Updated 2/2004

Watershed Restoration Action Strategy (WRAS)
State Water Plan Subbasin 06C
Mahantango Creek and Wiconisco Creek Watersheds
(Susquehanna River)
Northumberland, Schuylkill, Dauphin, Juniata, Perry, and Snyder Counties

Introduction

Subbasin 06C covers a 525-square mile area on both sides of the Susquehanna River from the village of Dalmatia downstream to the confluence of the Juniata River. The subbasin includes several major tributaries on the east side of Susquehanna River, (East) Mahantango Creek, Wiconisco Creek, Armstrong Creek, and Powell Creek, and one major tributary on the west side, (West) Mahantango Creek. A total of 804 streams flow for 971 miles through the subbasin. The subbasin is included in **HUC Area 2050201**, Lower Susquehanna River, Penns Creek, a Category I, FY99/2000 Priority watershed in the Unified Watershed Assessment.

Geology/Soils

The subbasin is in the Ridge and Valley Ecoregion, with the section west of the River and half of the section east of the River in the Northern Shale Valleys and Slopes section (67b). Rocks in this area are red, brown, or gray shales and sandstones of the Silurian, Devonian and Mississippian Ages. The subbasin has the typical Appalachian Mountains region topography with mountains forming its northern and eastern boundaries. Narrow valleys between these northeast-southwest trending ridges have medium sized creeks flowing towards the Susquehanna River and contain the best agricultural lands. Soils in 67b have a greater susceptibility to soil erosion, turbidity, and poorer habitat conditions than soils in limestone valleys.

The eastern third of the subbasin is in the Anthracite coal section (67e). This valuable "hard coal" in Dauphin, Schuylkill and Northumberland Counties was extensively deep mined for over 150 years and lead to much of the settlement in the eastern subbasin. Surface mining was also prevalent through the coal basin. The coal fields have been largely depleted of the easily obtainable coals and mining has declined significantly. Most of the mines were abandoned and discharge huge quantities of water polluted with iron, aluminum, and often, acid into the receiving streams.

Land Use

The watershed includes 5 boroughs, 4 of which are located along the Wiconisco Creek. The boroughs and additional villages in the eastern portion of the subbasin were originally associated with the Anthracite coal mines. The coal industry has declined and many of the people in the coal region now work at the state capital in Harrisburg. The population of the subbasin was 47,700 in 1990 and is projected to increase slightly to 50,000 in 2040. I-81 crosses through a remote section of the upper subbasin.

The West Mahantango Creek, East Mahantango Creek, and Armstrong Creek watersheds are small rural agricultural basins, with most of the development consisting of small farms or single-family dwellings. Wiconisco Creek flows through a sparsely settled rural area with several boroughs and villages. Its watershed is affected by a combination of nonpoint and point sources discharges, including municipal waste, farmland runoff, on-lot septic systems, and abandoned mine drainage. The largest watershed in the subbasin, East Mahantango Creek has the most miles affected by agriculture and AMD in the subbasin. Upper Powell Creek flows through sparsely populated undeveloped mountain and woodland terrain, the lower 3 miles flows through an agricultural area.

Natural/Recreational Resources:
State Game Lands (SGL) #264 is located on Short and Big Lick Mountains north of the Wiconisco Creek valley. Part of SGL #210 is located on Broad Mountain in the headwaters of EB Rattling Creek, Stone Cabin Run, and Powell Creek. Weiser State Forest lands are located at the headwaters of WB Rattling Creek and on Berry Mountain south of Wiconisco Creek.

DEP Chapter 93 Exceptional Value (EV) and High-Quality (HQ) Streams:
EV:

- Rattling Creek, source to confluence of East and West Branch (includes both branches).

High Quality:

- Rattling Creek, confluence of East and West Branches to mouth
- Unnamed tributary to Armstrong Creek at River Mile 9.86

Water Quality Impairment
Water quality impairments are of two sources, agriculture and abandoned mine drainage. Habitat modification has also impaired some stream miles. Some lowly buffered, naturally acidic mountain streams that are susceptible to acid precipitation have become more acidic and have experienced a reduction in the diversity of aquatic life.

Monitoring/Evaluation
DEP biologists assessed the subbasin under the Unassessed Waters Program in 1997. Portions of West Branch (West) Mahantango Creek, East Mahantango Creek, Armstrong Creek, and Powell Creek watersheds are impaired by agriculture nonpoint sources. The major impact noted was siltation; only one creek, the North Branch Mahantango Creek on the west side of the Susquehanna River, was impaired by nutrients and organic enrichment/low DO, in addition to siltation. Several streams were also impacted by habitat modification. The draft 2000 303d list cleared up the confusion about which of the two Mahantango Creeks was impaired; the earlier list did not specify which one was impaired.

Portions of Rausch Creek, Wiconisco Creek, and their tributaries are impaired by abandoned mine drainage (AMD). The major effect noted was iron precipitate coating stream substrates; however, several creeks are also affected by low pH. The DEP Bureau of Abandoned Mine Drainage operates an AMD treatment facility on Rausch Creek. The water quality improvements from acid neutralization and metals removal at this facility allow its receiving streams, Pine Creek and Mahantango Creek, to be stocked with catchable trout by the PA Fish and Boat Commission.

DEP biologists use a combination of habitat and biological assessments as the primary mechanism to evaluate Pennsylvania streams under the Unassessed Waters Program. This method requires selecting stream sites that would reflect impacts from surrounding land uses that are representative of the stream segment being assessed. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment. The length of the stream segment assessed can vary between sites. Several factors are used to determine site location and how long a segment can be, including distinct changes in stream characteristics, surface geology, riparian land use, and the pollutant causing impairment. Habitat surveys and a biological assessment are conducted at each site. Biological surveys include kick screen sampling of benthic macroinvertebrates, which are identified to family in the field, and an evaluation of their tolerances to pollution. Benthic macroinvertebrates are the organisms, mainly aquatic insects, that live on the stream bottom. Since they are short-lived (most have a one-year life cycle) and relatively immobile, they reflect the chemical and physical characteristics of a stream and chronic pollution sources or stresses. Habitat assessments evaluate how deeply the stream substrate is embedded, degree of streambank erosion, condition of riparian vegetation, and amount of sedimentation.

Several studies and reports looked at various methods of treating nitrates in groundwater within the basin. The Susquehanna River Basin Commission (SRBC) nitrate reduction study for Armstrong Creek considered using field drains for collecting surface water before it infiltrates into the groundwater and using constructed wetlands as a treatment solution. The report concluded that the extensive riparian vegetation along Armstrong Creek was effective in preventing nitrogen from farm runoff from entering surface waters and that the diffuse groundwater flow through the noncarbonate rocks also prevented build-ups of nitrates. Field drains and wetland cells are expected to work better in carbonate areas and where riparian vegetation is lacking.

A SRBC report on water quality in Wiconisco Creek watershed indicated that Wiconisco Creek has excellent quality from its headwaters downstream to the Porter Tunnel mine discharge. The discharge causes a thick covering of iron precipitate. The creek is essentially devoid of aquatic life and doesn't show signs of recovery until more than 2 miles downstream of the discharge. Other discharges farther downstream such as Big Lick Tunnel, degrade Wiconisco Creek. Bear Creek is degraded by alkaline-high iron discharges from several drift mines and contributes additional iron loading to Wiconisco Creek. Wiconisco Creek changes from mining to forested land use around Loyaltown and water quality conditions improve downstream so that trout can be stocked by the Pennsylvania Fish and Boat Commission from the confluence of Rattling Creek to the mouth. Rattling Creek is one the most pristine watersheds in the Wiconisco watershed. Little Wiconisco Creek is impacted by agriculture through streambank modification from pastured cattle; soil erosion is evident from poor farming practices.

The Dauphin County Conservation District is monitoring stream water quality and streambank stability at 5 sites in Powell Creek and 5 sites in Armstrong Creek watersheds.

Future threats to water quality

Water quality conditions in streams affected by AMD are likely to improve as the technology for passive treatment improves and treatment systems are installed to treat the discharges. Agricultural practices in the subbasin are shifting from small farms to larger, higher animal density operations. Residential lands are expanding in the subbasin. The Dauphin bypass widened US Route 322/22 into a divided highway has made commuting to Harrisburg easier from the subbasin and could increase the expansion of residential areas. Expansion of residential communities and its increased paving has the potential to modify stream hydrology and increase sedimentation from urban runoff.

Restoration Initiatives

Pennsylvania Growing Greener Grants:

- Dauphin County Conservation District:
  - $59,276 (FY2001) for education/outreach.
  - $10,428 (2001) for implementation of phase II of the Powell and Armstrong Creeks watershed management plan.
  - $130,350 (2000) for AMD and acid deposition remediation in upper Wiconisco Creek.
  - $22,300 (1999) to continue development of a passive treatment plan for AMD discharges to Bear Creek and limestone sand addition to the West Branch Rattling Creek.
  - $33,700 (1999) to start a watershed planning and management project for Powell and Armstrong Creeks. Funds will be used to educate the local government officials and the general public about stream issues. A core group of local government officials and citizens will be formed to pursue further activities in support of watershed management.
- Powell and Armstrong Creeks Watershed Association:
  - $45,000 (2002) to develop a watershed management plan that will address the lack of adequate land use controls necessary for watershed protection, and the education required for residents and officials to understand and accept watershed protection measures.

- $21,980 (2000) to for education and outreach activities.
- $10,428 to educate local government officials and the general public about interaction between land and water resources and to identify potential pollution problems in the basin.

U.S. Environmental Protection Agency (EPA) Clean Water Act Section 319 Grants:

FY 2003

- Dauphin County Conservation District:
    - $110,000 to repair streambank erosion in Little Wiconisco Creek;
    - $220,000 for acid mine drainage remediation on Bear Creek.
- Schuylkill Conservation District
    - $9,928 for streambank stabilization and fish habitat improvement on Mahantango Creek
    - $67,428 to install agricultural best management practices in the Mahantango Watershed.
- $94,500 (FY2001) to the Foundation for California University to improve fish and wildlife resources and reduce adverse water quality impacts from agriculture on four Pennsylvania Game Commission Farm Game Projects in the Mahantango Creek and adjacent watersheds. Restoration will consist of wetlands, streambank plantings, shrubby borders of fields and native grasslands.
- $50,000 (1999) to Dauphin County CD for remediation measures to reduce sediment, nitrogen and phosphorus in Powell Creek and Armstrong Creek watersheds. This project will include streambank fencing to exclude cattle and development of stream fact sheets to educate residents on watershed issues.

Chesapeake Bay Program

- Educational, financial, planning and technical assistance provided through the Dauphin County CD.

DEP Bureau of Mining and Reclamation WRPA Grant Program:

- $25,600 (1999) to Dauphin County Conservation District for limestone sand restoration for upper Wiconisco Creek and a study of passive treatment options for the large alkaline discharge to Bear Creek.

Act 167, Pennsylvania Stormwater Management Act:

- A Phase I study was prepared for the Susquehanna River basin in part of Dauphin County. Armstrong Creek and Powell Creek are included in this plan.

PENNVEST

- $2.5 million loan to Elizabethville Area Authority to expand existing sewage treatment plant to double capacity, eliminating possible wet weather discharges of improperly treated sewage to Wiconisco Creek.

League of Women Voters (WREN) Mini-grants:

- $3,000 to Powell and Armstrong Creek Watershed Association to produce a quarterly newsletter, fact sheet and a brochure to increase local water resource protection awareness. Educational meetings, including one targeted at municipal officials, will also be conducted.

Other

- $3,000 grant to the Wiconisco Creek Restoration Association from the Schuylkill County Commissioners through the county's share of Act 101 landfill fees.

Public Outreach

Watershed Notebooks

DEP's website has a watershed notebook for each of its 104 State Water Plan watersheds. Each notebook provides a brief description of the watershed with supporting data and information on agency and citizen group activities. Each notebook is organized to allow networking by watershed groups and others by providing access to send and post information about projects and activities underway in the watershed. This WRAS will be posted in the watershed notebook to allow for public comment and update. The notebooks also link to the Department's Watershed Idea Exchange, an open forum to discuss watershed issues. The website is www.dep.state.pa.us. Choose Subjects/Water Management/Watershed Conservation/Watershed and Nonpoint Source Management/Watershed Notebooks.

Citizen/Conservation groups:

- Alliance for the Chesapeake Bay
- Chesapeake Bay Foundation
- Wiconisco Creek Restoration Association has been actively working to improve water quality in Wiconisco Creek watershed since 1997. They are partnering with the Dauphin and Schuylkill County Conservation Districts on grant projects for water quality improvement.
- EASI-Mechanicsburg Chapter
- Powell and Armstrong Creeks Watershed Association

Funding Needs

The total needed dollars for addressing all nonpoint source problems in the watershed is undetermined at this time and will be so until TMDL's are developed for the watershed. Existing programs that address nonpoint source issues in the watershed will continue to move forward. TMDL's were developed for Hans Yost Creek, North Branch Mahantango Creek and Rausch Creek, tributaries of East Mahantango Creek, and Bear Creek, a tributary of Wiconisco Creek in December 2000.

Pennsylvania has developed a Unified Watershed Assessment to identify priority watersheds needing restoration. Pennsylvania has worked cooperatively with agencies, organizations and the public to define watershed restoration priorities. The Commonwealth initiated a public participation process for the unified assessment and procedures for setting watershed priorities. Pennsylvania's assessment process was published in the *Pennsylvania Bulletin, DEP Update* publication and World Wide Web site. It was sent to the Department's list of watershed groups, monitoring groups, and Nonpoint Source Program mailing list. Department staff engaged in a significant outreach effort which included 23 additional events to solicit public comment. The Department received 23 written comments from a variety of agencies, conservation districts and watershed groups. Pennsylvania is committed to expanding and improving this process in the future. After development of the initial WRAS a public participation process will take place to incorporate public input into expanding and "fine tuning" the WRAS for direction on use of 319 grant funds beyond FY2000.

The DEP Chesapeake Bay program estimated the following agricultural BMPs are needed in subbasin 06C:

- $257,200 in 1988 dollars for West Mahantango Creek watershed in Perry County for agricultural best management practices (BMPs) such as strip cropping, diversions, waterways, fencing, agricultural waste management/ feedlot management, and spring development. The main stem is unimpaired; however, BMPs are needed on portions of most tributaries.
- $3.23 million in 1989 dollars for agricultural BMPs such as strip cropping, terraces, diversions, waterway systems, and stream protection in main stem Wiconisco Creek watershed and several unnamed tributaries (UNTs) and Little Wiconisco Creek and UNTs, and in main stem East Mahantango Creek, Little Mahantango Creek, and portions of their UNTs.

The SRBC report on Wiconisco Creek watershed recommended the following:

- Agricultural BMPs to reduce farm runoff. Implementation of BMPs would reduce nitrogen by about 613 thousand pounds per year and phosphorus by 13 thousand pounds per year.
- AMD treatment: a constructed wetland on the alkaline, high iron discharge to Bear Creek, settling ponds for the Big Lick discharge, sand dosing in Rattling Run, and a vertical flow wetland for the Porter Tunnel.

The Dauphin County Conservation District (DCCD) has partnered with a variety of local groups, state and federal agencies, municipalities, and schools to restore the water quality in the upper portion of Wiconisco Creek watershed.

One project underway is the operation and maintenance of a limestone diversion well on the Porter Tunnel Mine discharge. The well helps neutralize acid mine drainage from the tunnel that discharges into Wiconisco Creek. DCCD and the Wiconisco Creek Restoration Association are in the early stages of monitoring chemical water quality and stream flow on the tunnel discharge and the main stem upstream and downstream of the discharge and water quality and flow of the Big Lick Tunnel discharge. The information will be used to establish a database that can be used to build public awareness of local resource issues and use towards future restoration grants. The data collected so far indicate that the pH is usually around 3.1 and the average flow is 1500 gallons per minute; acidity is 118 mg/l, iron is 21 mg/l, and aluminum is 5 mg/l. The Porter Tunnel discharge contributes about 330 pounds of iron and 91 pounds of aluminum to main stem Wiconisco Creek and causes the pH to drop from 5.5 to 3.4.

The DCCD have started limestone sand treatment of the West Branch Rattling Creek to neutralize acidic conditions resulting from a combination of naturally acidic geology and acid precipitation. DCCD is monitoring the stream flow, chemical water quality, and aquatic insect and fish communities in Rattling Creek watershed to determine the effectiveness of the limestone sand as a management tool for raising stream pH and alkalinity and restoring the aquatic communities. The sand is raising the pH slightly over one unit from the lower 4's to the mid-5's.

Other areas in need of AG remediation BMPs:

- Armstrong Creek: portions of main stem and UNTs
- Powell Creek: About one mile of main stem

Total Maximum Daily Loads (TMDL's)

TMDL's identify the amount of a pollutant that a stream or lake can assimilate without violating its water quality standards. TMDL's are calculated to include a margin of safety to protect against a mathematical or data error. TMDL's are set for each pollutant causing impairment.

TMDL for Hans Yost Creek:

Hans Yost Creek in the Deep Creek watershed drains part of a steep valley between Broad Mountain and Mahantango Mountain in the Southern Anthracite Coalfield of eastern Pennsylvania. Several active remining permits are located in the watershed; however, none of the operators have responsibility for the discharges on their permits because all the discharges were abandoned before active remining began. Existing DEP regulations state that remining permit operators are not responsible for prexisting discharges within their permit areas as long as the discharges do not become worse during the course of remining activities.

Hans Yost Creek is on the 303d list for impairment by low pH due to abandoned mine drainage (AMD). Two high gradient abandoned mine discharges adversely impact Hans Yost Creek, the Moser Mine Pool Discharge, which enters Hans Yost Creek in its headwaters, and a discharge locally called Rattling Run, which is the combination of at least two abandoned mine discharges, Collapsed Tunnel Discharge and Buck Mountain Vein Overflow Discharge, and drains into Hans Yost Creek in its lower reaches.

Hans Yost Creek was placed on the 303d list of impaired waters based on a 1997 investigation conducted as part of the Department 's Unassessed Waters Program that found that the entire length was impaired by low pH from abandoned mine drainage.

The TMDL was developed using the EPA national acute fish and aquatic life criterion for aluminum value of 0.75 mg/l as the instream criterion for aluminum. The current Pennsylvania aluminum criterion in Chapter 93 is 0.1 mg/l of the 96 hour LC-50. The EPA national criterion was substituted for the PA criterion for the TMDL loading calculations.

Applicable Water Quality Criteria			
Parameter	**Criterion Value (mg/l)**	**Duration**	**Total Recoverable/ Dissolved**
Aluminum	0.1 Of the 96 hour LC 50 0.75	Maximum one hour	Total recoverable
Iron	1.50 0.3	1 day average maximum	Total recoverable dissolved
Manganese	1.00	Maximum	Total recoverable
pH	6 to 9	At all times	NA

Flow Determination for Loading Points in Hans Yost Creek Watershed				
Point Identification	**Average Flow (MGD)**	**Determination Method**	**Number of Samples**	**Date Range**
HY1 (above Moser Discharge)	0.26	50% of HY2		
Moser Discharge	0.26	50% of HY2		
HY2 (below Moser Discharge)	0.52	Unit Area Method		
HY3 (above Rattling Run)	1.49	Avg. of Available Data	6	1992
Buck Mountain Discharge	0.17	Avg. of Available Data	26	1992-1999
HY4 (below Rattling Run)	3.59	Avg. of Available Data	6	1992

Allowable long-term average instream concentrations were determined for the 4 sampling points on Hans Yost Creek and the 2 discharges to produce a long-term average value that would be protective of water quality criterion for that parameter 99% of the time.

TMDL for Hans Yost Creek						
		Measured Sample Data		**Allowable**		
Station	**Parameter**	**Conc (mg/l)**	**Load (lbs/day)**	**LTA Conc (mg/l)**	**Load (lbs/day)**	**% Reduction**
Instream Monitoring Point HY1 (Headwaters of Hans Yost Creek)						
	Fe	0.56	1.2	0.35	0.8	38
	Mn	0.54	1.2	0.32	0.7	40
	Al	No data available.				-
	Acid	7.88	17.1	0	0	100

	Alkalinity	No data available.				
Moser Discharge						
	Fe	1.54	3.3	0.46	1.0	70
	Mn	0.77	1.7	0.55	1.2	28
	Al	No data available.				-
	Acid	10.62	23.0	0	0	100
	Alkalinity	No data available.				
Instream monitoring point HY2 (Hans Yost Creek Downstream of Moser Mine Discharge)						
	Fe	1.05	4.6	0.30	1.3	32
	Mn	0.53	2.3	0.39	1.7	0
	Al	No data available.				-
	Acid	9.13	39.6	0	0	0
	Alkalinity	No data available.				
Instream monitoring point HY3 (Hans Yost Creek Upstream of Rattling Run)						
	Fe	15.22	189.1	0.46	5.7	97
	Mn	1.78	22.1	0.29	3.6	84
	Al	2.07	25.7	0.23	2.8	90
	Acid	5.62	69.8	0	0	100
	Alkalinity	1.80	22.4			
Buck Mountain Discharge						
	Fe	0.17	0.2	0.16	0.2	0
	Mn	0.27	0.4	0.27	0.4	0
	Al	1.66	2.4	0.35	0.5	79
	Acid	21.24	30.1	0	0	100
	Alkalinity	1.72	2.4			
Instream monitoring point HY4 (Hans Yost Creek near Confluence with Deep Creek)						
	Fe	2.68	80.3	0.35	10.4	0
	Mn	1.11	33.1	0.16	4.8	68
	Al	3.77	112.8	0.15	4.5	95
	Acid	12.05	360.8	0	0	100
	Alkalinity	8.87	265.5			

Additional information and loadings calculations can be found in the Draft TMDL on the Department's website at http://www.dep.state.pa.us/, choose directLINK, TMDL, Hans Yost Creek.

The Tri-Valley Watershed Association is a local group interested in the water quality of the Deep Creek, Pine Creek, and Mahantango Creek watersheds. They received a small grant from Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) for limestone treatment of the Moser Mine Pool discharge to increase the alkalinity in the upper portions of the Hans Yost Creek watershed. They are considering options for treatment of lower Hans Yost Creek.

TMDL for Bear Creek Watershed:
Bear Creek is a tributary of Wiconisco Creek in upper Dauphin County. The watershed was heavily mined through the late 19th and early 20th centuries and is characterized by deep underground tunnel systems extending for miles. After the mine workings were abandoned, the tunnels filled with water and surface discharges formed. Many of these discharges are very large and are responsible for much of the

water quality impairment in the region. Studies by the Department indicated that Bear Creek supports little aquatic life due to the iron hydroxide covering the substrate and that no fish were present in Bear Creek.

Bear Creek originates between Bear and Big Lick Mountains in Bear Creek Swamp, which forms the eastern branch of Bear Creek and joins downstream with a small, unnamed tributary. Even though no discharges were documented in the headwaters, the pH is lower and metals concentrations are higher than what would be expected for background conditions.

The Lykens Water Level Drift Tunnel is the most upstream discharge into Bear Creek. This acidic discharge often makes up a large portion of the instream flow for Bear Creek and causes Bear Creek to become more acidic. The next discharge, the Lykens-Williamstown Drift, is alkaline. The drift opening is close to three smaller seeps located farther downstream on the banks of Bear Creek. Historical documents stated that another drift opening once existed, but that opening has been covered with fill material and now seeps to the surface elsewhere. All four discharges are alkaline and have similar chemical characteristics and were, therefore, addressed together in the TMDL.

The alkaline discharges help neutralize acidity from the Lykens Water Level Drift Tunnel discharge and also provide enough residual alkalinity to neutralize much of the acid load in Wiconisco Creek. The discharges contain large loads of iron, which precipitates onto the streambed and hinders the colonization of macroinvertebrates in the lower reaches of Bear Creek and also immediately downstream of Bear Creek in the Wiconisco Creek. The lower reaches of Bear Creek also contain a discharge from the Wiconisco Borough sewage treatment plant.

The TMDL addresses loadings for acidity, iron, manganese, and aluminum for three locations in Bear Creek and one major acidic discharge and the combined alkaline discharges. The TMDL focuses remediation efforts on the identified numerical reduction targets for the watershed. End points used in calculations were the same as those described above in the TMDL for Hans Yost Creek. The Table below presents the estimated reductions identified for all points in the Bear Creek watershed.

TMDL for Bear Creek Watershed						
Station	**Parameter**	**Measured Sample Data**		**Allowable**		**Reduction Identified**
		Conc (mg/l)	**Load (lb/day)**	**LTA Conc (mg/l)**	**Load (lb/day)**	**%**
B1	**Bear Creek Headwaters (Average Flow=1.17 MGD)**					
	Fe	1.94	18.9	0.15	1.5	93
	Mn	0.21	2.0	0.21	2.0	0
	Al	0.35	3.4	0.15	1.5	57
	Acidity	8.73	85.2	0.35	3.4	96
	Alkalinity	1.98	19.3			
Lykens	**Lykens-Water Level Drift Acidic Discharge (Average Flow=2.8 MGD)**					
	Fe	11.35	111.7	0.67	6.6	94
	Mn	0.78	7.7	0.78	7.7	0
	Al	0.48	4.7	0.35	3.4	26
	Acidity	45.43	447.1	0.46	4.5	99
	Alkalinity	0.92	9.1			

Alkaline	**Lykens-Williamstown Discharge and Other Alkaline Discharges (Average Flow=1.18 MGD)**					
Discharges	Fe	13.26	309.6	0.27	6.3	98
	Mn	2.22	51.8	0.84	19.6	62
	Al	<0.2	-	-	-	0
	Acidity	1.67	39.0	0.13	3.0	92
	Alkalinity	117.11	2734.8			
B2	**Bear Creek Downstream of the Alkaline Discharges (Average Flow=2.93 MGD)**					
	Fe	12.17	297.4	0.85	20.8	0
	Mn	1.44	35.2	0.59	14.4	0
	Al	0.15	3.7	0.15	3.7	0
	Acidity	29.45	719.6	0.24	5.9	97
	Alkalinity	66.67	1629.2			
B3	**Bear Creek at mouth (Average Flow=6.68 MGD)**					
	Fe	11.76	655.2	0.71	39.6	90
	Mn	1.55	86.4	0.43	24.0	64
	Al	0.51	28.4	0.19	10.6	63
	Acidity	6.94	386.6	0.28	15.6	0
	Alkalinity	70.17	3909.3			

MGD= Million Gallons per Day

The Operation Scarlift Report published in the early 1970's recommended remediation of Bear Creek by backfilling surface mine pits and cropfalls at four different locations in the watershed. Backfilling would reduce infiltration of surface water into the underground mine pools and reduce the volume of water discharging from the pools. A series of three settling ponds was also recommended in the lower watershed. None of the recommendations were implemented. The proposed location for the settling ponds now contains a residential development and the borough of Wiconisco sewage treatment plant. The Dauphin County Conservation District (DCCD) received a Growing Greener Grant in December 2000 for backfilling some of the surface mine pits and cropfalls in the upper watershed.

A 1998 report by Hedin Environmental recommended a 30-acre wetland complex to treat the mine discharge to Bear Creek. A later report by Hedin Environmental gave three alternative treatment scenarios and cost estimates for remediation: collect and treat the drift opening discharges, collect and treat both the Lykens Water Level Tunnel and the drift discharges, and treat the Bear Creek stream flow. The U.S. Geological Survey (USGS) is monitoring chemical water quality in Bear Creek and the Lykens-Williamstown Mine discharge. The alkaline discharge contributes about 420 pounds of iron per day to the main stem Wiconisco Creek. The data will be used to design a wetland treatment system to reduce the iron loading in Bear Creek and main stem Wiconisco Creek. The DCCD and the Wiconisco Creek Watershed Association are pursuing funding for remediation of AMD in the watershed that should accomplish the reductions listed in the TMDL.

<u>TMDL for Rausch Creek</u>:
A TMDL was prepared for the Rausch Creek watershed to address impairments noted on the 1996 Pennsylvania 303d list. High levels of metals, and in some areas depressed pH, are the cause of the impairments. The East Branch of Rausch Creek is also impaired by excessive sediment contributions. All impairments resulted from acid mine drainage from abandoned coal mines and sedimentation from abandoned mine lands. The TMDL addresses pH and the three primary metals associated with acid mine drainage, iron, manganese, aluminum. A narrative qualitative discussion addresses the sedimentation problem in the East Branch of Rausch Creek.

The Rausch Creek is formed at the confluence of the East and West Branches and flows northerly through Bear Gap to Pine Creek. The West Branch of Rausch Creek flows east between Bear Mountain and Big Lick Mountain. The East Branch of Rausch Creek flows west between Good Springs Mountain and Big Lick Mountain. The principle source of water in the three branches of Rausch Creek is abandoned mine discharges. The rugged contours of the landscape make the watershed unsuitable for development and most suitable for mining, hunting and lumbering.

The watershed was extensively deep mined in the early 1900's and contains five large abandoned mine pools. The pools where formed when the deep mine collieries were abandoned and pumping ceased. The mines are separated from one another by barrier pillars (areas of unmined coal), which keep the mine pools largely segregated from one another. Surface mining of the coal seam outcrops prior to regulations increased the flow of water into the mine pools.

Mine pools in Rausch Creek watershed:

- The Williamstown-Lykens pool is located beneath the western end of the West Branch of Rausch Creek watershed but discharges to the southwest from the Big Lick Tunnel and flows into Wiconisco Creek.
- The Brookside Mine pool discharges into the West Branch of Rausch Creek at the Valley View Tunnel (2WBRC) at elevation 915 feet above sea level. Flows from the Brookside Pool range from 0.70 million gallons per day (mgd) to 5.20 mgd, averaging 2.84 mgd.
- The Markson Mine Pool discharges into Rausch Creek from the Markson Airway (1RC) at an elevation of 865 feet above sea level. Flows from the Markson Pool range from 1.21 mgd to 10.67 mgd; averaging 3.40 mgd.
- The Good Spring No. 1 Pool discharges into the East Branch of Rausch Creek from the Orchard Airway (3EBRC) at an elevation of 1,104 feet above sea level. Flows from the Orchard Airway range from 0.18 mgd to 1.27 mgd, averaging 0.32 mgd.
- The Good Spring No. 3 mine pool is located beneath the eastern end of the headwaters of the East Branch of Rausch Creek but discharges east through the Tracy Airway at an elevation of 1,155 feet above sea level into Good Spring Creek, a tributary of Swatara Creek.

A March 1969 report by the Anthracite Research and Development Company, Inc. recommended three potential approaches to abate the acid mine drainage contaminating Rausch Creek and receiving streams: individual treatment at the source, strategically located treatment units, and a single treatment plant north of Bear Gap prior to confluence of Rausch Creek with Pine Creek.

Although individual treatment of the sources of the acid water was economically feasible, operation, maintenance and control was considered physically more difficult than operation of a single treatment plant. Shock loading of the stream could also occur through temporary individual plant operation failure. The three major sources of abandoned discharges that totaled 62% of the total flow would also have to be addressed; therefore, the recommended best approach to treat the acid mine drainage polluting Rausch Creek was to treat the total flow at or immediately north of Bear Gap prior to mixing with Pine Creek.

Construction of the Rausch Creek Treatment Plant was completed in 1973. The plant is located on Rausch Creek approximately 0.8 miles upstream of the confluence with Pine Creek. The entire flow of Rausch Creek is intercepted and diverted into the treatment plant. The plant is capable of treating a maximum of 16 million gallons per day (mgd). When the flow is in excess of 16 mgd, the excess flow is neutralized with lime slurry and bypassed in the stream channel around the plant. Flows have exceeded 150 million gallons per day after periods of heavy rainfall.

Eight active mining operations are located in the Rausch Creek watershed, five of which do not have NPDES Permits or discharges. One operation has an NPDES Permit but has never had a discharge. Two of the operations are deep mines that regularly pump water out of the mine. All other discharges in the watershed are from abandoned mines and are treated as nonpoint sources. When there is no responsible party, the discharge is considered to be a nonpoint pollution source. Each segment on the 303d list is addressed as a separate TMDL and expressed as long-term, average loading. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations.

Remining operations in recent years have backfilled numerous abandoned surface mine pits and reduced the recharge to the mine pools. The DEP Bureau of Abandoned Mine Reclamation also backfilled a 44-acre site on the south side of Big Lick Mountain south of the East Branch through their Abandoned Mine Lands Program.

The East Branch Rausch Creek originates in the large abandoned surface mine area in the southeast area of the watershed. The entire watershed has been affected by mining and the upstream sampling point 3EBRC has acceptable pH values but no buffering capacity. Sampling point 5EBRC has pH's ranging from 4.5 to 6.8, the lowest in the East Branch.

The Orchard Airway (3EBRC) which discharges water from the Good Spring No.1 Mine Pool is the largest single source of acid mine drainage in the East Branch Rausch Creek watershed. Seven permitted mining operations are also located in the watershed; however, K & C Coal Company is the only operation with an NPDES Permit and an active discharge. The Harriman Coal Corporation, Good Spring South surface mine operation has an NPDES Permit but does not have an active discharge. The Harriman Coal Corporation; Good Spring West, Kocker Breaker, Markson and Shoener & Raub operations do not have NPDS Permits or active discharges. The Porter Associates Porter Mine is a fly ash surface mine backfilling operation that also does not have an active discharge.

The TMDL for East Branch Rausch Creek consists of a wasteload allocation for the K&C Coal Company discharge and a load allocation for the rest of the watershed above sampling point 5EBRC near the confluence with the West Branch. The K & C discharge results from pumping water from the deep mine to their treatment pond when necessary and, therefore, is not continuous point source. The wasteload allocation (WLA) for the K&C discharge is a daily loading value based on current permit requirements.

The West Branch Rausch Creek originates in a swamp on Pennsylvania State Game Lands and flows 3.53 miles to its confluence with the East Branch. Abandoned small deep and surface mines line the mountainside slopes north and south of the West Branch. Only a small percentage of the surface mines have been reclaimed. The Valley View Tunnel (2WBRC) which discharges water from the Brookside Mine Pool is the largest single source of acid mine drainage in the watershed.

E and E Fuels has a permitted discharged (1WBRC) to the West Branch Rausch Creek under Permit No.54901302 that is associated with deep mining permit. The discharge is not continuous; flow results from pumping water from the deep mine to the treatment pond as necessary.

The TMDL for West Branch Rausch Creek consists of a wasteload allocation to the E&E Fuels discharge and a load allocation to all of the area above sampling point 3WBRC. Sampling point 3WBRC is just upstream of the confluence with East Branch and includes all the mining impacts for the entire upstream watershed. The wasteload allocation (WLA) for the E&E discharge is a daily loading value based on their current permit requirements. This WLA reserves a portion of the allowable load determined for point 3WBRC for allocation to this discharge.

The load allocation for was computed using water quality sample data collected at 3WBRC. Instream flow measurements were not available; therefore, flow was estimated using the unit-area hydrology from a known point (2RC) on Rausch Creek. The estimated average flow of 4.1 mgd was used for these calculations.

Main stem Rausch Creek is formed at the confluence of the East and West Branches of Rausch Creek and flows north through Bear Gap a distance of 1.66 miles to Pine Creek. Steep slopes with several abandoned deep mine openings line both banks of the creek in Bear Gap. The Markson Airway (1RC) which discharges water from the Markson Mine pool is the largest source of water / acid mine drainage in the Rausch Creek watershed. The Rausch Creek AMD Treatment plant is located approximately 0.86 miles downstream on Rausch Creek.

The TMDL for Rausch Creek consists of a load allocation to all of the area above sampling point 2RC. The load allocation was computed using water quality sample data collected at the treatment plant intake (2RC). An average flow of 8.7 mgd was used for these calculations.

Rausch Creek Watershed Allowable Loads						
		Measured Sample Data		Allowable		Reduction Identified
Station	Parameter	Conc (mg/l)	Load (lbs/day)	LTA Conc (mg/l)	Load (lbs/day)	%
5EBRC	In stream monitoring point located on East Branch Rausch Creek					
	Al	3.1	39.4	0.16	2.0	95%
	Fe	4.4	55.0	0.26	3.3	94%
	Mn	2.6	32.7	0.57	7.2	78%
	Acidity	10.7	133.4	1.70	21.3	84%
3WBRC	In stream monitoring point located on West Branch Rausch Creek					
	Al	0.2	8.0	0.17	5.7	28%
	Fe	15.1	517.7	0.91	31.1	94%
	Mn	1.6	55.4	0.73	24.9	55%
2RC	Monitoring point located on Rausch Creek (Treatment Plant Intake)					
	Al	1.3	16.6	0.23	2.8	83%
	Fe	12.3	153.6	0.98	12.3	92%
	Mn	3.0	37.3	0.66	8.2	78%
	Acidity	21.7	271.0	1.95	24.4	91%

The goal of any reclamation project in the watershed should be to reduce the amount of surface recharge into the mine pools. Backfilling abandoned surface mine pits, deep mines and crop falls to approximate original contours with drainage ditches and vegetation will divert surface runoff back into the stream channels and help to dilute the affects of the acid mine drainage reaching the stream.

Remining of previously mined areas by the coal mining industry would also benefit remediation. Considering the extensive coal reserves in the watershed a large surface mining operation could daylight and all or backfill portions of a mine pool, thereby reducing or eliminating the mine pool discharge. Projects to take advantage of the Rausch Creek AMD Treatment plant by reducing the effects of acid mine drainage in adjacent watersheds should also be undertaken.

Some of these practices have already been implemented. The Bureau of Abandoned Mine Reclamation, backfilled surface mines and deep mine openings in the East Branch of Rausch Creek through the

Abandoned Mine Lands Program. Forty-four acres containing pre-act deep mine openings, and surface mine pits were filled in, graded and vegetated and are now grassland.

The Rausch Creek watershed is unique because of the abandoned mine pool outflows contribute such a large percentage of the total watershed flow and the Rausch Creek AMD Treatment Plant was constructed to treat that flow. The treatment plant was constructed as the best option for treatment of the mine drainage problems in the watershed. The treatment plant has been successful in decreasing the pollution load coming from the watershed. Using the average values for the treatment plant effluent (3RC) and flow taken at the plant inlet (2RC) the loads leaving the plant can be computed and compared to the TMDL values computed at point 2RC.

Treatment Plant Efficiency (3RC)					
Parameter	Influent Load	Effluent Load	Allowable Load	Current % Reduction	% Reduction
Aluminum	96.6	20.5	16.4	79%	83%
Iron	890.8	45.4	71.3	95%	92%
Manganese	216.4	75.6	47.6	65%	78%
Acidity	1571.9	2.0	141.5	100%	91%

The treatment plant is currently meeting the TMDL objectives for iron and acidity. The removal of aluminum is very near the TMDL objective and the manganese removal is substantial but needs to be improved to meet the objective.

Funds to upgrade the Rausch Creek AMD Treatment Plant have been approved. The upgrades are intended to increase the hydraulic capacity and efficiency of the plant, which will assist in meeting the remediation standards and enable additional mine water from adjacent watersheds to be diverted and treated.

Additional information, loadings calculations and maps of locations can be found in the Draft TMDL on the Department's website at http://www.dep.state.pa.us/, choose directLINK, TMDL, Rausch Creek.

TMDL for North Branch Mahantango Creek:
A TMDL was developed to addresses a segment of the North Branch Mahantango Creek on the 1996 and 1998 303d lists for impairment by organic enrichment and low dissolved oxygen (DO) from agricultural sources. The designated use for the main stem North Branch Mahantango Creek in the Department's Chapter 93 is trout stocking. The primary land use in the watershed is agriculture, with areas of row crops and pasturelands that are directly adjacent to the stream banks. Livestock have free access to the stream. Excessive sedimentation and nutrients often characterize impairments caused by organic enrichment from agriculture; therefore, the TMDL addresses sediment and nutrient pollution.

A 1992 aquatic investigation by the Department identified degradation due to agricultural activities, notably livestock herds with free access to the stream. Livestock herds cause severe streambank erosion and are the source of phosphorus and sediments in the impaired stream segments. The survey also indicated the majority of the stream had no protected riparian zone. DEP biologists concluded that water quality would remain poor until buffer zones are established to protect the streams.

A DEP follow-up survey in 1997 survey indicated that sedimentation and manure continued to be a problem. Manure deposited in the streambed degrades the habitat for macroinvertebrates and adds nutrients that cause algae blooms. A site visit conducted by the Department in September 2000 confirmed that the stream still had no protected riparian zone.

Phosphorus is generally held to be the limiting nutrient in a water body when the nitrogen (N) to phosphorus (P) ratio exceeds 10/1. The N/P ratio on the North Branch Mahantango Creek is 18/1; therefore, the nutrient portion of the TMDL addresses phosphorus. Pennsylvania does not have water quality criteria for sediment or phosphorus; therefore, a reference watershed approach was used to determine the TMDL endpoints for the impaired uses. The endpoints for phosphorus and sediment are allowable loads that have been shown to meet water quality objectives in a reference watershed. The approach uses a generalized watershed loading function (GWLF) computer model to compare loads in the impaired and a reference watershed. The reference watershed was a portion of the North Branch Mahantango Creek that has similar land use and geology characteristics as the impaired segment. Existing conditions for nitrogen, phosphorus, and sediment loads were estimated with GWLF for the impaired and reference portions of the North Branch Mahantango Creek watershed.

Reference Watershed Comparisons

North Branch Mahantango Creek	Acres	Sediment lb/yr/acre	Total N lb/yr/acre	Total P lb/yr/acre
Reference Segment	3205	708	8.99	0.44
Impaired Segment	3195	928	10.03	0.57

TMDL Endpoints for the North Branch Mahantango Creek Watershed

Pollutant	Allowable Pollutant Load lb/yr	Load Allocation lb/yr	Waste Load Allocation lb/yr	Margin of Safety lb/yr
Sediment	2261234	2035111	0	226123
Phosphorus	1414	1273	0	141

The TMDL establishes agricultural nonpoint source load allocations (LAs), with 10% reserve for a margin of safety (MOS) for the total watershed. No waste load allocations (WLAs) were calculated for point sources of phosphorus and sediments, because there are no point source dischargers in the impaired portion of the watershed. Livestock farming is the major source of phosphorus and sediments.

TMDL Computation

Pollutant	Area Loading Rate in Reference Watershed (lbs/acre/year)	Total Watershed Area in North Branch Mahantango Creek (acres)	TMDL Value (lbs/year)
Phosphorus	0.44	3195	1414
Sediment	708	3195	2261234

TMDL's for North Branch Mahantango Creek Watershed

Pollutant	Allowable Pollutant Load (lbs/yr)	LA (lbs/yr)	WLA (lbs/yr)	MOS (lbs/yr
Sediment	2261234	2035111	0	226123
Phosphorus	1414	1273	0	141

The pollutant reductions in the TMDL are allocated entirely to agricultural activities in the watershed. Implementation of agricultural best management practices (BMPs) in the affected areas should achieve the loading reduction goals established in the TMDL. Substantial reductions in the amount of sediment reaching the streams can be made through the planting of riparian buffer zones, contour strips, and cover crops, which range in efficiency from 20% to 70% for sediment reduction. Implementation of BMPs

aimed at sediment reduction will also help reduce phosphorus. Additional phosphorus reductions can be achieved through the installation of more effective animal waste management systems. Other possible BMPs for attaining the desired reductions in phosphorus and sediment include streambank stabilization and fencing. A field investigation will be conducted to assess the extent of existing BMPs, and to determine the most cost effective and environmentally protective combination of BMPs required meeting the nutrient and sediment reductions outlined in this report.

Aquatic biota, water chemistry and bank stability monitoring will begin prior to the installation of BMPs. DEP will conduct follow-up assessments and determinations of stream recovery after BMPs have been implemented. Based on the results of follow-up analysis, additional BMPs may be necessary to further reduce pollutant loads and impairments.

Additional information and loadings calculations can be found in the Draft TMDL on the Department's website at http://www.dep.state.pa.us/, choose directLINK, TMDL, North Branch Mahantango Creek.

References/Sources of information

- State Water Plan, Subbasin 6, Lower Central Susquehanna River. Department of Environmental Protection, January 1980
- USGS Topographic Maps
- 319 project proposals and summaries
- DEP: Watershed Notebooks, Unified Assessment Document, and information from files and databases.
- Map of Draft Level III and IV Ecoregions of Pennsylvania and the Blue Ridge Mountains, Ridge and Valley, and Central Appalachians of EPA Regions III
- Water Quality and Biological Assessment of the Wiconisco Creek Watershed. Susquehanna River Basin Commission Publication #193, February 1998. Funded by US EPA through the Clean Water Act Section 104b3 grant.
- Lower Susquehanna River Basin Water Quality. PA Department of Environmental Resources, Publication #54, January 1980.
- Summary Report of Selected Agricultural Statistics from Published Watershed Assessment Reports in the Susquehanna and Potomac River basins. PA Department of Environmental Resources, Division of Chesapeake Bay and Agricultural Nonpoint Source Programs, 1990.
- Nitrate Reduction in the Armstrong Creek Basin. Susquehanna River Basin Commission Publication #169, January 1996.
- Draft Total Maximum Daily Load for Hans Yost Creek, North Branch Mahantango Creek, and Rausch Creek Watersheds. DEP. 2000.
- Dauphin County Conservation District Newsletters.

Streams in Subbasin 06C: 303d/304b Listings

Stream	**Stream Code**	**Drainage area square miles**	**Miles Attained**	**Miles Impaired**	**Causes/Sources/ *Comments***
1-**Susquehanna River**	06685		All UNTs		*Main stem unassessed*
2-**(West) Mahantango Creek** & 4 UNTs	17365	86.2	7.8		
3-West Branch Mahantango Creek	17427	46.9	15.51 main stem; 33.08, 30 UNTs	2.66 main stem; 3.41, 5 UNTs	Siltation from AG
4-Quaker Run & 6 UNTs	17460	4.57	8.26		
4-Leningers Run	17445	6.96	2.85 main stem; 8.89, 11 UNTs	2.10 main stem	Habitat alterations/ channelization
4-Dobson Run & 10 UNTs	17434	7.51	12.69		
3-North Branch Mahantango Creek	17370	37.1	11.72, main stem; 38.19, 34 UNTs	1.54, main stem	Organic enrichment/ low DO & siltation from AG *TMDL completed*
4-Potato Valley Run & one UNT	17408	3.52		6.18	Siltation from AG
4-Trout Valley Run	17385	6.74	2.97 main stem; 15.87, 18 UNTs	1.59 main stem	Siltation, nutrients, organic enrichment/low DO from AG
4-Aline Creek	17383	1.61	1.25 main stem; 0.65, one UNT	1.08 main stem	Siltation from AG and habitat modification
2-Boyers Run & one UNT	17360	1.63	5.16		
2-**(East) Mahantango Creek**	17117	164	36.57, main stem; 40.69, 56 UNTs	12.59, main stem; 25.94, 30 UNTs 4.65, 5 UNTs	Siltation from AG or Silvaculture Siltation from Vegetation removal & road runoff
3-Little Mahantango Creek & 21 UNTs	17295	15.1		30.89	Siltation from AG
3-**Pine Creek**	17208	76.8	6.89, main stem; 2.58, 30 UNTs	16.75, main stem; 0.04, one UNT	Siltation & low pH from AG & AMD

3-Rausch Creek	17266	9.55		1.69	Metals, siltation, low pH from AMD *TMDL completed*
4-East Branch Rausch Creek & one UNT	17268	3.99		3.82	Metals, pH, siltation from AMD *TMDL completed*
4-West Branch Rausch Creek	17267	4.78	3.57	3.59	Metals, siltation, pH from AMD *TMDL completed*
3-Deep Creek near Sacramento	17236	31.8	21.82 main stem; 16.0, 24 UNTs	0.83 main stem; 0.67, one UNT	Siltation from unknown source Siltation from AG & flow alterations
4-Hans Yost Creek	17259	3.52		3.36	Low pH from AMD *TMDL completed*
3-Snow Creek & 10 UNTs	17197	4.72	10.75		
3-Deep Creek at Pillow & 20 UNTs	17159	10.6	20.95		
2-Bargers Run & 18 UNTs	17082	13.0	22.63		
3-Spruce Run	17091	0.63	0.95		
4-"Toad Hollow"	17087	0.44	0.87		
2-Shippens Run & 5 UNTs	17070	2.37	6.05		
2-**Wiconisco Creek**	16895	116	24.14 man stem; 41.91, 46 UNTs	18.64 main stem; 7.88, 9 UNTs; 2.31, 2 UNTs; 1.58 2 UNTs	Metals, low pH, siltation from AMD Crop and grazing related AG Source unknown Siltation from Removal of vegetation & small residential development
3-Bear Creek & one UNT	17041	4.69		21.08	Metals from AMD *TMDL completed*
3-Rattling Creek	17015	19.5	2.23		*EV, source to confluence of East & West Branches;* *HQ-CWF, rest of basin*
4-East Branch Rattling Creek & 3 UNTs	17030	9.31	7.13		*EV*
4-Nine O'clock Run	17037	2.31			*HQ-CWF*
4-Stone Cabin Run & 3 UNTs	17031	2.06	3.84		*HQ-CWF*

3-West Branch Rattling Creek & one UNT	17016	9.14	6.25		*EV*
4-Wolf Run	17029	0.73	1.17		*HQ-CWF*
4-Mud Run	17027	1.10	1.48		*HQ-CWF*
4-Hawks Nest Run	17026		0.67		*HQ-CWF*
4-Shale Run	17023	1.40	2.53		*HQ-CWF*
4-Dry Run	17022	0.31	0.44		*HQ-CWF*
4-Doc Smith Run	17019	0.82	1.58		*HQ-CWF*
3-Big Run	17014	0.56			*Unassessed*
3-Canoe Gap Run	17009	0.82			*Unassessed*
3-Little Wiconisco Creek	16898	17.5	4.07 main stem; 2.09, 4 UNTs	9.28 main stem; 24.77, 33 UNTs	Siltation from Crop & grazing related AG
3-Hunters Run & 5 UNTs	16889	7.54	9.97		
3-Bucks Run	16880	4.06	0.61 main stem; 1.94, 3 UNTs	2.94 main stem; 3.08, 3 UNTs	Siltation and nutrients from small residential development
3-Gurdy Run & 10 UNTs	16862	5.13	11.56		
2-Armstrong Creek	16791	32.3	13.36 main stem; 37.69, 44 UNTs	3.55 main stem; 4.59, 6 UNTs	Siltation from AG
3-"Deep Hollow"	16855		3.70		
3-New England Run & 6 UNTs	16793	2.44	6.41		
2-Buffalo Creek & 6 UNTs	16772	2.61	7.76		
2-**Powell Creek**	16691	39.7	15.94, main stem; 33.11, 46 UNTs	0.91, main stem;	Siltation from AG
3-North Fork Powell Creek & 17 UNTs	16747	7.87	16.0		
3-South Fork Powell Creek & 3 UNTs	16739	6.80	12.20		
4-Smoke Hole Run	16742	1.40	1.68		

Streams are listed in order from upstream to downstream. A stream with the number 2 is a tributary to a number 1 stream, 3's are tributaries to 2's, etc. Susquehanna River=1.

UNT= Unnamed tributary. Totals include UNTs where indicated. AG= agriculture; AMD= Abandoned Mine Drainage.

HQ= High Quality, CWF= Cold Water Fishes, EV= Exceptional Value Classification in Chapter 93.