Preliminary Draft TMDL for Sediment in the Indian Creek Watershed, Montgomery County, PA

Existing Loads

US EPA Region 3
Philadelphia, PA 19103

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- Green Valleys Watershed Association
- U.S. Geological Survey
- Municipalities of the Indian Creek Watershed
    - Franconia Township
    - Lower Salford Township
    - Telford Borough

Executive Summary

The U.S. Environmental Protection Agency, Region 3 (EPA) has developed a preliminary draft total maximum daily load (TMDL) report to identify sources of sediment and quantify existing sediment loadings in the Indian Creek watershed, located in southeastern Pennsylvania (PA). This document will facilitate consultations with stakeholders and inform the development of allocations for point and nonpoint sources within the watershed. Ultimately, this effort will contribute to the development of a sediment TMDL for the Indian Creek watershed.

Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (codified at Title 40 of the *Code of Federal Regulations* Part 130) require states to develop TMDLs for impaired waterbodies. A TMDL establishes the amount of a pollutant that a waterbody can assimilate without exceeding its water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources and to restore and maintain the quality of the state's water resources.

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

$$\text{TMDL} = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

The Indian Creek watershed drains approximately seven square miles in Montgomery County, PA and includes portions of five municipalities. Various degrees of residential development (low, medium and high intensity residential) are scattered throughout the watershed while the middle portion is mostly agricultural.

The TMDL will be developed to address segments in the Indian Creek watershed listed on the state's 303(d) list as not attaining aquatic life uses due to siltation (sediment). The sediment TMDL was developed to protect designated aquatic life uses using the Generalized Watershed Loading Functions (GWLF) watershed model to meet sediment loading targets established through a reference watershed.

EPA expects that the final sediment TMDL for the Indian Creek watershed will likely be expressed as annual loads and daily loads in **Section 5** of the report. The sediment TMDL for the Indian Creek watershed will likely include an explicit MOS of five percent to account for uncertainty in the modeling process.

Any final TMDL will inform future National Pollutant Discharge Elimination System (NPDES) permits (re)issued in the watershed. Federal regulations require that NPDES permit effluent limits be consistent with the assumptions and requirements of the TMDL WLAs. While the applicable permit effluent limits need not be identical to the WLA, EPA anticipates that future permits will include appropriate limits and other controls on total suspended solids (TSS) discharged, including requirements for Municipal Separate Storm Sewer System (MS4) communities to develop and implement short and long-term plans to control sediment in stormwater.

EPA is required to seek public comment pursuant to 40 C.F.R. §130.7(d)(2) for any TMDLs developed by EPA. Public participation for this TMDL development process is discussed in **Section 7**.

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List of Acronyms

CFR	Code of Federal Regulations
CN	Curve Numbers
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
GIS	Geographic Information Systems
GWLF	Generalized Watershed Loading Functions
KLSCP	Product of USLE Parameters
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristics Consortium
MS4	Municipal Separate Storm Sewer System
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
PADEP	Pennsylvania Department of Environmental Protection
SHG	Soil Hydrologic Group
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UA	Urbanized Area
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WLA	Wasteload Allocation
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

1 Background

Section 303(d) of the Clean Water Act (CWA) and its implementing Water Quality Planning and Management Regulations (codified at Title 40 of the *Code of Federal Regulations* Part 130) require states to develop total maximum daily loads (TMDLs) for waterbodies that are not supporting their designated uses even if pollutant sources have implemented controls sufficient/necessary to meet technology-based effluent limitations and guidelines. A TMDL establishes the maximum allowable load (mass per unit of time) of a pollutant that a waterbody is able to assimilate and still support its designated use(s). The maximum allowable load is determined based on the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of the state's water resources. The development of TMDLs requires an assessment of streams' assimilative capacity, critical conditions, and other considerations.

Several segments in the Indian Creek watershed have been listed on Pennsylvania's 303(d) list of impaired waters for not meeting aquatic life uses due to siltation and nutrient impairments. This preliminary draft TMDL report represents an effort by EPA to identify sources of sediment and quantify existing sediment loadings in the Indian Creek watershed. This document will facilitate consultations with stakeholders and inform the development of load allocations for point and nonpoint sources within the watershed. The successive TMDL report will document revised sediment TMDLs developed to address the siltation impairments in Indian Creek and its tributaries.

1.1 History of the Indian Creek Watershed Nutrient and Sediment TMDLs

On June 30, 2008, EPA established nutrient and sediment TMDLs for the Indian Creek watershed in southeastern Pennsylvania (*Nutrient and Sediment TMDLs for the Indian Creek Watershed, Pennsylvania Established by the U.S. Environmental Protection Agency*).[1]

The 2008 TMDLs assigned all load allocations to the wasteload allocation (WLA) category. EPA assigned wasteload allocations (WLAs) to three wastewater treatment plants (WWTPs): Telford Borough Authority, Pilgrim's Pride, and Lower Salford Authority (Harleysville sewage treatment plant) and four MS4 jurisdictions: Lower Salford, Telford, Souderton, and Franconia. EPA could not identify areas within MS4 political boundaries not serviced by the MS4s; therefore, EPA was unable to separate potential nonpoint source load allocations from MS4 wasteload allocations.

EPA developed nutrient and sediment TMDLs for the Indian Creek watershed at the request of the Pennsylvania Department of Environmental Protection (PADEP), and pursuant to requirements of the Pennsylvania TMDL Consent Decree, American Littoral Society v. EPA, Civil No. 96-489 (E.D.Pa.) (J. Katz). The consent decree required EPA to establish TMDLs for water quality limited segments (WQLSs) identified on Pennsylvania's 1996 CWA section 303(d)

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[1] *Nutrient and Sediment TMDLs for the Indian Creek Watershed, Pennsylvania Established by the U.S. Environmental Protection Agency, June 30, 2008*, (USEPA 2008) accessed at: http://www.epa.gov/tmdl/nutrient-and-sediment-tmdls-indian-creek-watershed-pennsylvania

list of impaired waters. Pennsylvania identified Indian Creek on its 1996 list as a WQLS impaired for aquatic life uses by an unknown "cause" and "source unknown." Pennsylvania's 2004 list refined this listing as impaired by nutrients, identified the source as municipal point sources, and added an impairment for siltation with sources from agriculture, small residential runoff and urban runoff/storm sewers.

EPA established the Indian Creek TMDLs to address WQLSs listed on Pennsylvania's 303(d) list that were not meeting aquatic life uses as a result of siltation (sediment) and nutrients. As explained in detail in the 2008 Indian Creek TMDL report and supporting documents, EPA relied on extensive water quality data and expert scientific analysis in establishing these TMDLs. Please refer to the Indian Creek Watershed TMDL (USEPA 2008) for further details.

The Indian Creek TMDL has been challenged in two lawsuits. Plaintiffs Lower Salford Township Authority, Lower Salford Township, Franconia Sewer Authority and Franconia filed a Complaint against EPA for both nutrient and sediment TMDLs on October 18, 2011, *Lower Salford Township Authority et al. v. EPA*, Civil Action No. 2:11-cv-06489-CDJ (E.D.PA). In November 20, 2012, Telford Borough Authority filed an additional challenge to the Indian Creek nutrient TMDL, *Telford Borough Authority v. EPA*, Civil No. 2:12-cv-06548-CDJ (E.D. PA) (*Telford)*.

EPA issued a reconsideration decision[2] on March 21, 2014 in response to requests by the Telford Borough Authority and Lower Salford Township for reconsideration of the nutrient and sediment TMDLs for Indian Creek. For the nutrient TMDL, EPA considered the additional information and comments received, reviewed the nutrient TMDL in light of that information, and determined that the nutrient TMDL remains technically sound. EPA therefore denied the requests to withdraw the nutrient TMDL. For the sediment TMDL, EPA's analysis of the Indian Creek sediment TMDL confirmed concerns that the reference watershed approach and sediment loading rates used should be revisited. Based on that analysis, EPA filed a request dated April 1, 2014 seeking a voluntary remand of the Indian Creek sediment TMDL in the case *Lower Salford Township Authority et al. v. EPA*, Civil Action No. 2:11-cv-06489-CDJ (E.D.PA). The U.S. District Court for the Eastern District of Pennsylvania granted that request by Order dated April 3, 2014.

EPA issued a second reconsideration decision[3] on September 8, 2016 in response to a second request by Telford Borough Authority on December 23, 2014 for reconsideration and withdrawal of the Indian Creek nutrient TMDL. For the nutrient TMDL, EPA considered the additional information and comments received from Telford, reviewed the TMDL in light of that information, and determined that the nutrient TMDL remains technically sound. EPA therefore

[2] *March 21, 2014 Reconsideration Decision and Rationale: Nutrient and Sediment TMDLs for the Indian Creek Watershed, Pennsylvania Established by the U.S. Environmental Protection Agency, June 30, 2008*, (USEPA 2014) accessed at: http://www.epa.gov/tmdl/nutrient-and-sediment-tmdls-indian-creek-watershed-pennsylvania

[3] *September 8, 2016 Second Reconsideration Decision and Rationale: Nutrient and Sediment TMDLs for the Indian Creek Watershed, Pennsylvania Established by the U.S. Environmental Protection Agency, June 30, 2008*, (USEPA 2016) accessed at: http://www.epa.gov/tmdl/nutrient-and-sediment-tmdls-indian-creek-watershed-pennsylvania

denied Telford's second request to withdraw the nutrient TMDL. The 2008 Indian Creek nutrient TMDL remains in effect.

As part of the voluntary remand of the Indian Creek sediment TMDL, EPA has contracted with Michael Baker and its subcontractor MapTech to develop existing sediment loads and allocations for the Indian Creek watershed. The purpose of this work is to establish a watershed-based TMDL for sediment to address the sediment impairments in the Indian Creek watershed. This preliminary draft TMDL report represents an effort by EPA to identify sources of sediment and quantify existing sediment loadings in the Indian Creek watershed. A stakeholder group has been formed to provide input on the existing sediment loads and discuss allocation scenarios. The stakeholder group includes representatives from municipalities and WWTPs within Franconia Township, Lower Salford Township, Souderton Borough, and Telford Borough, as well as County Conservation Districts for Bucks, Chester and Montgomery Counties, Montgomery County Planning Commission, Green Valleys Watershed Association, Pennsylvania Department of Transportation (PennDOT), Pennsylvania Turnpike Commission, PADEP, and EPA.

1.2 Watershed Description

Indian Creek, a third-order stream with a drainage area of approximately seven square miles, flows 6.1 miles through areas of Montgomery County, Pennsylvania (**Figure 1-1**). 27 tributaries drain to Indian Creek, some of which are intermittent. Indian Creek watershed includes portions of five municipalities and has 14 National Pollutant Discharge Elimination System (NPDES) permitted discharges. Various degrees of residential development (low, medium, and high intensity residential) are scattered throughout the watershed, while the middle portion is predominantly agricultural. More developed land uses such as commercial, residential, and road comprise 52.7 percent of the watershed while agriculture, open areas, and forest make up the remaining 27.1, 13.3, and 6.9 percent, respectively. Interstate 476 bisects the Indian Creek watershed.

The mainstem of Indian Creek flows southwesterly and discharges to the East Branch Perkiomen Creek which flows into the Perkiomen Creek which is a tributary of the Schuylkill River which discharges to the Delaware River. The nearest U.S. Geological Survey (USGS) stream gauging station (01472810) is located on East Perkiomen Creek near Schwenksville. **Figure 1-1** shows the locations of gauge stations, NPDES permittees, PADEP sampling locations, and municipal boundaries.

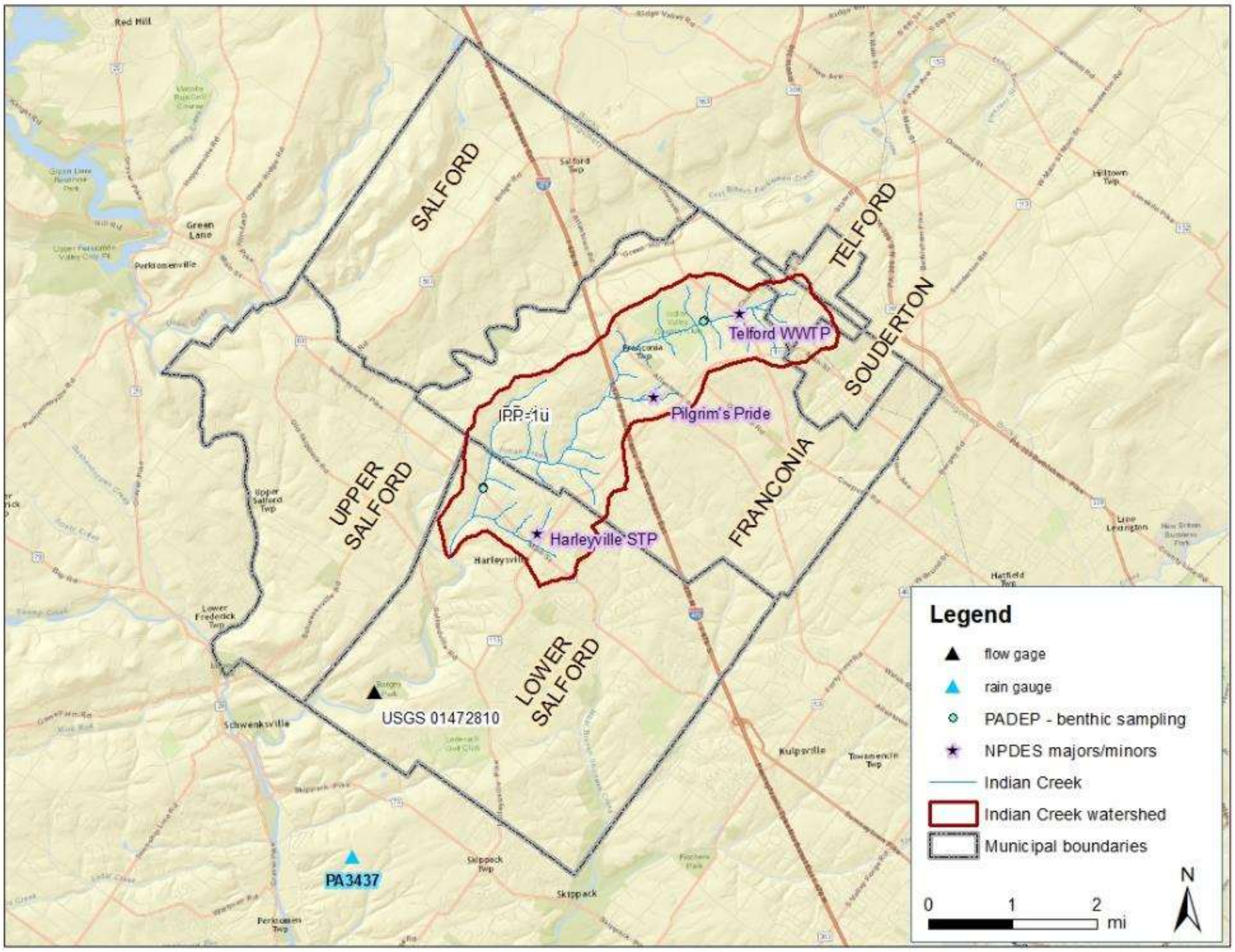

Figure 1-1. Site map of the Indian Creek watershed.

National Land Cover Data (NLCD) are available through the Multi-Resolution Land Characteristics Consortium (MRLC) as a joint effort between EPA and USGS. After comparing the 2011 30-meter resolution MRLC/NLCD land use to aerial photography from similar years, it was determined that this land use dataset was not a good fit for the watershed, as too much non-agricultural open space and residential yards were included in agricultural land uses. Instead, the land use data layer provided by Franconia Township was analyzed and determined to be a good fit, requiring few supplementary data.

The Indian Creek land use data provided by Franconia Township were used and extrapolated to cover the entire watershed. Using aerial photography, the methodology to generate the Franconia Township data was analyzed. Then, by applying this methodology to the entire watershed, the land use for the remainder of the watershed was delineated based on aerial photography. The resulting land use map is presented in **Figure 1-2**. Franconia Township's data layer lumped all agricultural land uses together under one title. Based on assessment of aerial photography and input from local stakeholders, this land use is predominantly cropland, with pasture and hay comprising less than 10% each, of the total agricultural acreage.

Based on this analysis, residential is the dominant land use, comprising approximately 39.6 percent of the watershed, followed by agriculture (27.1), open areas (13.3), commercial (10.1), roads (3.0), and forest (6.9). Data provided by the Montgomery County Conservation District further segregated agricultural land into cropland (22.7), hay (2.5), and pasture (1.9).

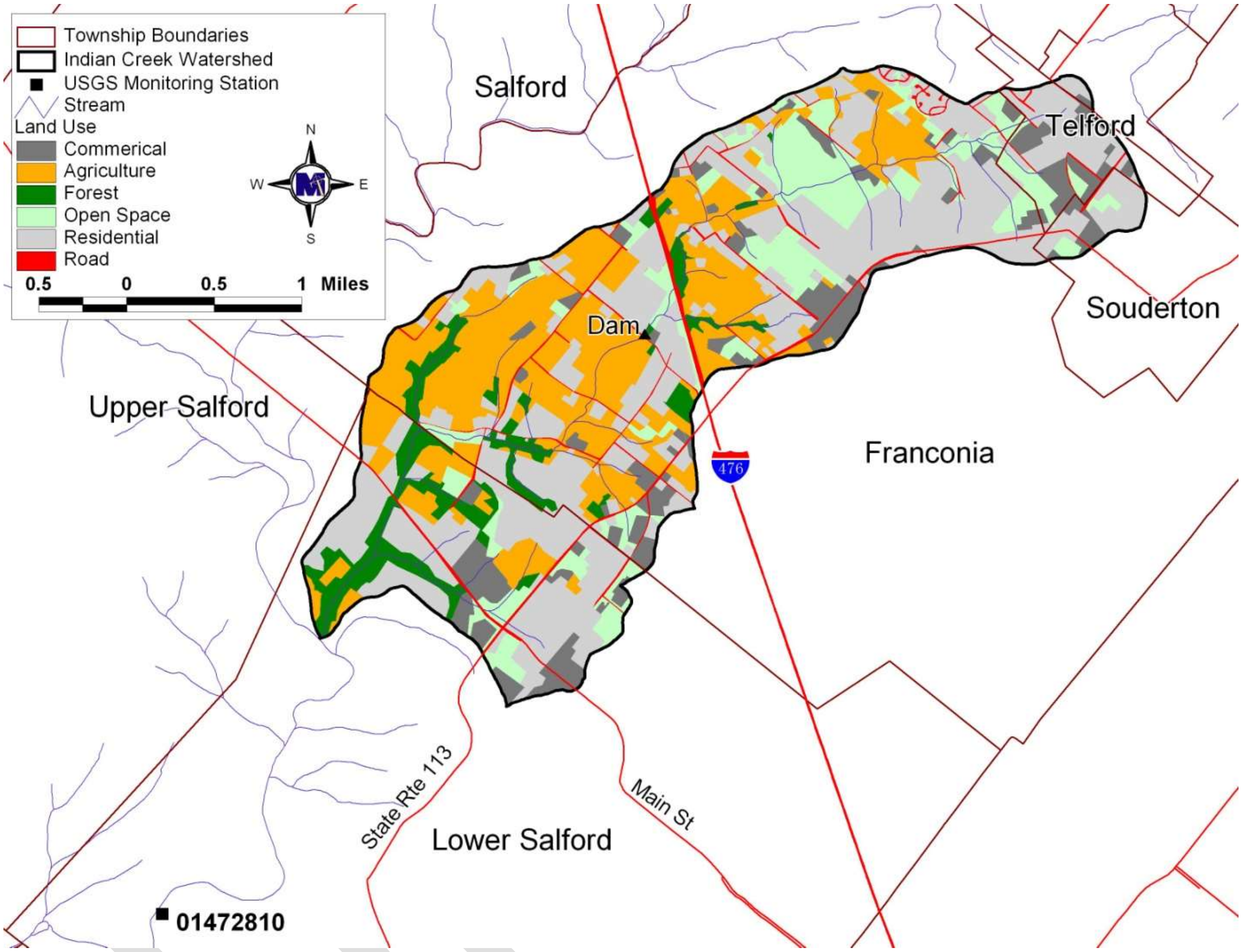

Figure 1-2. Land use distribution in the Indian Creek watershed.

1.3 Pennsylvania's Water Quality Standards

Under the Clean Water Act, States and authorized Tribes are responsible for setting water quality standards (WQS) to protect the physical, biological, and chemical integrity of their waters. WQSs are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and criteria for those waters based upon such uses. Criteria are "elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use" (USEPA 1994).

Statewide and designated water uses are applicable to Indian Creek, which is a tributary to the East Branch Perkiomen Creek, pursuant to *Pennsylvania Code*, Title 25, Environmental

Protection, Department of Environmental Protection, Chapter 93.4 and Chapter 93.9(f), respectively. The protected uses applicable to the Indian Creek watershed are shown in **Table 1-1** and include: trout stocking fishes (TSF) and migratory fishes (MF).

Table 1-1. Applicable protected uses for the Indian Creek Watershed.

Symbol	Protected Use	Description
Aquatic Life (Statewide)		
WWF	Warm Water Fishes	Maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.
Aquatic Life (Designated)		
MF	Migratory Fishes	Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which move to or from flowing waters to complete their life cycle in other waters.
TSF	Trout Stocking	Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.
Water Supply (Statewide)		
PWS	Potable Water Supply	Used by the public as defined by the Federal Safe Drinking Water Act, 42 U.S.C.A. § 300F, or by other water users that require a permit from the Department under the Pennsylvania Safe Drinking Water Act (35 P. S. §§ 721.1—721.18), or the act of June 24, 1939 (P. L. 842, No. 365) (32 P. S. §§ 631—641), after conventional treatment, for drinking, culinary and other domestic purposes, such as inclusion into foods, either directly or indirectly.
IWS	Industrial Water Supply	Use by industry for inclusion into nonfood products, processing and cooling.
LWS	Livestock Water Supply	Use by livestock and poultry for drinking and cleansing.
AWS	Wildlife Water Supply	Use for waterfowl habitat and for drinking and cleansing by wildlife.
IRS	Irrigation	Used to supplement precipitation for crop production, maintenance of golf courses and athletic fields and other commercial horticultural activities.
Recreation (Statewide)		
B	Boating	Use of the water for power boating, sail boating, canoeing and rowing for recreational purposes when surface water flow or impoundment conditions allow.
F	Fishing	Use of the water for the legal taking of fish. For recreation or consumption.
WC	Water Contact Sports	Use of the water for swimming and related activities.
E	Esthetics	Use of the water as an esthetic setting to recreational pursuits.

Pennsylvania does not currently have specific numeric water quality criteria for sediment, but does have an applicable narrative criterion. The General Criteria defined in Pennsylvania's WQSs (25 PA Code §93.6) provides narrative water quality criteria necessary to protect designated uses from substances that may interfere with their attainment. The general water quality criteria state:

> *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)).

Because Pennsylvania WQS regulations do not currently include numeric criteria for sediment, EPA used a reference watershed approach to develop the allowable loading rates to protect designated uses in Indian Creek.

1.4 Impaired Waterbodies

Pennsylvania's 2015 *Assessment and Listing Methodology for Integrated Water Quality Monitoring and Assessment Reporting* documents the Commonwealth's cause definitions for water quality impairments, which are informative in interpreting Pennsylvania's narrative criteria. The cause definition for siltation (sediment) is:

> Siltation – aggradation of sediments or soils in excess of what the stream channel can transport. Results in smothering of streambed habitat for macroinvertebrates and fishes (PADEP, 2015).

Table 1-2 and **Figure 1-3** show Pennsylvania's 303(d) list of impaired waters in the Indian Creek watershed as presented in Pennsylvania's Final 2014 Integrated Report. Since 2010, Pennsylvania has identified Indian Creek on Category 4A of its Integrated Report as impaired waters with nutrient and sediment TMDLs developed in 2008. In their 2016 Integrated Report, Pennsylvania intends to list Indian Creek and its tributaries on category 5 for sediment as the 2008 sediment TMDL has been remanded. Once the 2016 Integrated Report is finalized and approved by EPA, this section will be updated.

Table 1-2. Summary of 303(d) Listings in the Indian Creek Watershed in Pennsylvania's Final 2014 Integrated Report

Source	Cause	Assessment Unit	Miles	Date Listed	Integrated Report Category
Indian Creek					
Agriculture	Siltation	2851	2.16	2004	4A
Agriculture	Siltation	3372	2.64	2004	4A
Municipal Point Source	Nutrients	3372	2.64	2004	4A
Small Residential Runoff	Siltation	3372	2.64	2004	4A

Source	Cause	Assessment Unit	Miles	Date Listed	Integrated Report Category
Urban Runoff/Storm Sewers		3372	2.64	2004	4A
Small Residential Runoff	Siltation	3373	0.78	2004	4A
Municipal Point Source	TDS	7958	0.61	1996	4A
Source Unknown	Cause Unknown	7958	0.61	1996	4A
Indian Creek Unnamed To (ID:25986868)					
Small Residential Runoff	Siltation	3373	0.39	2004	4A
Indian Creek Unnamed Of (ID:25986878)					
Small Residential Runoff	Siltation	3373	0.33	2004	4A
Indian Creek Unnamed Of (ID:25986902)					
Small Residential Runoff	Siltation	3373	0.25	2004	4A
Indian Creek Unnamed Of (ID:25987770)					
Small Residential Runoff	Siltation	3373	0.35	2004	4A
Indian Creek Unnamed Of (ID:25999064)					
Small Residential Runoff	Siltation	3373	0.38	2004	4A
Indian Creek Unnamed To (ID:25986882)					
Municipal Point Source	Nutrients	2948	0.3	2004	4A
Small Residential Runoff	Siltation	3373	0.87	2004	4A
Indian Creek Unnamed To (ID:25986892)					
Small Residential Runoff	Siltation	3373	0.39	2004	4A
Indian Creek Unnamed To (ID:25986904)					
Small Residential Runoff	Siltation	3373	0.76	2004	4A
Indian Creek Unnamed To (ID:25986920)					
Small Residential Runoff	Siltation	3373	0.4	2004	4A
Indian Creek Unnamed To (ID:25986926)					
Small Residential Runoff	Siltation	3373	0.49	2004	4A
Indian Creek Unnamed To (ID:25986930)					
Small Residential Runoff	Siltation	3373	0.62	2004	4A
Indian Creek Unnamed To (ID:25987060)					
Small Residential Runoff	Siltation	3373	1.26	2004	4A
Indian Creek Unnamed To (ID:25987062)					
Small Residential Runoff	Siltation	3373	0.41	2004	4A
Indian Creek Unnamed To (ID:25999068)					
Small Residential Runoff	Siltation	3373	0.25	2004	4A
Indian Creek Unnamed To (ID:25999070)					
Small Residential Runoff	Siltation	3373	0.32	2004	4A
Indian Creek Unnamed To (ID:25999072)					
Small Residential Runoff	Siltation	3373	0.46	2004	4A
Indian Creek Unnamed To (ID:25999074)					
Small Residential Runoff	Siltation	3373	0.65	2004	4A
Indian Creek Unnamed To (ID:25999076)					
Small Residential Runoff	Siltation	3373	0.29	2004	4A

Source	Cause	Assessment Unit	Miles	Date Listed	Integrated Report Category
Indian Creek Unnamed To (ID:25999078)					
Small Residential Runoff	Siltation	3373	0.49	2004	4A
Indian Creek Unnamed To (ID:25999080)					
Small Residential Runoff	Siltation	3373	0.38	2004	4A
Indian Creek Unnamed To (ID:25999082)					
Small Residential Runoff	Siltation	3373	0.28	2004	4A
Indian Creek Unnamed To (ID:25999092)					
Agriculture	Siltation	3372	0.45	2004	4A
Municipal Point Source	Nutrients	3372	0.45	2004	4A
Small Residential Runoff	Siltation	3372	0.45	2004	4A
Urban Runoff/Storm Sewers		3372	0.45	2004	4A
Indian Creek Unnamed To (ID:25999102)					
Small Residential Runoff	Siltation	3373	0.55	2004	4A
Indian Creek Unnamed To (ID:25999424)					
Agriculture	Siltation	3372	0.54	2004	4A
Municipal Point Source	Nutrients	3372	0.54	2004	4A
Small Residential Runoff	Siltation	3372	0.54	2004	4A
Urban Runoff/Storm Sewers		3372	0.54	2004	4A
Small Residential Runoff	Siltation	3373	0.38	2004	4A
Indian Creek Unnamed To (ID:25999522)					
Municipal Point Source	TDS	7958	0.45	1996	4A
Source Unknown	Cause Unknown	7958	0.45	1996	4A
Indian Creek Unnamed To (ID:25999528)					
Small Residential Runoff	Siltation	3373	0.43	2004	4A

TDS: Total Dissolved Solids

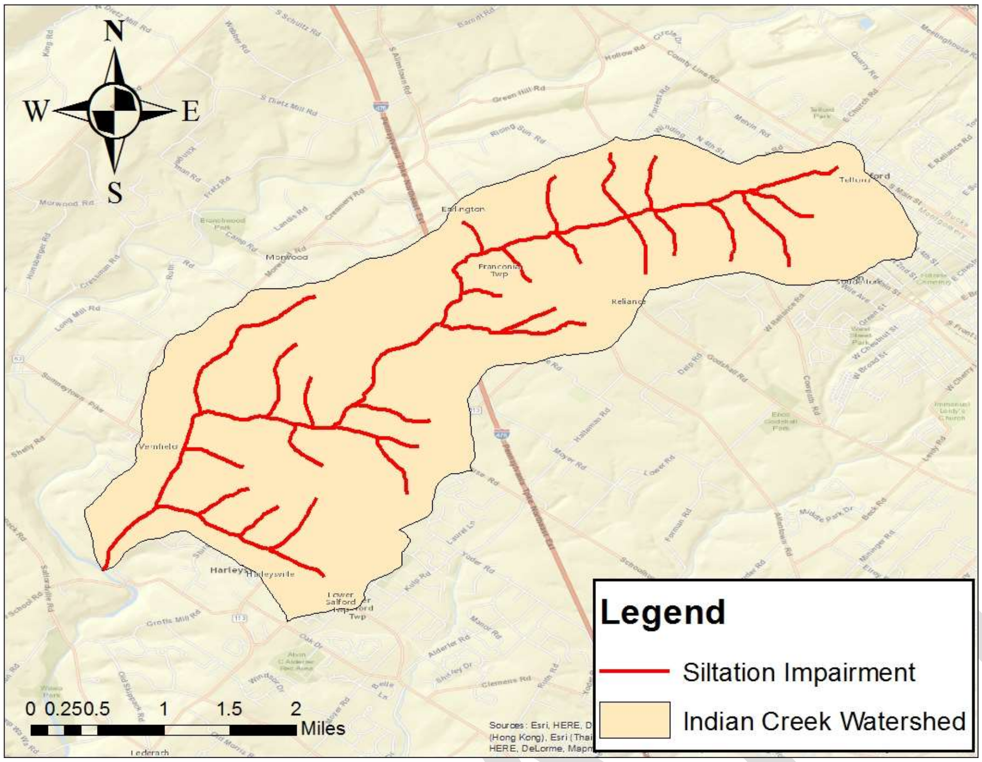

Figure 1-3. Waters impaired by sediment in the Indian Creek watershed as listed in the 2014 Final Integrated Report.

2 Reference Watershed Approach

Because Pennsylvania water quality standards (WQS) do not currently include numeric criteria for sediment, EPA used a reference watershed approach to estimate the necessary sediment load reductions that are needed to restore a healthy aquatic community and allow Indian Creek to achieve its designated uses.

2.1 Reference Watershed Approach

A reference watershed approach is used to estimate the necessary pollutant load reductions that are needed in Indian Creek to restore a healthy aquatic community and allow the streams in the watershed to achieve their designated uses. The reference watershed approach analyzes the current loading rates for the pollutants of interest from a selected unimpaired watershed that has similar physical and ecological characteristics to those of the impaired watershed. Characteristics that are considered include climate, soil properties, watershed size and topography, ecoregion and stream size. In addition, land use is considered as it represents human activities within the watershed. However, it is understood that a similar watershed, with similar land uses and management, is likely to be similarly impaired; therefore, differences in land uses between the impaired and reference watersheds are expected and displayed in **Table 2-2**. For example, commercial, residential, and road land uses comprise 52.7 percent of the Indian Creek watershed as compared to 23.7 in the Birch Run watershed. Although, agricultural land uses are comparable between Birch Run and Indian Creek watersheds (32.1 and 27.1, respectively), forest differs from 39.0 percent in Birch Run watershed to 6.9 percent in Indian Creek watershed. Regardless of the differences in land use, Birch Run represents a suitable reference watershed for the Indian Creek sediment TMDL due to similar watershed characteristics and the attainment of its designated uses.

The objective of this process is to reduce the loading rate of sediment (or other pollutant) in the impaired stream segment to a level equivalent to or slightly lower than the loading rate in the unimpaired reference stream segment. Achieving the sediment loadings set forth in the TMDLs will ensure that the designated aquatic life use of the impaired stream is achieved.

For this sediment TMDL, the modeling process uses annual loads of sediment in the non-impaired, reference watershed as a target for load reductions in the impaired watershed. The impaired watershed is modeled to determine the current loading rates and establish reductions needed to meet the loading rates of the unimpaired watershed.

2.1.1 Selected Reference Watershed and TMDL Target

Birch Run in Chester County, Pennsylvania was chosen as the reference watershed for the Indian Creek TMDL for sediment. Birch Run is designated as an Exceptional Value stream in Pennsylvania. The Birch Run watershed and Indian Creek watershed are shown in **Figure 2-1** with watershed characteristics displayed in **Table 2-1**.

On April 26, 2012, PADEP conducted benthic macroinvertebrate sampling and found that Birch Run had a benthic macroinvertebrate index of biological integrity score of 74.6 out of a possible 100, where the impairment threshold score is 50. This score of 74.6 indicates that Birch Run is attaining the aquatic life use.

EPA compared the Birch Run and Indian Creek watersheds and determined that they possessed similarities in watershed characteristics including size, climate, stream order, ecoregion location, land use and soil characteristics. Both the Indian Creek and Birch Run watersheds are completely within the Northern Piedmont Level III ecoregion and the watersheds share similar soil characteristics. Although the acreages of each land use are different as shown in **Table 2-2**, the total acreages of the watersheds are similar, resulting in third order streams. Because the watersheds share stream orders and ecoregions, benthic communities are expected to be comparable. Because Birch Run is unambiguously unimpaired and is similar in watershed characteristics to Indian Creek, Birch Run represents an appropriate reference watershed.

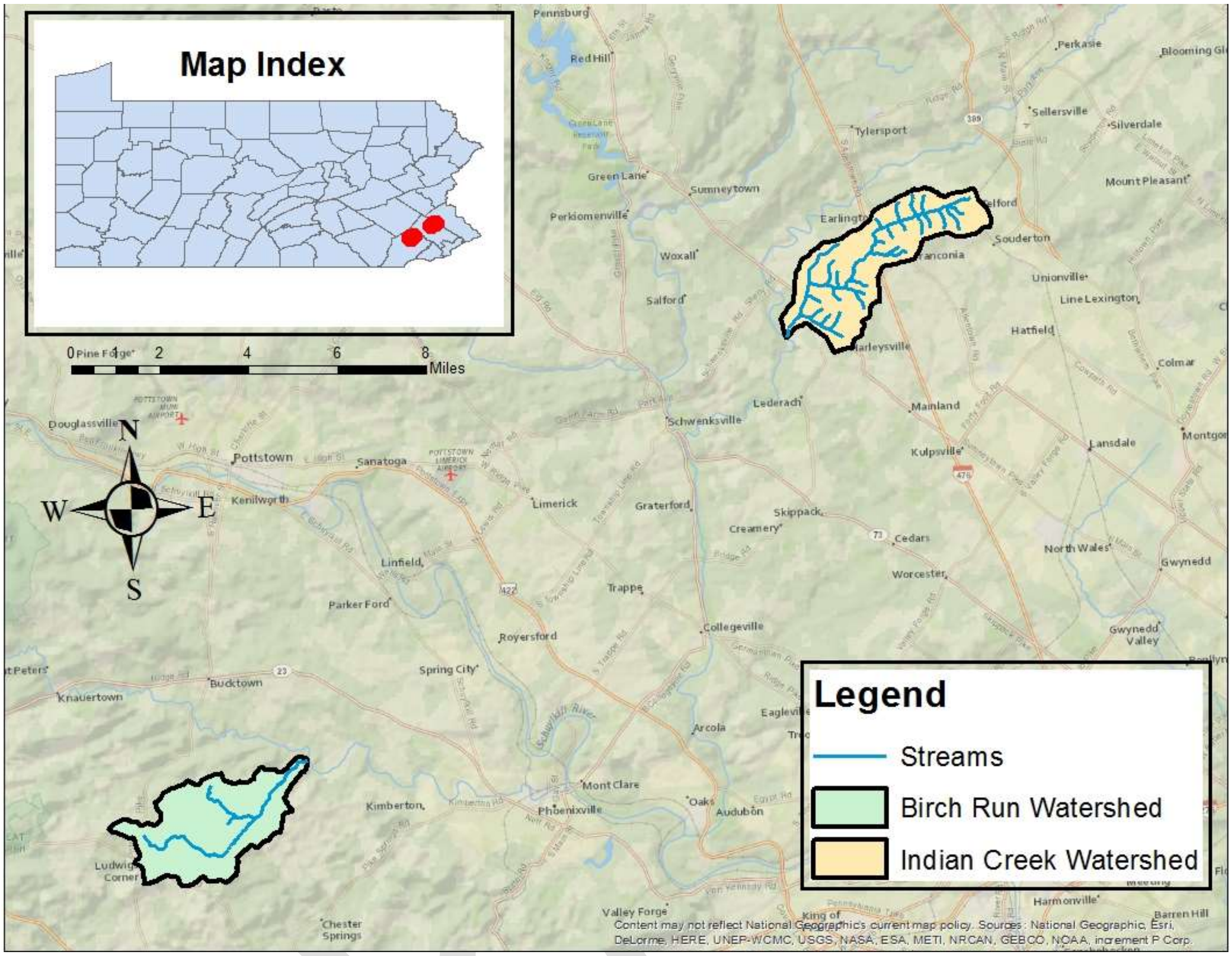

Figure 2-1. Location of Birch Run watershed in Chester County, Pennsylvania and Indian Creek watershed in Montgomery County.

Table 2-1. Comparison of Indian Creek watershed to Birch Run watershed.

Watershed Properties	Indian Creek	Birch Run
County	Montgomery	Chester
HUC (8-digit)	02040203	02040203
Discharges to Watershed	East Branch Perkiomen	French Creek
Square Miles	7	6.5
Benthic Macroinvertebrate IBI Score	30.3	74.6
IBI Date	9/6/2013	4/26/2012
Designated Uses	TSF, MF	EV, MF
Watershed Characteristics		
Stream Order	3	3
Slope (percent)	5.93	5.58
Aspect (degrees)	200.69	192.6
Soil Characteristics		
Hydrologic Group (avg)	2.75591	2.177083
Erodibility Kf factor	0.30033	0.426898
Available Water Capacity	0.116595	0.131346
Level 3 EcoRegion		
Northern Piedmont	100%	100%
Level 4 EcoRegion		
Triassic Lowlands	100%	1%
Piedmont Lowlands		99%

IBI: Index of Biotic Integrity
HUC: Hydrologic Unit Code
TSF: Trout Stocking Fishes; MF: Migratory Fishes; EV: Exceptional Value

Table 2-2. Land use areas in Indian Creek and Birch Run watersheds.

Sediment Source	Indian Creek (ac)	Indian Creek Percentage (%)	Birch Run (ac)	Birch Run Percentage (%)
Commercial	452	10.1	12	0.3
Crop	1,014	22.6	187	4.5
Forest	311	6.9	1,633	39.0
Hay	112	2.5	926	22.1
Open	594	13.3	179	4.3
Pasture	87	1.9	231	5.5
Residential	1,776	39.6	957	22.9
Road	134	3.0	24	0.6
Water	0	0.0	38	0.9
Watershed Total	**4,480**	**100**	**4,187**	**100**

2.2 Data Calls

To date, EPA has held two calls for local data including MS4 boundaries, land use/land cover, impervious surfaces, soils, topography, livestock numbers and best management practices including type, location, area treated, and efficiency. The first solicitation for data was held in December 2014 to January 2015 and requested local data for the Indian Creek watershed. The second data call was held in February 2016 to March 2016 and requested local data for the reference watershed, Birch Run.

EPA received Geographic Information Systems (GIS) information, maps, livestock numbers, permit information, photos, monitoring data, watershed plans, best management practices completed, conservation tillage data and stream channel surveys. The following is a list of the stakeholders that provided data for this study:

- Chester County Conservation District
- Chester County Department of Computing and Information Services
- Chester County Planning Commission
- Chester County Water Resources Authority
- Franconia Township
- Green Valleys Watershed Association
- Lower Salford Township
- Montgomery County Conservation District
- PADEP
- Pennsylvania Department of Transportation
- PA Turnpike Commission
- Telford Borough Authority
- EPA
- U.S. Geological Survey

3 Sediment Source Assessment

This section presents the information on point and nonpoint sources of sediment in the Indian Creek watershed. Two source areas were identified as the primary contributors to sediment loading in Indian Creek and are the focus of this study – point sources and nonpoint sources, including surface runoff and streambank erosion. The sediment-delivery process is a naturally occurring and continual process, but is often accelerated by human activity. An objective of the TMDL method is to minimize acceleration of the process. Strategies to allocate sediment loadings to point and nonpoint sources, and in turn reduce sediment loadings to Indian Creek, will be discussed with stakeholders subsequent to this preliminary draft TMDL report.

3.1 Point Sources

A point source, according to 40 *Code of Federal Regulations* (CFR) 122.3, is any discernible, confined, and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or might be discharged. The NPDES program, established under CWA sections 318, 402, and 405, generally requires permits for the discharge of pollutants from point sources.

Permitted dischargers to the Indian Creek watershed include continuous discharges from wastewater treatment plants (WWTP) with effluent discharge rates up to 1.1 million gallons per day (MGD) and stormwater discharges from MS4s and other stormwater dischargers. **Table 3-1** shows the permitted dischargers within the Indian Creek watershed and their associated total suspended solids (TSS) loads, which limit fine sediments. Sediment loads from permitted dischargers will be included in the WLA component of the TMDL, in compliance with 40 CFR§130.2(h). There are no permitted point sources in the Birch Run watershed.

Table 3-1. Permitted Sources in the Indian Creek watershed.

Permit Number	Permit Name	Design Flow (MGD)	Permitted Area (ac)	TSS Limit (mg/L)
General/Stormwater	Aggregate Load	NA	NA	NA
Individual				
PA0024422	Harleysville Sewage Treatment Plant	0.7	NA	30
PA0036978	Telford Borough Authority WWTP	1.1	NA	30
PA0054950	Pilgrim's Pride Facility (Franconia)	0.3	NA	10
MS4				
PAG130147	Franconia MS4	NA	TBD[1]	NA
PAG130133	Telford MS4	NA	TBD[1]	NA
PAG130132	Souderton MS4	NA	TBD[1]	NA
PAG130131	Lower Salford MS4	NA	TBD[1]	NA
PAI-1315-00-06-0001	Pennsylvania Turnpike Commission	NA	TBD[1]	NA
PAI-1315-00-05-0001	Pennsylvania Department of Transportation	NA	TBD[1]	NA

1 EPA seeks feedback from each stakeholder to determine the acreage that is part of the area for which discharges are regulated by the respective MS4 NPDES permit.

3.1.1 Individual Wastewater Treatment Plants (WWTPs)

As shown in **Table 3-1**, there are three WWTPs within the Indian Creek watershed. The Telford Borough Authority WWTP discharges 1.1 MGD and has a TSS limit of 30 mg/L. The Lower Salford Authority's Harleysville Sewage Treatment Plant discharges 0.7 MGD and has a TSS limit of 30 mg/L. The Pilgrim's Pride facility has been shut down, but the permit and associated TSS limit has been transferred to Franconia Township.

3.1.2 Municipal Separate Stormwater Sewer Systems (MS4s)

During dry periods, sediment from air or traffic builds up on surfaces and is transported to streams as stormwater discharge during precipitation events. The magnitude of sediment loading from this source is affected by various factors. These discharges often contain high concentrations of pollutants, which travel through MS4s and enter nearby water bodies through conveyance pipes. For regulatory purposes, stormwater discharges from urbanized areas (UAs) may be point sources and require coverage by an NPDES MS4 permit.

Under the NPDES stormwater program, operators of large, medium, and regulated small MS4s must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 Federal Register 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population in the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population between 100,000 and 249,999; a large MS4 has a population of 250,000 or more. Phase II of the rule extends coverage of the NPDES Storm Water Program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Storm Water Program. Only a select subset of small MS4s, referred to as regulated small MS4s, require an NPDES stormwater permit. Regulated small MS4s include (1) all small MS4s in an urbanized area (UA) as defined by the Bureau of the Census, and (2) those small MS4s outside a UA that are designated by NPDES permitting authorities.

A GIS coverage of Pennsylvania UAs, as defined by the 2010 U.S. Census, was used to establish the boundaries of the MS4s as EPA lacked detailed MS4 sewershed boundary information. A majority of the Indian Creek watershed falls within the boundaries of four MS4 communities including Lower Salford, Telford, Souderton, and Franconia as shown in **Figure 3-1** and **Table 3-1**. The remaining MS4 community, Upper Salford, is found in a small and insignificant portion of the watershed and is therefore excluded from load allocation scenarios. All of the municipalities are considered urbanized according to United States Census Data and, therefore, are subject to PADEP's permit for Phase II municipalities. Two additional MS4s are included for the Pennsylvania Department of Transportation and the Pennsylvania Turnpike Commission due to the presence of state roads and Interstate 476 within the watershed.

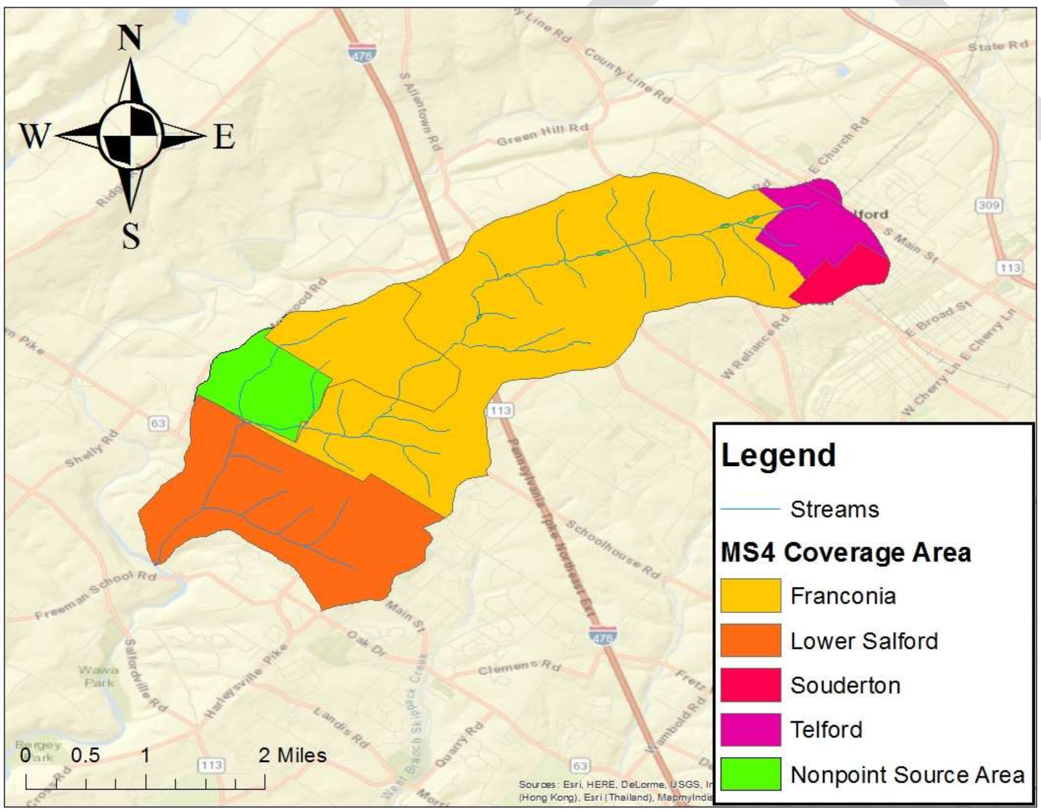

Figure 3-1. MS4 Boundaries in the Indian Creek watershed as determined by U.S. Census Data.

3.1.3 General Stormwater Permits

General stormwater permits in the Indian Creek watershed do not have TSS limits. Permittees covered under general stormwater permits are often temporary in nature, meaning that additional permittees may be added under a general permit and current permittees may be removed over time. A bulk reserve of the TMDL will be allocated to general stormwater permittees based on their expected loadings to the watershed at any given time. In addition to these permitted facilities within Indian Creek watershed, stakeholders noted the Telford Baseball Field (5.6 ac) and Moyer & Son - Souderton Facility. Stormwater originating at the Telford Baseball field is discharged to the Telford MS4, and is consequently accounted for under that permit. The Moyer & Son - Souderton Facility is permitted for control of gas and oil only. Since it is not permitted for control of TSS, it is assumed that any TSS discharged is negligible.

3.1.4 Illicit Discharges

Another potential point source of sediment originates from uncontrolled discharges including illicit discharges such as straight pipes, illegal connections, etc. These illicit discharges can carry residential wastewater directly from homes to nearby waterbodies. While these are illegal, and are corrected when discovered, it is recognized that they typically continue to exist in watersheds across the country. Population, housing units, and type of sewage treatment from U.S. Census Bureau were calculated using GIS analysis. In the 1990 U.S. Census questionnaires, housing occupants were asked which type of sewage disposal existed. Houses can be connected to a public sanitary sewer, a septic tank, a cesspool, or the sewage is disposed of in some other way. The Census category “Other Means” includes the houses that dispose of sewage other than by public sanitary sewer or a private septic system. The houses included in this category are assumed to be disposing of sewage via a straight pipe or other illegal connection. The TSS loading from these discharges is typically small, but is not legal. This loading was accounted for in development of the existing loads for the sediment TMDL and will be removed as part of the allocation process. A TSS concentration from human waste was estimated as 320 mg/L (Lloyd, 2004) at 75 gal of wastewater per day per person. Based on the analysis of Census data, it was estimated that there were 11 active illicit discharges used by 29 people in the Indian Creek watershed and 4 active illicit discharges used by 13 people in the Birch Run watershed.

3.2 Nonpoint Sources

In addition to point sources, nonpoint sources contribute to water quality impairments in the Indian Creek watershed. Nonpoint sources represent contributions from diffuse, non-permitted sources. Nonpoint sources can be precipitation driven and occur as runoff from common, widespread land uses, such as golf courses, agricultural lands, wooded areas, and other land uses. Nonpoint sources can also be non-precipitation driven events such as contributions from groundwater, septic systems, or direct deposition of pollutants from wildlife and livestock.

3.2.1 Surface Runoff

During runoff events (natural rainfall or irrigation), sediment is transported directly to streams from widespread land areas (e.g., agricultural fields, lawns, forest). Rainfall energy, soil cover, soil characteristics, topography, and land management affect the magnitude of this sediment loading. Agricultural management activities such as overgrazing (particularly on steep slopes), conventional tillage operations, livestock concentrations (e.g., along stream edge, uncontrolled access to streams), forest harvesting, and land disturbance due to mining and construction (roads, buildings, etc.) all tend to accelerate sediment loading from surface runoff at varying degrees.

Agricultural lands, forest, and open areas make up 27.1, 6.9, and 13.3 percent of the Indian Creek watershed respectively, and may represent non-permitted land areas (see **Table 4-1** in **Section 4.2.2**). Nonpoint sources of sediment within watersheds typically include surface runoff from these land uses; however, and as discussed in **Section 3.1.2**, a majority of the Indian Creek watershed, including these land uses, falls within the MS4 boundaries. If the loads associated with these land uses originate within the MS4 boundaries, EPA suggests allocating the loads to the MS4s. Without detailed sewershed maps that identify lands within MS4 boundaries not serviced by the MS4, EPA is unable to separate the associated sediment loads from nonpoint source areas from the MS4 WLA. Additionally, those sediment loads originating from lands outside of MS4 boundaries will be assigned load allocations.

3.2.2. Channel and Streambank Erosion

Channel and streambank erosion represent a substantial nonpoint source of sediment to Indian Creek. An increase in impervious land, without appropriate stormwater controls, increases runoff volume and peaks which leads to greater channel erosion potential. Additionally, management practices that allow mowing, paving, and building of material storage up to the edge of a stream cause bank instability. These practices prevent natural stream migration along the floodplain and allow room for flood waters to dissipate, which increases stream instability and bank erosion. Sediment loads as a result of channel and streambank erosion adversely affects aquatic habitat (USDI, 1998) and are accelerated by both point and nonpoint sources.

3.2.3. Natural Background

A load allocation (LA) is the portion of a receiving water's loading capacity attributed either to existing or future nonpoint sources of pollution, or to natural background sources. Wherever possible, natural and nonpoint source loads should be distinguished (40 CFR 130.2(g)). Sources of natural background sediment loads include naturally occurring stream channel erosion and nonpoint source loadings from the different land uses that would occur under natural conditions. The Birch Run reference watershed, in which there are no aquatic life use impairments, was used to estimate natural background sediment loads expected in the Indian Creek watershed as described in **Section 2.1**.

3.3 Other Water Quality Factors

There are other human activities that affect water quality in Indian Creek Watershed including a low level dam.

3.3.1 Dam at Keller Creamery Road Crossing in Franconia Township

A dam is located near Keller Creamery Road within the Indian Creek watershed as shown in **Figure 1-1** and **Figure 3-1**. This dam is a low level dam that has a small reservoir and minimal trapping capacity. During high flows, it is anticipated that the dam does not slow the flow or delivery of sediment downstream. The Pennsylvania Turnpike Commission informed EPA that this dam will be removed in a dam restoration project scheduled for fall 2017. Dam removal will have potential near-term and long-term impacts that should be considered. Near-term impacts, due to the actual process of removing the dam, will likely be minimized as much as possible, but it is possible that some sediment may be delivered to the stream during dam removal. Long-term impacts would occur due to the absence of the reservoir behind the dam which provides trapping capacity. However, since the reservoir and trapping capacity behind the dam is small, minimal impacts are expected from removal of the dam.

Figure 3-2. Photograph of the dam near Keller Creamery Road within Indian Creek Watershed.

4 TMDL Technical Approach

4.1 Sediment Modeling Framework

Computer modeling is used in this study as a tool for simulating the sediment loads to Indian Creek from various activities within the watershed. The sediment model used in this study was the *Visual Basic*^{TM} version of the Generalized Watershed Loading Functions (GWLF) model with modifications for use with ArcView (Evans et al., 2001). The GWLF model was developed at Cornell University (Haith and Shoemaker, 1987; Haith, et al., 1992) for use in ungauged watersheds. The model also included modifications made by Yagow et al., (2002) and BSE, (2003).

GWLF is a continuous simulation, spatially lumped model that operates on a daily time step for water balance calculations and monthly calculations for sediment and nutrients from daily water balance. The GWLF model was developed to simulate runoff, sediment, and nutrients in ungauged watersheds based on landscape conditions such as land use/land cover, topography, and soils. In essence, the model uses a form of the hydrologic units concept to estimate runoff and sediment from different pervious areas (hydrologic units) in the watershed (Li, 1975; England, 1970). In the GWLF model, the nonpoint source load calculation for sediment is affected by land use activity (e.g., farming practices and development), topographic parameters, soil characteristics, soil cover conditions, stream channel conditions, livestock access, and weather. The model uses land use categories as the mechanism for defining homogeneity of source areas. A number of parameters are included in the model to index the effect of varying soil-topographic conditions by land use entities. The model considers flow input from both surface and groundwater. Land use classes are used as the basic unit for representing variable source areas. The calculation of stream-bank erosion, and the inclusion of sediment loads from point sources are also supported.

The model uses daily precipitation records to simulate runoff based on the Soil Conservation Service's Curve Number method (SCS, 1986). Erosion is calculated from a modification of the Universal Soil Loss Equation (USLE) (Schwab et al., 1981; Wischmeier and Smith, 1978). The portion of estimated erosion that reaches waterbodies is calculated based on a delivery ratio, which is calculated as a function of watershed area.

A reference watershed approach was used in this study to develop a sediment TMDL for Indian Creek. The numeric, in-stream, water-quality endpoint was based on the loading rate calculated for the reference watershed, Birch Run. The sediment TMDL will be developed for the impaired watershed based on this endpoint and the results from load allocation scenarios.

4.1.1 GWLF Model Setup

Watershed data needed to run GWLF, and used in this study, were generated using GIS spatial coverage, local weather data, streamflow data, literature values, and other data. Subwatersheds are not required to run the GWLF model. For the sediment TMDL development, the total area for the reference watershed was equated to the area of the impaired watershed. To accomplish this, each land use category in the reference watershed was proportionately increased by a fixed ratio based on the relative size of the reference watershed to the impaired watershed as discussed in Section 4.2.2.

4.2 Sediment Source Representation – Input Requirements

The GWLF model was developed to simulate runoff and sediment in ungauged watersheds based on landscape conditions such as land use/land cover, topography, and soils. The following sections describe required inputs for the GWLF program.

4.2.1 Streamflow and Weather Data

Daily precipitation data were available from the nearby Sellersville, PA (GHCND: USC00367938) and Graterford, PA (GHCND: USC00363437) weather stations as shown in **Figure 4-1**. The Sellersville precipitation data was used as the primary source. These data were supplemented with data from the Graterford weather station, where data were missing in the original set. Data were available from the Sellersville station for the period of 10/2/1996 to 2/21/2015, and from the Graterford station for the period of 1/1/1994 to 9/5/2013.

Streamflow data were not available on either the impaired stream (Indian Creek) or the reference stream (Birch Run). However, data from gauges on downstream waterways were identified and used for calibration. USGS station 01472810 on East Branch Perkiomen Creek, near Schwenksville, PA was used in calibrating Indian Creek, and has flow data available from 1/18/1991 to the present. USGS station 01472157 on French Creek, near Phoenixville, PA, was used in calibrating Birch Run, and has flow data available from 10/1/2007 to the present. Locations of the stream gauges are presented in **Figure 4-1**.

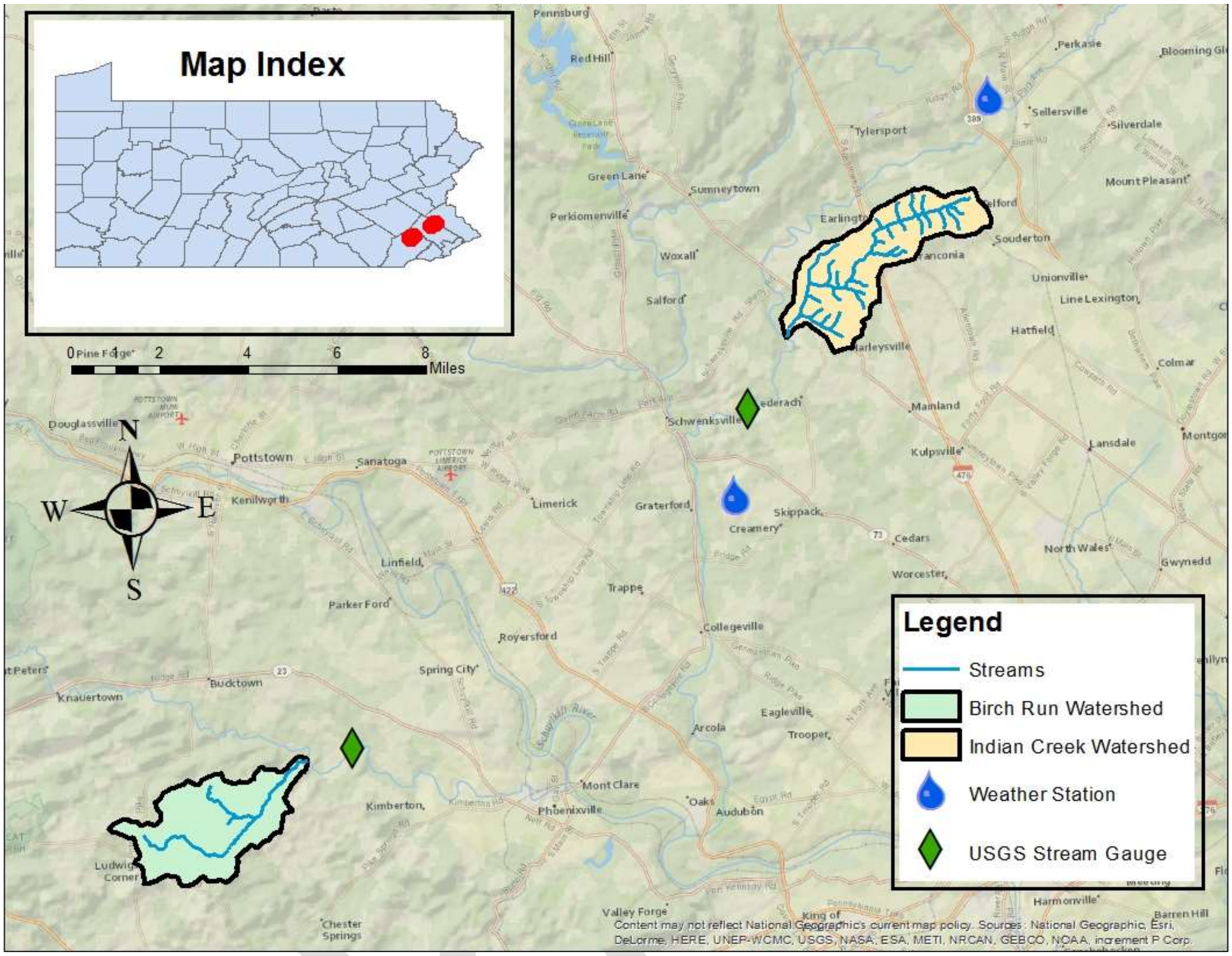

Figure 4-1. Location of weather stations used to collect precipitation data and USGS gauges used to collect streamflow data.

4.2.2 Land Use and Land Cover

Land use distributions for the Indian Creek watershed and for the area-adjusted Birch Run watershed are given in **Table 4-1**. Land use acreage for the reference watershed was adjusted up by the ratio of impaired watershed to reference watershed (1.07), maintaining the original land use distribution. These areas were used for modeling sediment. Land use maps are provided in **Figure 4-2** and **Figure 4-3** for the Indian Creek and Birch Run watersheds, respectively.

National Land Cover Data (NLCD) are available through the Multi-Resolution Land Characteristics Consortium (MRLC) as a joint effort between EPA and USGS. After comparing the 2011 30-meter resolution MRLC/NLCD land use to aerial photography from similar years, it was determined that this land use dataset was not a good fit for the watersheds, as too much non-agricultural open space and residential yards were included in agricultural land uses. Instead, the land use data layers provided by local/county organizations were analyzed and determined to be a good fit, requiring few supplementary data.

The Indian Creek land use data provided by Franconia Township were used and extrapolated to cover the entire watershed. Using aerial photography, the methodology to generate the Franconia

Township data was analyzed. Then, by applying this methodology to the entire watershed, the land use for the remainder of the watershed was delineated based on aerial photography. Additionally, supplemental data provided by the Montgomery County Conservation District further segregated agricultural land into cropland, hay, and pasture. Land use shapefiles, provided by the Chester County Department of Computing and Information Services, were the basis of the Birch Run land use dataset.

Each of these data sources lumped all agricultural land uses together under one title. Using aerial photography as a reference and data provided by the Conservation Districts, the agricultural land use was divided between crop, pasture, and hay areas for both watersheds.

Table 4-1. Land use areas used in the GWLF model for Indian Creek and area-adjusted Birch Run watersheds.

Sediment Source	Indian Creek (ha)[1]	Area-Adjusted Birch Run (ha)
Pervious Area:		
Commercial	73.2	2.6
Crop	410.3	81.1
Forest	126.0	707.2
Hay	45.3	400.8
Open	240.3	77.3
Pasture	35.2	100.2
Residential	539.1	352.3
Road	10.9	2.1
Water	0.0	16.5
Impervious Area:		
Residential	179.7	62.2
Commercial	109.9	2.6
Road	43.5	8.3
Watershed Total	**1,813**	**1,813**

[1] 1ha = 2.47 ac

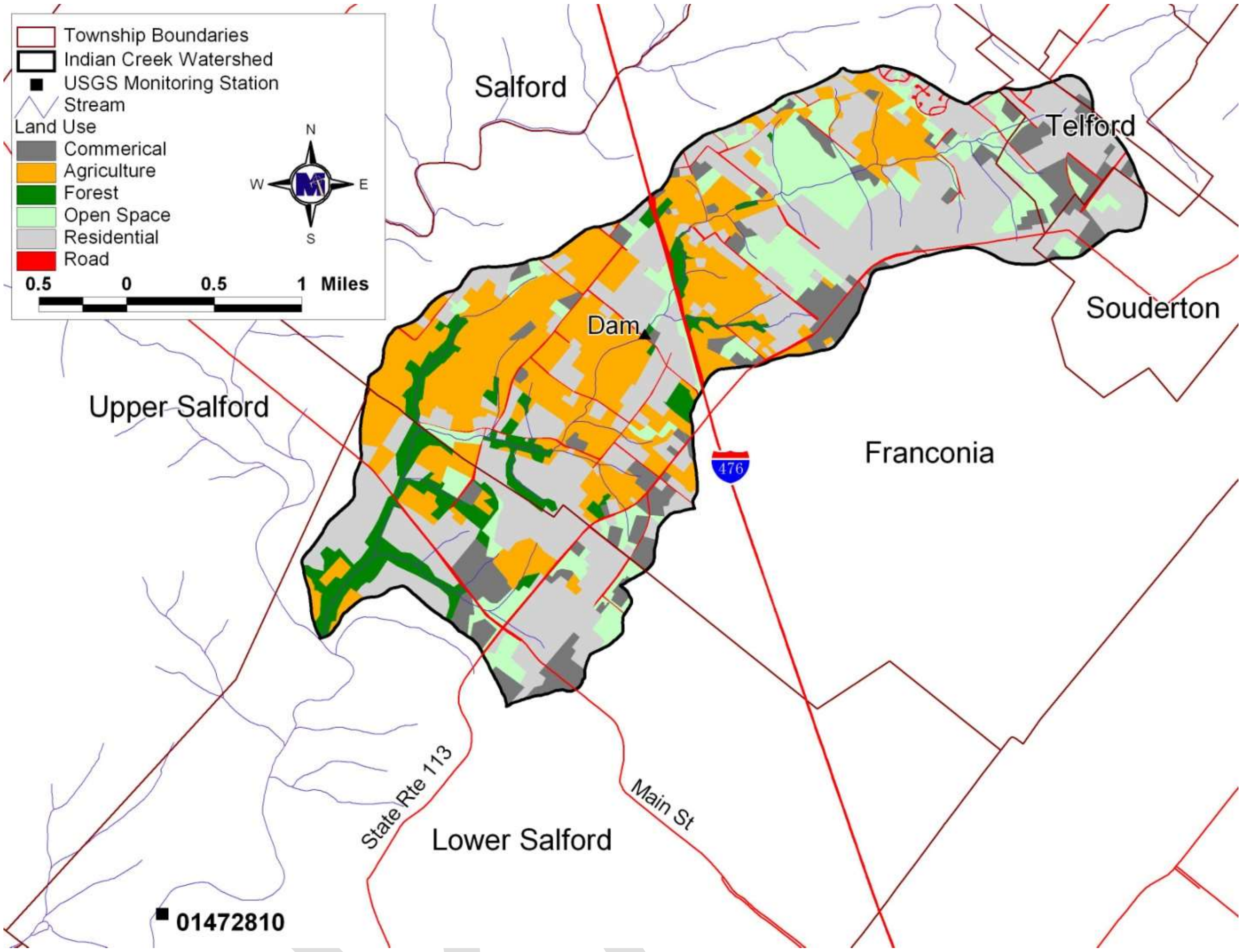

Figure 4-2. Land use distribution in the Indian Creek watershed.

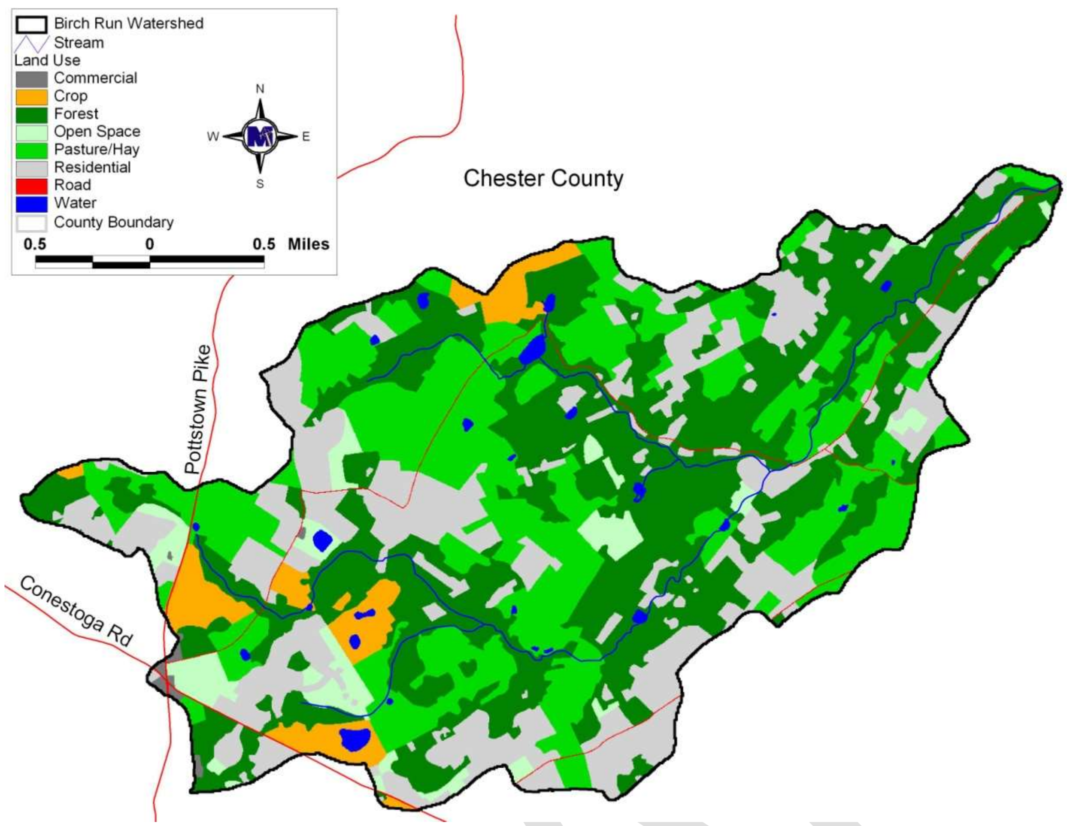

Figure 4-3. Land use distribution in the Birch Run watershed.

4.2.3. Accounting for Critical Conditions and Seasonal Variation

4.2.3.1 Selection of Representative Modeling Period

Selection of the modeling period was based on the availability of daily weather data, the need to represent variability in weather patterns over time in the watershed, and the desire to compare results from the earlier modeling effort. A long period of weather inputs was selected to represent long-term variability in the watershed. The model was run using a weather time series from October 1, 1997 to September 30, 2004, which was consistent with earlier modeling efforts. This time period was checked against more recent data to verify that it was representative of the local conditions, as shown in **Figure 4-4**.

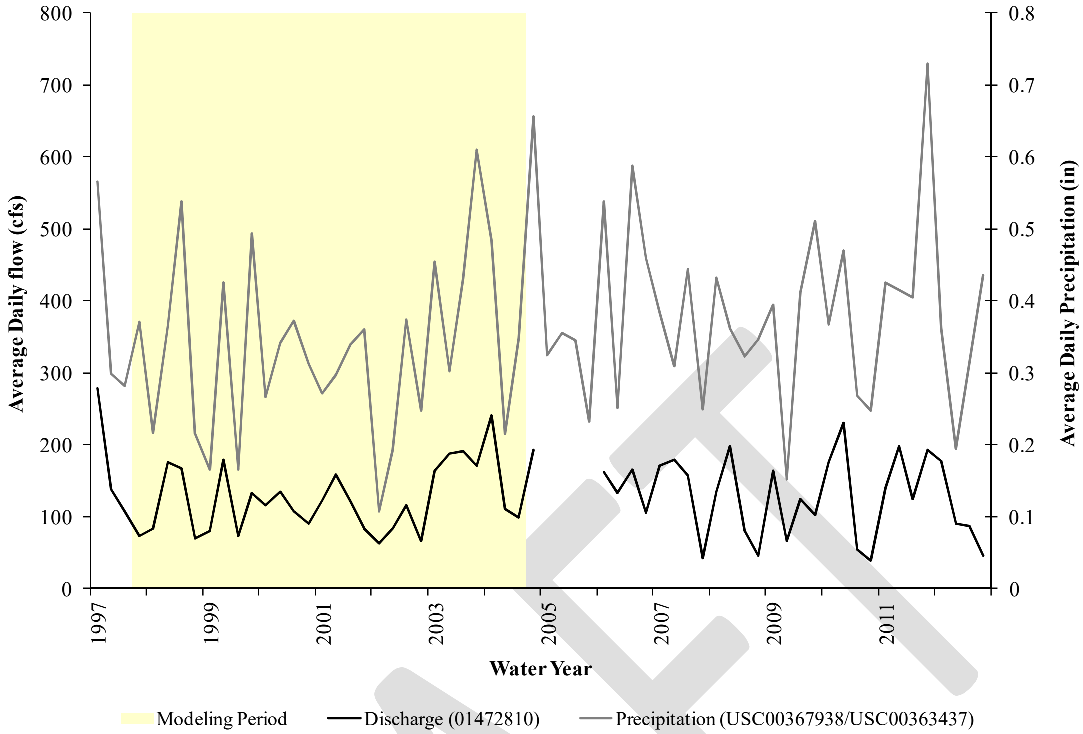

Figure 4-4. Comparison of average daily flow and precipitation between modeled period and more recent data, by quarter.

4.2.3.2. Critical Conditions

The GWLF model is a continuous simulation model that uses daily time steps for weather data and water balance calculations. The period of rainfall selected for modeling was chosen as a multi-year period that was representative of typical weather conditions for the area, and included "dry", "normal" and "wet" years. The model, therefore, incorporated the variable inputs needed to represent critical conditions during low flow – generally associated with point source loads – and critical conditions during high flow – generally associated with nonpoint source loads.

4.2.3.3. Seasonal Variability

The GWLF model used for this analysis considered seasonal variation through a number of mechanisms. Daily time steps were used for weather data and water balance calculations. The model also used monthly-variable parameter inputs for evapotranspiration cover coefficients, daylight hours/day, and rainfall erosivity coefficients for user-specified growing season months.

4.2.4. Sediment Parameters

Sediment parameters include USLE parameters erodibility factor (K), length/slope factor (LS), cover crop factor (C), and practice factor (P), sediment delivery ratio, and a buildup and loss functions for impervious surfaces. The product of the USLE parameters, KLSCP, is entered as input to GWLF. Soils data for the watersheds were obtained from the Soil Survey Geographic database. The K factor relates to a soil's inherent erodibility and affects the amount of soil erosion from a given field. The area-weighted K-factor by land use category was calculated using GIS procedures. Land slope was calculated from USGS National Elevation Dataset data using GIS techniques. The length of slope was estimated using GIS procedures developed by MapTech, Inc., which consider the path of flow in raster-based GIS. The area-weighted LS factor was calculated for each land use category using procedures recommended by Wischmeier and Smith (1978). The weighted C-factor for each land use category was estimated following guidelines given in Wischmeier and Smith, 1978, and GWLF User's Manual (Haith et al., 1992). The practice factor (P) was set at 1.0 for all, but croplands.

The cropland C-factor was adjusted using the estimates of conservation tillage from Montgomery County (Indian Creek) and Chester County (Birch Run). These estimates were provided by the Conservation Technology Information Center. Estimates from 1998, 2000, 2002, and 2004 were very consistent, so an average of these years was used.

Reported percent of acreage in conservation tillage for Montgomery County and Chester County were 31.5 and 66.4 percent, respectively. A C-factor of 0.51 and 0.20 was used to represent conventional tillage and conservation tillage, respectively. The weighted cropland C-factors are provided below:

C-factor for Indian Creek = 31.5% x 0.20 + 68.5% x 0.51 = 0.412

C-factor for Birch Run = 66.4% x 0.20 + 33.6% x 0.51 = 0.304

The P-factors used for crop land were the county average P-factors, as provided in GWLF-E software package (Evans and Corradini, 2016). The cropland P-factors are provided below:

P-factor for Indian Creek = 0.76

P-factor for Birch Run = 0.45

4.2.5. Sediment Delivery Ratio

The sediment delivery ratio specifies the percentage of eroded sediment delivered to surface water outlet and is empirically based on watershed size. The sediment delivery ratios for impaired and reference watersheds were calculated as an inverse function of watershed size (Evans et al., 2001). The value used for Indian Creek and area-adjusted Birch Run watersheds was 0.18, which indicates that approximately 18 percent of eroded soil is delivered to the outlet of the watershed.

4.2.6. SCS Runoff Curve Number

The runoff curve number is a function of soil type, antecedent moisture conditions, and cover and management practices. The runoff potential of a specific soil type is indexed by the Soil Hydrologic Group (SHG) code. Each soil-mapping unit is assigned SHG codes that range in increasing runoff potential from A to D. The SHG code was given a numerical value of 1 to 4 to index SHG codes A to D, respectively. An area-weighted average SHG code was calculated for each land use/land cover from soil survey data using GIS techniques. Runoff curve numbers (CN) for SHG codes A to D were assigned to each land use/land cover condition for antecedent moisture condition II following GWLF guidance documents and SCS, 1986 recommended procedures. The runoff CN for each land use/land cover condition then was adjusted based on the numeric area-weighted SHG codes.

4.2.7. Parameters for Channel and Streambank Erosion

Parameters for streambank erosion include animal density, total length of natural stream channel, fraction of developed land, mean stream channel depth, average watershed curve number, average watershed erodibility, and average watershed slope. The local conservation districts informed EPA that no animals are given stream access to Indian Creek, so animal density was determined to be zero. The total length of the natural stream channel was estimated from USGS National Hydrography Dataset coverage using GIS techniques. The mean stream channel depth is typically estimated as a function of watershed area, using USGS regional curves. In areas where streambank erosion is a contributing, but less significant factor with regard to sediment delivery in the watershed, this is a viable option. However, because streambank erosion in the watershed was anticipated to be a primary factor, EPA personnel performed a field survey to gain a better estimate of stream depth.

EPA personnel measured the stream bank height on both sides of the channel at 14 and 11 locations in the Indian Creek and Birch Run watersheds, respectively (**Appendix A**). The measurements were averaged in each watershed. The results of both the USGS calculation and the EPA survey can be seen in **Table 4-2**. The USGS regional curves are based on properly functioning streams (*i.e.*, not exhibiting excessive streambank erosion). As expected, the actual measured stream bank heights were larger in both streams, reflecting the ongoing erosion process. Therefore, these EPA field results for stream channel depth were used instead of USGS values.

Table 4-2. Calculated and measured stream bank heights in Indian and Birch Run.

Average Stream Bank Height	Indian Creek (m)	Birch Run (m)
USGS Calculation	0.27	0.27
EPA Survey	1.50	0.66

4.2.8. Evapotranspiration Cover Coefficients

Evapotranspiration cover coefficients were entered by month. Monthly evapotranspiration cover coefficients were assigned each land use/land cover condition following procedures outlined in Novotny and Chesters (1981) and GWLF guidance. Area-weighted evapotranspiration cover coefficients were then calculated for each sediment source class. These values were then adjusted during hydrology calibration.

4.3. GWLF Calibration

Although the GWLF model was originally developed for use in ungauged watersheds, calibration was performed to ensure that hydrology was being simulated accurately. This process was performed in order to minimize errors in sediment simulations due to potential gross errors in hydrology. The model's parameters were assigned based on available soils, land use, and topographic data. Parameters that were adjusted during calibration included the recession constant, the monthly evapotranspiration cover coefficients, and the seepage coefficient.

Because there is no recorded flow record in the Indian Creek watershed, a paired watershed approach was used for calibration. Observed flow from USGS station 01472810 on East Branch Perkiomen Creek, near Schwenksville, PA, was used in calibrating model hydrologic parameters for the contributing watershed, which includes Indian Creek. Adjustments made to parameters during calibration were applied to Indian Creek. The final GWLF calibration results are displayed in **Figure 4-5** through **Figure 4-7** for the calibration period, with statistics showing the accuracy of fit given in **Table 4-3**. Model calibration was considered good for total runoff volume. Monthly fluctuations were variable but were still reasonable considering the general simplicity of GWLF.

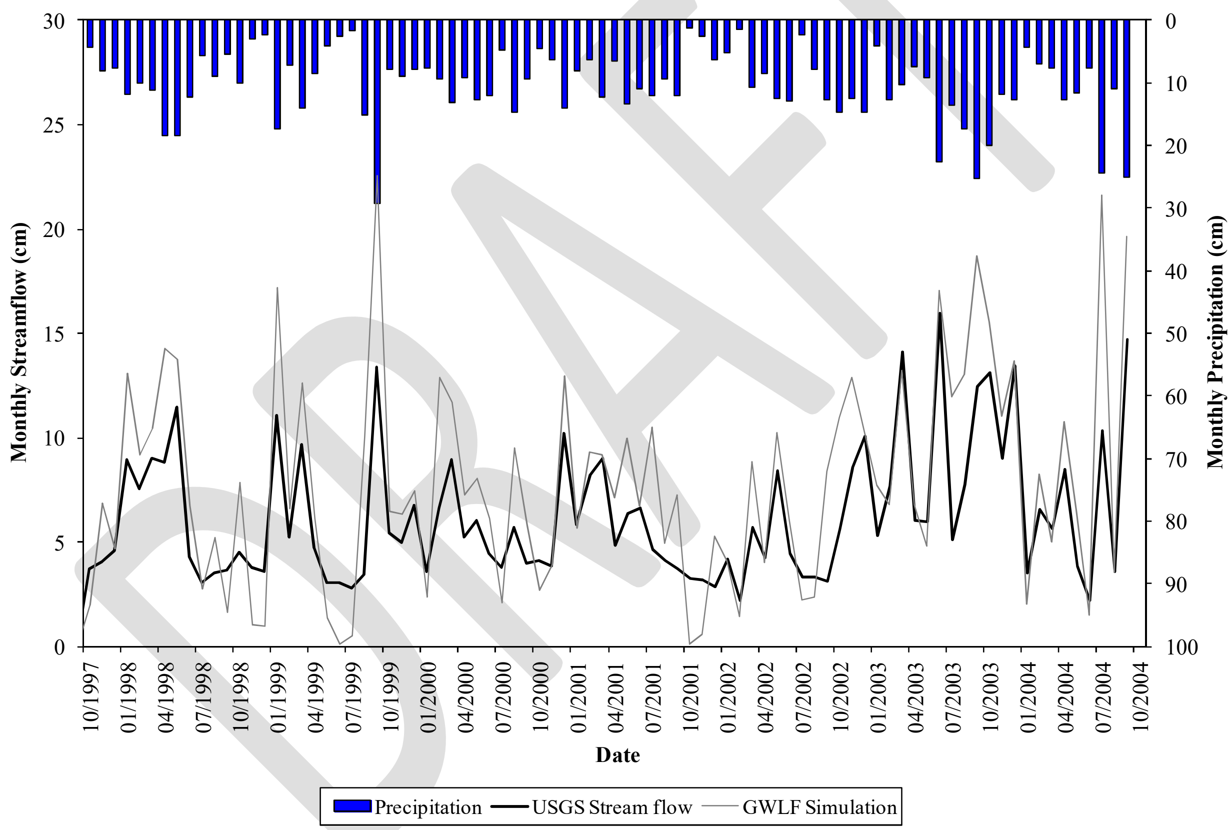

Figure 4-5. Comparison of monthly GWLF simulated (modeled) and monthly USGS (observed) stream flow in East Branch Perkiomen Creek (USGS station 01472810) for the calibration period including Indian Creek.

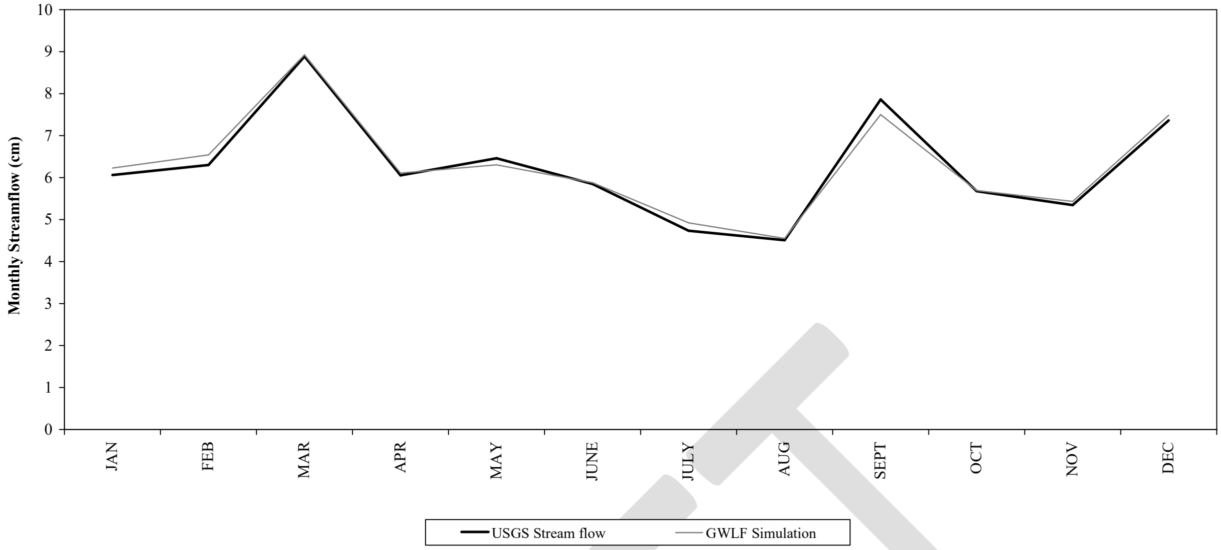

Figure 4-6. Comparison of average monthly GWLF simulated (modeled) and average monthly USGS (observed) stream flow in East Branch Perkiomen Creek (USGS station 01472810) including Indian Creek.

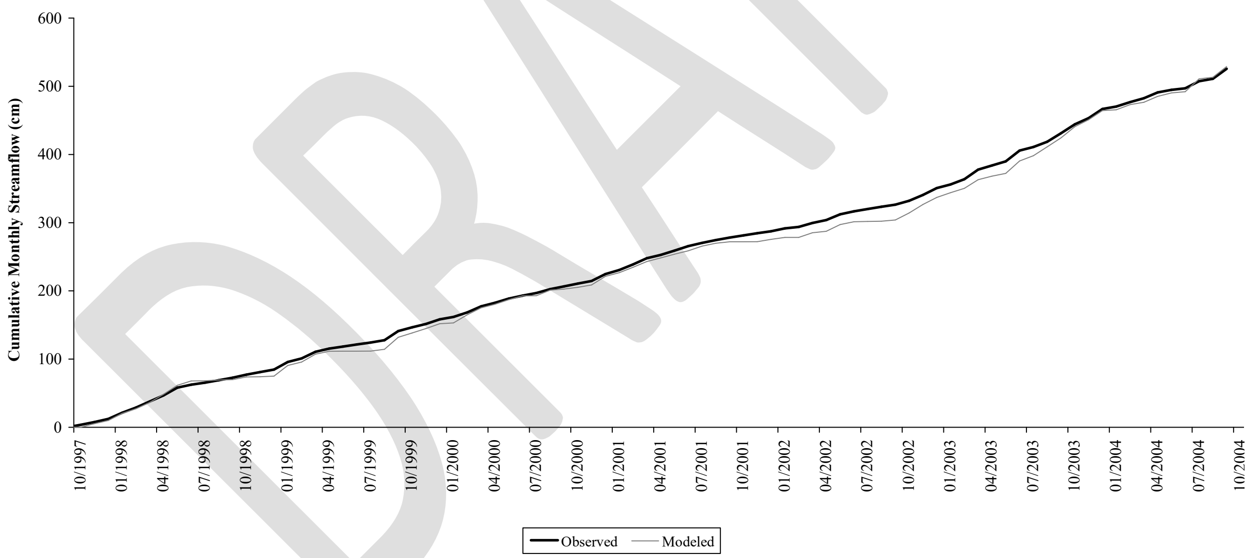

Figure 4-7. Comparison of cumulative monthly GWLF simulated (modeled) and cumulative USGS (observed) streamflow in East Branch Perkiomen Creek (USGS station 01472810) for the calibration period including Indian Creek.

Table 4-3. GWLF flow calibration statistics for East Branch Perkiomen Creek including Indian Creek.

Watershed	Simulation Period	R^2 Correlation value	Total Volume Error (Simulated-Observed)
East Branch Perkiomen Creek at USGS Station 01472810	10/1/1997 – 9/30/2004	0.914	0.63%

The low level dam at Keller Creamery Road was not specifically incorporated into the GWLF modeling. The hydrology calibration was based on a watershed without this dam. Therefore, removal of this dam will not have a direct impact on the hydrology.

Similarly, there is no recorded flow record in the Birch Run watershed. Consequently, a paired watershed approach was used for calibration. Observed flow from USGS station 01472157 on French Creek, near Phoenixville, PA, was used in calibrating model hydrologic parameters for the contributing watershed, which includes Birch Run. Adjustments made to parameters during calibration were applied to Birch Run. The final GWLF calibration results are displayed in **Figure 4-8** through **Figure 4-10** for the calibration period, with statistics showing the accuracy of fit given in **Table 4-4**. Model calibration was considered good for total runoff volume. Monthly fluctuations were variable but were still reasonable considering the general simplicity of GWLF.

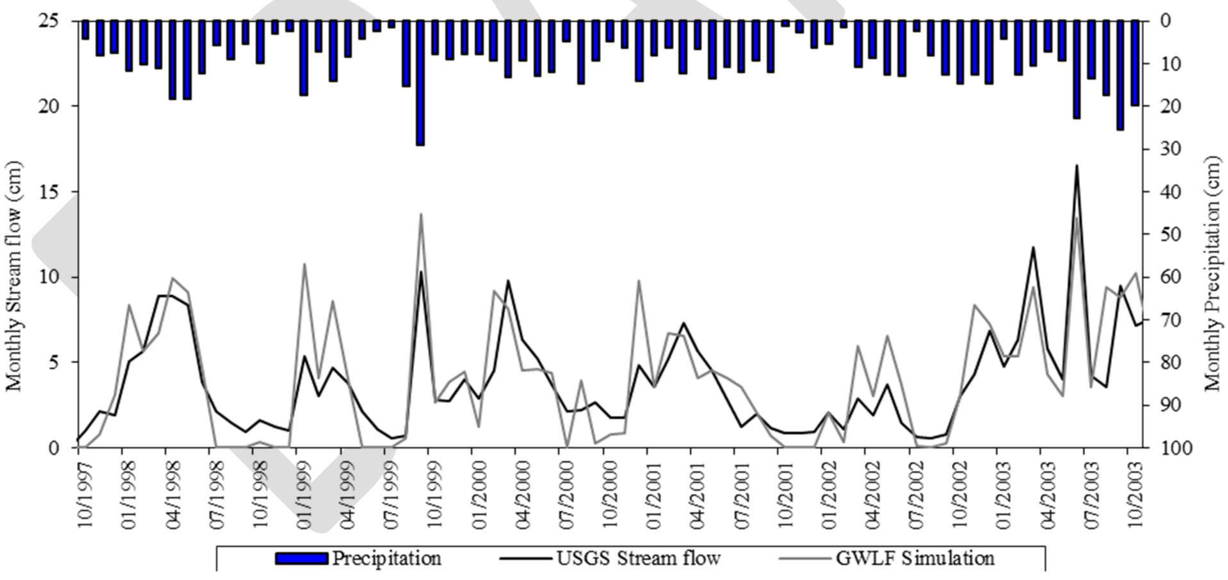

Figure 4-8. Comparison of monthly GWLF simulated (modeled) and monthly USGS (observed) stream flow in French Creek (USGS station 01472157) for the calibration period including Birch Run.

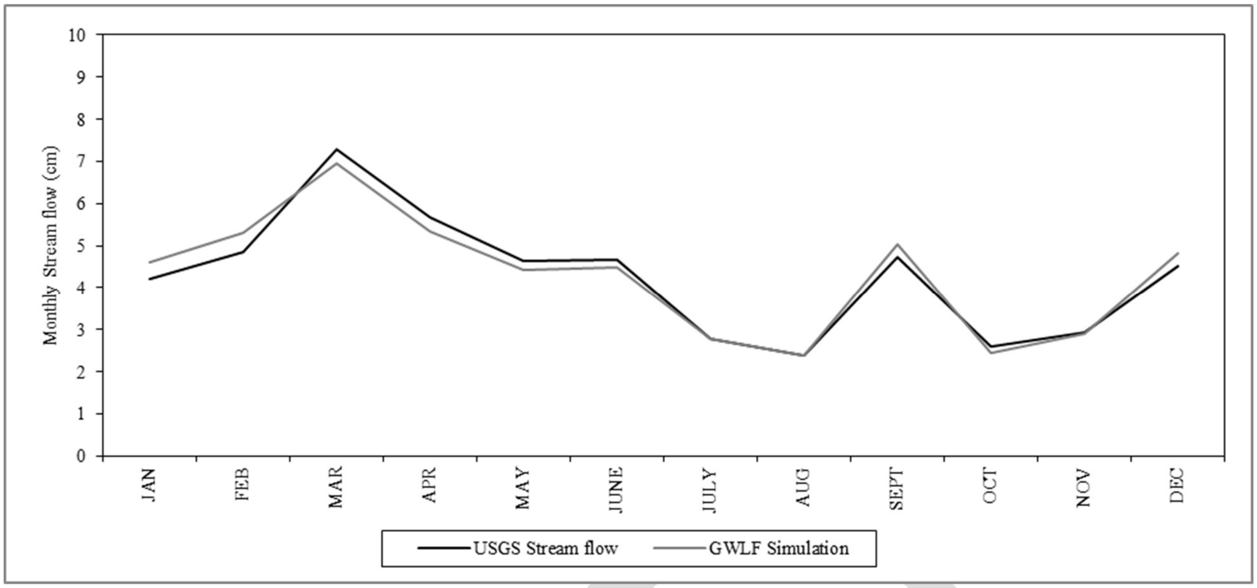

Figure 4-9. Comparison of average monthly GWLF simulated (modeled) and average monthly USGS (observed) stream flow in French Creek (USGS station 01472157) including Birch Run.

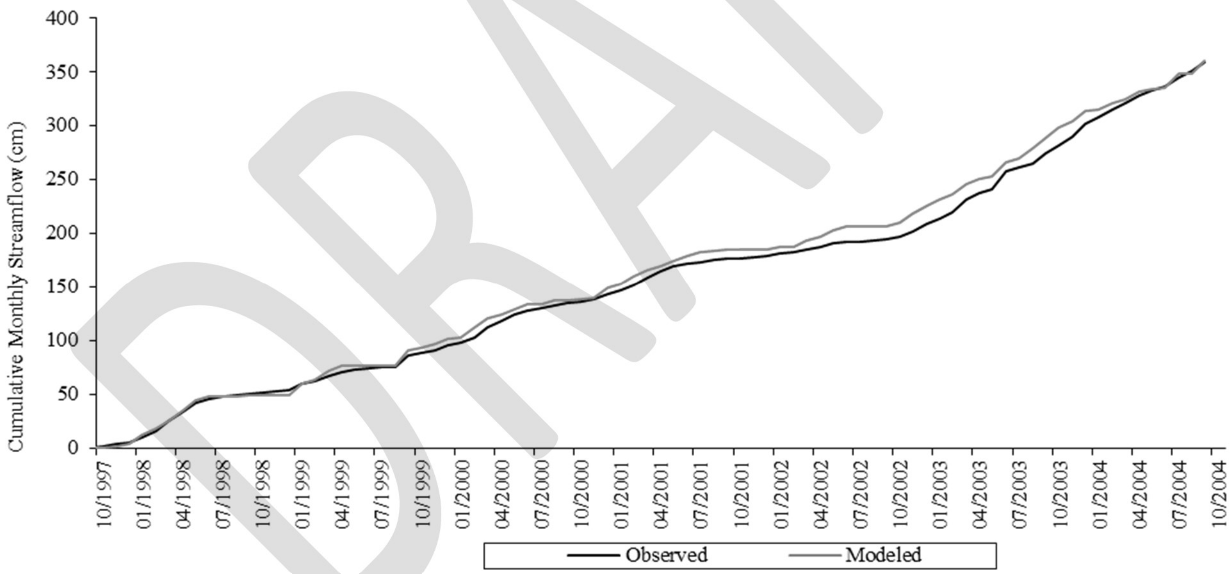

Figure 4-10. Comparison of cumulative monthly GWLF simulated (modeled) and cumulative USGS (observed) streamflow in French Creek (USGS station 01472157) for the calibration period including Birch Run.

Table 4-4. GWLF flow calibration statistics for French Creek including Birch Run.

Watershed	Simulation Period	R^2 Correlation value	Total Volume Error (Simulated-Observed)
French Creek at USGS Station 01472157	10/1/1997 – 9/30/2004	0.810	0.33%

5 Allocation Analysis and TMDLs

5.1. Sediment Existing Conditions

The approach to estimate existing sediment loadings is a land use based approach, which calculates sediment loading rates for each land use identified using local data, as discussed in **Section 1-2**. The GWLF model was parameterized to represent existing sediment conditions within the impaired and reference watersheds. A list of parameters from the GWLF transport input files that were finalized for existing conditions are given in **Table 5-1**. Monthly evaporation cover coefficients are listed in **Table 5-2**, while **Table 5-3** lists the area-weighted USLE erosion parameter (KLSCP) and runoff curve number by land use for each watershed. The curve number values are area weighted by land use.

Table 5-1. GWLF watershed parameters in the calibrated impaired and reference watersheds.

GWLF Watershed Parameter	Units	Indian Creek	Birch Run
Recession Coefficient	Day^{-1}	0.5	0.5
Seepage Coefficient	Day^{-1}	0	0.23
Sediment Delivery Ratio	---	0.18	0.18
Unsaturated Water Capacity	(cm)	9.8900	11.5122
Rainfall Erosivity Coefficient (Apr-Sep)	---	0.30	0.30
Rainfall Erosivity Coefficient (Oct-Mar)	---	0.12	0.12
% Developed land	(%)	52.7	23.7
Livestock density	(AU/ac)	0	0.9824
Area-weighted soil erodibility (K)	---	0.3003	0.4269
Area-weighted Curve Number	---	78.61	63.29
Total Stream Length	(m)	31,249	15,400
Mean channel depth	(m)	1.5	0.66

Table 5-2. Calibrated GWLF monthly evaporation cover coefficients.

Watershed	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Indian Creek	0.92	0.66	0.58	0.29	0.66	1.11	0.62	0.67	0.61	1.34	1.34	0.79
Birch Run	0.75	0.73	0.46	0.56	0.66	1.32	1.40	1.06	1.05	1.79	1.39	0.74

Table 5-3. The GWLF curve numbers and KLSCP values for existing conditions in the Indian Creek and Birch Run watersheds.

Sediment Source	Indian Creek		Birch Run	
	CN	KLSCP	CN	KLSCP
Pervious Area:				
Forest	64.60	0.0007	57.66	0.00228
Open	71.15	0.0109	63.30	0.02438
Residential	71.44	0.0027	63.30	0.00975
Cropland	81.40	0.068428	78.89	0.05827
Commercial	71.76	0.0036	63.30	0.00451
Road	87.98	0.0067		
Pasture	75.8	0.0164	70.77	0.04917
Hay	66.8	0.0028	60.30	0.00852
Impervious[1] Area:				
Residential	98.00	N/A	98.00	N/A
Commercial	98.00	N/A	98.00	N/A
Road	98.00	N/A	98.00	N/A

[1] Since erosion processes are not applicable to impervious surfaces, there is not an associated KLSCP value. Contributions from impervious areas are modeled as a build-up and wash-off process.

The sediment loads were modeled for existing conditions in Indian Creek and the reference watershed, Birch Run (**Table 5-4**). The existing condition in Indian Creek is the combined sediment load of 4,274.71 t/yr as compared to the area-adjusted reference watershed load of 1,439.25 t/yr, which suggests a necessary reduction in total watershed sediment loadings of 66.3 percent.

Sediment loading rates were determined for (1) permitted sources: including individual permits and general stormwater permits, (2) direct sources: including streambank erosion and straight pipes, and (3) impervious and pervious land uses: including more developed areas (commercial, residential, road) and less developed areas (agriculture, forest, open areas). Sediment loadings associated with land uses from either pervious or impervious areas represent the majority of loadings in both Indian Creek (68.1%) and Birch Run (88.0%). In this table, the MS4 and nonpoint source loads are not directly expressed.

In both the impaired and reference watershed, agricultural land uses (crop, pasture, and hay) account for majority of the sediment loading: 57.2 percent in Indian Creek and 60.6 percent in Birch Run. Sediment loadings from more developed areas from either pervious or impervious surfaces accounts for 6.6 percent of the total watershed loading in Indian Creek and 15.4 percent in Birch Run. A greater prevalence of streambank erosion is demonstrated in Indian Creek with those sediment loadings accounting for 30.0 percent of total watershed loading as compared to 12.0 percent in Birch Run.

Table 5-4. Existing sediment loads for Indian Creek and area-adjusted Birch Run watersheds.

Sediment Source	Indian Creek			Reference Watershed Area-Adjusted Birch Run		
	t/yr	Percent (%) of Total Load	t/ha/yr	t/yr	Percent (%) of Total Load	t/ha/yr
Pervious Area:						
Forest	5.43	0.13	0.04	71.33	4.96	0.1
Open	175.86	4.11	0.73	100.87	7.01	1.3
Residential	105.2	2.46	0.21	183.73	12.77	0.52
Crop	2,394.16	56.01	5.84	380.04	26.41	4.69
Commercial	18.51	0.43	0.26	0.63	0.04	0.24
Road	6.65	0.16	0.61	4.17	0.29	0
Pasture	44.8	1.05	1.27	324.74	22.56	3.24
Hay	8.05	0.19	0.18	167.28	11.62	0.42
Impervious Area:						
Residential	81.49	1.91	0.45	28.2	1.96	0.45
Commercial	49.82	1.17	0.45	1.17	0.08	0.45
Road	19.72	0.46	0.45	3.78	0.26	0.45
Direct Sources:						
Streambank Erosion	1,283.25	30.02		172.89	12.01	
Straight Pipes	0.95	0.02		0.42	0.03	
Permitted Sources:						
Individual Permits	78.8	1.84		0	0	
General Stormwater Permits	2.02	0.05		0	0	
Watershed Total	**4,274.71**	**100**	**2.35**	**1,439.25**	**100**	**0.79**

t: tons; ha: hectare; yr: year

5.2. Allocation Strategy

The objective of the subsequent TMDL report is to reduce the sediment loadings in Indian Creek to the existing conditions in the reference watershed, Birch Run, which will attain water quality standards. Individual wasteload allocations (WLAs) will be developed for the WWTPs and MS4s, an aggregate WLA will be developed for general stormwater permits, and load allocations (LAs) will be developed for nonpoint sources of sediment. Additionally, no allocation will be provided to illicit discharges or straight pipes, as these are illegal and will be eliminated as detected.

EPA proposes to assign TMDL WLAs to each of the three WWTPs in the watershed, Telford Borough Authority, Lower Salford Authority (Harleysville sewage treatment plant), and Pilgrim's Pride Facility (Franconia Township), as well as a bulk WLA to general stormwater permits. All of these permittees are already required to meet stringent technology-based effluent limitations, as described in their permit. Therefore, it is expected that WLAs for WWTPs and general stormwater permits will be based upon current permit limits.

The remaining NPDES permittees are MS4s including the four MS4 communities (Lower Salford, Telford, Souderton, and Franconia) and two additional MS4s (Pennsylvania Department of Transportation and the Pennsylvania Turnpike Commission). The MS4s will require significant reductions in sediment loading as their boundaries cover much of the watershed. Because EPA lacks detailed MS4 sewershed boundary information, EPA proposes to allocate sediment loadings from all land uses (including impervious and pervious surfaces) from within urbanized areas to the MS4s. Ideally, sediment loads that travel directly to streams via surface runoff would be excluded from MS4 WLAs and included in the nonpoint source LA, while sediment loads that travel through the MS4 conveyance would be allocated to the MS4s. In the absence of sewershed boundary information, EPA cannot distinguish these loads. Consequently, EPA requests from stakeholders detailed sewershed delineation maps to identify serviced vs. non-serviced areas. With this information, EPA and stakeholders can separate potential nonpoint source LAs from MS4 WLAs.

EPA proposes to establish LAs based on land use for those nonpoint source areas located outside of MS4 boundaries. Additionally, sediment loads attributed to streambank and channel erosion will be appropriately allocated to point and nonpoint sources so as to reduce sediment loading in the Indian Creek watershed to the determined TMDL endpoint.

The proposed load allocation strategy described here will be discussed with stakeholders and further detailed in **Section 5.2.1.**, **Section 5.2.2.**, **Section 5.2.3.**, and **Section 5.5** in the final Indian Creek Sediment TMDL report.

5.2.1. Allocation Process

This section will be composed after consultation with stakeholders.

5.2.2. Load Allocations (LAs)

This section will be composed after consultation with stakeholders.

5.2.3. Wasteload Allocations (WLAs)

This section will be composed after consultation with stakeholders.

5.3. Margin of Safety (MOS)

The margin of safety (MOS) is the portion of the TMDL equation that accounts for any lack of knowledge concerning the relationship between LAs and WLAs and water quality [CWA 303(d)(1)(c) and 40 CFR 130.7(c)(1)]. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural waterbodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. On the basis of EPA guidance, the MOS can be achieved through two approaches (USEPA 1999): (1) implicitly incorporate the MOS by using conservative model assumptions to develop allocations; or (2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. **Table 5-5** describes different approaches that can be taken under the explicit and implicit MOS options.

Table 5-5. Different approaches available under the explicit and implicit MOS types

Type of MOS	Available approaches
Explicit	• Set numeric targets at more conservative levels than analytical results indicate. • Add a safety factor to pollutant loading estimates. • Do not allocate a portion of available loading capacity; reserve for MOS.
Implicit	• Use conservative assumptions in derivation of numeric targets. • Use conservative assumptions when developing numeric model applications. • Use conservative assumptions when analyzing prospective feasibility of practices and restoration activities.

Source: USEPA 1999

EPA expects that a five percent explicit MOS will be used to account for uncertainty in the modeling process. This is based on previous experience for TMDL development in Pennsylvania, professional judgment and published literature.

5.4. Critical Conditions and Seasonal Variations

Federal regulations (40 CFR 130.7(c)(1)) require TMDLs to consider critical conditions for streamflow, loading, and water quality parameters. Critical conditions are the set of environmental conditions, which, if met, will ensure attainment of objectives for all other conditions. This is typically the period in which the impaired water body exhibits the most vulnerability. As described in **Section 4.2.3**, the TMDL accounts for critical conditions and seasonal variation. The TMDL was developed using continuous simulation (modeling over a period of several years that captured precipitation extremes), which inherently considers seasonal hydrologic and source loading variability. The GWLF model is a continuous simulation model that uses daily time steps for weather data and water balance calculations. The period of rainfall selected for modeling was October 1, 1997 to September 30, 2004 and was chosen as a multi-year period that was representative of typical weather conditions for the area, and included “dry”, “normal” and “wet” years. Additionally, this time period was compared with more recent weather data to verify that it was representative of current local conditions. The model, therefore, incorporated the variable inputs needed to represent critical conditions during low flow – generally associated with point source loads – and critical conditions during high flow –

generally associated with nonpoint source loads. Seasonal variation is also captured in the time variable simulation, which represents seasonal precipitation on a year-to-year basis.

5.5. TMDLs

This section will be composed after consultation with stakeholders.

5.6. Future TMDL Modifications and Growth

EPA will establish the Indian Creek sediment TMDL, including its component WLAs, LAs, and explicit MOS, based on the applicable water quality standard (WQS) and the totality of the information available concerning water quality and hydrology, and present and anticipated pollutant sources and loadings. EPA recognizes, however, that neither the world at large, nor the watershed, is static. In a dynamic environment, change is inevitable. Much change can be generated during TMDL implementation and could include new monitoring data, installation of best management practices and land use changes.

It is possible to accommodate some of those changes in the existing TMDL without the need to revise it in whole, or in part. For example, EPA's permitting regulations at 122.44(d)(1)(vii)(B) require that permit water quality based effluent limitations be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge" in the TMDL. As the EPA Environmental Appeals Board has recognized, "WLAs are not permit limits per se; rather they still require translation into permit limits." *In re City of Moscow*, NPDES Appeal No. 00-10 (July 27, 2001). In providing such translation, the Environmental Appeals Board said that "[w]hile the governing regulations require consistency, they do not require that the permit limitations that will finally be adopted in a final NPDES permit be identical to any of the WLAs that may be provided in a TMDL." Id. Accordingly, depending on the facts of a situation, Pennsylvania may write a permit limit that is consistent with (but not identical to) a given WLA without revising that WLA (either increasing or decreasing a specific WLA), provided the permit limit is consistent with the operative *assumptions* (e.g., about the applicable WQS, the sum of the delivered point source loads, the sufficiency of reasonable assurance) that informed the decision to establish that particular WLA. There might, however, be circumstances with the degree to which a permit limit might deviate from a WLA in the TMDL such that one or more WLAs and LAs in the TMDL would need to be revised. In such cases, it might be appropriate for EPA to revise the TMDL (or portions of it).

As an assumption of the Indian Creek Sediment TMDL, EPA expects the jurisdictions to account for and manage new or increased sediment loadings. Strategies to account for future growth include (1) allocating an explicit sediment load (i.e., 5 percent) to "future growth", or (2) offsetting new or increased loadings through additional reductions in sediment loadings elsewhere in the watershed in an amount necessary to implement the TMDL and applicable WQS in the Indian Creek watershed. EPA requests input from stakeholders to determine the appropriate strategy to manage future growth, which will be applicable in the Indian Creek watershed.

If an offset strategy is incorporated into the Indian Creek sediment TMDL, the offsets are to be in addition to reductions already needed to meet the allocations in the TMDL and must be consistent with applicable federal and state laws and regulations. For nonpoint sources, this assumption and expectation is based on the fact that any new or increased nonpoint source loadings not accounted for in the TMDL's LA will have to be offset by appropriate reductions from other sources if the TMDL's pollutant loading cap and applicable WQS are to be met. For permitted point sources, the assumption and expectation is based on the statutory and regulatory requirements that effluent limits for any such discharger be derived from and comply with all applicable WQS and be consistent with the assumptions and requirements of any available WLAs [CWA sections 301(b)(1)(C), 303(d); 40 CFR 122.44(d)(1)(vii)(A) & (B)].

EPA recognizes that in some cases, it may be appropriate for EPA to revise the TMDL (or portion of it). EPA would also consider a request made by the public or PADEP to revise the TMDL. Alternatively, PADEP could propose to revise the TMDL and submit those revisions to EPA for approval. A proposed WLA can be made available for public comment concurrent with the associated permits revision/reissuance public notice. If EPA approved any such revisions, those revisions would replace their respective parts in the EPA-established TMDL. In approving any such revisions or in making its own revisions, EPA would ensure that the revisions themselves met all the statutory and regulatory requirements for TMDL approval and did not result in any component of the original TMDL not meeting applicable WQS.

6 Reasonable Assurance for TMDL Implementation

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, the TMDL must provide reasonable assurances that nonpoint source control measures will achieve the expected load reductions. For point sources, such as MS4s and WWTPs, it is expected that the TMDL will be implemented through the NPDES program. NPDES permits must be consistent with the assumptions and requirements of the WLAs in the TMDL.

The Indian Creek Watershed sediment TMDL does not direct or require implementation of any specific set of actions or selection of controls. It is expected that the TMDL will be implemented through a variety of regulatory and non-regulatory programs operating under federal, state, and local law. Implementation may occur through a staged approach using a variety of tools, such as compliance schedules, permit requirements, and/or monitoring towards progress. EPA is sensitive to the fact that the WLAs set forth in this TMDL may take time to achieve. It may also be appropriate to set priorities in order to secure larger reductions early on, recognizing that final compliance by all permittees may take some time. EPA looks forward to engaging PADEP, the public, and stakeholders in further developing an appropriate implementation framework.

The issuance of NPDES permits provides the reasonable assurance that the WLAs assigned to point sources in the Indian Creek Watershed TMDL will be achieved. This is because 40 CFR 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an EPA-approved TMDL. Furthermore, EPA has the authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

The implementation of pollutant reductions from nonpoint sources (LA) relies heavily on incentive-based programs. Pennsylvania has a number of funding programs in place to ensure that the LAs assigned to nonpoint sources in the Indian Creek Watershed TMDL can be achieved. Some of the potential sources of funding for LA implementation are EPA's Section 319 funds, Pennsylvania's State Revolving Loan Program (also available for permitted activities), and landowner contributions. EPA seeks feedback from stakeholders to identify other strategies and potential sources of funding for LA implementation.

7 Public Participation

Public participation is a necessary step in the TMDL development process. Each state must provide for public participation consistent with its own continuing planning process and public participation requirements. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment pursuant to 40 C.F.R. §130.7(d)(2). EPA believes there should be full and meaningful public participation in the TMDL development process. This section describes the public participation for this TMDL development process.

To date, EPA has held two informational stakeholder webinars during the course of the preliminary draft TMDL development process. The webinars occurred on December 4, 2014 and on February 11, 2016 with approximately 30 stakeholders attending each.

This section of the document will be updated prior to finalization to reflect the public participation during the public comment period.

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Appendix A: Parameters for Channel and Streambank Erosion

Parameters for streambank erosion include animal density, total length of natural stream channel, fraction of developed land, mean stream depth, average watershed curve number, average watershed erodibility, and average watershed slope. The mean stream depth is typically estimated as a function of watershed area, using USGS regional curves. In areas where streambank erosion is a contributing, but less significant factor with regard to sediment delivery in the watershed, this is a viable option. However, because streambank erosion in the watershed was anticipated to be a primary factor, EPA personnel performed a field survey to gain a better estimate of stream depth. Field surveys were conducted on December 30th, 2014 and December 21st, 2015 in the Indian Creek and Birch Run watersheds, respectively. **Figure A** shows the 16 site locations on the mainstem and unknown tributaries of Indian Creek. **Figure B** shows the 11 site locations on the mainstem and unnamed tributaries of Birch Run.

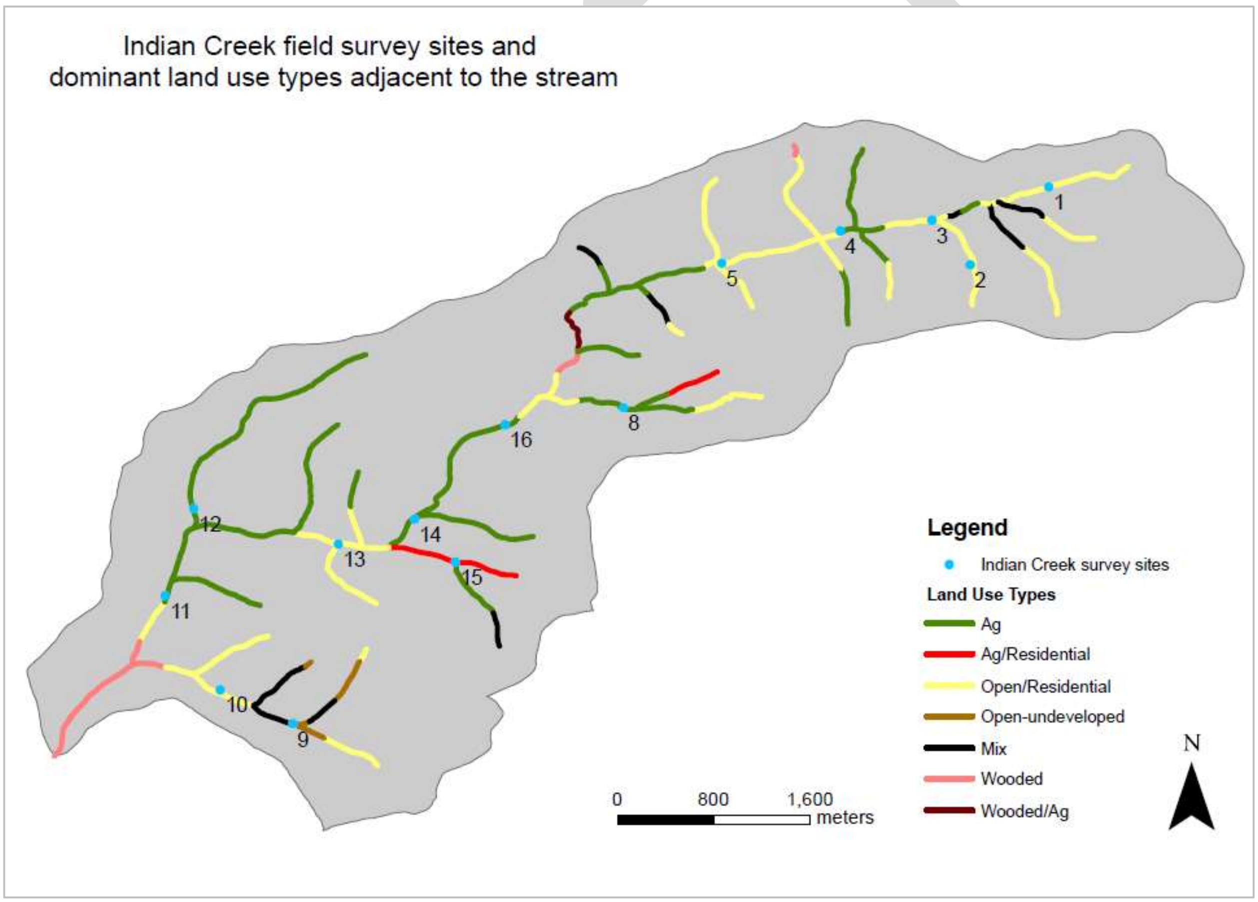

Figure A: Map of the Indian Creek field survey sites and the dominant land use types adjacent to the stream.

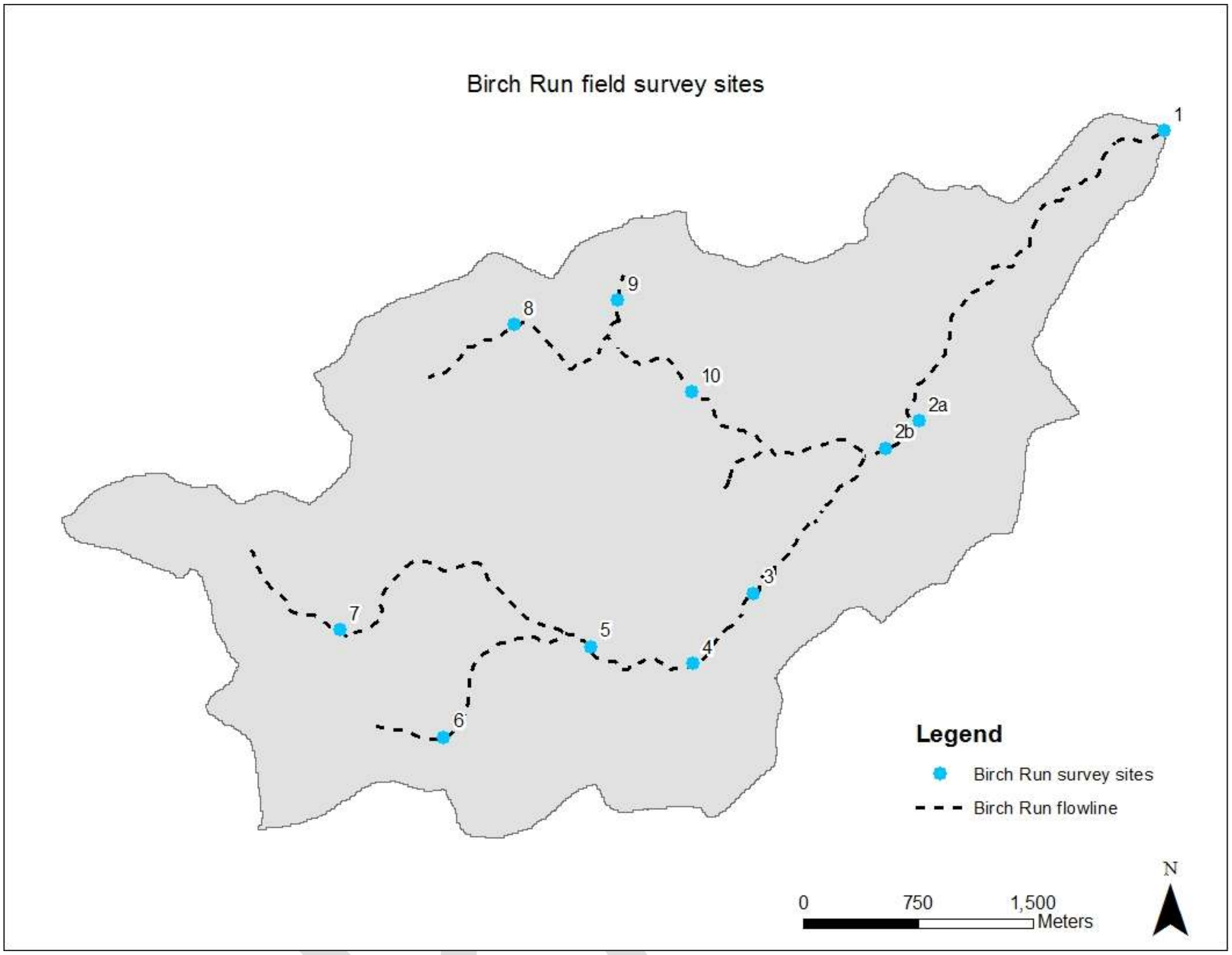

Figure B: Map of the Birch Run field survey sites.

Accessibility and predominant land use adjacent to stream was taken into account when selecting sampling locations. This ensured representative sampling within the Indian Creek watershed. Site accessibility was limited along Birch Run; however, multiple land use categories were still represented. The Protocol for Collecting Eroding Streambank and Channel Attributes (2014) describes the site selection and data collection process for in situ measurements and observations of streambank and channel attributes. The following attributes were collected at each site: channel depth, channel length, streambank condition, and Geographic Positioning System location. Additional site information such as land use type, riparian vegetation, and flow condition were noted. The site locations and corresponding stream depth measurements for each watershed are shown in **Tables I and II**.

Table I: Channel depth measurements for the Indian Creek watershed field survey on December 30th, 2014.

Watershed/Stream	**Site**	**GPS Latitude**	**GPS Longitude**	**Channel Depth (m)**	**Channel Length (m)**
Indian Creek/mainstem	1	40.32412	-75.33742	1.6	250
Indian Creek/UNT	2	40.3183	-75.34331	0.6	100

Watershed/Stream	Site	GPS Latitude	GPS Longitude	Channel Depth (m)	Channel Length (m)
Indian Creek/mainstem	3	40.32166	-75.34617	1.7	100
Indian Creek/mainstem	4	40.32087	-75.35303	1.8	100
Indian Creek/mainstem	5	40.31843	-75.36188	2.2	150
Indian Creek/UNT	6	-	-	Dry Channel	-
Indian Creek/UNT	7	-	-	Dry Channel	-
Indian Creek/UNT	8	40.30763	-75.36923	1.7	100
Indian Creek/UNT	9	40.284	-75.394	1.2	250
Indian Creek/UNT	10	40.28653	-75.3994	0.9	200
Indian Creek/mainstem	11-RL	40.29358	-75.40354	3.0	200
Indian Creek/mainstem	11-RR	40.29358	-75.40354	0.9	200
Indian Creek/UNT	12	40.30009	-75.40138	0.7	> 250
Indian Creek/mainstem	13	40.29745	-75.39058	1.7	500
Indian Creek/mainstem	14	40.2993	-75.38489	1.4	200
Indian Creek/UNT	15	40.2961	-75.38181	0.9	200
Indian Creek/mainstem	16-RL	40.30637	-75.3781	2.8	300
Indian Creek/mainstem	16-RR	40.30637	-75.3781	1.6	300

Note: RL – river left RR – river right UNT – unnamed tributary GPS: Geographic Positioning System

Table II: Channel depth measurements for the Birch Run watershed field survey on December 21st, 2015.

Watershed/Stream	Site	GPS Latitude	GPS Longitude	Average Channel Depth (m)	Channel Length (m)
Birch Run/mainstem	1	40.1477	-75.6209	0.85	300
Birch Run/mainstem	2a	40.1311	-75.6404	0.95	200
Birch Run/mainstem	2b	40.1296	-75.6432	1.05	200
Birch Run/mainstem	3	40.1214	-75.6537	0.25	200
Birch Run/mainstem	4	40.1174	-75.6585	0.85	200
Birch Run/mainstem	5	40.1186	-75.6663	0.6	300
Birch Run/UNT	6	40.1136	-75.6778	0.6	100
Birch Run/mainstem	7	40.1201	-75.6855	0.55	400
Birch Run/UNT	8	40.1377	-75.6713	0.55	200
Birch Run/UNT	9	40.1389	-75.6632	0.45	200
Birch Run/UNT	10	40.1334	-75.6578	0.55	100

Note: RL – river left RR – river right UNT – unnamed tributary GPS: Geographic Positioning System

Photographs were taken to document the site location and streambank condition (i.e. observable erosion). **Figures C – E** show stream depth measurements taken at several sites in Indian Creek while **Figures F – H** show sites along Birch Run. The average results of both the USGS calculation, and the EPA survey can be seen in **Table 4-2** of the preliminary draft TMDL report. The USGS regional curves are based on properly functioning streams (*i.e.*, not exhibiting excessive streambank erosion). As expected, the actual measured stream depths were larger, reflecting the ongoing erosion process in both streams.

Figure C: Site 3, observable erosion on the left bank of the Indian Creek mainstem.

Figure D: Site 14, stream depth measurement taken on the left bank of the Indian Creek mainstem.

Figure E: Site 16, stream depth measurement taken on the left bank of the Indian Creek mainstem.

Figure F: Site 7, stream depth measurement taken on the left and right bank of the Birch Run mainstem. This picture shows the predominant wooded land use.

Figure G: Site 3, stream depth measurement taken on the left and right bank of Birch Run. This picture shows the predominant wooded land use along with residential.

Figure H: Site 4, stream depth measurement taken on the left and right bank of Birch Run. This picture shows residential and open land uses present within the watershed.

Appendix A References

U.S. Environmental Protection Agency. 2014. Protocol for Collecting Eroding Streambank and Channel Attributes. Dated 29 December 2014.