EPCAMR

Eastern Pennsylvania Coalition for Abandoned Mine Reclamation

Laurel Run Coldwater Conservation Plan

Luzerne County, PA

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Funded by:

Coldwater Heritage Partnership

Table of Contents

List of Figures

List of Tables

Acknowledgements

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Technical reports and historical documents were also reviewed to support data and information found in the Laurel Run Coldwater Conservation Plan. This includes information from PA American Water, Borton-Lawson Engineering and Architecture, and the Pennsylvania Department of Transportation.

EPCAMR would like to thank the following entities for allowing access to their lands and outreach support.

Glossary

AMD: Acid Mine Drainage/Abandoned Mine Drainage

AOP: Aquatic Organism Passage

CCP: Coldwater Conservation Plan

cfs: cubic feet per second

CHP: Coldwater Heritage Partnership

CWF: Coldwater Fishery

DO: Dissolved Oxygen

EPCAMR: Eastern Pennsylvania Coalition for Abandoned Mine Reclamation

Fe: Iron

gpm: gallons per minute

LCD: Luzerne Conservation District

LR: Laurel Run

mg/L: milligrams per liter

NAACC: North Atlantic Aquatic Connectivity Collaborative

ORP: Oxidation Reduction Potential

PA DCNR: Pennsylvania Department of Conservation & Natural Resources

PA FBC: Pennsylvania Fish & Boat Commission

PGC: Pennsylvania Game Commission

ppm: parts per million

TDS: Total Dissolved Solids

TU: Trout Unlimited

UNT: Unnamed Tributary

USGS: United States Geological Survey

µ: Microsiemens

Introduction and Background

The Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) is a public non-profit. Founded in 1996, our mission is to promote and facilitate the reclamation and remediation of land and water adversely affected by past mining practices in Northeastern Pennsylvania. EPCAMR specializes in restoring streams affected by abandoned mine drainage (AMD), a water pollution problem that impacts over 5,000 miles of streams in PA. Many coldwater fisheries in the anthracite region with deep mining lose surface water streams to the underground mine pools which discharge AMD to streams harming aquatic life, water quality, fishery habitat, and stream habitat.

EPCAMR's goals are to reduce health and safety hazards, eliminate soil erosion, improve water quality, and reclaim past mine lands for practical use. We also work in underserved coalfield communities to conduct environmental education projects.

Thanks to funding from CHP, EPCAMR has been able to compile a complete Laurel Run Coldwater Conservation Plan. Like many streams within the Anthracite Coal Region of Pennsylvania, Laurel Run is subject to abandoned mine land (AML) and AMD impacts, both of which contribute to the degradation of biodiversity in CWF (coldwater fisheries), WWF (warm water fisheries), and other aquatic habitats. The Laurel Run CCP has allowed EPCAMR to invest time and funds into developing a plan to protect and restore a thriving natural CWF in Pennsylvania. The plan also evaluates mining impacts, makes recommendations for future implementation projects, and makes recommendations for preserving existing conservation work within the Laurel Run watershed.

Coldwater Heritage Partnership Grant Program

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.

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 Coldwater Conservation Plans help community leaders identify potential impacts, threats, problems, and opportunities for 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 coldwater streams.

Disclaimer

The Eastern PA Coalition for Abandoned Mine Reclamation (EPCAMR), its professional staff, and work performed by students, interns, and volunteers is to be used for educational and planning purposes only and makes no warranties, expressed or implied, regarding the quality of any product produced. Sponsor agrees to indemnify and hold harmless EPCAMR against any claims arising of the Sponsor's utilization, sale, or transfer of reports developed in whole or in part by EPCAMR, it's professional staff, students, interns, and or volunteers. The Laurel Run Coldwater Conservation Plan is to be used as a tool that will help to educate and build community consensus within the watershed with various stakeholders for the conservation of the coldwater stream and its tributaries. The limits of this project were determined by the number of individuals involved, their knowledge and expertise of tasks outlined in the project plan, amount of funding available for staff time, equipment, etc., the timeline of the project, prevailing weather conditions during the project period, and the amount of existing data and research for the project location. Additionally, EPCAMR's referral to parts of the watershed as "impaired" refer only to the findings as indicated in EPCAMR's visual habitat parameters including but not limited to: vegetation, sedimentation, water chemistry, macroinvertebrate surveys, and fish surveys. It does not refer to any classification of the watershed put forth by the Federal List of Impaired Waters and Section 303(d) listing.

Figure 1: Laurel Run Watershed Pictorial Description

Watershed Description

Location

The 3.18 square mile Laurel Run watershed (PA Gazetteer of Streams, 2001) is wholly located within Luzerne County in Northeastern Pennsylvania. The watershed encompasses 5 local municipalities, Plains Township, Wilkes-Barre City, Wilkes-Barre Township, Bear Creek Township, and Laurel Run Borough.

Table 1: Laurel Run Watershed Stream Miles and Locations

Municipality	Laurel Run	Coal Brook	Deep Hollow	Wheelbarrow Run	Total Miles per Municipality
Wilkes-Barre City	1.47	0.95	0	0	2.42
Wilkes-Barre Township	0	1.49	0	0	1.49
Plains Township	0	0.44	0.35	0.83	1.62
Bear Creek Township	1.13	0	0.92	1.91	3.96
Laurel Run Borough	2.54	0	0	0	2.54
Total Miles per Sub-Watershed	**5.14**	**2.88**	**1.27**	**2.74**	**12.03**

History: Mining and Historic Uses of Laurel Run

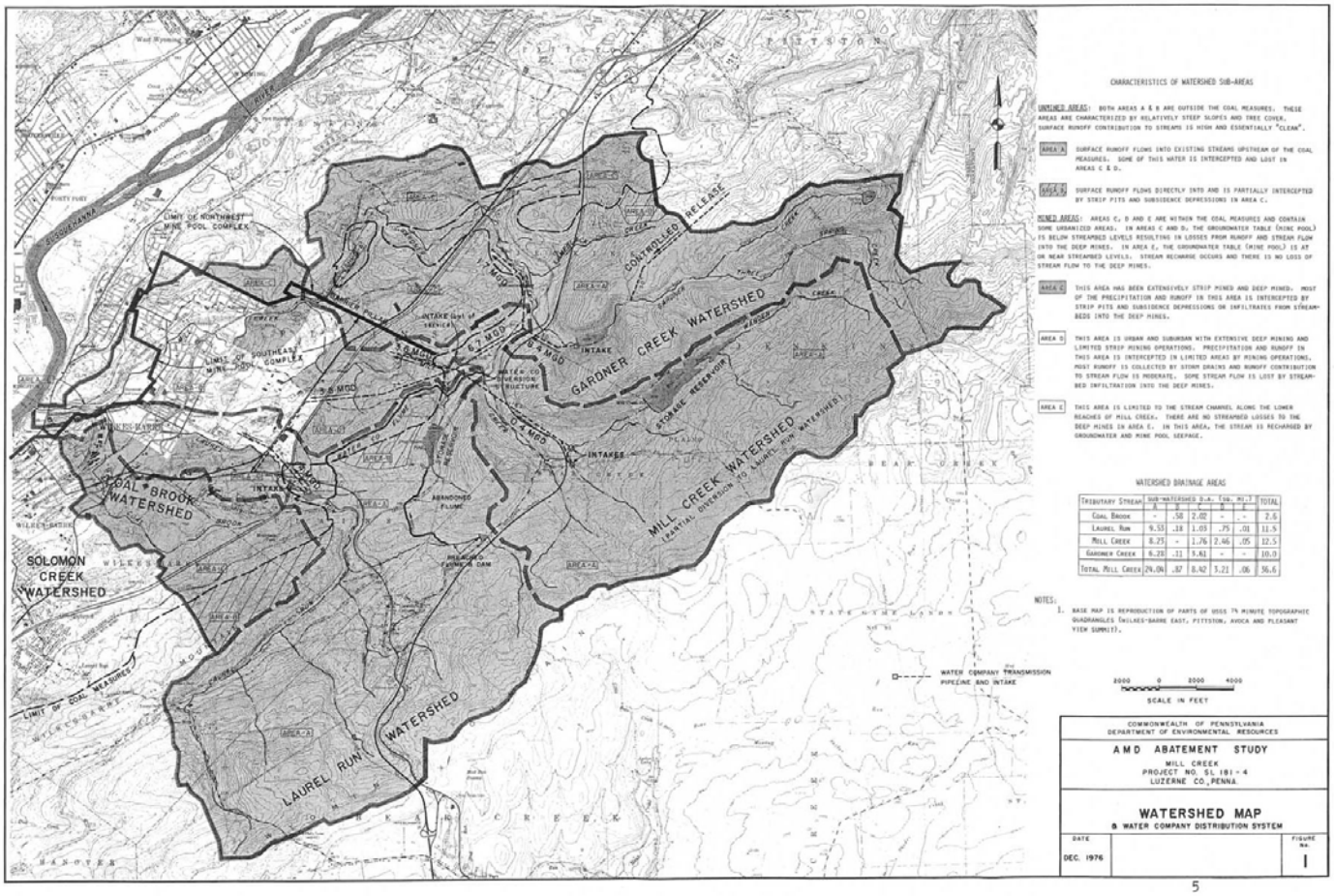

Figure 2: 1976 Scarlift Report Map of the Laurel Run Watershed (Map 1)

Mining

Coal attracted many new inhabitants to the Wyoming Valley in the mid-1800s. Railroads and canals were constructed allowing transport of this raw material to other parts of Pennsylvania, the West, and the East. Around 1850, the Wilkes-Barre Water Company, now part of PA American Water, was incorporated by act of legislature. The company used Laurel Run and Mill Creek as their water supply source. They had 35 miles of wrought-iron and cement pipe laid down and used Laurel Run during the time of flume construction and coal cleaning purposes (luzernecounty.org, 2016).

In 1915, approximately 60 years after mining began near the Laurel Run watershed, the Laurel Run Red Ash Mine Fire was started when a miner supposedly left his lantern in the mine, setting fire to the timbers and eventually, the coal seams. Fly-ash barrier filled trenches were used to contain the fire, which was thought to be extinguished until 1922 when it was determined the fire was still burning within the veins of coal beneath the ground. In the 1960's, many buildings in the town of Laurel Run were abandoned as a result. The community moved up the mountain away from the fire, which still burns to this day. (luzernecounty.org, 2016)

In addition to being used for cleaning coal, Laurel Run also contains some AML and AMD impacts within its watershed boundaries. Laurel Run and Coal Brook, a tributary, flow across the limits of the coal measures, leading to stream flow loss and small AMD seeps. A more detailed description of AMD and AML impacts can be found in each section of the Watershed Description.

Historic Uses

The earliest historic record of Laurel Run is from 1810, when the stream was used as a power source for a gristmill, a carding-mill, a cloth-dressing mill, and a turning-mill. For a brief time, Laurel Run was also used as a power-mill, which was blown up several times and after 1848, was never rebuilt. By 1850, all mills had been closed and the machinery removed to Wilkes-Barre. (Bradsby, 346).

Land near Laurel Run was also home to Mountain Park, an amusement park that existed from 1883-1914, and bordered what is now the Seven Tubs Nature Area. Mountain Park had towers for observing the mountains, and later added a roller coaster, a Ferris wheel, and a carousel. The park was closed due to coal mining happening beneath and around the park. Remnants of foundations can be found at the site today. ("Lost in Time…").

Additionally, Laurel Run was the source of the 1889 Typhoid outbreak in Wilkes-Barre. Although the infrastructure for drinking water had been in place since 1850, it was not receiving any form of screening or treatment at the time, causing residents to become infected with Typhoid. Residents were advised to boil and strain water from Laurel Run before use. Additionally, runoff from Mountain Park entered Laurel Run and further contaminated the water. ("Annual Report," 112-115).

Stream Characteristics

Laurel Run has approximately 12.03 miles of stream. It is one of the major tributaries of Mill Creek and joins Mill Creek at its confluence .7 mi upstream from the mouth of Laurel Run. Laurel Run has one officially named tributary, known as Deep Hollow.

Laurel Run contains a naturally reproducing trout population from its headwaters downstream to Coal Brook Dam, which is also known as Laurel Run #2. An unnamed tributary (UNT) to Laurel Run, sometimes referred to as Wheelbarrow Run is designated as a Class A Wild Trout Coldwater Fishery (CWF) for 1.4 of its 2.74 stream miles. A coldwater fishery is characterized as a stream that is able to maintain fish species including trout and salmon that are native to a cold water habitat (PA Code 93 – Class A Trout Waters July 2016). Naturally reproducing trout fisheries that are adjacent to and/or receive tributary water from wetlands declare the wetlands as Exceptional Value wetland areas. (PA DEP Title 25; Chapter 105). This regulatory measure extends further protections to the watershed.

Climate

The Laurel Run Watershed is located entirely within Pennsylvania's Climate Division 1 – Pocono Mountains ("Physical Science Division," NOAA). According to data from the past ten years, the average annual temperature for Luzerne County was 48 degrees Fahrenheit. The average temperature in the winter months (December through February) was 27 degrees Fahrenheit with an average precipitation of about 3.1 inches. The average temperature in the Spring months (March through May) is 46 degrees Fahrenheit with an average precipitation of 3.5 inches. In the Summer months (June through August) average temperature was 68 degrees Fahrenheit and average precipitation rises to 4.5 inches. As the fall season approaches (September to November) average temperature falls to 51 degrees Fahrenheit with an average precipitation of about 3.8 inches. ("Physical Science Division," NOAA). The total annual average precipitation per year was approximately 50 inches for this region, with approximately 68 inches of snowfall during the winter months ("Temperature…").

During the project period, especially when EPCAMR was conducting field work for this assessment in the summer months of 2015, Luzerne County experienced a high amount of precipitation in June (5.20 inches) which dropped to 2.63 inches in July with only an increase of .10 inches between July and August. The year also produced the warmest May on record and Northeastern PA had reached a daily high of at least 90 degrees Fahrenheit 13 times (Nicosia). In spite of this, Nicosia explains, there was not a significant amount of extreme weather in 2015, only a small hint of drought in July and August and minimal flooding. Conditions were similar for assessment periods in Spring and Summer 2016.

Geology

The Geology in Luzerne County is important to note because it is a major influence for all AMD and AML impacts affecting the Laurel Run watershed. Laurel Run is located in the Anthracite Valley section of the Ridge and Valley Province. The Anthracite Valley is a canoe-shaped valley enclosed by steep-sloped mountain rims. The underlying rock located in the Wyoming Valley (Northeastern PA) is made-up of Pennsylvania formations, these formations mainly consist of shale, sandstone, and anthracite coal (PA DCNR - Geology).

Coal mining thrived in the Anthracite Valley section because of the geology found here. Both historic mining and the natural geology of the Wyoming Valley play a huge role in how Laurel Run flows. When the mining industry disappeared, the Anthracite Valley was left with abandoned mine lands throughout the area and mined-out workings underground. These workings have since filled up with groundwater and some streams have been lost through the coal workings, in particular, Coal Brook which historically was a tributary to Laurel Run. As a result of coal measure flow loss, a portion of the water flowing through the Laurel Run Watershed infiltrates into underground mine pools and discharges in lower portions of the watershed, and in some instances, outside the watershed and into adjacent ones.

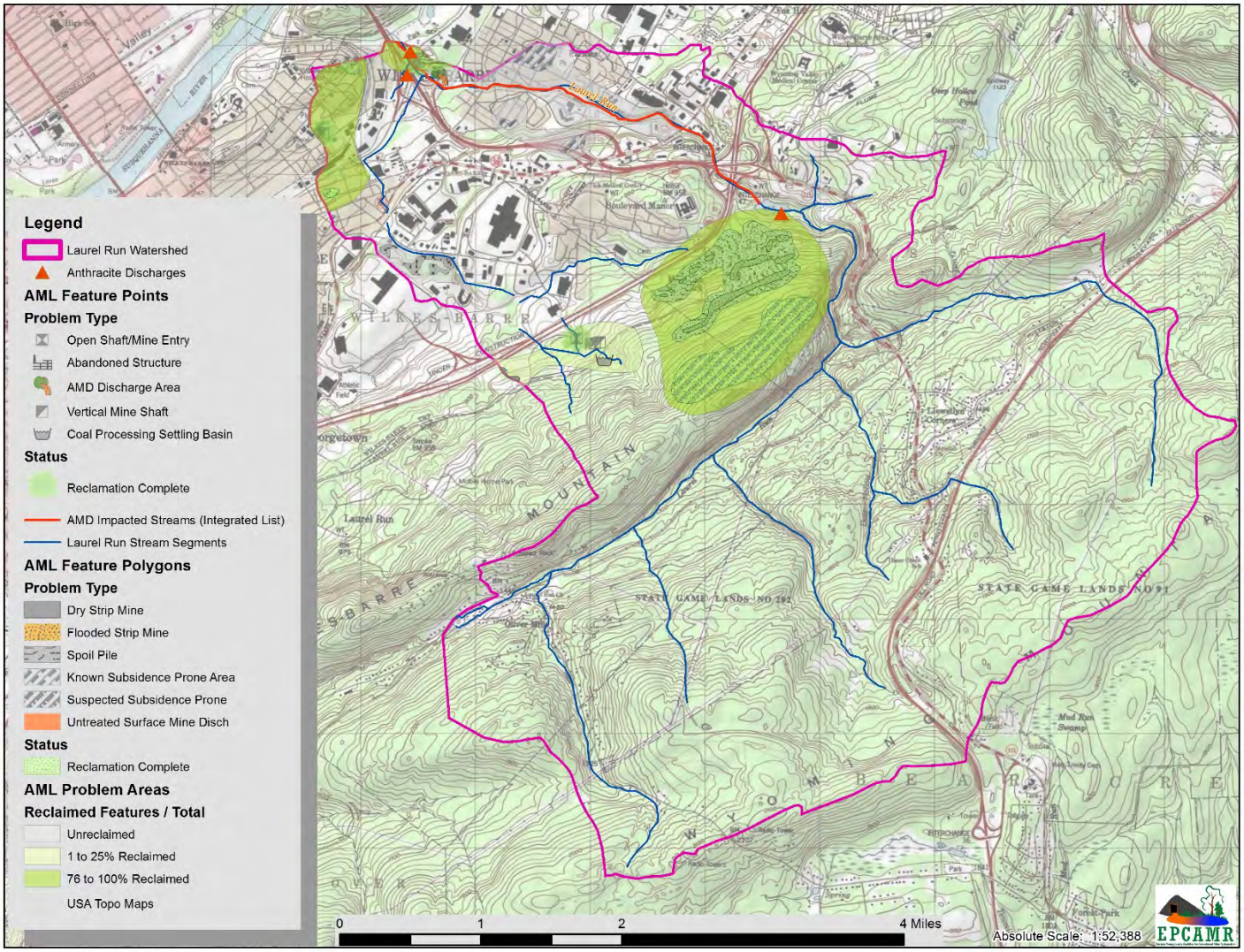

Figure 3: Laurel Run Geology and Mining Impacts

Land Use

The Laurel Run Watershed has many land uses within its boundaries. This includes active mining and coal reprocessing operations, as well as large-scale urban development projects. The watershed also contains State Game Lands-292, State Forest Lands, and the Seven Tubs Nature Area affording the watershed drainage area much outdoor recreation opportunities, a critical point in the protection of coldwater fisheries.

Historic coal mining practices disrupted stream flow in parts of the Laurel Run Watershed, particularly in Coal Brook. After historic coal mining, large scale urbanization projects caused portions of the watershed to be diverted and piped underground. As the Wyoming Valley became urbanized and the Wyoming Valley Mall complex and Interstate-81 were built, parts of the Laurel Run watershed were diverted through a series of culverts, underground piping systems, and stormwater basins to control and capture water from Coal Brook, a tributary to Laurel Run.

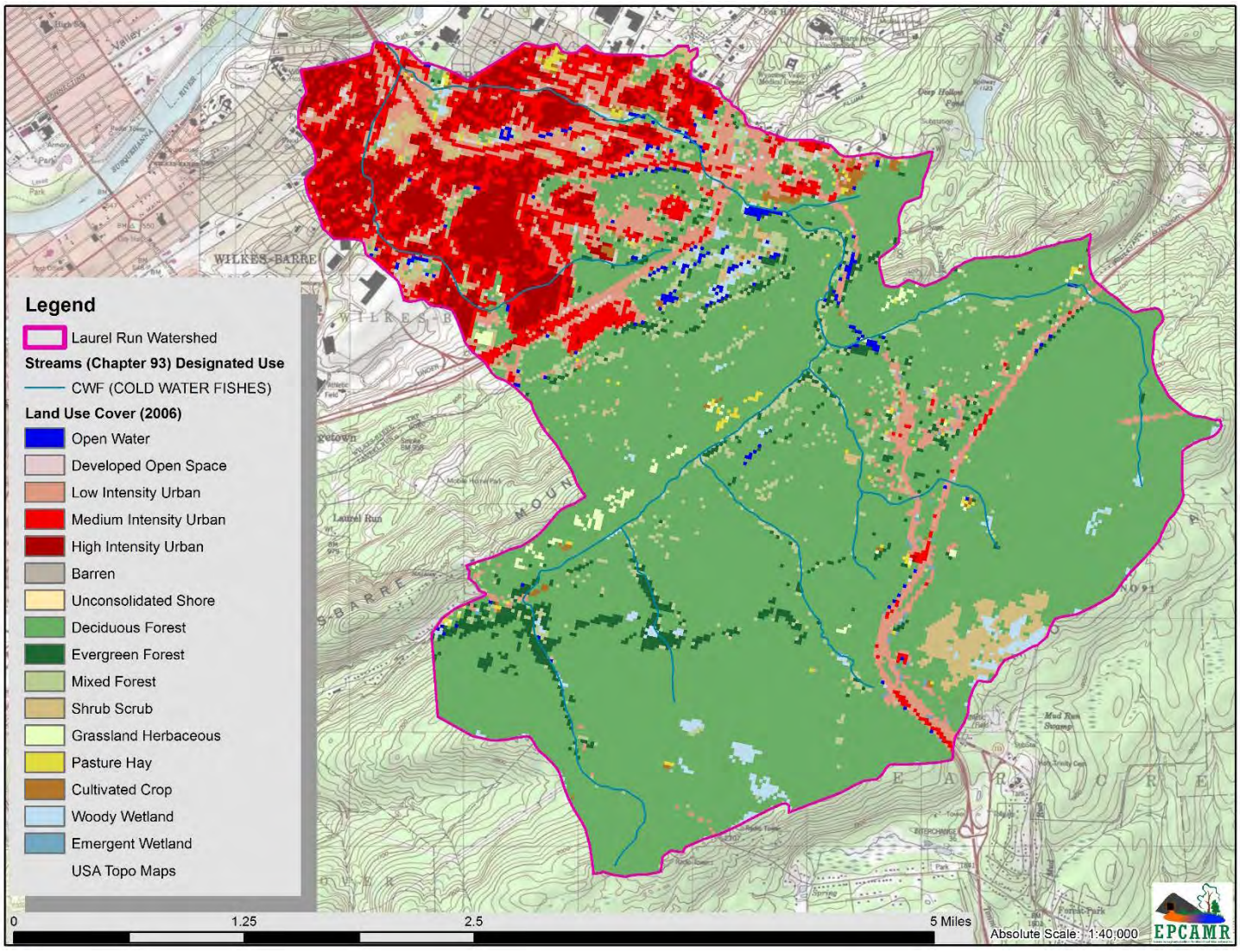

Figure 4: Laurel Run Land Use (Map 2)

Section 1: Laurel Run Wilkes-Barre City Section

Stream Characteristics

Laurel Run begins to lose habitat quality as it travels through the City of Wilkes-Barre and begins to be impacted by urbanization and industrialization. The loss of riparian vegetative structure is a key diminishment to the water quality and temperatures for a coldwater water fishery during summer conditions. Lack of leaf litter creates negative food chain impacts to the biology through the urbanized sections of the watershed. From the Laurel Run #2 Dam to the confluence with Mill Creek, main stream quality concerns present in this stream section are floodwall and stream bank erosion, illegal dumping, and sedimentation. While this section of stream does have some habitat issues, overall water quality is not impaired and this stream section does contain some areas of high quality stream habitat with a variety of vegetation and stream cover.

Overview of Results

EPCAMR's water quality findings show that the overall water chemistry for the stream is healthy and contains minimal impacts from urban runoff and AMD impacts. Habitat is slightly impaired by erosion and sedimentation. However, habitat parameter scores were significantly higher than expected from a stream located in such an urbanized setting. EPCAMR staff also observed small schools of Black Nose Dace and found a variety of macroinvertebrates during the project period, all indications of a healthy stream.

There are a few AMD and AML impacts in this section of the watershed, with 2 small seeps, a potential third seep entering the stream via the Peach Orchard Shafts, and stream loss occurring due to past mining practices. The AMD seeps assessed during the project period were small and appear to only flow during storm events, with iron readings never seen above 3mg/L. While these seeps still contain iron above the drinking water standard, the impact on stream quality is minimal, as most iron dilutes out and is undetectable. Additionally, Laurel Run is impacted by stream flow loss due to one of its tributaries, Coal Brook, rarely reaching its confluence. Surface flow hydrology lost in the Coal Brook drainage to coal mine voids beneath this watercourse are discharged from the mine pool to the Solomon Creek basin diverting a substantial amount of water flow. EPCAMR also suspects that some stream loss along Laurel Run also occurs as a result of historic mining practices. However, identification of quantities of water would take extensive studies beyond the scope of this investigation and is included in the "Recommendations" section of this report found on page 32.

Table 2: Visual Habitat Assessment - Section 1: Laurel Run Wilkes-Barre City

Station ID	Location Description	GPS Coordinates	Land Use	Embeddedness + Sediment Deposition (if <24 impaired)	Condition of Banks + Bank Vegetation (if <24 impaired)	Total Habitat Parameter Score (if <140 generally impaired)
LR1	Mouth of Laurel Run; Confluence with Mill Creek	41.26.048, -75.85527	Urban/Industrial	5	28*	102
LR2	Confluence of small wetland basin flow and Laurel Run	41.25922, -75.85461	Urban/Industrial	13	39*	145
LR3**	In Wetland Basin (AMD discharge investigation)	41.254453, -75.855376	Urban/Industrial	N/A	N/A	N/A
LR4	Confluence of Laurel Run and large wetland basin flow; Near PennDOT riparian planting project	41.258070, -75.853450	Urban/Industrial	21	33*	169
LR5	Behind MotorWorld (near Olive Street, WB)	41.256898, -75.839818	Urban/Industrial	34	33*	169
LR6	Laurel Run #2 Dam in Seven Tubs Nature Area	41.247967, -75.817414	Forest/Industrial/Urban	14	2***	67

*Vegetation found at test site primarily invasive Japanese Knotweed
**Visual Habitat Assessment not performed; period of drought-like conditions with no flow in basins; AMD investigation only
***Water in Dam very low from drought-like conditions; Test site was below water line so parameter scores for this site are slightly skewed

Table 3: Water Quality Monitoring - Section 1: Laurel Run Wilkes-Barre City

Station ID	Date	Temp (°C)	Total Iron (mg/L)	pH	Total Alkalinity (mg/L)	Total Acidity (mg/L)	Dissolved Oxygen (mg/L)	ORP	Channel Width (ft)	Stream Flow (cfs)
LR1	6/5/15	17.9	0	7.02	17.1	.86	7.84	22.5	19	2.15
LR2	6/5/15	18.8	.5 in stream; 3 from discharge	7.85	17.1	.86	7.85	6.8	16	4.65
LR3*	7/23/15	20.5	2	6.8	17.1	14.6	6.02	52.6	N/A	N/A
LR4	6/17/15	21.4	0	7.14	17.1	14.65	7.41	101.3	19	20.84
LR5	7/9/15	19.3	0	6.83	17.1	14.65	7.04	174.2	31	17.64
LR6	9/28/15	16.4	1.5 in stream; 3 from discharge	6.5 stream; 6 discharge	17.1	9.77	7.07	39	4	.16

*Drought-like period; flow too low to test

Table 4: Macroinvertebrate Surveys - Section 1: Laurel Run Wilkes-Barre City

Station ID	Date	Stoneflies	Caddisflies (case builders)	Caddisflies (free living)	Common Netspinners	Hellgrammites	Non-Operculate Snails	Total Macros for Site
LR1*	3/31/16	0	0	0	0	0	0	**0**
LR2	3/31/16	4	17	0	0	0	3	**26**
LR3**	3/31/16	0	4	0	0	0	1	**5**
LR4	3/31/16	1	20	5	0	2	0	**28**
LR5	5/12/16	2	20	0	0	0	3	**25**
LR6***	9/28/15	0	0	0	0	0	0	**0**
Totals		**7**	**57**	**5**	**0**	**2**	**7**	**84**

*Sedimentation at site; little to no habitat for macroinvertebrates
**Wetland basin AMD investigation; period of drought-like conditions with no flow in basins; slight orange staining on rocks
***Water in Dam very low from drought-like conditions; Test site was below water line and in the Fall; macro scores for this site are skewed

Table 5: AMD Sites

Station ID	Location Description	GPS Coordinates	Total Iron (mg/L)*	pH
LR2**	Downstream from small basin near Cross Valley	41.25922, -75.85446	0 in stream; 3 from pipe	7.8**5**
LR3	Small basin near RR tracks and Cross Valley	41.254453, -75.855376	2 in stream (could not locate discharge)	6.8
LR6	Laurel Run #2/Coal Brook Dam	41.247967, -75.817414	1.5 in stream; 3 from discharge	6.5 in stream; 6 from discharge

**Iron readings may be affected by fluctuations in precipitation and mine pool volume
**LR2 and LR3 reference the same AMD discharge, with readings taken at the confluence with Laurel Run at LR2 as well as near the source at LR3

Section 2: Coal Brook

Stream Characteristics

Coal Brook is a tributary to Laurel Run and is the most severely impacted section of stream within the watershed. A more in-depth description of the sub-watershed is in the field notes section of this report. Due to historic coal mining, Coal Brook loses almost all surface stream flow to the mines at the upstream coal measures and only reaches Laurel Run during high storm events. Furthermore, much of the stream has diverted or encased underground through a largely urbanized and developed section of Wilkes-Barre Township near the Wyoming Valley Mall. Remnants of Coal Brook (broken yellow sections on photo) show where the historic documents indicate the stream once existed near the Wyoming Valley Sports Dome and the WilkesWood Apartments.

The major issue facing the Laurel Run Watershed and the Solomon Creek Watershed (adjacent watershed) as a result of Coal Brook piping and flow loss is AMD. As a result of historic mining, Coal Brook loses almost all surface flow as it crosses the coal measures. Any flow as a result of stormwater runoff or other high precipitation events is diverted and captured in large stormwater basins at the Wyoming Valley Mall complex. The water percolates into the mine pool complexes, later occurring as AMD discharging from the Solomon Creek Boreholes in South Wilkes-Barre, polluting an adjacent watershed. Additionally, as a result of stream modifications, Coal Brook suffers from sedimentation, with road culverts acting as low head dams.

Figure 5: Approximate Alignment of Coal Brook; Yellow dashes indicate possible historic alignment (Photo 1)

Overview of Results

EPCAMR staff assessed Coal Brook and traced its approximate alignment throughout Wilkes-Barre and to the other side of Interstate 81 and found where the stream loses almost all flow to the mines. At this point, the

stream breaks into two tributaries and drains the mountain from the Laurel Run Estates. Water quality monitoring of the stream revealed high water quality in the small stream mileage where water was flowing. However, it should be noted that Coal Brook rarely flows past the coal measures at any time except to carry storm water during major flow events.

Table 6: Visual Habitat Assessment - Section 2: Coal Brook

Station ID	Location Description	GPS Coordinates	Land Use	Embeddedness + Sediment Deposition (if <24 impaired)	Condition of Banks + Bank Vegetation (if <24 impaired)	Total Habitat Parameter Score (if <140 generally impaired)
CB1	Headwaters of Coal Brook	41.2345627, -75.8381057	Mining; Forested; Industrial & RR	28	17	87
CB2^	Before flow loss on South tributary	41.236209, -75.840409	Forested and AML	18	29	153
CB3^	Before flow loss on Flume Tributary	41.236271, -75.839250	Forested and AML	30	32	162
CB4^	Northern Tributary behind WilkesWood	41.24287, -75.83702	Residential and Commercial	2	12	52

*Vegetation found at test site primarily invasive Japanese Knotweed
**Visual Habitat Assessment not performed; period of drought-like conditions with no flow in basins; AMD investigation only
***Water in Dam very low from drought-like conditions; Test site was below water line so parameter scores for this site are slightly skewed
^Visual habitat assessment score do not take into account extreme flow loss caused by historic coal mining

Table 7: Water Quality Monitoring - Section 2: Coal Brook

Station ID	Date	Temp (°C)	Total Iron (mg/L)	pH	Total Alkalinity (mg/L)	Total Acidity (mg/L)	Dissolved Oxygen (% & mg/L)	ORP	Channel Width (ft)	Stream Flow (cfs)
CB1	6/7/16	19.3	0	6.4	17.1	41.04	79.7% & 7.35	129.9	1.5	.25
CB2	5/10/16	11	0	6.38	17.1	41.04	68.1% & 7.53	126.4	2	.03
CB3	5/10/16	11	4.5	6.13	17.1	41.04	87.7% & 9.4	171.6	2	.03
CB4**	5/9/16	12.7	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A

*Drought-like period; flow too low to test
**Very low flow; unable to do chemistry without results being very skewed; channel dry except for storm events

Table 8: Macroinvertebrate Surveys - Section 2: Coal Brook

Station ID	Date	Stoneflies	Caddisflies (case builders)	Caddisflies (free living)	Common Netspinners	Hellgrammites	Non-Operculate Snails	Total Macros for Site
CB1	6/7/16	0	0	0	0	0	0	**0**
CB2	5/10/16	0	0	0	0	0	0	**0**
CB3	5/10/16	0	0	0	0	0	0	**0**
CB4	5/9/16	0	0	0	0	0	0	**0**
Totals*		**0**	**0**	**0**	**0**	**0**	**0**	**0**

*Coal Brook was not tested during breeding seasons, which may slightly skew results

Section 3: Wheelbarrow Run

Stream Characteristics

Wheelbarrow Run is the unofficial name for one of the unnamed tributaries to Laurel Run. Designated as a Class A naturally reproducing trout stream in 2012, Wheelbarrow Run flows from its headwaters, a small pond located on residential property, until it meets Laurel Run in the Seven Tubs Nature Area. The stream is characterized by nearly pristine fish and macroinvertebrate habitat.

Overview of Results

EPCAMR staff did an in-depth assessment of Wheelbarrow Run due to its designation as a Class A naturally reproducing trout stream. Laurel Run's other unnamed tributaries from the headwaters down to the Laurel Run #2 dam are classified as a Naturally Reproducing Trout CWF.

EPCAMR staff found that although Wheelbarrow Run has prime habitat with a healthy eco-system including a variety of salamanders, fish, and macroinvertebrates, the stream is impacted by sedimentation. Wheelbarrow Run also experiences erosion as a result of steep stream bank walls and run off from an active Railroad Crossing, State Route 115, and the Northeast Extension of the Pennsylvania Turnpike and suffers from poor bank conditions and vegetative protection. No basins are observed in aerial photograph review along the PA Turnpike for stormwater quality enhancement or detention and may include negative contributing factors to the watershed. Additionally, a PPL Electric Utilities Corporation powerline crosses the stream near the headwaters and is an additional source of sediment entering the stream. EPCAMR observed adult native brook trout as well as fingerlings in this section of the stream, indicating high water quality. Presence of native brook trout at the stream crossing location indicates industrial disturbance at a potential trout breeding area. A more detailed recommendation for solving this problem can be found on page.

Table 9: Visual Habitat Assessment - Section 3: Wheelbarrow Run

Station ID	Location Description	GPS Coordinates	Land Use	Embeddedness + Sediment Deposition (if <24 impaired)	Condition of Banks + Bank Vegetation (if <24 impaired)	Total Habitat Parameter Score (if <140 generally impaired)
LR_UNT_WB1	Confluence of UNT "Wheelbarrow Run" and other UNT in Seven Tubs Nature Area	41.2371290 -75.8067790	Forested and Industrial	33	28	184
LR_UNT_WB2	Between 115 culvert and RR culvert	41.2378694, -75.8041671	Forested and Industrial	25	13	151
LR_UNT_WB3	"Wheelbarrow Run" upstream of RR culvert	41.2384591, -75.8025839	Forested and Industrial	19	26	162
LR_UNT_WB4	Powerline Crossing; channel altered and experiences heavy sedimentation	41.2392949, -75.8007275	Forested and Industrial	8	10	60
LR_UNT_WB5	Upstream of powerline crossing; under tree cover near headwaters	41.240857, -75.796895	Forested	31	37	204

Table 10: Water Quality Monitoring - Section 3: Wheelbarrow Run

Station ID	Date	Temp (°C)	Total Iron (mg/L)	pH	Total Alkalinity (mg/L)	Total Acidity (mg/L)	Dissolved Oxygen (% & mg/L)	ORP	Channel Width (ft)	Stream Flow (cfs)
LR_UNT_WB1	5/4/16	9.5	0	6.8	17.1	41.04	90.7% & 10.3	371.9	17	6.75
LR_UNT_WB2	5/4/16	9.5	0	6.6	17.1	27.4	92.8% & 10.6	356.7	14	1.02
LR_UNT_WB3*	5/4/16	9.6	0	6.5	17.1	41.04	85.8% & 9.76	354	9	1.47
LR_UNT_WB4*	5/4/16	9.7	0	6.5	17.1	41.04	83.8% & 9.52	339	6	1.38
LR_UNT_WB5	5/20/16	13.4	.5	6.4	9.09	9.8	17.1	126.5	10	.52

*Drought-like period; flow too low to test

Table 11: Macroinvertebrate Surveys - Section 1: Laurel Run Wilkes-Barre City

Station ID	Date	Stoneflies	Caddisflies (case builders)	Caddisflies (free living)	Common Netspinners	Hellgrammites	Non-Operculate Snails	Total Macros for Site
LR_UNT_WB1	5/4/16	0	13	0	0	0	0	**13**
LR_UNT_WB2	5/4/16	3	15	0	0	0	0	**18**
LR_UNT_WB3*	5/4/16	0	3	0	0	0	0	**3**
LR_UNT_WB4*	5/4/16	0	0	0	0	0	0	**0**
LR_UNT_WB5	5/20/16	8	8	1	0	0	0	**17**
Totals		**11**	**39**	**1**	**0**	**0**	**0**	**51**

*Sedimentation at site; little to no habitat for macroinvertebrates

Section 4: Laurel Run, Deep Hollow, and Unnamed Tributaries

Stream Characteristics

Laurel Run and Deep Hollow are designated as Naturally Reproducing Trout CWF from the headwaters of Laurel Run to the Laurel Run #2 Dam, where the urbanized, city section of the watershed begins. Unnamed tributaries in this section are also of high water quality. This section of the watershed contains forested recreation area, active and abandoned railroad grades, residential areas, and some heavily used roadways. The main land use for this area is the Seven Tubs Nature Area, which contains prime habitat for native brook trout. Additionally, during the project period, the Seven Tubs Nature Area was acquired by DNCR and is now a part of the Pinchot State Forest Land. EPCAMR staff noted improvements being completed at the park including improved trails, new signage, and updates to the parking lot and other infrastructure.

Overview of Results

EPCAMR's assessment of Laurel Run, Deep Hollow, and Unnamed Tributaries revealed overall pristine habitat and water quality. Little to no illegal dumping was found within the well-known portions of the Seven Tubs Nature Area, and visual habitat assessments revealed no issues with erosion or sedimentation. Deep Hollow, the

stream containing the Seven Tubs, is located within Whirlpool Canyon, a glacial geologic area which caused the formation of the tubs. Three unnamed tributaries meet Laurel Run in this section of the watershed: 2 small mountain streams and 1 larger stream tributary. EPCAMR staff tested water at the confluence of each tributary with Laurel Run and determined high water quality coming from each.

Additionally, EPCAMR staff tested 2 sites located in the headwaters of Laurel Run and found high water quality and habitat. While overall, the headwaters are of a high quality, this portion of the watershed does contain some erosion issues. Located in a shallow valley between residential areas as well as one active and one abandoned railroad grade, stormwater runoff from these areas contributes to some bank erosion.

Table 12: Visual Habitat Assessment - Section 4: Laurel Run, Deep Hollow, and Unnamed Tributaries

Station ID	Location Description	GPS Coordinates	Land Use	Embeddedness + Sediment Deposition (if <24 impaired)	Condition of Banks + Bank Vegetation (if <24 impaired)	Total Habitat Parameter Score (if <140 generally impaired)
LR7	Confluence of Laurel Run & UNT "Wheelbarrow Run" in Seven Tubs Nature Area	41.237430, -75.809347	80% forested & recreational; 20% industrial	38	35	165
LR8	Confluence of Deep Hollow and Laurel Run in Seven Tubs Nature Area	41.235113, -75.811270	90% forested & recreational; 10% industrial	33	34	202
LR9	Confluence of UNT and Laurel Run in Seven Tubs Nature Area	41.2332410, -75.8143487	Forested and Recreational	30	33	205
LR10	Confluence of Small mountain UNT and Laurel Run in Seven Tubs Nature Area	41.2307920, -75.8179630	Forested and Recreational	36	37	207
LR11	Confluence of UNT and Laurel Run in Seven Tubs Nature Area	41.228793, -75.8222291	Forested and Recreational	34	39	215
LR12	Laurel Run Headwaters near Quarry Road	41.223572, -75.829242	Forested and Residential; Industrial RR Tracks	34	38	202
LR13	Laurel Run Headwaters near Quarry Road	41.219698, -75.837434	Forested and Residential; Industrial RR Tracks	14	37	118

Table 13: Water Quality Monitoring - Section 4: Laurel Run, Deep Hollow, and Unnamed Tributaries

Station ID	Date	Temp (°C)	Total Iron (mg/L)	pH	Total Alkalinity (mg/L)	Total Acidity (mg/L)	Dissolved Oxygen (% & mg/L)	ORP	Channel Width (ft)	Stream Flow (cfs)
LR7	11/15/15	11.5	0	7.22	17.1	N/A	95.3% & 10.39	109.9	14	9.98
LR8	11/5/15	12.0	0	7.26	17.1	N/A	93.5% & 10.6	118.8	18	9.89
LR9	5/5/16	9.1	0	7	17.1	20.5	85.2% & 9.81	320.8	13	18.7
LR10	5/5/16	9.1	0	6.7	17.1	13.1	87% & 10.02	297.6	16	17.9
LR11	5/12/16	12.4	0	6.6	17.1	20.5	90.2% & 9.63	151.7	22	6.6
LR12	8/25/15	17.3	0	6.8	17.1	14.6	85.5% & 8.24	188.7	9	.37
LR13*	8/25/15	18.1	0	7.1	17.1	13.1	86.3% & 8.12	171.7	N/A	N/A

*Drought-like period; flow too low to test

Table 14: Macroinvertebrate Samples - Section 4: Laurel Run, Deep Hollow, and Unnamed Tributaries

Station ID	Date	Stoneflies	Caddisflies (case builders)	Caddisflies (free living)	Common Netspinners	Hellgrammites	Non-Operculate Snails	Total Macros for Site
LR7	5/5/16	6	10	0	0	3	0	**19**
LR8	5/5/16	6	7	1	7	2	0	**23**
LR9	5/3/16	0	15	0	0	0	0	**15**
LR10	5/12/16	5	11	0	3	0	0	**19**
LR11	5/12/16	3	17	0	4	0	0	**24**
LR12 & LR13****	8/25/15	2	2	1	0	0	0	**5**
Totals		**22**	**62**	**2**	**14**	**5**	**0**	**105**

****Headwaters sites taken together; off-season for macros therefore low numbers

Methodology

Water Quality Monitoring & Data Collection Overview

EPCAMR staff collected data from assessment sites during the 18-month project period (February 2015-August 2016). Water quality data included flow monitoring, water chemistry sampling, macroinvertebrate counts, fish surveys, and visual habitat assessment. EPCAMR staff began data collection starting from the mouth of Laurel Run at the confluence of Laurel Run and Mill Creek in the City of Wilkes-Barre up to the Headwaters of Laurel Run.

Water Quality Monitoring equipment used this assessment included: 1) YSI Professional Plus meter to test pH, DO (% and m/L), ORP, and temperature; 2) Swoffer Flow Meter for flow monitoring; 3) HACH AMD kit to test iron and acidity; and 4) YSI Photometer to test iron and alkalinity. Other monitoring methods used included: 1) EPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers Periphyton, Benthic Macroinvertebrates, and Fish; and 2) Technical Assistance from TU for fish population surveys and culvert crossing assessments.

Additionally, EPCAMR also held two public meetings during the project period in order to involve communities within the watershed as well as obtain input and suggestions for the project. Notes from this meeting can be found in the "Public Meeting Notes" section of this report.

Visual Assessment

EPCAMR's Stream Quality and Quantity Field Assessment sheet is based on the EPA Visual Assessment protocols and includes physical conditions, land use, and visual habitat assessments. Conditions observed include water color, clarity, odor, surface foam, streambed color, algae abundance, growth habit, and color. Habitat Visual Assessment also consisted of a scored sheet containing 12 features including: instream cover, epifaunal substrate, embeddedness, velocity/depth regimes, channel alteration, sediment deposition, channel flow, bank conditions, bank vegetation, grazing or disruptive pastures, and riparian zone width. Each parameter is given a score from 1 (poor) to 20 (optimal). A total score below 140 indicates impairment. Combined scores for embeddedness and sediment deposition below 24 indicate impairment. Combined scores for condition of banks and bank vegetation below 24 indicate impairment.

Macroinvertebrate Sampling & Fish Surveys

Macroinvertebrate sampling was completed using EPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers Periphyton, Benthic Macroinvertebrates, and Fish, July 1999. Macroinvertebrates were sampled at select test sites in 2015, but had to be re-sampled at all sites during Spring 2016 of the project period in order to coincide with breeding periods. In Spring-Summer 2015, site assessments were interrupted by heavy rains in May-June and drought-like conditions with +90°F in July-August, which created unsafe monitoring conditions and poor sampling conditions. EPCAMR reassessed sites as needed based on weather conditions. Fish Surveys were conducted in Summer 2016 with technical assistance from TU.

TU provided electroshocking technical assistance in the form of a TAG grant in July 2016. EPCAMR and LCD staff assisted during the survey, which included five electroshocking sites throughout the Laurel Run Watershed. Sites included confluences with major tributaries as well as suspected trout habitats from the headwaters to the mouth of Laurel Run. Healthy populations of native Brook Trout were found in the designated Naturally Reproducing Trout CWF from the headwaters to the Lauren Run #2 dam. Additionally,

EPCAMR and TU caught 2 native brook trout behind the Woodlands at Site LR4. More were observed in deep pools but were unable to be captured. EPCAMR and TU anticipate re-sampling this area in order to potentially extend the Naturally Reproducing Trout CWF designation for Laurel Run.

EPCAMR and TU will also be performing culvert assessments in the city section of Laurel Run. These assessments will take place after the project period ends. Results for these assessments and the re-sampling of Site FS4 will be submitted as an addendum upon completion.

Aquatic Organism Passage

EPCAMR and TU performed Aquatic Organism Passage (AOP) culvert assessments according to North Atlantic Aquatic Connectivity Collaborative (NAACC) guidelines in late September 2016. Eighteen culverts were selected as possible sites and thirteen were completed during the assessment period. Culverts evaluated included large dual cell box culverts, small pipe culverts, and large oval concrete culverts under Interstate 81. Most culverts were in good condition and only a few barriers inhibiting AOP were found. However, EPCAMR and TU found one failing culvert in the Seven Tubs Nature Area. This culvert appears to be an aging culvert that was installed before the new route 115 existed and has falling concrete slabs and internal blockages. Photos from the Culvert Assessments can be found starting on page 64. * Additional data regarding NAACC culvert assessment for Laurel Run will be available at the Stream Connectivity website as it becomes approved. (https://www.streamcontinuity.org/cdb2/naacc_search_crossing.cfm)

*EPCAMR only has photos for those sites for which TU was unable to take a photo

Findings

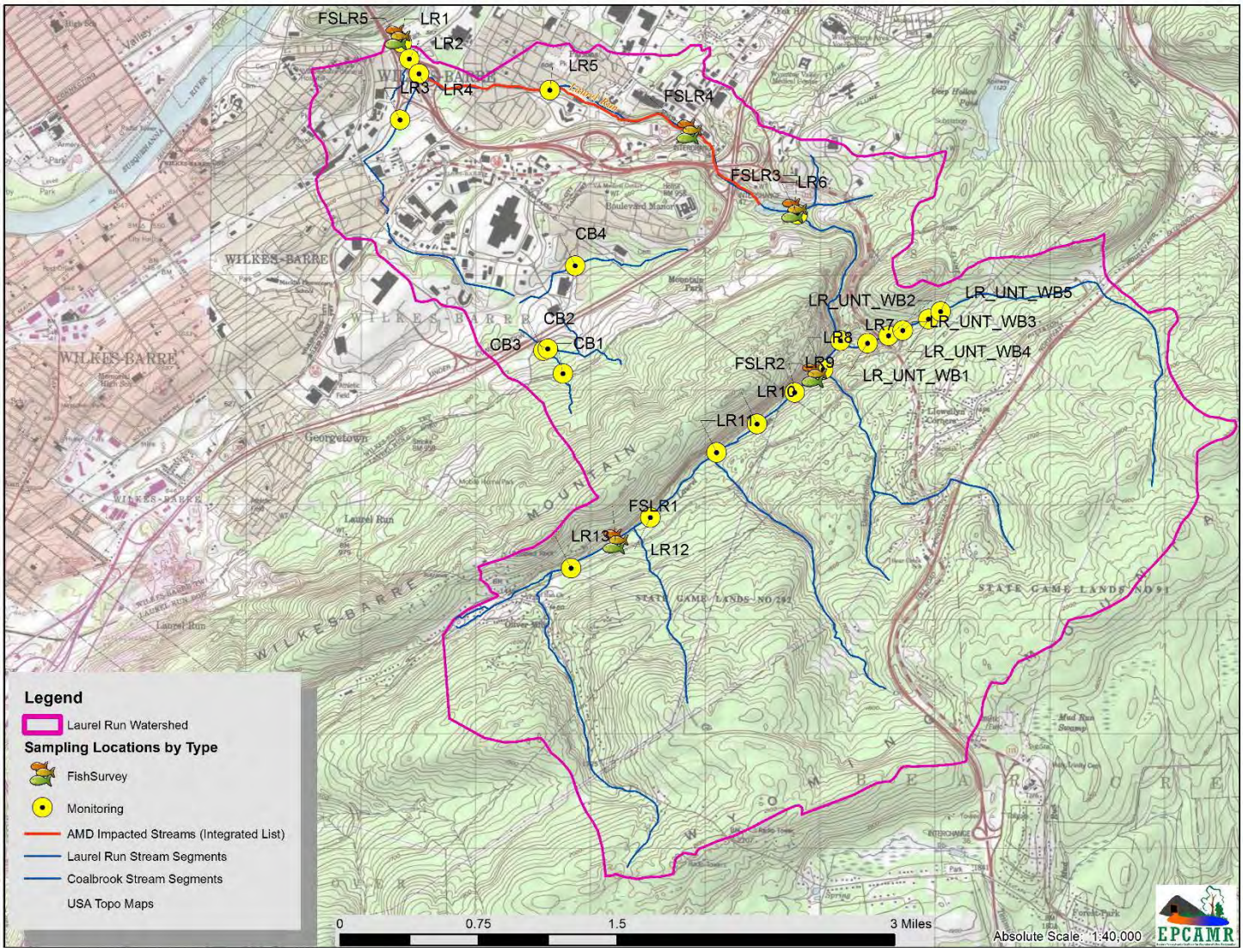

Figure 6: Sampling Location Map (Map 3)

Visual Assessment Data

Habitat data for the entire Laurel Run watershed and its tributaries shows overall high quality habitat. The main habitat issues facing Laurel Run are sedimentation, flow loss, stream path alterations, and invasive species overgrowth. The headwaters to the Laurel Run #2 dam as well as Deep Hollow have little habitat degradation and are near pristine habitat for native Brook Trout. UNT "Wheelbarrow Run," a Class A tributary to Laurel Run has overall good habitat, but suffers from sedimentation as a result of the powerline crossing. As seen in the table below, according to EPCAMR's Stream Quality and Quantity Field Assessment sheet, six sites, or 27% of all sites assessed during the project period, scored lower than 140, indicating general impairment during the assessment period.

Table 15: Visual Habitat Assessment Scores for Laurel Run Watershed (continued on next page)

Station ID	Location Description	GPS Coordinates	Land Use	Embeddedness + Sediment Deposition (if <24 impaired)	Condition of Banks + Bank Vegetation (if <24 impaired)	Total Habitat Parameter Score (if <140 generally impaired)
LR1	Mouth of Laurel Run; Confluence with Mill Creek	41.26.048, -75.85527	Urban/Industrial	5	28*	102
LR2	Confluence of small wetland basin flow and Laurel Run	41.25922, -75.85461	Urban/Industrial	13	39*	145
LR3**	In Wetland Basin (AMD discharge investigation)	41.254453, -75.855376	Urban/Industrial	N/A	N/A	N/A
LR4	Confluence of Laurel Run and large wetland basin flow; Near PennDOT riparian planting project	41.258070, -75.853450	Urban/Industrial	21	33*	169
LR5	Behind MotorWorld (near Olive Street, WB)	41.256898, -75.839818	Urban/Industrial	34	33*	169
LR6	Laurel Run #2 Dam in Seven Tubs Nature Area	41.247967, -75.817414	Forest/Industrial/Urban	14	2***	67
LR7	Confluence of Laurel Run & UNT "Wheelbarrow Run" in Seven Tubs Nature Area	41.237430, -75.809347	80% forested & recreational; 20% industrial	38	35	165
LR8	Confluence of Deep Hollow and Laurel Run in Seven Tubs Nature Area	41.235113, -75.811270	90% forested & recreational; 10% industrial	33	34	202
LR9	Confluence of UNT and Laurel Run in Seven Tubs Nature Area	41.2332410, -75.8143487	Forested and Recreational	30	33	205
LR10	Confluence of Small mountain UNT and Laurel Run in Seven Tubs Nature Area	41.2307920, -75.8179630	Forested and Recreational	36	37	207
LR11	Confluence of UNT and Laurel Run in Seven Tubs Nature Area	41.228793, -75.8222291	Forested and Recreational	34	39	215
LR12	Laurel Run Headwaters near Quarry Road	41.223572, -75.829242	Forested and Residential; Industrial RR Tracks	34	38	202
LR13	Laurel Run Headwaters near Quarry Road	41.219698, -75.837434	Forested and Residential; Industrial RR Tracks	14	37	118
LR_UNT_WB1	Confluence of UNT "Wheelbarrow Run" and other UNT	41.2371290 -75.8067790	Forested and Industrial	33	28	184
LR_UNT_WB2	Between 115 culvert and RR culvert	41.2378694, -75.8041671	Forested and Industrial	25	13	151

Station ID	Location Description	GPS Coordinates	Land Use	Embeddedness + Sediment Deposition (if <24 impaired)	Condition of Banks + Bank Vegetation (if <24 impaired)	Total Habitat Parameter Score (if <140 generally impaired)
LR_UNT_WB3	"Wheelbarrow Run" upstream of RR culvert	41.2384591, -75.8025839	Forested and Industrial	19	26	162
LR_UNT_WB4	Powerline Crossing ; channel altered and experiences heavy sedimentation	41.2392949, -75.8007275	Forested and Industrial	8	10	60
LR_UNT_WB5	Above powerline crossing near headwaters	41.240857, -75.796895	Forested	31	37	204
CB1	Headwaters of Coal Brook	41.2345627, -75.8381057	Mining; Forested; Industrial & RR	28	17	87
CB2^	Before flow loss on South tributary	41.236209, -75.840409	Forested and AML	18	29	153
CB3^	Before flow loss on Flume Tributary	41.236271, -75.839250	Forested and AML	30	32	162
CB4^	Northern Tributary behind WilkesWood	41.24287, -75.83702	Residential and Commercial	2	12	52

*Vegetation found at test site primarily invasive Japanese Knotweed

**Visual Habitat Assessment not performed; period of drought-like conditions with no flow in basins; AMD investigation only

***Water in Dam very low from drought-like conditions; Test site was below water line so parameter scores for this site are slightly skewed

^Visual habitat assessment score do not take into account extreme flow loss caused by historic coal mining

Water Quality Data

Table 16: Water Quality Monitoring Results for Laurel Run Watershed

Station ID	Date	Temp (°C)	Total Iron (mg/L)	pH	Total Alkalinity (mg/L)	Total Acidity (mg/L)	Dissolved Oxygen (mg/L)	ORP	Channel Width (ft)	Stream Flow (cfs)
LR1	6/5/15	17.9	0	7.02	17.1	.86	7.84	22.5	19	2.15
LR2	6/5/15	18.8	.5 in stream; 3 from discharge	7.85	17.1	.86	7.85	6.8	16	4.65
LR3*	7/23/15	20.5	2	6.8	17.1	14.6	6.02	52.6	N/A	N/A
LR4	6/17/15	21.4	0	7.14	17.1	14.65	7.41	101.3	19	20.84
LR5	7/9/15	19.3	0	6.83	17.1	14.65	7.04	174.2	31	17.64
LR6	9/28/15	16.4	1.5 in stream; 3 from discharge	6.5 stream; 6 discharge	17.1	9.77	7.07	39	4	.16
LR7	11/15/15	11.5	0	7.22	17.1	N/A	10.39	109.9	14	9.98
LR8	11/5/15	12.0	0	7.26	17.1	N/A	10.6	118.8	18	9.89
LR9	5/5/16	9.1	0	7	17.1	20.5	9.81	320.8	13	18.7
LR10	5/5/16	9.1	0	6.7	17.1	13.1	10.02	297.6	16	17.9
LR11	5/12/16	12.4	0	6.6	17.1	20.5	9.63	151.7	22	6.6
LR12	8/25/15	17.3	0	6.8	17.1	14.6	8.24	188.7	9	.37
LR13*	8/25/15	18.1	0	7.1	17.1	13.1	8.12	171.7	N/A	N/A
LR_UNT_WB1	5/4/16	9.5	0	6.8	17.1	41.04	10.3	371.9	17	6.75
LR_UNT_WB2	5/4/16	9.5	0	6.6	17.1	27.4	10.6	356.7	14	1.02
LR_UNT_WB3*	5/4/16	9.6	0	6.5	17.1	41.04	9.76	354	9	1.47
LR_UNT_WB4*	5/4/16	9.7	0	6.5	17.1	41.04	9.52	339	6	1.38
LR_UNT_WB5	5/20/16	13.4	0 in stream; 1 mg/L near iron deposition	6.4	17.1	41.04	9.09	126.5	10	.52
CB1	6/7/16	19.3	0	6.4	17.1	41.04	7.35	129.9	1.5	.25
CB2	5/10/16	11	0	6.38	17.1	41.04	7.53	126.4	2	.03
CB3	5/10/16	11	4.5	6.13	17.1	41.04	9.4	171.6	2	.03
CB4**	5/9/16	12.7	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A

*Drought-like period; flow too low to test

**Very low flow; unable to do chemistry without results being very skewed; channel dry except for storm events

Aquatic Life Surveys

Macroinvertebrate Sampling

Table 17: Macroinvertebrate Surveys for Laurel Run Watershed

Station ID	Date	Stoneflies	Caddisflies (case builders)	Caddisflies (free living)	Common Netspinners	Hellgrammites	Non-Operculate Snails	Total Macros for Site
LR1*	3/31/16	0	0	0	0	0	0	**0**
LR2	3/31/16	4	17	0	0	0	3	**26**
LR3**	3/31/16	0	4	0	0	0	1	**5**
LR4	3/31/16	1	20	5	0	2	0	**28**
LR5	5/12/16	2	20	0	0	0	3	**25**
LR6***	9/28/15	0	0	0	0	0	0	**0**
LR7	5/5/16	6	10	0	0	3	0	**19**
LR8	5/5/16	6	7	1	7	2	0	**23**
LR9	5/3/16	0	15	0	0	0	0	**15**
LR10	5/12/16	5	11	0	3	0	0	**19**
LR11	5/12/16	3	17	0	4	0	0	**24**
LR12 & LR13****	8/25/16	2	2	1	0	0	0	**5**
LR_UNT_WB1	5/4/16	0	13	0	0	0	0	**13**
LR_UNT_WB2	5/4/16	3	15	0	0	0	0	**18**
LR_UNT_WB3*	5/4/16	0	3	0	0	0	0	**3**
LR_UNT_WB4*	5/4/16	0	0	0	0	0	0	**0**
LR_UNT_WB5	5/20/16	8	8	1	0	0	0	**17**
CB1	6/7/16	0	0	0	0	0	0	**0**
CB2^	5/10/16	0	0	0	0	0	0	**0**
CB3^	5/10/16	0	0	0	0	0	0	**0**
CB4^	5/9/16	0	0	0	0	0	0	**0**
Totals		**40**	**162**	**8**	**14**	**7**	**7**	**238**

*Sedimentation at site; little to no habitat for macroinvertebrates

**Wetland basin AMD investigation; period of drought-like conditions with no flow in basins; slight orange staining on rocks

***Water in Dam very low from drought-like conditions; Test site was below water line and in the Fall; macro scores for this site are skewed

****Headwaters sites taken together; off-season for macros therefore low numbers

^Flow from these Coal Brook locations is from run-off or storm events; channel almost always dry

Fish Surveys

Table 18: Fish Survey Results

Date	Site Name	Site Description	Latitude	Longitude	Brook Trout #
7/20/2016	LR1	Laurel Run headwaters at SGL boundary	41.22269	-75.83035	67
7/20/2016	LR2	Laurel Run at Deep Hollow confluence	41.235172	-75.811317	32
7/20/2016	LR3	Laurel Run UPS Laurel 2 Dam	41.247562	-75.814247	29
7/20/2016	LR4	Laurel Run behind Woodlands Resort	41.25291	-75.82478	2 (more were seen in deep holes unable to be captured with the backpack electrofishing equipment)
7/20/2016	LR5	Laurel Run at mouth	41.260710	-75.855947	0 (too warm)

Recommendations

During the project period, EPCAMR developed recommendations to further protect and investigate the Laurel Run watershed. EPCAMR's series of recommendations for future watershed implementation and restoration plans are as follows:

1) Mine Pool Mapping for the Laurel Run Watershed: Coal Brook and Laurel Run both experience mining impacts and stream flow loss as a result of historic anthracite coal mining. Developing a model of the underground mine pool for this watershed would help determine where lost flow enters the mine pool and potential impacts for other local watersheds. EPCAMR also suspects that the Peach Orchard Shafts, an Anthracite mine operation near Laurel Run at Mile .5 from confluence with Mill Creek may be infiltrating an aging storm overflow system in Wilkes-Barre. Further investigation of the mine pool in this area would help determine our suspicions. Lastly, mine pool mapping of this watershed would further add to EPCAMR's mapping of the Anthracite Coal Fields and would allow for improved understanding of the mine pool and stream for not only EPCAMR, but the City of Wilkes-Barre, and other regional watershed groups. Additionally, uncovering issues with aging stormwater infrastructure could lead to improved water quality as well as updated infrastructure for MS4 projects within the City of Wilkes-Barre.

2) Flow Tracking: EPCAMR and the LCD recommend performing flow monitoring at a series of sites within the Laurel Run watershed in order to track flow loss and better determine the effects of historic mining on base flow. Testing would take place during a low groundwater 7-10 days after rainfall, and would consist of choosing 6 monitoring points, 3 above the coal measures and 3 below. Flows would be recorded and a baseline for flow loss could be determined.

3) Develop a Resolution for Wheelbarrow Run Sedimentation: In partnership with PPL and private landowners, EPCAMR would work to find funding and a solution to prevent further erosion of Wheelbarrow Run. As Wheelbarrow Run was only recently designated as a Class A CWF in 2012, the powerline was installed before it was known that native Brook Trout populate these waters. However, the powerline contributes to stream erosion & sedimentation and has a road crossing within an area that we suspect to be a trout breeding location. EPCAMR recommends working together with PPL to potentially build a suitable road crossing that would allow them access their pole line without driving through the stream. This would help resolve some of the sedimentation issues, preserving a Class A naturally reproducing trout stream as well as strengthening regional partnerships to promote environmental stewardship with a Public Utility.

4) Stream Cleanups and Community Outreach: EPCAMR noted illegal dumping and woody debris buildup throughout the urbanized section of Laurel Run as well as parts of the Seven Tubs Nature Area. EPCAMR recommends holding stream cleanups in order to mitigate these issues. Furthermore, cleanups would allow community members to be more aware of their surroundings and promote responsible use of local streams. Additional community outreach would include public access to materials regarding Laurel Run as well as general environmental stewardship information. EPCAMR would achieve this by updating materials on our website and continuing to share information through our social media pages, email initiatives, and volunteer programs.

5) Riparian Plantings and Invasive Knotweed Removal: Erosion and sedimentation are an area of concern for Laurel Run throughout the city section. EPCAMR recommends holding riparian plantings in order to help reduce erosion and sedimentation downstream. Additionally, while some stream sections do not have erosion issues, the main bank vegetation is invasive Japanese Knotweed. EPCAMR recommends further research into

realistic control & removal methods such as continuous knotweed removal, and professional select herbicide use, replacing exotic invasive species with native species, and looking into eco-friendly alternatives such as use of goats to remove invasive plants.

6) Municipal Outreach and Future Project Support: EPCAMR will send a copy of this report to each municipality and watershed group in the Laurel Run watershed. Additionally, EPCAMR recommends working with each municipality to determine ongoing or new issues they find within the Laurel Run watershed and develop future implementation projects to mitigate these issues. Assist the City of Wilkes-Barre with developing stream channel restoration projects for the former Coal Brook Creek Tributary. Possible projects include AMD remediation and MS4 technical assistance.

7) **Other Ideas Regarding Trout Stream Conservation**: Monitor the apparent recent increase in trout abundance; Implement restoration projects to preserve the existing populations and work to try and get Laurel Run to Class A CWF status; Provide regulatory protection for high quality trout streams; Increase public awareness and appreciation of brook trout in the Laurel Run watershed, Promote land use practices and landowner stewardship that protect trout; and Promote safe recreation angling activities that support native brook trout and increase environmental stewardship.

Public Meeting Notes

Public Meeting #1 Notes

Bear Creek Neighborhood Facilities Bldg | April 16th @ 6pm

HOST: EPCAMR

- Groups/Organizations/People to follow-up with for the project!
    - Stan Cooper and West Pocono TU Chapter
    - The Game Commission – NE Region
        - REMINDER: When talking to the Game Commission, mention the correlation from protecting/cleaning up/preserving ecology pertaining to Laurel Run benefiting target species for the GC (BATS & BIRDS)—would benefit foraging,etc.
    - Phil White – District Game Protection for Southern Luzerne
        - Interested in fisheries
    - Other municipalities that did not make it to the meeting (W-B City was present)
    - John Levitsky knows owners who reside near a major tract of the headwaters—look into ASAP
    - NW Edge boundary of the watershed
        - Part of Hollenback Park; access to creek from N Washington St, W-B.
        - End of Project Area; Confluence with Mill Creek
    - Find historical contacts on the RAMP Program, or information on the RAMP program
        - For abandoned mine reclamation projects around the Tubs parking lot area
    - Residential areas in Pittston? Private? Find contacts
    - Contact Mike Simonson or Butch F. (Director of Operations) to clue us in on projects going on in the City
    - Dallas office for PDF Maps of state game lands pertaining to Laurel Run
    - Contact for Borton-Lawson Enviro Studies around Laurel Run
        - Coal Brook Delineations, Crossvalley Expressway, Coal Brook Design
        - If cannot reach contact via the help of John Levitsky try Anthony Ellis (Friend of Lizz's that works at Borton)

- PA DEP and West Virginia quantitative and qualitative data assessments (examples)
    - PA DEP standards

- Laurel Run Issues
    - Location Start = Laurel Run Waterhsed near Geisinger/E. Mountain Blvd
        - Canal system routed water from all mountain streams to the reservoirs to stop it from going to the mines. All unnamed tribs that come into Laurel Run are diverted into canals and lost to fractures.
        - Canals divert a major chunk of Lauren Run watershed to the "Coal Brook Dam" (Laurel Run #2)
            - Diverted water was once used to wash coal
        - Flume follows Pocono formation outbounds
            - Earthen flume—one of many issues in stream because it diverts all natural drainage on East/NEast side into the back end of Coal Brook
    - Location = Laurel Run Watershed right up against Crossvalley Expressway
        - Basin where Laurel Run flows before it enters in Mill Creek
        - PennDot wetland delineation project
            - Basin builds up with sediment during flooding and drops out into the creek. Water from the river doesn't allow it to flow/leave.

        - Basin/Lake below Penn
        - Sand was coming from upstream
        - Mine drainage discharges into the basin—natural passage treatment located in basin
    - Location = EPSCO (lower portion)
        - Virgin clay located underneath basins
            - Shows cobbles/sediments are coming from upstream
    - Location = Parsons Section (W-B Area)
        - Work on Oliver and Mineral Street?
    - Location = Pine Ridge Colliery area (Miners Mills, Jumpers)
        - Davey Jones and Whitehouse Dams
    - Location = beginning of WB Boulevard before Laurel Run runs under the street
        - Beaver Dam
    - Location = Access Rd above the Woodlands
        - Drainage going into Laurel Run
        - Trash? Illegal dumping??
    - Location = Seven Tubs Nature Area
        - Mining
        - RAMP Abandoned Mine Reclamation Project near the parking lot
    - Location = Wilkes Wood Apartments
        - Flooding
    - Location = Southbound 81 to Northbound Crossvalley
        - Impounded water culvert from 81 to expressway until it evaporates- trib to Laurel Run
        - West Nile Issues due to standing water, etc.
        - Google Map View: appears to have a potential AMD discharge into this sediment basin
    - Alden Mills Trib? Look into
    - If we find any acid loadings
        - Contact John L. for Limestone Sand Study
    - Sediment load, gravel and sand bar remediation
        - Limited by gradient when the river backs up!
            - River backs up and stream cannot flow out
            - Becomes a huge sediment drop
    - Watershed Boundary
        - May be in error due to flumes (EPCAMR did not take into account b/c did not know existed)
        - Boundary may go out to divide instead, drainage probably takes the boundary out to back of Trailer Park off Jumper
            - Possibly need to bring boundary in
            - Look into canal and flume system more and bring Mike in to fix boundary via GIS

- Recommendations for Plan
    - pH Contour Map from Penn State only one in PA
        - possibly suggest a pH program to start at one of the colleges in the area—King's, Wilkes?
    - That crossings on headwater streams w/ ruts throw down limestone to allow to drop down and go downstream?

- Laurel Run Creek
    - Per John Levitsky looking at map layers on 4/16 (EPCAMR look into on our own as well)
        - 6.2 actual stream miles

- Approx. 3.2 mi upstream of the confluence where mine impacts end is first sightings of orange-rust, etc….disturbed soils and surface areas

- Coal Brook Creek Info (for entire Mill Creek Watershed planning if funded)
  - Lost after the interstate into the ground due to fractures and mining
    - Proposal to enclose Coal Brook and bring it out of the mines? (Look into)

Laurel Run Historical Uses and Information

- http://www.usgwarchives.net/pa/luzerne/1893hist/parsons.htm
  In the spring of 1813 Hezekiah Parsons built the main part of the house now occupied by his son, Calvin Parsons. The house was then but one story high, and was the first framed house in Parsons. Hezekiah Parsons was a clothier by trade, and built a cloth-dressing mill on the north side of Laurel Run, a short distance from his house. In 1814 he associated with him in business Jehoida P. Johnson, and they built a carding-mill, and carried on both branches of business until 1820, when Mr. Parsons became sole proprietor. He continued the business till 1850, when he sold all the machinery to J. P. Rice, who removed it to Truxville. In 1810 Jehoida P. Johnson built a gristmill near Laurel Run, below where the carding-mill was built. In 1812 John Holgate built a turning-mill below Johnson's gristmill. They were both on what is now known as the Johnson property; they went to decay many years ago.

  In 1832 Hiram McAlpine built a turning-mill on Laurel Run, near Mr. Parson's house, for the scythe snaths; in 1839 the machinery was moved to Wilkes-Barre. The first resident blacksmith in Parsons borough was Rufus Davidson. He worked in McAlpine's shop. In 1838 Capt. Alexander built a powder-mill on the site of Laurel Run coal breaker. It was blown up several times, last in 1864 or 1865, when owned by Capt. Parrish. In 1844 the Johnson heirs built a powder-mill just above the side of the gristmill on Laurel Run. This mill was blown up in 1848, and was never rebuilt. J. P. Johnson and C. Parsons manufactured powder kegs on Laurel Run from 1838 until 1858.

- Wikipedia (Laurel Run Mill Creek) and History of Luzerne County Website: Wilkes-Barre Water Company used it during time of flume construction and coal cleaning usage. The Wilkes-Barre Water Company was incorporated by act of the legislature February 12, 1850. The company has about thirty-five miles of cement and wrought-iron pipe laid, the source of water supply being Laurel run and Mill creek.

Public Meeting #2 Notes

Wilkes University | April 28th, 2016 @ 6:30pm

HOST: EPCAMR

- Coal Brook
    - Important to note the loss of the source through the coal seams and to a completely different watershed (Solomon's)
    - If wasn't lost would flow if it were to be resurfaced but would cause flooding in WB area
- Highlight flooding near Wilkeswood Apts
- Contact to get in touch with – Terry Ostrowski (engineer for Plains, may be able to find in PennEast info)
- Canalworks System
    - Outside Penn formation. Picked up all streams and discharged them to Coal Brook Dam
    - Now destroyed.
    - Highlight Coal companies and canal issues in History section
- Recommendation from J. Levitsky
    - To show loss of water into mines, shows loss of flow and how much water the area is losing due to past mining
    - One day event, will entail the entire EPCAMR team
        - After a period of no rain (about 15 days)
    - Calculate the volume of flow of the LR watershed before and after CB Dam #2
    - Plot graph of watershed area to flow
    - Will most likely show how much water quality and quantity diminished due to mines
- Check scarlift reports on M:Drive
- Gabby's Google MyMaps of LR watershed
- Recommendations for invasive knotweed? Found all-over LR
    - Contact: V. Cotrone PSU Ext.
        - Late June/Early July
            - Mow knotweed to ground, it will attempt to get to flowering stage, but then add herbicide. Takes about 3 yrs to completely disappear
            - Root is too big to impair all the way
    - Plant native invasive the doesn't allow knotweed to grow but then you will have to deal with in the future
- Find any info on historic Spring Brook WC that has to do with Laurel Run and maybe the dam
- EPCAMR to get in touch with municipalities to see any issues they may have surrounding Laurel Run. Would be able to add any recommendations to CHP Final Report. Can contact via email from PennEast contacts

Water Quality Test Site & Miscellaneous Photos

Section 1: Laurel Run City Section - LR1 through LR6

Figure 7: LR1 Upstream (Photo 2)

Figure 8: LR1 Downstream (Photo 3)

Figure 9: LR2 Upstream (Photo 4)

Figure 10: LR2 Downstream (Photo 5)

Figure 11: LR2 AMD seep discharge from small basin (Photo 6)

Figure 12: LR3 Upstream (Photo 7)

Figure 13: LR3 Downstream (Photo 8)

Figure 14: LR4 Upstream (Photo 9)

Figure 15: LR4 Downstream (Photo 10)

Figure 16: Erosion near LR4 (Photo 11)

Figure 17: Erosion Near LR4 (Photo 12)

Figure 18: Flood Wall Undercutting (Photo 13)

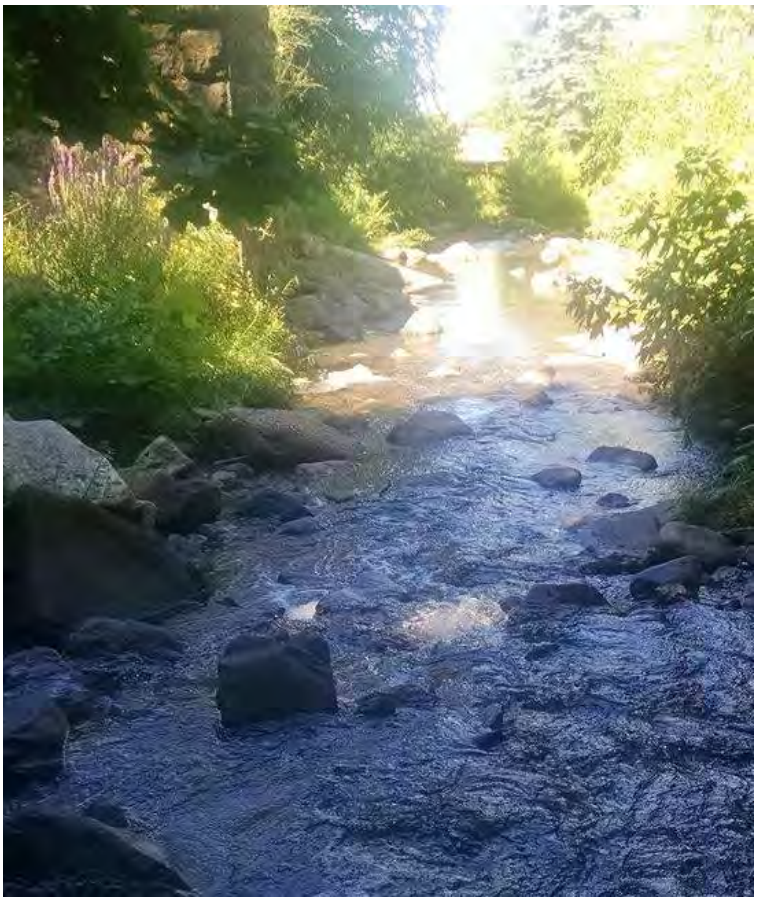

Figure 19: LR5 Downstream (Photo 14)

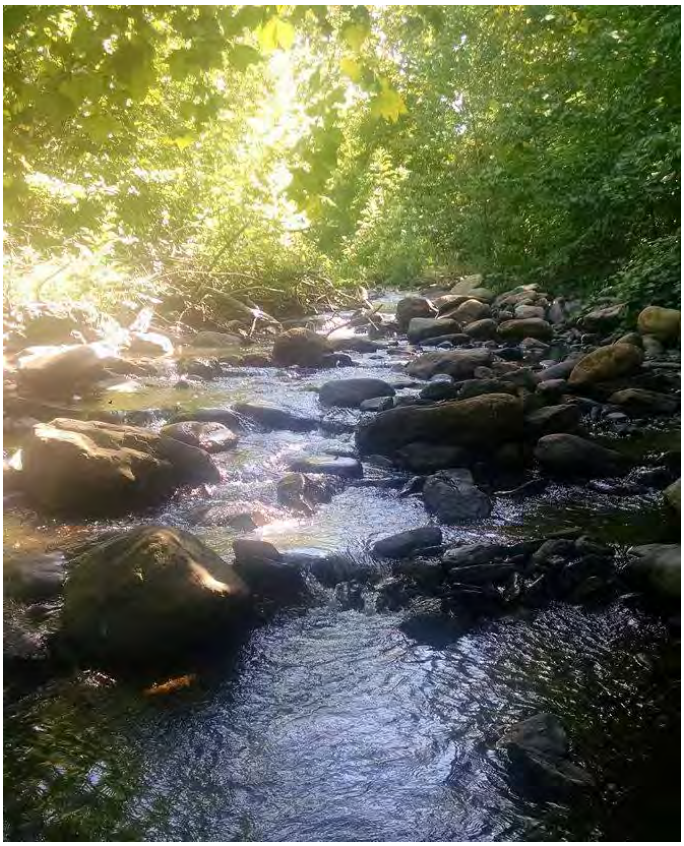

Figure 20: LR5 Upstream (Photo 15)

Figure 21: LR6 Downstream - AMD Staining from seep (Photo 16)

Figure 22: LR6 Upstream - AMD seep located below waterline (Photo 17)

Section 2: Coal Brook – CB1 through CB4

Figure 23: CB1 Upstream (Photo 18)

Figure 24: CB1 Downstream (Photo 19)

Figure 25: CB2 Upstream (Photo 20)

Figure 26: CB2 Downstream (Photo 21)

Figure 27: CB3 Upstream (Photo 22)

Photo 1: CB3 Downstream

Figure 28: CB4 Upstream (Photo 24)

Figure 29: CB4 Downstream (Photo 25)

Section 3: Wheelbarrow Run – WB1 through WB5

Figure 30: LR_UNT_WB1 Upstream (Photo 26)

Figure 31: LR_UNT_WB1 Downstream (Photo 27)

Figure 32: LR_UNT_WB2 Upstream (Photo 28)

Figure 33: LR_UNT_WB2 Downstream (Photo 29)

Figure 34: LR_UNT_WB3 Upstream (Photo 30)

Figure 35: LR_UNT_WB3 Downstream (Photo 31)

Figure 36: LR_UNT_WB4 Upstream (Photo 32)

Figure 37: LR_UNT_WB4 Downstream (Photo 33)

Figure 38: LR_UNT_WB5 Upstream (Photo 34)

Figure 39: LR_UNT_WB5 Downstream (Photo 35)

Section 4: Laurel Run, Deep Hollow, and Unnamed Tributaries – LR7-LR13

Figure 40: LR7 Upstream (Photo 36)

Figure 41: LR7 Downstream (Photo 37)

Figure 42: LR8 Downstream (Photo 38)

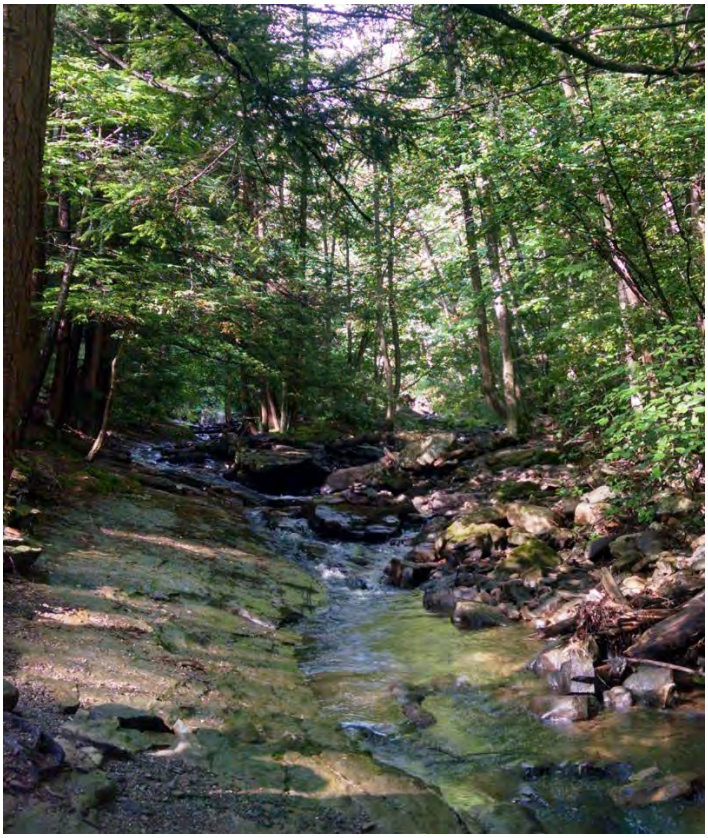

Figure 43: LR8 Upstream (Photo 39)

Figure 44: LR9 Upstream (Photo 40)

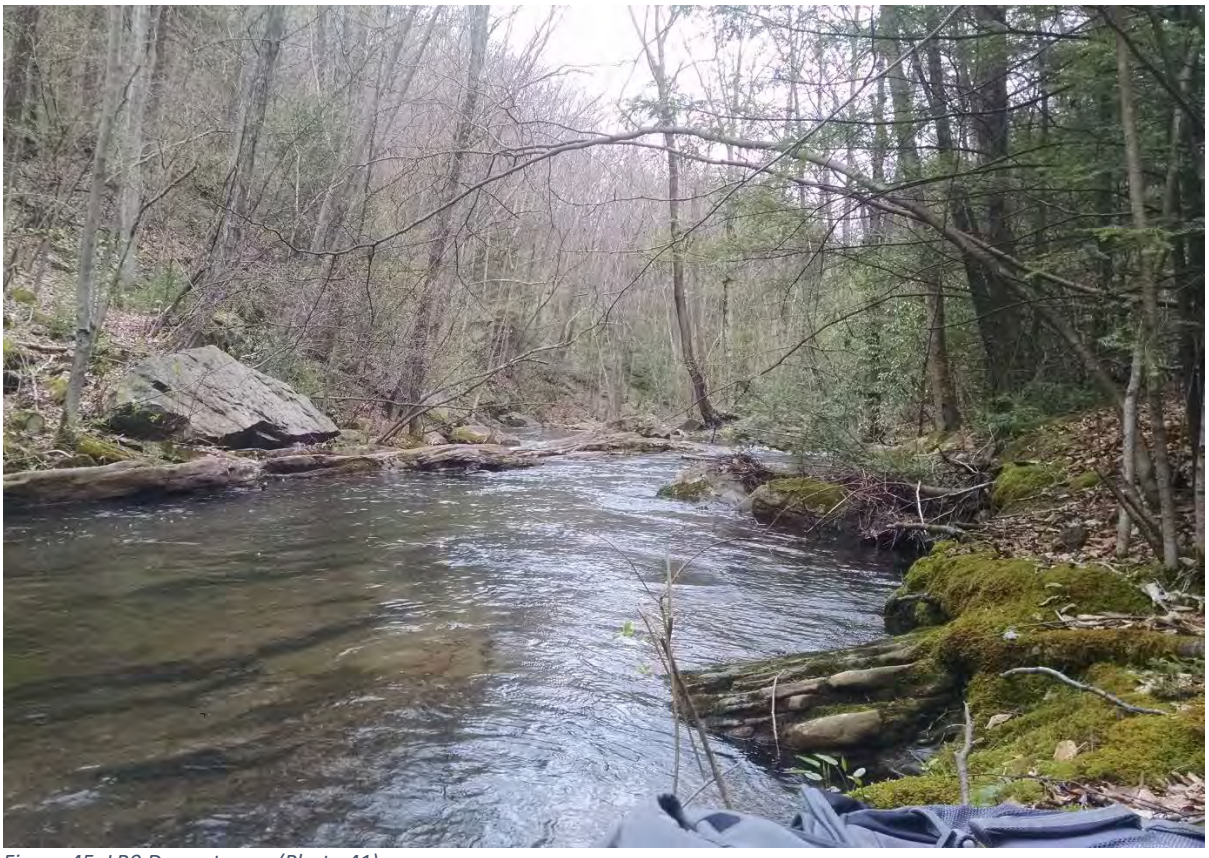

Figure 45: LR9 Downstream (Photo 41)

Figure 46: LR10 Upstream (Photo 42)

Figure 47: LR10 Downstream (Photo 43)

Figure 48: LR11 Upstream (Photo 44)

Figure 49: LR11 Downstream (Photo 45)

Figure 50: LR12 Downstream (Photo 46)

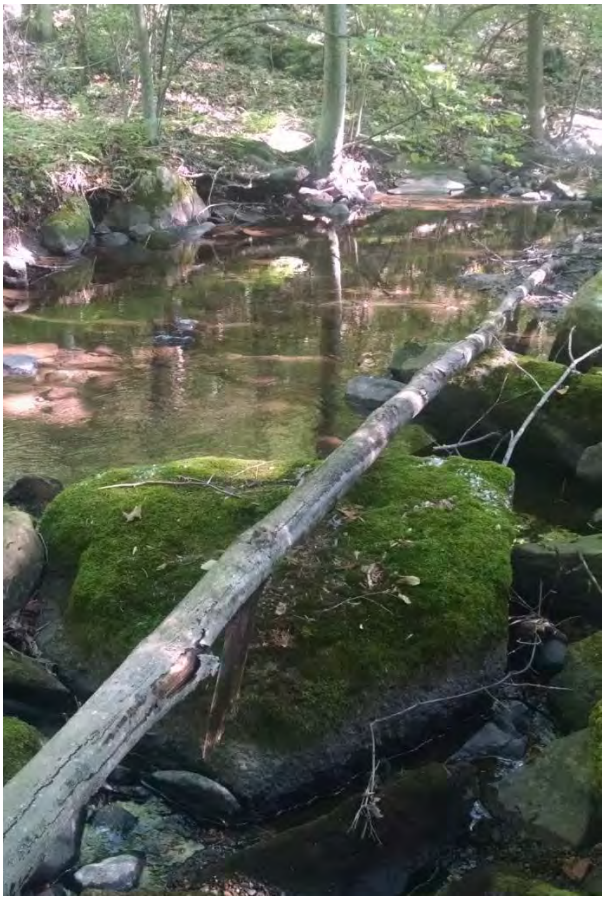

Figure 51: LR12 Upstream (Photo 47)

Figure 52: LR13 Upstream (Photo 48)

Figure 53: LR13 Downstream (Photo 49)

Figure 54: Electroshocking Laurel Run (Photo 50)

Figure 55: Brook Trout - Young of the Year (Photo 51)

Figure 56: Adult Brook Trout (Photo 52)

Figure 57: EPCAMR staff assisting TU staff with weighing and measuring Brook Trout (Photo 53)

Figure 58: Culvert #1 Inlet (Photo 54)

Figure 59: Culvert #1 Outlet (Photo 55)

Figure 60: Culvert #2 Inlet (Photo 56)

Figure 61: Culvert #2 Outlet (Photo 57)

Figure 62: Culvert #3 Inlet (Photo 58)

Figure 63: Culvert #3 Outlet (Photo 59)

Figure 64: Train Crossing Inlet (Photo 60)

Figure 65: Train Crossing Outlet (Photo 61)

Figure 66: Inside Culvert under 81 near Laurel Run #2 Dam (Photo 62)

Historic Photos and Other Points of Interest

Figure 67: Laurel Run Watershed 1939 (Photo 54)

Figure 68: Laurel Run #2 Dam 1959 (Photo 55)

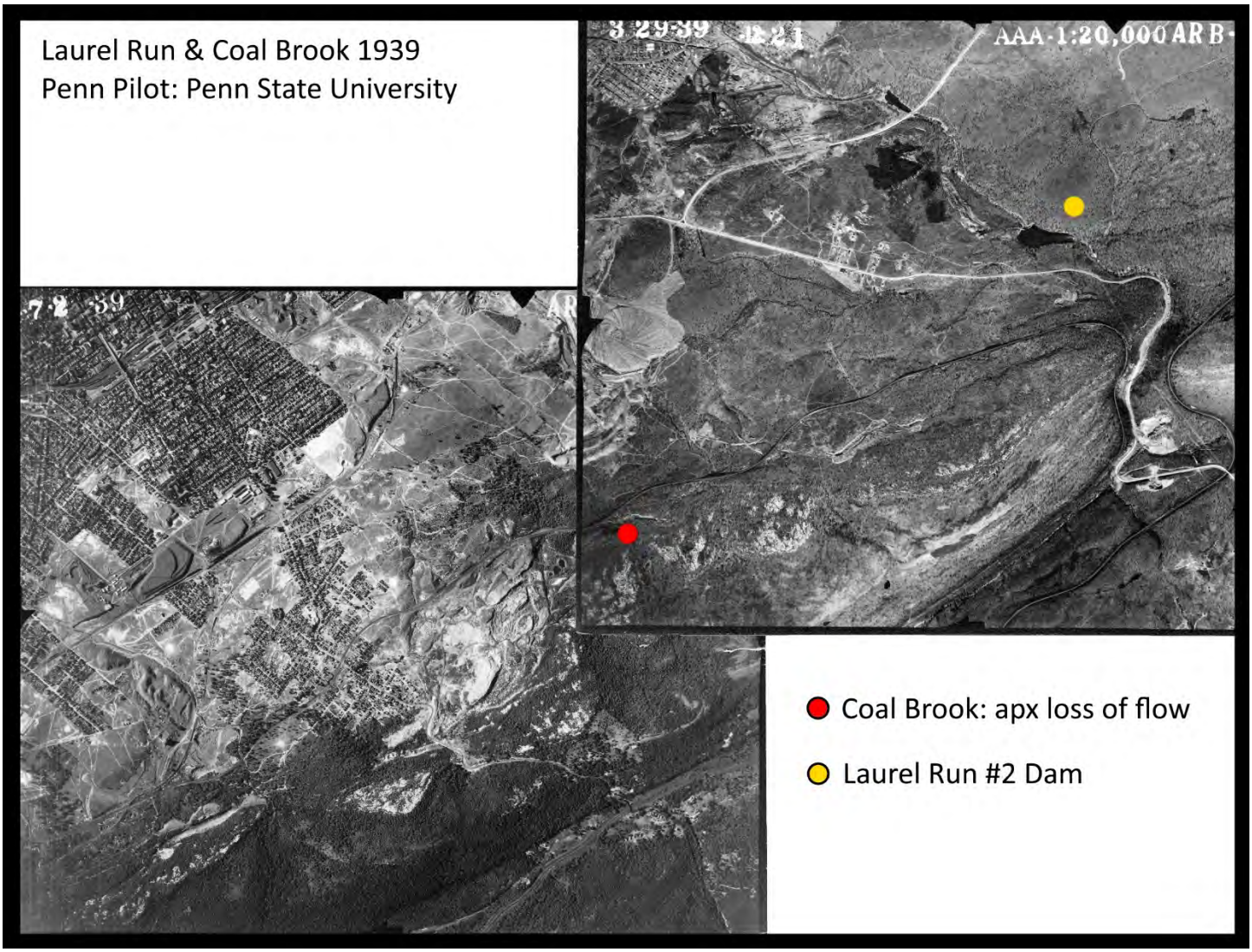

Figure 69: Coal Brook and Laurel Run #2 Dam 1939 (Photo 56)

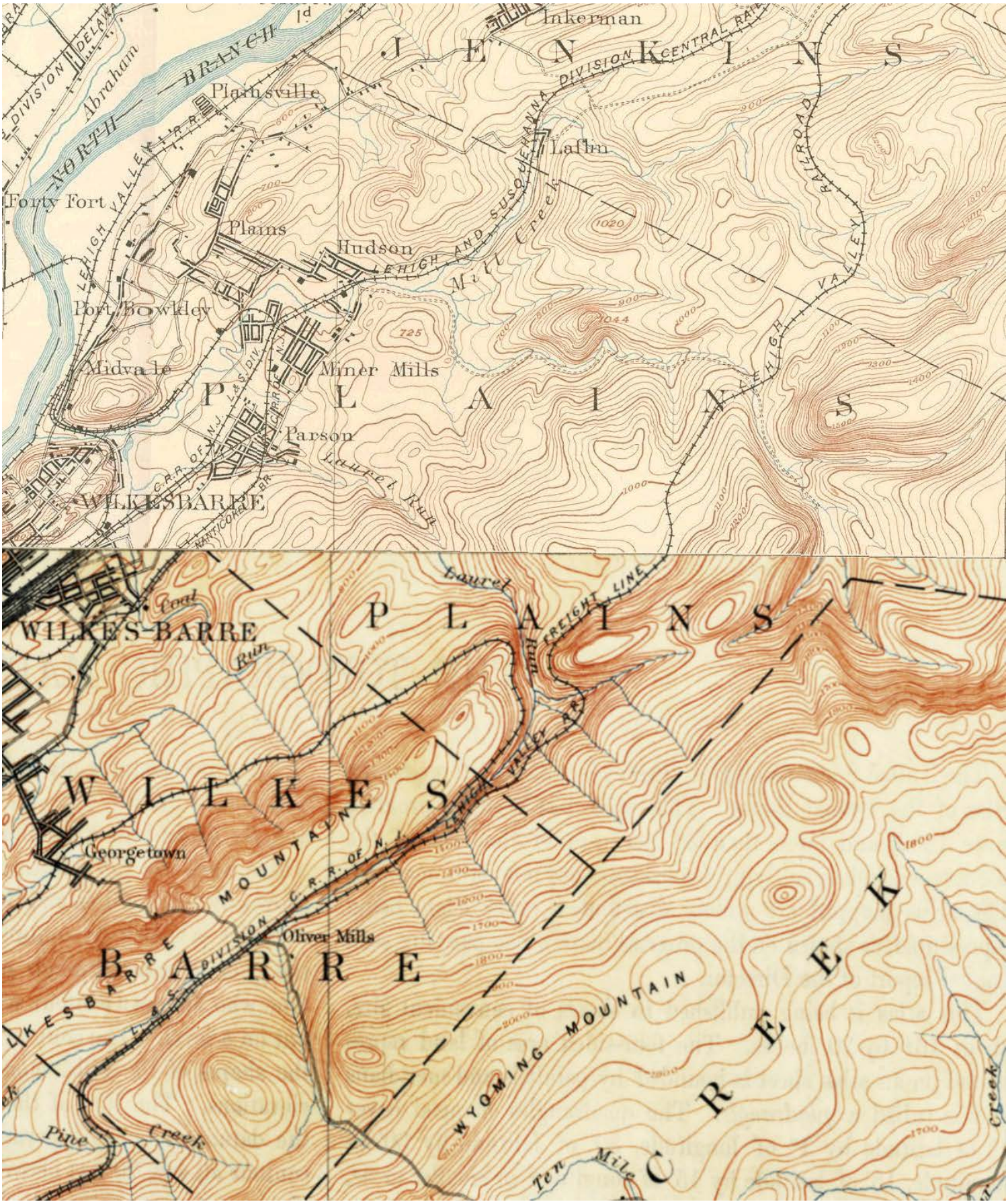

Figure 70: Historic Laurel Run Watershed Map 1891-1893 (Photo 57)

Figure 71: Map of Proposed AMD Projects; Coal Brook listed in Green showing project requested but never completed; year unknown (Photo 58)

Laurel Run Watershed Maps

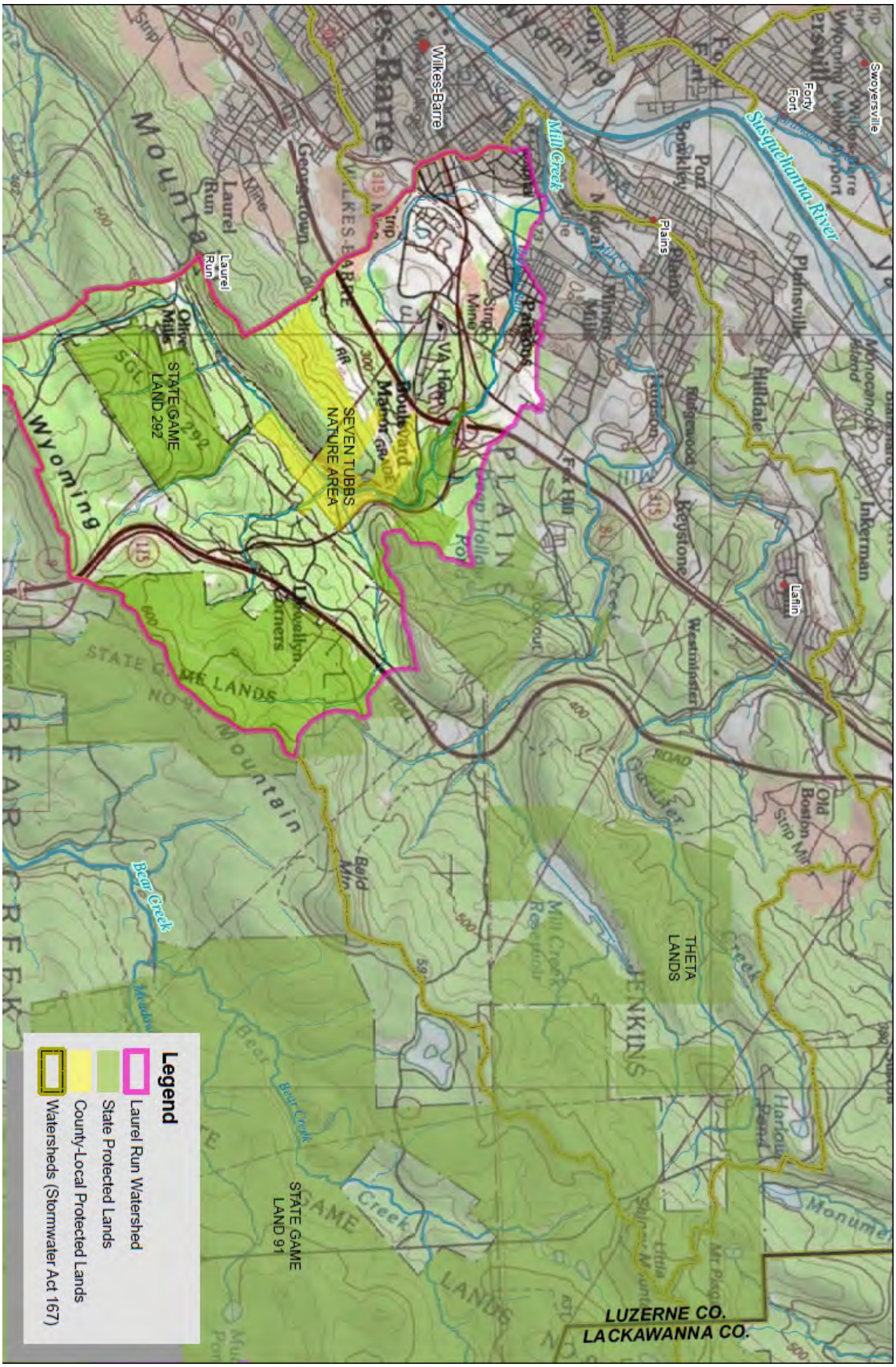

Figure 72: Laurel Run Watershed Boundaries (Map 4)

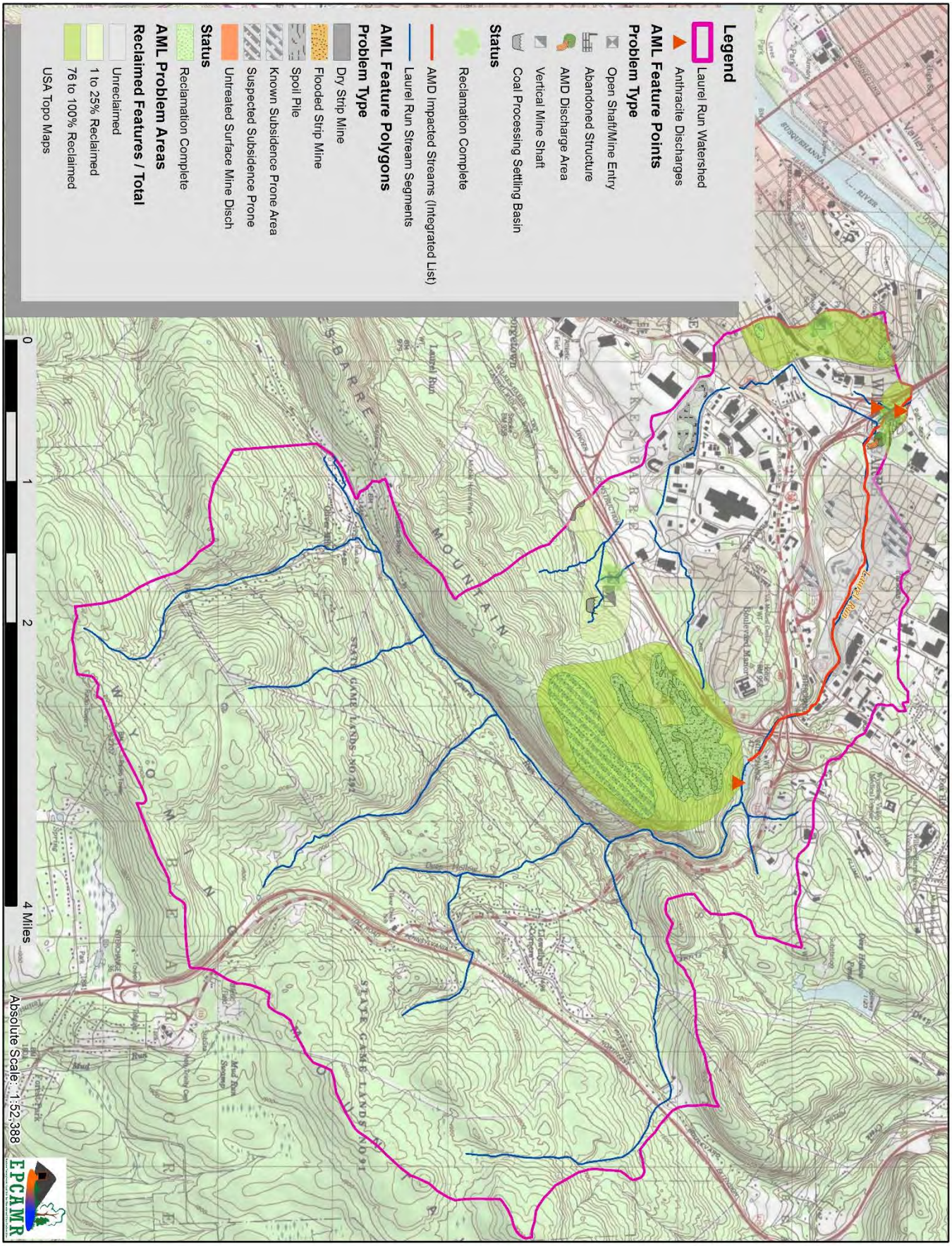

Figure 73: Laurel Run AML Impacts (Map 5)

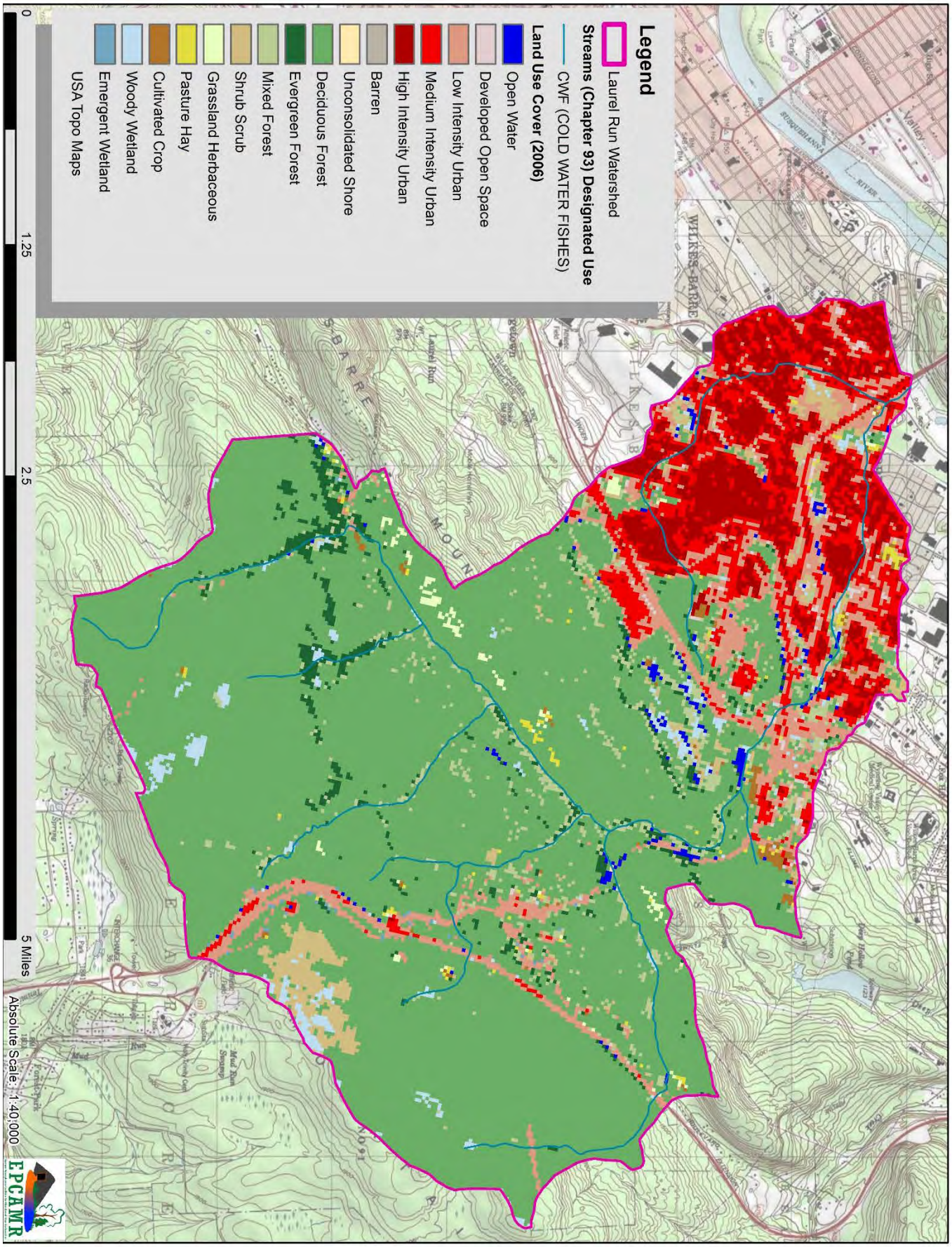

Figure 74: Laurel Run Land Cover Map (Map 6)

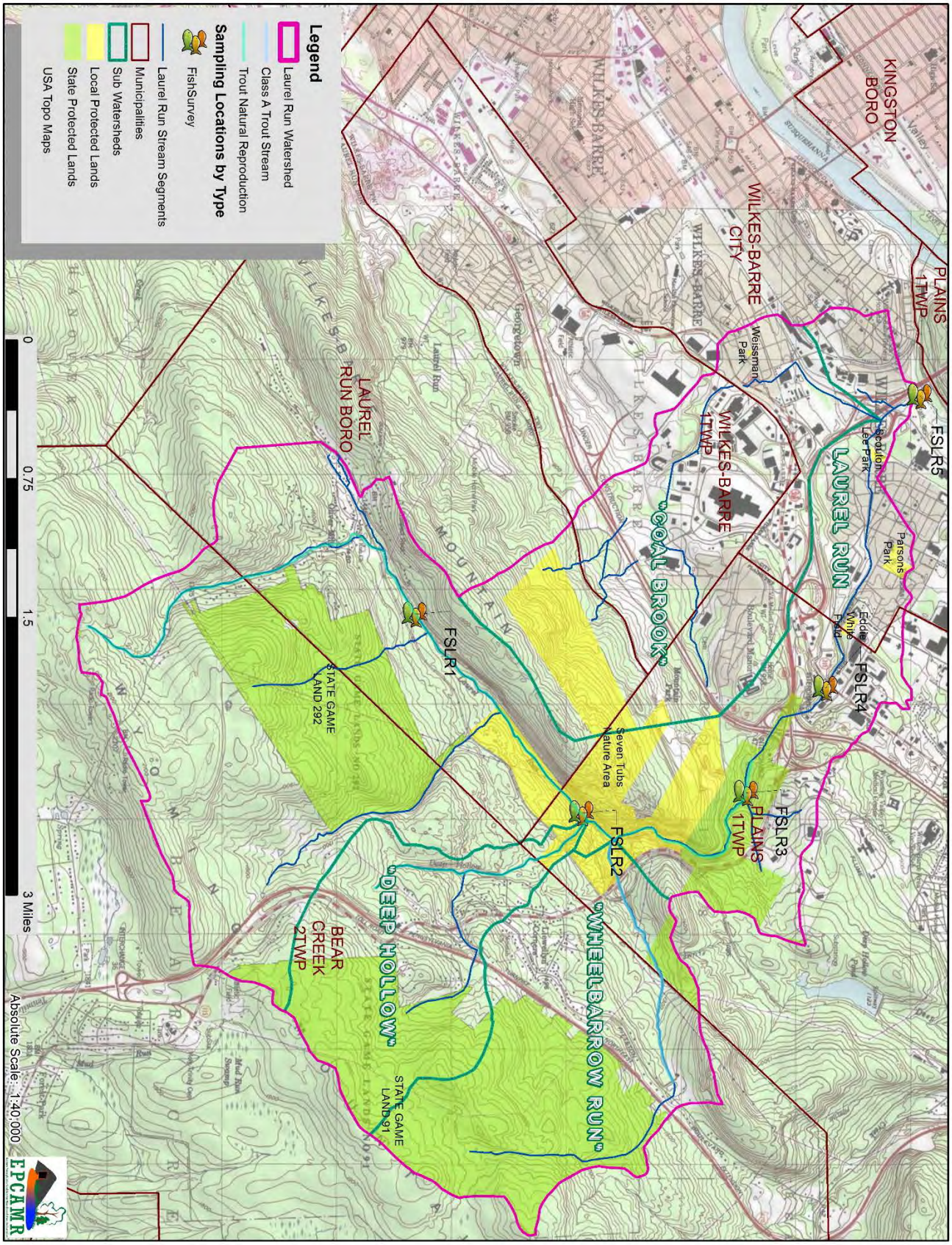

Figure 75: Laurel Run Designated Fisheries and Protected Areas (Map 7)

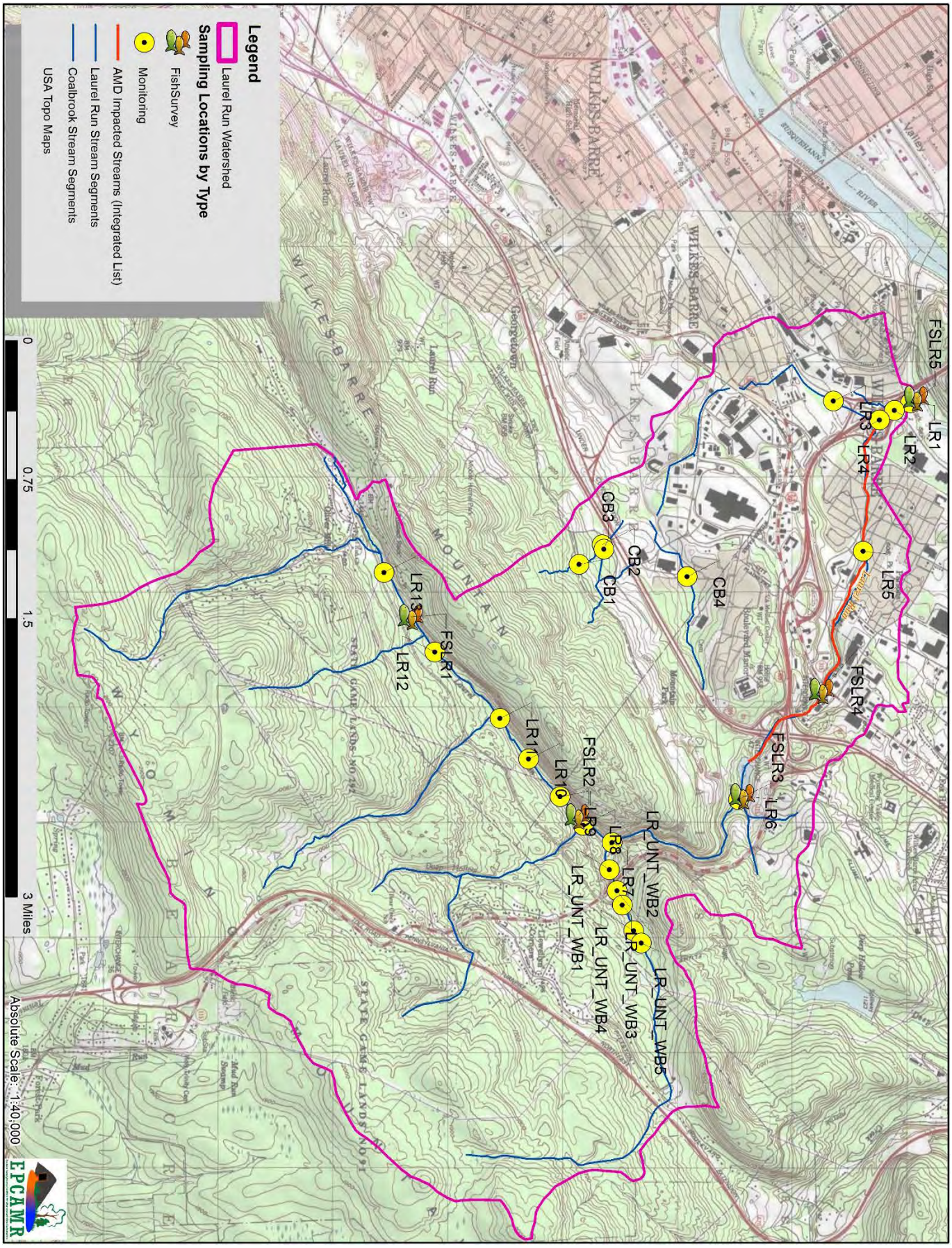

Figure 76: Laurel Run Assessment Sites and Fish Survey Sites (Map 8)

Field Notes

Coal Brook Tributary to Laurel Run

EPCAMR staff noted that Coal Brook is the most heavily impacted stream mileage within the Laurel Run Watershed. Due to historic coal mining, and later, heavy urbanization, Coal Brook's flow is lost to the mine pool and most flow, if not all, is a result of stormwater runoff or high precipitation events. EPCAMR also notes that in order to bring Coal Brook back to its original flow and water quality, the Wyoming Valley Mall complex as well as various residential homes and small businesses would need to be removed. Additionally, to stop Coal Brook from losing flow as it crosses the coal measures, large-scale AML projects would need to be completed. EPCAMR also notes that some of the information presented in these field notes may be inaccurate due to uncertainty about Coal Brook's true flow patterns.

Coal Brook Headwaters and Unnamed Tributary

EPCAMR Staff assessed two upstream unnamed tributaries of Coal Brook. Upon further investigation, it is believed that test site CB1 may be the headwaters of Coal Brook. This was the only area seen flowing at all field investigation periods during the project period. A large bedrock plane was found at this location. EPCAMR Staff followed the northernmost tributary through historic concrete flume systems built to carry water from Coal Brook to the Laurel Run #2 dam in order to clean coal. Rocks were intentionally laid along the bank of the 5' wide streambank and poured concrete slabs were located within the channel. Stream flow was noted over some sections and flowing under others into the channel. However, total flow loss occurred as the stream flowed over outcrops.

EPCAMR staff also noted heavy sedimentation in culvert pipes along Bed, Bath, and Beyond. Household trash was also observed. A small cleanup at this location, as well as others throughout the Coal Brook sub-watershed would help decrease trash and improve habitat.

Coal Brook General Notes

At Coal Brook's northernmost headwater tributary, which drains from the northeastern side of Interstate 81 flowing down from Wilkes-Barre Township Mountain Park, EPCAMR Staff assessed the stream channel as it outlets from a series of connected culvert pipes into a wetland area in a ravine below Bear Creek Boulevard.

Two dry stormwater channels were noted heading directly towards the Coal Brook headwaters, leading drainage through a 48" concrete culvert pipe under I-81. Abandoned cropfalls 100' high and .5 miles in length were noted on the north side in the Mountain Park area, where ponded stream water could be visibly seen from the top of the cropfall. EPCAMR believes much of this water infiltrates the underground coal workings, eventually discharging at the Plainsville Borehole along the Susquehanna River in Plains Township. Minor groundwater seepage was visibly seen from the outlet of the concrete culvert pipe as it led into the wetland area.

Near the Wyoming Valley Sportsdome, Coal Brook flows along a wooded area and forested wetland area below an active reclamation project on Earth Conservancy property. The tributary then flows out of the wooded area and into a grassed waterway located between Lenape Court and Lexington Court in the WilkesWood

Apartments. Very little flow and some standing water was present during the initial site investigation and assessment. EPCAMR Staff assessed for habitat and aquatic insect life. No macroinvertebrates were found.*

Gravel bars and sandy soils were prevalent and some minor streambank erosion was present due to another 18" concrete drainage pipe from Revere Court draining underneath the Outback and Lowe's Parking Lot. Placement of a rock apron at the end of the drainage pipe or a riparian planting might reduce stream channel erosion. Trash and windblown debris is abundant along the hillside and steep embankment behind these businesses. Additional culverts behind Bed, Bath, and Beyond drain water from Coal Brook underneath 81 and into large stormwater basins near Target. EPCAMR believes this drainage infiltrates the mine pool that eventually discharges at the Solomon Creek Boreholes.

*EPCAMR was unable to test during macroinvertebrate breeding season; results may be slightly skewed

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