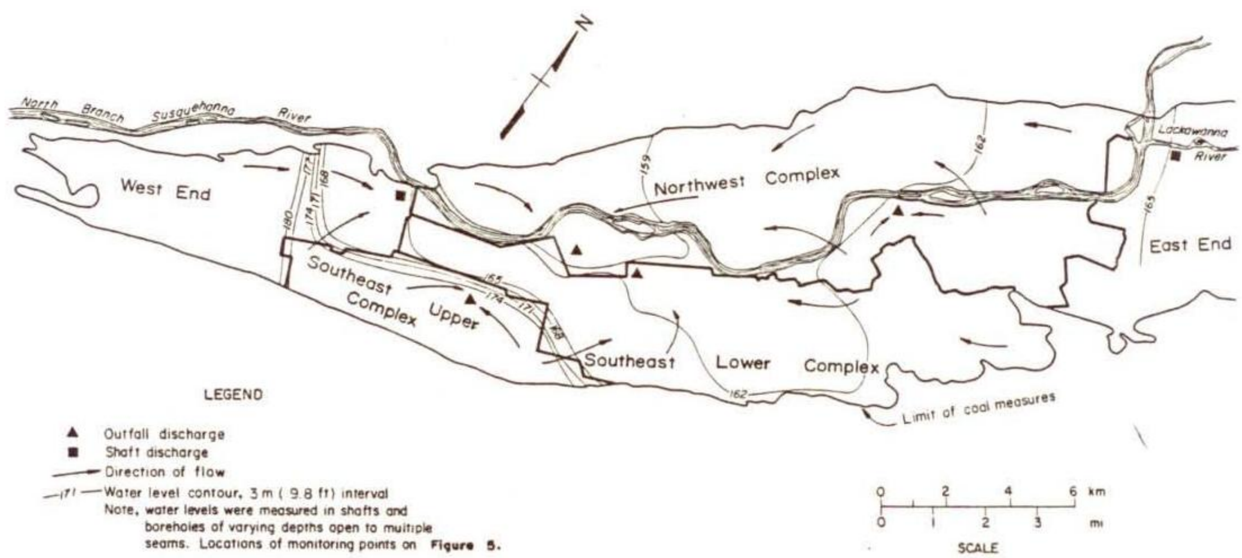


Figure 2-13 Flow diagram showing generalized direction of mine water flow in the Wyoming Basin (Ladwig 1983)

The impact of mining from abandoned mine lands and coal fields on water quality is highlighted on a map of impaired streams (**See *Figure 2-14***). This type of impairment is devastating to aquatic ecosystems and difficult to remedy. A discharge of AMD pollutants may be a single point at the surface; however, the source of the discharge can be a very large and vast underground mine pool complex several square miles in drainage.

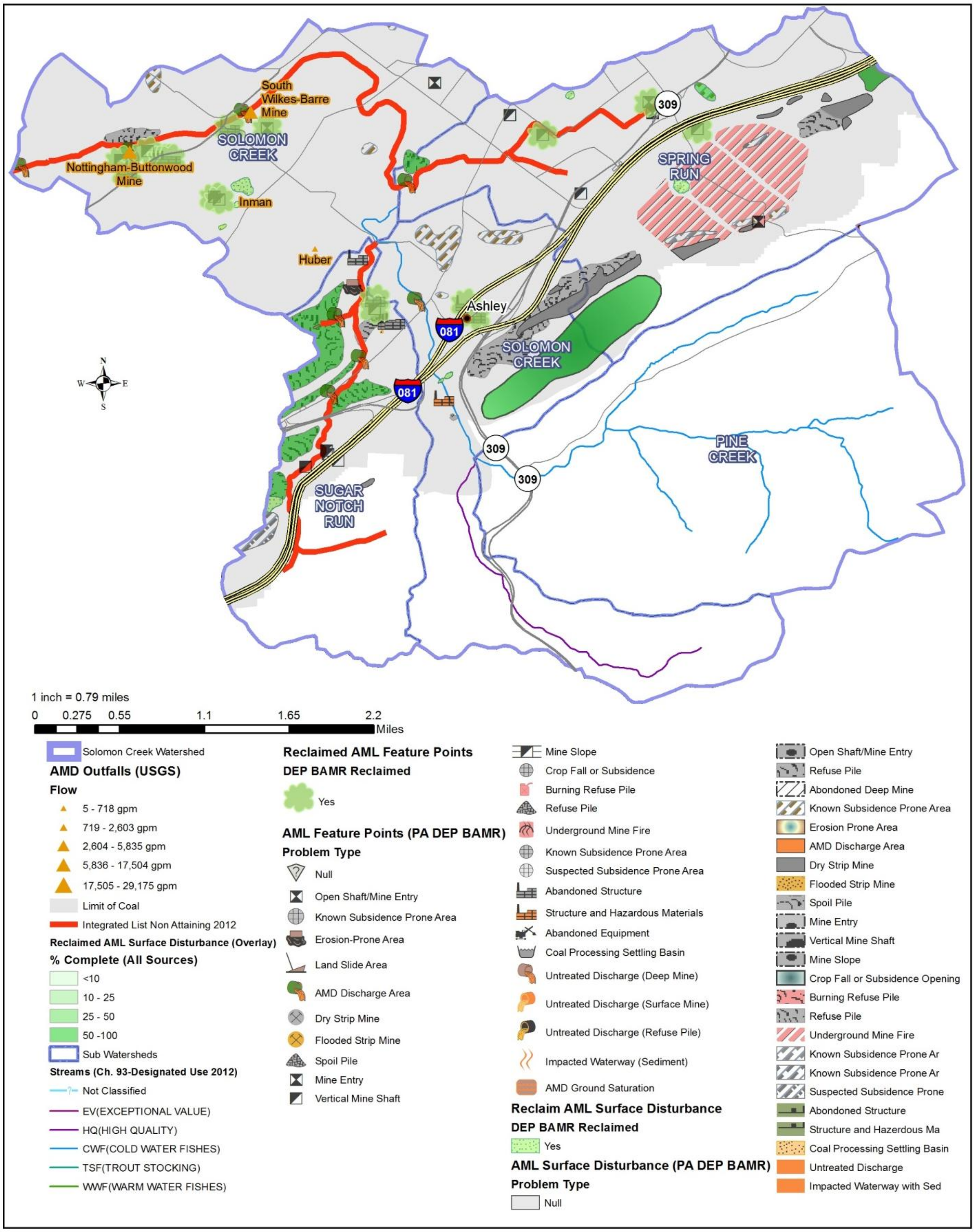


Figure 2-14 Abandoned Mine Lands and Mine Drainage Impacts to the Solomon Creek Watershed

Abandoned mine drainage and runoff from past surface and deep mining operations released large quantities of iron hydroxide metals, acidity, pyritic material, hydrogen sulfide gas, and water into streams. This reduces the pH of water and raises concentrations of dissolved metals to levels that render streams almost lifeless. Many of the headwater streams that flow through the abandoned mine lands are likely more vulnerable to increased acidity loadings during high flow storm events because of the additional leaching of metals that may runoff from the culm banks and silt basins that are within the watershed. A unique aspect of the watershed is that on abandoned mine lands where there is storm water detention and infiltration occurring into the underground mine pools, at some point, this water will have to redirected elsewhere into the watershed when the sites are reclaimed and backfilled. EPCAMR suggests considering some of these abandoned mine lands for future stormwater detention and diversions to alleviate the flash flooding flows within the watershed, provided that the ponds that are constructed, are lined with a bentonite clay, to prevent further infiltration into the mine pool. The Susquehanna River Basin Commission might even be interested in this idea because it supports their low flow augmentation policy.

The most extensive abandoned mine land impacts located in the watershed that are still visible today can be found to the northeast run parallel to Interstate 81. Majority of the acreage of abandoned mine lands are located within the Laurel Run Borough, Wilkes-Barre Township, and portions of the City of Wilkes-Barre. Many unnamed headwater tributaries flow from the top of the east facing side of the mountains and intercept previously mined areas just south of the Exit 168 Interchange between Interstate 81 and State Route 309, that runs from Solomon Gap, north along N. Mountain Boulevard to the Exit 165 AB interchange to Interstate 81.

State Route 309 divides the South East portion of the Solomon Creek watershed from its southernmost boundary along Interstate I-81 just south of the Exit 164 Interchange. Abandoned mine lands located in Wilkes-Barre Township, to the southwest side of Interstate 81, begin in the area of the Mohegan Sun Arena and along Highland Park Boulevard in Wilkes-Barre Township and continue in a southwesterly direction through the City of Wilkes-Barre and in the Spring Run sub watershed of Solomon Creek to its confluence with the main stem of Solomon Creek, located just south of W. Liberty St. in Hanover Township near Franklin Junction.

Additional acreages of abandoned mine lands can be found scattered throughout the communities of Newtown, Preston, and the boroughs of Sugar Notch and Ashley, along the historic Ashley Planes and further south along S. Main Street in Ashley, through the historic Huber Colliery grounds in the Sugar Notch run watershed and within the Hanover Industrial Park to the north of New Commerce Boulevard, around Stewart Road, over to S. Main Street in Hanover Township, otherwise known as Middle Road.

Abandoned mine lands located in the southwestern portion of the Solomon Creek watershed can also be sporadically found in the Hanover Township communities of Buttonwood, Breslau, and Lee Park. Abandoned mine lands located within the center of the watershed can be found around Franklin Junction, which is located to the northwest of the confluence of the Sugar Notch Run sub watershed and the Spring Run sub watershed with the main stem of Solomon Creek.

Southwest of Franklin Junction, remnant abandoned railroad grades and abandoned mine colliery structures can be found in the vicinity of the community of Lee Park, Hanover Township, between Lee Park Avenue and the Sans Souci Parkway, behind the Lee Park Towers over to the end of the road along Keith Street, where an unnamed tributary, EPCAMR has decided to call the Lee Park tributary, flows into the main stem of Solomon Creek.

Even more abandoned mine lands can be found to the Southwest of Fellows Ave. in the Hanover Township community of Breslau, between the railroad tracks and the Sans Souci Parkway. North of Lee Park back to the City of Wilkes-Barre, much of the abandoned mine lands in the smaller communities have been reclaimed and/or developed for residential homes and/or industrial and commercial redevelopment. Abandoned mine shafts, slope entries, bootleg coal holes, crop falls, mine subsidence, historic foundations and structures from old breakers are scattered throughout the City of Wilkes-Barre and in many of the other smaller Anthracite mining communities located within the Solomon Creek watershed.

According to EPCAMR'S Reclaimed Abandoned Mine Land Inventory System (RAMLIS), there are nearly **1148** acres of unreclaimed abandoned mine lands located in the Solomon Creek watershed. There are **23** Problem Areas within the Solomon Creek watershed. There are **92** abandoned mine land features within the Solomon Creek watershed. There are **36** features reclaimed, **10** of which were completed by ARIPPA members, and **8** more reclaimed by the PA DEP Bureau of Abandoned Mine Reclamation. There are **14** coal seams that were historically mined within the watershed. More than **50%** of the watershed is underlain by anthracite coal. There are **29** Priority 1 and 2 Health & Safety Hazard features and **6** Priority 3 (AMD related) features.

The Positive Land Reclamation & Redevelopment Efforts of the Earth Conservancy

The Earth Conservancy, a not-for-profit organization, founded in 1992 to address the problem of abandoned coal mine lands, specifically the Blue Coal Corporation lands totaling more than **16,300** acres in Luzerne County, Pennsylvania owns a large portion of the abandoned mine lands within the Solomon Creek watershed. EC is dedicated to mine land reclamation, conservation and economic development in the Wyoming Valley of Luzerne County, Pennsylvania. EC has been a long time partner of EPCAMR supporting both land reclamation, AMD remediation, and outdoor environmental education and historic preservation of abandoned mine lands and abandoned structures such as the Ashley Planes and the Huber Breaker for many years.

The Earth Conservancy's Office is in the former Glen Alden Coal Company Building. EPCAMR, since April of 2009, leases space from within the Earth Conservancy Building and has renovated 2000 square feet of the former Payroll Office to run its operations and Technical Assistance Center. The Huber Breaker Preservation Society, another local non-profit historical preservation organization dedicated to preserving the Huber Breaker grounds, also has spaced donated for its use, within the former Glen Alden Coal Company Building.

Addressing the Past, Reclaiming the Future

Since its formation in 1992, Earth Conservancy has reclaimed **1,276** of its **16,300** acres at a cost of **$21.7** million, which totals **$17,000** per acre. An additional **1,219** acres are in process at an estimated cost of **$60** million. Clearly, the reclaiming mine scarred land is slow and expensive. As costs for gas, material and labor increase, so does the cost of reclamation, which explains why the totals for in-process acreage is estimated at a higher rate than the actual cost of what has already been completed.

Reclamation of mine-scarred lands is expensive for several reasons, some of which must take place prior to any land being touched. Before reclamation can begin:

- each site must be surveyed and staked to delineate the site boundaries and determine its topography;
- each site must be inspected for hazards such as stripping pits, sink holes or mine opening;
- plans must be prepared that address the specific needs of each site;
- abandoned mine discharges must be monitored for pre-post mine water chemistry if AMD treatment systems are proposed to be constructed;
- engineering specs must be prepared by a qualified consultant that will estimate the amount of culm and waste material present at each site and detail how the site is to be graded and filled;
- appropriate permits must be obtained from the state Department of Environmental Protection (DEP), and the Luzerne Conservation District to ensure that all work meets required standards;
- Planning and Zoning officials need to review and provide comments on plan submissions for reclamation; and
- refuse and garbage dumped illegally by residents and contractors alike must be removed from the site and placed in an appropriate landfill prior to any work beginning

Once each of the above pre-work items are completed, reclamation work can then begin. Work at each site differs depending on its condition, but generally, some or all of the following work will be performed at each site:

- Existing culm or other mining waste must be either removed from the site and properly disposed of or leveled and covered with a substantial amount of fill material;
- Use of heavy equipment is necessary in all reclamation projects for the removal and/or moving of material or leveling of the site;
- After material has been removed or graded and leveled, the entire reclaimed area must be seeded to stabilize the soil and prevent future erosion; and
- For some projects, more intensive re-vegetation is necessary to create a riparian buffer for nearby streams. A riparian buffer is simply an area along a stream that is typically up to 100 feet wide and is planted with trees, shrubs and grasses to not only protect the stream from erosion but to provide habitat for animals.

The Benefits of Reclamation

Pre-regulatory mining was an invasive process that damaged the land, watersheds, left unsafe conditions at some sites and produced numerous environmental negative impacts.

Unreclaimed sites are easily recognizable because of their impacted conditions:

- sparse or nonexistent vegetation
- dry and rocky soil
- large piles of culm dot the landscape
- mine shaft openings
- steep high walls
- mine subsidence
- abandoned mine drainage seeping into the watershed
- potential for underground mine fires or existing mine fire

Northeast Pennsylvania has a proud mining heritage, one that fueled the American Industrial Revolution. The historical significance of that achievement will never fade, but neither will these sites fade from our landscape unless we address the unsafe and harmful conditions left behind by the pre-regulated mining industry. People throughout this region and across the state have become accustomed to looking at these conditions, but these conditions should motivate us to address each of these conditions that pose either an environmental or health hazard or both.

As Earth Conservancy and others like EPCAMR, work to reclaim the mine scarred lands, it addresses each of these issues in an effort to bring about positive change to the region. As each site is reclaimed, many of the above issues are remediated to the degree possible. In the case of vegetation and rocky soils, the culm banks and AMD, the reclamation process can most easily address these issues. There are some that are less easily solved.

Mine subsidence occurs when underground mine working and/or supports collapse, causing the ground to shift, resulting in holes opening up at the surface. These holes can be very large, swallowing cars, destroying houses, and even buildings. A sink hole is a subsidence on a much smaller scale. They are generally localized and can be recognized by a sudden depression of the ground surface as it collapses into a mine void. Sink holes can cause property damage but, it is usually to a lesser degree than subsidence.

Laurel Run Mine Fire

Some conditions, like underground mine fires, are virtually impossible to stop. Mine fires run along the underground mine seams and in some cases can reach the surface, emitting smoke and noxious fumes. Earth Conservancy's Laurel Run mine fire has been burning since 1915 and could burn for another 100 or more years. Unfortunately, because mining followed the coal seams, areas were mined underneath areas where houses and towns were built.

This was the case in the 1970s in Centralia, Pennsylvania, a mining town where a fire started at a dumpsite and ignited an abandoned mine shaft. The fire continued to burn along the coal seam slowly spreading under the town. In 1983, the Federal government was authorized to buy all the homes, which would be razed. The majority of residents relocated, but some remained for a time but eventually took the buyout. In January 2010, the remaining **63** residents were forced to leave their homes because the fire had come too close to the remaining houses. Many residents moved to a newer private mobile home park in Laurel Run Borough just above the mine fire above Laurel Run Road with two intersecting streets along Blueberry Lane and Rabbit Lane. Residents still have to pass areas where vents and pipes still are vented to the surface and where smoke and gases still can be seen on a daily basis. The entire area of the Laurel Run Mine Fire is within the Solomon Creek watershed.

Franklin Bank Reclamation

The Franklin Bank was a **13+-**acre, mine-scarred land site in Hanover Township, Luzerne County, PA, adjacent to an existing residential neighborhood, locally known as Franklin Junction. The previous owner, the Blue Coal Corporation, had mined this site and left it in an environmentally degraded state as a culm bank when it declared bankruptcy in the mid-1970s. Earth Conservancy (EC) reclaimed the Franklin Bank and made it available for residential development, while also eliminating an environmentally degraded site from the community. This project removed thousands of tons of mining waste, eliminating a source of abandoned mine drainage (AMD) runoff that presently makes its way into the existing storm water system and the already impaired Spring Run tributary of the Solomon’s Creek watershed. This reduction in AMD will beneficially impact the Solomon’s Creek Watershed by reducing a significant source of AMD contamination, siltation, erosion, and eventual downstream contamination of the Susquehanna River. The reclamation project encourages future development in urban populated areas, helping to preserve pristine green space and virgin forest lands by redeveloping in areas where existing infrastructure already exists in the adjacent communities and just needs to be extended into these new grayfield locations. In addition, the conversion of the site to a residentially zoned use will provide more space to expand the surrounding neighborhood, improve the local housing stock, increase surrounding property values and attract new residents to Hanover Township, thereby improving the local tax base and economy. Much of the Wyoming Valley’s housing stock is antiquated, with 43.8% of it having been built prior to 1939. The reclamation of this site can now support new modern housing, and should be a positive addition to the area's landscape and a beneficial re-use of this abandoned mining site.

I-81/Route 115 Connector Road Master Plan and it's Relationship to portions of the Spring Run sub-watershed in Laurel Run

In December of 2003, Sasaki Associates, Inc., Economic Research Associates, and Quad Three Group, Inc. completed the ***I-81/State Route 115 Connector Road Master Plan*** for Luzerne County, PA and the Earth Conservancy that proposes to work its way through the northeastern corner of the Spring Run sub-watershed in Laurel Run Borough within the Solomon Creek watershed. Stripping pits and cropfalls are common along this alignment were identified to be reclaimed and parallel I-81 Northbound north of Exit 168 off of I-81 Northbound to the northeast.

In accordance with the long-range land use plan, Luzerne County worked with the Earth Conservancy to initiate this master planning process to bring about the creation of a mixed-use development for a 310-acre parcel located just south of, and visible from, Interstate 81 and the City of Wilkes-Barre in Luzerne County, Pennsylvania. The project site serves as an important "gateway" property for Wilkes-Barre and Luzerne County. In commissioning the master plan, Luzerne County and the Earth Conservancy sought to make the best use of their prime developable land holdings for business park, commercial, residential, and recreational amenities. Their primary goal was to create high-quality jobs and to economically revitalize northeastern Pennsylvania while at the same time restoring and enhancing the surrounding environment. The master plan outlines a framework for phased development in concert with market demand. A study of real estate market conditions, development opportunities, and financial and economic impact analysis was conducted in conjunction with the plan and was summarized in the report is found in **Appendix F**.

Huber III Abandoned Mine Land Reclamation

Earth Conservancy's Huber III Reclamation Project (***See Figure 2-15***) completed in 2010 is an important component of the restoration of the **18** square-mile Solomon Creek watershed and the revitalization of the Wyoming Valley. Huber III's location in close proximity to State Route 29, Interstate 81, and New Commerce Boulevard, one of the two main entrances to the Hanover Industrial Estates, means that the completed project will provide room for economic expansion for the Hanover Industrial Park.

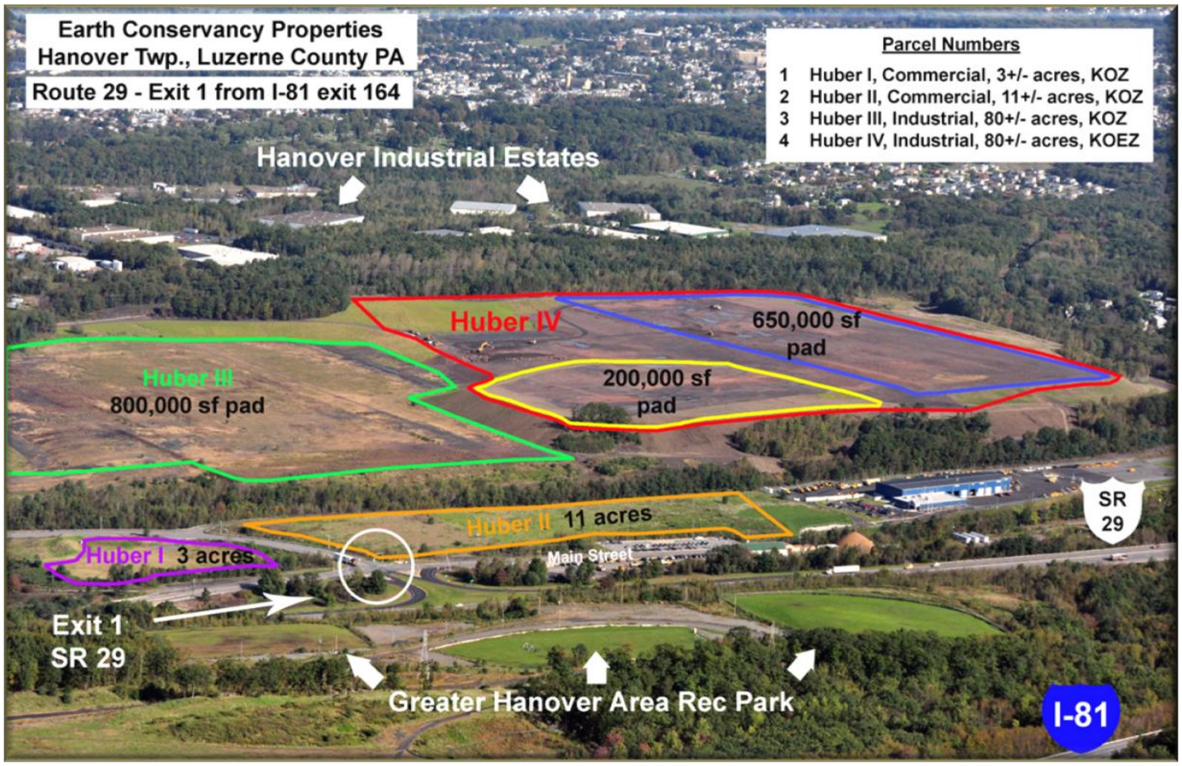


Figure 2-15 Earth Conservancy's Huber I - IV Reclamation Projects

Additional information on the number of parcels available within the Hanover Industrial Estates can be found on www.pennsnortheast.com , Penn's Northeast, Incorporated's website (***See Figure 2-16***).

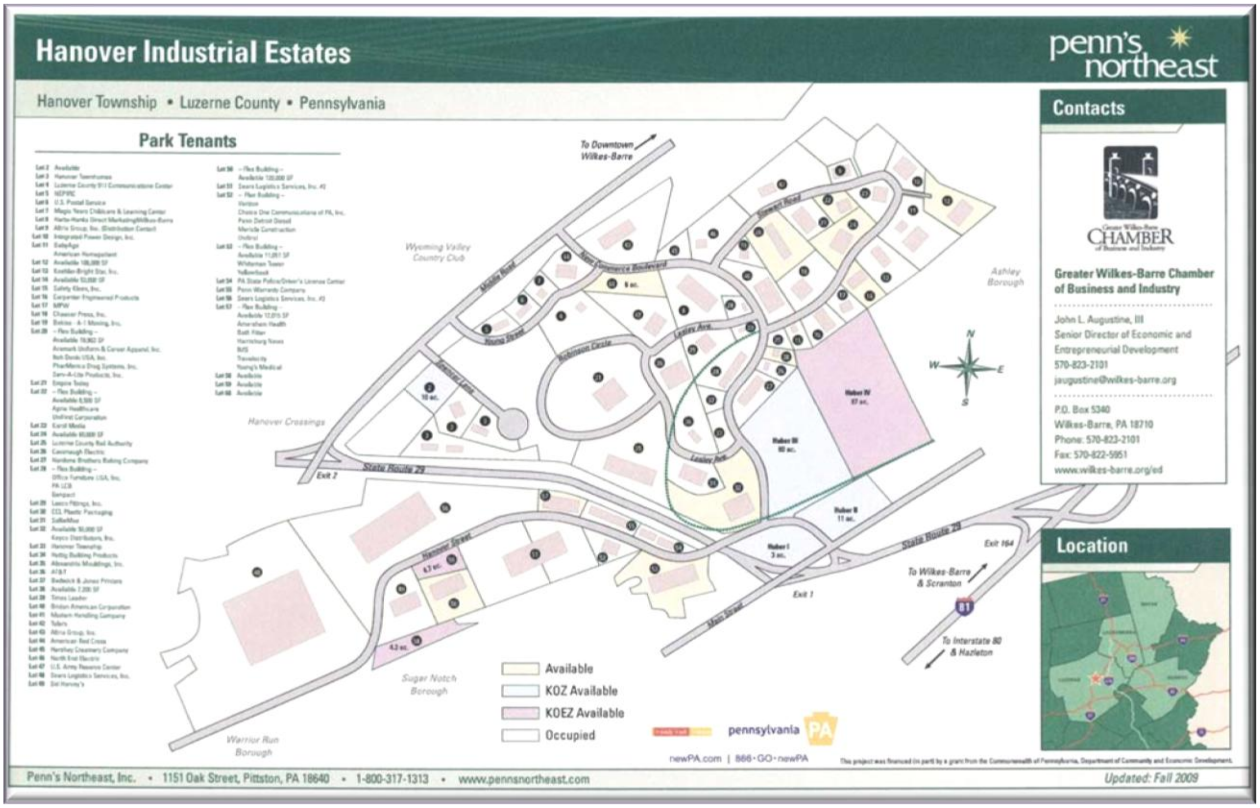


Figure 2-16 Hanover Industrial Estates built on former Abandoned Mine Lands

Now funded by the Pennsylvania Department of Community and Economic Development's ***Business In Our Sites Program*** and the Earth Conservancy, these two entities worked in partnership with Northampton Generating Company and Emerald Anthracite to develop an ambitious strategy for reclamation and reutilization of the previously abandoned mine lands. As a part of the reclamation process some of the culm material was removed from the site, converted into electrical energy in the co-generation facility located in Northampton, PA and the lime treated ash was transported back to fill stripping pits by Northampton Generating Company. New technologies in combustible fluidized bed (CFB) boiler plant operations now allow generating facilities to create electricity by burning material that was once considered a waste rock, along with the addition of limestone in the burning process, that now magnifies a positive environment outcome for the land, the water, and the economic redevelopment potential of the reclamation project.

Prior to reclamation, the site was an eyesore to any person passing by or entering the Hanover industrial estates more than 22,000 cars per day drive on their commutes to and from work along the Exit 164 Interchange off Interstate I-81. Covered by mountains of coal waste material and scrub vegetation it was a visual reminder of the damage done by the areas historic mining industry. The site was a hindrance to positive things happening as a part of Earth Conservancy's other reclamation projects occurring around Exit 1 off of State Route 29.

This project not only eliminated an environmental hazard and an eyesore, but added value to the area by utilizing a designated brownfield/grayfield are the lower one Valley needs the economic benefits provided through projects like this which will entice greater numbers of businesses to locate in the area therefore providing more jobs for area residents for responsible economic development rather than looking to mar pristine green space areas throughout the mountainsides of the Wyoming Valley.

The Lower Wyoming Valley needs the economic benefits provided through projects like this to entice greater numbers of businesses to locate in the area that could lead to additional jobs for area residents. The project addressed the reclamation of an 82-acre abandoned mine lands site with a resulting **50**-acre building had the site that is now occupied by the PA Department of Transportation. Above the PA DOT pad is the Huber IV, an approximate 80 acre pad, some of which is currently, leased by BP Energy**,** to store dozens of windmill blades temporarily, that will be going to a large windmill construction project in the Tunkhannock/South Mountain Area in Wyoming County (***See Figure 2-15***).

Earth Conservancy's Recreational Trails Constructed on Abandoned Mine Lands

In 1998, EC completed the Lower Wyoming Valley Open Space Master Plan (OSMP), (http://www.earthconservancy.org/html/osmp.html), which dedicated **10,000** of EC's **16,300** acres for recreational/green space. The goal of the OSMP was to create a network of open space and recreational opportunities throughout the Lower Wyoming Valley, while complementing existing and future open/green space projects throughout the greater region. The plan proposed **55** miles of hiking and biking trails; six parks; one golf community; **6,694** acres of conservation lands; **4,258** acres of open space; and, a **37**-mile scenic drive through the Wyoming Valley. Some of the recreational spaces developed by the EC that are within the Solomon Creek watershed are: the Sugar Notch Trail, and the Greater Hanover Area Recreation Park. Together, these recreational/green spaces provide hundreds of acres for passive recreation. All recreation and green space areas are intended only for non-motorized uses.

Although trash receptacles are provided at trailheads, EC asks that all park and trail users please practice Leave No Trace™ techniques when using the sites. To find out more about Leave No Trace™ principles and practices, please go to www.lnt.org . Some of the basic principles of leave No Trace™ that apply to EC sites are:

- Plan Ahead and Prepare
- Travel Durable Surfaces
- Dispose of Waste Properly
- Leave What You Find (cultural artifacts, plants, etc.)
- Respect Wildlife
- Be Considerate of Other Visitors

The Sugar Notch Trail System, Hanover Township & Sugar Notch Borough

The Sugar Notch Residential Area Reclamation effort remediated **50** acres of mine scarred lands in a larger **189**-acre site in Sugar Notch, Luzerne County. The result is an approximately **50**-acre area intended for single-family homes, while the remaining 139+ acres area designated as green/recreational space. As part of that project, EC created the Sugar Notch Trail System, which includes two trails of varied technical difficulty within the Sugar Notch Run sub watershed of the Solomon Creek watershed (***See Figure 2-17***).

The remaining **139** acres of the site are pristine woodlands with the Sugar Notch Run tributary running through a section of the site. The green space was a prime area to create the Sugar Notch Trail System, which runs on both an existing unimproved trail and through the newly designated residential area. The trails were proposed in EC's Open Space Master Plan.

The trail system consists of two trails, the Ridge top Trail and the Park Access Trail (***Figure 2-17***). The Ridge top Trail utilizes an existing trail. EC strove to keep the trail as natural as possible by simply trimming branches and leveling ground where necessary. The **3.06**-mile trail begins at a trailhead in the Phase I section of the Greater Hanover Area Recreation Park and runs the ridgeline of Wilkes-Barre Mountain, ending at a second trailhead on Main Street on the West end of Sugar Notch beside St. Mary's/Holy Family Cemeteries which takes you over a ridge into the adjacent Warrior Run watershed. Along the trail you will cross an old railroad bridge and walk along Sugar Notch Run within the Solomon Creek watershed.

The Park Access Trail, at **0.64** miles, is much shorter but provides residents of Sugar Notch a safe alternative route to and from the Greater Hanover Area Recreation Park. The trail begins at a trailhead located on the Phase II section of the park and runs through the designated residential area, ending at a second trailhead in the Sugar Notch Playground, on Broadhead Avenue.

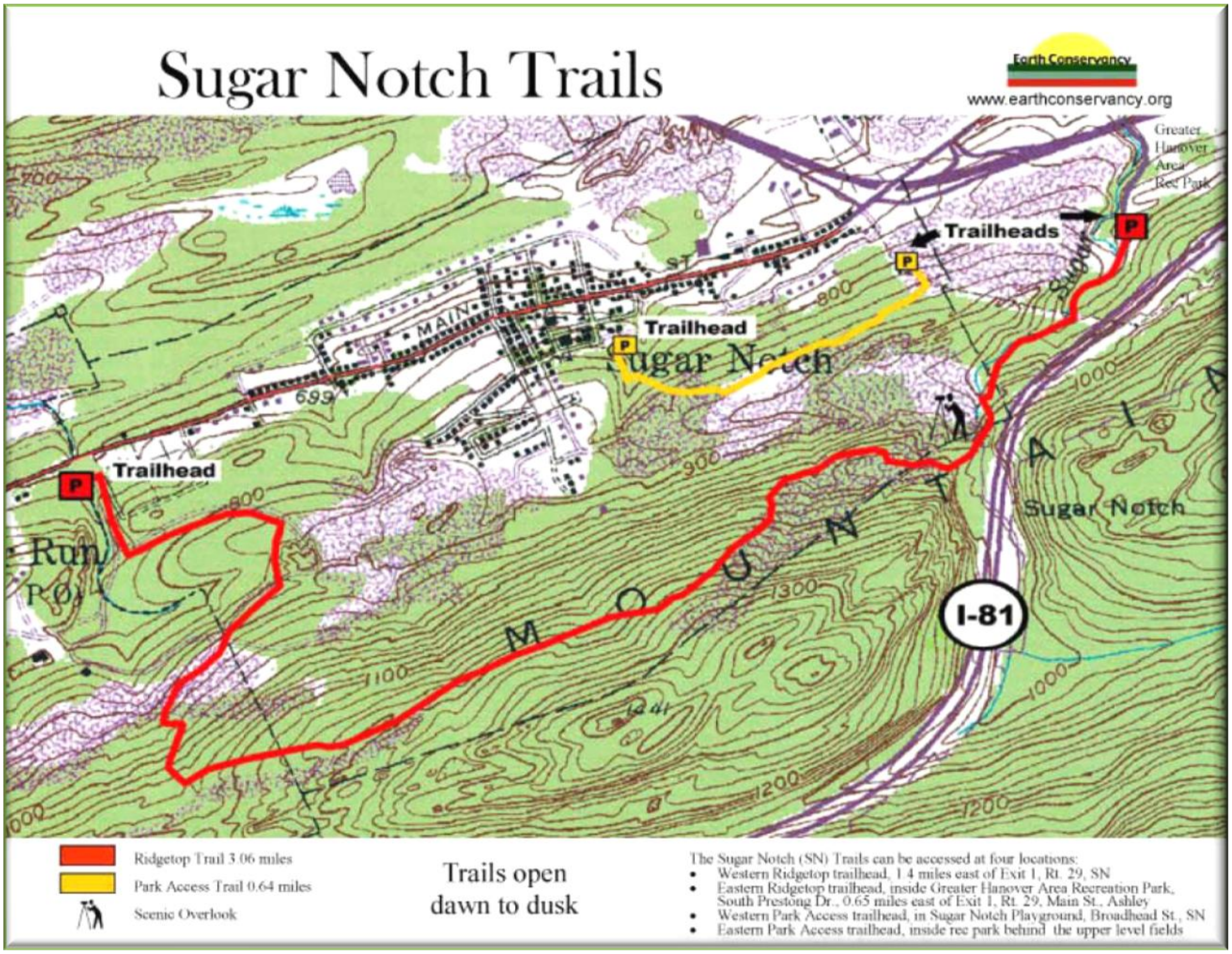


Figure 2-17 Earth Conservancy's Sugar Notch Trail System

Both trails have white blazes on trees and there are parking lots at three of the trailheads. The opportunities for active living and recreational activities are components of residential design Earth Conservancy attempted to incorporate into its design plans for the combined project area: the Greater Hanover Area Recreation Park, the Sugar Notch Residential Area Project and the Sugar Notch Trail System. EPCAMR, EC, and ARIPPA have funded reprinting of Trail Map Signage for these two trails in 2010 since these trails were created on former abandoned mine lands. It is important to remember that appropriate clothes and shoes/hiking boots and socks be worn for any trail hiking and that hikers be prepared for quick changes in weather by brining rain gear. Hydration and energy are also keys to successful hiking. Always bring bottled water and easy trail foods like granola bars to keep in pockets or backpacks. Check out (www.americantrails.org) for more information on hiking "dos and don'ts".

Greater Hanover Area Recreation Park, Hanover Township

Early in its work, EC recognized the need for centrally located playing fields in the Greater Hanover Area community. The organization resolved to turn a mine-scarred wasteland into a site where communities would be able to gather, play sports and enjoy the outdoors. The need was met by the creation of the Greater Hanover Area Recreation Park, a **65**-acre park dedicated to youth athletics. The park is located in Hanover Township, Luzerne County, adjacent to State Route 29 on what was at one time severely mine scarred lands (***See Figure 2-18***). The project was initially named in the EC Lower Wyoming Valley Open Space Master Plan. During the master planning process for this facility, a series of meetings with local stakeholders and elected officials revealed that there was a dire shortage of playing fields, particularly for soccer. Plans were drafted to address the need and also adding other amenities to the plan, such as a comfort station, basketball and tennis courts, and a walking trail.

Because of the large scope of work, the project was divided into two phases. Phase I of the project was a **15**-acre area that includes two multi-purpose athletic fields, a basketball court, parking area. It was completed in 2002. In May 2004, EC donated the Phase I lands to the Greater Hanover Area Recreation Park Commission (GHARPC), created as a non-profit to assume ownership, operation and maintenance.

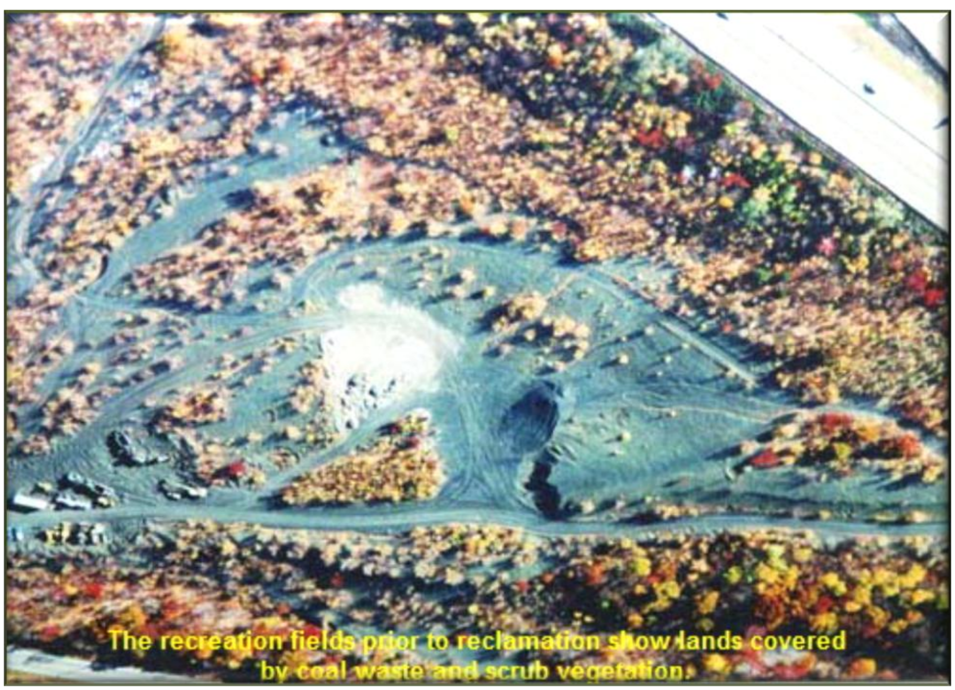


Figure 2-18 Before Shot of the Greater Hanover Youth and Recreation Park

Figure 2-19 (Above) During the Construction of the Greater Hanover Area Youth

Figure 2-20 After construction Greater Hanover Recreation Park and the Sugar Notch Residential Parcel with Sugar Notch Run meandering through the two areas following the tree line along S. Preston Road underneath State Route 29

The first portion of the park served approximately **600** youth playing soccer on a seasonal basis. The success of this part of the park has created greater demand for more park space. Phase II work included the creation of an additional six (**6**) multi-sport fields that accommodated an additional **700-1,500** youth playing a variety of sports throughout much of the year. Phases II, approximately **45** acres, included two softball fields, a baseball field, a soccer/football field and additional parking areas. Phase II is finished with the exception of some amenities such as an irrigation system, backstops and benches, which will be added as funding becomes available. The completed park plays host to a variety of youth sports and practice space for some Greater Hanover Area High School sports teams.

The park also includes the Sugar Notch Trail System, mentioned above, and sits adjacent to the proposed Sugar Notch Residential Area Parcel. This site, which until just a few short years ago, was a mining wasteland that attracted illegal dumpers and provided a secluded place for illicit activity (***See Figure 2-18***) now provides an amenity for families and civic organizations in several area communities (***See Figure 2-20 and 2-21***). More than **2200** youth participate in organized sports on a seasonal basis on the two completed portions of the park. The design decision to combine the park, trails and **50**-acre residential area exemplifies EC's commitment to providing the Lower Wyoming Valley with environmental enhancements while serving the needs of the community (***See Figure 2-20***).

Figure 2-21 Earth Conservancy's Parcel 7, Sugar Notch Future Residential Development

PA DOT District 4-3 Maintenance Office Constructed on Abandoned Mine Lands

The Pennsylvania Department of Transportation in February 2011 celebrated the opening of its **$9.4** million District 4-3 Maintenance Office, a modern headquarters for Luzerne County operations that PA DOT hopes will improve efficiency at the state-of-the-art facility. The building, located on Main Street in Ashley near the on ramp to Route 29, replaces PA DOT's 75-year-old garage in Bear Creek Township as the department's central office and garage in the county. It will be the home office for about 40 of the **135** full-time employees of PA DOT's Luzerne County division. At **38,000** square feet, the garage dwarfs the **22,000**-square-foot Bear Creek garage, where about half the available space could not be used due to structural deficiencies in the floor. However, despite its larger size, PA DOT officials said the garage will also be more cost-efficient to operate. The garage has **12** vehicle maintenance bays, providing enough space to make major repairs to summer equipment in winter and vice versa without impeding day-to-day maintenance schedules. It also consolidates equipment and storage spaces spread across the Bear Creek garage, improving efficiency and security. The new garage is also more environmentally friendly than its predecessor because it is heated with cleaner-burning natural gas rather than heating oil and is constructed on rehabilitated mine land purchased from Earth Conservancy that is within the Solomon Creek watershed's Sugar Notch Run sub-watershed.

Abandoned culm banks formerly occupied the **12**-acre site where the garage now stands were removed by Northampton Generating, which used the culm to generate electricity before returning waste ashes for use as fill in grading and leveling the site. PA DOT chose to build the garage in Ashley because it is near the geographic center of Luzerne County, a requirement for any County headquarters, and it has easy access to major state roads, Interstate 81 and it is not near any residential or busy commercial districts.

Tax Liability

The Keystone Opportunity Zone (KOZ) program is providing a once-in-a-lifetime opportunity to develop land with greatly reduced state and local taxes. KOZs reflect a true sense of partnership among state and local taxing bodies, school districts, economic development agencies and community-based organizations. All of these sites are KOZ's. Information that is more detailed can be found on KOZ's at the Department of Revenue's website (http://www.revenue.state.pa.us/revenue/site/default.asp). Keystone Opportunity Zones are such a breakthrough idea that Business Facilities magazine calls them "the number one economic development strategy in the nation." By eliminating specific state and local taxes for a time (10 years) within specific underdeveloped and underutilized areas, communities within Pennsylvania are experiencing economic growth and investment.

Binding ordinances and resolutions were passed granting the waiver, abatement or exemption of certain state and local taxes. Depending on the situation, the tax burden may be reduced to zero through exemptions, deductions, abatements, and credits for the following:

- State Taxes: Corporate Net Income Taxes, Capital Stock & Foreign Franchise Tax, Personal Income Tax, Sales & Use Tax, Bank Shares and Trust Company Shares Tax, Alternative Bank and Trust Company Shares Tax, Mutual Thrift Institutions Tax, Insurance Premiums Tax
- Local Taxes: Earned Income/Net Profits Tax, Business Gross Receipts, Business Occupancy, Business Privilege and Mercantile Taxes, Local Real Property Tax, Sales and Use Tax

Paying for Reclamation

The Earth Conservancy funds its reclamation work in a number of ways: grants and loans, land sales, timbering and the sale of culm to co-generation facilities. Grants are a significant way in which EC pays for their reclamation work, but administrative costs are not covered by most grants, so they use these other methods to make up for what grants and loans do not pay. As reclamation costs increase, it is imperative the EC find a variety of ways to fund its work, as it is for EPCAMR.

Grant funding can come from a variety of sources: the Federal or State government, County or local governments or private foundations. The Earth Conservancy has been very successful at obtaining funding through sources such as the U.S. Environmental Protection Agency (US EPA) Brownfield and Land Revitalization Program. The program is designed to assist states, communities, and non-profits in economic redevelopment, by preventing, assessing, safely cleaning up, and sustainably reusing a brownfield site. A brownfield site is a property, the expansion, redevelopment, or reuse of an existing site, which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Congressman Paul E. Kanjorski was instrumental in having abandoned mine lands included in the Brownfields program.

The Commonwealth of Pennsylvania Department of Environmental Protection (PA DEP) has been another important partner in funding reclamation work on Earth Conservancy's land. They have received funding through the Growing Greener, initiated by Gov. Tom Ridge and expanded by Growing Greener II, started by Gov. Ed Rendell. Additional support has come through the Energy Harvest Program and the Illegal Dump Cleanup Program. The DEP is the state entity responsible for the state's environmental laws and regulations and supporting environmental improvements in the community including air, water, energy technology development improvement programs.

The Earth Conservancy has partnered with EPCAMR, the Huber Breaker Preservation Society, the Delaware and Lehigh National Heritage Corridor, Inc., local Colleges and Universities, local municipalities, local school districts, the Pennsylvania Environmental Council-NE Office, PA Department of Conservation and Natural Resources, the PA DEP Bureau of Abandoned Mine Reclamation, the Wilkes-Barre Chamber of Business & Industry, the South Valley Chamber of Commerce, Penn's Northeast, and many other economic redevelopment authorities and agencies to reclaim abandoned mine lands throughout the Solomon Creek watershed.

Abandoned Mine Drainage (AMD) and Water Quality Impacts

As noted earlier, **14** layers of coal bearing strata (or coal seams) occur in the Solomon Creek watershed. The lowest layer, which was often deep mined, was the Bottom Red Ash**.** The upper layers consisted of the Middle Red Ash, Top Red Ash, Ross Bed, Skidmore (Twin) Bed, Pittston (Baltimore, Bennet or Cooper or Forge) Bed, Checker (Stanton or Orchard) Bed, Hillman Bed, Kidney (Lance or Mills) Bed, Abbott (Rose) Bed, Snake Island (George) Bed, and the #2, #3, and #4 Beds.

As the name implies, abandoned mine drainage comes from the runoff of water from mines. However, it is less commonly understood why such runoff should be acidic. The actual cause of acid drainage is the result of naturally occurring metals and minerals in the soils and rocks that interact with the atmosphere. Once exposed to water and air, the reaction byproduct includes a net increase in hydrogen ions or acidity. Among the reacting elements is iron, aluminum, manganese, and sulfur iron or pyrite. Iron and aluminum are among the five most abundant elements in the Earth's crust while manganese and pyrite are often found in association with coal bearing strata in Pennsylvania (Cecil, 2005).

A common reaction producing acid is the result of combining iron-sulfur (pyrite), with oxygen & water:

$$4\ FeS_2\ (s) + 15\ O_2\ (g) + 14\ H_2O\ (l) \text{--->} 4\ Fe(OH)_3\ (s) + 8SO_4^{2-}\ (aq) + 16H^+\ (aq)$$

The product of this reaction is a net increase in hydrogen ions, and a decrease in pH, which precipitates out Fe(OH), better known as iron hydroxide or rust. This iron oxide reaction can give streambeds and rocks a yellowish-orange coating sometimes called "yellow boy."

Aluminum, a metal highly toxic to trout and other fish in relatively low concentrations, also precipitates out at pH 5.2, through the reaction:

$$2Al^{3+} + 2H_2O \text{--->} Al(OH)_2^{\ 4+} + 2H^+$$

This is one of a variety of reactions with aluminum that generate a net increase in hydrogen ions and which lower the pH. Interestingly, aluminum also precipitates out in streams but forms a white coating on rocks. Besides discoloring stream bottoms, aluminum also affects biological life in more direct ways. When in waters with a more neutral pH, aluminum precipitates out and can clog fish gills (Exley C., 1991). However, at a lower pH, aluminum mobilizes and can disrupt the sodium balance in fish blood, leading to renal failure and death at exposure concentrations of less than one part per million (Gagen and Sharpe, 1987).

The presence of these elements within soils varies with the geology of the area. Despite the natural abundance of these elements within soils, streams normally do not become acidic. The reason is because such elements are usually deep within the earth's crust and blocked from atmospheric exposure. Time and natural weathering removed the source from exposure and allowed streams to evolve life-supporting conditions. When minerals are exposed to atmospheric oxygen in underground channels, in contact with water, the resulting chemical reactions disrupt the normal equilibrium. Coal mining allowed for this exposure at a large scale, which requires extensive remediation. The weathering of these elements in the soils occurs on a geological time scale, similar to natural weathering from exposure. As a result, impacts from acid mine drainage, once initiated, are not likely to dissipate in a short time span.

Although the coal seams were relatively shallow (up to less than 50 feet below the surface), deep mining extended below the existing water table. During mining operations, mines would fill up with water while coal was being extracted. In dealing with this situation, operations were performed in such a way as to take advantage of the downward sloping geology where work would start at the bottom and progress up the slope, allowing water to drain by gravity (Gannett Fleming, 1970). The other solution used was a system of underground tunnels and pumps to remove the water. Once operations were abandoned, water was left to fill channels and sumps in the land and created a continuous source of acidic discharge, by infiltrating the groundwater (base flow) or as a direct surface discharge (Gannett Fleming, 1970).

Most of the High Quality Stream classifications according to Chapter 93 are located in the Pine Creek sub watershed on the south side of Wilkes-Barre Mountain to the northeast, located in portions of Hanover Township, Bear Creek Township, Fairview Township, Rice Township, and Laurel Run Borough , and northwest from Haystack Mountain down to the Pine Creek Reservoir just below Solomon Gap. The main stem of Solomon Creek is classified as cold-water fishery. The entire length of the Sugar Notch Run sub watershed that can be found draining from portions of the State Game Lands 207 off Penobscot Mountain to the northeast and off Wilkes-Barre Mountain from the southeast in its headwaters. The majority of the Spring Run sub watershed drains the northwest terminus of Wilkes-Barre Mountain, through the communities of Georgetown, Laurel Run Borough, and Wilkes-Barre Township and were listed on the Federal Integrated list of non-Attaining Uses (**Figure 2-11***,* PA DEP 2012), including the point of confluence with the main stem of Solomon Creek all the way to its mouth on the Susquehanna River.

A total of **6** mine drainage discharges have been reported within the Solomon Creek watershed. The greatest amount of exposure in Solomon Creek comes from runoff within deep mines. A typical mining practice of the day was to refill abandoned deep mines with mine spoil and overburden. Another way that mine water pollution is occurring in the watershed is when overburden piles that covered the entrance to mines would crack or fissure and allow surface waters to seep through and interact with acid producing elements. The mine discharges will be described further in the report in detail as well as their connection to one of several underground mine pools in the area as will the separate sub watersheds within Solomon Creek. This abandoned mine drainage phenomenon turns out to be the main problem in the lower reach of the Solomon Creek watershed.

The main stem of Solomon Creek is impaired because of this acidic loading from impaired streams, but this pollution is diluted along the main stem of Solomon Creek by inflows from unpolluted streams. Because of this, pollutant-loaded tributary streams further downstream—towards the mouth of Solomon Creek, contribute additional acidic loading toward the total acidic pollution and iron loadings directly to Solomon Creek and then to the Susquehanna River. While Solomon Creek is typically capable of sustaining aquatic life in the upper headwater reaches, increased mine drainage into this stream from the 6 AMD discharge locations results in higher concentrations of metals, particularly iron and lower pH in the lower reaches of Solomon Creek that can stress fish and other aquatic organisms.

Atmospheric Deposition and Water Quality

Atmospheric acid deposition is another impact on water quality within the Solomon Creek watershed. Due to the particulate emissions that has air currents that hover over the Mid-Atlantic states from coal-burning power plants, automobile exhaust, and other industrial facilities hundreds of miles away in the Ohio Valley and other parts of the Midwest. Pennsylvania watersheds experience some of the most acidic rainfall and highest levels of acid deposition in all of North America.

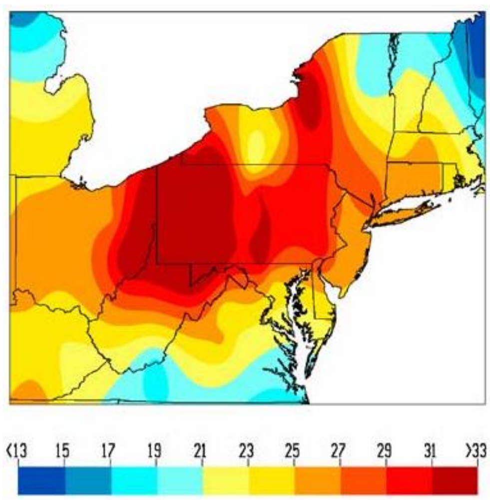


Figure 2-23 (Above) Annual Sulfate Deposition (kg/ha) from 1983 - 1994

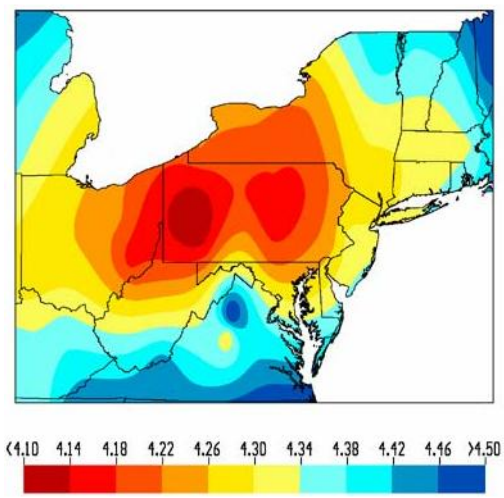


Figure 2-22 (Above) Annual pH from 1983 - 1994

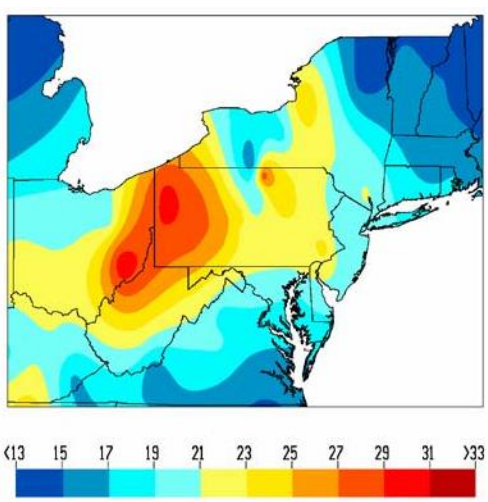


Figure 2-25 (Above) Annual Sulfate Deposition (kg/ha) from 1995 – 2005

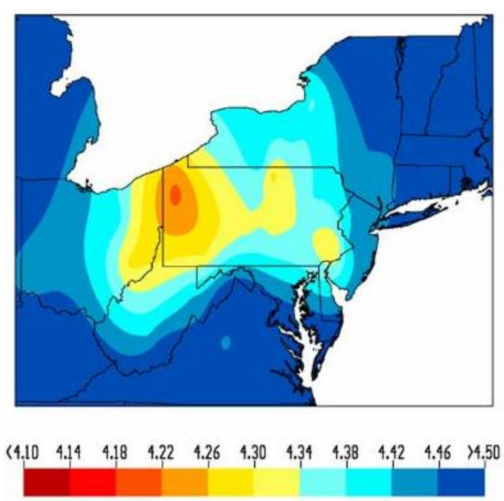


Figure 2-24(Above) Annual pH from 1995 - 2005

Dry deposition occurs as suspended particulate materials, nitrates and sulfates, settle on the land or leaf surfaces and are then washed into streams through overland flow during a precipitation event resulting in a temporarily spike of hydrogen ions, and a reduction in pH, to levels sometimes toxic to aquatic life (See **Figure 2-22 & Figure 2-24**). Deposition in the form of dry particulate matter and wet precipitation can be acidic due to air pollution from burning fossil fuels. Sulfur dioxide (SO2) and nitrogen oxides (NO, NO2) react in the atmosphere to form sulfuric and nitric acids. These acids can alter the environment where they fall from the atmosphere, which can be long distances from the pollution source.

This episodic acidification can be quite severe in small streams with little buffering or dilution capacity. Wet deposition occurs where the pH of rain is lowered as it forms in and falls through particulate-laden air (See **Figure 2-23 & Figure 2-25**), then directly falls or indirectly flows into streams as acidic runoff. The melting and runoff of snow pack laden with acid-yielding particulates can also cause an episodic acidification event. The periodic acidification can be quite severe in smaller headwater streams that have little buffering capacity or dilution abilities. (Lynch et al., 2005). The impacts of acidic deposition are usually noticed in the higher elevations or ridge tops that receive more deposition due to the orographic effect, and also in areas that have geologic formations with limited buffering capacity (Sharpe et al., 1984; Kimmel, 1999). Impacts to the environment include damage to trees, depletion of nutrients in the soil, and acidic stream water. Streams impaired from atmospheric deposition have low alkalinity and elevated aluminum during high flows (Sharpe et al, 1984; Kimmel, 1999). The aluminum is leached from the soil when other minerals such as calcium and magnesium are not available or are already depleted (Swistock et al., 1989). Inorganic aluminum is toxic to some aquatic life at levels higher than 200 µg/l when pH values are lower than 5.0 for sustained periods (Baker and Schofield, 1982; Gagen et al., 1993). The combination of low pH and toxic aluminum causes osmo-regulatory failure and can cause the depletion of fish populations in headwater streams. Some macro invertebrates are tolerant of acidic conditions, such as many different kinds of Plecopterans (stoneflies) and Dipterans (true flies); however, other macro invertebrates, such as Ephemeropterans (mayflies) are very sensitive to acidic conditions.

Since the implementation of Title IV of the Clean Air Act Amendments of 1990 mean annual pH of rainfall and sulfate deposition concentrations in Pennsylvania and neighboring states have been on the decline.

Recent Assessments and Restoration Projects

There are several major existing or plans developed related to restoration projects within in the Solomon Creek watershed.

Operation Scarlift

A comprehensive assessment of water quality in Solomon Creek was first performed in 1970 as part of Operation Scarlift, a Pennsylvania state program undertaken in the 1960s and 1970s to remediate land damaged by mining operations. Since then, additional assessments have been undertaken in various tributaries throughout the watershed. The absence of any fish species was documented in the Scarlift Report from 1975. Upstream of all coal activity the creek is unpolluted (GEO-Technical, 1975).

PA Fish and Boat Commission Fishery Management Reports

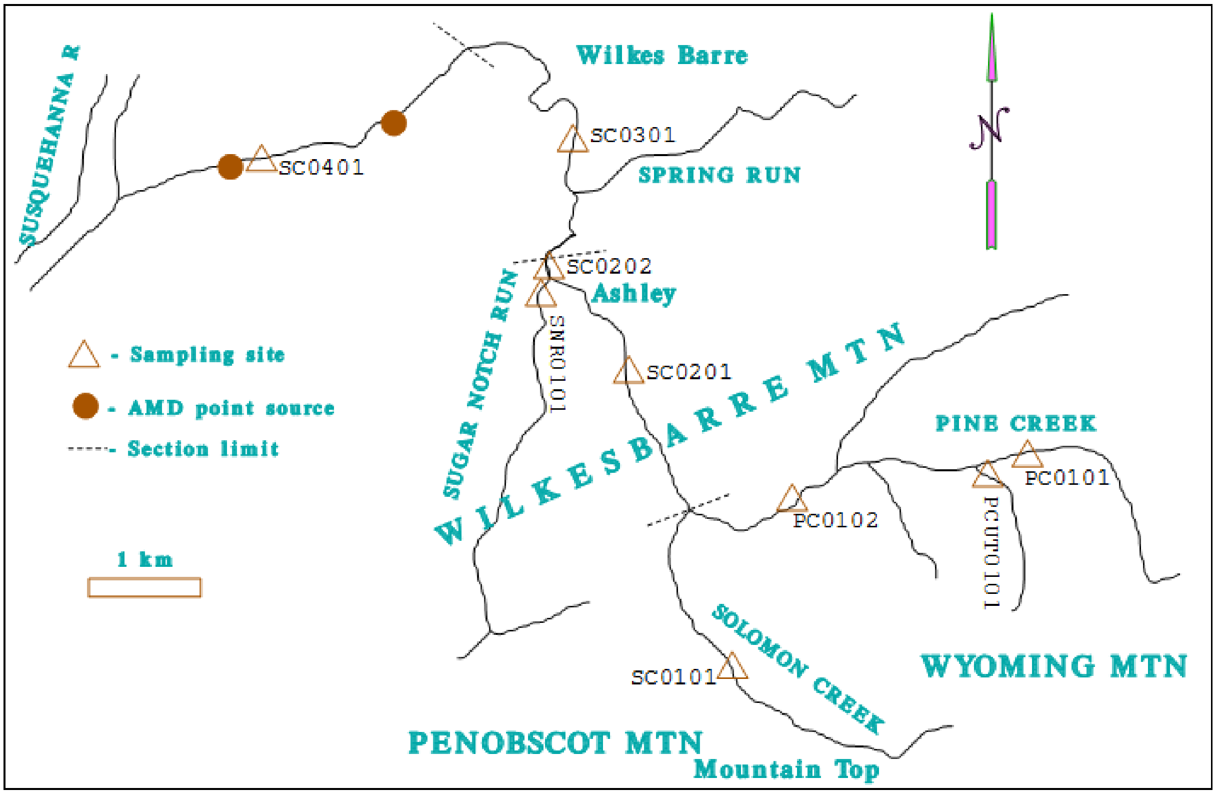
The work by Daniels et al. (1977) constitutes the first survey by the Pennsylvania Fish and Boat Commission (PFBC) personnel in the Solomon Creek watershed. They examined Solomon Creek in response to a request to stock the middle reaches of the stream. The only native fish present were brook trout. They recommended against stocking and characterized this area and downstream as degraded by siltation and acid mine drainage (AMD). This area was stocked by local sportsmen for children, a practice that continues today in partnership with the PA Fish & Boat Commission and the Ashley Trout Stocking Association. The area is dammed up, which tends to increase pool temperatures in that area. An article from a local newspaper in the area, the Citizen's Voice from Sunday, April 17, 2011, depicts youth having fun on the Solomon Creek main stem, locally called "Chester Creek", at their Annual fish derby for youth 15 and under. Approximately 100 youth participate each year. Youth who catch a tagged fish win prizes. This area was stocked with approximately 2,000 trout.

Malione et al. (1984) sampled above and below the upstream AMD source. They observed several unidentified minnows above the outfall on the main stem of Solomon Creek. Their other results were consistent with those found previously by Daniels et al. (1977). They noted that much of the flow in this lower reach originates from the mine outfalls of the Solomon Creek AMD Boreholes and the Buttonwood Shaft Tunnel AMD discharge. Their work shows the devastation caused by AMD to even the most tolerant biota. They did not electrofish the headwaters or downstream reaches at this time. EPCAMR, in partnership with the PA Trout Unlimited, however, was able to electrofish sections of the headwaters and other downstream reaches as well as strategic locations where fish were present during the field investigations conducted by the EPCAMR Staff while walking the stream channels during the assessment phase of the project. A Fishery Survey Technical Report from the PA Trout Unlimited of the conclusions of the two-day electroshocking survey completed in the Fall of 2012 are attached in **Appendix B**.

There have been several studies within the watershed to assess the biological community and water quality (Wood, 1996; Bruns and others, 2000; 2001; 2005). In June of 1995, a Fishery Survey was conducted by the PA Fish & Boat Commission, Bureau of Fisheries, Division of Fisheries Management called the ***Solomon Creek Basin 405B Management Report***. The initiation of this investigation was spurred by reports of native brook trout populations in the headwaters of the Solomon Creek drainage and the concerns of citizens about their protection. Solomon Creek, Pine Creek, and Sugar Notch Run were the focus of this particular Fisheries Management Report. The report was prepared by Timothy Copeland, Robert Moase, and Todd Myers, Fishery Biologists for the PA Fish & Boat Commission *(**See Figure 2-26**)*. The full report was completed in September of 1995 and can be found in **Appendix G**.

EPCAMR Benthic Macro Invertebrate Sampling

EPCAMR has also conducted sampling of benthic macro invertebrates and water chemistry in the Solomon Creek Watershed in 2003. The sampling performed at the boreholes and just downstream in Solomon Creek, along its main stem where the South Wilkes-Barre AMD boreholes discharge, found no macro invertebrates present and the stream index was rated as poor (Hughes et al., 2003).



Site		RT	BT	ST	FHM	BND	LND	CC	WS	PS
Solomon	0101		X							
	0201	XX	X	X	X	X	X	X		
	0202	X	X		X		X	X		
	0301		X				X	X		
Pine	0101									
	0102		X		X			X		

RT = Rainbow trout (*Oncorhynchus mykiss*)
BT = Brown trout (*Salmo trutta*)
ST = Brook trout (*Salvelinus fontinalis*)
FHM = Fathead minnow (*Pimepheles promelas*)
BND = Blacknose dace (*Rhinichthys atratulus*)
LND = Longnose dace (*Rhinichthys cataractae*)
CC = Creek chub (*Semotilus atromaculatus*)
WS = White sucker (*Catostomus commersoni*)
PS = Pumpkinseed (*Lepomis gibbosus*)

2-26 PA Fish & Boat Commission, Bureau of Fisheries, Division of Fisheries Management called the Solomon Creek Basin 405B Management Report

Solomon Creek Watershed TMDL, Luzerne County, For Acid Mine Drainage Affected Segments

The Clean Water Act (CWA) requires that Total Maximum Daily Loads (TMDLs) be developed for those water bodies identified as impaired by the state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water body without exceeding water quality standards.

The Pennsylvania Department of Environmental Protection (PADEP) Bureau of Watershed Management originally submitted the ***Solomon Creek Watershed TMDL Report for Acid Mine Drainage Affected Segments***, ***Luzerne County, PA*** to the U.S. Environmental Protection Agency (EPA) in February 2005. PADEP revised the TMDL Report to address the 1996 suspended solids listing and electronically submitted the TMDL Report dated March 20, 2007, to EPA for final Agency review on March 22, 2007. That report includes the TMDLs for the three primary metals associated with acid mine drainage (AMD) (i.e., iron, manganese, and aluminum), pH, and sediment, and addresses one segment on Pennsylvania's 1996 Section 303(d) list of impaired waters. In 1997, PADEP began utilizing the Statewide Surface Waters Assessment Protocol to assess Pennsylvania's waters. This protocol is a modification of EPA's 1989 Rapid Bioassessment Protocol II and provides for a more consistent approach to conducting biological assessments than previously used methods. The biological assessments are used to determine which waters are impaired and should be included on the State's Section 303(d) list. The entire Solomon Creek TMDL is in **Appendix A**.

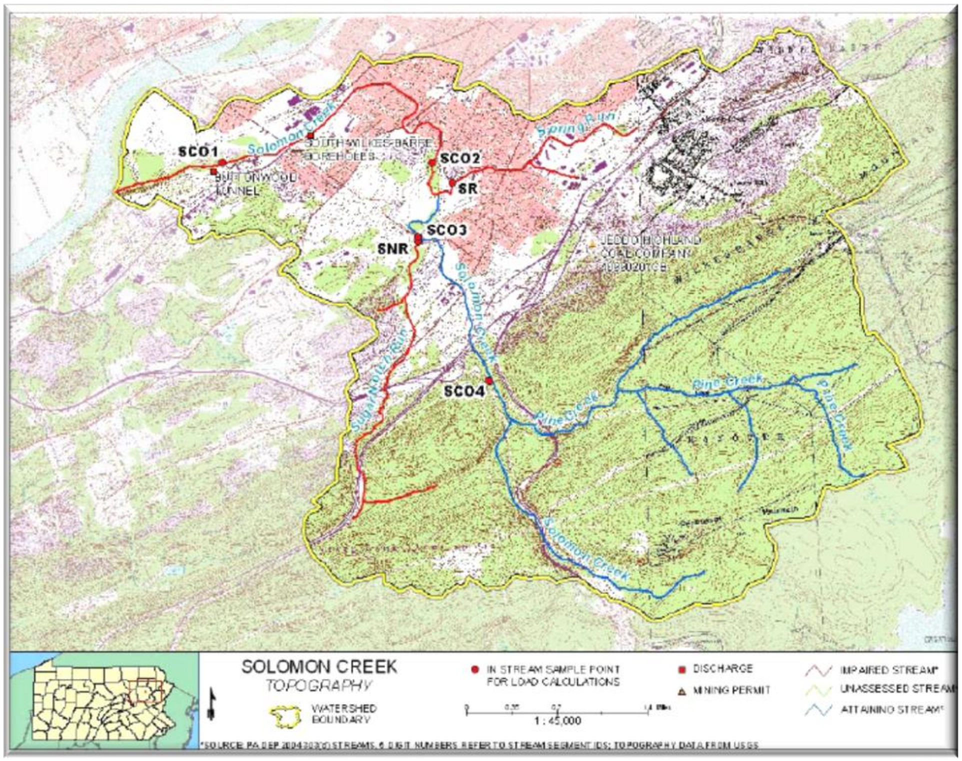


Figure 2-27 In stream Sampling Points for Load Calculations and Discharge Points, along with the categories of the stream impairments within the Solomon Creek Watershed (Solomon Creek TMDL Report, 2007)

Act 167 Stormwater Management Plan for Luzerne County, PA

In June 2010, Luzerne County developed a Stormwater Management Plan. The Stormwater Management Plan was developed to comply with the requirements of the 1978 Pennsylvania Stormwater Management Act, Act 167. This Plan was the initial county-wide ***Stormwater Management Plan for Luzerne County***, and served as a Plan Update for the portions or all of 6 watershed-based previously approved Act 167 Plans including Solomon's Creek. The report was developed by Borton-Lawson Engineering to document the reasoning, methodologies, and requirements necessary to implement the Plan. The Plan covers legal, engineering, and municipal government topics which, combined, form the basis for implementation of a Stormwater Management Plan. For the Act 167 Study, watershed characteristics such as land cover, hydrologic soil groups, and topography were input into a GIS model in order to develop the hydrologic characteristics of the Solomon Creek watershed. The study broke down Solomon Creek into **63** smaller sub-basins for analysis.

It is the responsibility of the individual municipalities located within the County to adopt this Plan and the associated Ordinance to provide a consistent methodology for the management of stormwater throughout the County. The Plan was managed and administered by the Luzerne County Planning Commission in consultation with Borton-Lawson, Incorporated. The Luzerne County Planning Commission Project Manager was Nancy Snee. Plan development occurred over the course of 3 years with the final adoption of the Plan at the County level in July 2010. The ***Luzerne County Act 167 Stormwater Management Plan Phase II Executive Summary*** is in **Appendix H**.

Anthracite Region AMD Remediation Strategy

On March 11, 2010, EPCAMR and Tom Clark, AMD Program Coordinator for the Susquehanna River Basin (SRBC), jointly held a regional meeting at the Penn State Hazleton Campus to discuss the development of an ***Anthracite Region AMD Remediation Strategy*** for the Susquehanna River Basin. EPCAMR was seeking additional mining maps and locations of other references, borehole, or discharge data that would assist us with covering the gaps that we have located throughout the entire four Anthracite Coal Fields with an emphasis on the Northern and Eastern Middle Coalfields, but was also interested in the Western Middle and Southern Coalfields too. EPCAMR even put forth several proposals to further develop the mine pool mapping initiative in its Northern Bituminous Region to map out those areas to see if it can be duplicated state-wide in the future. In December 2011, the Susquehanna River Basin Commission (SRBC), in partnership with EPCAMR completed the ***Anthracite Region AMD Remediation Strategy (Publication 279a)***.

To help address the environmental impacts while promoting the resource development potential of the Anthracite Coal Region, the SRBC determined there would be significant benefits to developing a remediation strategy for this AMD-impaired region. SRBC initiated a review and analysis of water quality impacts with EPCAMR and prepared the remediation strategy to be used as a guide to help resource agencies and organizations achieve comprehensive, region-wide environmental results over the long term. From the outset of this project, SRBC stated its intention not to duplicate the efforts of other agencies and organizations where problem-identification and problem-prioritization initiatives were already underway or completed. Instead, the purpose of this strategy was to help identify overlapping goals and opportunities, and to offer alternatives for remediation efforts through conceptual treatment plant suggestions.

The amount of discharges found in each watershed does not always correlate with the amount of discharge flow and loading created in each watershed. For example, Solomon Creek, located in the contained only **2** large volume discharges (**0.6** percent), yet is impacted by **9.3** percent (**61.72** cubic feet per second (cfs)) of the total Anthracite discharges flow within the Susquehanna River Basin. Nearly **12,500** pounds of iron per day, **1,291** pounds of manganese per day, **78** pounds of aluminum per day, **103,340** pounds of alkalinity per day, and **22,172** pounds of acidity per day are associated with the loading rates just from these **2** discharges that emanate from the three South Wilkes-Barre AMD Boreholes and the Buttonwood Shaft, alone. They are the ***third*** and ***fourth*** highest average AMD flows and the ***second*** and ***third*** highest iron loading discharges in the entire Susquehanna River Basin portion of the Anthracite Coal Fields. Consequently, the discharge flow rate in Solomon Creek is the highest of any watershed at **3.39** $ft_3/s/mi_2$. **16.9%** of the iron loading comes from Solomon Creek that enters the Susquehanna River.

Mine Water Resources of the Anthracite Coal Fields

In June 2011, EPCAMR and a team of experts from the Pennsylvania Department of Environmental Protection (PA DEP) Pottsville District Mining Office, the PADEP Bureau of Abandoned Mine Reclamation (BAMR), U.S. Geological Survey (USGS) Pennsylvania Water Science Center, and the Office of Surface Mining (OSM) Appalachian Regional Office completed a 4 year study of water quantity, quality, and potential usage from underground mines in the Anthracite Region. A majority of the study was funded by a Growing Greener grant from PA DEP and a grant from the Foundation for Pennsylvania Watersheds.

The objective of the project was to determine the immediate and long-term availability (water quantity and water quality) of mine-water resources, particularly for the Western Middle and Southern Anthracite Fields of Eastern Pennsylvania. However, an overview and methodology of mining for the Northern Anthracite and Easter Middle Anthracite Region were included in the report as well, including information on the Solomon Creek Watershed.

The project involved the compilation, evaluation, and synthesis of data on the hydrogeology of flooded underground mines. Information maintained in paper files by State and Federal authorities was digitized and combined with other available data to develop a comprehensive geographic information system (GIS) database containing the locations, topographic elevations, water-level elevations, flow rates, and water quality in wells, boreholes, abandoned mine drainage (AMD) sources, and associated stream reaches throughout the region. Additional data on the locations of coal outcrops, barrier pillars, and mine boundaries will be included in the GIS database. These data will be evaluated to delineate horizontal and vertical boundaries and to estimate corresponding current flooded volumes for the major mine pools, also known as multi-colliery hydrogeologic units. The associated recharge area(s) and primary discharge points for each of the major mine pools will be identified considering digital topographic, mine map, and aerial photography data.

The full report is available for download explaining in detail the hydrogeological characteristics of each mine pool in the western middle field and the results of the GIS and ground-water resources analysis that identify the quantity and quality of the mine-pool water resources. The maps will be useful to guide land-use managers as well as public and private interests concerned with water availability and economic redevelopment in Pennsylvania's Southern and Western Middle Anthracite Region. EPCAMR is currently working to continue this work for the Northern Anthracite Coal Fields with funding provided by the SRBC, which includes priority AMD impacted areas in the Lackawanna River watershed (Old Forge and Duryea AMD) and in the Wyoming Valley (Solomon Creek AMD Boreholes and the Buttonwood Shaft AMD discharge) that also flows into Solomon Creek.

The full report is entitled ***Mine Water Resources of the Anthracite Coal Fields: Water Quantity, Quality, and Potential Usage from Underground Mines in the Anthracite Region—Western Middle and Southern Fields.***

Cultural and Historical Character

Natural resources have played an important role in the Solomon Creek watershed's long and rich cultural history. Use of these resources has defined the character of the watershed's landscape, waters, and settlers. Native Americans had lived in the region for 8,000-10,000 years prior to European settlement. They sustained themselves by farming, hunting, and fishing throughout the watershed. Beginning in the 19th century, early European settlers recognized the value of the watershed's various natural resources. Coal and timber extraction attracted many new inhabitants to the Wyoming Valley in the mid-1800s. Railroads and canals were constructed allowing transport of materials from the watershed to other parts of Pennsylvania, the West, and the East Coast, further fueling the demand for these raw materials.

Solomon's Creek—so called, says Pearce ("Annals," p.170, 1860), "from a Mr. Solomon who settled near its confluence with the Susquehanna in 1774." This stream has its chief source in Wright Township, Luzerne County, whence it flows through Solomon's Gap, previously mentioned, into Hanover Township. It passes through the borough of Ashley, receiving in its course two or three small tributaries, the principal one of which rises in the uplands of Wilkes-Barre' Township. Crossing the Wilkes-Barre-Hanover boundary-line it flows a short distance within the limits of the city of Wilkes-Barre, and then, flowing back into Hanover, pursues a south-westerly course along the margin of the Upper Hanover Flats to the river. From the Wilkes-Barre line to the river the stream has been known for some years as Buttonwood Creek, because there were at one time many buttonwood trees growing along its banks. This stream—from source to mouth—is designated as "Moses' Creek" on the plot of the Manor of Stoke previously mentioned; and is indicated by the same name on William Scull's maps of Pennsylvania published in 1770 and 1775. On the manuscript map mentioned on page 27, it is noted as "Moses' or Solomon's Creek." Why the name "Moses" was given to it we do not know; but in all probability, it was named for some Indian chief who dwelt hereabouts in early days, and was known by the name of "Moses" to the traders and surveyors who visited the Valley at that period.


Figure 2-29 (Above) Lower Falls


Figure 2-28 (Above) Upper Falls

The accompanying photo-illustrations of the Lower and Upper Falls of Solomon's Creek are reduced copies of wood-engravings, after drawings by Jacob Cist of Wilkes-Barre, published in The ***Portfolio*** of Philadelphia in the year 1809—one in the November and the other in the December issue of the magazine. In the latter issue there appears, also, the following description (in part) of these falls—written without a doubt by Mr. Cist: (***See Figures 2-28 & 29***)

"Among the numerous streams that rush from the mountain into the bosom of the majestic Susquehanna, the beautiful cascade of Solomon's Falls is well calculated to gratify the ardent admirer of the works of Nature. It is situated about three miles from Wilkes-Barre, the county-town of Luzerne, Pennsylvania. Surrounded with dark hemlocks, the rocks stained with moss and partially covered with laurel and other evergreens, it forms one of the finest scenes for the pencil of the painter. Dashing, foaming and working its tempestuous way down the mountain's side, it here precipitates itself, in the most romantic and picturesque manner, over a ledge of rocks between fifty and sixty feet high into a natural bason of about twenty-five feet diameter; from which, winding beneath o'erhanging rocks, it passes through a narrow, perpendicular fissure and pours into a second bason, forming the lower fall—from which latter it runs in a rapid and winding course to the river."

Sharp D. Lewis of Wilkes-Barre, writing of these falls in 1830, said:

"In Solomon's Creek, about midway up the mountain and two miles from Wilkes-Barre, in what is called Solomon's Gap, is a beautiful cascade, which has long been visited as a great natural curiosity. Its wild and romantic aspect, and the delightful natural scenery around it, has, within a few years, been considerably injured by the erection of a very superior merchant mill immediately below the falls, by Gen. William Ross of Wilkes-Barre, who is the proprietor of this valuable water-power." A visitor of today to the locality would find it difficult to discover many remains or traces of the "picturesque" and "delightful" conditions mentioned as existing there seventy and more years ago; and which, in fact—as the present writer remembers—continued in evidence, to a degree, up to about thirty or thirty-five years ago (Harvey and Smith, 1909).

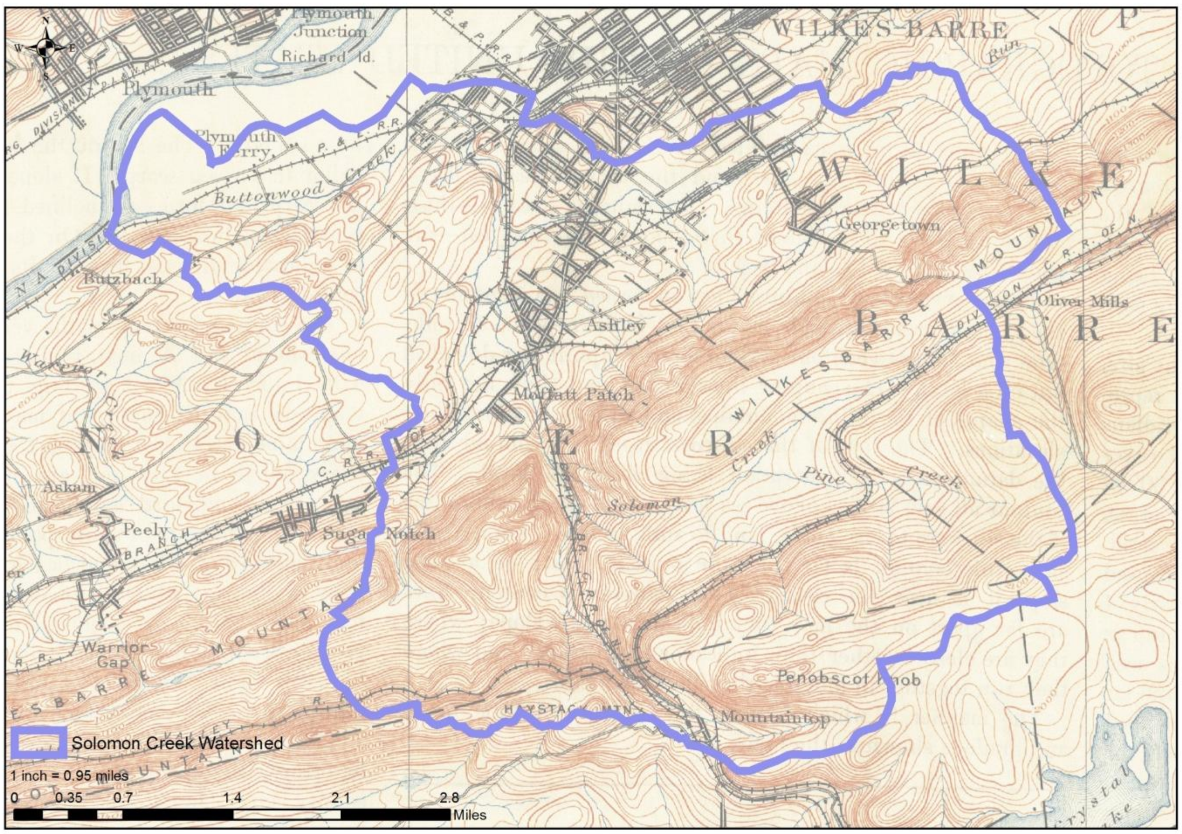


Figure 2-30 Map from the 2nd Geological Survey (1894) showing Buttonwood Creek and the historic streams that made up Solomon Creek (modified by EPCAMR with GIS Watershed Boundary, 2012)

In another reference, ***"A History of Wilkes-Barre, Luzerne County: From Its Beginning to the Present Time, Including Chapters of Newly Discovered Early Wyoming Valley History"*** (Harvey and Smith, 1909), the short mountain range forming the northeastern, eastern, and southeastern boundary of the Wyoming Valley is known as Wilkes-Barre Mountain, and that forming the northwestern, western, and southwestern boundary is called Shawanese Mountain. The continuation of the Wilkes-Barre range in a north-easterly direction from the head of the Wyoming Valley is known by the name of Lackawanna Mountain; while the continuation of the Shawanese Mountain beyond the north-eastwardly from the Susquehanna at the head of the Valley is called Capouse Mountain. That part of Wilkes-Barre Mountain lying between Laurel Run and Solomon's Creek was called in 1809-1813 (and, perhaps, before those years as well as later), "Bullock's Mountain"—evidently from Nathan Bullock, who, with his family, was an early settler on the mountain. Paralleling the Wilkes-Barre-Lackawanna range on the south-east, and lying near it, is a much longer and higher, although more broken and irregular range, bearing different names in different localities. At its south-west end, and thence for several miles north-easterly, it's known as Penobscot Mountain.

The mountains that form the Valley of Wyoming are quite regular in their conformation and appearance, and are almost uniform in height throughout their whole extent. The crest-line of Wilkes-Barre Mountain varies from 1,200' to 1,400' feet above sea-level, while that of Shawanese Mountain varies from 1,000' to 1,625'=its average height being about 1,450'.

Historically, the Solomon Creek watershed had many more visible and flowing tributary streams prior to the heavy pressure that mining began to put on the watershed following the late 1890s. Buttonwood Creek was a tributary to Solomon Creek and there were at least **7** other tributaries that carried freshwater from off Wilkes-Barre Mountain north towards the City of Wilkes-Barre area before entering the Spring Run sub watershed between Ashley and Georgetown. Much of the Spring Run sub watershed has been damaged from past mining and only remnant ephemeral flows come down the mountain on the east side of Interstate I-81 through the area by Allan Industries and Corgin's Industry in Wilkes-Barre Township heading towards Blackman Street and business State Route 309.

In the very headwaters of the Spring Run sub watershed, where EPCAMR sampled, is a unique geologic formation, known as Prospect Rock, some 1,300’ above sea level and 794’ above the Susquehanna River. It’s almost due south-east from Public Square, Wilkes-Barre, 2.25 miles, “as the crow flies”, and is a steep ledge—limited in extent and very irregular in its conformation---composed of light gray, almost, white conglomerate. For years it has been the favorite and most accessible point from which to obtain an almost complete view of the Wyoming Valley. The Harvey reference document is listed as **Appendix I**, and contains over 700 pages of text, therefore, it is only included on the DVD, as a digital document file.

Pine Creek has stayed relatively intact as has the headwaters of Solomon Creek that has carried freshwater from Penobscot Knob in Mountaintop, through Solomon Gap, and then down towards the historic Moffatt Patch and Ashley. The Pine Creek Main Stem historically was known as Solomon Creek in 1894. Sugar Notch Run has also been relatively been untouched in the headwaters of Wilkes-Barre Mountain down towards Sugar Notch before heading into Ashley. At this time, there were canal boats and steamboats still on the Susquehanna River and Plymouth Ferry was a stop within the Solomon Creek watershed just west of Richard Island. The historical watershed’s geography and hydrology is depicted in (***Figure 2-30***).

Historic Knox Mine Disaster and Changes to the PA Clean Streams Law of 1965

Figure 2-31 Knox Mine Disaster Breakthrough into the bed of the Susquehanna River, 1959

Two major events, the Knox Mine Disaster, on January 22, 1959, in the Northern Field's Jenkins Township, near Port Griffith, Luzerne County, and the changes in the ***Pennsylvania Clean Streams Law*** in 1965, spelled the end of almost all of the major collieries and the decline in Anthracite production as a major industry in Northeastern Pennsylvania. The Knox Mine disaster is described in detail in Chapter 5 and in (Wolensky, 1999). Essentially, a breach in the mine opened up (**Figure 2-31**). The text on the nearby State Historical Marker at the site succinctly describes the event. The overlying Susquehanna River flooded that mine and many adjacent mines in the Lackawanna and Wyoming Basins (**Figure 2-32**), and most of these mines never recovered to continue pumping and mining. The costs of pumping water became economically unfeasible for most, if not all mining operators in the Wyoming Valley at that time.

The Susquehanna River broke throughout the thin rock roof of the River Slope Mine, Knox Coal Company. The hole was an estimated 150 feet in diameter, funneling in **10** billion gallons of water through the mine and other mine pools in the vicinity. One of the railroad tracks above were cut and bent towards the river. Over 50 Coal Hopper cars were pushed into the breach by a diesel locomotive. Over 400 mine cars were dumped over the bank into the hole but the water just kept rushing right in. Thousands of bales of hay and hundreds of railroad ties were also added. Culm, dirt, and rock barely stopped the river. Finally, the river was diverted around Wintermoot Island by building dams at both ends. Once they pumped the water out between the dams, the size of the hole was evident. Tons of clay and rock were poured into the hole and a concrete cap was placed on top of the opening. They then pumped much of the water out of the mine to look for the **12** missing miners. No bodies were ever recovered.

Pictures on the front page of the New York Times and in (Wolensky, 1999) show a giant vortex in the Susquehanna River where the river invaded the underlying Knox Mine and numerous adjacent mines.

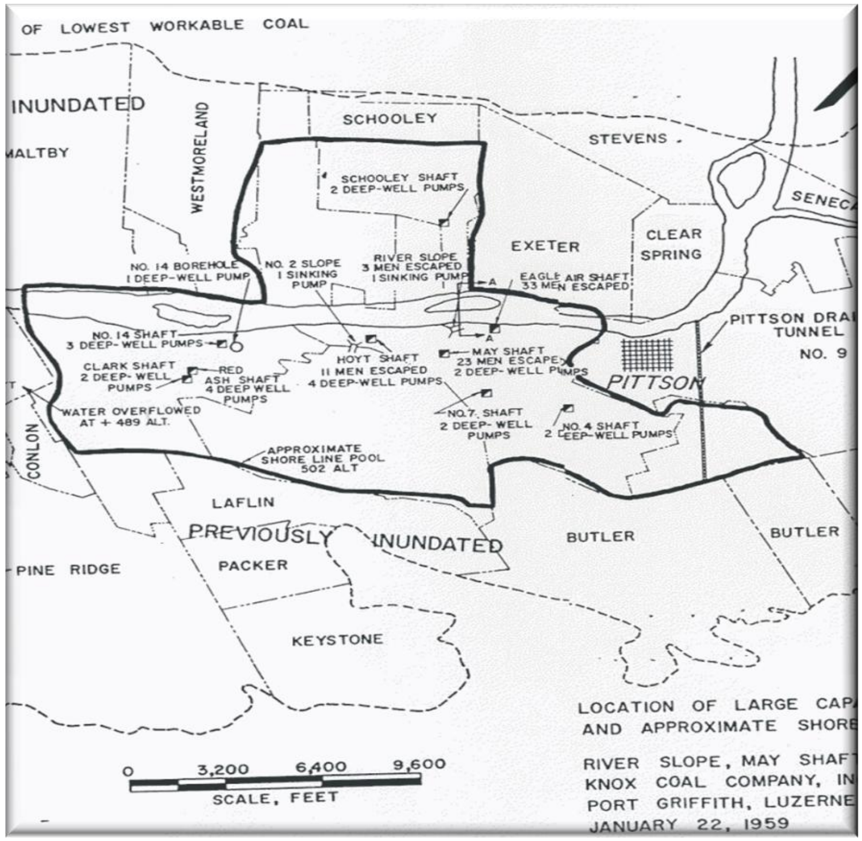


Figure 2-32 Knox Mine Disaster Pump Stations and places where men escaped, 1959

The volume of infiltrating water was so great that many mines could not pump a sufficient amount to remain dewatered, and consequently these mines became flooded and ceased working, never to reopen again. Wolensky et al. (Wolensky, 1999) include a photo showing where " Lehigh Valley Railroad tracks were cut and extended toward the river so that gondolas could be pushed into the whirlpool" (p.47) and they state that "In a scene that persists as one of the most powerful visual legacies of the disaster, trainmen thrust one gondola after another into the massive hole using a yard locomotive" (p.46).

Historic Coal and Refuse Bank Production in the Region

Most Anthracite coal was deep mined up through the 1930's, however, some surface mines existed and their coal production increased following World War II. Anthracite production peaked at just over one hundred million tons in 1917 (**100,445,299** tons) and most of this was obtained by underground mining. Surface mining is divided into open pits and coal refuse banks (i.e., refuse waste rock deposits from the collieries). Surface mine production did not exceed deep mine production until about 1960.

Refuse bank production increased sharply in the 1980's with the advent of cogeneration plants (i.e. fluidized bed combustors). Since 1985, refuse bank production and reclamation by cogeneration plants and affiliated mining companies has accounted for a significant amount of the total annual production and use. See the trade association's website formerly known as the Anthracite Region Independent Power Producers Association (ARIPPA), (www.arippa.org) for the history and the legacy of past mining on the PA landscape at (ARIPPA, 2011). The Pennsylvania Department of Environmental Protection's (PA DEP) Bureau of Mine Safety and its predecessor, the Department of Mines and Mineral Industries (DMMI), has maintained coal production statistics since 1870, when the total yearly production was **14,172,004** tons. The DMMI started reporting Anthracite coal production from refuse banks in 1894 and Anthracite coal production from strip mining in 1932. Prior to 1932, almost all of the Anthracite coal production was from underground mines.

The History of the Ashley Planes (1848-1948)

The remains of the Ashley Planes, an engineering work designed to move railroad cars over steep inclines, run through the mountain cut from Ashley to Solomon gap, south of US 81 and west of state route 309 along Solomon Creek. Construction of the Planes began in 1837 as part of the construction of the Lehigh & Susquehanna Railroad linking the Lehigh Navigation Canal with the Wyoming Anthracite Fields. Renovated and altered in the 1860s and in 1909, they eventually consisted of four separate inclined plane railroads used to connect Ashley with Solomon Gap, rising to an elevation of about 1,600'. Both passenger and freight cars were raised and lowered along 5-15 degree inclines by cables powered by steam engines. The Ashley Planes were in use until 1948. They were a critical part of the passage from the third Anthracite basin to Solomon Gap, and thence to all points south. Now in ruins, the remains of the Ashley Planes include the ruins of boiler, engine and drum houses; culverts, bridges, impoundments, and dams; and a village called Dogtown. Parts of the Ashley Planes are located on PA State Game Lands 207 and other portions are owned by the Earth Conservancy and are under rehabilitation as a hiking and recreational trail. The ***Ashley Planes Heritage Park Conceptual Master Plan*** prepared for Earth Conservancy by Urban Research and Development Corporation in association with the RBA Group and Borton-Lawson Engineering completed in December of 2000, helps to determine the most effective use of the Ashley Planes historic features, while capitalizing on the site's natural resources and environmental setting within the Solomon Creek watershed. A digital copy of the Plan is in **Appendix J** on the DVD.

The Earth Conservancy, (www.earthconservancy.org), a non-profit organization committed to the revitalization of former coal company owned land, became poised to revive the Ashley Planes, embarking on an ambitious plan to resurrect many of its hidden secrets. The **400** plus acre park would showcase the historical significance of the Ashley Planes and utilize the sites scenic wooded areas for hiking and biking trails along Solomon Creek. The goal was to highlight the unique attributes and history of the Ashley Planes to a new generation of residents, outdoor enthusiasts, and tourists as well as provide a recreational park for area residents. The Planes project is part of the Earth Conservancy's ***Lower Wyoming Valley Open Space Master Plan***, (http://earthconservancy.org/html/osmp.html), which includes several recreational parks. The land is part of **16,300** acres the Earth Conservancy purchased from the bankrupt Blue Coal Corporation in 1994.

James J. Cotter is the Chairman and Chief Executive Officer of Reading International Inc., owner of **130** acres in the Ashley Planes area. Reading International is an international operator of cinemas and it takes its name from the former Reading Railroad. Despite the name linkage to a historic past, Reading International and Mr. Cotter are not responding to collaborative efforts intended to secure the land and pave the way for extension of the Delaware & Lehigh National Heritage Corridor trail through Fairview and Hanover Townships, and Ashley Borough, which could lead directly to the Huber Breaker. Michael Dziak, President/Chief Executive Officer of Earth Conservancy, and his organization have reclaimed about **1,500** acres of scarred mine lands over the last few decades and have been unable to rouse a response from Mr. Cotter. Mr. Dziak sent a letter to Mr. Cotter earlier this year tracing the efforts to secure the land for the trail and heritage park. In 1998, a broker with the Reading Co. approached Earth Conservancy and offer three parcels. EC bought **47** acres at that time and wanted to purchase **130** acres of Ashley Planes land. A purchase price of $139,000 was agreed to, but the sale did not occur. Mr. Dziak has made repeated efforts through John Hunter at Reading to accomplish the sale but those attempts were also unsuccessful.

Earth Conservancy does not have funds for the land purchase, and asked if Reading International would be willing to donate **107** acres. Earth Conservancy is willing to recognize Reading International as a benefactor and highlight the historic role the company has played in our regional and national history in return for the donation for the Ashley Planes Heritage Park. Mr. Cotter did not reply. Cotter, 73, presides over a company that had net income of $245.8 million in 2011. The Delaware & Lehigh National Heritage Corridor wants to link regions that mined and shipped coal and those that benefitted from its use. A 165-mile trail is envisioned from the Wyoming Valley south through the Lehigh Valley to Bristol in the Delaware Valley. The Ashley Planes would be a key segment. Luzerne County has opted out of participation in the Ashley Planes Heritage Park project due to its debt load. Earth Conservancy is willing to donate about **250** acres to the park. The Pennsylvania Department of Transportation (PA DOT) committed $1 million to pay for a parking area and kiosks. The county's money woes delayed land acquisition, the cost of which could not involve the PA DOT money. Construction will begin soon on trail segments totaling about **10** miles from White Haven to Glen Summit. The Ashley Planes trail would tie in to this segment. Visions of a restored Huber Breaker, Ashley, and Huber Miner's Memorial Park, would join Eckley Miners' Village and other anthracite sites as components of the heritage corridor. However, No. 1 Contracting Co., the breaker's owner, is in Chapter 7 bankruptcy, which calls for liquidation of assets and payments to 200-plus creditors. (http://citizensvoice.com/news/calif-based-business-stands-in-way-of-local-trail-system-1.1385116). A detailed report on **"The History of the Ashley Planes"**, including Annie Bohlin's contribution, can be found in the **Appendix K** and yet another reference to a more comprehensive cultural landscape inventory for Ashley, PA can be found in **Appendix L** that makes recommendations for areas around the Ashley Planes completed by the Delaware & Lehigh Navigation Canal & National Heritage Corridor Commission. Both of these digital documents are on the DVD.

The Huber Breaker Colliery

The Huber breaker could prepare **7,000** tons of anthracite daily. It featured Menzies cones, devices which separated coal from rock. The main conveyor was **450** feet long, and delivered coal to the top floor. An aerial tramway carried refuse from the plant. Prepared coal was hauled by rail south to Atlantic coast markets. All coal processed at the Huber breaker was sprayed with a blue iridescent chemical and marketed as “Blue Coal" (NPS HAER 1991).

The plans for the Huber Breaker were developed during 1937 and construction proceeded throughout 1938. It began operation on February 1, 1939. The breaker was built on a colliery site where coal was mined and prepared since 1851. The original mine at this site, the Hartford colliery, was sunk in 1851, and the breaker was built in 1856. It prepared coal until 1884, when it burned down. On the same site, a new breaker, the Maxwell was constructed by the Lehigh and Wilkes-Barre Coal Company, in 1895. By 1937, the Maxwell colliery and breaker, owned since 1929 by the Glen Alden Coal Company, needed extensive modernization as a result of advances in coal preparation technology and market demand for smaller sizes. The company determined the Maxwell Breaker did not lend itself to modernization, and, since it was faced with combining production from other mines for central cleaning, it announced a **$2,000,000** improvement program. The program was to include a new breaker and other shops at the colliery in Ashley, Luzerne County, Pennsylvania.

The power house generated power at levels considered the highest in the anthracite region. Four Stirling boilers, each with a capacity of **40,000** lbs. per hour, supplied the steam. The boilers were fired by Coxe traveling-grate stokers, **17** feet, **10** inches long and **12** feet wide. The plant produced **160,000** lbs. of steam hourly at a temperature of **632** degrees Fahrenheit. Its turbo-generator yielded 7,500 kw. The Spring Brook Water Company supplied water from the nearby Solomon’s Creek. The water for the power house was treated with zeolite to prevent scaling on the high temperature boilers. The power house stack rose to a height of **210** feet, the highest structure at the colliery.

Fourteen of the Menzies units were installed at the Huber breaker in 1939. Each of the commercial sizes was treated separately. Twelve cones were **9** feet, **4** inches in diameter and two were **7** feet. Each prepared approximately one ton per hour per square foot of area of the top of the cone. Each used

8,000 g.p.m. of circulating water. The Menzies cones were the principal coal washing units at Huber until the 1950s when new technology complemented their use (Janasov 1992).

As the market for anthracite coal diminished and the nature of anthracite mining changed from underground to stripping operations, the Huber breaker was phased out. Glen Alden sold its coal-producing subsidiary, Blue Coal Corporation, in 1966; the Huber breaker was sold to Lucky Strike Coal Company in 1975 and Blue Coal Corporation declared bankruptcy in 1967. The breaker ceased operation shortly thereafter.

In 1991, the Huber Coal Breaker Recording Project was part of the Historic American Engineering Record (HAER), a. program to document America's historic industrial, engineering, and transportation resources (NPS HAER 1991).

The cause to "Save the Huber" began in the early 90's, and the present Huber Breaker Preservation Society has recently gained momentum in securing the land from a private owner for development into an Anthracite Park and/or Museum. The Society has established itself in Pennsylvania as a 501(c)(3) non-profit corporation and has a growing active membership that meets on a monthly basis. The society is open to new members and is accepting donations to help to save the last original Anthracite coal breaker standing in the Northern Anthracite Coal Field. Their website is www.huberbreaker.org.

Figure 2-33 Huber Breaker Colliery

The Vulcan Iron Works

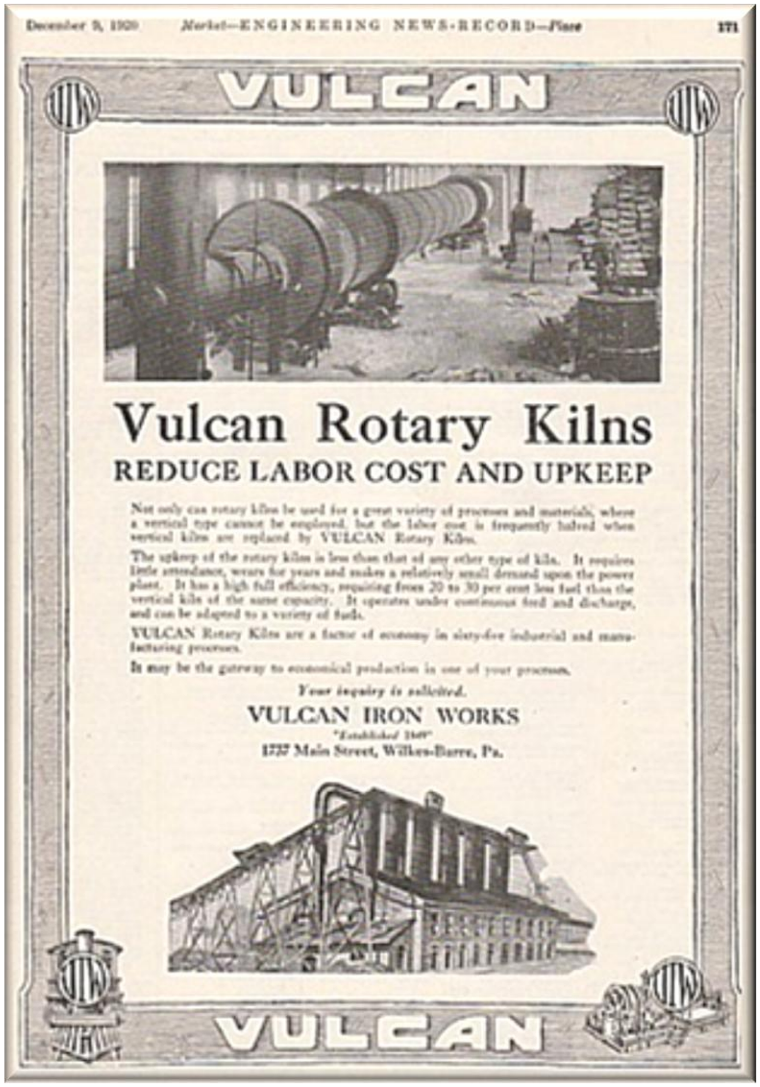


Figure 2-34 1920 Vulcan Iron Works Wilkes-Barre PA Ad: Rotary Kilns (http://www.ebay.com/itm/1920-Vulcan-Iron-Works-Wilkes-Barre-PA-Ad-Rotary-Kilns /310342199621#ht_1385wt_944)

The Vulcan Iron Works was born when Richard Jones on July 4, 1835, placed a miniature steam engine inside a 6½ foot long wooden boat with side wheels and launched a small steam-powered boat, that he had built, through the Wilkes-Barre canal basin that was an original part of the Solomon Creek Watershed in 1835. Jones, a local mill worker, had built his own steam engine two years earlier based on drawings he had seen in books. It was a small engine with a cylinder just 1½ inches in diameter. As the steam-powered boat dashed through the water, a crowd of youngsters gathered along the canal to watch the spectacle. Jones' success inspired him to establish alternative uses for his steam engine, including the construction of railroad locomotives.

He later formed Jones Iron Works in 1849, and Incorporated as Vulcan in 1867. "Vulcan Iron Works began to expand through mergers and acquisitions, taking over Wyoming Valley Manufacturing Co, Pittston Engine and Machine Co., and Carter & Allen Co of Tamaqua. In 1883, Vulcan merged with Pittston Iron Works and Wilkes-Barre Iron Works. The merger created a business valued at $586,000, about $25 million today. The operation established branch offices in Hanover Township, West Pittston and Tamaqua. Five years later, Vulcan acquired the Wyoming Valley Manufacturing Company, makers of locomotives. Locomotive building quickly became a major part of its operation. Over the next half century, Vulcan produced a total of 108 steam locomotives of various sizes for domestic and foreign industries.

The Vulcan Iron Works of Wilkes-Barre, PA, began producing internal-combustion locomotives in the 1920' and included a machine shop, a foundry, a blacksmith-boiler shop and a pattern store and office. The operation was centrally located with access to the Lehigh Valley Railroad, the Lehigh and Susquehanna Railroad, and the Pennsylvania Canal. Later, Vulcan expanded its business to include building locomotives and were the first company to manufacture diesel electric engines for World War.

Figure 2-35 Advertisement Railway Age Magazine, February 5, 1944

World War I led to further expansion. Vulcan built a steel plant with open-hearth furnaces to supply their needs. The United States, British, French, German and Italian armies all owned Vulcan engines and the company prospered during this era.

Vulcan, the Roman god of fire and smithery, was a popular namesake for foundries. They were suitable for the use of alcohol, gasoline, kerosene, distillate, and crude oil. These locomotives may be direct geared drive, or equipped for electric drive. Weights range from 4 tons to 70 tons. Business continued to grow during World War II when the Vulcan employed about 2,500 people.

Ironically enough, little did they know, that by building rotary kilns in the 1920s, that today, those same types of kilns could be an effective piece of machinery that could be used to dry and process iron oxides in mass quantities by other industries if they chose to locate in the Wilkes-Barre area and focus their efforts on removing the iron oxides that pollute the lower portions of the Solomon Creek watershed from abandoned mine drainage emanating from the South Wilkes-Barre Boreholes and the Buttonwood Shaft.

Figure 2-36 Summer 1929 Photo of the Vulcan Yard in Wilkes-Barre
(http://www.northeast.railfan.net/diesel98.html)

By 1929, the Vulcan was one of the City of Wilkes-Barre's most valuable assets, with 1,600 employees and Vulcan locomotive were running rampant throughout the Anthracite Region. It produced locomotives, sugar mills, mine hoists, giant kilns and other iron products for an international market. It produced locomotives like the Dorothy, Union Pacific 119, the Dewitt Clinton, and the Old War Horse. (Times- Leader Profile, 1992). A total of 54 diesel-electric switcher units, each weighing 25 tons or more, came out of Vulcan's shops during this era. Vulcan Engine No. 4385, manufactured in 1942, was one of the first diesel electric engines built for the U.S. Army. The company's largest unit was a 70-ton B-B unit built for Carnegie Steel Company in 1944. In February 1944, during the War, before the 'Doomsday Normandy landings, the company claimed "Today, hundreds of Vulcan locomotives are rendering vitally important war-time service, both at home and overseas, and our shops are working at top speed to complete urgent orders for Army, Navy and defense plant requirements. Tomorrow, more and larger Vulcan locomotives will be available to help rebuild a war-torn world."

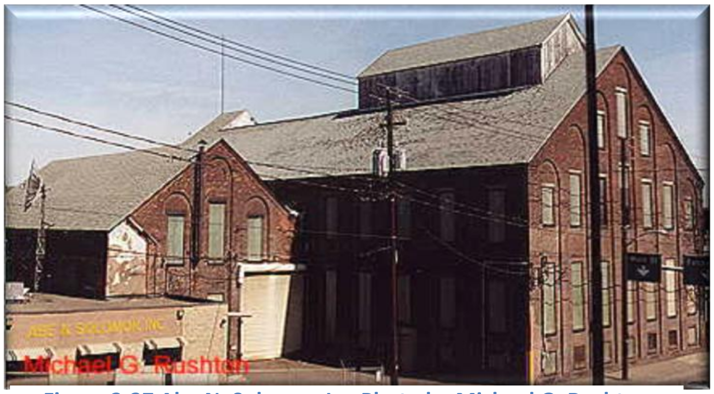


Figure 2-37 Abe N. Solomon Inc Photo by Michael G. Rushton

Vulcan also built a large number of gasoline powered locomotives with mechanical drives at this time. After the war, Vulcan switched to making diesel electric engines, but struggled to compete against General Electric and General Motors. Business declined and Vulcan was forced into bankruptcy in 1954.

Figure 2-38 Abe N. Solomon Inc Photo by Michael G. Rushton

For well over 50 yrs, the Vulcan Iron Works, Wilkes-Barre, PA built industrial/mine, switching and feeder line locomotives of various gauges and utilizing varied sources of power. Vulcan was noted for producing quality products worldwide. As a young lad Ed O'Donnell, witnessed the "birth" of various locomotives in the Hazle Street erection complex. In later years, (1946), as a freight conductor on the CNJ, he nursed (20 Horse Power) "French", "Turkish" etc. engines from Ashley, PA to Allentown PA, from which they would move to Jersey City, NJ for export. The company also maintained a plant in West Pittston, just north and across the Susquehanna River from Wilkes-Barre, where various metal parts were fabricated. (William Kashatus, March 6, 2011, Staff Correspondent, Citizen's Voice newspaper article, (http://citizensvoice.com/arts-living/iconic-ironworks-1.1113965#axzz1biSPvCxV)

Figure 2-39 Abe N. Solomon Inc Photo by Michael G. Rushton

Empire Silk Mill

The success of coal brought a steady stream of entrepreneurs who grew very rich and powerful. J. C. Atkins built the Wilkes-Barre Lace Manufacturing Co., and Fred M. Kirby opened his first five-and-dime stores at 172 E. Market St. in Wilkes-Barre. Men like Charles Parrish and the Coxe brothers owned mines, powder mills, timber companies, and railroads. In 1857, Charles Stegmaier began brewing beer on Hazle St, and he was turning out over 200,000 barrels a year by 1916. Silk and garment mills became major employers for mining woman with companies such as the Empire Silk Mill, importing silk from Japan. Today there are plans to make the Empire Silk Mill into loft apartment complex. Empire Silk Mill will provide affordable and market rate housing in an area where research has proven its need. The goal is to convert this brick majestic structure into its highest and most valued use while at the same time act as a catalyst by creating a strong, positive economic impact in the City of Wilkes-Barre. It's located in the Spring Run sub-watershed of Solomon Creek. It is also the very last mill, amongst many, that proudly remains standing in Wilkes-Barre, Pennsylvania. (**http://www.empiresilkmill.com/Business_Plan.pdf**). The article on the following page from March 10, 1940 recalls some details of working at Empire (**Figure 2-40**).

Railroads, boats, and buses competed for shipping dominance, but railroads eventually won out. However, Frank Martz opened what is now the very successful ***Martz Trailways*** bus line in 1908. The Boston Store opened in 1879, which is the Boscov's Department Store today in downtown Wilkes-Barre, owned by Al Boscov, whose father's name, coincidentally, happened to be Solomon, opened the first Department Store in downtown Reading in 1911. The Pomeroys Department Store and others followed in 1927, which has long since closed in the 1980s and is now home to the a satellite campus for the Luzerne County Community College, the Greater Wilkes-Barre Chamber of Commerce, and the PA Department of Environmental Protection's NE Regional Office, on Public Square. All of these businesses and industries built within the confines of the Solomon Creek watershed.
(**http://home.epix.net/~captclint/history.html**)

MARCH 10, 1940

More Heights Memories: The Old Empire Silk Mill

(Contributed)

Those articles of recent weeks dealing with the old days on Brewery Hill, the Heights section and others take me back 35 years ago when I started my days in the old Empire silk mill on North Empire street in the Empire section of the Heights.

I recall well how I left school shortly before the end of the term from the eighth grade, never to return after taking employment at the mill. It was the old red brick schoolhouse on Grant street that I left and I'd like to pay a tribute to that old school. The principal was G. W. James, who made his home on Madison street. Teachers were Mrs. Susan Bodimer, Margaret McGinty, who was later transferred to the high school on North Washington street; Miss Margaret Morgan, who died a few years ago, after being transferred to the principalship of the Hill street school; Miss Carry Spare, who married a member of the Fourth Estate; Margaret Gallagher, who married a city druggist later; Elizabeth Bell and Mary Mulherin.

FOR $2 A WEEK

When I started work at the Empire mill, I received the sum of 33 1/3 cents a day, or $2 a week. There were raises as one grew in proficiency to 42½ cents, next 50 cents, then 66 2/3, then 75 cents and the top of $1 per day, which I received after the end of six years.

Regardless how low the wages were we were a happy throng, singing most of the day, "Sweet Rosy O'Grady" or "Down by the Old Mill Stream." Among the best voices was that of a forelady, Sarah Evans, who had a beautiful soprano. I remember the girls used to go across the street to purchase Red Rose chewing gum, in the absence of any form of candy bars.

Sarah Evans had a sister, May, and two brothers, George and Tom, employed there. The brothers have risen high in the silk industry to the present. They lived near the Hillside street Congregational Church. I recall a forelady who came with Carl Ferenbach, original owner, from Paterson, who had a shrieking voice which was heard above the clatter of the machinery throughout the plant.

OTHER WORKERS

Other foreladies whom we recall of that day were: Blodwyn and Nellie Jones, the latter of whom later became the wife of Thomas Gambold, now superintendent of the Huber Colliery of the Glen Alden Coal Company. They also had a sister, Edna, and a brother, Tom, who worked there. There were Sadie and Jennie Jones of Taft street. Jennie married a Harry Hunter and now resided in Detroit. There were two other sisters, Marie and Margaret McNulty.

Among the employees were Anna McCue, Edith Gribble (now the wife of Philip Barrett, member of the city fire department), Rachael Jones, Edith and Grace Lewis (Grace now the wife of Stanley Williams, first assistant fire chief of the city fire department), Elizabeth Donohue, Blodwyn Jones, Elizabeth Richards (now Mrs. John W. Jones of Taft street), Lizzie Jones of New street, Georgetown, now Mrs. Raymond Gardner of this city; three members of one family, Gertrude, Lizzie and Joseph Pugh; Joseph Lynch, foreman, now breaker boss at Lance colliery in Plymouth, who had a brother named Frank also working there. Both came from the Whiskey Hill section of Georgetown.

Mickey Martin was an employee, in charge of the reeling department. Howard Harrison had charge of the steaming operation. Archie and Gertrude Clocker were two other members of the mill staff; Billie Richards was the oiler and the engineer was Edward McGroarty.

Joseph McGlynn, a story of whose unique clock appeared in the Independent some weeks ago, was the chief mechanic and his assistant was Joe Steinhauer.

QUITE A WHILE AGO

I recollect a man by the name of John Herriot as an employee of the mill, as were Michael and Charles Simson. In charge of the office was Lawrence Bogart, a son of the Bogart who conducted the old Wilkes-Barre Leader, long since joined with the Times-Leader. Bogart did all the hiring for the plant.

None of the persons I name above is under the half-century mark.

The mill helped greatly in employing hundreds of girls who came from the Heights, Georgetown and Empire sections. The silk was brought to the mill by horse and van by the two express companies, direct from Japan in its raw state. It was spun, doubled, wound, reeled and steamed and then sent to other plants for production into ribbon and other silk goods.

The mill offered steady employment and more or less contentment. But then most of the days we look upon are colored by a bright haze that distinguishes them from the present. R.B.W.

Figure 2-40 The article from March 10, 1940 recalls some details of working at Empire Silk Mill

Laurel Run Red Ash Mine Fire


Figure 2-41 One of the vents from the Laurel Run Mine Fire along Laurel Run Road-Photo by Robert E. Hughes, EPCAMR

The fire started on the property of the Red Ash Coal Company in the town of Laurel Run, Pennsylvania. Not many people in the Wyoming Valley may know that an underground anthracite mine fire has been wreaking havoc on Laurel Run Mountain just east of Wilkes-Barre since 1915 when a miner supposedly left his lantern in the mine. Measures were taken to put the fire out with fly-ash barrier filled trenches and it was thought to be extinguished until 1922--when it was found that the fire had spread to underground coal seams. In the '60's many buildings had to be abandoned because of the fire and in 1973 it was declared contained (**Figure 2-41**).

A timeline of Laurel Run Mine Fire and pictures of smoke/gas rising from below the ground can be found on the following website. (**http://www.undergroundminers.com/laurelrun.html**). It has been actively burning for 97 years, longer than the famous Centralia Mine Fire, with much less fanfare.

Pat Hester Wiggins, wrote a novel ***"Whispers from the Ashes"*** about living in Laurel Run around 1955 at a time when all the residents had to move out of the area due to the mine fire that had been burning underneath and getting much too close to their homes. Pat, who is the daughter of the late Dan and Burneatta Hester, graduated from Coughlin High School and Wilkes-Barre General Hospital School of Nursing. She was a nurse at the Georgetown Settlement Camp during the summer of 1965. Pat wrote her first novel at the age of 66. She writes under her maiden name, Pat Hester. Her novel, is a coming-of-age mystery which is narrated by Molly Branigan, a descendent of the Molly Maguire Irish, and the staid English pioneers who survived the Wyoming Massacre.

She based her book on events experienced by the borough of Laurel Run that was declared hazardous in the early 1960s and razed due to the Red Ash mine fire. Laurel Run was a community struggling with economic collapse, religious differences, and an encroaching underground mine fire. Molly discovered a mysterious entry in her great grandfather's diary that listed the untimely deaths of five previous inhabitants of her mountainside home. She began eavesdropping on family and questioning community members about events surrounding the deaths; a father who had a troubled past, also a daughter's innocent curiosity and a house filled with secrets. ***"Whispers from the Ashes"*** incorporated locales that are familiar to most area residents.

Although the physical Borough of Laurel Run has disappeared, the community has survived and has reunited with reunions twice in the past eight years. The elders who remember the events are quickly disappearing. "***Whispers from the Ashes"*** keeps the story of one mine fire alive for generations of a mining town suffering from both economic collapse and the fumes of a long-burning underground coal fire that was poisoning trees, water and the people. The very headwater tributaries of Spring Run used to flow down the mountain through Laurel Run and now run deep underground into the crevasses where the fire still burns and further downstream the channels are all but dry the majority of the year except for flash flooding events. ***"Whispers from the Ashes"*** is available only from Amazon.com. It is available in paperback as well as on Kindle. The following is the website for Pat Hestor's novel on Amazon: **http://www.amazon.com/Whispers-Ashes-Patricia-Hester/dp/0984561609**

Some have wondered why area private businesses or the government has not harnessed the heat energy and geothermal potential of the mine fire to this date. Underground fires burn slowly, and very hot temperature rates. The technology does exist to gather steam energy from the heat escaping the ground. In Iceland, 85 percent of their energy is derived from hot springs that are 300 degrees. The Laurel Run coal fire burns on average at around 900 degrees and goes untapped. A very similar situation occurs with the mine water. We could actually be turning our legacy of our Anthracite Mining past practices, disasters and intentional pollution problems into blessings in disguise. Both the water and the heat energy are currently being underused and underestimated for their potential to bring about new jobs, new industries, and new technologies back to the Wyoming Valley at many of the now abandoned locations within the Solomon Creek watershed.

Stegmaier Brewing Company, Wilkes-Barre, PA

Ruddy Hechler, published in the Fall 1987 NABA Breweriana Collector – (http://www.oldbeerstuff.com/steg.html)

Figure 2-42 Stegmaier Brewery (http://www.northeast.railfan.net/captclint/stegmaier3.jpg)

Collectors can give thanks for that day in 1857 when Charles Stegmaier set up shop in the Northeastern Pennsylvania town of Wilkes-Barre, PA (**Figure 2-42**). He started with a bottling business and by the turn of the century had the largest brewing business in Pennsylvania outside of Philadelphia and Pittsburgh.

Charles Stegmaier, born October 7, 1821, learned his trade in his home area of Wurtenberg, Germany. At the age of 27, having been brew master at several large local breweries, he set sail for America. He quickly found employment at the small Corporation Brewery in Philadelphia. Shortly thereafter, he gained employment with the Louis Bergdoll brewery, where he met John Reichard, of the Reichard & Weaver brewery in Wilkes-Barre. This friendship of 1851 sent Charles packing on a 120-mile trip upstate, where he and John formed a short-lived partnership. This business association produced the first lager beer in their section of Pennsylvania. A longer partnership was formed in 1851, when Charles married Catharine Baer, daughter of George C. Baer.

Several years later, Charles accepted a position in Pottsville with the George Laurer brewery, but he returned to Wilkes-Barre in 1857 to establish a bottling business. He quickly formed a partnership with his father-in-law, George Baer, to build a small brewery on South Canal Street. The Wyoming Canal ran along South Canal Street, which is now Martin Luther King Jr. Boulevard, formerly Wilkes-Barre Boulevard, and was originally a part of the Solomon's Creek watershed. They brewed with a wooden kettle and stored their beer in an abandoned coal mine tunnel while a new brewery with underground vaults was built on East Market Street. The new Baer & Stegmaier Brewery was opened in 1863 and lasted until the Panic of 1873.

Out of a job, Charles entered the hotel business for two years before buying the Joel Bowkley Brewery on North River Street at the Canal. Forming a partnership with his son, Christian E. Stegmaier, he successfully increased business to the extent that they could repurchase the Bear & Stegmaier Brewery in 1880. Output continued to grow under the name of C. Stegmaier & Son; a new brew house and storage facility were built in 1894, increasing annual capacity to 300,000 barrels. By the standards of the time, this was an extremely large brewery. Charles and Christian incorporated the firm in 1897 as the

Stegmaier Brewing Company. Charles, who continued active management of company affairs until 1902, operated the firm with Christian and his other sons, Fred and George. The Stegmaier family was highly esteemed as citizens of the City of Wilkes-Barre; they were extremely charitable and contributed greatly toward the growth and development of the City (**Figure 2-43**). Success this time was not short-lived; the company enjoyed many productive years before closing during long years of slow decline of the local brewers in October, 1974.

Between 1910 and 1913, Stegmaier won eight gold medals at expositions in Paris, Brussels and Rome. After prohibition, Stegmaier became one of the largest independent breweries in North America, reaching an output of a half million barrels in 1940. Using a 60-truck fleet and rail services, the distribution areas eventually covered the East Coast from Maine to Florida - a considerable evolution from the days of 1857 when Charles Stegmaier personally delivered each barrel of beer with an express wagon drawn by a husky goat.

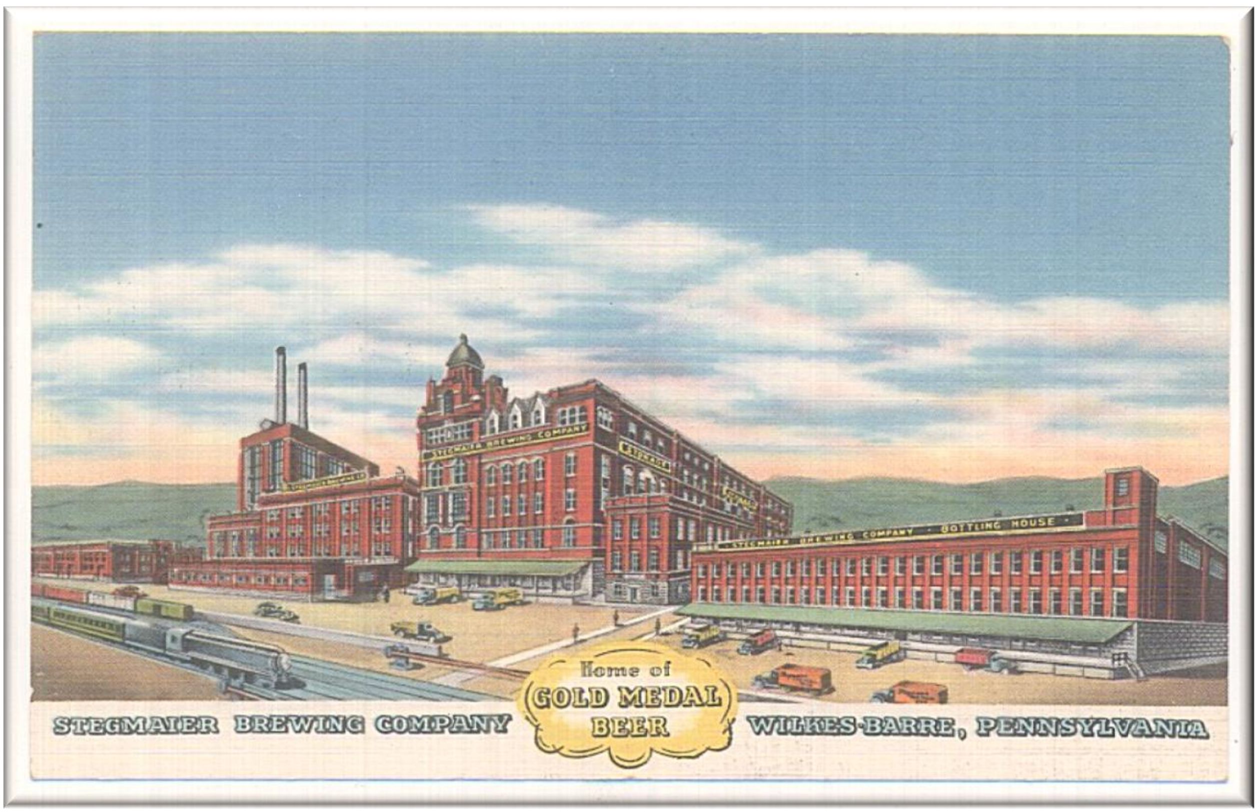


Figure 2-43 1952 Post Card (http://www.northeast.railfan.net/captclint/stegmaier1.jpg)

The sudden announcement in 1974 by Edward R. Maier, great grandson of Charles Stegmaier, that the Stegmaier label was sold to Lion, Inc. of Wilkes-Barre sent shock waves through the brewery's work force. The company's financial situation was known to be deteriorating, but the notice of sale still came as a surprise to most.

The company was a family-run business covering four generations, always respected as a "class act" by its loyal employees, many of whom were from families whose parents and grandparents had worked with Charles Stegmaier. About 50 employees, along with Maier as Executive Vice President, were employed by Lion, Inc., but some 150 workers lost their jobs. The vacated Stegmaier brewery, purchased for back taxes in 1978, was owned by the City of Wilkes-Barre. It has since been redeveloped into what was formerly Congressman Paul E. Kanjorski's Office, the Social Security Administration, the now closed Federal Office of Surface Mining-Wilkes-Barre District Office, Mine Safety Health Administration, and other business offices. Stegmaier beer, however is still produced by Lion, Inc., of Wilkes-Barre, and remains one of the firm's best selling products.

The North Branch Canal[1]

In 1826, the Pennsylvania Board of Canal Commissioners engaged John Bennett to survey the route of a new canal, to be called the North Branch Canal, to run alongside the North branch of the Susquehanna River from Northumberland to the New York border. In early 1827, Bennett reported that the canal was feasible, and in 1828, the State legislature authorized funds for construction. Charles T. Whippo, who had worked on the construction of the Erie Canal, was engaged to survey the route and supervise construction. The southern portion of the canal, as built, ran for 55-1/2 miles along the west side of the river, from Northumberland to West Nanticoke, where a dam at Nanticoke Falls was built to divert water from the river into the canal located in Plymouth Township, at what is now the Historic Canal Park, located at the intersection of State Route 29 and State Route 11. By the end of 1830, canal boats began to replace arks as the preferred method of transporting coal and other goods to market The work was generally complete by the Fall of 1830. The first load of coal shipped from Wyoming Valley reached Berwick in October, 1830.

Of the six main anthracite canals in Pennsylvania, the North Branch Canal, which included the Wyoming Division was one of the two that were state-owned, the other being the Delaware Division Canal. Pennsylvania had "canal fever" in 1831 when the state legislature authorized Governor George Wolfe to borrow $2.4 million for several Pennsylvania canal extensions, including the Wyoming Division. The vision behind the Wyoming Division was to connect coal in Luzerne County with descending trade to Philadelphia and ascending trade to New York State. All reasoned that this investment would prosper and with a $100,000 appropriation, the state legislature gave the canal a "go." The idea was for boats to travel unimpeded from the Pennsylvania canal system to the famed Erie Canal, but this achievement took years to accomplish. Proposed routes were hotly contested, contractors "lowballed" engineer's estimates, and weather problems caused delays; by February of 1832, the Wyoming Division was over budget with only six miles built. A new completion date was proposed – August of 1833 – but this date passed too.

[1] (**http://explorepahistory.com/hmarker.php?markerId=1-A-B3**), (**http://en.wikipedia.org/wiki/Plymouth,_Pennsylvania**), **and (http://en.wikipedia.org/wiki/Pennsylvania_Canal_(North_Branch_Division))**

Building a canal was a massive engineering and construction endeavor and many geographic difficulties arose in the construction of the Wyoming Division. A section along the river north of Wilkes-Barre, for example, had vertical rock bluffs more than 4,000 feet high. The construction of a 30-foot wall running along the river to contain the canal bed also added to the cost and the delays. When the canal was finally completed on June 23, 1834, it was well over budget, with a total cost of $342,625. These shortcomings, however, could not dampen the excitement of seeing the water rush into the canal when the Lackawanna feeder opened. As late as the 1840s, whenever high water allowed, coal from Wyoming Valley's coal mines was shipped down the Susquehanna River on wooden arks.

The entire North Branch line cost about $1.5 million to build. This represented a significant investment for a nineteenth-century state government, but during its nearly three decades as a state-run operation, the canal did return the initial outlay. The state sold the North Branch line in 1858. For the next twenty-five years, two private companies, the Wyoming Canal Company and the North Branch Canal Company, operated the steadily declining venture.

Wyoming Division Canal Redoubt Basin

Figure 2-45 Wyoming Canal from South Street Bridge looking North along what would now be Wilkes-Barre Boulevard

Boats coming up or down river used a rope ferry above West Nanticoke to cross the river from the North Branch to the Wyoming Division Canal, which started near Solomon Creek. The canal ran to near Back Street (now Pennsylvania Ave), along that street, up along Wilkes-Barre Boulevard, right in front of the Stegmaier Building, and then cut back towards the river between Union and Bennett Streets. The Redoubt was the name given to a rocky spur that projected at right angles across the river common from the main hill about 165 feet above Union street. Its precipitous sides reached nearly to the edge of the Susquehanna River bank. Standing some 70 feet above water, it was a prominent landmark and an advantageous position in the local military operations during Wilkes-Barre's early settlement. The North Branch Canal, by a sweeping turn at this point, sheared off two of the rocky faces of the barrier. The extension of River Street cut a deep channel through it in another direction, severing it from the main hill. The Lehigh Valley railroad, successor to the canal, to obtain room for its tracks, took off another portion; and the City deported the remainder, bringing it to the level of the rest of the common and down to the city grade. The name however, has always adhered to it, and although no vestige remains, the "Redoubt" is a familiar name that still marks the spot. (**Figures 2-44 thru 2-47**)

Figure 2-44 Wyoming Canal through Redoubt Bluff in Wilkes-Barre

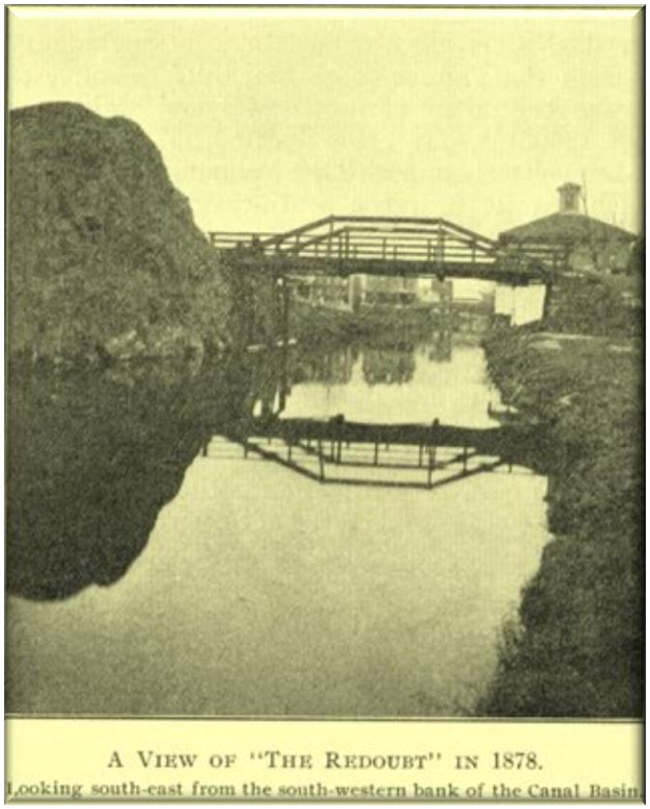


Figure 2-46 The Redoubt in 1878

The following authors wrote books on the subject of the Canals:

F. Charles Petrillo, ***Anthracite & Slack water: The North Branch Canal 1828-1901*** (Easton, PA: Center for Canal History and Technology), 1986.

H. Benjamin Powell, ***The PA Anthracite Industry, 1769-1976***, PA History: 46 (1980): 3-27.

William H. Shank, ***The Amazing PA Canals*** (York, PA: American Canal and Transportation Center), 1981.

Website:**http://www.waymarking.com/waymarks/WM4V5_Wyoming_Division_Canal_Redoubt_Basin**

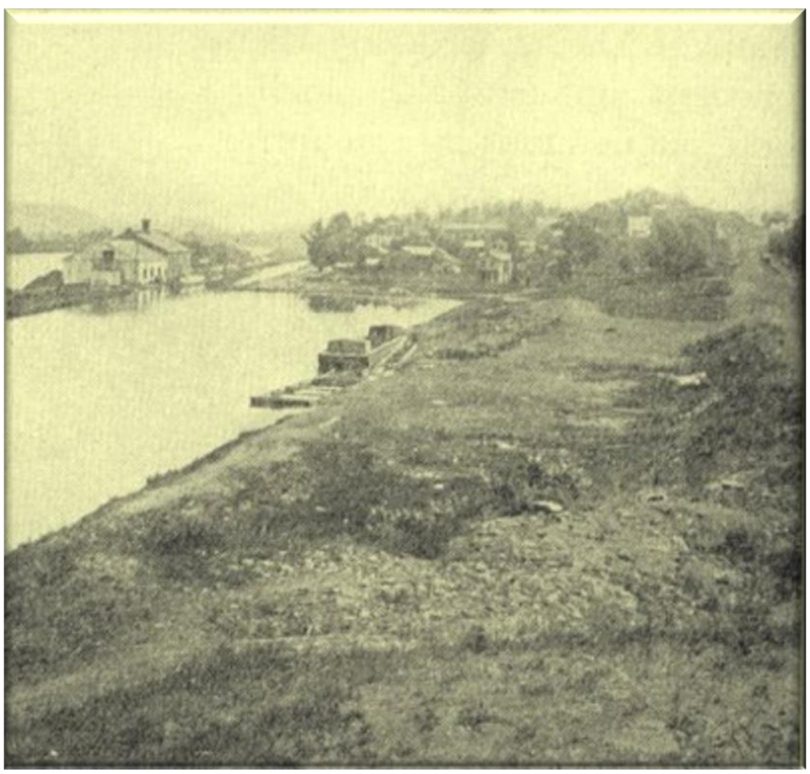


Figure 2-47 Canal Basin - Redoubt (site of now Luzerne County Courthouse)

Chapter Three: Overview of Trout in Pennsylvania

Brook trout are the only native salmonid species of Pennsylvania's streams. Brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) both reproduce naturally in Pennsylvania streams today, but only brook trout are native to eastern North America. In fact, brook trout are the only native salmonid species of Pennsylvania's streams (EBTJV 2006). Brown trout are originally from Europe and were brought to the United States by fish culturists during the early 1880s, and first introduced in Pennsylvania in 1886.

In Pennsylvania, mixed brook and brown trout fisheries are slightly more common than brook trout-only fisheries. Mixed brook and brown trout fisheries comprise **1,984** miles compared to **1,730** miles of brook trout streams (EBTJV 2006). According to recent reports by the Eastern Brook Trout Joint Venture, wild brook trout populations have been documented in **5,044** miles of streams in Pennsylvania (Hudy, 2005), about **6%** of the Commonwealth's **83,000** total miles of streams. There are **1,270** miles of streams that are stocked with hatchery trout in Pennsylvania (EBTJV, 2006).

Brook trout are smaller and generally more sensitive than brown trout to ecological disturbances, although brook trout are most tolerant of acidic conditions—an especially pertinent difference in the Solomon Creek watershed. Since its introduction, non-native brown trout have spread throughout the mid-western and eastern US and into Canada (PFBC 2006), threatening many native brook trout populations. In addition, while brown trout compete with, and can displace, brook trout, many of the streams they currently inhabit in Pennsylvania are not suitable for native brook trout. Brown trout were not found to be present in the Solomon Creek watershed during EPCAMR and PA Trout Unlimited's electroshocking survey.

Brook trout have very specific habitat requirements and are especially sensitive to human impacts to aquatic ecosystems. They require colder and cleaner water than most other fish species in Pennsylvania. Warm surface water, greater than 20 degrees Celsius, can be a limiting factor to the distribution of brook trout in Pennsylvania. As lands were cleared for timbering, agriculture, coal mining, roadways, and other human activities, the surface water temperature of streams exposed to solar radiation rose. As a result, trout typically survived only in forested areas with well-developed riparian areas and stream vegetative cover with shade that provided protection from drastic temperature changes, water quality degradation, flow regime alteration and substrate disturbance. Trout also have different habitat requirements at different life stages; trout fry or young of year (YOY) can exist in shallow “nursery” headwater streams with an adequate aquatic insect community, while larger trout generally require deeper pools and a more abundant food source, whether insects or small fish. The densely forested watersheds of northeastern Pennsylvania provided ideal in stream habitat for trout prior to the deforestation that took place during the 19th and 20th centuries. Thick canopies of trees protected streams (**Figure 3-1**) from excessive sunlight capable of warming waters and promoting algal and aquatic plant growth. Riparian vegetation protected stream banks from erosion and functioned as pollutant filters, reducing vulnerability of streams to any accumulated sediments and nutrients.

Figure 3-1 Forest riparian zones such as this area in the headwaters of Sugar Notch Run in the Solomon Creek watershed protect streams and provide excellent trout habitat.

Wild Brook Trout Distribution in the Eastern U.S and Pennsylvania: The Eastern Brook Trout Joint Venture

The current wild brook trout populations in Pennsylvania are very fragmented and primarily exist in first and second order headwater streams. Widespread lumbering operations in the late 1800's and early 1900's greatly reduced the amount and quality of habitat suitable for brook trout in Pennsylvania. Acid mine drainage from extensive historical coal mining has eliminated brook trout from many miles of coldwater streams, including in the lower portions of the Solomon Creek watershed. Today, in addition to the lingering effects of AMD, threats to wild brook trout populations include erosion and sedimentation from poor agricultural practices, urbanization, and road construction, the warming of surface water due to wastewater and storm water runoff and the loss of riparian vegetation, and episodic acidification resulting from acid deposition and precipitation (EBTJV, 2007).

The Eastern Brook Trout Joint Venture (EBTJV), initiated in 2005, has led to a much improved understanding of the status of brook trout across their historical range in the eastern United States, including Pennsylvania. The EBTJV is a larger collaborative effort and institutional partnership and is the first pilot project under the National Fish Habitat Initiative. The long-term goals of the EBTJV are to develop a comprehensive restoration and education strategy to improve aquatic habitat, to raise education awareness, and to raise federal, state and local funds for brook trout conservation (EBTJV, 2007).

At least seventeen state and federal agencies have participated in the EBTJV: the fish and wildlife agencies from 17 states; the U.S. Geological Survey; U.S. Forest Service; U.S. Fish and Wildlife Service; National Park Service; Office of Surface Mining; regional and local governments; businesses; conservation organizations including the Association of Fish and Wildlife Agencies, Trout Unlimited, Izaak Walton League of America, Trust for Public Land, and The Nature Conservancy; academia (Conservation Management Institute at Virginia Tech and James Madison University), and private citizens (EBTJV, 2007).

The EBTJV recently completed a watershed-level assessment of the distribution, status and threats to brook trout in the eastern United States, available at http://www.easternbrooktrout.org/statusta.html , and has drafted regional and state-specific conservation strategies based on these findings (EBTJV, 2007) and are listed in **Appendix N**. The EBTJV assessment was based on the Trout Unlimited's Conservation Success Index (CSI). The CSI is a GIS-based graphic database management tool used to analyze immense amounts of spatial and survey data related to trout and their habitat. Data from many formats and sources, including survey data from state and federal biologists, were compiled and entered into a central database for the entire historical range of the brook trout in the eastern U.S. The CSI systematically categorizes population health and habitat conditions allowing the identifying of areas and watersheds where populations are strong or vulnerable and the visual and tabular characterization of the local impacts in these areas. (TU, 2006)

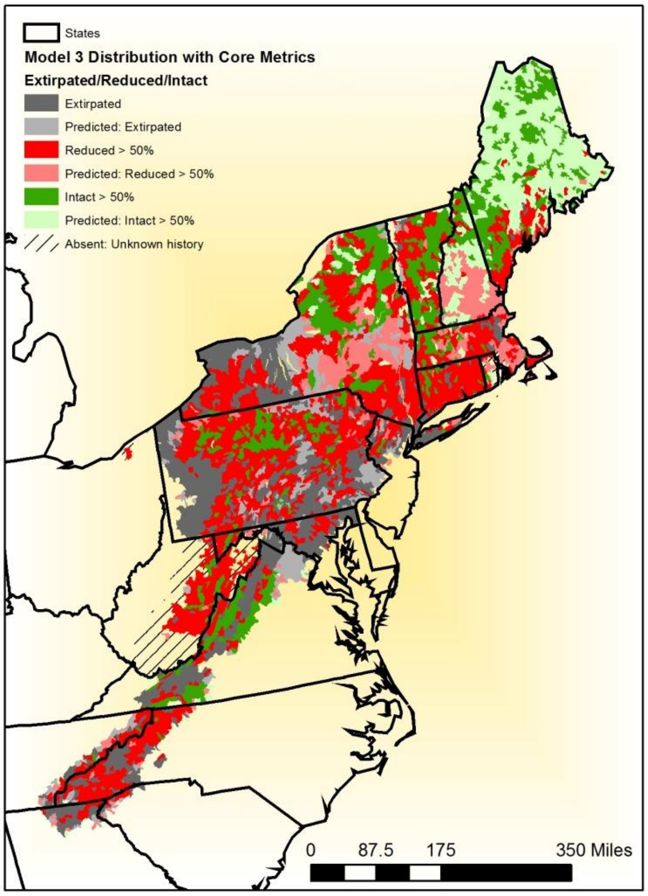


Figure 3-2 Model 3 Distribution of Trout Populations with Core Metrics (EBTJV, 2006)

The CSI scoring system examines four main categories: Range-wide Condition or Distribution, Habitat Integrity, Population Integrity, and Vulnerability to Future Threats. Watersheds are scored based on five components particular to each category (**Figure 3-2**). For instance, Habitat Integrity includes five components or metrics that are calculated for each sub watershed and summed as an overall score for the assessed watershed: land stewardship (% of land protected by special status), watershed connectivity (number of dams and road crossings), watershed condition (% forested and road density), water quality (303d listed streams, % agricultural land and ratio of riparian roads/total stream miles), and flow regime (dams exceeding a ratio of storage/stream mile and dewatered streams). The CSI also evaluates data quality for each component to identify data gaps that can guide future research and monitoring (TU, 2006).

The EBTJV assessment presents information on the status of brook trout populations in **17** states in the Appalachian region, an area that represents **70%** of the historical range of brook trout in the United States. The EBTJV evaluated a total of **11,400** watersheds (typically containing between 25 to 75 miles of streams) to determine the relative viability of brook trout populations. Approximately half (**5,563**) of those sub watersheds historically supported brook trout. **Table 3-1** and **Figure 3-2** shows the current status of brook trout populations in those sub watersheds where brook trout historically thrived.

The EBTJV assessment tells a dismal story of the decline of brook trout across their range. Watersheds with healthy brook trout populations do exist, but they are rare. The majority of these intact sub watersheds are located in Maine, New Hampshire, New York, Vermont and Virginia. Pennsylvania, Maryland, West Virginia and the other New England states each possess only a handful of these intact sub watersheds (**Figure 3-2**).

Table 3-1 Sub watershed status of EBTJV assessed watersheds (EBTJV 2006)

Brook Trout Classification of EBTJV Assessed Watersheds	Total % in Study Region
Intact	5%
Reduced	9%
Greatly Reduced	27%
Present, Qualitative Data	19%
Extirpated	21%
Absent, Unclear History	6%
Unknown, No Data	13%

Brook trout are extirpated from over **20%** of the sub watersheds across the eastern United States (**Table 3-1**), being eliminated from Brook Trout Status in Assessed sub watershed all streams and rivers within those areas according to available data (EBTJV, 2006).

In Pennsylvania, although the historical range of brook trout extended across most of the state, only **1%** of the state's historical sub watersheds remain intact, while **9%** are reduced. Brook trout are greatly reduced and typically occupy only small headwater streams in **39%** of sub watersheds (**Table 3-2**). Brook trout have vanished from **34%** of historical brook trout sub watersheds. The EBTJV found that a significant portion of the state, (**17%**), lacks conclusive data on the presence of brook trout in a format suitable used for a trout distribution assessment (EBTJV, 2006). EPCAMR will be providing our data collected from our electro shocking survey report compiled by the PA Trout Unlimited and EPCAMR to the EBTJV to assist in providing additional data to cover those areas within Northeastern PA where they still have no data on the fishery populations. When one zooms into the EBTJV data, one finds that in the case of the Solomon Creek watershed greater than **50%** of the trout population is still intact (*green*) (**Figure 3.3**, EBTJV, 2006). All of the surrounding watersheds in the area have reduced (*red*) trout populations greater than **50%**, including Laurel Run, Ten Mile Run, Geneceda Creek, Big Wapwallopen Creek, Little Wapwallopen Creek, and Nuangola Outlet.

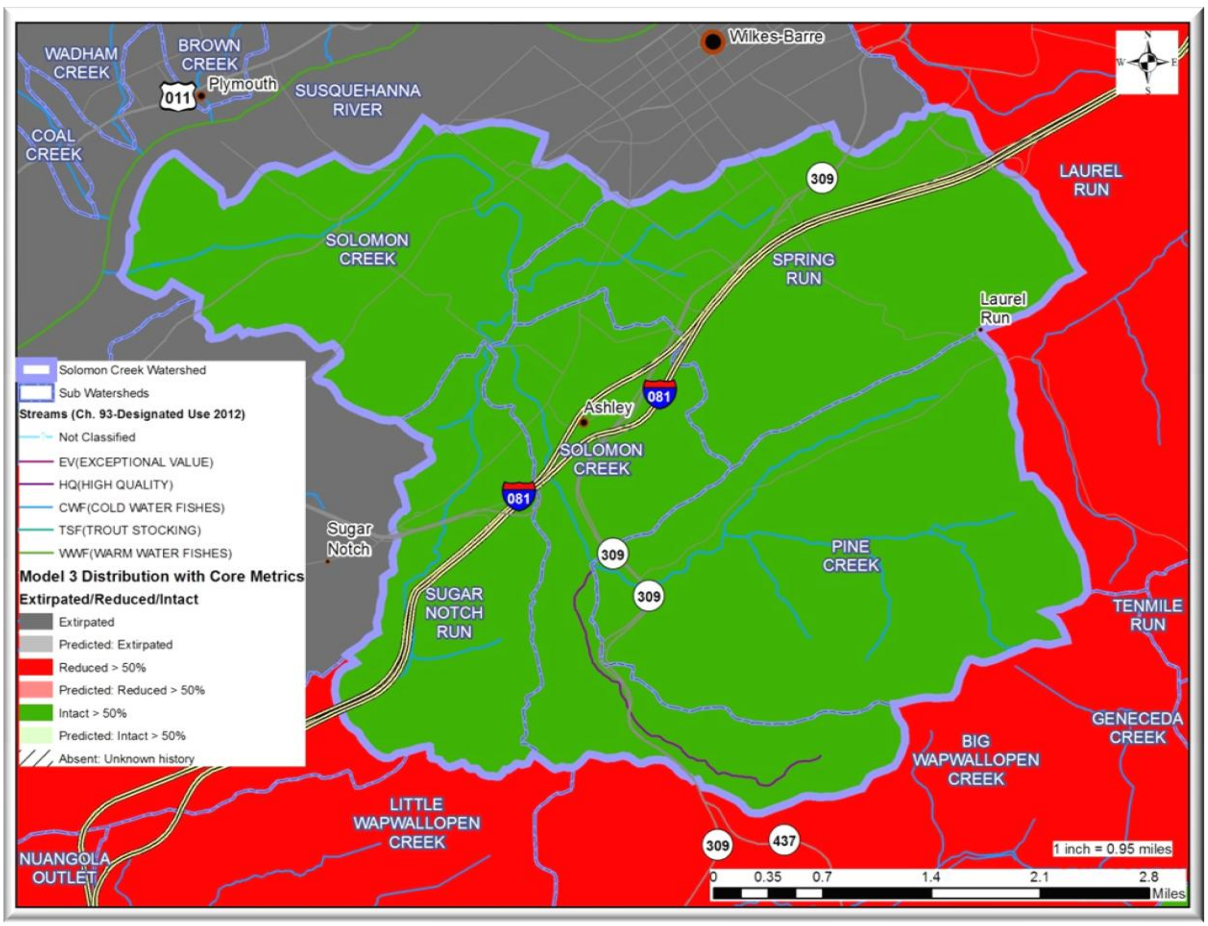


Figure 3-3 Solomon Creek Model 3 Distribution with Core Metrics and Surrounding Streams (EBTJV, 2006)

The strongholds for wild brook trout populations in Pennsylvania occur in the Northern Tier of the state. The North Branch Susquehanna River basin, which contains the Solomon Creek watershed, has **936** miles of wild brook trout populations. The West Branch of the Susquehanna has **1,875** miles compared to only **942** miles of streams in the Upper Allegheny River basin. Collectively, these three major drainage basins support the majority, **74.4%**, of the documented miles of wild brook trout streams in PA.

Table 3-2 PA sub watershed status of EBTJV assessed watersheds (EBTJV 2006)

Brook Trout Classification of EBTJV Assessed Watersheds in PA	Total % in Study Region
Intact	1%
Reduced	9%
Greatly Reduced	39%
Present, Qualitative Data	<1%
Extirpated	34%
Absent, Unclear History	0%
Unknown, No Data	17%

The EBTJV also ranked the most common disturbances on existing trout populations in Pennsylvania, according to the CSI data and the input of local experts consulted by the EBTJV. The most common disturbances to existing trout streams in Pennsylvania include impacts due to land use (such as poor land management practices, road runoff, sedimentation, and urbanization), the presence of nonnative brown trout, and high ambient surface water temperatures. Surface water temperatures in streams can be increased by removing riparian forest cover or by using water for municipal or industrial purposes, i.e., wastewater treatment plants or for cooling in a pass-through process at power plants or industrial facilities.

Although not as widespread as the top five disturbances, acid deposition was found to impair **123** total sub watersheds, mostly those recognized to have geologically low buffering capacities. Abandoned mine drainage was not listed as a disturbance in this table because in most cases, AMD has resulted in the complete extirpation, not disturbance or stress, of trout on impaired stream segments.

Water Quality and Brook Trout

Studies have determined that brook trout cannot tolerate sustained water temperatures exceeding 77°F (25° C) and prefer water temperatures less than 68º F (20° C). Brook trout are less tolerant of warmer water temperatures than brown trout. Research has documented that brook trout will migrate many miles to find thermal refuge during disturbance events (EBTJV, 2006).

The chemistry of surface water can be complex and there are a variety of pollutants that can influence water quality. Brook trout are the most tolerant of all the trout species to acidic conditions, and adult fish can tolerate pH levels as low as 5.0, although they survive best at pH above 6. Brook trout are extremely tolerant of alkaline conditions and survival has been recorded at pH levels as high as 9.8 (TU, 2007). The water quality of trout streams in the Solomon Creek watershed can be characterized by infertile streams with little dissolved substances, little capacity to buffer runoff highways and road salts, coal cinders, and suffering from episodic acidification from mine drainage and atmospheric acid deposition.

Although there are a few areas with very limited localized pollution from nearby land use runoff, the trout in the Solomon Creek watershed have sufficiently cold, clear, and clean water to survive in many streams segments. While these streams are not too acidic to support trout, they are subject to periodic events that stress the trout populations.

Acidification is the primary water quality impact in the Solomon Creek watershed, and is largely a function of local land use and the chemistry of surface runoff that flows into streams. Mining activities have altered the contour of the land and natural drainage patterns, and exposed acid producing geology to the atmosphere. Acid deposition deposits particulates across the watershed that can significantly alter stream chemistry during storm flow and runoff events.

There are several important parameters related to acidification, the most basic being the hydrogen ion concentration, pH. Since the pH of surface water influences how metals can remain in solution, the dissolved concentration of aluminum, especially toxic to aquatic life, is also a parameter of interest. When metals like aluminum, iron, and manganese in soil and rock interact with the air and water they react to yield a net increase in hydrogen ions, decreasing pH. Acid rain accelerates the flux of metals from soils and exposed acid rock. Aluminum is the least worrisome metal loading problem in the Solomon Creek watershed, with manganese, being the second most worrisome, and iron being the most problematic.

Alkalinity, as well as the total amount of dissolved substances, strongly affects how resistant streams are to acidification (EBTJV, 2006). Streams with higher alkalinity typically are derived from limestone geology, calcium and magnesium carbonates—and more neutralizing dissolved substances have the potential to buffer acidity better and maintain a life supporting pH of around seven. However, Solomon Creek's infertile headwater streams, underlain by mostly glacial, sandstone, and conglomerate geology, offer little buffering capacity for the influence of AMD and acid deposition. There are no limestone formations in the watershed. Essentially, those streams with even slightly higher buffering capacity, albeit low, are less vulnerable to acidification than those with almost no buffering capacity. Acid Neutralizing Capacity (ANC) is similar to alkalinity, but it is a more cumulative measurement of buffering capacity that takes into account the background concentrations of acidic anions that offset the acid-buffering effect of basic cations, like calcium and magnesium.

Table 3-3 Levels of concern and tolerance limits of aquatic life and trout for water quality parameters based on various state and federal regulations (*LeFevre-SRBC, 2004)

Parameter (units)	Limits	Reference
Temperature	< 25° C	a, e
Dissolved Oxygen (mg/l)	< 4	a, f
Conductivity (umhos/cm)	>800	C
pH	< 5	b, e
Alkalinity (mg/l)	< 20	a, f
Total Suspended Solids (mg/l)	> 25	G
Calcium (mg/l)	> 100	A
Magnesium (mg/l)	> 35	H
Sulfate (mg/l)	> 250	A
Iron (mg/l)	> 1.5	A
Aluminum (mg/l)	> 0.2	b

[2]**Table 3-3** lists levels of concern and reference guidelines for trout and aquatic life tolerance limits for common surface water quality parameters from various academic and regulatory sources.

2 *Source: LeFevre, S. 2005. ***Juniata River Sub basin Survey, A Water Quality and Biological Assessment*** June-November 2004. Susquehanna River Basin Commission, Harrisburg, PA. She references these sources a-h.

a. http://www.pacode.com/secure/data/025/chapter93/s93.7.html

b. Gagen & Sharpe (1987) and Baker and Schofield (1982)

c. http://www.uky.edu/waterresources/watershed/krb_ar/wq_standards.htm

e. http://www.hach.com/h2ou/h2wtrqual.htm

f. http://sites.state.pa.us/pa_exec/fish_boat/education/catalog/pondstream.pdf

g. http://www.epa.gov/waterscience/criteria/sediment/appendix3.pdf

h. http://www.dec.state.ny.us/website/regs/part703.html

Acid Deposition Impacts on Trout

The episodic acidification of small headwater streams due to air pollution, especially during high flow, is one of the primary stressors of trout in the Solomon Creek watershed. Acid deposition is caused by particulate emissions from coal-burning power plants and other industrial facilities and motor vehicles. Acidifying particles are sprayed and carried into the air and deposited across Pennsylvania as acid rain or as particulates that settle on ground and foliage surfaces, which are then washed into the stream during runoff events. NorthCentral Pennsylvania experiences some of the most severe acid deposition than any region in North America (PA DEP, 2006).

Episodic acidification becomes worse during larger storms, and at higher flows, as more acid rain and acid particulates are flushed into the stream. Headwater streams in the Solomon Creek watershed are infertile and contain very little dissolved substances, making them susceptible to any degree of pollution.

Small low-order streams in landscapes, with geology similar to the Solomon Creek watershed, have been documented to be especially vulnerable to impacts of episodic acidification as a result of wet (acid rain) and dry acid deposition (Baker et al., 1996). Trout can survive episodic acidification events by migrating downstream or by moving into less impacted areas, to take refuge where inflows of groundwater or less acidic tributaries provide plumes of less polluted water. Trout can then eventually recolonize the acidified areas if severe episodes are infrequent.

A study by Baker et al. (1996) found trout abundance was reduced and acid-sensitive fish species like blacknose dace and sculpin were absent from streams with a median pH less than 5.2-5.4 and inorganic aluminum exceeding 100-200 µg/L during high flow. It is reasonable to infer that a similar pattern is present in the trout streams in Solomon Creek watershed that brook trout may be regularly subject to acidification events that are adversely affecting them. EPCAMR did not have the ability or water testing kits or lab samples to obtain measurements of inorganic aluminum presence in the headwater areas of the Solomon Creek. The water chemistry sampling by the EPCAMR Staff are inconclusive as to whether evidence of episodic acidification is a chronic problem in the watershed. Bioindicators such as trout and benthic macro invertebrates can also provide evidence of acidification. Brook trout are slightly more tolerant of acidic conditions. Another fish species known to be highly sensitive to stream acidification found in the Solomon Creek watershed included the blacknose dace.

More information about acid deposition is available on the PA DEP Bureau of Air Quality website (http://www.dep.state.pa.us/DEP/DEPUTATE/airwaste/aq/acidrain/acidrain.htm) and at the website of the National Atmospheric Deposition Program (http://nadp.sws.uiuc.edu).

Flash Flood and Flooding Impacts on Trout

In the Solomon Creek watershed, flash floods and flooding impacts on the trout population are dependent upon where in the streams the populations are holding over during high flow periods during and following rain storm and runoff events. The higher in elevation in the watershed they are in pools where they can find shelter from the storms, the better off they will be. During storm events in the Solomon Creek watershed, in the headwaters, roadside runoff from pipes and culverts carry additional volumes of water that make the downstream areas of those pipes vulnerable to erosion and sedimentation. High flows also tend to create additional blockages of woody debris and other illegally dumped materials within the stream channels creating safe havens for fish populations. In the upper portions of the main stem of Solomon Creek, along State Route 309, during high flow periods of flooding, tons of cemented coal ash that can normally be found across one section of the stream channel can be eroded and transported to the lower reaches of Solomon Creek. EPCAMR has found coal ash cinders in depths of up to 4’ in the Brookside section of S. Wilkes-Barre all the way to the northwest behind the Turkey Hill on Oxford Street and the Kentucky Fried Chicken on Division Street.

The Pine Run sub watershed is very forested and protected from heavy downpours directly on the landscape and can accommodate the stream flows without much change in morphology to the existing trout stream habitat. As these headwater tributary begin to fill, it allows the trout to migrate up into further out of the torrent volumes of flood waters that build up on their way downstream towards the main stem.

The Spring Run sub watershed is virtually dry all year due to the large volumes of water that are lost to the open mine voids and permeable stream channels that have been changed due to past mining practices. Spring Run does get a lot of storm flow and debris blockages within the confines of its stream channel and has to be one of the most degraded tributaries assessed in the Solomon Creek watershed. Since there were no trout found in this section, it is not a concern at this time, however, if the Spring Run were to be reconnected with a normal base flow of water, it may provide opportunities for trout to migrate into other areas of the watershed for shelter.

Downstream further in the City of Wilkes-Barre much of the streambed in Solomon Creek is covered with huge depositions of sand, gravel, coal ash, coal silt, and fines that are leading to poor habitat for trout and other fishery species as they migrate through these sections and try to spawn. Gravel bars and point bars are most common throughout the lower, slower reaches of Solomon Creek where the slope and gradient of the stream channel tends to flatten out and meander, allowing for the increased deposition of these materials. Maintenance of these areas should be seriously considered at not just at the locations where the recent flooding damages have occurred in the Brookside section where new flood gates and access ramps to Solomon Creek have been constructed, but much further upstream and downstream of those areas. In order to reduce the overall tonnage of deposition of coal fines and coal ashes to this portion of the watershed, maintenance and removal of many of the larger cement-like boulders of coal-ash and continued reclamation of culm banks near the water's edge need to be addressed in the future. Increased turbidity has a negative effect on trout populations. High levels of suspended solids choke fish by clogging their gills, and excessive sedimentation can destroy suitable breeding habitat for trout by covering the bottom of rocky streams (Chin, 2004). A detailed sedimentation assessment could be performed by EPCAMR in the future to determine the impact of sediment on the trout population and the capacity of the Solomon Creek main stem.

In 2001, Borton Lawson Engineering, completed a ***Solomon Creek Flood Protection Feasibility Study*** under *Project 2001-1023-01* for the City of Wilkes-Barre. The report summarized the preliminary hydrologic and hydraulic analysis, structural design, and construction quantities prepared for the study. Stream flows were analyzed for both existing conditions in the watershed and "with project" conditions looking to the future. It also discussed and recommended alternatives in great detail that were evaluated prior to developing the recommendations and associated approximate construction costs of those future projects. While the focus is not on the trout fishery within Solomon Creek, it is on reducing pollution and sedimentation issues that are heavily tied to the viability of the fisheries in the area. The entire Solomon Creek is subject to flash flooding, so older bridges are constantly being looked at by Luzerne County and the City of Wilkes-Barre and other municipalities where flooding is their greatest concern. This study can be found in **Appendix C** as a digital document.

Prior to the mining industry coming to the Wyoming Valley, the population centers were nowhere near what they are today. The highly developed areas of Wilkes-Barre, Wilkes-Barre Township, Hanover Township, the growth of Ashley Borough, and the increase in roads and housing in the other 5 municipalities have added additional impervious surface area within the watershed that normally would contribute to the base flow of the streams within the Solomon Creek watershed through infiltration. Now, this surface runoff makes its way into our streams, through storm drain systems and overland flow during storm events making the tributaries that normally don't flow or that have a very low flow, become very flashy.

Much of the channel constrictions between the Oxford Street bridge and the Sans Souci Parkway that was constructed in the early part of the last century are problems due to the pattern of the development that occurred in this area over time. Prior to this, the area along Solomon Creek was a large low lying wetland area and swamp. The stream channel was realigned to the configuration that it is now and lowered by several feet decreasing the profile grade to .13% beginning at the San Souci Parkway. This construction, in effect, drained the swamp and allowed for the placement of fills in the former swamp and wetland areas for construction of the present residential neighborhoods. It is this relatively flat grade, which contributes primarily to the flooding issues in the lower reaches of the watershed.

Extensive flooding of residential, industrial, and commercial areas within the watershed have been extensive historically on both sides of the Creek and its tributaries. The City of Wilkes-Barre, in particular has experienced extensive flooding in 2011 (Tropical Storm Irene and Lee), 2006, 1996, 1985, 1975 (Hurricane Eloise), 1972, during Hurricane Agnes (http://www.accuweather.com/en/weather-news/40th-anniversary-of-agnes/66707), and 1906. This year marked the 40^{th} Anniversary of Agnes that caused the most extensive damage across the country on June 23, 1972, when almost 19" of rainfall fell over Northeastern PA and upstate New York in a period of just a few days. Details of Agnes can be found in ***"The Trouble With Agnes, 1972, A Color Pictorial of the Greatest Natural Disaster in the History of the United States"*** (Krantz, 1973), ***"The Wrath of Agnes, A Complete Pictorial and Written History of the June, 1972 Flood in the Wyoming Valley"*** (Romanelli and Griffith, 1973), and ***"Appointment with Disaster: The Swelling of the Flood"*** (Mussari, 1974). These are the most referenced works on Agnes.

Much of the damage was related to flooding of the Susquehanna River which causes the Valley streams to back up with water within their natural floodplain areas, developed or not. Flooding events threaten 3 miles of downstream reaches of Solomon Creek from South Main Street in Wilkes-Barre to the River annually. Most of the high water flows are accompanied by a large amount of debris and sediment. The bridges over the streams cause damming of debris, woody debris, ice, and sediments due to the inadequate under clearance for most of the structures. Severe backwatering of the Creek has occurred, resulting in the overtopping of the bridge deck and flows discharging to the low adjacent land areas through the bridge approaches. Floodwalls in the S. Main Street to Division Street are ineffective due to the bridge approaches causing discontinuity in the system protection. The large deposits of sediment within the channel leave less room for the volumes of water to move downstream quickly. The bridges are Waller, Barney, Regent, and Franklin Street. The concrete walls were built in the 1930s and some reaches, between Vulcan and S. Franklin Streets, prior to 1930, by the Works Progress Administration (WPA) (http://www.u-s-history.com/pages/h1599.html). These walls today are in disrepair, leaning towards the Creek, and have localized failures all along the Creek, with other sections likely to fail in the near future if not maintained and reinforced. The decks are also lower than the top of the walls, which essentially results in a break in the line of flood protection. Bridge replacements have taken place on each of these sections in the last few years with financial support from the City of Wilkes-Barre and PA Department of Transportation (PA DOT).

Upstream of this area, Solomon Creek has a fairly steep grade from the flood area. Downstream, however, there is less than a .2% grade as it meanders lazily through the municipalities. The flat slope and inadequate channel sizes are the primary reasons why Solomon Creek can't convey a 10 year flood event. Channel improvement projects downstream of the City of Wilkes-Barre in Hanover Township along Solomon Creek could improve the backwater effects in the City by eliminating constriction points downstream to improve the water flow and flash flood flows through the City.

There are **15** bridges alone from the confluence of Spring Run with Solomon Creek down to the confluence with the Susquehanna River, which is a stretch of only **20,000** feet. Above S. Main Street in Wilkes-Barre, there are possible locations for detention and storage of storm flows that are near Franklin Junction in some low-lying basin areas.

Pollution Loading and Seasonal Effects

Concentration is measured as the weight of an element in a given volume. As a result, dilution (increasing the volume) plays a major role in reducing water pollution. When the volume of water increases, such as when a tributary flows into a stream, the effective concentration of a pollutant may decrease if the additive water has a lower concentration. Likewise, the converse may also be true in that the concentration of pollutants in a stream with a continuous pollutant discharge will increase if the stream's flow decreases. As a result, pollutant loading is often used to analyze water quality. Pollutant loading results from combining the concentration of a pollutant (mg/l) with the stream flow (volume/time) to show the quantity of a pollutant flowing in a given time (mg/day). This allows a calculation of the quantity of a pollutant discharging from a tributary or a watershed at a given time. However, in analyzing stream chemistry it is very important to understand that pollutant concentrations are dynamic and may vary from day to day or hour to hour. While monitoring does give a current picture of stream chemistry, data collected once or twice every month will only reflect a value within a range. The shorter the interval between measurements, the more precise a picture of stream chemistry will be. The same is also true of flow, which greatly varies throughout the year. In the Solomon Creek watershed, stream flow is now gauged in the City of Wilkes-Barre along S. Franklin and Regent Street bridges using a staff gauge reading along one of the retaining walls.

Seasonal variations, which influence stream flow, can alter stream chemistry significantly. In some situations, increased precipitation will dilute the concentration of pollutants to make them less harmful. However, in other situations, where tributaries discharge intermittently, increases in rain or snow can allow these tributaries to actively discharge pollutants at high concentrations. Weather measurements have not been developed specific to Solomon Creek, however, average annual precipitation logs are probably available at Montage, where Channel 16-WNEP has their news station and does the weather reporting.

Trout Fisheries Management in Pennsylvania

The Pennsylvania Fish and Boat Commission (PFBC), formed in the 1860s, is the primary state agency involved in the management and protection of fisheries resources in the Commonwealth. Prior to the 1980s, the PFBC managed fisheries mostly for recreational uses. Many streams throughout the state were managed and stocked under the same statewide policies, regardless of the particular region or county in which they were located. For many years limited attention was given to the preservation of natural fish communities or native Pennsylvania fish species such as brook trout.

Since the 1980s, statewide management has begun to focus on protection of wild and native fish communities. Since the development of the PFBC's "resource-based" trout management program in 1981-1983, the enhancement of wild and native trout populations became a priority. As a result, many wild trout streams were removed from stocking lists in order to protect their native trout populations from competition by introduced nursery and nonnative fish.

The PFBC has developed several different, sometimes overlapping management programs and stream designation schemes for managing trout streams on a case-by-case basis throughout the state—balancing the concerns for angling, trout stocking, and the enhancement of wild reproducing populations. The Fish and Boat Commission's most basic stream classification related to wild trout management is based on the biomass of certain wild trout species calculated from electro fishing surveys of segments of the stream. Class A Wild Trout Streams, which are not stocked by the Commission, support a population of naturally reproducing wild trout of sufficient size and abundance that is considered necessary to support a long-term and rewarding sport fishery. The criteria for Class A Trout Streams is based on trout biomass; Class A streams contain greater than 30 kg/ha of wild trout (***See Table 3-4***).

Table 3-4 PA Fish & Boat Commission Brook and Brown Trout Stream Biomass Criteria (PFBC 57, PA Code Section 57.8)

Criteria	Biomass	Other Requirements
Class A Brook Trout	Total Brook Trout Biomass > or = 30 kg/ha; and Total Biomass of brook trout < 15 cm in Total length of at least .1kg/ha	Brook Trout shall constitute at least 75% of the Total Biomass
Class A Brown Trout	Total Brown Trout Biomass > or = 40 kg/ha; and Total Biomass of Brown Trout < 15 cm in Total length of at least .1 kg/ha	Brown Trout shall constitute at least 75% of the Total Biomass. PA FBC findings must indicate that at least 10% of the Total Biomass must be Wild Reproducing Trout
Class A Mixed Brook/Brown Trout	Total Combined Brook/Brown Trout Biomass > or = 40 kg/ha; and Total Biomass of Brook Trout < 15 cm in Total length of at least .1 kg/ha	Neither Brook or Brown Trout shall constitute MORE THAN 75% of the Total Biomass
Class B (All Types)	Total Biomass > or = 20 kg/ha	

The PFBC uses the stream area, measured at the sample site, and a statewide mean weight for 25 mm size groups or from fish weights at specific sites to calculate trout biomass. Trout recognized as likely to be stocked fish are noted during the survey and excluded from the biomass calculations. Legal fish per mile, based on the catch of fish seven inches or larger in the surveyed section, is sometimes calculated as a more non-technical metric.

Currently, **247** stream sections and **679** miles of Pennsylvania streams have been designated as Class A wild brook trout waters (EBTJV 2006). Class A streams are automatically designated High Quality (HQ) protection and slated for evaluation for Exceptional Value (EV) protection by the PA DEP.

The PFBC oversees several additional trout management programs. The Approved Trout Waters are open to public fishing and stocked with trout by the Commission or other authorized organization, and Special Regulation Areas that have tackle, harvest or other fishing restrictions (See http://www.fish.state.pa.us/fishpub/summary/troutregs_nc.htm). Also, The PFBC lists stream segments in Pennsylvania with known wild reproducing trout, as evidenced from PFBC field surveys, regardless of their biomass, in accordance with the **58 Pa. Code §57.11**. The Trout Reproduction List (available at http://www.fish.state.pa.us/trout_repro.htm).

As previously mentioned the PFBC designates remote, relatively pristine wild trout streams as Wilderness Trout Streams to protect and promote the ecological requirements necessary for the natural reproduction of native trout and maintain and enhance wilderness aesthetics for recreational angling. Wilderness Trout Streams were previously automatically afforded Exceptional Value (EV) protection under DEP permitting regulations, but recently this procedure was changed. Now PFBC-designated Wilderness Trout Streams are first evaluated through the PA DEP assessment based on water quality and benthic macro invertebrate criteria to determine whether they merit HQ or EV protection.

In 2004, the PFBC established the Wild Brook Trout Enhancement Program, to encourage catch-and-release trout fishing on particularly healthy and popular wild brook trout streams. Several streams and whole watersheds in Carbon, Forest, Warren, Monroe, Perry, Potter, Tioga and Westmoreland counties are currently enrolled in the Program (Reilly 2006). The Commission has collaborated with organizations like Trout Unlimited and EPCAMR to conduct brook trout habitat enhancement and restoration actions over the last several years and have pursued grants to begin to look at ways to remove barriers to trout. See PFBC website at http://www.fish.state.pa.us/fishpub/summary/wildbrook.html for more details.

An interesting article appeared in the Times-Leader newspaper locally on May 8, 2011, by Outdoors Writer and friend of EPCAMR's, Tom Venesky that discusses how wild trout have been dealt a blow from the current coal industry in May 2011. Mr. Venesky uses Solomon Creek as an example of what once was a picturesque trout stream until mining destroyed the majority of the watershed's landscape (***See article in Appendix M***).

Economic Impact of Trout Angling

The Solomon Creek watershed supports wild trout angling in addition to many outdoor recreational activities—mountain biking, hiking, wildlife watching, camping, and ATVing. These activities are becoming increasingly important to the local economies of the communities in the Solomon Creek watershed. Wild trout angling by itself contributed approximately **$7.1** million to the Pennsylvania economy in 2004, according to a study by the Pennsylvania Fish and Boat Commission and Penn State University (Greene et al. 2004). An estimated **1.6** million Pennsylvania residents participated in cold water fishing in the Pennsylvania Wilds region alone, according to the U.S. Department of Agriculture's 2005 National Survey of Recreation and the Environment (NSRE) (USDA 2005). Coldwater fishing, like many outdoor recreational activities, has increased in recent years. It is expected to grow by another **24%** to almost **6.5** million participants by 2015 (Fermata, 2005). Residents of the Solomon Creek watershed are faced with ensuring that the quality of watershed is not unduly compromised by the further development of eco-tourism and recreation opportunities in coming years ahead. A balance between low impact activities, such as angling and wildlife watching, and higher impact activities, such as ATVing, would be most something to consider.

Cleaning up these AMD impacted streams will undoubtedly cost millions of dollars, but these expenditures would provide a tremendous boost to the largely urban local economy that is within the Solomon Creek watershed and some of the outlying rural areas. ***An Economic Benefit Analysis for AMD Remediation in the West Branch Susquehanna River Watershed, PA*** Report was completed in July 2008 by Downstream Strategies, LLC, for the Trout Unlimited's West Branch Susquehanna River Initiative that described and quantified the local and state-wide economic benefits stemming from the remediation of AMD and improving trout fisheries. The most obvious benefit of AMD remediation to the local community is that funds are pumped into the local economy to design, build, and maintain treatment systems. Many goods and services are provided by local businesses, jobs are created, and these dollars circulate through the economy as workers spend their paychecks on other local goods and services.

A restoration economy with “green-collar” jobs is then created in which people work toward environmental restoration that supports local communities over the long term. Restoration of the trout fisheries that are impacted will bring additional dollars into the watershed when increased pressure is put on the streams that have recovered and are seeing increased populations of brook trout and other fish species in lower reaches of the Solomon Creek.

Remediation of AMD streams leads to a host of other benefits for local communities and those outside the watershed. Inside the watershed, property values that have been depressed near AMD impaired streams should rise once remediation is accomplished. Drinking water supply options, now limited or more expensive due to AMD, will expand or become cheaper with cleaner source water. Remediation of polluted streams improves recreational opportunities for local residents and will lead to increased recreational spending by tourists. Finally, remediation improves the aquatic habitat of streams in the watershed, leading to environmental improvements, which many citizens feel passionately about. This type of analysis and survey within the Solomon Creek Watershed could help to derive more concrete values on a watershed scale that is focused on the residents and businesses that are located within the watershed that are affected most directly by ancillary impacts of AMD within the watershed. Details of this report are in **Appendix N** as a digital document file that can be found on the DVD.

Chapter Four: Condition Assessment of the Solomon Creek Fisheries

The assessment of the Solomon Creek watershed fisheries draws on EPCAMR's field sampling during 20011 and 2012, along with additional environmental data, to discuss the major issues and impacts on Brook Trout populations and general stream water quality conditions throughout the entire watershed.

Condition Assessment of the Solomon Creek Fisheries

The preceding sections were intended to provide a descriptive overview of the Solomon Creek watershed and of the status and important characteristics of trout as they relate to environmental conditions in the watershed. Field research conducted by the EPCAMR Staff and volunteers, and a focused examination of historical environmental data provides an in-depth assessment of the condition of the trout fisheries and macro invertebrate communities in the Solomon Creek watershed as well as other fish species. This assessment provides detailed scientific data related with an emphasis on trout that has been fundamental in the development of goals and strategies for the Solomon Creek Coldwater Conservation Plan.

EPCAMR has incorporated environmental sampling data into the development of the Solomon Creek Coldwater Conservation Plan through two general phases: **1)** the analysis and interpretation of environmental data into scientifically valid observations and conclusions about the state of trout in the Solomon Creek watershed, including the identification of major issues and impacts on trout in the watershed; and **2)** the translation of these observations and conclusions into conservation management goals and strategies, as outlined in the Recommendations section of the Plan. To ensure the former, EPCAMR obtained technical guidance from various environmental professionals in how to interpret the compiled environmental data and incorporated their thoughts and suggestions into the Final Report. This process begged the question, *What patterns and trends are indicated by the environmental data that reflect the distribution and condition of trout and suitable trout habitat in the Solomon Creek watershed?*

The second phase, the translation of environmental data into management strategies, is the key stage in the Coldwater Heritage community planning process. EPCAMR was able to develop a set of preliminary draft of goals and strategies to present to the public for comment and ideas before producing the Final Solomon Creek Coldwater Conservation Plan. The overall approach and perspective of the goals and strategies emerged over time from through stakeholder discussions and informal interdisciplinary discussion of the political, social, economical, and environmental factors unique to the Solomon Creek watershed. The general questions posed were, *Given the issues identified by the compiled environmental data and stakeholders within the community, which implementation projects and future planning efforts are we going to be able to achieve in the short term? Long term?*

Coldwater fish communities, especially those containing wild brook trout, are a valuable natural resource and serve as important indicators of the condition of the aquatic ecosystem health in the Solomon Creek's upper watershed. With sufficient monitoring, the effects of acid mine drainage, storm water runoff, and acid precipitation, may be reflected in the structure and health of these fish communities.

It is not unusual for small, lower order headwater streams to support only a few fish species and at lower densities. Higher order streams, such as the Susquehanna River, into which Solomon Creek flows, or deeper waters such as areas impounded by reservoirs or natural pools, are likely to support a more abundant and diverse fish community and may contain some warm water fish species. The smaller headwater streams with steeper gradients, higher velocity flows, and colder temperatures, typically support fewer species and are dominated by trout.

Protection measures in these headwater areas of Solomon Creek, habitat improvement projects, and diversion of direct stormwater inputs to the headwater tributaries would go a long way to improve and maintain the wild brook trout populations in the upper watershed. EPCAMR would like to continue to create a heightened awareness with private property owners that live along several of the tributary streams of the value of the trout and improved habitat improvements that could be made in cooperation with the landowners as individuals or as a community effort. Removal of certain impediments like check dams, low head dams, and old reservoir dams in cooperation with the PA Fish & Boat Commission would also increase the downstream migration of the trout and other fishery populations in the headwater tributaries of Solomon Creek. The creation of natural stream design structures that could assist trout and fish populations to be able migrate upstream from steeply sloping natural bedrock features more easily. Some of these dams are truly what the PFBC calls “drowning machines”. Water going over these dams create a back current or undertow that can pull a person into the turbulence and the hydraulic action can trap and hold a person underwater.

Exceptional Fisheries Resources in the Solomon Creek Watershed

Although Solomon Creek contains almost **10** miles of mine drainage-impacted streams essentially incapable of supporting aquatic life, most of the headwater streams in Solomon Creek watershed are small, infertile mountain streams with excellent coldwater habitat that support a moderate brook trout fishery.

There are about **5,000** miles of streams that are thought to support some level of brook trout reproduction in Pennsylvania (EBTJV 2006). This amount to about **6%** of all the streams in Pennsylvania. In contrast, in the Solomon Creek watershed, about **10%** (**2.6** miles) of stream miles are recognized by the PA Fish and Boat Commission to contain wild-reproducing trout populations. However, the trout population in the Solomon Creek watershed is significantly reduced from its pre-colonial historical range, fragmented by AMD, heavy siltation from culm banks and eroded streambanks, flooding, and acute episodic acidification.

In addition to trout, many of the watershed’s headwater streams support other fish species. Brook trout reproduce naturally in many headwater streams throughout the Solomon Creek watershed. The watershed contains **1 *Class A trout stream***, totaling **2.6** stream miles: Solomon Gap headwaters to confluence of Pine Creek (**Figure 4-1**).

The PA Fish and Boat Commission recognize **1** stream (**2.6** miles) in the Solomon Creek watershed to contain wild reproducing populations as listed on the 2006 ***Class A Trout*** Reproduction List. ***Natural Trout Reproduction*** can be found throughout the Pine Creek and Solomon Main Stem from its headwaters in Mountaintop down to Division Street in S. Wilkes-Barre. Approved Trout Waters are only found in the Pine Creek sub watershed. There are **no *Wilderness Trout*** Streams in the watershed. Trout stocking has been carried out in various streams in the Solomon Creek watershed for more than two decades by the Ashley Trout Stocking Association and the PA Fish & Boat Commission and provides a valuable resource for recreational trout angling for the local community. There is **1** stocked trout section (**1/2** mi), locally called "Chester Creek" on the Main Stem of Solomon Creek north of S. Main Street in Ashley. (**Figure 4-1**).

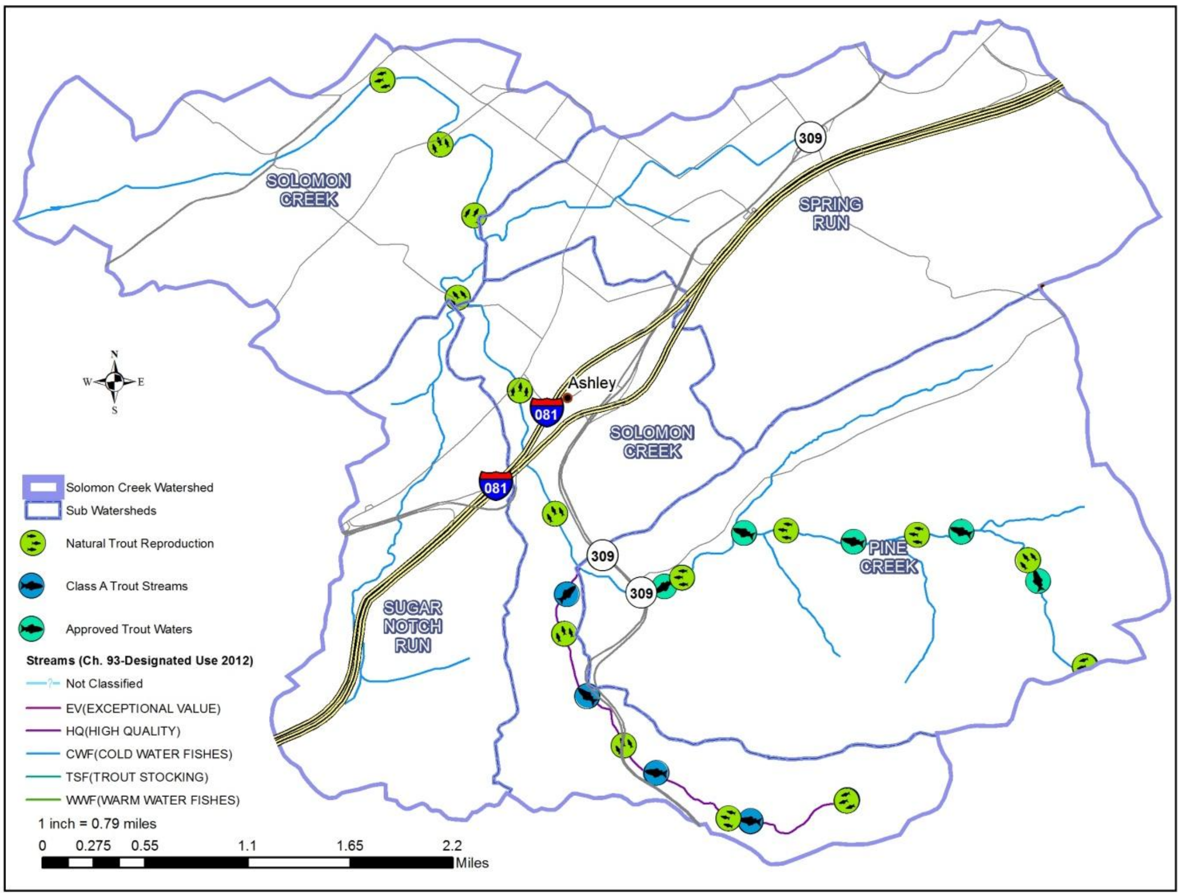


Figure 4-1 PA Fish and Boat Commission Classifications of Trout Waters in Solomon Creek

Bioindicators and Sample Site Selection

The biological assessment of Solomon Creek watershed is based on four indicators: wild trout biomass, EPA Rapid Bioassessment Protocol (RBP) benthic macro invertebrate scores, visual habitat assessment scores, and water chemistry. Water chemistry sampling targeted the effect of acidification on streams at high and low flows. Fish community surveys provided a valuable insight into the variable productivity of native brook trout streams and the presence of other fish species in the watershed, and helped to compare widespread declines or increases in brook trout throughout the watershed when compared to historical survey data. Streams with diverse aquatic insect communities are more robust and likely to sustain wild trout populations. Similarly, streams with particularly well-buffered water chemistry and little evidence of episodic acidification are more likely to provide suitable conditions for trout. Visual Habitat Assessments provided a description of the sample sites and document where natural and human disturbances may affect a stream.

Prior to EPCAMR's field investigations and stream walks, it was pre-determined objectively that **46** stream sections, assumed to be all flowing representative segments of tributaries and larger order streams in the watershed, were chosen for evaluation and assessment of macro invertebrates, stream visual habitat assessment, water quality, and fish communities in the Solomon Creek watershed. **5** tributaries, some named, others unnamed, and additional monitoring points on Solomon Creek were also included. **12** sites from within the watershed following the field assessments were then recommended to be further surveyed for a more thorough fish survey by the PA Trout Unlimited and EPCAMR. Each of the photos taken will have a description of what was found during our investigation as opposed to preparing a lengthy narrative section that would not correspond as well to the photos. Recommendations for some of the sites surveyed throughout the watershed will appear in the captions of many of the photos as future implementation projects. (**Figure 4-2**)

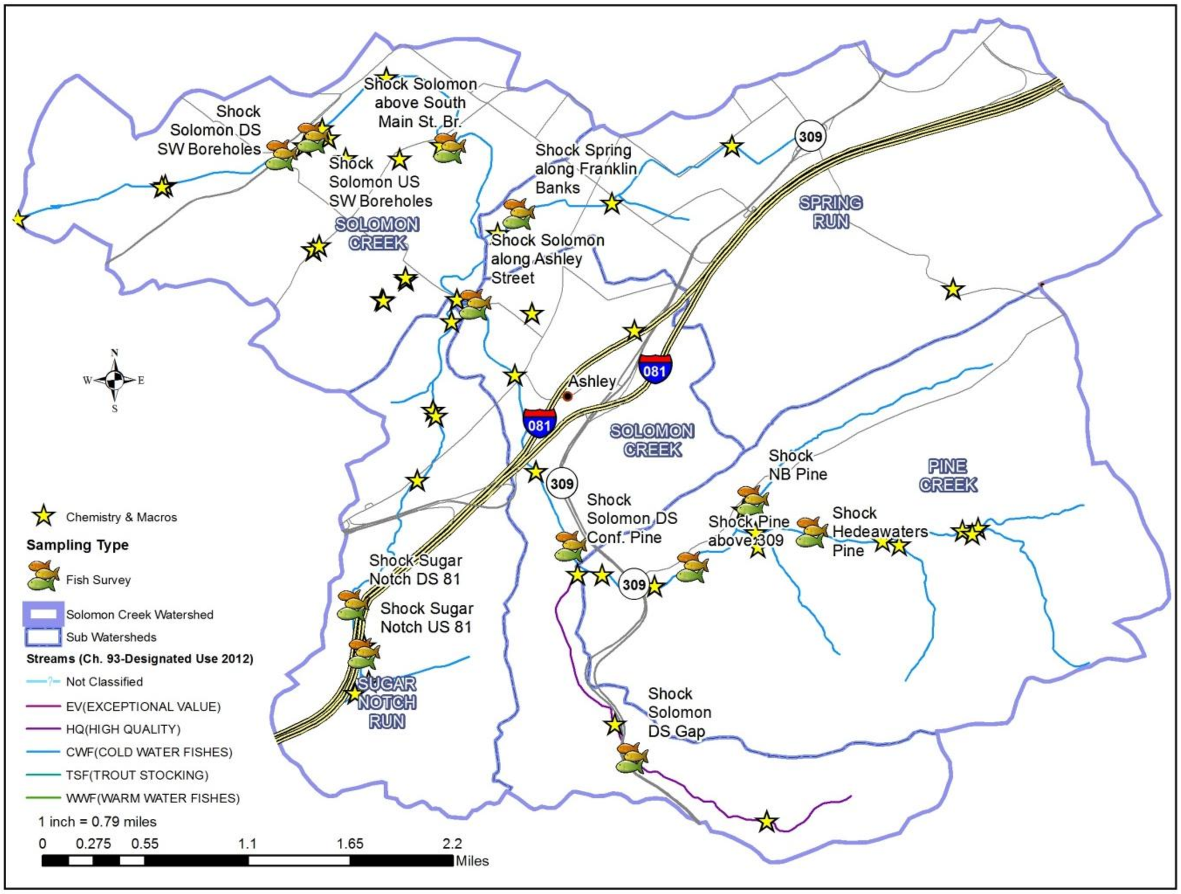


Figure 4-2 Sampling Sites were Assessed by EPCAMR and 12 Sites were Surveyed by PA TU (A larger version available in the Map Pocket)

Water Chemistry Sampling Methods and Results

Water quality samples were collected in order to assess the relative susceptibility of the sampled streams to acidification and to evaluate the impact that a typical acidification and storm water runoff event has on streams in the Solomon Creek watershed. Sedimentation and temperature pollution was of more concern in the past due to mining activities. Most of the streams are well protected with riparian buffers and vegetative stream cover. Initial water quality samples were collected in late July, 2011 during unusually low flow water levels. Additional water quality samples were then collected in the Fall of 2011 at a time when high flows occurred when Tropical Storm Lee made its way through the Wyoming Valley.

EPCAMR did not have flow measuring equipment at the time of the completion of the field monitoring to accurately measure stream flows in the field. EPCAMR also did not have a Multi-Parameter Water Meter Probe that could assess the ANC or conductivity of each of the stream segments monitored. Testing kits were not available to conduct calcium, magnesium, or aluminum tests either.

Acid Neutralizing Capacity (ANC) is the ability of a stream to buffer acids and resist significant fluctuations in pH. A stream is sensitive to sudden acidic influx between 0 and 50 mEq/l. A stream with negative values demonstrates extreme sensitivity to acid deposition or Acid Mine Drainage (AMD).

Conductivity is the amount of inorganic dissolved solids, measured in microsiemens per centimeter.

pH is the concentration of hydrogen ions measured through a logarithmic scale between 0 and 14, with 7 being neutral.

Calcium (Ca) and Magnesium (Mg) are base cations that are a measurement of alkalinity and can buffer acidic deposition if found in sufficient dissolved concentrations in streams, typically as a result of limestone geology.

Manganese (Mn) and Aluminum (Al) are metals that interact with air and water to yield a net increase in hydrogen ions, decreasing pH, and are toxic to aquatic life. They are often found in Acid Mine Drainage (AMD) and runoff from acid deposition, and adversely affect trout at high levels (typically greater than 0.2 mg/l, although effects on trout can begin at 0.1 mg/l).

The Solomon Creek watershed is dominated by glacial till, sandstone, and quartzite conglomerate bedrock and there is little limestone geology contributing base cations in most parts of the watershed. The water chemistry results are presented in **Tables 4-1**.

Table 4.1 depicts the parameters that were monitored at each site and their results. Only **2** sampling sites (SNR 02, 03) in the Sugar Notch Run watershed had pH readings below 5.0, and all other sites were within the limits of acceptable ranges for aquatic life, indicating that chronic acidification was not the main cause of impairment in the Solomon Creek watershed.

Table 4-1 Water chemistry results of sampling sites within the Solomon Creek Watershed

Station ID	Temperature (°F)	Total Iron (mg/L)	pH (s.u.)	Total Alkalinity (mg/L)	Total Acidity (mg/L)	Dissolved Oxygen (mg/L)
SC01	61	27.4	6.5	34.2	136.8	5
SCAMD01	60	29	6	17.1	119.7	0
SC02	60	27	6	17.1	119.7	4
SCAMD02	60	36	6	17.1	153.9	0
SC03	40	0	7	17.1	34.2	11
LP01	42	2	7.5	17.1	68.4	11
LP02	52	0	7.5	17.1	51.3	8
LP03	60	1.8	7.2	34.2	136.8	6
LPAMD	60	3	6.5	17.1	170.1	0
LP04	60	1.6	6	34.2	51.3	7
SC04	32	1.8	7	17.1	102.6	6
SC05	53	0	6	17.1	34.2	10
SCUT01	54	1.2	6.5	17.1	17.1	0
SR01	56	1.8	6	17.1	34.2	6
SR02	42	0.4	6	17.1	51.3	7
SR03	50	1	5.5	17.1	34.2	7
SRUT01	45	0	7	17.1	51.3	11
DF01	56	1	7.4	17.1	34.2	9
DFAMD	57	30	6.5	17.1	68.4	7
DFUT01	59	3	7.5	34.2	51.3	9
DFUT02	54	1	7	17.1	34.2	6
SC06	70	1.4	7.5	85.5	102.6	0
SNR01	70	0.8	7	51.3	85.5	0
SNR02	62	6.6	4.6	34.2	68.4	7
SNR03	62	0.6	4.5	34.2	102.6	9
SNR04	66	0	5.5	51.3	102.6	0
SNR05	64	0	6.8	17.1	17.1	5
SNRUT01	62	1.7	6.7	17.1	17.1	8
SNR06	63	0.8	6.2	17.1	17.1	6
SC07	70	1.4	7.5	85.5	102.6	0
SU01	34	0	7.5	34.2	85.5	13
SC08	62	0	6.5	17.1	17.1	9
SC09	62	0.1	6.5	17.1	17.1	9
PC01	62	0	6.5	17.1	17.1	10
PC02	40	0	6.5	17.1	34.2	13
PCUT01	41	0	7	17.1	34.2	11
PC03	38	0	5.8	17.1	34.2	13
PCUT04	44	0	5.5	17.1	34.2	11
PC04	40	0	5.8	17.1	51.3	11
PCUT10	42	0	6	17.1	34.2	11
PC05	40	0	5.5	17.1	34.2	10
PCUT14	40	0	5.5	17.1	34.2	10
PCUT13	40	0	5.5	17.1	34.2	10
SC10	61	0	6	17.1	34.2	9
SC11	54	0	6.5	17.1	34.2	10
SC12	34	0	6	17.1	34.2	11

Results of Benthic Macro invertebrate Community Sampling

Healthy macro invertebrate communities were found throughout the watershed in many of the sub watersheds. The tributaries showing the highest diversity and abundance of aquatic insects had the higher EPT%. The dominant groups found in most of the clean headwater streams were mayfly (*Ephemeroptera*), stonefly (*Plecoptera*), caddis fly (*Trichoptera*), and dragonfly (*Odonata*). Cranefly (Tipulidea) and alderfly (*Megoloptera*) larvae nymphs were found at several sites. It is important to note that stoneflies and alderflies, although sensitive to organic pollution, are not sensitive to acid conditions (Buda, 2007). Mayflies and caddis flies are sensitive to both acid and organic pollution and are the best overall macro invertebrate indicators of water quality and aquatic habitat. Compare % EPT Taxa to % Mayfly Taxa for a representation of headwater streams that may be partially impacted by acidity (**See *Table 4-2, and Table 4-3***).

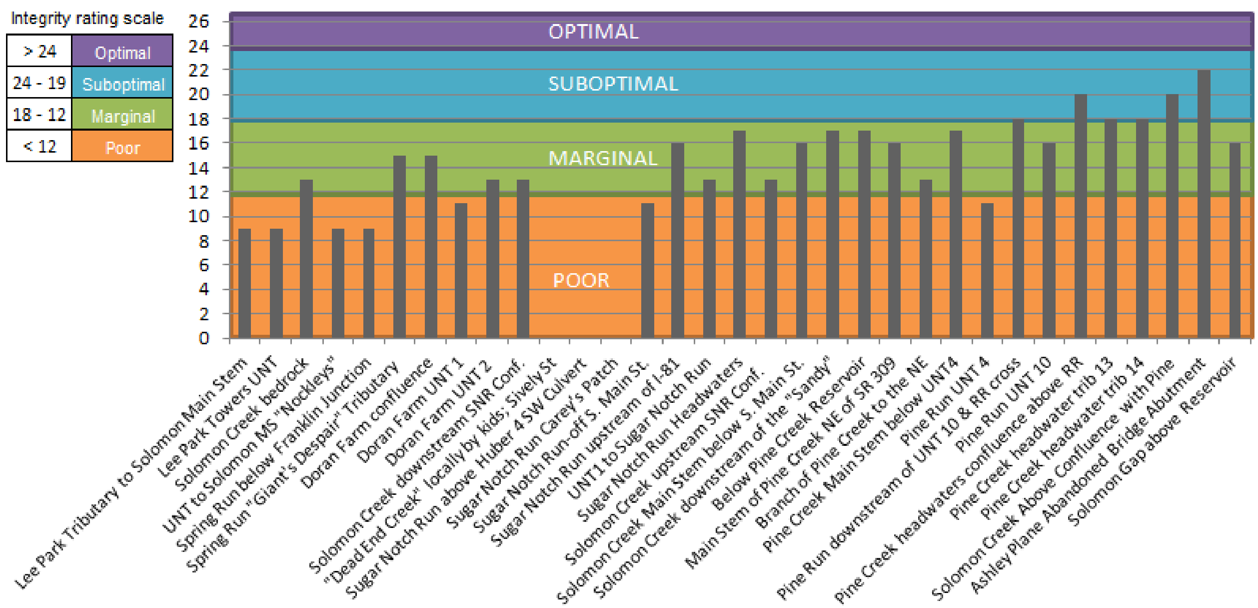
A potential indication of acid pollution occurs when stoneflies are overly dominant and mayflies or caddis flies occur in relatively low numbers. Stone flies are a part of our natural biological diversity and are very useful as indicators of water quality because of their tolerance to acidity (possible sources natural tannins, acid precipitation, and AMD). They are interesting insects in their life cycle adaptations and aquatic habitats. Stone flies are an order of insects that are aquatic in their immature stage. In PA, there are officially **136** species. In North America, there are **630** species. PA is listed as having one of the top 10 highest state total number of species. They are usually restricted to flowing waters that are cold and well oxygenated. (Earle, 2008) Since EPCAMR sampled in the Winter and Spring, we were able to identify them in relative abundance. For the rest of the year, many species are hyporheic (live down in the substrate). Small winter stone flies (*Capniidae*), Large winter stone flies (*Taeniopterygidae-Taeniopterx*), Rolled-winged stone flies (Needle flies) (*Leuctridae*), Spring stone flies (Nemouridae-Amphinemura, Soyedina, and *Ferruginea*), Green or Yellow stone flies (*Chloroperlidae-Sweltsa*), Secretive Summer stone flies (Perlodidae) were all abundant during our macro invertebrate sampling. The roach-like stone flies (*Peltoperlidae-Peltoperla*), the common shredders and (Pteronarcyidae) found in leaf packs, were in great abundance in the Pine Creek headwaters and in Solomon Gap. Common Summer stone flies (Perlidae) were also found. However, because of the variable sensitivity of macro invertebrates to different types of pollution, certain indexes for rating acid pollution are still skeptical.

Table 4-2 Benthic Macro invertebrate Community Sampling

Station ID	Stream Reach	% EPT Taxa	% Mayfly Taxa
LP01	Lee Park Tributary to Solomon Main Stem	0%	0%
LP02	Lee Park Towers UNT	0%	0%
SC05	Solomon Creek bedrock	50%	0%
SCUT01	UNT to Solomon MS "Nockleys"	14%	0%
SR01	Spring Run below Franklin Junction	20%	0%
SRUT01	Spring Run "Giant's Despair" Tributary	50%	10%
DF01	Doran Farm confluence	33%	11%
DFUT01	Doran Farm UNT 1	17%	0%
DFUT02	Doran Farm UNT 2	25%	0%
SC06	Solomon Creek downstream SNR Conf.	75%	0%
SNR01	"Dead End Creek" locally by kids; Sively St	No Bugs Present	No Bugs Present
SNR02	Sugar Notch Run above Huber 4 SW Culvert	No Bugs Present	No Bugs Present
SNR03	Sugar Notch Run Carey's Patch	No Bugs Present	No Bugs Present
SNR04	Sugar Notch Run-off S. Main St.	44%	11%
SNR05	Sugar Notch Run upstream of I-81	63%	13%
SNRUT01	UNT1 to Sugar Notch Run	50%	0%
SNR06	Sugar Notch Run Headwaters	50%	0%
SC07	Solomon Creek upstream SNR Conf.	43%	0%
SC08	Solomon Creek Main Stem below S. Main St.	100%	0%
SC09	Solomon Creek downstream of the "Sandy"	78%	0%
PC01	Below Pine Creek Reservoir	60%	20%
PC02	Main Stem of Pine Creek NE of SR 309	67%	33%
PCUT01	Branch of Pine Creek to the NE	25%	0%
PC03	Pine Creek Main Stem below UNT4	63%	0%
PCUT04	Pine Run UNT 4	50%	13%
PC04	Pine Run downstream of UNT 10 & RR cross	83%	0%
PCUT10	Pine Run UNT 10	67%	0%
PC05	Pine Creek headwaters confluence above RR	75%	0%
PCUT13	Pine Creek headwater trib 13	100%	0%
PCUT14	Pine Creek headwater trib 14	100%	0%
SC10	Solomon Creek Above Confluence with Pine	63%	38%
SC11	Ashley Plane Abandoned Bridge Abutment	64%	9%
SC12	Solomon Gap above Reservoir	100%	0%

The raw data of the macro-invertebrate samples for each stream sampled is in **Appendix O**.

Table 4-3 Benthic MacroInveterbrate Stream Integrity Score (WVSOS)



Visual Habitat Assessment Methods & Results

Stream habitat was assessed according to the **EPA Volunteer Stream Monitoring Methods Manual** (EPA, 1997). The ten metrics were scored at each site to characterize habitat quality. These metrics represent stream attributes that affect important factors, including availability of attachment sites for macro invertebrates, cover, and suitable spawning habitat for fish. Metrics also characterize the status of the stream channel, and describe the condition of the riparian zone surrounding each stream.

Stream Habitat Metrics

1. Attachment sites for macro invertebrates
2. Embeddedness
3. Shelter for fish
4. Channel alteration
5. Sediment deposition
6. Stream velocity and depth combinations
7. Channel flow status

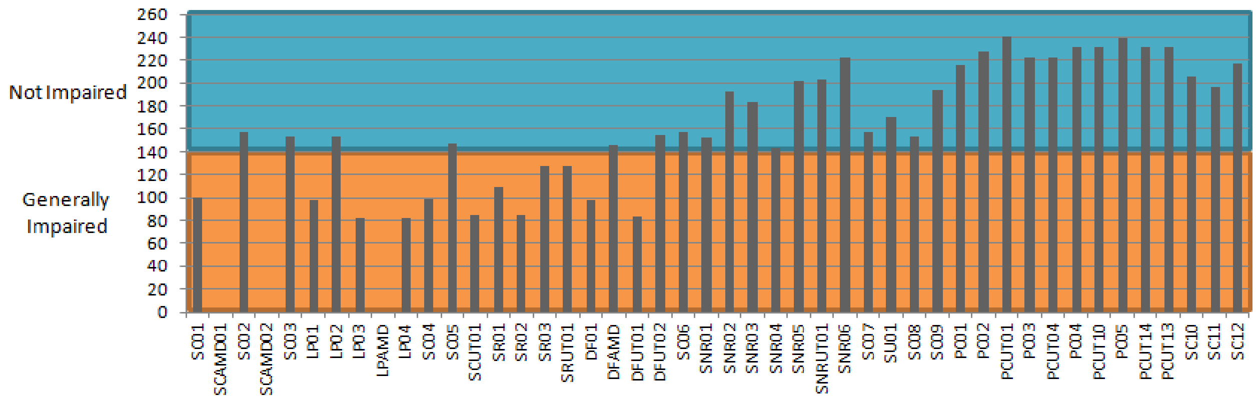
8. Bank vegetative protection
9. Condition of banks
10. Riparian vegetative zone width

A representative 30 meter stream reach was designated for evaluation for each stream. Within each designated reach, each of the ten metrics were observed and scored on a scale between 0 and 20, with 20 being the highest possible score for each metric. Scores for all metrics were added together for a total possible score of 200 for each stream reach scored. At each site, metrics were individually assessed and scored by the EPCAMR Staff. Team members then discussed their results and came to a consensus for a final score for each metric, and a single total score.

The purpose of the survey is to assess what the current habitat quality is and how well it provides livable environments for the macro invertebrates. The survey evaluates the streams in the watershed compared to the best possible conditions. The surveyed streams found in the Solomon Creek watershed were assessed using the rocky-bottom habitat protocols. In conjunction with the other surveys, the habitat survey evaluates a representative stream reach of that particular stream.

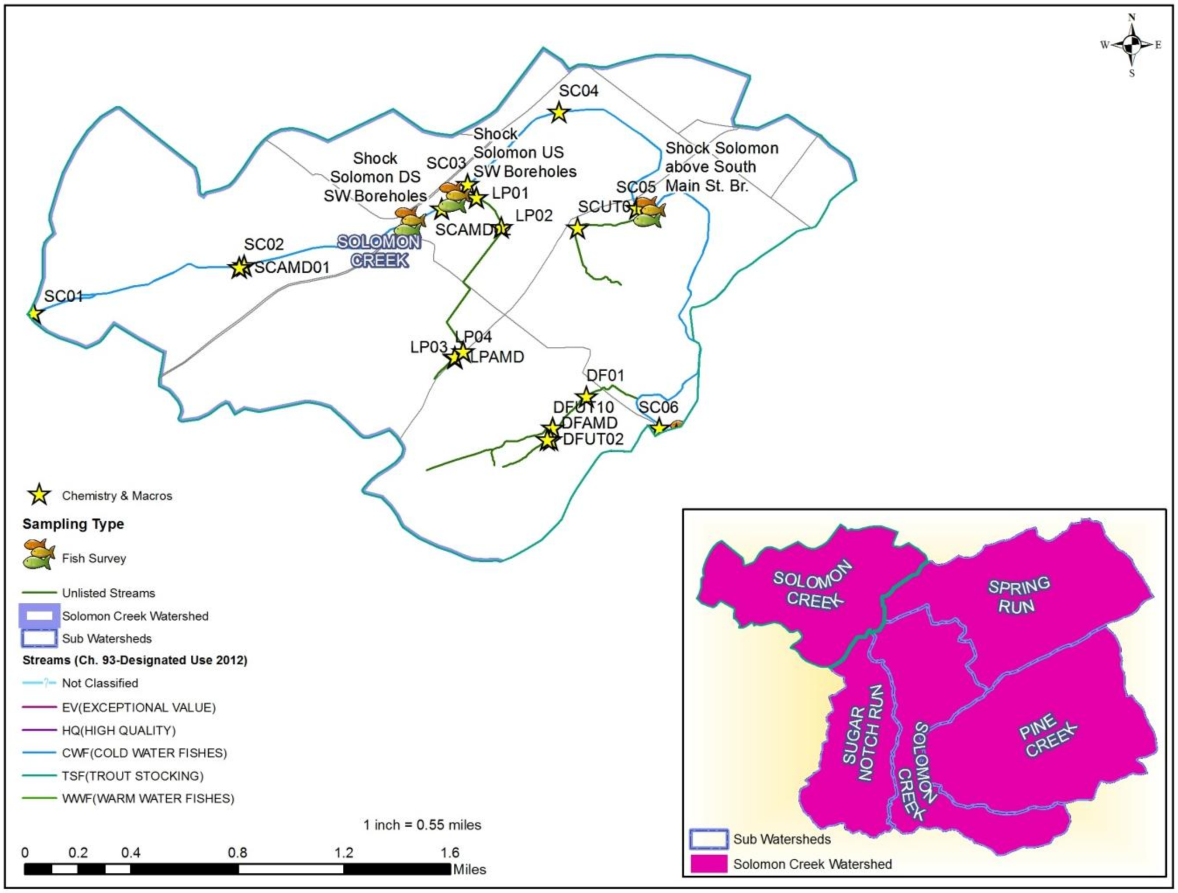
See **Table 4-4** for Qualitative and Quantitative Analyses Totals and Determination of Impairment Status due to the habitat assessed, sedimentation, and stream bank erosion. In the **Appendix P**, the reader can find the raw data Excel tables that correspond to each of the sites samples and the individual scores for each of the criteria that were assessed visually looking upstream and downstream from the monitoring points.

Table 4-4 Visual Habitat Assessment Score Totals



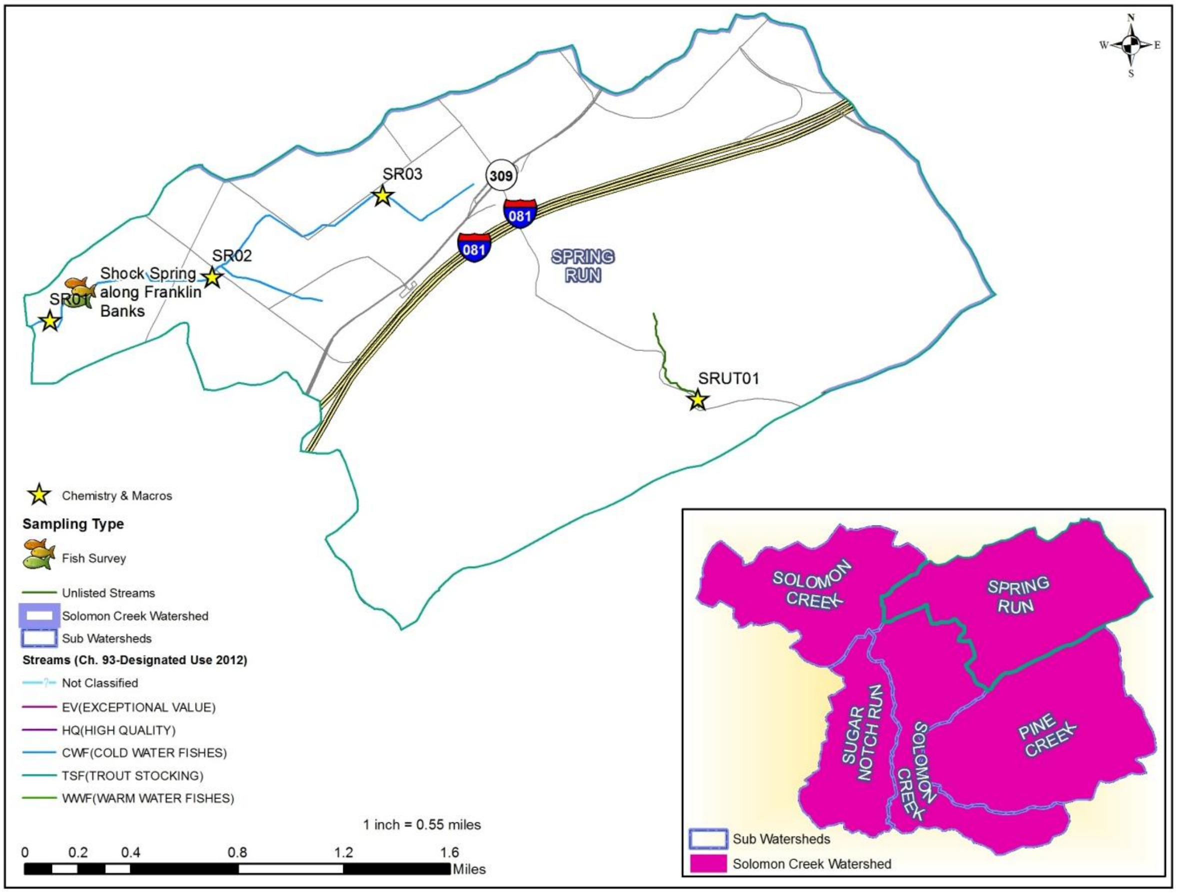
Solomon Creek Subwatershed in the Photo-Essay : from its Confluence with the Susquehanna River to headwaters and unnamed tributaries

Solomon Creek Subwatershed from the Mouth to Ashley Street



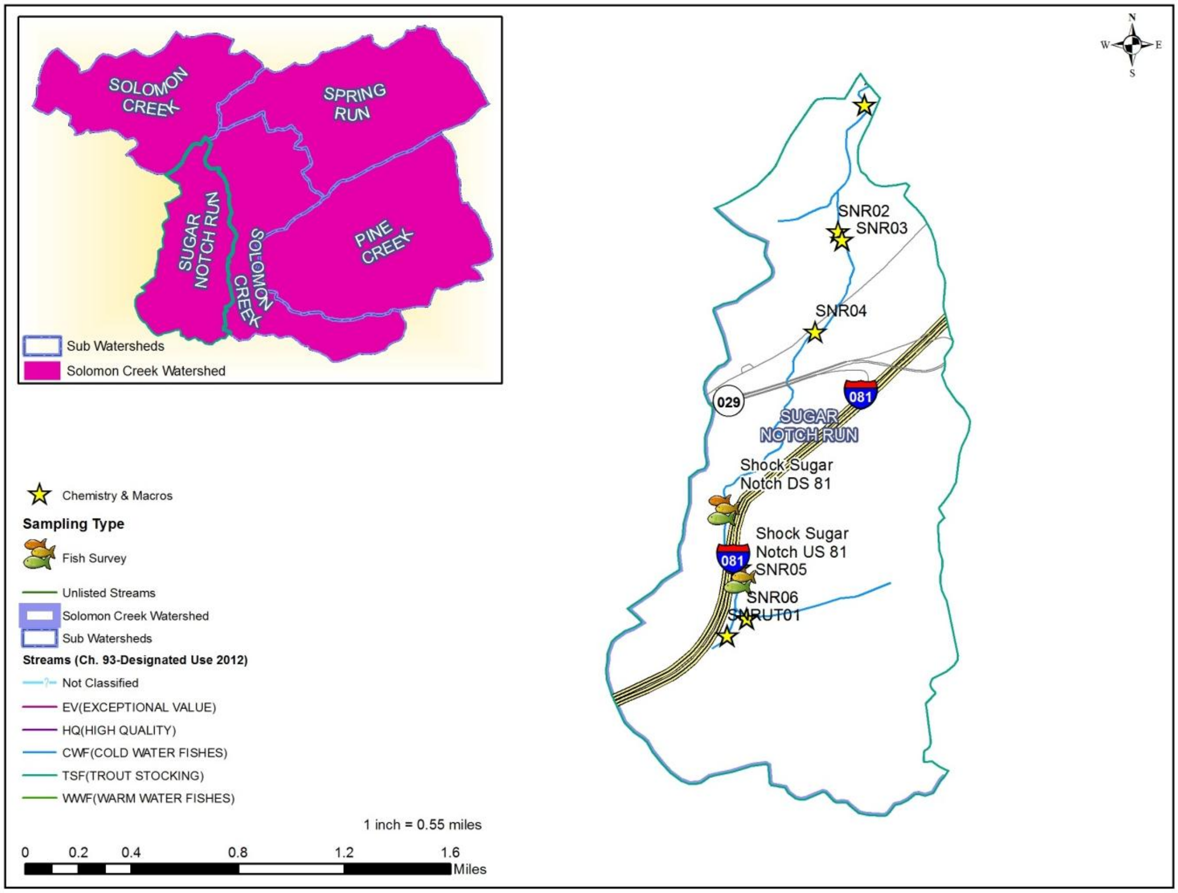
The reader is encouraged to see "Solomon Creek AMD Boreholes, Buttonwood AMD Shaft Impacts," "Solomon Creek Main Stem from South Main Street, Wilkes-Barre to the South Wilkes-Barre AMD Boreholes," "Solomon Creek Main Stem downstream from the Wilkes-Barre Fraternal Order of the Police Lodge along E. Division Street near Franklin Junction to S. Main Street," "Solomon Creek downstream from the Ashley Street Bridge to the Wilkes-Barre Fraternal Order of Police Lodge along W. Liberty Street," " Unnamed Tributary to Solomon Creek Main Stem, "Lee Park Trib"," " Unnamed Tributary to Solomon Creek Main Stem, "Nockley's tributary"," and "Tributaries and AMD Impacts to Solomon Creek Main Stem that flow from the Doran's Farm Property" sections of the photo essay for a virtual stream-walk of this subwatershed.

Spring Run Subwatershed



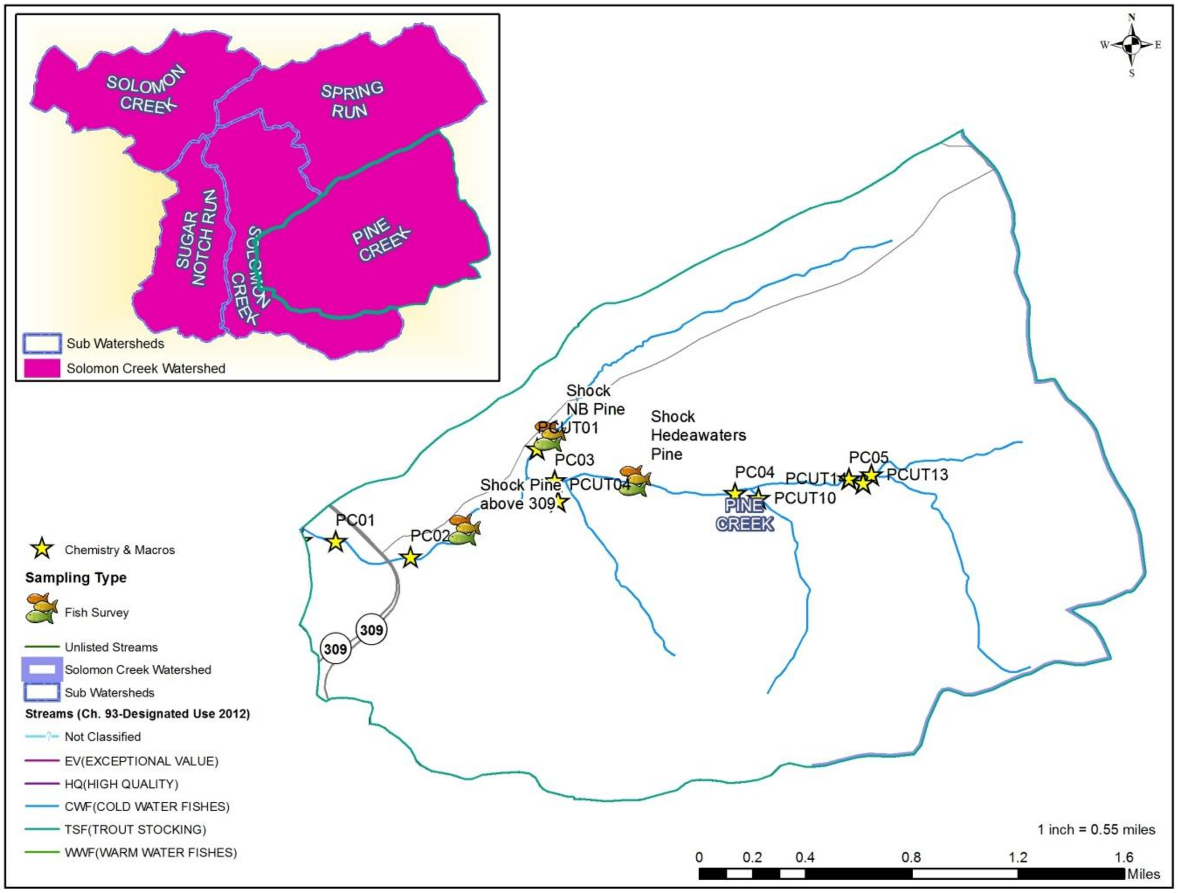
The reader is encouraged to see “Spring Run Tributary to Solomon Creek Main Stem” section of the photo essay for a virtual stream-walk of this subwatershed.

Sugar Notch Run Subwatershed



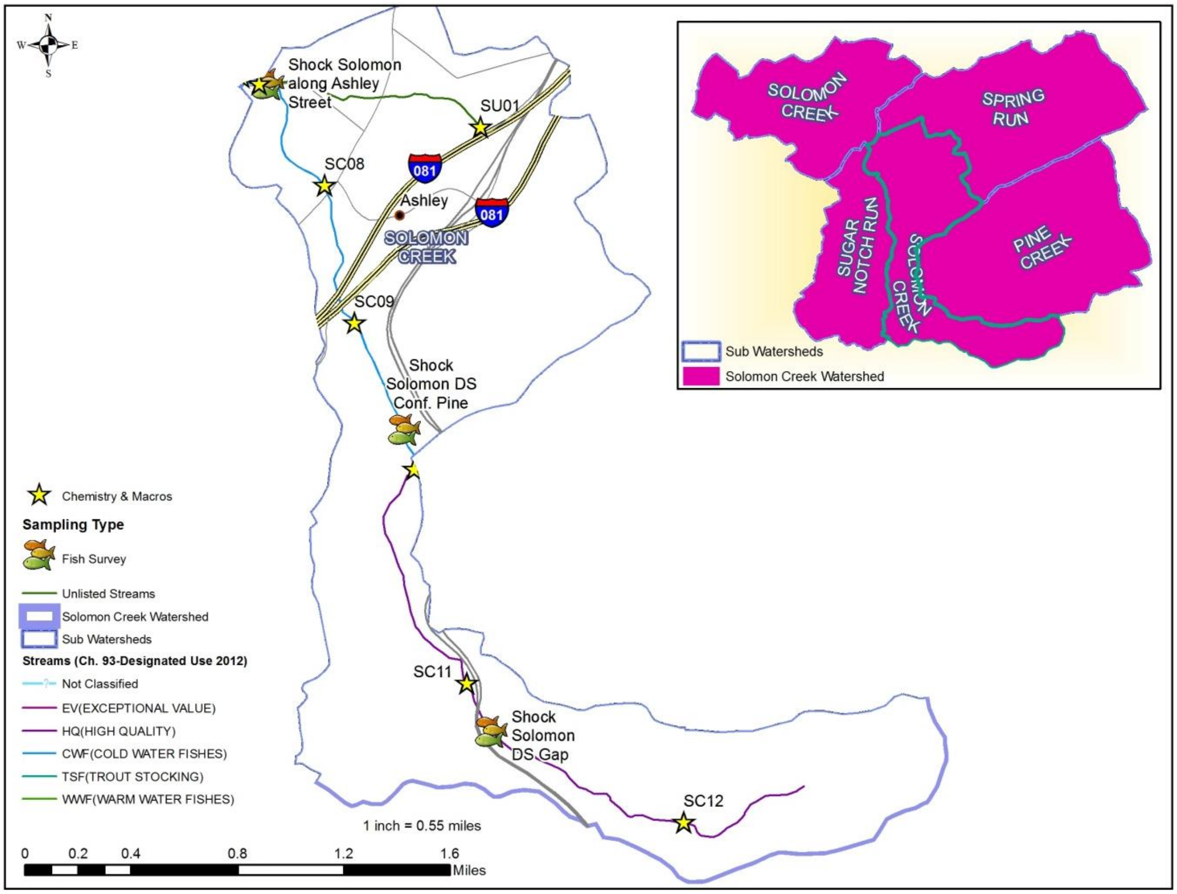
The reader is encouraged to see " Sugar Notch Run sub-watershed Assessment" section of the photo essay for a virtual stream-walk of this subwatershed.

Pine Run Subwatershed



The reader is encouraged to see "Pine Creek, North Branch Pine Creek, downstream to confluence with Solomon Creek Main Stem below the Pine Creek Reservoir" section of the photo essay for a virtual stream-walk of this subwatershed.

Solomon Creek Subwatershed from Ashley Street to Headwaters above Solomon's Gap



The reader is encouraged to see "Main Stem Solomon Creek, Ashley St upstream to Tunnel Road along State Route 309," "Solomon Creek Gap along Tunnel Road over State Route 309 south towards Mountaintop and the Solomon Creek headwaters," "Sulfur Run Tributary to the Main Stem of Solomon Creek along Ashley Street," and "Hazleton Street Unnamed Tributary to Solomon Creek Main Stem just upstream of the S. Main Street Bridge after crossing Planes Avenue" sections of the photo essay for a virtual stream-walk of this subwatershed.

PA Trout Unlimited Fishery Survey of Solomon Creek, Luzerne County, PA Technical Report

This report is in **Appendix B** as a Technical Report provided through the Trout Unlimited AMD Technical Assistance Program to EPCAMR-November 2012.

Conclusions of the EPCAMR and PA Trout Unlimited Fishery Survey

The bioindicators for which the EPCAMR Staff and PA Trout Unlimited personnel sampled are most informative as a comparative sample of high quality streams within the Solomon Creek watershed. Each indicator can inform on slightly different, yet interrelated, aspects of the watershed's high quality trout streams: in stream water chemistry and vulnerability to acidification; aquatic insect community; trout populations; and stream corridor condition. While the fish survey data are arguably the most direct and reliable measure of the status of trout in the Solomon Creek watershed, the other indicators provide supplementary explanation of these findings and highlight clear disparities.

Overall, this study portrays the majority of the streams in the Solomon Creek watershed provide suitable physical habitat conditions for trout, particularly in the headwaters areas of Pine Creek, Sugar Notch Run, and Solomon Creek main stem in Solomon Gap. However, the watershed also contains much poorer trout abundance in the lower reaches of the watershed where the AMD is most prevalent.

The visual habitat assessment scores and benthic macro invertebrate sampling show that **30** out of **46** streams segments sampled provide very suitable trout habitat. Slightly more diverse macro invertebrate communities were found in some streams, but all the streams, contained healthy macro invertebrate communities that would provide a suitable food source for trout. There were many streams that contained high numbers of the acid-tolerant stoneflies that were overly dominant, which indicated to EPCAMR that significant impairment from episodic acidification was the source of impairment in the Solomon Creek watershed where trout were present. Many acid-sensitive mayflies and stone building and net-spinning caddis flies were found as well.

The water chemistry analyses show that while the streams are very poorly-buffered and do suffer from acute episodic acidification, the water chemistry of most streams—even during a high flow event—is within the tolerable limits of brook trout.

Key Conclusions

Outlined below are key conclusions resulting directly from the EPCAMR and PA Trout Unlimited Bioassessment sampling and associated data collection. Following these conclusions are Additional Issues related to the status of trout that have arisen from the planning process and other background study of the watershed.

1. Recent EPCAMR and PA Trout Unlimited fish surveys may indicate an increase in native brook trout abundance in the Solomon Creek watershed, especially in the higher biomass trout streams with core trout populations.

EPCAMR compiled historical fish survey data from archived Pennsylvania Fish and Boat Commission records (**See Figure 2-26**). This data includes trout abundance and presence-absence surveys that indicate where relatively stable populations of trout have been consistently found and where no trout have been found to be present, based on periodic surveys. The historical data also provides a background against which to compare the recent trout abundance survey data collected by EPCAMR and PA Trout Unlimited.

Variability in trout populations is normal for non-fertile headwater streams, especially those subject to episodic acidification events. Natural variations in climate or hydrologic conditions can confound detectable trends in periodic survey data as well. However, the EPCAMR and PA Trout Unlimited fish surveys show somewhat higher densities of trout in these streams, using comparable sampling techniques and survey sites.

According to the Pennsylvania Fish and Boat Commission's historical survey data, low densities of trout have been found in the Pine Creek, Sugar Notch Run, and Solomon Gap reaches of Solomon Creek EPCAMR and PA Trout Unlimited found the presence of a number of trout and Young of Year in the month of September 2012. Densities were not calculated.

There were no biomass statistics calculated by the PFBC for most of the other surveyed streams in the Solomon Creek watershed, although the raw survey data does record fish size and weight for most of these streams. It is likely, though, that the trends in these core streams are representative of the other trout streams in the watershed. In this case, the EPCAMR and PA Trout Unlimited survey indicates that trout abundance has significantly increased since the last PFBC surveys were conducted in the mid 90s. More sites were sampled in September of 2012 by EPCAMR and PA Trout Unlimited than the 1995 PFBC Survey.

Episodic acidification is an acute contributing factor in the watershed considering there has been an increase in trout abundance across the watershed. Today, atmospheric acid deposition and precipitation, that typically cause episodic acidification, have been reduced across Pennsylvania. Increased regulation and technological improvements have resulted in a reduction in the emissions from power plants in Pennsylvania and elsewhere (**Figure 4-3**). The National Atmospheric Deposition Program (NADP) has documented the reductions in both wet and dry acid deposition over the past few decades at locations throughout Pennsylvania (**See Figure 2-22-25**) (Lynch et al. 2005).

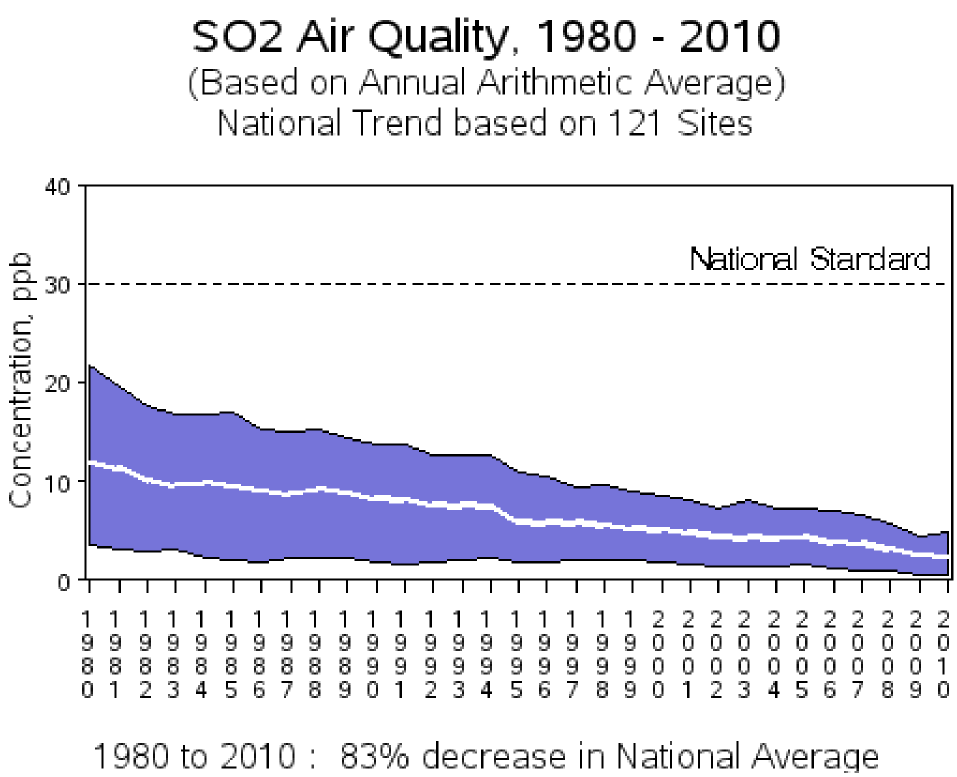


Figure 4-3 Sulfur dioxide emissions trend from all point and area sources in the United States (EPA AirData, http://www.epa.gov/airmarkets/emissions/index.html)

At the same time, abandoned mine land reclamation and restoration activities that are occurring within the watershed are reducing the total amount of clean water that is entering the underground mine pool workings that eventually contribute to the AMD loading and flows further downstream on Solomon Creek. The trout population declines and non-existence in the lower portions of the watershed indicate that improvements in AMD remediation efforts need to be made, even though the discharges are providing a source of cold water. Other impacts and disturbances on trout in the Solomon Creek watershed have worsened in other areas and need to be addressed through many of the suggested recommendations at those locations in the photo-essays.

2. There is variable susceptibility of trout streams in the Solomon Creek watershed to some episodic acidification.

The EPCAMR and PA Trout Unlimited fishery survey shows that some of the streams that contain the watershed's core trout populations may be vulnerable to the effects of some episodic acidification. The pH ranges, however, during the sampling does not indicate that it is a serious threat, although some acidity levels are high in some sample sites throughout the watershed. EPCAMR contributes this occurrence to the local geology and natural erosion forces of water on the bedrock and surrounding rock that leach metal silicates into the streams that cause the acidification. Conversely, streams that have not been noted to have high trout abundance according to historical records show slightly more capability of buffering episodic acidification and less severe effects.

PFBC surveys and regulatory protection have not focused on the above mentioned streams that are better-buffered and have been recognized to contain trout. EPCAMR and the PA Trout Unlimited found native brook trout densities in these streams that were comparable to the other streams in the watershed, including those designated as Class A. Being less vulnerable to acidification in the long term, these streams, may make more appropriate targets for conservation management activities to preserve native brook trout.

3. Pressure on existing trout populations due to angling

Trout fishing in the watershed is subject to the regulations of the Pennsylvania Fish and Boat Commission (**Table 4-5**). The regular trout season runs April through September. The daily catch-and-keep limit for trout is **5** per day of legal-sized fish (greater than **7 in**) (**58 PA Code § 63**). In the headwaters of the Solomon Creek watershed, there are limited numbers of large native brook trout. Exceeding the catch limit could impact the breeding population of trout in many of the headwater streams. Recreational angling activities can have major impacts on native brook trout populations in the Solomon Creek watershed. Brook trout populations can also be impacted by harvest angling as well as from increased hook mortality from catch and release angling.

Table 4-5 Trout fishing regulations of the Pennsylvania Fish and Boat Commission

Species	*Seasons*	*Minimum Size*	*Daily Limit*
All Species of Trout and Salmon	**Regional Opening Day of Trout Season*** March 31 at 8 a.m. through Sept. 3 (*only 18 southeastern PA counties)	7 inches	5-streams, lakes and ponds (combined species)
	Regular Season April 14 at 8 a.m. through Sept. 3	7 inches	5-streams, lakes and ponds (combined species)
	Extended Season (approved trout waters and all waters downstream of approved trout waters) Jan. 1 through Feb. 29 and Sept. 4 through Dec. 31	7 inches	3 (combined species)

4. There are many roads throughout the watershed, although the sub watersheds of certain trout stream reaches contain relatively few roads.

There are many roads throughout the watershed. The State and local municipalities maintain most roads, although some are multiple use roads maintained by private residents. There are utility maintenance roads throughout the watershed. In addition to the roads, there are dirt and unmaintained roads that appear on a topographic map. Roads, especially road crossings of streams, interrupt natural drainage patterns and aquatic habitat, and contribute to water pollution as various pollutants are taken up by road runoff. Dirt roads contribute sediment to streams, especially if improperly maintained or constructed. The highest density of roads occurs in N, S, E, Western end of the watershed.

5. Sewer Line Breaks from the Wyoming Valley Sanitary Sewer Authority, residential, or municipal lines

Further investigation is recommended to find out the sources and responsible parties of the gray water, and suspected raw sewage leaks into some portions of the watershed through the antiquated sewer line systems that are in need of updating and maintenance. This type of impairment of water quality can increase fecal coliform and other pathogens that are typically treated at a sewage treatment plant, if left unnoticed.

6. Trout Habitat fragmentation and AMD in the Solomon Creek Watershed.

The Solomon Creek watershed is a good example of fragmented aquatic habitat. Trout and other aquatic organisms depend on being able to access different habitats for different stage of their life cycle, during different seasons. While stream fragmentation is typically thought to be caused by physical impediments to fish movement such as dams, culverts, the impediments are chemical in the case of the lower portions of the Solomon Creek watershed. Many dams in the upper portion of the watershed need to be looked more closely if additional trout habitat improvement projects are to be made. There are also storm water culverts that are impediments throughout the more urban areas of the watershed that prevent further migration of the trout from the tributaries to other areas of the watershed. The AMD impaired stream segments, with viable trout populations, are barriers to the movement of trout throughout the watershed. Habitat fragmentation also limits interactions among nearby populations of trout; this can reduce genetic diversity in local populations over time. EPCAMR suspects that in the last 17 years that this has occurred locally within the watershed because the only species of trout that was found was the native brook trout as opposed to what had been surveyed historically.

The ongoing abandoned mine land reclamation restoration activities in the Solomon Creek watershed will eventually improve habitat connectivity of trout throughout the watershed by allowing trout to migrate across these restored stream segments. In the short term, any increase in trout habitat can improve the trout abundance on the headwater streams with populations so small that they are in constant danger of extirpation. It will also provide more solace for trout escaping pollution events.

EPCAMR has identified core trout populations, currently isolated from each other, that will benefit from the removal of these barriers through the restoration of the abandoned mine lands and stream channels restoration projects that are more suitable for trout habitat improvement. In the long term, should the main stem of Solomon Creek be restored to suitable trout habitat, it will greatly improve the chances of survival of current trout populations by allowing fish movement throughout the tributaries and increasing opportunities for recolonization of streams following storm events or a catastrophic event that wipes out a local population.

9. All Terrain Vehicles (ATV) and Off-roading Trails

Trails for ATVing and off-roading run throughout the Solomon Creek watershed, across and along many trout streams. ATV regulations in Pennsylvania permit ATVing only on “preexisting” trails to limit the impact on these public lands but still provide suitable recreational opportunities. However, EPCAMR observed ATV tracks off of these designated or preexisting trails during our field work. In some cases, it appears that ATV users drove in streams as substitute for designated trails.

Traffic along streams and stream crossings disturbs stream substrate and erodes stream banks, resulting in increased turbidity and sedimentation downstream. Increased turbidity has a negative effect on trout populations. High levels of suspended solids choke fish by clogging their gills, and excessive sedimentation can destroy suitable breeding habitat for trout by covering the bottom of rocky streams (Chin, 2004).

ATV operators driving outside of designated areas negatively impact the watershed and significantly damage healthy trout streams. Excessive sediment runoff from trails and dirt roads in the watershed adds additional impacts on a system already stressed by acidic episodic acidification. Driving off of designated ATV trails compounds these impacts, especially by increasing the number of stream crossings and irresponsibly driving though viable trout streams.

10. Climate Change and Trout in the Solomon Creek Watershed

Climate change is almost certain to have an adverse effect on the trout in the Solomon Creek watershed—the only uncertainty is the magnitude of this negative effect. Climate change is very likely to have two major effects on the Solomon Creek watershed that could impact trout: 1) the warming of average ambient air and surface water temperatures, and 2) the increasing variability of weather, especially the intensity of rain storms and droughts.

Most climate models show that average annual air temperatures in the northeastern U.S. will increase by at least 2° F by 2050 and again by between 4° F and 8° F by 2080 (CARA, 2007). Much of the average air temperature increase will be manifested as higher maximum temperatures during the summer (CARA, 2007). Trout require cold water temperatures year round, typically less than 20° C, so any elevation in water temperatures during the warmest months could potentially increase surface water temperatures to levels intolerable for trout and other cold water fish. While Solomon Creek's tributary streams are generally very cold year-round and could buffer any slight increase in water temperature during the summer to remain within a temperature range acceptable to trout, small headwater streams have less volume and so less thermal inertia or buffering capacity against heat exchange with warm air temperatures. Hotter air temperatures during summer and fall, together with lower low flows in the small streams during drought periods, could put coldwater habitat at risk. Maintaining the riparian area and vegetative cover over streams can mediate this effect.

Warming mean air and surface water temperatures will also shift the range of many species northward and to higher altitudes in Pennsylvania, and trout are no exception. While Solomon Creek is not at the southern end of the brook trout range in the northeastern United States, there may be microclimatological effects due to altitude and topography that will result in slightly warmer surface water temperatures in upland headwater streams—i.e., warm water habitat may extend further upstream.

In addition to mean atmospheric warming, weather has already become more variable and extreme, resulting in hotter summers, more severe droughts and floods, and abnormal warm spells during winter. As rainfall events become more intense and more frequent in the Solomon Creek watershed, runoff volumes are likely to increase. This may increase AMD discharges and—assuming that acid deposition continues in the near future—may result in large volumes of acidic runoff entering the streams, aggravating the impacts to the detriment of the existing trout populations.

For more information on climate projections and local decision-making tools to address climate change, see the Consortium for Atlantic Regional Assessment at http://www.cara.psu.edu/tools , the U.S. Global Change Research Program at http://www.usgcrp.gov/usgcrp , or the U.S. EPA's website on Climate Change at http://www.epa.gov/climatechange .

Chapter Five: Strategic Planning Recommendations and Goals

The three overall goals for trout management in the Solomon Creek watershed are: *Preserve trout where they are currently present; Improve trout habitat; and restore tributary streams to the surface to reduce abandoned mine drainage within the lower reaches of the watershed.*

The environment of the Solomon Creek watershed has been closely linked to the fossil fuel economy for many decades. Coal has left its mark, directly through mining and has contributed abandoned mine drainage (AMD) pollution into the watershed's lower reaches, streams and tributaries. Amidst all this, populations of wild brook trout have persisted in many of the small headwater streams in Solomon Creek watershed. These trout present a valuable natural resource worth protecting and enhancing for future generations and allow for the more pristine landscape to be utilized by outdoor enthusiasts for years to come.

Today, several stream monitoring and land reclamation projects are being conducted by EPCAMR, the Susquehanna River Basin Commission, King's College, Wilkes University, the Huber Breaker Preservation Society, and the Earth Conservancy to reduce the pollution that drains from abandoned mine sites in the Solomon Creek watershed and to monitor the levels of the underground water elevations that are in the surrounding mine pool complexes throughout the Wyoming Valley. In time, these restoration and reclamation project will hopefully restore polluted streams to suitable trout habitats and improve the fishery status and classifications of other sections of Solomon Creek. Improvements are slow and steady, because the legacy of the Anthracite Industry in Northeastern PA is daunting.

With the December 2006 Congressional reauthorization of the Abandoned Mine Reclamation Fund, federal and state funding for abandoned mine restoration projects in Pennsylvania has increased and more and more reclamation and AMD remediation work has been completed state-wide. This increased support has the potential to accelerate the remediation of AMD-impaired streams in Solomon Creek.

Apart from the acidification and metal loadings at high levels due to AMD, trout fisheries of the Solomon Creek watershed are at risk from the steadily increasing impacts from various outdoor recreational activities, from local land use, sedimentation, and stormwater runoff. As all of our partners eliminate the legacies of past mining practices, we can ensure a new and respectful heritage of coldwater resources in the Solomon Creek watershed with the conservation of the existing wild native brook trout streams.

GOAL 1: Monitor the apparent increases in trout abundance and implement mitigation projects to reduce acid loadings on trout streams

RATIONALE:

Recent EPCAMR and PA Trout Unlimited fish surveys indicate an increase in trout abundance in the Solomon Creek watershed, especially in the streams historically having the most abundant trout populations since the last PFBC surveys were last conducted in the mid 1990s. If confirmed by future surveys, the recent increases found by the EPCAMR and PA Trout study are a call for protection and conservation that requires prompt and concerted management action. Rainbow and Brown trout populations are already significantly reduced in abundance and distribution in the Solomon Creek watershed due to a combination of many different impacts that have stressed trout populations, including habitat loss and degradation due to AMD, acid deposition, and dirt and gravel roads, streambank erosion, stormwater, and blockages for fish passage. The local increases in the Solomon Creek watershed are consistent with the findings of the regional Eastern Brook Trout Joint Venture

(EBTJV) study, which found brook trout populations to be increasing in this area, while most of the surrounding watersheds are seen declines across their entire range in the eastern United States.

According to the historical records of the PFBC, Brown trout were prevalent in the watershed at 5 of 6 surveyed sites by the PFBC in 1995. No brown trout were found during our electro-shocking survey. Native brook trout were only found in Solomon Creek 300 meters below I-81. Rainbow trout were found by the PFBC in 1995 below I-81 and downstream of the Ashley Borough line. The EPCAMR and PA Trout Unlimited survey also found notable numbers (common and abundant) of native brook trout in Pine Creek main stem above SR 309, Solomon Creek Gap main stem below SR 309, and Sugar Notch Run above and below I-81. These trout streams likely represent the core populations of the Solomon Creek watershed that stand the best chance for the continued survival of brook trout in the watershed. Rare numbers of trout were also found in Pine Creek headwaters above the UNT4, on the North Branch of Pine Creek, and surprisingly, in the "Lee Park Tributary".

STRATEGIES:

1.1 Re-inventory and further monitor trout streams, especially Pine Creek, Solomon Gap, Sugar Notch Run, by the PA Fish and Boat Commission to determine the extent of recent increases in population observed by EPCAMR and PA TU.

1.2 Concentrate trout conservation efforts on core populations that represent the best chance for the long-term survival of brook trout in the Solomon Creek watershed.

1.3 Conduct study of archived EPCAMR, PA Trout Unlimited, and PFBC trout data to detect missing age/size classes that may indicate periodic acidification events.

1.4 Establish bio-indicator criteria and volunteer-friendly aquatic macro invertebrate guides tailored to the assessment of streams impacted by AMD and episodic acidification. Specific indicators might include: (1) the dominance of acid- tolerant stoneflies and alderflies; (2) lack of acid-sensitive mayflies and caddis flies; and (3) low species diversity (less than four orders present)

1.5 Watershed liming on trout streams where accessibility exists; the main method of mitigating acid deposition in lakes and streams is through a process called liming, by which a basic mineral, often limestone sand, is applied across the surface of an acidified stream or lake. EPCAMR has funded and supported such projects in the Bowman's Creek, Schuylkill River tributaries, Catawissa Creek, and Loyalsock Creek Watersheds over the last fifteen years. Dissolution of the alkaline material raises the pH and provides greater buffering capacity by additionally neutralizing acidic runoff into streams. Liming of acidified waters is usually a very involved and expensive process and can take a variety of methods. Watershed liming involves spreading ground limestone, with a diameter approximately 0.02 inches, to the forest floor to neutralize water flowing on or through the soil (Sharpe and Schmidt 2002). In stream liming involves direct placement of ground limestone sand into the streambed of high gradient headwater streams (Sharpe and Schmidt 2002). Lime can be trucked into a watershed to be spread onto watersheds or stream with good accessibility (TU 2007).

1.6 Support policies intended to reduce air pollution that causes episodic acidification, including power plant emissions reductions, improve automotive efficiency, employ energy conservation, and alternative energy sources.

GOAL 2: Restore Abandoned Mine Drainage (AMD) impaired streams to suitable trout habitat

RATIONALE:

Habitat degradation and fragmentation due to abandoned mine drainage (AMD) are major impacts to water quality and trout in the Solomon Creek watershed. Pollution from AMD has rendered many streams, including the main stem of Solomon Creek, unsuitable for trout and other aquatic life. In areas of the watershed where the pollution is less severe and trout persist, the water chemistry is impacted enough to stress trout, especially during high flow events. Not only does AMD reduce the overall amount of potential trout habitat and diminish the quality of existing habitat, but AMD-polluted stream segments create barriers to the movement of trout and other fish species throughout the watersheds' network of healthy trout streams. Downstream AMD-polluted tributaries create water barriers for wild reproducing trout populations in relatively unimpacted tributaries.

AMD restoration planning has not specifically focused on selecting projects that maximize benefit to trout, such as by reducing mild pollution into existing trout streams or restoring impaired stream segments in otherwise unpolluted stream basins to improve overall trout habitat connectivity. Many of the AMD restoration proposed projects that need to be completed are in the northwestern portion of the watershed and include the main stem of Solomon Creek, the Lee Park unnamed tributary, an unnamed tributary located on the Doran Farm in Hanover Township, south of the St. Mary's Cemetery, and in a tributary to Sugar Notch Run that is located in Carey's Patch. These are the areas with the most widespread AMD impacts and the most severely polluted streams. Not surprisingly, these areas do not support any trout streams. The southern and eastern portions of the headwaters of the watershed, especially Sugar Notch Run, Solomon Creek main stem near Solomon Gap, and Pine Creek seem to contain the highest quality and most abundant trout streams. Furthermore, severely polluted streams, such as main stem of Solomon Creek behind the Sans Souci Highway in Hanover Township, beginning at the rear of Leonard's Auto Tags, flowing northwest towards the confluence with the Susquehanna River require extensive and long-term treatment before they could be returned to suitable trout habitat.

Although these worst-case restoration projects may do more to improve overall pollution loading on the main stem of Solomon Creek, they are less likely to provide immediate benefits to the existing trout streams that are located in the headwaters.

STRATEGIES:

2.1 Focus restoration efforts in areas that provide the most potential benefits to trout in terms of improving existing trout habitat and enhancing the connectivity of overall trout habitat, such as along quality trout streams like Sugar Notch Run, main stem of Solomon Creek between Solomon Gap and Ashley, and the Pine Creek sub watershed.

2.2 Give greater consideration of the potential ecological values of impaired streams, especially as trout habitat, in AMD restoration planning. The PA Department of Environmental Protection has typically focused on improved stream miles as a measurable environmental result of restoration progress. This is understandable in the context of regulatory designated use attainment goals and pollution reduction based on water quality objectives. However, this is a one-dimensional metric that does not account for the relative ecological significance of different streams as habitat for trout or other species of concern. AMD restoration planning in the Solomon Creek watershed would benefit from considering the potential value of candidate streams for trout habitat enhancement, such as improving habitat connectivity by focusing on restoration projects near existing trout populations. Restoration plans should consider the quality, not just the quantity, of stream miles to be recovered. Furthermore, while EPCAMR has focused particularly on addressing AMD degradation in the Solomon Creek watershed, it should be noted that there are excellent trout fisheries in the Solomon Creek watershed that are also in need of attention.

2.3 Use the recovery of suitable trout habitat and the return of trout to formerly impaired streams as a long-term indicator of successful stream restoration projects. Monitoring reduced pollutant loadings from future AMD treatment sites can possibly increase the presence of trout in formerly impaired stream segments that may provide a metric that could be more appreciable and understandable to the public in tracking the success of the improvements in water quality and fishery improvements within Solomon Creek. In the long term, reclaiming trout and other fisheries, not just stream miles, should be an important goal in the Solomon Creek watershed.

2.4 Further study to identify candidate AMD-impaired stream segments that have the most potential to be restored to suitable trout habitat and that would enhance the overall habitat connectivity of trout streams in the Solomon Creek watershed. For instance, identify where there are polluted stream segments that currently are barriers to the movement of trout throughout the Sugar Notch Run watershed and the main stem of Solomon Creek above S. Main Street in Ashley. Alternatively, identify polluted tributaries which singularly contribute to the degradation of otherwise healthy trout streams, such as tributaries to Sugar Notch Run, the Inman borehole AMD discharge to the Lee Park tributary that flows into the main stem of Solomon Creek, the unnamed tributary to the main stem of Solomon Creek along St. Mary's Road coming from the Doran property, and Sulfur Run, an unnamed tributary to the main stem of Solomon Creek within the Borough of Ashley. Give priority to these streams for AMD and stream restoration planning .

GOAL 3: Ensure proper construction and maintenance of dirt roads

RATIONALE:

With tens of miles of roads in the watershed and a small minority of them being dirt, it is important to consider the impacts dirt roads can have on the trout fisheries of Solomon Creek watershed. Many of these roads are in close proximity to, or cross, streams that contain trout and could be detrimental to the health of the streams if they are not properly managed. The majority of the dirt roads in the watershed are owned and maintained by PA DCNR Bureau of Forestry- Lackawanna State Forest and the PA Game Commission on the State Game Land 207. The biggest concern with dirt roads is erosion of sediment into the stream. Many of the roads in the watershed are used by hunters, anglers, hikers, bikers, and ATV riders.

STRATEGIES:

3.1 Properly install and maintain erosion and sediment control devises to minimize the amount of sediment entering streams during construction and land development activities.

3.2 Retire roads that no longer serve a purpose to minimize impacts of motorized vehicles on streams and the watershed.

3.3 Collaborate with various private road owners and the PA DCNR or PA Game Commission to agree on a road management plan that details properly constructed and maintained roads.

3.4 Encourage local municipalities or counties to adopt and implement best management practices (BMPs) for dirt and gravel roads developed by the Penn State University Center for Dirt and Gravel Road Studies (www.mri.psu.edu/centers/cdgrs).

3.5 Monitor roads for problems and contact parties responsible for road maintenance to request corrective action.

3.6 Designate permitted uses of roads more clearly.

3.7 Install culverts or improved stream crossings where roads and trails directly cross streams to alleviate erosion problems.

GOAL 4: Provide regulatory protection for high quality trout streams

RATIONALE:

The DEP HQ/EV Special Protection streams designation program offer regulatory protection of trout streams in the Solomon Creek watershed.

EPCAMR and PA Trout Unlimited have identified several streams with abundant wild trout and pristine habitat that are not currently under EV or HQ Special Protection by the DEP, including Sugar Notch Run, above and below Interstate I-81, the main stem of Solomon Creek downstream of Solomon Gap, and Pine Creek. The trout biomass in Sugar Notch Run found by EPCAMR and the PA Trout Unlimited is not nearly enough to qualify through PFBC for Class A and the coupled EV protection, but these streams may qualify for EV or HQ through DEP water quality and macro invertebrate criteria. Currently, Sugar Notch Run is listed as impaired and on the 2008 Integrated List of Non-Attaining Streams from it's confluence with the main stem of Solomon Creek to its headwater tributaries. EPCAMR believes that there is a great possibility that this designation can be partially removed from the downstream monitoring point of our electro shocking survey to above Interstate I-81 into its two first order tributaries. Pine Creek quite possibly could be upgraded to a Class A Trout Stream to go along with its Natural Trout Reproduction and Approved Trout Waters status.

The upgrading of stream designation to HQ or EV can be a contentious issue, especially for streams on private land, because it results in increased permitting regulations along streams. Local landowners may be hesitant to support upgrading of streams on their property because of the perception of increased government regulations. The need to obtain support and "buy-in" from landowners for the conservation of trout on their property is important. On public lands, upgrading streams can sometimes place greater regulatory burdens on local management agencies during day-to-day operations. However, the additional permitting review afforded by HQ or EV special protection ensures that management actions do not have any unforeseen detrimental effects on trout streams. Despite the drawbacks, HQ/EV status is one of the few definitive measures that can be taken to secure trout from future detrimental land use impacts.

STRATEGIES:

4.1 Petition DEP to conduct surveys on Sugar Notch Run, the main stem of Solomon Creek downstream of Solomon Gap, and Pine Creek, above the Pine Creek Reservoir parallel to Pine Run Road, to support upgrade to HQ or EV Special Protection status. PennFuture (www.pennfuture.org) has published a guide for the HQ/EV stream redesignation process entitled the ***Stream Redesignation Handbook: A Step-By-Step Guide for Petitioning to Upgrade Your Stream to HQ or EV Special Protection in Pennsylvania***.

GOAL 5: Increase the public awareness and appreciation of native brook trout streams

RATIONALE:

Future trail development of the Ashley Planes would definitely improve access to some trout streams, resulting in increased recreational usage of these streams. It is important to ensure that visitors to the watershed are educated about the importance of protecting trout so that increased recreational activities along the Planes do not adversely impact nearby trout populations. One of the key connecting points of the proposed Ashley Planes begins in Ashley Borough along its Main Stem that runs along Planes Ave, just east of S. Main Street. The Ashley Planes could also improve access to Pine Creek and the upper portions of Solomon Creek along its main stem up to Solomon Gap, near Mountain Top. Several of the unnamed tributaries have intact ecosystems and viable trout populations. Sugar Notch Run could also be used more since there is a trail owned by the Earth Conservancy, the Sugar Notch Trail System, which runs along the tributary south of Sugar Notch Borough, up along Interstate I-81 and into the headwaters that are on the other side of the State Highway. With the increased public use, Sugar Notch Run and the Ashley Planes would also be good locations to install educational signage related to native brook trout and the Solomon Creek Coldwater Conservation Plan.

There are many recreational groups, including local sportsmen clubs, state forest land managers, state game land managers, and ATVers, that utilize the watershed that would benefit from learning about how to minimize impacts on trout. Most recreational activities that occur in the watershed, whether angling, hunting, or ATVing, have some impact on trout. Providing educational opportunities for these stakeholder groups to learn how their actions can harm and benefit trout is essential to maintaining grassroots support for the Coldwater Conservation Plan.

STRATEGIES:

5.1 Install educational signage about wild trout and the Solomon Creek Coldwater Conservation Plan along the Ashley Planes and the Sugar Notch Run Trail System, and at other key locations within the watershed, particularly at the AMD discharge locations further downstream.

5.2 Continue to communicate with the PA Fish & Boat Commission NE Regional Office fishery biologists, Waterways Conservation Officers, PA DCNR Lackawanna State Forest District and the PA Game Commission land managers and district foresters by holding a meeting on the Coldwater Conservation Plan and trout conservation practices that can be further implemented in partnership with both agencies.

5.3 Bridge memberships and promote cooperative efforts between PA ATV groups, hikers, birders, mountain bikers, Trout Unlimited, the EPCAMR, Earth Conservancy, Huber Breaker Preservation Society, Ashley Trout Stocking Association, PA Game Commission, PA DCNR, PA FBC, the PA Environmental Council-NE Office, and other local environmental and recreational organizations. Focus on trout-sensitive recreational activities as a common goal.

GOAL 6: Promote land use practices and land owner stewardship that protect trout

RATIONALE:

The land use practices of private landowners have a direct affect on the health of these streams. Therefore, it is import that landowners employ proper stewardship practices and stewardship practices to protect streams on their land. Public education and outreach programs are one way to promote proper stewardship.

A large portion of the North Branch of Pine Creek watershed is on private land and additional outreach will be necessary to inform them of importance of the recommendations that are in the Solomon Creek Coldwater Conservation Plan. Land use practices on both private and public land that directly affect streams include runoff from on-lot sewage systems, lawns, illegal dumping, and timbering operations. Additionally, the popularity of ATV-use on private (as well as public) lands also directly impact streams.

Encouraging the entire range of stewardship activities related to the protection of trout benefits the private landowners by building a sustainable native brook trout population in the Solomon Creek watershed for locals to enjoy, or benefit from funds generated by out-of-town anglers.

STRATEGIES:

6.1 Develop and present educational outreach programs for local landowners and anglers about sustainable land use management practices that support the protection of trout

6.2 Promote forest management Best Management Practices (BMPs) in partnership with the PA DCNR

6.3 Support private landowners employment of best management practices (BMPs) for timber harvest, especially to maintain riparian buffers and limit stream crossings. All Pennsylvania state forests, are certified through Sustainable Forestry Initiative (SFI) as well as Forest Stewardship Council (FSC) and employ BMPs. It is reasonable for private landowners to request that timbering companies employ the same BMPs for operations on their private property. See the USDA Forest Service's Forest Landowner Guide at http://www.na.fs.fed.us/pubs/misc/flg or the Forestry BMP site at http://forestrybmp.org for more information about BMPs and proper silviculture practices

6.4 Encourage landowners to work with their local extension service forester to sponsor forest stewardship workshops in partnership with EPCAMR. Workshop examples include implementing BMPs on private land; streambank stabilization practices; and developing riparian buffers

6.5 Provide ATV and mountain biking outreach programs that educate riders on the effects of ATVing and mountain biking on trout streams, especially regarding driving through streams and outside of designated areas

6.6 Provide increased enforcement of ATVing on public lands

6.7 Promote sustainable lawn care including leaving a riparian buffer adjacent to streambanks and limiting the use of herbicides and pesticides in the more urban areas of the Solomon Creek watershed

6.8 Investigate and eliminate possible sewage runoff from faulty and antiquated sewer lines that are tied into the Wyoming Valley Sanitary Authority or other municipal sewer systems just north of west of Franklin Junction below the Wilkes-Barre Fraternal Order of Police Lodge on the main stem of Solomon Creek, in the area of Carey's Patch, and along the mouth of the Sugar Notch Run tributary that flows into Solomon Creek main stem along Ashley Street

6.9 Provide opportunities for local resident to dispose of white goods and tires in order to eliminate illegal dumping within the watershed. Several small cleanups are necessary to improve the stream corridors and tributaries that feed Solomon Creek at several locations within the watershed

6.10 Install signage at common community dumping areas to discourage dumping due to the impacts on trout. An example of a sign could be "This area drains to a healthy wild trout stream, a rare and precious resource in Pennsylvania. Don't Dump on the Trout!"

6.11 Encourage residents within the watershed to recognize and report POLLUTION or DISTRUBANCE of waterways to the PA Fish & Boat Commission; 1-800-541-2050 (24/7) or contact the NE Regional Office, Sweet Valley, PA 570-477-5717

GOAL 7: Promote recreational angling activities that support native brook trout, while ensuring that angling activities do not adversely affect native trout

Wild-reproducing populations of brook trout provide a valuable fishing resource, in addition to ensure the future of native wild brook trout fisheries in the watershed. While angling should be encouraged as an important way to appreciate and support the protection of wild trout, recreational angling activities can also have major impacts on the native brook trout populations in the Solomon Creek watershed

The stocking of non-native species (including brown trout) can negatively affect wild brook trout populations. Brown trout, in particular, out-compete wild brook trout for food and breeding habitat as well as prey upon wild brook trout fry. The competition and predation from non-native brown trout decreases wild brook trout populations in an already stressed system. In order to ensure the sustainability of the native brook trout population as a fishing resource and to help restore native trout populations, stocking should be prohibited from these streams.

Catch-and-release fishing pressure stresses wild brook trout populations by increasing hook mortality. Harvest fishing, especially poaching during the off-season and exceeding catch limits, can significantly reduce local wild trout populations as well.

STRATEGIES:

7.1 Refrain from stocking trout, especially brown trout, on streams that currently only contain wild reproducing brook trout, especially in tributaries including: (1) Sugar Notch Run above the Hanover Youth Recreational Fields off Preston Road; (2) the main stem of Solomon Creek below Solomon Gap; and (3) Pine Creek

7.2 Consult with the Ashley Trout Stocking Association and the Fish and Boat Commission to identify streams that could be permanently set aside only for native trout and not stocked

7.3 Discourage poaching of native brook trout

7.4 Balance the promotion of recreational opportunities without increasing fishing pressures

Goals & Suggested Partners

GOAL 1: Monitor the apparent recent increase in trout abundance and implement mitigation projects to reduce acid loadings on trout streams

All, EPCAMR, local school groups, TU, PFBC, PA DEP, SRBC, TU

GOAL 2: Restore streams impaired by acid mine drainage (AMD) to suitable trout habitat.

EPCAMR, EC, HBPS, SRBC, WVWC, PA DEP, BCWA, DEP

GOAL 3: Ensure proper construction and maintenance of dirt roads.

Construction and land managers, Luzerne Conservation District, Local municipalities and Lackawanna State Forest, PA Game Commission, Local residents and landowners, Luzerne County

GOAL 4: Provide regulatory protection for high quality trout streams.

EPCAMR, PA DEP, PFBC, local residents, landowners, or school groups

GOAL 5: Increase public awareness and appreciation of brook trout in the Solomon Creek watershed.

EPCAMR, EC, TU, ATV Groups, Mountain Biking Groups, Birders, Hikers

GOAL 6: Promote land use practices and landowner stewardship that protect trout.

EPCAMR, Luzerne Conservation District, Lackawanna State Forest, PA Game Commission, local schools

GOAL 7: Promote recreational angling activities that support native brook trout, while ensuring that angling activities do not adversely affect native trout.

EPCAMR, EC, TU, PFBC, ATV Groups, Mountain Biking Groups, Birders, Hikers

Acronyms

TU – Trout Unlimited (Stanley Cooper Ch.)

SRBC – Susquehanna River Basin Commission

ATV-All Terrain Vehicle Groups

PFBC – Pennsylvania Fish and Boat Commission

PA DEP – PA Dept. of Environmental Protection

ATSA-Ashley Trout Stocking Association

HBPS-Huber Breaker Preservation Society

EC-Earth Conservancy

Concluding Remarks

Though significant environmental problems exist, the Solomon Creek watershed encompasses a landscape that is ripe with beauty, nature abound, forested canopies, natural rock outcroppings, coal outcroppings, historical and cultural areas that are significant to the Anthracite Coal Region of the Wyoming Valley, and a myriad of recreational opportunities. The environmental stewards of the Solomon Creek watershed have a critical role to play in providing an opportunity for trout to survive and prosper amidst the many impacts. Trout abundance may never be what it once was, but we can save what we can as a legacy for the future.

Photo-essay of the Solomon Creek Watershed from its Confluence with the Susquehanna River to headwaters and unnamed tributaries

Appendix A Solomon Creek Watershed TMDL Report for Acid Mine Drainage Affected Segments, Luzerne County, PA

Appendix B PA Trout Unlimited Fishery Survey Technical Report

The EPCAMR Staff and PA Trout Unlimited surveyed the fish communities by sampling a designated reach in each stream using backpack electro fishing units. Fish community surveys were sampled at the same sites as the macro invertebrates and habitat assessments. The collection method was performed as closely as possible to the PFBC sampling protocol. The sites selected were as close as possible to sites previously sampled by the PFBC in order to compare size structure and population densities over time.

At each stream site, a section either 100m or 300m in length was delineated that included representative riffle, run, and pool habitat types. Passes were made using the electro fishing backpack unit. A fishery technician performed the electro fishing with the assistance of EPCAMR Staff and volunteers. The team members carried nets and buckets to capture the fish for the assessment. At the end of each pass, the fish were identified, measured, and weighed. The data were recorded for the use in population, absence/presence, class size distribution, and abundance. All trout were identified to species, with lengths used to calculate relative abundance for brook trout.

Appendix C Solomon Creek Flood Protection Project Feasibility Report

Appendix D Lackawanna & Luzerne County Indicators Report

Appendix E SRBC Historic Flow and Water Quality Data on the South Wilkes-Barre AMD Boreholes and the Buttonwood Shaft AMD Discharge

Appendix F I-81/Rte 115 Connector Road Master Plan

Appendix G PA Fish & Boat Commission Solomon Creek 405B Fisheries Management Report

Appendix H Luzerne County Act 167 Stormwater Management Plan Phase II Executive Summary Including Solomon Creek

Appendix I A History of Wilkes-Barre, Luzerne County: From Its Beginning to the Present Time, Including Chapters of Newly Discovered Early Wyoming Valley History

Appendix J Ashley Planes Heritage Park Conceptual Master Plan

Appendix K History of the Ashley Planes-Annie Bohlin

Appendix L The Delaware & Lehigh Navigation Canal & National Heritage Corridor Commission’s Cultural Landscape Inventory, Part 2, Ashley, PA

Appendix M Article by Tom Venesky-Citizen's Voice and an Article by PGC via Times Leader

Appendix N An Economic Benefit Analysis for AMD Remediation in the West Branch Susquehanna River Watershed, Pennsylvania

Appendix O Macro Invertebrate Collection Raw Data

Appendix P EPCAMR Stream Quality and Quantity Raw Data Summary

Appendix Q Brook Trout Conservation Strategies proposed for PA by the EBTJV

Appendix R Eastern Brook Trout Joint Venture (EBTJV) Background

Appendix S DVD with Solomon Creek Coldwater Conservation Plan Data, Maps, Figures, Tables, Photo-essay, Reference Documents, Appendices, and Digital Copy

Attached DVD with Solomon Creek Coldwater Conservation Plan data, maps, figures, tables, photo-essay, reference documents, appendices, and digital copy of Plan.

Contact EPCAMR for a digital copy of GIS maps and database used in the production of the Solomon Creek Coldwater Conservation Plan.

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