Poplar Run Watershed TMDL

(Monongahela River)
Fayette County, Pennsylvania

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

August 2018

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Poplar Run Watershed TMDL
Fayette County, Pennsylvania

Executive Summary

A Total Maximum Daily Load (TMDL) for siltation was developed to address impairments in the Poplar Run watershed, as noted in Pennsylvania's 2016 Integrated Water Quality Monitoring and Assessment Report (Integrated List), initially listed 2002 (Table 2.). The metals impairment, originating from Abandoned Mine Drainage (1996 and 2002), will not be addressed in this TMDL; metals reductions, related to AMD, are calculated through a different methodology. Poplar Run is a Coldwater Fishery (CWF) and a tributary of Indian Creek, the Youghiogheny River, and the greater Monongahela River Basin, Fayette County (Figure 1.). The impairments were documented during biological surveys of the aquatic life present in the watershed (1998 and 2002). Excessive siltation has been identified as the cause of benthic habitat impairment. This non-point source pollution was described in the 1998 bioassessment (page 8.) as influenced by land developed namely, but this TMDL will address loading from other land uses such as agricultural activities within the watershed.

Because Pennsylvania does not currently have water quality criteria for excessive siltation, a TMDL endpoint for sediment loading was identified using a reference watershed approach. Based on a comparison to similar, yet non-impaired CWF watershed, such as Laurel Run (tributary to Indian Creek; Figure 1.), the maximum sediment loading that should still allow water quality objectives to be met in the impaired segments of Poplar Run. Components of the TMDL are summarized below:

Table 1. Summary of TMDL for Poplar Run in lbs./yr. & lbs./day

Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	**496,631.1**	**4,966.3**	**49,663.1**	**442,001.7**	**3,200.0**	**438,801.7**

TMDL – Total Maximum Daily Load, WLA – Waste Load Allocation, MOS – Margin of Safety
LA – Load Allocation, LNR – Loads Not Reduced, ALA – Adjusted Load Allocation

The Poplar Run Sediment TMDL is allocated to nonpoint sources, with 10% of the TMDL reserved explicitly as a margin of safety (MOS). The waste load allocation (WLA) is that portion of the total load assigned to National Pollutant Discharge Elimination System (NPDES) permitted point source discharges. A search of the Pennsylvania Department of Environmental Protection's (Department), online, GIS database, EMAP, identified **no** known point source discharges within the Poplar Run. Despite this, an additional allocation of 1% of the TMDL was incorporated into the WLA as a bulk reserve to take in account the dynamic nature of future permit activity. The load allocation (LA) is that portion of the total load assigned to non-point sources, all sources other than NPDES permitted point sources. Loads not reduced (LNR) are the portion of the LA associated with non-point sources other than agricultural (croplands, hay/pasture), adjacent stream banks, and specifically, land development as noted in the original bioassessment, and is equal to the sum of forest and bare rock coverage. The adjusted load allocation (ALA) represents the remaining portion of the LA to be distributed among these sources using receiving load reductions. The TMDL developed for the sediment-impaired segments of Poplar Run established a **72.5%** reduction (79.4% for cropland and 60.8 for Hay/Pasture, Stream Banks, and Development) in the current sediment loading in Poplar Run (the equal percent reduction, i.e., the ALA divided by the summation of the baselines)

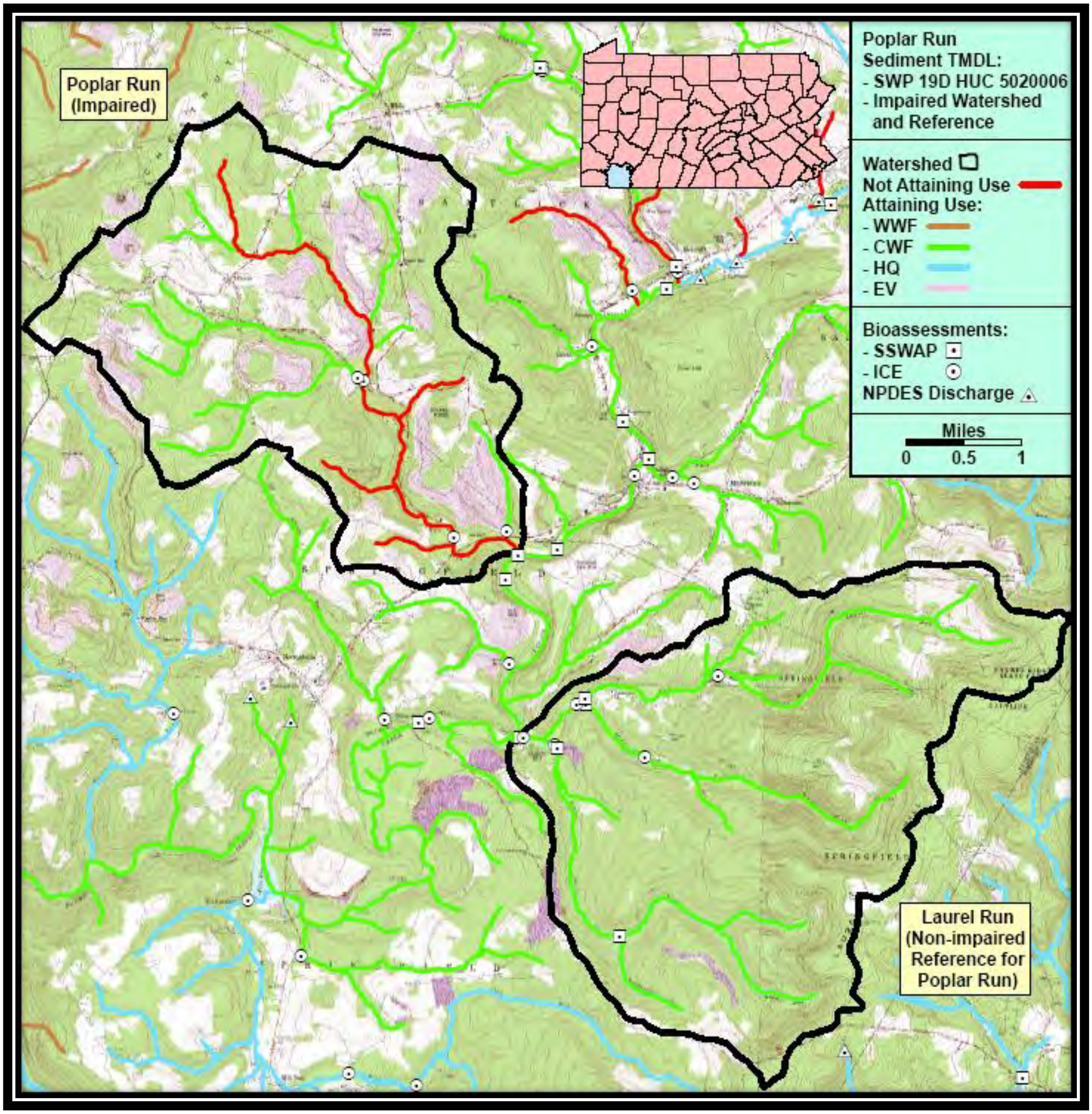

Figure 1. – Impaired CWF segments of Poplar Run and its non-impaired CWF, Laurel Run

Introduction

The Poplar Run watershed is currently considered a Cold-water Fishery (CFW), (PA Code 25 § 93.9o), § 93.4b(a). The designation of CWF provides for the maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold-water habitat. The stream originates on the western flank of the Chestnut Ridge, near the town of Clinton and flowing southeast to its confluence with Indian Creek, near the town of Roadside, Fayette County (Figure 1.). The headwaters of Poplar Run are not impaired until Newmyer Run (impaired) and is biologically impaired as a CWF for approximately 19.1 stream miles.

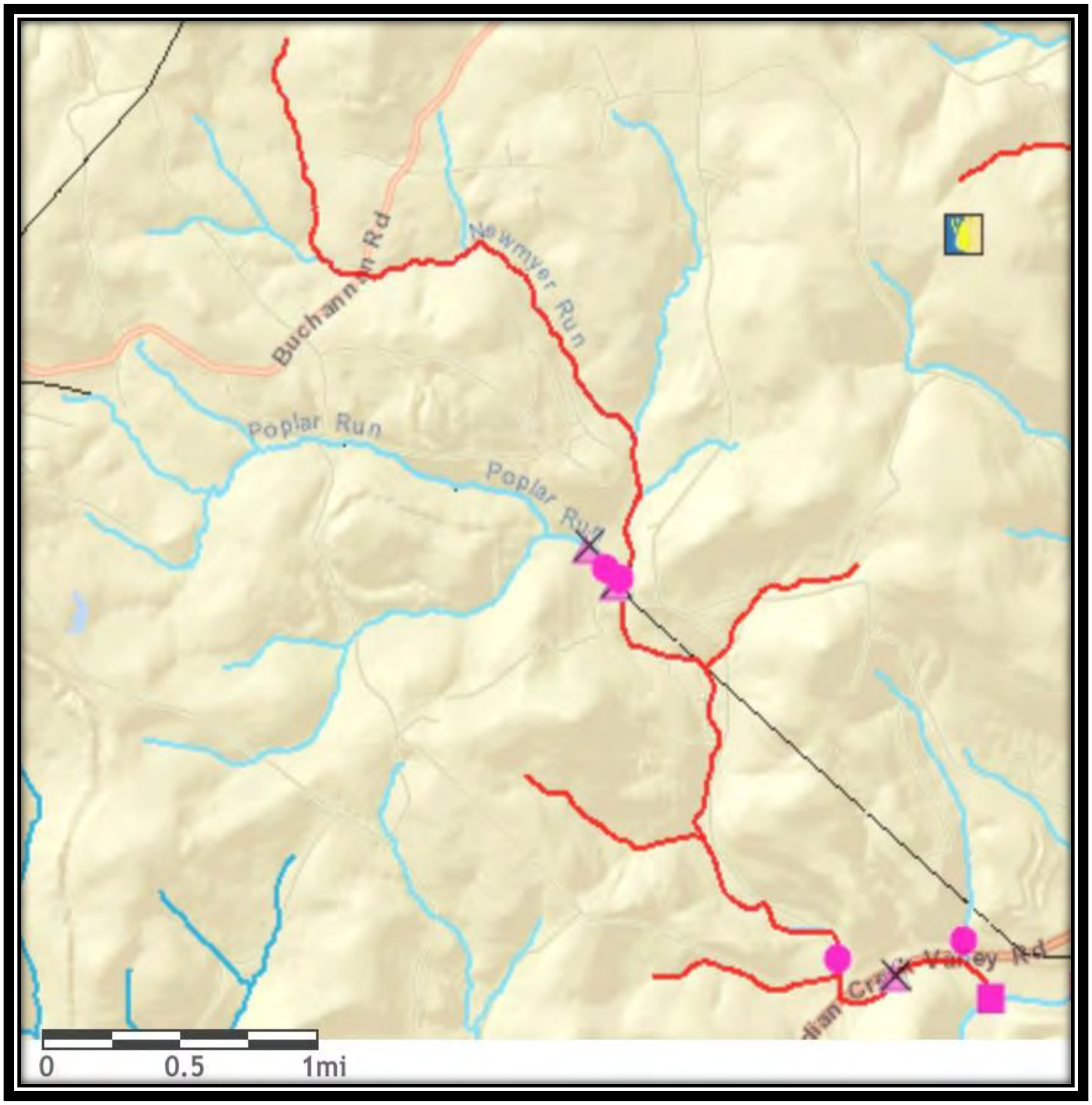

Figure 2. – Water Quality Uses and Bioassessment Sites on Poplar Run
(Light blue-CWF, red-impaired CWF, red polygons-bioassessment sites, X-fish stations)

Pennsylvania Department of Environmental Protection - Statewide Surface Waters Assessment Protocol (SSWAP)

Benthic macroinvertebrate sample summary

Station ID 19980727-1250-ALF
Stream Name Poplar Run (01184258) **Stream Code** 38302 **Strahler** 1
Survey ID 42341 **Sample Method** Kick Screen: Statewide Surface Water Assessment Program
Collection Date **Collection Time** **Latitude** 40.0178491 **Longitude** -79.4260217
HUC8 05020006 Youghiogheny

Station Location Comments
Left onto 711/381 North at Poplar Run 3rd crossing

Biology / Physical Habitat Comments
very little life in stream

Land Use Comments
Can hear bulldozers from stream-looks to be some new development

Impairment Status Comments
construction, tons of sediment in stream, otherwise habitat would be fine
also, probably receives effects of mining on Newmeyer Run

Taxa List

Taxa Name	Abundance Category	Abundance Range	PTV	FFG
Baetidae	Rare	<3	6	CG
Hydropsychidae	Rare	<3	5	FC
Cambaridae	Present	3-9	6	CG

SSWAP metrics and IBI

	Raw Metric Value	Standardized Metric Value
Total Richness	3	13.6
EPT Richness (PTV 0 - 4)	0	0.0
Beck's Index (version 3)	0	0.0
Hilsenhoff Biotic Index	5.80	56.7
Shannon Diversitiy	0.95	36.0
SSWAP IBI		21.3

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Pennsylvania Department of Environmental Protection - Statewide Surface Waters Assessment Protocol (SSWAP)

Benthic macroinvertebrate sample summary

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Collection Date **Collection Time** **Latitude** 40.0178491 **Longitude** -79.4260217
HUC8 05020006 Youghiogheny

1. Abundance obviously low		Y
2. Seven or fewer families		Y
3. Three or fewer mayfly individuals (exclude Baetidae, Caenidae, Siphlonuridae)		Y
4. Stoneflies collectively present	N	
5. Mayflies and caddisflies collectively abundant (exclude Baetidae, Caenidae, Siphlonuridae, Hydropsychidae, Polycentropidae)	N	
6. Jul - Sep: at least four EPT families with tolerance value of 4 or less Nov - May: at least six EPT families with tolerance value of 4 or less	N	
7. Four or more famlies with tolerance value of 3 or less	N	
8. Six or more families with tolerance value of 4 or less	N	
9. Dominant family with tolerance value of 4 or less	N	
10. Dominant family with tolerance value greater than 5 (criteria 7 and 8 negate this criterion)		N
11. Seven or more families with tolerance value of 6 or more (criteria 7 and 8 negate this criterion)		N
12. Sample dominated by families with a mean tolerance value of 5 or less	N	
13. Sample dominated by families with a mean tolerance value of 6 or more		N
14. Embeddedness (or substrate character for pool/glide) + sediment deposition = 24 or less (20 or less for warmwater, low gradient streams)		Y
15. Condition of banks + bank vegetation = 24 or less (20 or less for warmwater, low gradient streams)		N
16. Total habitat score 140 or less for forested, coldwater, high gradient streams (120 or less for warmwater, low gradient streams)		N
17a. Special conditions (attaining)	N	
17b. Special conditions (impaired)		N
17c. Special conditons description		

Not impaired N **Biology impaired** Y **Habitat impaired** N **Insufficient data** N
Rock pick influenced assessment N **Impact is localized** N **Re-evaluate designated use** N

Physical Habitat Assessment **Pool/Glide Assessment** N

Instream Cover	17	Substrate / Cover	0	Frequency of Riffles	15	Contition of Banks	15
Epifaunal Substrate	5	Velocity/Depth Regimes	17	Channel Sinuosity	15	Bank Vegetation	17
Embeddedness	10	Pool Variability	0	Channel Flow Status	15	Disruptive Pressure	12
Pool Substrate	0	Sediment Deposition	12	Channel Alteration	14	Riparian Zone	11

Instream Score 44 Riparian Score 43 **Total Score** 160

Field Measurements **Lab samples**

Temperature (°C)	18.9	Dissolved Oxygen (mg/L)	9.34	Flow (CFS)	0
pH	6.38	Alkalinity (mg/L as $CaCO_3$)		Conductivity	564

Use Assessment Status for Stream Reach **Designated Use** CWF **Existing Use**

Aquatic Life Impaired (980727-1250-ALF)
Abandoned Mine Drainage - Metals, Land Development - Siltation

Fish Consumption
Potable Water Supply
Recreation

TMDL Information (if any)

Begin Date **Meeting Date** **Draft Date** **End Date** **Final Date**

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Figure 2a. 1998 Water Quality Bioassessments - Poplar Run, mouth (Impaired)
Figure 2b. 2010 Water Quality Bioassessments - Poplar Run, mouth (Impaired)

Pennsylvania Department of Environmental Protection - Rapid Bioassessment Protocols

Benthic macroinvertebrate sample summary

Station ID 20100408-1300-kspyker PRM
Stream Name Poplar Run (01184258) **Stream Code** 38302 **Strahler** 1
Survey ID 60680 **Sample Method** 6-Dframe Composite, 200 subsample
Collection Date 20100408 **Collection Time** 1300 **Latitude** 40.0157724 **Longitude** -79.4154205
HUC8 05020006 Youghiogheny

Station Location Comments
PRM - poplar run mouth. Water sample 7485-984.

Biology / Habitat Comments

Land Use Comments

Station Impairment Status Comments

Taxa List # grids from first pan 28 # grids from second pan 0 Subsample Size 32

Taxa Name	Individuals	PTV	FFG	BCG Attribute (coldwater)	BCG Attribute (warmwater)	*any EV indicator taxa names are highlighted*
Maccaffertium	1	3	SC	3	3	
Ephemera	1	2	CG	3	2	
Leuctra	12	0	SH	2	2	
Chloroperlidae	1	0	PR	2	2	
Ceratopsyche	2	5	FC	4	4	
Cheumatopsyche	2	6	FC	5	5	
Pycnopsyche	1	4	SH	3	3	
Psephenus	1	4	SC	4	4	
Tipula	3	4	SH	5	5	
Chironomidae	2	6	CG	5	5	
Oligochaeta	1	10	CG	5	5	
Cambarus	2	6	CG	4	4	
Caecidotea	3	6	CG	5	5	

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Pennsylvania Department of Environmental Protection - Rapid Bioassessment Protocols

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Survey ID 60680 **Sample Method** 6-Dframe Composite, 200 subsample
Collection Date 20100408 **Collection Time** 1300 **Latitude** 40.0157724 **Longitude** -79.4154205
HUC8 05020006 Youghiogheny

Metrics and IBI scores * Highlighted colums indicate the appropriate metrics and IBI score to use.

Subsample out of range! Metrics and IBI scores MAY NOT BE VALID!

Metric Names	Raw Metric Values	Standardized Metric Values: Freestone Riffle-Run 6D200 2013 small	6D200 2013 large	2D100	Multihabitat Pool-Glide	Limestone 2009
Total Richness	13	39.4	41.9		41.9	72.2
Ephemeroptera Richness	2				33.3	
Trichoptera Richness	3				27.3	
EPT Richness	7			45.8	41.2	87.5
Trichoptera Richness (PTV 0-4)	1			27.8		
EPT Richness (PTV 0-4)	5	26.3	31.3			
Beck's Index (version 3)	7	18.4	31.8			
Beck's Index (version 4)	9			45.2	40.9	75.0
FC + PR + SH Richness	6			51.7		
Hilsenhoff Biotic Index	3.09	85.2	99.4	102.5		112.1
% Inolerant Individuals (PTV 0-3)	46.9	55.5	70.3			
% Tolerant Individuals (PTV 7-10)	3.1					98.4
Shannon Diversity	2.15	75.3	75.3		88.7	101.2
IBI score		50.0	58.3	54.1	45.5	88.8

% Ephemeroptera	6.3	% Ephemeroptera (PTV 0-4)	6.3	% Dominant Taxon	37.5	BCG Richness Ratio	0.63
% Plecoptera	40.6	Ephemeroptera Richness (PTV 0-4)	2	% Chironomidae	6.3	BCG Individuals Ratio	1.00
% Trichoptera	15.6	Plecoptera Richness	2	% Simuliidae	0.0	EV Indicator Taxa Richness	0

Not impaired N **Biology impaired** N **Habitat impaired** N **Insufficient data** Y
Rock pick influenced assessment N **Impact is localized** N **Re-evaluate designated use** N

Physical Habitat Assessment **Pool-Glide Assessment?** N

Instream Cover	15	Substrate / Cover	0	Frequency of Riffles	16	Contition of Banks	14
Epifaunal Substrate	15	Velocity/Depth Regimes	12	Channel Sinuosity	16	Bank Vegetation	14
Embeddedness	13	Pool Variability	0	Channel Flow Status	15	Disruptive Pressure	17
Pool Substrate	0	Sediment Deposition	13	Channel Alteration	16	Riparian Zone	17

Instream Score 56 Riparian Score 45 **Total Score** 177

Field Measurements **Lab samples**

Temperature (°C)	0	Dissolved Oxygen (mg/L)	0	Flow (CFS)	0
pH	0	Total Alkalinity (mg/L as $CaCO_3$)	0	Conductivity (uS/cm)	0

Use Assessment Status for Stream Reach **Designated Use** CWF **Existing Use**

Aquatic Life Impaired (980727-1250-ALF)
Abandoned Mine Drainage - Metals, Land Development - Siltation

Fish Consumption
Potable Water Supply
Recreation

TMDL Information (if any)

Begin Date **Meeting Date** **End Date** **Draft Date** **Final Date**

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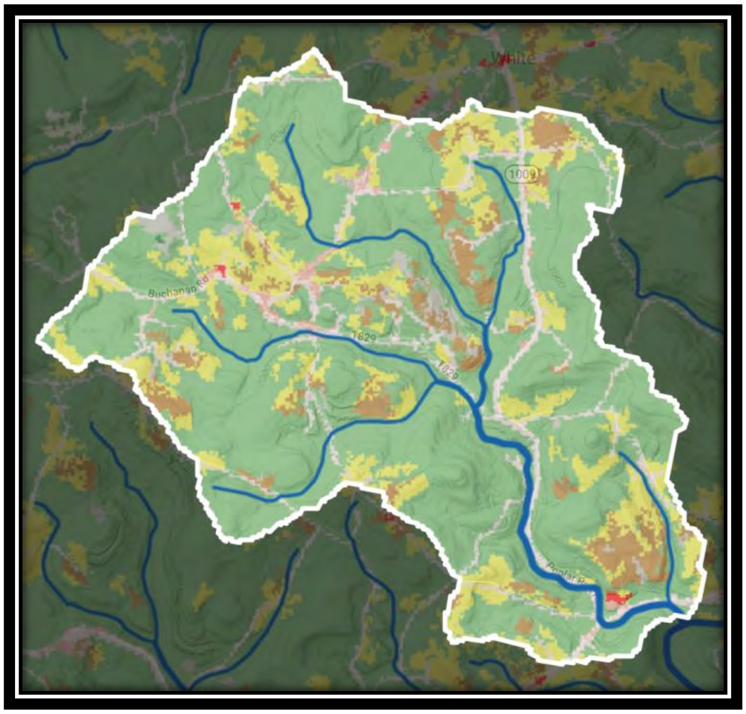
Geography of Poplar Run

This Total Maximum Daily Load (TMDL) calculation has been prepared for all sediment-impaired segments in the Poplar Run. The watershed is located in Saltlick and Springfield Townships, Fayette County. Poplar Run, including all its tributaries, encompasses approximately an area of approximately 10.0 square miles (6424.7 acres). Land use in this watershed is composed of agriculture (22.8%), including croplands and hay/pasture, forestland (67.5%), and other (9.7% open space, and development). (Figure 3a.). Laurel Run (Figure 3b.) will be further discussed later, under "***Selection of a Reference Watershed***".



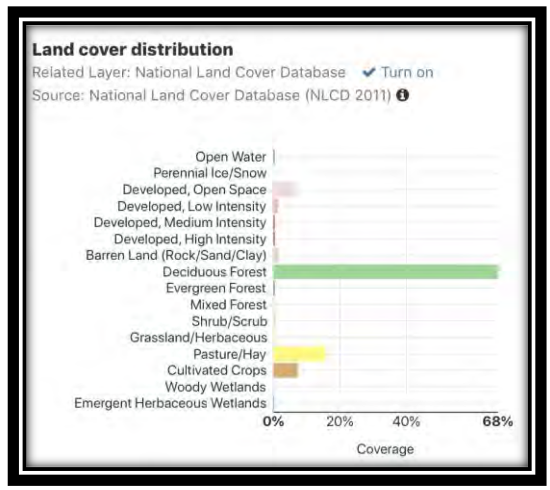
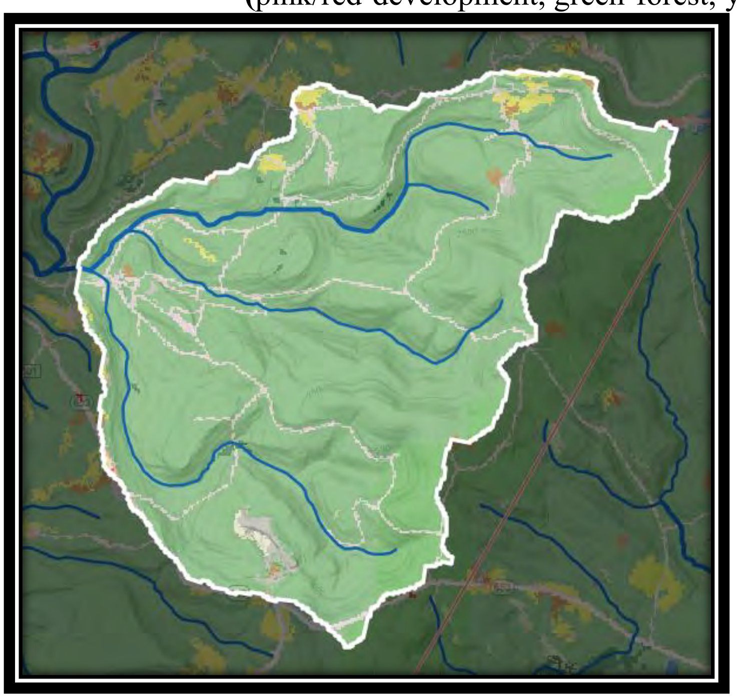
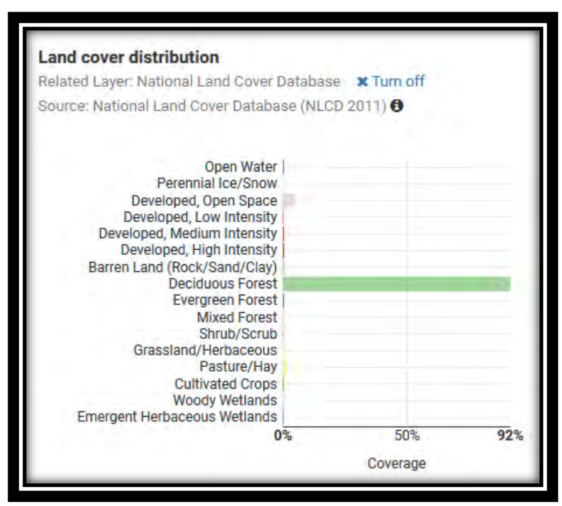


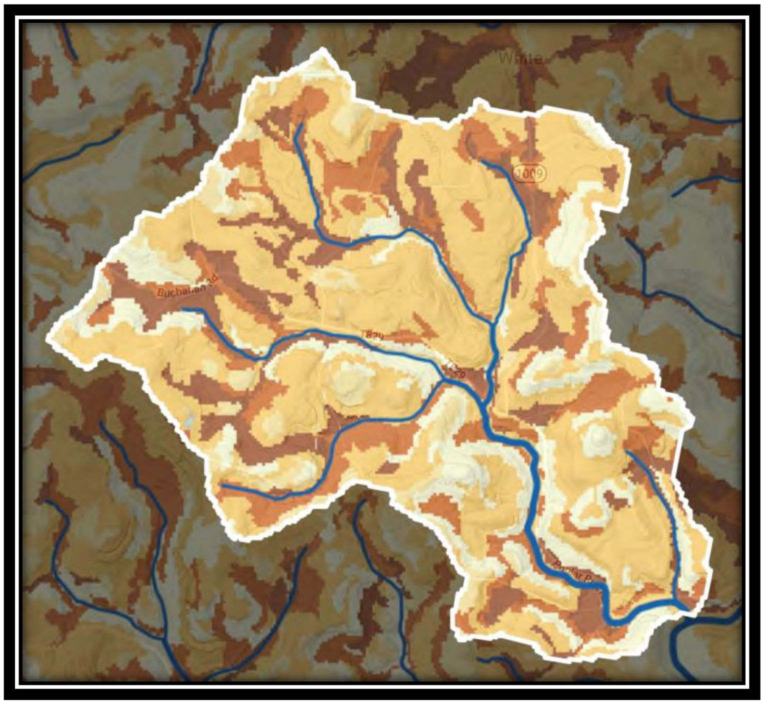
Figure 3a. and 3b., Comparison of land use distribution in Poplar Run and Laurel Run
(pink/red-development, green-forest, yellow-pasture/hay, brown-cropland**)**





Hydrologic Soils of Poplar Run

The soils of the Poplar Run watershed (Fig. 4a.) have a range of Hydrologic Soils Groups (HSG), but is dominated as by HSG C. HSG C soils generally have slow infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that moderately impedes downward movement of water and soils with moderately fine to fine structure. HSG C and D soils, being in stream valleys, have a high runoff potential and must be managed as such to minimize impairments to receiving waters. Laurel Run (Fig. 4b.) is dominated by HSG A, with high infiltration.



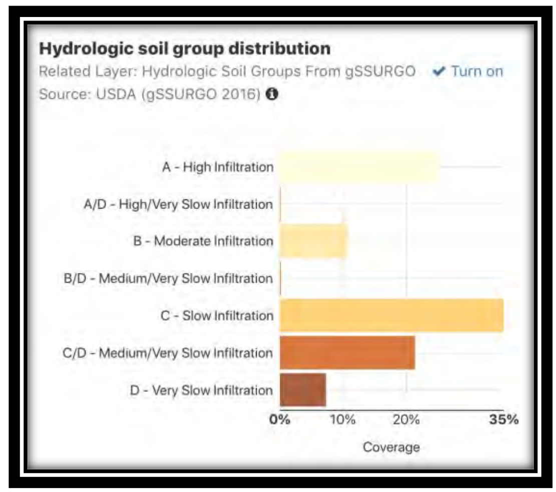
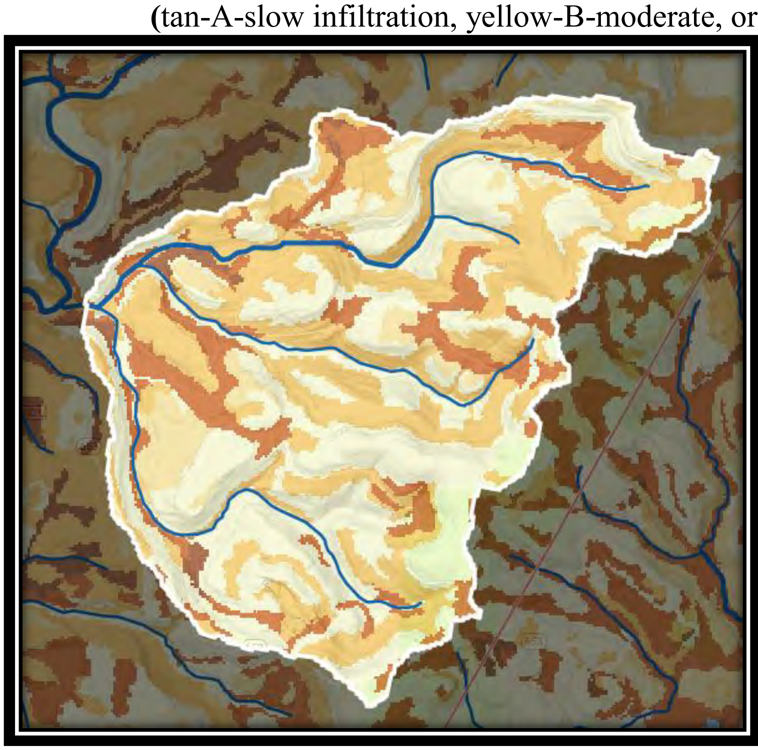
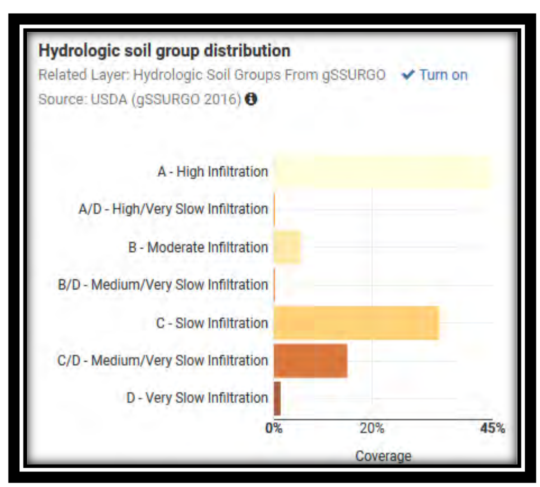


Figure 4a. and 4b., Comparison of soil distribution in Poplar Run and Laurel Run
(tan-A-slow infiltration, yellow-B-moderate, orange-C-slow, red-D-very slow infiltration**)**





Topography and Geology of Poplar Run

Poplar Run (Figure 5a.) and Laurel Run (Figure 5b.) are within the Appalachian Plateaus physiographic province of western PA with an elevation range of over 2,200 feet to less than 1380 feet.
The superficial geology is primarily interbedded sedimentary. Two major rock formations underlie the watersheds. The Glenshaw Formation (tan) consists of repeated sequences of sandstone, siltstone, shale, claystone (including red beds), limestone, and coal. The Allegheny Formation (green) is made up of primarily cyclic sequences of clay shale, claystone, siltstone, sandstone, limestone, and coal. The Pottsville Formation is mainly of well, to very well, cemented, medium-grained to conglomerate sandstone beds (ranging in thickness from about 10 to 70 feet), with minor amounts of siltstone, claystone, shale, and thin coals. The Mauch Chunk is found deeply cut into the ridges and is made up of grayish-red shale and siltstone, brown, gray, and white sandstone, and some conglomerate. Burgoon Sandstone is a cross bedded, quartzite sandstone with some conglomerate near its base.

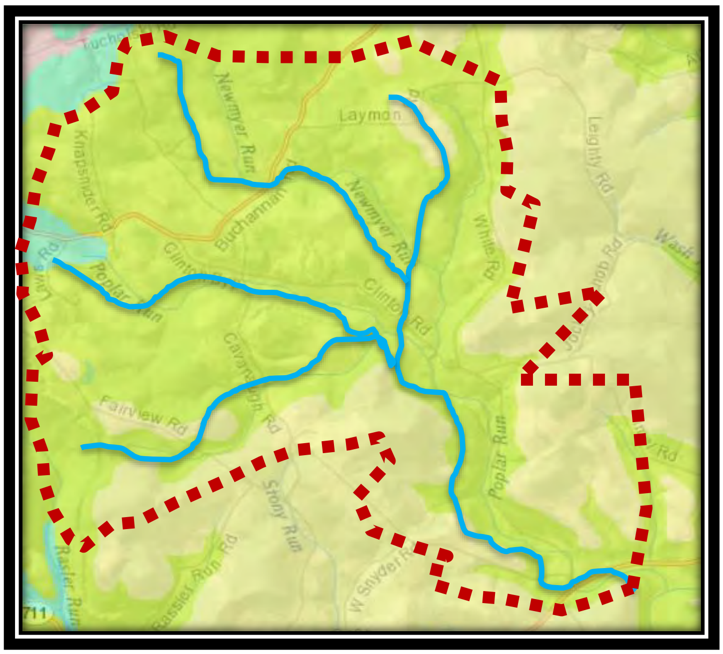
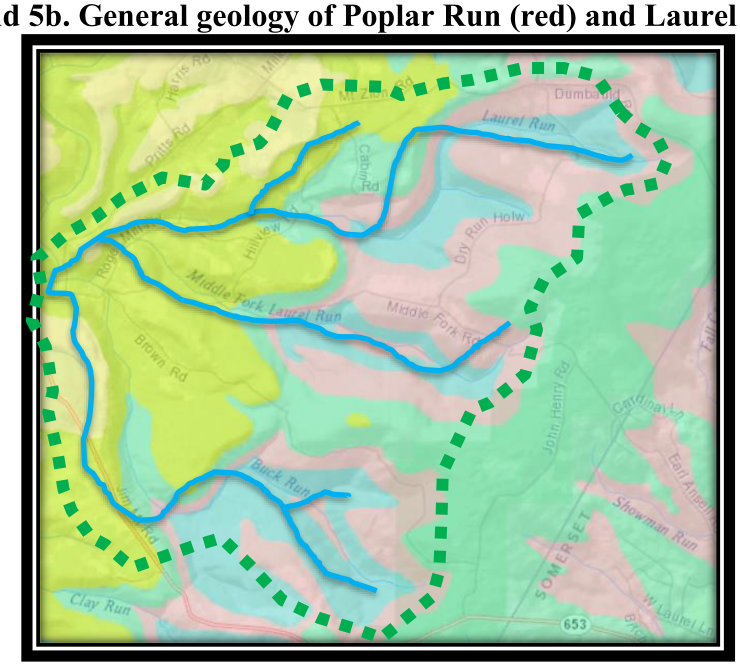


Figure 5a. and 5b. General geology of Poplar Run (red) and Laurel Run (green)



Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be "fishable" and "swimmable." Additionally, the federal Clean Water Act and the United States Environmental Protection Agency's (EPA) implementing regulations (40 CFR 130) require: States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs); States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

The TMDL was completed to address the impairments noted on the Pennsylvania's 2016 Integrated Water Quality Monitoring and Assessment Report required under the Clean Water Act, and cover the listed segments shown in Table 2. Excessive siltation resulting from land development is listed as causing biological impairment to Poplar Run (Figure 6., green-not impaired CWF, red-impaired CWF).

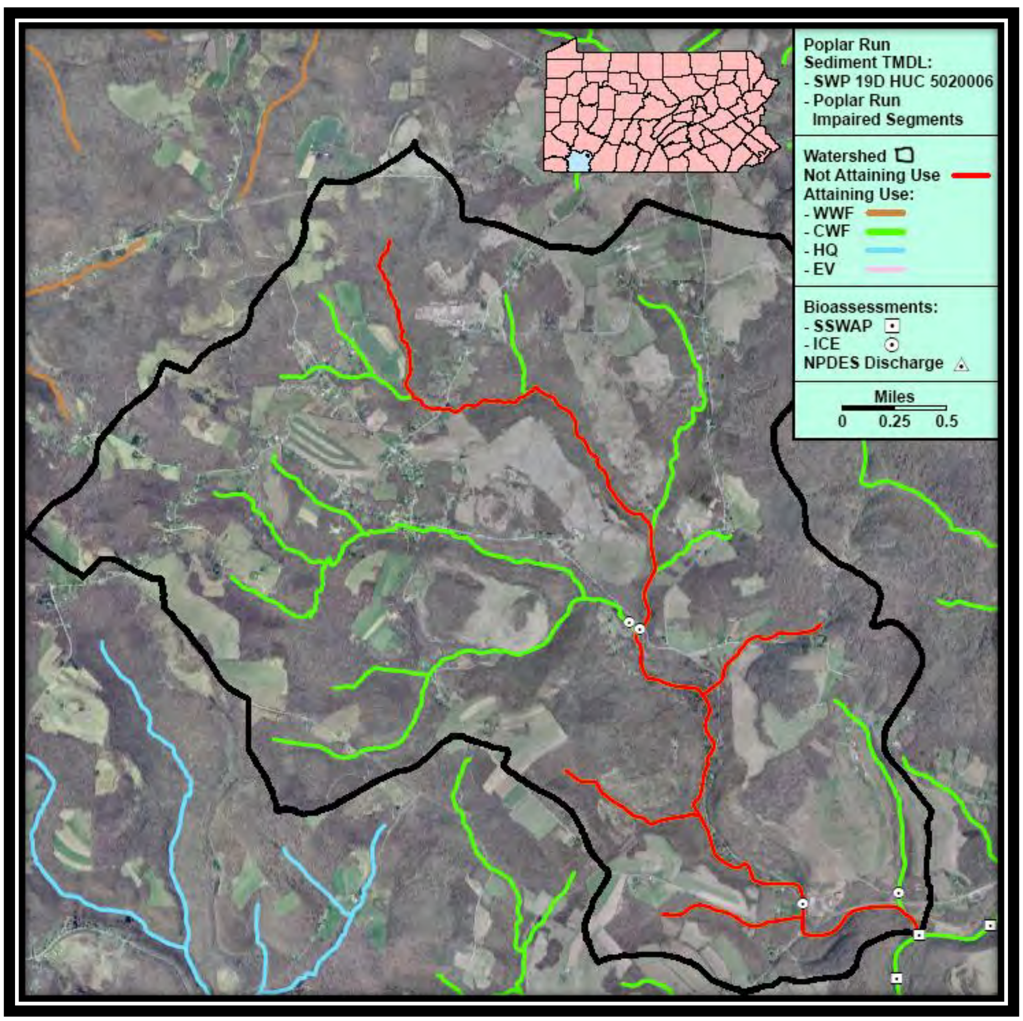


Figure 6. Aerial view of land uses and Impaired segments of Poplar Run

Table 2. Integrated Water Quality Monitoring and Assessment Report Listed Segments

2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 4a and 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name / HUC / Use Assessed (Assessment ID) - Miles / Source	Cause	Date Listed	TMDL Date
Hydrologic Unit Code: 05020006-Youghiogheny			
Newmyer Run (HUC: 05020006)			
Aquatic Life (9299) - 0.2 miles			
Abandoned Mine Drainage	Metals	1996	2009
Aquatic Life (9300) - 2.8 miles			
Abandoned Mine Drainage	Metals	2002	2015
Poplar Run (HUC: 05020006)			
Aquatic Life (9298) - 2.78 miles			
Abandoned Mine Drainage	Metals	2002	2015
Land Development	Siltation	2002	2015
Aquatic Life (9303) - 2.58 miles			
Poplar Run Unnamed Of (ID:69917053) (HUC: 05020006)			
Aquatic Life (9303) - 0.49 miles			
Poplar Run Unnamed To (ID:69916741) (HUC: 05020006)			
Aquatic Life (9303) - 0.61 miles			
Poplar Run Unnamed To (ID:69916887) (HUC: 05020006)			
Aquatic Life (9303) - 0.73 miles			
Poplar Run Unnamed To (ID:69916917) (HUC: 05020006)			
Aquatic Life (9298) - 0.73 miles			
Abandoned Mine Drainage	Metals	2002	2015
Land Development	Siltation	2002	2015
Poplar Run Unnamed To (ID:69916981) (HUC: 05020006)			
Aquatic Life (9303) - 1.94 miles			
Poplar Run Unnamed To (ID:69917165) (HUC: 05020006)			
Aquatic Life (9298) - 0.75 miles			
Abandoned Mine Drainage	Metals	2002	2015
Land Development	Siltation	2002	2015

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2016 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 4a and 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name / HUC / Use Assessed (Assessment ID) - Miles / Source	Cause	Date Listed	TMDL Date
Poplar Run Unnamed To (ID:69917225)			
HUC: 05020006			
Aquatic Life (9297) - 1.15 miles			
Poplar Run Unnamed To (ID:69917313)			
HUC: 05020006			
Aquatic Life (9298) - 0.72 miles			
Abandoned Mine Drainage	Metals	2002	2015
Land Development	Siltation	2002	2015

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Despite these requirements, states, territories, authorized tribes, and EPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against EPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While EPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., Abandoned Mine Drainage (AMD), implementation of nonpoint source Best Management Practices (BMPs), etc.).

Pennsylvania Clean Streams Law Requirements and Agricultural Operations

All Pennsylvania farmers are subject to the water quality regulations authorized under the Pennsylvania Clean Streams Law, Title 25 Environmental Protection, and found within Chapters 91-93, 96, 102 and 105. These regulations include topics such as manure management, Concentrated Animal Operations (CAOs), Concentrated Animal Feeding Operations (CAFOs), Pollution Control and Prevention at Agricultural Operations, Water Quality Standards, Water Quality Standards Implementation, Erosion and Sediment Control Requirements, and Dam Safety and Waterway Management.

To review these regulations, please refer to http://pacode.com/ or the Pennsylvania Water Quality Action Packet for Agriculture which is supplied by the County Conservation Districts. To find your County Conservation District's contact information, please refer to http://pacd.org/ or call any DEP office or the Pennsylvania Conservation Districts Headquarters at 717-238-7223.

Integrated Water Quality Monitoring and Assessment Report, List 5, 303(d), Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be listed in the Integrated Water Quality Monitoring and Assessment Report. Prior to 2004 the impaired waters were found on the 303(d) List; from 2004 to present, the 303(d) List was incorporated into the Integrated Water Quality Monitoring and Assessment Report and found on List 5. Please see Table 3 below for a breakdown of the changes to listing documents and assessment methods through time.

With guidance from EPA, the states have developed methods for assessing the waters within their respective jurisdictions. From 1996-2006, the primary method adopted by the Pennsylvania Department of Environmental Protection for evaluating waters found on the 303(d) lists (1998-2002) or in the Integrated Water Quality Monitoring and Assessment Report (2004-2006) was the Statewide Surface Waters Assessment Protocol (SSWAP). SSWAP was a modification of the EPA Rapid Bioassessment Protocol II (RPB-II) and provided a more consistent approach to assessing Pennsylvania's streams.

The assessment method required selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selected as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment could vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macroinvertebrates were identified to the family level in the field.

The listings found in the Integrated Water Quality Monitoring and Assessment Reports from 2008 to present were derived based on the Instream Comprehensive Evaluation protocol (ICE). Like the SSWAP protocol that preceded the ICE protocol, the method requires selecting representative segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment could vary between sites. All the biological surveys include D-frame kick net sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity.

Collected samples are returned to the laboratory where the samples are then subsampled to obtain a benthic macroinvertebrate sample of 200 + or – 20% (160 to 240). The benthic macroinvertebrates in this subsample were then identified to the generic level. The ICE protocol is a modification of the EPA Rapid Bioassessment Protocol III (RPB-III) and provides a more rigorous and consistent approach to assessing Pennsylvania's streams than the SSWAP.

After these surveys (SSWAP, 1998-2006 lists or ICE, 2008-present lists) were completed, the biologist determined the status of the stream segment. The decision was based on the performance of the segment using a series of biological metrics. If the stream segment was classified as impaired, it was then listed on the state's 303(d) List or presently the Integrated Water Quality Monitoring and Assessment Report with the source and cause documented.

Once a stream segment is listed as impaired, a TMDL must be developed for it. A TMDL addresses only one pollutant. If a stream segment is impaired by multiple pollutants, all of those pollutants receive separate and specific TMDLs within that stream segment. In order for the TMDL process to be most effective, adjoining stream segments with the same source and cause listing are addressed collectively on a watershed basis.

Table 3. Impairment Documentation and Assessment Chronology

Listing Date	Listing Document	Assessment Method
1998	303(d) List	SSWAP
2002	303(d) List	SSWAP
2004	Integrated List	SSWAP
2006	Integrated List	SSWAP
2008-Present	Integrated List	ICE

Integrated List= Integrated Water Quality Monitoring and Assessment Report
SSWAP= Statewide Surface Waters Assessment Protocol
ICE= Instream Comprehensive Evaluation Protocol

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);

2. Calculate TMDL for the waterbody using EPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. EPA approval of the TMDL.

TMDL Elements (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation (WLA) is the portion of the load assigned to point sources (National Pollutant Discharge Elimination System (NPDES) permitted discharges). The load allocation (LA) is the portion of the load assigned to nonpoint sources (non-permitted). The margin of safety (MOS) is applied to account for uncertainties in the computational process. The MOS may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

Future TMDL Modifications

In the future, the Department may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that are developed or discovered during the implementation of the TMDL when a review of the new information or circumstances indicate that such adjustments are appropriate. Adjustment between the load and wasteload allocation will only be made following an opportunity for public participation. A wasteload allocation adjustment will be made consistent and simultaneous with associated permit(s) revision(s)/reissuances (i.e., permits for revision/reissuance in association with a TMDL revision will be made available for public comment concurrent with the related TMDLs availability for public comment). New information generated during TMDL implementation may include among other things, monitoring data, BMP effectiveness information, and land use information. All changes in the TMDL will be tallied and once the total changes exceed 1% of the total original TMDL allowable load, the TMDL will be revised. The adjusted TMDL, including its LAs and WLAs, will be set at a level necessary to implement the applicable water quality standards (WQS) and any adjustment increasing a WLA will be supported by reasonable assurance demonstration that load allocations will be met. The Department will notify EPA of any adjustments to the TMDL within 30 days of its adoption and will maintain current tracking mechanisms that contain accurate loading data for TMDL waters.

Changes in TMDLs That May Require EPA Approval

- Increase in total load capacity.
- Transfer of load between point (WLA) and nonpoint (LA) sources.
- Modification of the margin of safety (MOS).
- Change in water quality standards (WQS).
- Non-attainment of WQS with implementation of the TMDL.
- Allocation transfers in trading programs.

Changes in TMDLs That May Not Require EPA Approval

- Total loading shift less than or equal to 1% of the total load.

- Increase of WLA results in greater LA reductions provided reasonable assurance of implementation is demonstrated (a compliance/implementation plan and schedule).
- Changes among WLAs with no other changes; TMDL public notice concurrent with permit public notice.
- Removal of a pollutant source that will not be reallocated.
- Reallocation between LAs.
- Changes in land use.

TMDL Endpoints

PA does not currently have water quality criteria for siltation and habitat alterations per se, but because it does significantly influence excess siltation, a sediment TMDL endpoint was identified using a reference watershed approach. Therefore, so as to meet the designated uses of the Poplar Run watershed for attainment and maintenance, for all waterbodies, Pennsylvania utilizes its narrative water quality criteria, which state that:

Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life. (25 PA Code Chapter 93.6 (a)); and,

In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances which produce color, tastes, odors, turbidity or settle to form deposits. (25 PA Code, Chapter 93.6 (b)).

Based on a reference watershed approach, a total load capacity (or endpoint) of **496,631.1** lbs./yr. of sediment loading in the Poplar Run watershed was determined sufficient in order to be protective of all Coldwater Fishery attributes as it is maintained in the reference watershed, Laurel Creek.

Defining Sedimentation

Sedimentation is an essential component of aquatic ecosystems, as it often contains minerals used by many aquatic organisms, and provides habitat. Sedimentation is a natural process that is caused by the weathering of landscape, whereby wind and water erode the surfaces of rocks and soils creating small particles. When these particles enter streams, they may flow with the current (suspended solids), or be deposited on the streambed. Typically, natural inputs of sediment to streams do not cause problems; however, when landscape is modified, excessive amounts of sediment can enter streams or erode from streams and cause undesirable effects (Bryan and Rutherford 1995).

Agricultural practices such as row cropping involve the tilling of landscapes to make the soil porous and fertile, which consequently loosens soil directly, as well as indirectly by removing plants whose roots once held soil in place. During rain events, loosened soil is directed toward nearby streams via overland runoff, and depending upon the density of vegetation along the shoreline, sediment enters into the water. The soil of pasture land is often more stable than that of cropland, yet in-stream sedimentation issues arise from the surface runoff associated with this land use. If the pasture land is grazed, the soil becomes compacted from the constant trampling by livestock, and therefore precipitation leaves the area via surface runoff and enters streams instead of infiltrating into the soil. In addition, because vegetation within pasture land typically has shallow roots and little water retention ability, precipitation that does infiltrate the soil saturates the soil quickly, which consequently reduces absorbance and increases surface runoff. The sudden increase in water volume in a stream raises the velocity of the flow to a point where soil from the stream banks begins to erode into the channel. Runoff volume from this land use is further increased in areas with steep topography, and areas in which cattle have overgrazed the vegetation.

In addition to facilitating hydrology-related sedimentation issues, the overgrazing and trampling of vegetation in riparian zones leads to loosened soil that directly enters streams. Eroded sediment can cause numerous problems for aquatic organisms. Suspended sediment causes turbidity, which can interfere with predation efficiency; cause respiration problems by clogging gills of aquatic organisms (Horne and Goldman 1994); and also reduces sunlight penetration, which affects plant photosynthesis (Waters 1995). Causing a higher magnitude of problems, deposited sediment can 1) suffocate eggs of fish and other organisms, 2) suffocate small organisms, 3) severely reduce habitat and habitat diversity, and 4) alter flow patterns (USEPA 1999).

Selection of the Reference Watershed

The reference watershed approach was used to estimate the appropriate sediment and total phosphorus (nutrient) loading reduction necessary to restore healthy aquatic communities to the Poplar Run. This approach is based on selecting a non-impaired, or reference, watershed and estimating its current loading rates for the pollutants of interest. The objective of the process is to reduce loading rates of those pollutants identified as causing impairment to a level equivalent to or lower than the loading rates in the reference watershed. Achieving the appropriate load reductions should allow the return of a healthy biological community to affected stream segments.

First, there are three factors that should be considered when selecting a suitable reference watershed: impairment status, similarity of physical properties, and size of the watershed. A watershed that the Department has assessed and determined to be attaining water quality standards should be used as the reference. Second, a watershed that closely resembles the impaired watershed in physical properties such as land use/land cover, physiographic province, elevation, slope and geology should be chosen. Finally, the size of the reference watershed should be within 20-30% of the impaired.

The search for a reference watershed that would satisfy the above characteristics was done by means of a desktop screening using several GIS shapefiles, including a watershed layer, geologic formations layer, physiographic province layer, soils layer, Landsat-derived land cover/use grid, and the stream assessment information found on the Department's Instream Comprehensive Evaluation Protocol (ICE) GIS-based website. The suitability of the chosen watershed was confirmed through discussions with Department staff as well as through field verification of conditions.

Laurel Run was selected as the reference for developing the Poplar Run Sediment TMDL. The watershed has a total drainage area of 7,517.0 acres and is another Coldwater Fishery (CWF), but is attaining its designated aquatic life uses based on biological sampling initially done by the Department in 2011 (Figure 10. non-impaired-green, impaired-purple) (Figure 10.). The headwaters flow generally east to west, from Laurel Hill ridge, to its confluence of Indian Creek, near the town of Rogers Mill and the greater river basin of the Youghiogheny River, HUC: 02050006, SWP: sub-basin 19D**.** Land use in this watershed is composed of agriculture (1.9%) including croplands and hay/pasture, forestland 92.0%), and other (6%) in development, open space, and bare rock (Figure 7.).

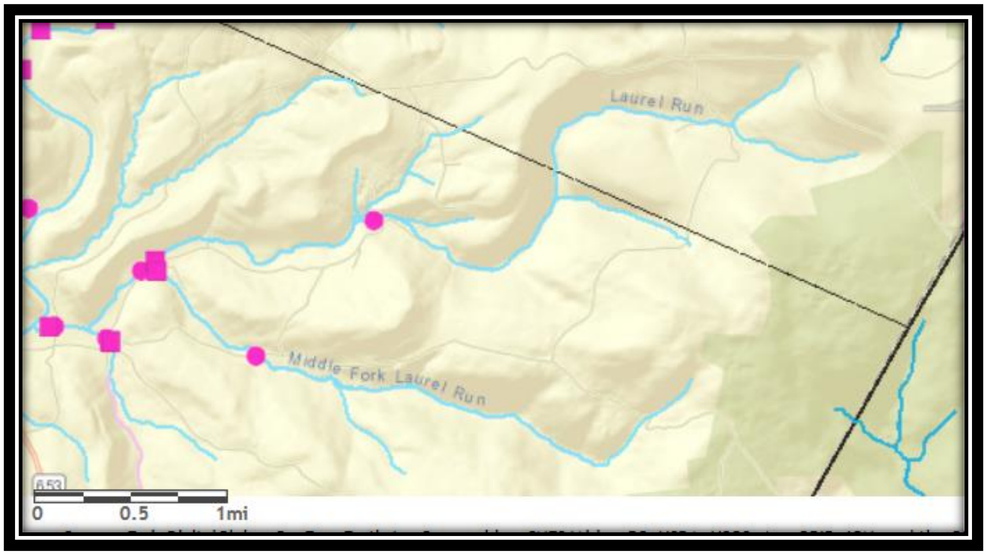

Figure 7a. Map of bioassessment sites and non-impaired CWF segments of Laurel Run

Figure 7b. 2011 Water Quality Bioassessments – Laurel Run, SR1003 (Not impaired)

Pennsylvania Department of Environmental Protection - Rapid Bioassessment Protocols

Benthic macroinvertebrate sample summary

Station ID 20110210-1320-mbrickner Laurel Run, Fayette County
Stream Name Laurel Run (01179001) Stream Code 38285 Strahler 1
Survey ID 61753 Sample Method 6-Dframe Composite, 200 subsample
Collection Date 20110210 Collection Time 1320 Latitude 39.9932891 Longitude -79.4146344
HUC8 05020006 Youghiogheny

Station Location Comments
Laurel Run aprox 65 yards downstream of bridge on SR1003. Mill Run quad.
Biology / Habitat Comments
Land Use Comments
Station Impairment Status Comments

Taxa List

grids from first pan 0 | # grids from second pan 0 | Subsample Size 214

any EV indicator taxa names are highlighted

Taxa Name	Individuals	PTV	FFG	BCG Attribute (coldwater)	BCG Attribute (warmwater)
Ameletus	1	0	CG	2	2
Baetis	3	6	CG	4	5
Epeorus	5	0	SC	2	2
Stenacron	1	4	SC	4	4
Maccaffertium	13	3	SC	3	3
Serratella	23	2	CG	3	3
Paraleptophlebia	8	1	CG	2	2
Ephemera	1	2	CG	3	2
Tallaperla	1	0	SH	1	1
Taeniopteryx	1	2	SH	3	3
Strophopteryx	2	3	SH	3	3
Ostrocerca	3	2	SH	1	1
Allocapnia	43	3	SH	3	3
Acroneuria	1	0	PR	3	3
Nigronia	1	2	PR	3	3
Chimarra	16	4	FC	4	4
Dolophilodes	2	0	FC	2	2
Polycentropus	1	6	FC	4	4
Ceratopsyche	7	5	FC	4	4
Cheumatopsyche	16	6	FC	5	5
Hydropsyche	8	5	FC	5	5
Rhyacophila	1	1	PR	2	2
Optioservus	9	4	SC	4	4
Oulimnius	3	5	SC	3	2
Promoresia	1	2	SC	3	2
Probezzia	2	6	PR	4	4
Dicranota	2	3	PR	3	3
Hexatoma	5	2	PR	3	3
Limnophila	1	3	PR	4	4
Chironomidae	32	6	CG	5	5
Hydracarina	1	7	PR	4	4

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Benthic macroinvertebrate sample summary

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Collection Date 20110210 Collection Time 1320 Latitude 39.9932891 Longitude -79.4146344
HUC8 05020006 Youghiogheny

Metrics and IBI scores

* Highlighted colums indicate the appropriate metrics and IBI score to use.

Metric Names	Raw Metric Values	Freestone Riffle-Run 6D200 2013 small	Freestone Riffle-Run 6D200 2013 large	Freestone Riffle-Run 2D100	Multihabitat Pool-Glide	Limestone 2009
Total Richness	31	93.9	100.0		100.0	172.2
Ephemeroptera Richness	8				133.3	
Trichoptera Richness	7				63.6	
EPT Richness	21			137.3	123.5	262.5
Trichoptera Richness (PTV 0-4)	3			83.3		
EPT Richness (PTV 0-4)	16	84.2	100.0			
Beck's Index (version 3)	26	68.4	118.2			
Beck's Index (version 4)	29			145.7	131.8	241.7
FC + PR + SH Richness	19			163.8		
Hilsenhoff Biotic Index	3.68	78.0	91.0	93.8		102.6
% Inolerant Individuals (PTV 0-3)	53.7	63.6	80.6			
% Tolerant Individuals (PTV 7-10)	0.5					101.0
Shannon Diversity	2.73	95.2	95.3		112.2	128.0
IBI score		80.6	94.5	95.4	93.9	100.0

% Ephemeroptera	25.7	% Ephemeroptera (PTV 0-4)	24.3	% Dominant Taxon	20.1	BCG Richness Ratio	1.58
% Plecoptera	23.8	Ephemeroptera Richness (PTV 0-4)	7	% Chironomidae	15.0	BCG Individuals Ratio	1.21
% Trichoptera	23.8	Plecoptera Richness	6	% Simuliidae	0.0	EV Indicator Taxa Richness	6

Not impaired Y Biology impaired N Habitat impaired N Insufficient data N
Rock pick influenced assessment N Impact is localized N Re-evaluate designated use N

Physical Habitat Assessment

Pool-Glide Assessment? N

Instream Cover	17	Substrate / Cover	0	Frequency of Riffles	19	Contition of Banks	15
Epifaunal Substrate	18	Velocity/Depth Regimes	16	Channel Sinuosity	19	Bank Vegetation	18
Embeddedness	19	Pool Variability	0	Channel Flow Status	20	Disruptive Pressure	17
Pool Substrate	0	Sediment Deposition	17	Channel Alteration	16	Riparian Zone	20

Instream Score 71 Riparian Score 53 Total Score 212

Field Measurements

Lab samples 0587214

Temperature (°C) 0.7 Dissolved Oxygen (mg/L) 16.4 Flow (CFS) 0
pH 7.34 Total Alkalinity (mg/L as CaCO3) 12 Conductivity (uS/cm) 96

Use Assessment Status for Stream Reach

Designated Use CWF Existing Use

Aquatic Life Attaining (980722-1015-ALF)

Fish Consumption
Potable Water Supply
Recreation

TMDL Information (if any)

Begin Date Meeting Date End Date Draft Date Final Date

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Figure 8. – Overview aerial map of the impaired Poplar Run and its corresponding non-impaired, reference of Laurel Run

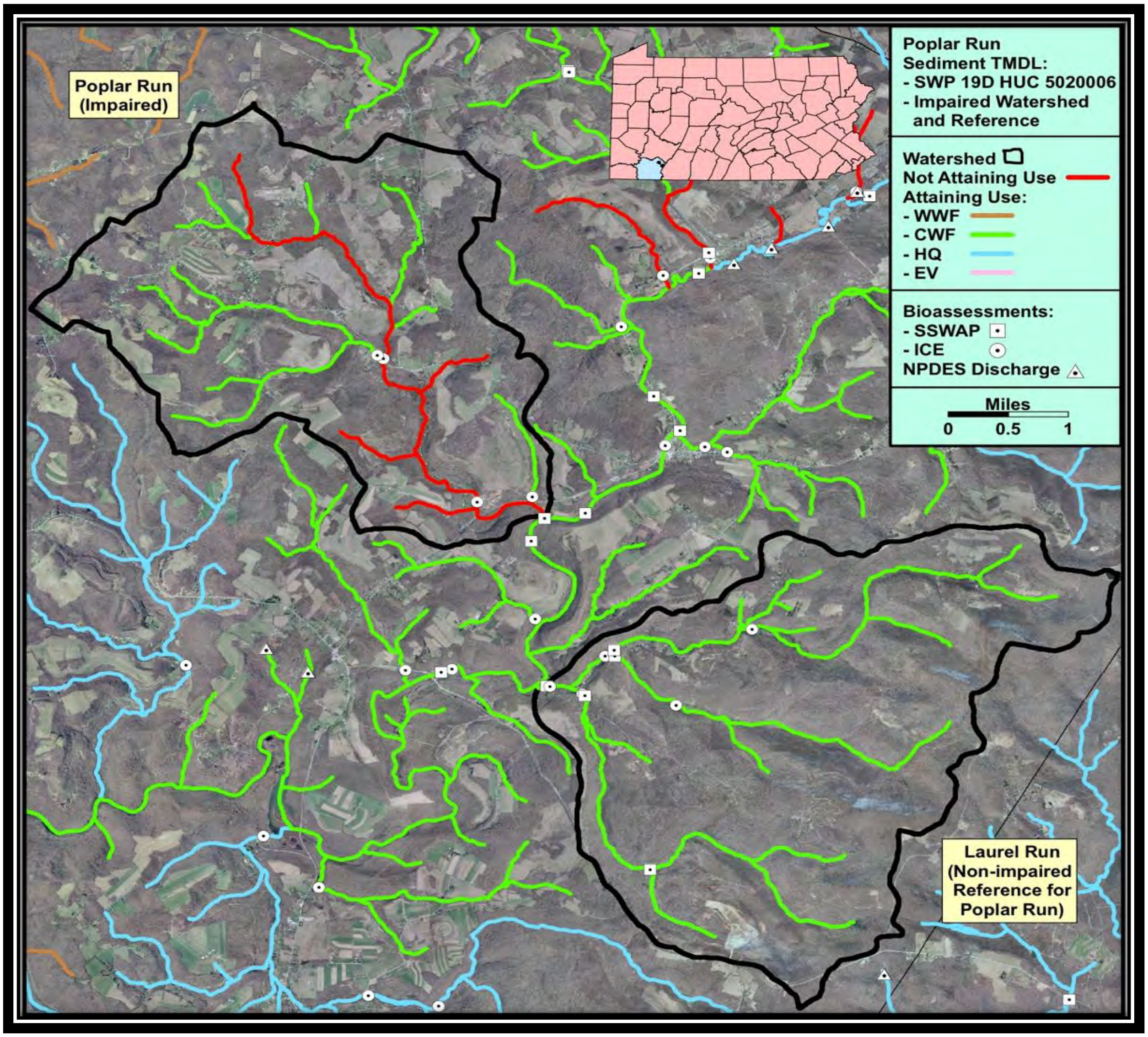


Table 4. compares the respective impaired and reference watersheds in terms of size, location, and other physical characteristics.

Table 4. Comparison of Poplar Run (impaired) and Laurel Run (reference)		
	Poplar Run	Laurel Run
Physiographic Province	Appalachian Plateaus	Appalachian Plateaus
Area (acres)	6,497.0	7,517.0
Land Use Distribution		
% Agriculture	22.8	1.9
% Forest	67.5	92.0
% Other	9.7	6.0
Mix of Hydric Soils	100	100
Surface Geology: Interbedded Sedimentary	100	100
Average Rainfall (in.)	42.21, 19 years	43.24, 19 years
Average Runoff (in.)	2.03, 19 years	2.10, 19 years

Watershed Assessment and Modeling

The MAPSHED model was used to establish existing loading conditions for the sediment-impaired segments of the Poplar Run Watershed and its corresponding reference, Laurel Run. All MAPSHED data and outputs have been attached to this TMDL as Attachment B. Department staff visited the listed watersheds to get a better understanding of existing conditions that might influence the MAPSHED model. The following summarizes details noted in the field, aerial maps, and field photographs as detailed on the following pages.

General observations of the individual watershed characteristics of Poplar Run and Laurel Run:

Poplar Run (impaired)

- In-stream pastureland (horse and cow)
- Compacted and slumping banks
- Sediment build up, wetland creation, and pooling in floodplain
- Minimized sediment transport and turbidity
- Inundation of benthic habitat
- Minimal variety of substrate

Laurel Run (reference)

- **Forested game lands** in higher elevations of the watershed
- Riparian buffering between crops and stream
- Riparian buffering between fenced-off pastureland and stream
- Extensive storm water retention in cropland vegetative cover and no till farming
- Stable banks
- Variety of substrate material, including gravel/cobble
- Successful sediment transport

Based on field observations adjustments may be made to specific parameters used in the MAPSHED model. These adjustments were as follows:

Poplar Run (impaired)

- No changes to the model were necessary for Poplar Run.

Laurel Run (reference)

- No changes to the model were necessary for Laurel Run.

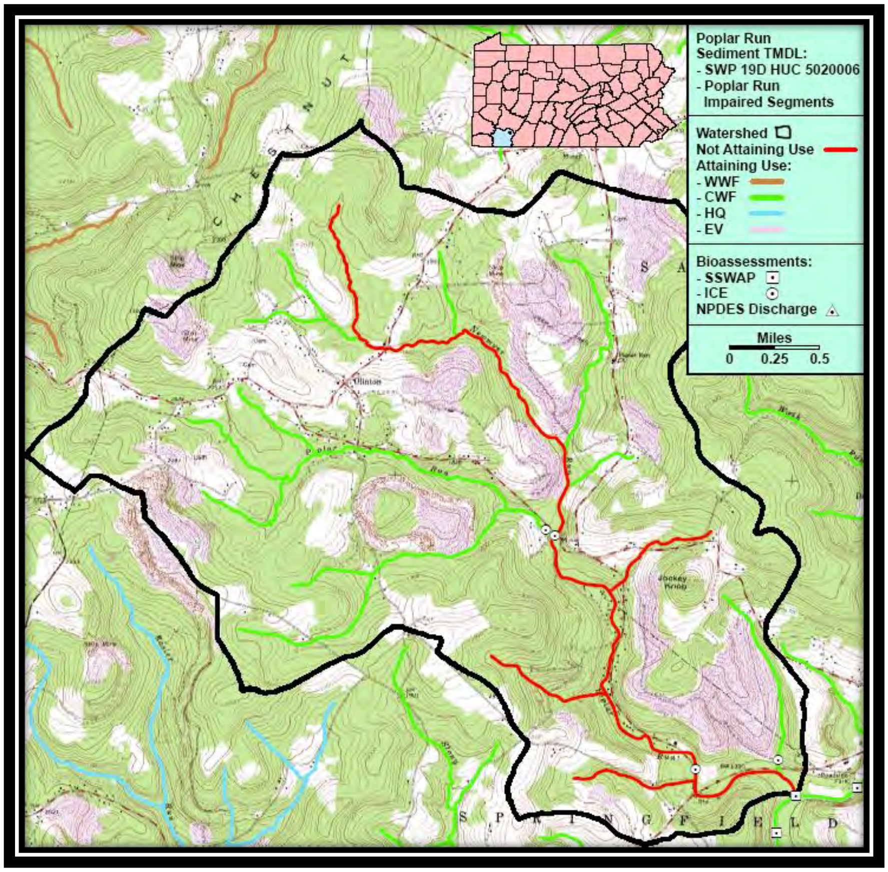


Figure 9. and 10. – Topography and aerial maps of Poplar Run

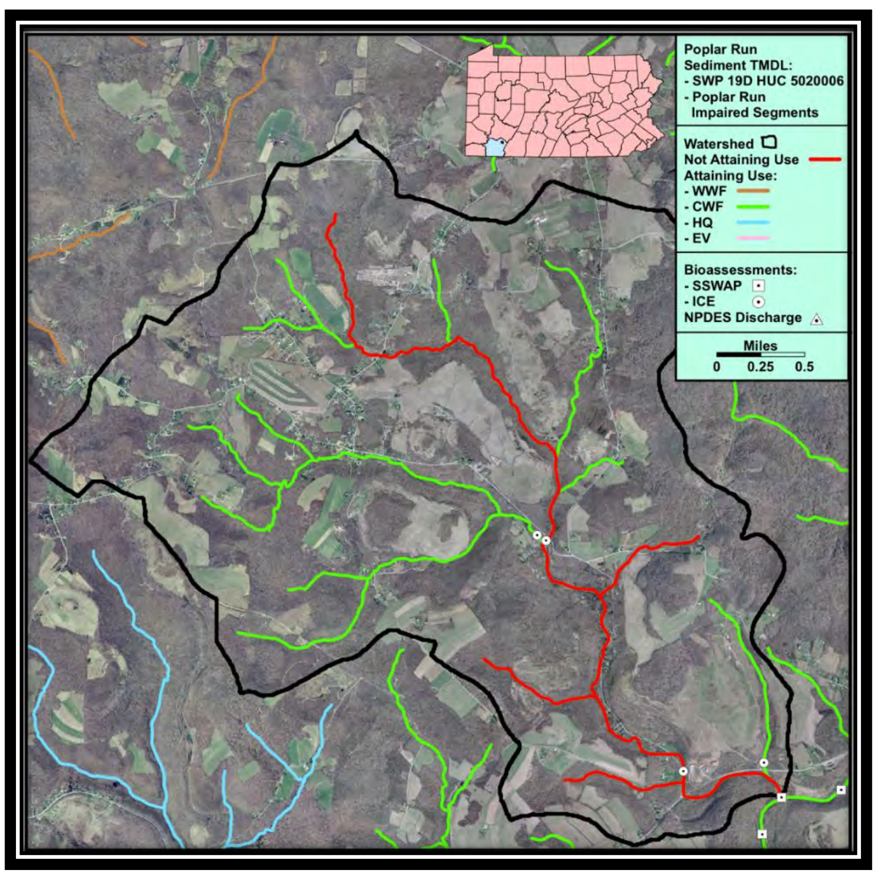
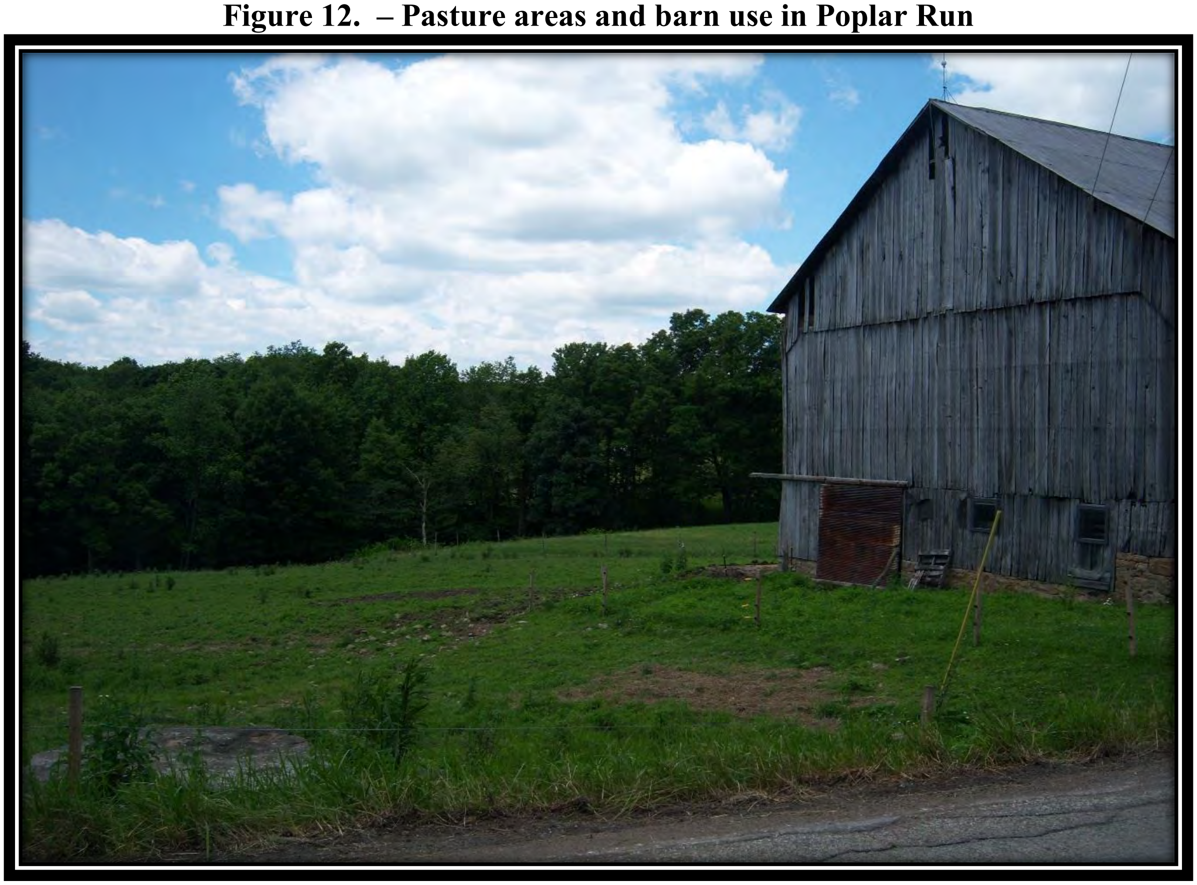


Figure 11. – Headwaters generally forested and old fields

Figure 12. – Pasture areas and barn use in Poplar Run



- Figure 13. – Substrate generally flushed where natural riffles and flow occur

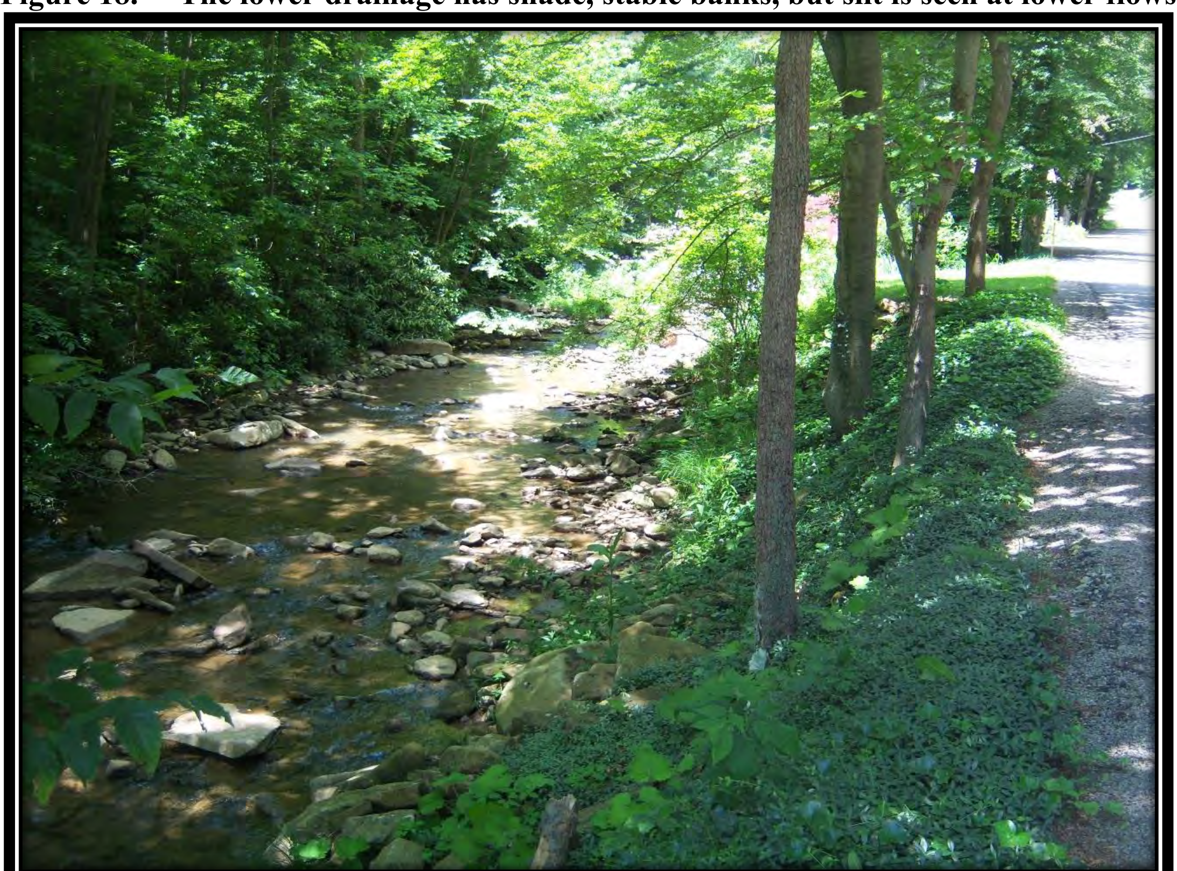
Figure 14. – Inhibited flow allows inundation of benthic substrate

Figure 15. – Large swaths of bare cropland pool up rainwater to mud puddles

Figure 16. – Low sediment transport leads to silt layering

Figure 17. – Further downstream, heavy siltation covers even cobble substrate

Figure 18. – The lower drainage has shade, stable banks, but silt is seen at lower flows



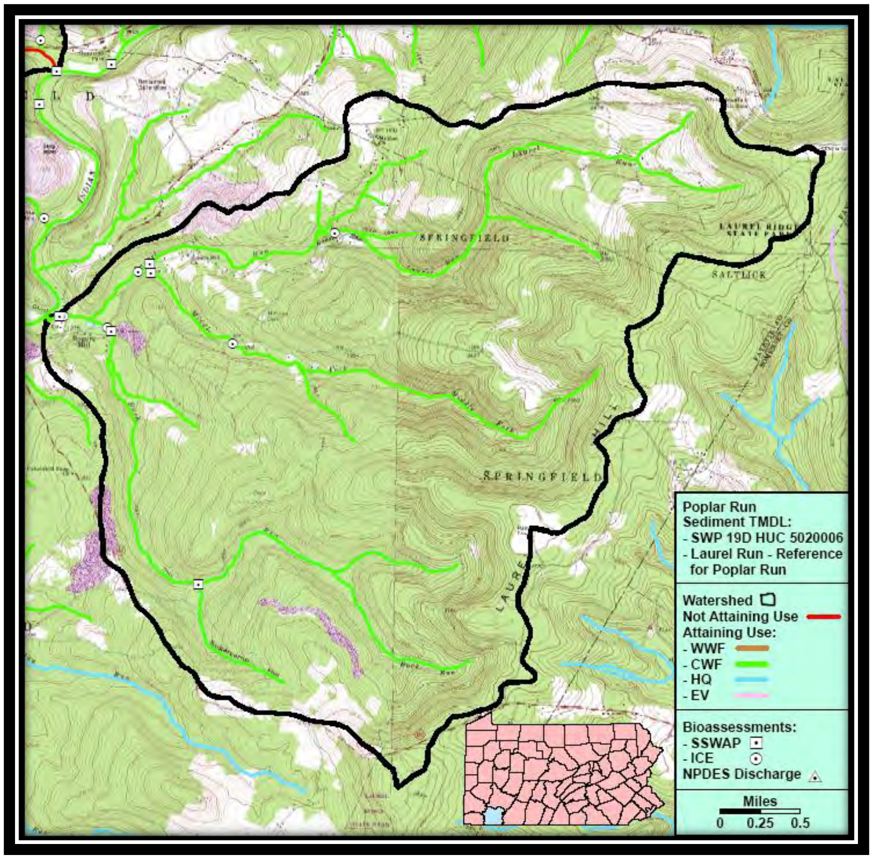
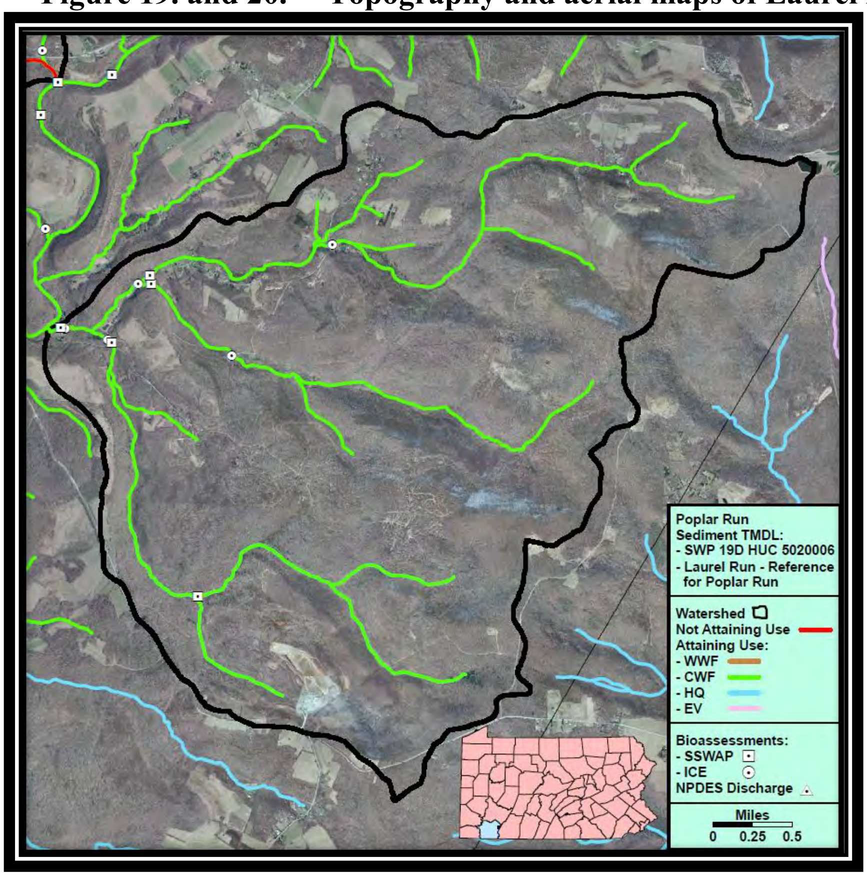


Figure 19. and 20. – Topography and aerial maps of Laurel Run



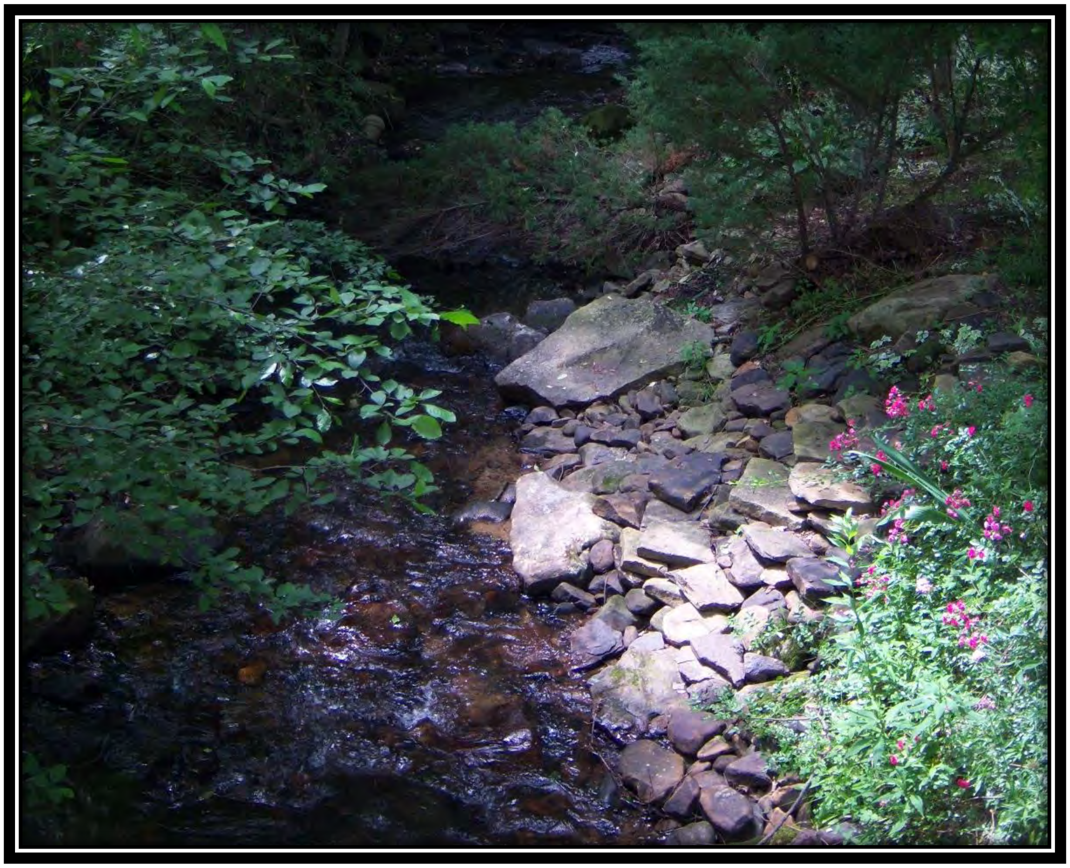


Figure 21. – Headwaters of Laurel Run are forested with cold-water fishery attributes

Figure 22. – Various sizes of substrate provide good habitat.

Figure 23. – Lower flows provide for small silt islands

Figure 24. – Generally, sediment transport and riffle frequency is good

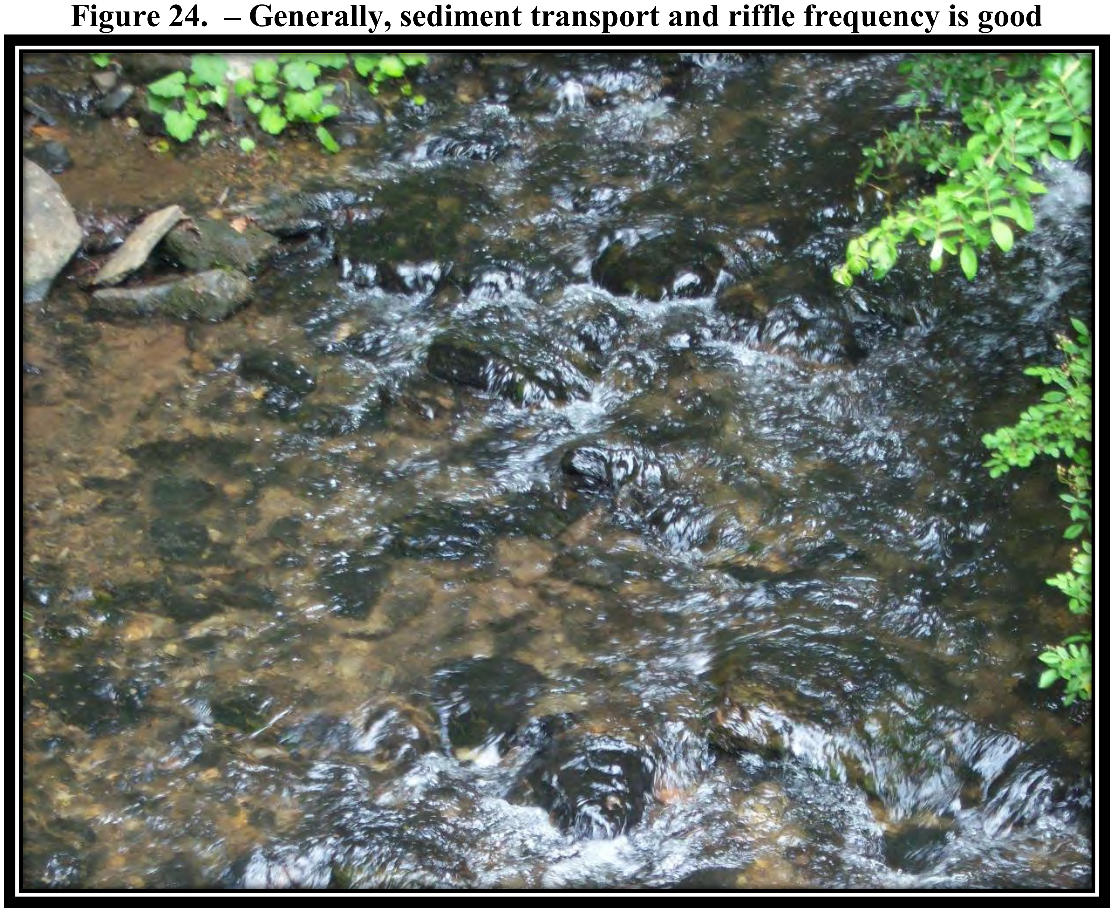


Figure 25. – The clarity of water and variety of habitat creates biological sustainability

Hydrologic / Water Quality Modeling

Part 1. Model Overview & Data Compilation

The TMDL for this watershed was calculated using the Generalized Watershed Loading Function (MAPSHED) Interface for Windows, version 7.2.3. The remaining paragraphs in this section are excerpts from the GWLF User's Manual (Haith et al., 1992).

The core watershed simulation model for the MAPSHED software application is the GWLF (Generalized Watershed Loading Function) model developed by Haith and Shoemaker. The original DOS version of the model was re-written in Visual Basic by Evans et al. (2002) to facilitate integration with ArcView, and tested extensively in the U.S. and elsewhere.

The GWLF model provides the ability to simulate runoff and corresponding sediment from a watershed given variable-size source areas (i.e., agricultural, forested, and developed land). It is a continuous simulation model that uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads based on the daily water balance accumulated to monthly values.

GWLF is considered to be a combined distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios, but each area is assumed to be homogenous in regard to various attributes considered by the model. Additionally, the model does not spatially distribute the source areas, but simply aggregates the loads from each source area into a watershed total; in other words there is no spatial routing. For sub-surface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for sub-surface flow contributions. Daily water balances are computed for an unsaturated zone as well as a saturated sub-surface zone, where infiltration is simply computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

With respect to the major processes simulated, GWLF models surface runoff using the Soil Conservation Service Curve Number, or SCS-CN, approach with daily weather (temperature and precipitation) inputs. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation USLE algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (i.e., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss erosion (K), the length slope factor (LS), the vegetation cover factor (C), and the conservation practices factor (P). A sediment delivery ratio based on watershed size and transport capacity, which is based on average daily runoff, is then applied to the calculated erosion to determine sediment yield for each source area. Evapotranspiration is determined using daily weather data and a cover factor dependent upon land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values.

For execution, the model requires two separate input files containing transport and weather-related data. The transport (transport.dat) file defines the necessary parameters for each source area to be considered (e.g., area size, curve number, etc.) as well as global parameters (e.g., initial storage, sediment delivery ratio, etc.) that apply to all source areas. The weather

(weather.dat) file contains daily average temperature and total precipitation values for each year simulated.

Since its initial incorporation into MAPSHED, the GWLF model has been revised to include a number of routines and functions not found in the original model. For example, a significant revision in one of the earlier versions of MAPSHED was the inclusion of a streambank erosion routine. This routine is based on an approach often used in the field of geomorphology in which monthly streambank erosion is estimated by first calculating a watershed-specific lateral erosion rate (LER). After a value for LER has been computed, the total sediment load generated via streambank erosion is then calculated by multiplying the above erosion rate by the total length of streams in the watershed (in meters), the average streambank height (in meters), and the average soil bulk density (in kg/m3).

The inclusion of the various model enhancements mentioned above has necessitated the need for several more input files than required by the original GWLF model, including a “scenario” (*.scn) file, an animal data (animal.dat) file. Also, given all of the new and recent revisions to the model, it has been renamed “GWLF-E” to differentiate it from the original model.

As alluded to previously, the use of GIS software for deriving input data for watershed simulation models such as GWLF is becoming fairly standard practice due to the inherent advantages of using GIS for manipulating spatial data. In this case, a customized interface developed by Penn State University for ArcView GIS software (versions 3.2 or 3.3) is used to parameterize input data for the GWLF-E model. In utilizing this interface, the user is prompted to load required GIS files and to provide other information related to various “non-spatial” model parameters (e.g., beginning and end of the growing season; the months during which manure is spread on agricultural land, etc.). This information is subsequently used to automatically derive values for required model input parameters which are then written to the appropriate input files needed to execute the GWLF-E model. Also accessed through the interface are Excel-formatted weather files containing daily temperature and precipitation information. (In the version of MAPSHED used in Pennsylvania, a statewide weather database was developed that contains about twenty-five (25) years of temperature and precipitation data for seventy-eight (78) weather stations around the state). This information is used to create the necessary weather.dat input file for a given watershed simulation.

Part 2. GIS Based Derivation of Input Data

The primary sources of data for this analysis were geographic information system (GIS) formatted databases and shapefiles. In using the MAPSHED interface, the user is prompted to identify required GIS files and to provide other information related to “non-spatial” model parameters (e.g. beginning and end of growing season, manure spreading period, etc.). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.DAT and WEATHER.DAT input files needed to execute the GWLF model. For use in Pennsylvania, MAPSHED has been linked with statewide GIS data layers such as land use/cover, soils, topography and physiography; and includes location-specific default information such as cropping practices. Complete GWLF-formatted weather files are also included for the seventy-eight weather stations around the state.

Table 5. lists GIS datasets and shapefiles used for the Poplar Run Watershed TMDL calculations via MAPSHED and provides explanations of how they were used for development of the input files for the GWLF model.

Table 5. GIS Datasets	
DATASET	**DESCRIPTION**
county.shp	The county boundaries coverage lists data on conservation practices which provides C and P values in the Universal Soil Loss Equation (USLE).
padem	100 meter digital elevation model; this is used to calculate land slope and slope length.
palumrlc	A satellite image derived land cover grid which is classified into 15 different landcover categories. This dataset provides landcover loading rates for the different categories in the model.
physprov.shp	A shapefile of physiographic provinces. This is used in rainfall erosivity calculations.
smallsheds.shp	A coverage of watersheds derived at 1:24,000 scale. This coverage is used with the stream network to delineate the desired level watershed.
streams.shp	The 1:24,000 scale single line stream coverage of Pennsylvania. Provides a complete network of streams with coded stream segments.
PAgeo	A shapefile of the surface geology used to compare watersheds of similar qualities.
weathersta.shp	Historical weather files for stations around Pennsylvania to simulate flow.
soils.shp	A shapefile providing soil characteristics data. This is used in multiple calculations.
zipcodes.shp	This shapefile provides animal density numbers used in the LER calculation.

In the GWLF model, the nonpoint source load calculated is affected by terrain conditions such as amount of agricultural land, land slope, and inherent soil erodibility. It is also affected by farming practices utilized in the area. Various parameters are included in the model to account for these conditions and practices. Some of the important parameters are summarized below:

Areal extent of different land use/cover categories: This is calculated directly from a GIS layer of land use/cover.
Curve number: This determines the amount of precipitation that infiltrates into the ground or enters surface water as runoff. It is based on specified combinations of land use/cover and hydrologic soil type, and is calculated directly using digital land use/cover and soils layers.
K factor: This factor relates to inherent soil erodibility, and affects the amount of soil erosion
LS factor: This factor signifies the steepness and length of slopes in an area and directly affects the amount of soil erosion.
C factor: This factor is related to the amount of vegetative cover in an area. In agricultural areas, the crops grown and the cultivation practices utilized largely control this factor. Values range from 0 to 1.0, with larger values indicating greater potential for erosion.
P factor: This factor is directly related to the conservation practices utilized in agricultural areas. Values range from 0 to 1.0, with larger values indicating greater potential for erosion.
Sediment delivery ratio: This parameter specifies the percentage of eroded sediment that is delivered to surface water and is empirically based on watershed size.
Unsaturated available water-holding capacity: This relates to the amount of water that can be stored in the soil and affects runoff and infiltration. It is calculated using a digital soils layer.

Development of Sediment TMDL

The target TMDL value for the sediment-impaired segments of Poplar Run was established based on current loading rates for sediment in its corresponding reference, Laurel Run. Reducing the loading rates of sediment in the Poplar Run Watershed to levels equal to, or less than, the reference watershed should allow for the reversal of current use impairments and maintain its WWF value.

As described in the previous section, sediment loading rates were computed for the reference watersheds using the MAPSHED model (Attachment B.). The target TMDL value for sediment was determined by multiplying the unit area loading rates for the reference watershed by the total watershed area of impaired segments.

The MAPSHED model produced area information and sediment loading based on land use (Tables 6. for impaired streams and 7. for references (Attachment B.)

Table 6. Existing Loading Values for the Poplar Run (impaired)

Source	Area (ac.)	Sediment (lbs.)	Unit Area Load (lbs./ac./yr.) Sediment
HAY/PAST	1,006.0	235,600.0	234.2
CROPLAND	473.0	835,000.0	1,765.3
FOREST	4,392.0	2,800.0	0.6
LOW DEVEL.	512.0	6,200.0	12.1
MED. DEVEL.	10.0	800.0	80.0
BARE ROCK	104.0	400.0	3.8
STREAM BANKS	-	517,800.0	**-**
Total	**6,497.0**	**1,598,600.0**	**246.1**

Table 7. Existing Loading Values for the Laurel Run (reference)

Source	Area (ac.)	Sediment (lbs.)	Unit Area Load (lbs./ac./yr.) Sediment
HAY/PAST	102.0	26,000.0	254.9
CROPLAND	38.0	78,000.0	2,052.6
FOREST	6,918.0	4,600.0	0.7
BARE ROCK	68.0	400.0	5.9
OPEN LAND	16.0	2,400.0	150.0
LOW DEVEL.	372.0	4,600.0	12.4
MED. DEVEL.	3.0	200.0	66.7
HIGH DEVEL.	0	0	0
STREAM BANKS	-	**458,400**	-
Total	**7,517.0**	**574,600.0**	**76.4**

Table 8. TMDL Values for Poplar Run				
Pollutant	Loading Rate in Reference (lbs./ac.-yr.)	Total Area Impaired Watershed (ac.)	Target TMDL Value (lbs./yr.)	Target TMDL Value (lbs./day)
Sediment	**76.4**	**6,497.0**	**496,631.1**	**1,360.6**

The target TMDL value was then used as the basis for load allocations and reductions in Poplar Run, using the following two equations:

1. TMDL = WLA + LA + MOS and LA = ALA + LNR

where:

TMDL = Total Maximum Daily Load
WLA = Waste Load Allocation (Point Sources)
LA = Load Allocation (Non point Sources)
MOS = Margin of Safety
ALA = Adjusted Load Allocation
LNR = Loads Not Reduced

Waste Load Allocation

The waste load allocation (WLA) portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. A search of the Pennsylvania Department of Environmental Protection's (Department), online, GIS database, EMAP, no NPDES point source discharges within the Poplar Run Watershed were identified. Despite this, an allocation of 1% of the TMDL (496,631.1 lbs./yr.) was incorporated as a bulk reserve (4,966.3 lbs./yr.) to take in account the dynamic nature of future permit activity. This bulk reserve is the WLA of this TMDL.

WLA = 496,631.1 lbs./yr. (TMDL) x 0.01 (1% Bulk Reserve)

WLA = 4,966.3 lbs./yr. or 13.6 lbs./day

Margin of Safety

The margin of safety (MOS) is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for sediment was reserved as the MOS. Using 10% of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of the sediment impaired segments of Poplar Run. The MOS used for the sediment TMDL was set at 49,663.1 lbs./yr.

MOS = 496,631.1 lbs./yr. (TMDL) * 0.1 = 49,663.1 lbs./yr. or 136.1 lbs./day

Load Allocation

The load allocation (LA) is that portion of the TMDL that is assigned to nonpoint sources. The LA for sediment and phosphorus was computed by subtracting the MOS value and the WLA from the TMDL value. The LA for sediment was 442,001.7 lbs./yr.

LA = 496,631.1 lbs./yr. (TMDL) – 49,663.1 lbs./yr. (MOS) – 4,966.3 lbs./yr. (WLA) =
LA = 442,001.7 lbs./yr. or 1,211.0 lbs./d.

Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those nonpoint source loads that are not being considered for reductions (loads not reduced (LNR)) from the LA. While the Poplar Run Watershed TMDL was developed to address impairments caused by agricultural activities including, hay/pastureland and cropland, they were not the only land uses considered for reductions. Associated stream banks and more specifically, land development were contributors to the sediment loading in the watershed. Land uses/source loads not reduced (LNR) were carried through at their existing loading (Table 9).

Table 9. Load Allocations, Loads Not Reduced and Adjusted Load Allocations (Poplar Run)

	Sediment (lbs./yr.)	Sediment (lbs./day)
Load Allocation	**442,001.7**	**1,360.6**
Loads Not Reduced:	**3,200.0**	**8.8**
Forest	2,800.0	7.7
Bare Rock	400.0	1.1
Adjusted Load Allocation	**438,801.7**	**1,202.2**

TMDL Summary

The sediment TMDL established for the Poplar Run Watershed consists of a Load Allocation (LA) and a Margin of Safety (MOS). The individual components of the Poplar Run Watershed TMDL are summarized in Table 10. Daily expressions of the TMDLs are based on dividing the annual load by 365 days.

Table 10. TMDL Components for Poplar Run

	Sediment (lbs./yr.)	Sediment (lbs./day)
TMDL (Total Maximum Daily Load)	496,631.1	1,360.6
WLA (Waste Load Allocation)	4,966.3	13.6
MOS (Margin of Safety)	49,663.1	136.1
LA (Load Allocation)	442,001.7	1,211.0
LNR Loads Not Reduced)	3,200.0	8.8
ALA (Adjusted Load Allocation)	438,801.7	1,202.2

Calculation of Sediment Load Reductions

The adjusted load allocation established in the previous section represents the sediment and phosphorus loads that are available for allocation between Hay/Pasture, Cropland, Stream Banks, and the sum of Development in the Poplar Run Watershed. Data needed for load reduction analyses, including land use distribution, were obtained by GIS analysis. The Equal Marginal Percent Reduction (EMPR) allocation method, Attachment B, was used to distribute the ALA between the three land use types and stream banks. The process is summarized below:

Each land use/source load is compared with the total allocable load to determine if any contributor would exceed the allocable load by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load to the receiving waterbody. If the contributor exceeds the allocable load, that contributor would be reduced to the allocable load. This is the baseline portion of EMPR. For this evaluation Cropland was in excess of the adjusted load allocation (ALA). After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the total allocable load. If the allocable load is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed. For this evaluation the allocable load was exceeded. The equal percent reduction, i.e., the ALA divided by the summation of the baselines, worked out to a **72.5%** reduction in sediment loading in Poplar Run. Tables 11. (Annual Values) and Table 12. (Daily Values) contain the results of the EMPR in sediment loading and Table 13. (Annual Values) and Table 14. (Daily Values) contain the results of the EMPR in current for the respective land use in the Poplar Run Watershed (Attachment B.). The load allocation for each land use is shown along with the percent reduction of current loads necessary to reach the targeted LA.

Table 11. Sediment Load Allocations/Reductions for Land Uses and Stream Banks In Poplar Run (Annual Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/yr.)	(lbs./acre/yr.)	(lbs./yr.)	(lbs./yr.)	% Reduction
Cropland	473.0	1,765.3	363.4	835,000.0	171,885.7	**79.4%**
Hay/Pasture	1,006.0	234.2	91.7	235,600.0	92,288.3	**60.8%**
Stream Bank	-	-	-	517,800.0	171,885.7	**66.8%**
Development	522	13.4	5.3	7,000.0	2,742.0	**60.8%**

Table 12. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in Poplar Run (Daily Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/day)	(lbs./acre/day)	(lbs./day)	(lbs./day)	% Reduction
Cropland	473.0	4.80	1.00	2,287.7	470.9	**79.4%**
Hay/Pasture	1,006.0	0.60	0.25	645.5	252.8	**60.8%**
Stream Bank	-	-	-	1,418.6	470.9	**66.8%**
Development	522.0	0.04	0.01	19.2	7.5	**60.8%**

Consideration of Critical Conditions

The MAPSHED model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads, based on daily water balance accumulated in monthly values. Therefore, all flow conditions are taken into account for loading calculations. Because there is generally a significant lag time between the introduction of sediment to a waterbody and the resulting impact on beneficial uses, establishing this TMDL using average annual conditions is protective of the waterbody.

Consideration of Seasonal Variations

The continuous simulation model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

Consideration of Background Contributions

The MAPSHED model accounts for all land uses within the watershed and their respective contributions to the sediment load. The only background sources of sediment within the watershed would be from forested areas. There are no additional "upstream" sources of sediment to this watershed. The remaining land uses are anthropogenic sources to the watershed, thus will not be considered background.

Recommendations

Sediment reduction in the TMDL is allocated to nonpoint sources in the watershed including: agricultural activities, transitional lands, coal mines, and stream banks. Implementation of best management practices (BMPs) in these affected areas are called for according to this TMDL document. The proper implementation of these BMPs should achieve the loading reduction goals established in the TMDL.

From an agricultural perspective, reductions in the amount of sediment reaching the streams in the watershed can be made through the right combination of BMPs including, but not limited to: establishment of cover crops, strip cropping, residue management, no till, crop rotation, contour farming, terracing, stabilizing heavy use areas and proper management of storm water. Vegetated or forested buffers are acceptable BMPs to intercept any runoff from farm fields. For the pasturing of farm animals and animal heavy use areas, acceptable BMPs may include: manure storage, rotational grazing, livestock exclusion fencing and forested riparian buffers. Some of these BMPs were observed in the sediment-impaired watershed of Poplar Run; however, they were more extensively used in the unimpaired, reference stream, Laurel Run, with forested riparian buffers being the predominant BMP in use. Since most watersheds have a considerable amount of agricultural activities, it is apparent that the greater use of BMPs, especially forested riparian buffers, in the reference streams have contributed to their ability to maintain their attainment status as a Cold Waters Fishery (CWF).

Stream banks also contribute to the sediment load in the watershed. Stream bank stabilization projects would be acceptable BMPs for the eroded stream banks in the area. However, the establishment of forested riparian buffers is the most economical and effective BMP at providing stream bank stabilization and protection of the banks from freeze/thaw erosion and scouring flows. Forested riparian buffers are also essential to maintaining the biologically rich yet sensitive CWF habitat. Forested riparian buffers also provide important natural and durable connectivity of land and water. This connectivity is necessary to provide cover, nesting and nursery sites, shade and stable temperatures, and viable substrate for aquatic organisms of all layers of the food web protected under the CWF use designation.

Important to TMDLs, established forested riparian buffers act as nutrient and sediment sinks. This is because the highly active and concentrated biological communities they maintain will assimilate and remove nutrients and sediment from the water column instead of allowing them to pass downstream, thus forested riparian buffers work directly toward attaining the goals of the TMDL by reducing pollutant loads. These forested riparian buffers also provide the essential conditions necessary to meet the CWF designated use of the waterway. Forested riparian buffers also provide critical habitat to rare and sensitive amphibious and terrestrial organisms as well as migratory species. While forested riparian buffers are considered the most effective BMP, other possibilities for attaining the desired reductions may exist for the agricultural usages, as well as for the stream banks.

For both the agricultural land uses, further ground truthing should be performed in order to assess both the extent of existing BMPs, and to determine the most cost effective and environmentally protective combination of BMPs required for meeting the sediment reductions outlined in this report. A combined effort involving key personnel from the southwest regional DEP office, the Fayette County Conservation District and other state and local agencies and/or the Mountain Watershed Association would be the most effective in accomplishing any ground truthing exercises. Development of a more detailed watershed implementation plan is recommended.

Funding Sources

The Federal Nonpoint Source Management Program (§ 319 of the Clean Water Act) is one funding source for nonpoint source pollution reduction BMPs, such as those described above. This grant program provides funding to assist in implementing Pennsylvania’s Nonpoint Source Management Program. This includes funding for abandoned mine drainage, agricultural and urban run-off, and natural channel design/stream bank stabilization projects.
Information on Pennsylvania’s Nonpoint Source Management Program can be found at:
http://www.portal.state.pa.us/portal/server.pt/community/nonpoint_source_management/10615

As mentioned before, a second funding source is Pennsylvania’s Growing Greener Watershed Grants, which provides nearly $547 million in funding to clean up non-point sources of pollution throughout Pennsylvania. The grants were established by the Environmental Stewardship and Watershed Protection Act.
Information on Pennsylvania’s Growing Greener Watershed Grants can be found at:
http://www.depweb.state.pa.us/portal/server.pt/community/growing_greener/13958
Information on these and other programs and additional funding sources can be found at:
http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Grants/GrantLoans

Public Participation

Public notice of the TMDL will be published in the Pennsylvania Bulletin on May 26, 2018 to foster public comment on the allowable loads calculated. A 30-day period will be provided for the submittal of comments and notice. Any public contribution will be placed in the ***Comments and Response***, Section B, Pg.48.

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Attachment A
Equal Marginal Percent Reduction Method

Equal Marginal Percent Reduction (EMPR) (An Allocation Strategy)

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing nonpoint sources. The load allocation and EMPR procedures were performed using a MS Excel spreadsheet. The 5 major steps identified in the spreadsheet are summarized below:

Step 1: Calculation of the TMDL based on impaired watershed size and unit area loading rate of reference watershed.

Step 2: Calculation of Adjusted Load Allocation based on TMDL, Margin of Safety, and existing loads not reduced.

Step 3: Actual EMPR Process:

a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of EMPR.

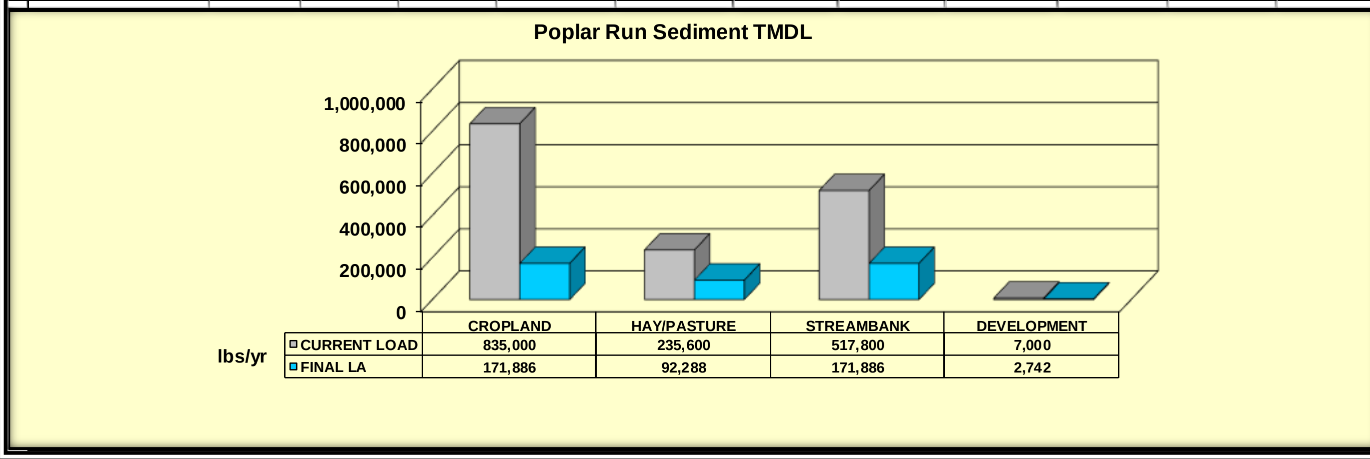
b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

Step 4: Calculation of total loading rate of all sources receiving reductions.

Step 5: Summary of existing loads, final load allocations, and % reduction for each pollutant source.

Table A1. Equal Marginal Percent Reduction calculations for sediment loading in Poplar Run

1	TMDL				2	Adjusted LA = TMDL total load - ((MOS) - loads not reduced)						
	TMDL = Sediment loading rate in ref. * Impaired Acres					438801.7	438801.7					
	496631.1											
		Annual				Recheck	% reduction	Load			Allowable	%
3		Avg. Load	Load Sum	Check	Initial Adjust	Adjust	allocation	Reduction	Initial LA	Acres	Loading Rate	Reduction
	CROPLAND	835000.0	1588400.0	bad	438801.7		0.4	266916.0	171885.7	473.0	363.4	79.4%
	HAY/PASTURE	235600.0		good	235600.0	681401.7	0.2	143311.7	92288.3	1006.0	91.7	60.8%
	STREAMBANK	517800.0		bad	438801.7		0.4	266916.0	171885.7			66.8%
	DEVELOPMENT	7000.0		good	7000.0		0.0	4258.0	2742.0	522.0	5.3	60.8%
					1120203.4		1.0		438801.7			
4	All Ag. Loading Rate	178.62										
			Allowable		Current	Current						
		Acres	loading rate	Final LA	Loading Rate	Load	% Red.			CURRENT LOAD	FINAL LA	
5	CROPLAND	473.0	363.4	171885.7	1765.3	835000.0	79.4%		CROPLAND	835,000	171,886	
	HAY/PASTURE	1006.0	91.7	92288.3	234.2	235600.0	60.8%		HAY/PASTURE	235,600	92,288	
	STREAMBANK			171885.7		517800.0	66.8%		STREAMBANK	517,800	171,886	
	DEVELOPMENT	522	5.3	2742.0	13.4	7000.0	60.8%		DEVELOPMENT	7,000	2,742	
				438801.7		1595400.0	72.5%					



Attachment B
MAPSHED Generated Data Tables

Table B1. GWLF model data outputs for Poplar Run

GWLF Total Loads for file: PoplarRun-0 | Period of analysis: 30 years from 1961 to 1990

Source	Area (Acres)	Runoff (in)	Tons: Erosion	Tons: Sediment	Total Loads (Pounds): Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	1006	2.2	715.3	117.8	402.2	874.5	175.0	403.0
Cropland	473	4.4	2535.9	417.5	1373.1	3047.4	167.7	975.9
Forest	4392	1.1	8.3	1.4	217.2	222.8	11.4	14.1
Wetland	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turfgrass	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Land	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bare Rock	104	7.5	1.3	0.2	53.1	53.9	1.8	2.2
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	512	3.2	0.0	3.1	58.2	176.4	7.8	19.4
MD Mixed	10	12.4	0.0	0.4	5.1	15.5	0.6	1.6
HD Mixed	0	18.7	0.0	0.0	0.2	0.8	0.0	0.1
LD Residential	0	3.2	0.0	0.0	0.0	0.0	0.0	0.0
MD Residential	0	6.4	0.0	0.0	0.0	0.0	0.0	0.0
HD Residential	0	9.4	0.0	0.0	0.0	0.0	0.0	0.0
Farm Animals						1380.1		364.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				258.9		259.5		125.3
Groundwater					11512.3	11512.3	467.3	467.3
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					31.9	31.9	0.0	0.0
Totals	6496.6	4.2	3260.8	799.4	13653.5	17575.1	831.7	2372.9

Table B2. GWLF model data outputs for Laurel Run

GWLF Total Loads for file: LaurelRun-0   Period of analysis: 30 years from 1961 to 1990

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	102	2.2	81.1	13.0	40.6	110.2	18.0	43.7
Cropland	38	4.4	244.0	39.0	109.8	319.2	13.6	91.0
Forest	6918	0.7	14.6	2.3	213.6	226.1	11.2	15.9
Wetland	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turfgrass	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Land	16	4.4	7.3	1.2	8.2	14.5	0.2	2.5
Bare Rock	68	4.4	1.3	0.2	20.6	21.7	0.7	1.1
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	372	3.2	0.0	2.3	42.2	127.8	5.6	14.1
MD Mixed	3	12.4	0.0	0.1	1.4	4.1	0.2	0.4
HD Mixed	0	18.7	0.0	0.0	0.0	0.0	0.0	0.0
LD Residential	0	3.2	0.0	0.0	0.0	0.0	0.0	0.0
MD Residential	0	6.4	0.0	0.0	0.0	0.0	0.0	0.0
HD Residential	0	9.4	0.0	0.0	0.0	0.0	0.0	0.0
Farm Animals						1602.5		421.5
Tile Drainage				0.0		0.0		0.0
Stream Bank				229.2		307.2		113.4
Groundwater					14468.3	14468.3	378.7	378.7
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					7.1	7.1	0.0	0.0
Totals	7516.7	2.1	348.2	287.3	14911.7	17208.7	428.2	1082.2

Attachment F
Comment and Response

No public comments were received.