319 Watershed Implementation Plan: Little Wiconisco Creek Watershed

Prepared by the Dauphin County Conservation District

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I. WATERSHED BACKGROUND

The Little Wiconisco Creek or "Little Wic" is the largest subwatershed of the Wiconisco Creek, one of Dauphin County's larger streams that drains directly into the Susquehanna River and ultimately to the Chesapeake Bay. Its location is identified as Hydrologic Unit Code (HUC) 2050301 within the Lower Susquehanna River Basin. The Little Wiconisco Creek Watershed (LWCW) drains a 17.5 square mile area in northern Dauphin County comprised of the less elevated areas within the larger Lykens Valley between the boroughs of Berrysburg and Millersburg. The watershed boundary begins northeast of Berrysburg Borough and extends westward along the southern flank of Mahantango Mountain through Mifflin and Upper Paxton townships. Several miles northeast of Millersburg, the boundary turns south sharply as the Little Wic heads towards its confluence with the Wiconisco Creek in Millersburg (Figure 1).

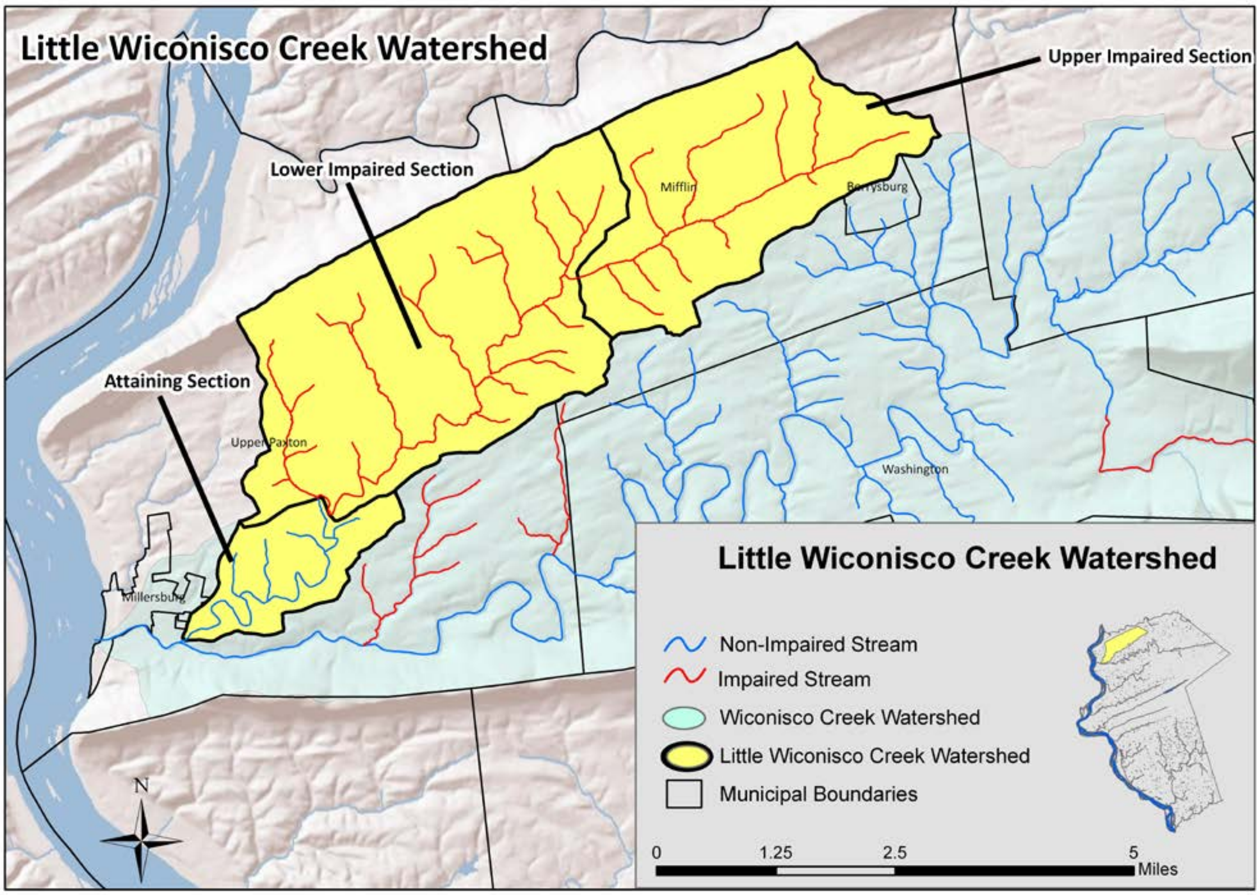


Figure 1: *Little Wiconisco Creek Watershed*

The watershed is predominantly rural, and has only small concentrations of urban or suburban development along major road frontages in the most downstream portion of the watershed near Millersburg, where it joins the Wiconisco Creek. The majority of land use in the LWCW is agriculture, followed by forested areas on Mahantango Mountain and in small sections of riparian buffer along the stream's reach. There are 125 farm tracts covering approximately 8,740 acres – 78 percent – of the watershed's 11,200 acres. These agricultural operations have contributed significantly to siltation and nutrient enrichment in the Little Wic.

A. Topography, Geology, and Soils

The LWCW lies within the Susquehanna Lowland Section of the Valley and Ridge Physiographic Province, which is characterized by folded, faulted, and often steeply dipping stratified sedimentary rock sequences. The smaller tributaries of the Little Wic drain the southern slopes of Mahantango Mountain, which is part of the Minersville Synclinorium. The Mahantango Mountain ridge is occupied by the Mississippi-Pocono Formation, which consists of less erosive grey sandstone, conglomerate, siltstone, and thin coal beds. The Mississippian-aged Mauch Chunk Formation, which consists of less resistant interbedded siltstone, claystone, and poorly cemented sandstone, occupies the Lykens Valley. The formation is generally exposed throughout the valley. Of note, both of the formations mentioned are important water supply sources, particularly the Mauch Chunk Formation, which forms the valley's most important aquifer. Nearly all private water supplies and most municipal wells in the watershed are located in this formation. No carbonate (limestone) is present in the LWCW.

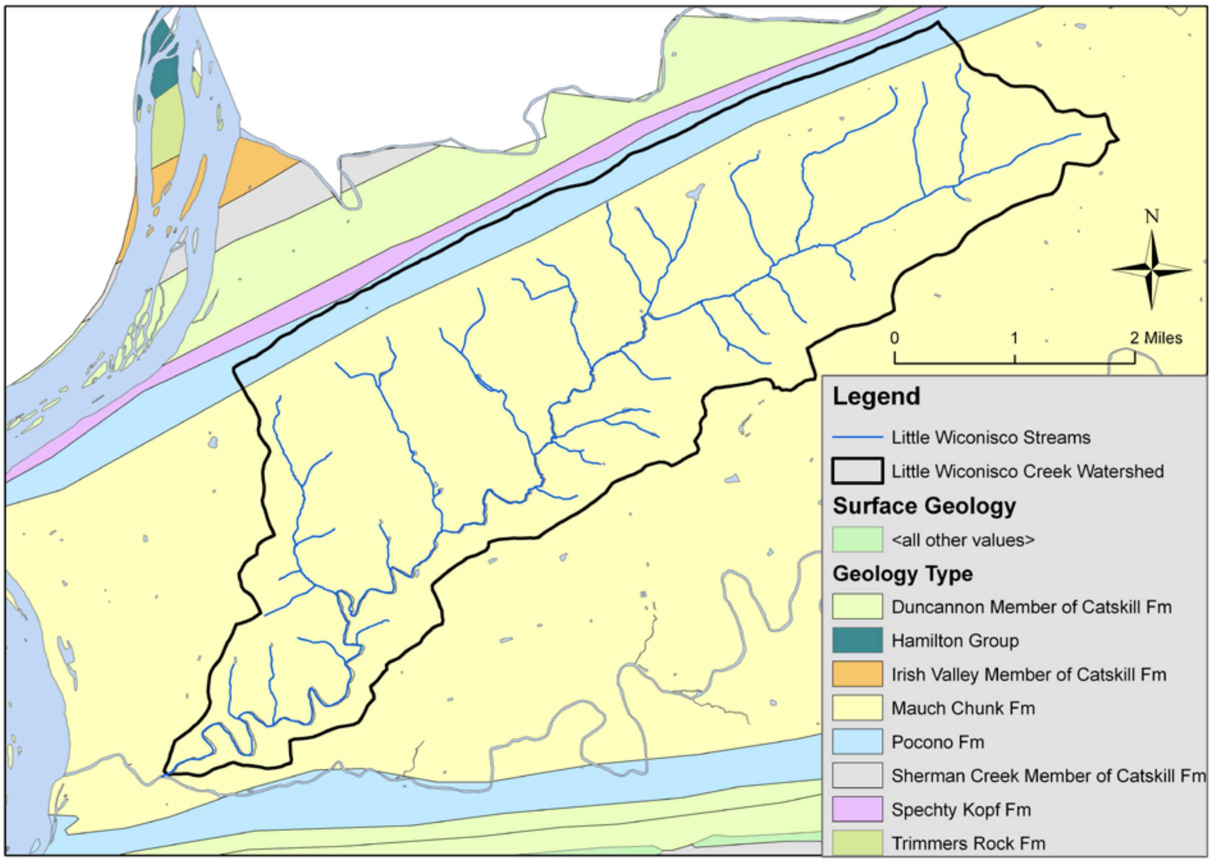


***Figure 2**. Surface Geology within the Little Wiconisco Creek Watershed.*

The soils of the Lykens Valley are of the Calvin-Leck Kill-Klinesville Association, formed from red shale and sandstone. The primary land use of these soils is for agricultural purposes. Because these soils are extensively intermingled on the landscape, Calvin-Leck Kill and Calvin-Klinesville soils are each identified as a single soil complex on the Dauphin County Soil Survey. In cases where a mapping unit is easily distinguished, as in the case of steeper areas, Klinesville soils are mapped separately.

Calvin-Leck Kill soils range from two to six feet deep. These soils have moderate permeability, are well drained, and have a moderate capacity to hold moisture. Calvin-Klinesville soils are shallow, having a depth of up to approximately 2.5 feet. Soils in this profile are well drained, and tend to have a low to moderate available water capacity, with areas of Calvin soils having more moisture available to plants. Calvin-Klinesville soils require intensive management for good plant growth. Klinesville soils are very shallow. In the LWCW, these areas tend to be outcrops of shale or steep areas where erosion has removed most of the surface layer. Erosion is a moderate to severe hazard, and establishing a permanent vegetative cover to slow surface runoff is the key to erosion control.

The slopes of Mahantango Mountain are composed of Laidig soils near the base and Dekalb-Lehew soils along the ridges. Laidig soils are deep, well-drained soils that are rich in organic content and have a moderate available water capacity. Slopes along the base range from 8 to 25 percent, with areas of lesser slope being well suited for general farm crops or pasture. Controlling erosion by reducing surface runoff will maintain the organic content of these soils. The soils of the Dekalb-Lehew Association form the mountain ridge, which has a slope ranging from 25 to 80 percent. This association is wooded because it is too stony for cultivation; runoff is not an issue.

B. Land Use

The major land uses in the LWCW are agriculture (74.3%); forest (12.6%), most of which includes wooded tracts located along the Mahantango Mountain; and residential (8.5%). The majority of developed land is located near the confluence of the Little Wic Creek with the Wiconisco Creek at Millersburg (Figure 3). Land use percentages were obtained from The Dauphin County Planning Commission.

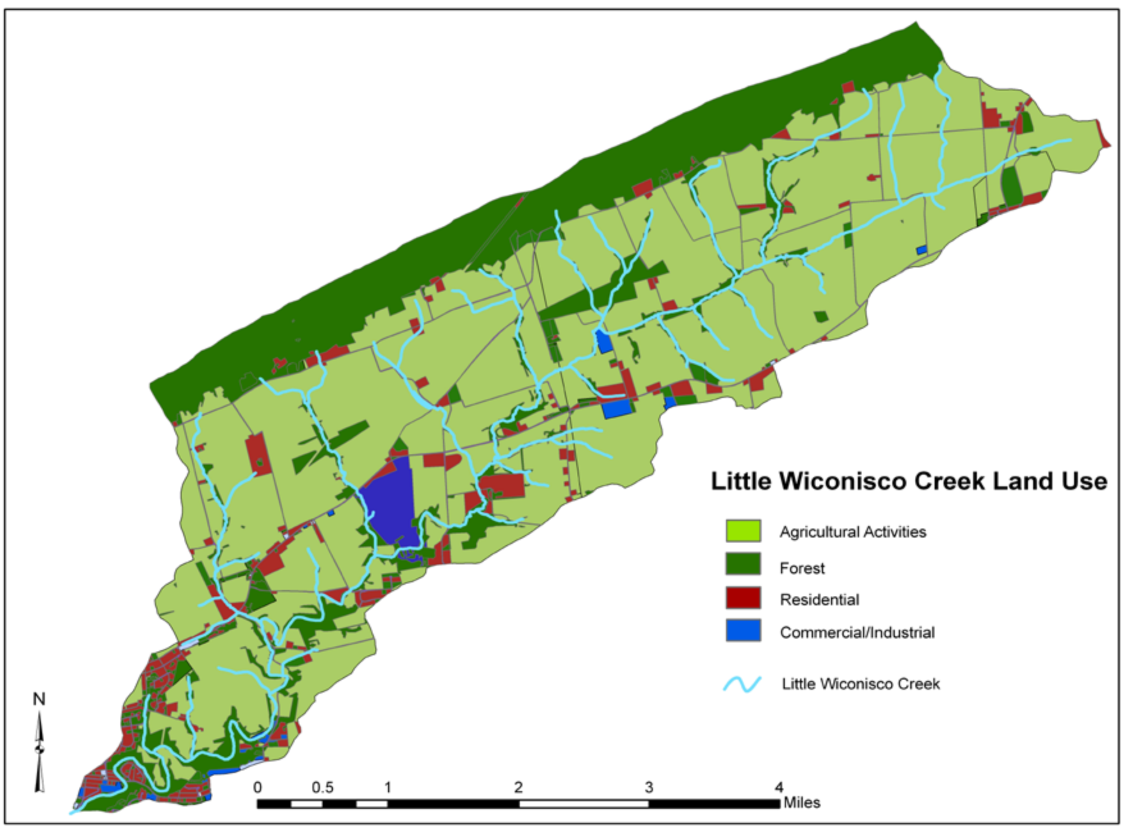


Figure 3*. The Little Wiconisco Creek Watershed Land Use.*

It is also worthy of note that the vast majority of land in the LWCW is enrolled in Agricultural Security Areas and a significant number of the farms, partially or entirely within the watershed are permanently preserved as farmland through the Dauphin County Agricultural Conservation Easement Purchase Program.

II. WATER QUALITY STANDARDS

The Pennsylvania Code Title 25, Environmental Protection, Chapter 93, Water Quality Standards outlines protected water uses, statewide water uses, and water quality standards that surface waters must meet. General water quality criteria cited in Chapter 93, Section 6 stipulates that (a) "Water may not contain substances attributable to point or non-point 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; and (b) 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 that produce color, tastes, odors, turbidity or settle to form deposits."

All streams in the LWCW are classified as warmwater fisheries (WWF). Therefore, in addition to general surface water standards, the LWCW is required to meet all water quality standards specific to a WWF, which are listed in Tables 1a and 1b below.

Parameter	***Criteria***
Dissolved Oxygen (DO)	Minimum daily average 5.0 mg/L; minimum 4.0 mg/L
Iron (FE)	30 day average 1.5 mg/L as total recoverable
pH	6.0 to 9.0 inclusive
Alkalinity	Minimum 20 mg/l as $CaCO_3$, except where natural conditions are less. Where discharges are to waters with 20 mg/l or less alkalinity, the discharge should not further reduce the alkalinity of the receiving waters
Total Dissolved Solids (TDS)	500 mg/l as a monthly average value; maximum 750 mg/L

Table 1a. *WWF Water Quality Standards – Source: Pennsylvania Code Title 25, Environmental Protection, Chapter 93, Water Quality Standards.*

Critical Use Period	***Temperature (°F)***
January 1-31	40
February 1-29	40
March 1-31	46
April 1-15	52
April 16-30	58
May 1-15	64
May 16-31	72
June 1-15	80
June 16-30	84
July 1-31	87
August 1-15	87
August 16-30	87
September 1-15	84
September 16-30	78
October 1-15	72
October 16-31	66
November 1-15	58
November 16-30	50
December 1-31	42

Table 1b. *Temperature chart for Warm Water Fisheries (WWF). -- Source: Pennsylvania Code Title 25, Environmental Protection, Chapter 93, Water Quality Standards*

A. Past Studies

As part of the state's obligations under the Federal Clean Water Act (CWA), the Pennsylvania Department of Environmental Protection (PA DEP) performs surveys to assess the water quality of streams and other surface waters. PA DEP uses macroinvertebrate sampling to determine whether the water body meets its Chapter 93 designated use. Streams were classified as either "attaining" their use or "impaired." Statewide results are listed in the Integrated Water Quality Report, formerly known as the 303(d) list of Impaired Streams. Of the three subwatersheds, the only section that supports aquatic life use is 1.81 mi^2 listed as "attaining section" on Figure 1. Upstream, the lower impaired section; 9.69 mi^2, and the upper impaired section; 5.97 mi^2 are impaired along the mainstem and its tributaries. According to EPA's Envirofacts website, there is no point source discharges found within the watershed (EPA, 5).

In 1996, the Susquehanna River Basin Commission (SRBC) performed a biological and chemical evaluation of the entire Wiconisco Creek watershed. The results showed 79.9% of its stream miles impaired due to agriculture-related nonpoint source pollution. The evaluation included three sites along Little Wiconisco Creek. The macroinvertebrate data collected for the SRBC study in 1996 was used by PA DEP to list 32.11 of the 40.21 stream miles in the LWCW on the 303(d) list for siltation and nutrients due to agriculture. The only sections listed as attaining their designated use are at the downstream, western end of the watershed. The Wiconisco Creek Watershed Assessment and Plan summary of the Little Wic Creek indicates that it is "stressed by agricultural impacts such as streambank destruction in pastures and soil erosion in poorly managed crop land. The addition of streambank stabilization methods and channel restoration could vastly improve the overall physical habitat, biological conditions, and water quality of the Little Wiconisco Creek Watershed (Wiconisco Creek Watershed Assessment and Plan, 1999)."

Sediment filled waterway in the LWCW.

In 2008, a TMDL report was developed for Wiconisco Creek watershed, along with a section of the report pertaining to the Little Wiconisco Creek watershed. Details of the TMDL will be discussed in later sections of the report.

2010 Pennsylvania Integrated Water Quality Monitoring and Assessment Report – Streams, Category 2 Waterbodies, Attaining Some Uses

Stream Name Use Designation	Miles (Assessment ID)
Little Wiconisco Creek	Miles = 5.75996678893
Aquatic Life	(8243)
Little Wiconisco Creek Unnamed Of (ID:54973573)	Miles = 0.48874464152
Aquatic Life	(13598)
Little Wiconisco Creek Unnamed To (ID:54973625)	Miles = 0.49159926394
Aquatic Life	(8243)
Little Wiconisco Creek Unnamed To (ID:54973655)	Miles = 0.49307727758
Aquatic Life	(8243)
Little Wiconisco Creek Unnamed To (ID:54973825)	Miles = 0.69499973608
Aquatic Life	(8243)
Little Wiconisco Creek Unnamed To (ID:54973831)	Miles = 0.53388075903
Aquatic Life	(8243)

Table 2. *Attaining stream sections in the Little Wiconisco Creek watershed.*

Stream Name
Use Designation (Assessment ID)
Source Cause Date Listed, TMDL Date

Little Wiconisco Creek
HUC: 02050301
Aquatic Life (8245) - 9.52 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54972695)
HUC: 02050301
Aquatic Life (8245) - 0.56 miles
Agriculture Nutrients 2002 2008
Siltation 2002 2008

Little Wiconisco Creek Unnamed Of (ID:54972769)
HUC: 02050301
Aquatic Life (8245) - 0.39 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54972781)
HUC: 02050301
Aquatic Life (8245) - 1.02 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54972995)
HUC: 02050301
Aquatic Life (8245) - 0.28 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54973101)
HUC: 02050301
Aquatic Life (8245) - 0.41 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54973127)
HUC: 02050301
Aquatic Life (8245) - 0.51 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54973347)
HUC: 02050301
Aquatic Life (8245) - 0.4 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54973437)
HUC: 02050301
Aquatic Life (8245) - 0.38 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed Of (ID:54973495)
HUC: 02050301
Aquatic Life (8245) - 0.2 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972287)
HUC: 02050301
Aquatic Life (8245) - 1.13 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972339)
HUC: 02050301
Aquatic Life (8245) - 0.18 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972375)
HUC: 02050301
Aquatic Life (8245) - 1 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972575)
HUC: 02050301
Aquatic Life (8245) - 2.03 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972629)
HUC: 02050301
Aquatic Life (8245) - 0.39 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972637)
HUC: 02050301
Aquatic Life (8245) - 1.17 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972757)
HUC: 02050301
Aquatic Life (8245) - 0.54 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972795)
HUC: 02050301
Aquatic Life (8245) - 0.45 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972801)
HUC: 02050301
Aquatic Life (8245) - 1.06 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972845)
HUC: 02050301
Aquatic Life (8245) - 0.82 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972973)
HUC: 02050301
Aquatic Life (8245) - 0.52 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54972977)
HUC: 02050301
Aquatic Life (8245) - 1.42 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54973167)
HUC: 02050301
Aquatic Life (8245) - 0.97 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54973177)
HUC: 02050301
Aquatic Life (8245) - 0.5 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54973215)
HUC: 02050301
Aquatic Life (8245) - 1.83 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54973275)
HUC: 02050301
Aquatic Life (8245) - 0.39 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54973387)
HUC: 02050301
Aquatic Life (8245) - 2 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Little Wiconisco Creek Unnamed To (ID:54973441)
HUC: 02050301
Aquatic Life (8245) - 0.41 miles
Agriculture Nutrients 2002, 2008
Siltation 2002, 2008

Table 3. *TMDL stream sections in the Little Wiconisco Creek Watershed.*

B. Total Maximum Daily Loads

The United States Environmental Protection Agency (EPA) and PA DEP must set guidelines and determine conditions that will return impaired waters to a status that meets the water quality standards defined in Chapter 93. To accomplish this, water bodies that do not meet water quality standards may be assigned a total maximum daily load (TMDL), which quantifies the loading capacity of a water body for a given stressor and ultimately provides a quantitative scheme for allocating loadings among pollutant sources.

A TMDL is the sum of allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the body of water can be used for the purposes that PA DEP has designated, and it must also account for seasonal variation in water quality (Ref. #4 EPA, 2008). TMDLs are established in accordance with Section 319(h) of the Clean Water Act, and focus on nonpoint source management.

The goal of a TMDL report is to provide detailed technical and scientific documentation that identifies the water quality impairment and the causes of impairment. An important part of the TMDL determination is the use of scientific and mathematic models in conjunction with stream sampling. Current loading rates and TMDL endpoints are determined from the models. An instream numeric endpoint represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. Sampling can then be done to determine if change is being made over time as the load reductions and additional BMPs are implemented. It is important that a TMDL be reasonable for the watershed(s) for which they are proposed (Ref. #4 EPA, 2008).

A TMDL for the greater Wiconisco Creek Watershed was developed and approved by the US EPA in November 2008. As part of that document the Little Wiconisco Creek TMDL was developed to address impairments caused by phosphorous and sediment. Both Nitrogen and Phosphorus contribute to excessive nutrients, but phosphorus was determined to be the limiting nutrient (Ref. #9 SRBC, 2008). The ratio of nitrogen to phosphorus determines the limiting nutrient to be nitrogen if $N/P < 10$, and phosphorus if $N/P > 10$. The Wiconisco Creek TMDL specifies that the N/P ratio was found to be 15 on average, which indicates phosphorus as the limiting nutrient. For this reason, TMDL allocations were given for only phosphorus and sediment loads.

The limiting nutrient is that which is in shortest supply, indicating that its presence affects aquatic biomass. Numerical water quality criteria are not specified for these contaminants by US EPA or by PA DEP; therefore, the results for the Little Wiconisco Creek TMDL were determined by using the “Reference Watershed Approach.” This method compares two watersheds – one that is attaining its use and one that is impaired – that have similar land use/cover distributions. The objective of this method is to reduce the loading rate of pollutants in an impaired stream segment to a level equivalent to the loading rate in the non-impaired reference stream segment. This load reduction will result in conditions favorable to the return of a healthy biological community to the impaired stream segments. The East Branch of Stony Fork in Tioga County, Pennsylvania was used in determining the TMDL values for Little Wiconisco Creek (Ref. #9 SRBC, 2007).

	PHOSPHOROUS (lbs/day)	SEDIMENT (lbs/day)
CURRENT LOAD LBS/DAY	**19**	**19,973**
TMDL LBS/DAY	**11**	**18,755**
MARGIN OF SAFETY LBS/DAY	**1.1**	**1,875**
LOAD ALLOCATION LBS/DAY	**9.9**	**16,880**
LOADS NOT REDUCED	**2.9**	**821**
ADJUSTED LOAD ALLOCATION	**7.0**	**16,058**
PERCENT REDUCTION NEEDED	**42**	**6**

Table 4. *Phosphorous and sediment loads, TMDL and reductions*

The TMDL has established mean annual loadings of total phosphorus at 11 pounds per day (lbs/day) and total sediment at 18,755,820 pounds per day (Table 4). These reductions are the amounts to be achieved in order to ensure attainment and maintenance of state water quality standards. Currently, mean annual loadings are estimated to be 19 lbs/day of phosphorus and 19,973 lbs/day of sediment. Therefore, target reductions for phosphorus are 42% of the current load, or 8.630 lbs/day. The sediment reduction needed is 6% of the current load amount, or 1,218.017 lbs/day.

The Little Wiconisco Creek TMDL loading limits were developed to address excessive nutrients entering the creek. Table 4 shows the breakdown of current loads, TMDL allocated loads, and the factors that shaped those loads.

III. PROBLEM IDENTIFICATION AND PRIORITIZATION

The problems in the LWCW are well documented and relate primarily to sedimentation and nutrient loading from agricultural sources. The TMDL developed for the LWCW is discussed above. This implementation plan focuses on addressing the TMDL by concentrating on agricultural land use and Best Management Practices.

Current agricultural practices in the LWCW provide many opportunities for non-point source pollution reduction. The Susquehanna River Basin Commission (SRBC), in their 1998 publication "Water Quality and Biological Assessment of the Wiconisco Creek Watershed," stated the following:

> "Little Wiconisco Creek is stressed by agricultural impacts such as streambank destruction in pasture areas and soil erosion in poorly managed crop areas. The addition of streambank stabilization methods and channel restoration could vastly improve the overall physical habitat, biological conditions, and water quality of the Little Wiconisco Creek Watershed."

Access to unfenced streams weaken streambanks, adds sediment to streambeds, along with increasing nitrogen and phosphorus concentrations.

A subsequent 1999 publication by the SRBC "Wiconisco Creek Watershed Assessment and Plan" stated:

> "In the western part of the watershed, including the Little Wiconisco Creek Watershed, sedimentation is due to a loss of forested riparian buffer zones, erosion from crop and pasture lands, and trampling of stream banks by livestock."

The reduction of sediment and nutrient loads in the Little Wiconisco Creek will improve quality in the Susquehanna River, and therefore the Chesapeake Bay. These reductions will help to achieve milestones set in the Chesapeake Bay Watershed Implementation Plan.

A. Sedimentation and Nutrient Loading

There are 38.13 stream miles in the LWCW, with almost the entire stream being located in agricultural land. Agriculture related nonpoint source pollution issues are the major threat to water quality and include: nutrient loading from fertilizers in runoff, sediment from crop runoff, streambank erosion from livestock, and bacteria from animal waste. Streams flowing into The Little Wic can be categorized into three subwatersheds shown in Figure 1 above. The subwatersheds drain the following areas: the upper impaired section drains an area of 5.97 mi^2, the lower impaired section drains an area of 9.69 mi^2, and the attaining section drains an area of 1.81 mi^2.

Stream impairments within Little Wiconisco Creek Watershed are related to its land use. Farmland covers 78% of the watershed, giving reason for conservation best management practices to be a priority. 125 farm tracts are at least partially located within Little Wiconisco Creek watershed. Of that, 118 farms have conservation plans that are up-to-date or nearly up-to-date. The Dauphin County Conservation District and NRCS work to make sure conservation plans are implemented and followed. To reduce the impact of nonpoint source pollution in the Little Wic, Best Management Practices (BMPs) designed to reduce or prevent runoff of nutrients and sediment have been implemented on farms throughout the watershed. Examples of BMPs include: cover crops and conservation tillage, nutrient management, streambank fencing, and animal waste management systems.

B. Streambank Stability

Streambanks throughout Little Wiconisco Creek have lost their protective riparian buffer that once covered the entire watershed hundreds of years ago. As land within the area was converted to farmland, the majority of streams do not have the shaded cover from surrounding trees, whose roots stabilize banks from being eroded during flashy storm flow events. This is evident in Figure 4, showing tree coverage as spotty throughout riparian areas, with most tree coverage being found at the border of the watershed, Mahantango Mountain. It is an ongoing effort by District Ag Technicians to work with land owners and operators to implement riparian buffers and maintain seedling upkeep from competing grasses, weeds, and animals. Likewise, The Dauphin County Conservation District also works with farmers to fence their streams from livestock access, a major cause for sedimentation and nutrients in the stream.

Figure 4. *Tree coverage within the Little Wiconisco Creek watershed.*

C. Aquatic Life Habitat

Another issue within the Little Wiconisco Creek watershed is the lack of aquatic life habitat. The buildup of sedimentation over the years has covered sand, gravel, and boulders suitable as habitat for aquatic insects and fish spawning. The attaining section of the watershed near its confluence with Wiconisco Creek offers the stream bottom substrate and tree coverage sufficient to support macroinvertebrate communities, shown in SRBC's Wiconisco Creek Watershed Assessment and Plan. Of the three sites monitored, the site nearest the mouth of Little Wiconisco Creek supported a diverse macroinvertebrate community (Ref. #8 SRBC, 1999 pg. 97), thus classifying the section as attaining aquatic life use. The challenge, and hopeful outcome, is to de-list upstream sections of the creek from the list of impaired streams.

As macroinvertebrates are a common type of water quality indicator, they are also the source of food for fish communities. Though studies have not been done on the fish community in Little Wiconisco Creek, fish habitat such as riffle areas, pools, overhanging banks, and shade from trees, are not easily found. Conservation practices to minimize sedimentation and in-stream habitat projects can improve the creek over time.

D. Prioritization of Projects

Each proposed project is assigned a priority ranking developed by District and NRCS staff. As potential projects surface with limited funding, priority must be given to those projects that rank higher than others. In order to rank projects, conservation practice ranking must be considered, along with its effectiveness to improve water quality, willingness of the landowner, and results from a site evaluation. Each of these factors contributes to the total priority ranking. Each factor is based on a 1-3 scale, where 3 is the highest priority. The following tables detail the priority ranking process. Table 5 indicates the priority ranking of each conservation practice, while Table 6 represents the form that is completed to document each of the prioritization categories.

Every month, the Dauphin County Ag Committee meets to discuss current and future projects. Potential projects are presented and decided upon at each meeting. The use of prioritization techniques allows each project to be weighed out for effectiveness, cost, and landowner willingness, assuring the best use of grant funding.

NRCS Code #	Name of Practice	Total Staff Ranking (1-3)
313	Waste Storage Structure	1
318	Composting Facility	1
330	Contour Farming	3
342	Critical Area Planting	2
357	Barnyard Runoff Control	2
358	Waste Transfer	1
362	Diversion	3
382	Fencing	3
393	Filter strip	3
412	Grassed Waterway	3
468	Lined waterway	3
512	Pasture and Hayland Planting	2
516	Pipeline	1
556	Planned Grazing System	2
558	Roof Runoff Management	1
561	Heavy Use Area Protection (barnyard)	1
561	Heavy Use Area Protection (non-barnyard)	3
574	Spring Development	1
575	Animal Trails/Walkways	2
580	Streambank/Shoreline Protection	3
586	Stripcropping	3
587	Structure for Water Control	3
600	Terrace	3
606	Subsurface Drainage	1
614	Tank or Trough	2
620	Underground Outlet	2
638	Water / Sediment Control Basin	2
645	Upland Wildlife Management (Tree Planting)	1

Table 5. *Conservation Best Management Practices listed with each determined priority ranking score.*

Farm Name:

Goal of the Project is to promote water quality and to work to remove the watershed from the 303D list

Ranking is based on a 1-3 scale, with 3 being the highest priority

BMP to be Installed	BMP Ranking*	Farm/Water Quality Ranking	Willingness Ranking	Site Evaluation	Total Ranking

Individual BMP's will be ranked and funded separately according to the goals of the Project.
exception: BMP's that need other BMP's to function properly will be funded together

* BMP ranking is based on the DCCD ranking
Farm/Water Quality Ranking is based on water quality improvements specific to the farm
Willingness ranking is based on the landowners willingness to install a specific BMP
Site Evaluation is based on specific site characteristics

Table 6. *Priority ranking BMP form.*

IV. DAUPHIN COUNTY EFFORTS IN THE LITTLE WICONISCO CREEK WATERSHED

Since the initial assessment by PA DEP, the Dauphin County Conservation District (DCCD) has assigned priority status to restoration efforts in the LWCW, and has been investing considerable effort towards addressing the impacts to the Little Wic. A summary of those efforts follows.

A. Grants

The Conservation District has obtained several grants including:

- A $110,000 Section 319 grant for implementation of agricultural BMPs in the LWCW. The grant was awarded in 2004 as part of Phase I within the watershed, and ended in 2006.
- A $100,000 National Fish and Wildlife Foundation (NFWF) grant for implementation of agricultural BMPs in 2006 as part of Phase II, ending in 2009.
- A $105,000 Growing Greener grant for agricultural BMPs was awarded in 2009 as part of Phase III, ending in 2011.

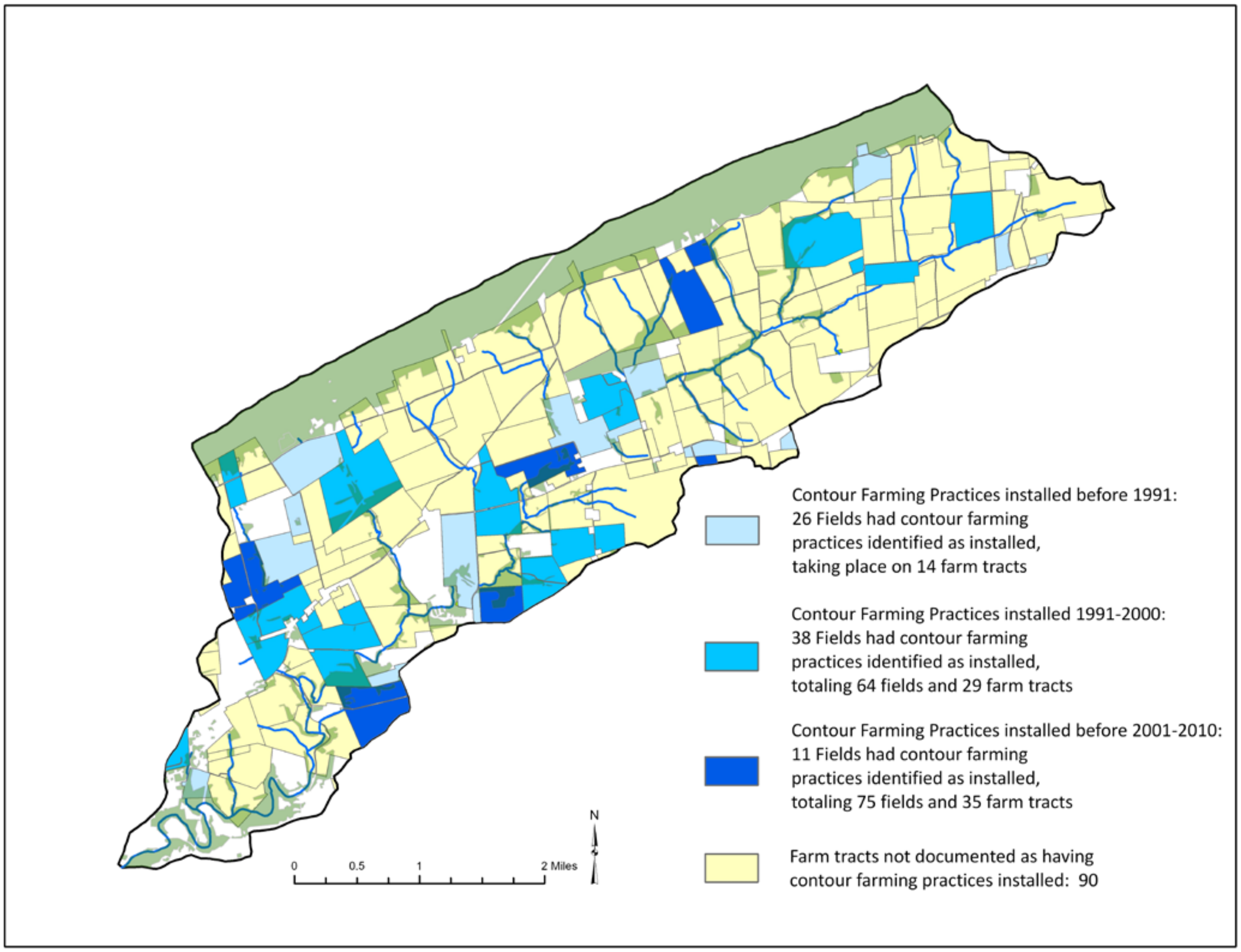


Figure 5a. *Contour farming is one example of conservation Best Management Practices. Implementation of this BMP is indicated by the color scheme representing different time periods.*

B. Landowner Outreach

A DCCD presentation on Agriculture and water quality impacts in the LWCW, 2003.

The Conservation District conducted two workshops for agricultural landowners and one workshop for non-agricultural landowners, conducted in 2003. The workshops presented water quality information on the Little Wic, pollution impacts, and steps landowner could take to minimize impacts. A direct mailing and in person follow up visits to agricultural land owners where there was no conservation plan was conducted in 2003 informing these landowners of the need for a conservation plan.

Since 2003, DCCD has increased the total number of conservation plans in the LWCW each year. The development of a conservation plan documents best management practices that have been identified on the farm, and prescribes improvements that are to be installed in order to improve soil and water conservation. Figure 5b indicates the trend of increasing conservation plans in the LWCW through the 2000s. At this point, 113 of 125 farm tracts have a conservation plan in the Little Wic watershed.

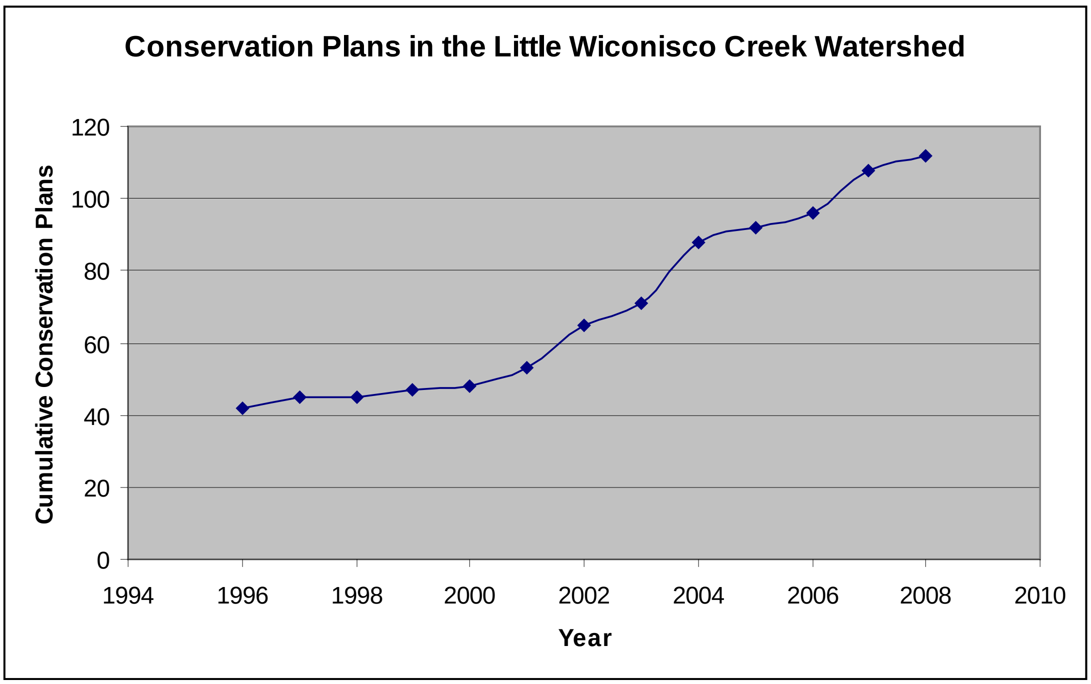


Figure 5b. *Total conservation plans in the Little Wiconisco Creek watershed between 1997-2008. A large increase was seen during the 2000s, accounting for documented BMPs that have been installed and proposed BMPs for future funding.*

C. Conservation Practices

Ag technicians are working closely with farmers and operators in the LWCW to improve water quality. Regular field visits allow our technicians to check on the status of each farm's conservation plan and document potential projects, along with making sure previously documented practices are in proper use. As landowners are willing and funding is available, projects are planned and carried out. The Dauphin County Ag Committee is comprised of DCCD Ag staff, managers, and directors. The Committee acts as the watershed advisory group, prioritizing projects to fund within the watershed.

A 2004 streambank planting in the LWCW.

i. Riparian Buffers

As seen in Figure 4 and again in Figure 6, riparian vegetative/tree cover is thin along the Little Wic, to say the least. Riparian buffers are important for many reasons, each linking to water quality. Mentioned above, streambank stability is greatly protected from erosion when long rooted grasses and trees are present. Riparian buffers also help to prevent runoff of sediment during rain events. Trees along streambanks also provide shade which cools water temperatures during summer months, benefiting the aquatic community, and provides food and habitat from leaf packs found in streambeds.

Before the time of considerable GIS technological improvement, a field survey of the extent and quality of riparian buffers in the LWCW was conducted by District staff. This survey, which was conducted in 2003, provided insight to identify target areas for riparian vegetative projects. In 2004, 1.4 acres of riparian buffer were installed on three farms using trees and shrubs provided by the Chesapeake Bay Foundation. A picture from the tree installation is shown above.

Streambank fencing, grassed waterways, stream crossings, and riparian buffer projects have been implemented on various farms throughout the LWCW, both through funding opportunities and individual farmer's initiatives. Various grants mentioned above allow the District to work with farmers to cover a portion of the cost of construction, materials, and labor in earth moving projects. Stream crossings constructed for livestock to cross streams at a given area helps to reinforce stability on streambanks with vegetation. This conservation BMP also minimizes the impact of erosion at each crossing. Two pictures are found below that document stream conditions before implementation of conservation BMPs and the resulting conditions one year after installation.

Before installation of a stream crossing and streambank fencing.

Vegetation growth surrounding streambanks one year After installation of streambank fencing.

One year after installation of a stream crossing.

ii. Countywide Agriculture Database

The Conservation District has worked with GIS consultants to create a countywide Farm Application featuring a BMP geodatabase which includes the LWCW. Information is entered regularly to update conservation plan status, livestock information, conservation practices that are proposed for prioritization of projects, and conservation practices that have been implemented on the farm. The application created accessible data management, which is frequently updated in a BMP table that is directly related to each farm tract. To date, a total of 723 Best Management Practices have been documented as installed in the LWCW. 96 of the 125 total farm tracts have a documented BMP.

As each farm tract has an individual ID, selections can be made to quickly and efficiently pull out data for specific queries and identify results on a map of farm tracts in the watershed. The database is helpful to see what types of BMPs have been installed, a time progression of the installed BMPs, and proposed BMPs for future projects. For example, Figure 5a illustrates the installment of contour farming practices on farm tracts within the LWCW over time. As each BMP is documented in the database, its use is easily represented with the aid of GIS.

Current GIS shapefile sharing allows for visual representations to assist in prioritizing proposed projects. With the aid of GIS shapefiles, a map was created to show sections of Little Wiconisco Creek that have some form of riparian tree buffer. The selection separated stream sections under canopy coverage from stream sections without riparian buffers; a minimum buffer distance from streambanks was not set. The clipped shapefile provides total riparian stream miles (17.4 mi), along with the total mileage of uncovered stream sections (20.6 mi). This is just one way to target areas within the watershed for conservation practice implementation. As mentioned above, other factors weigh into the prioritization process such as landowner agreement/involvement, and practices already installed on the farm.

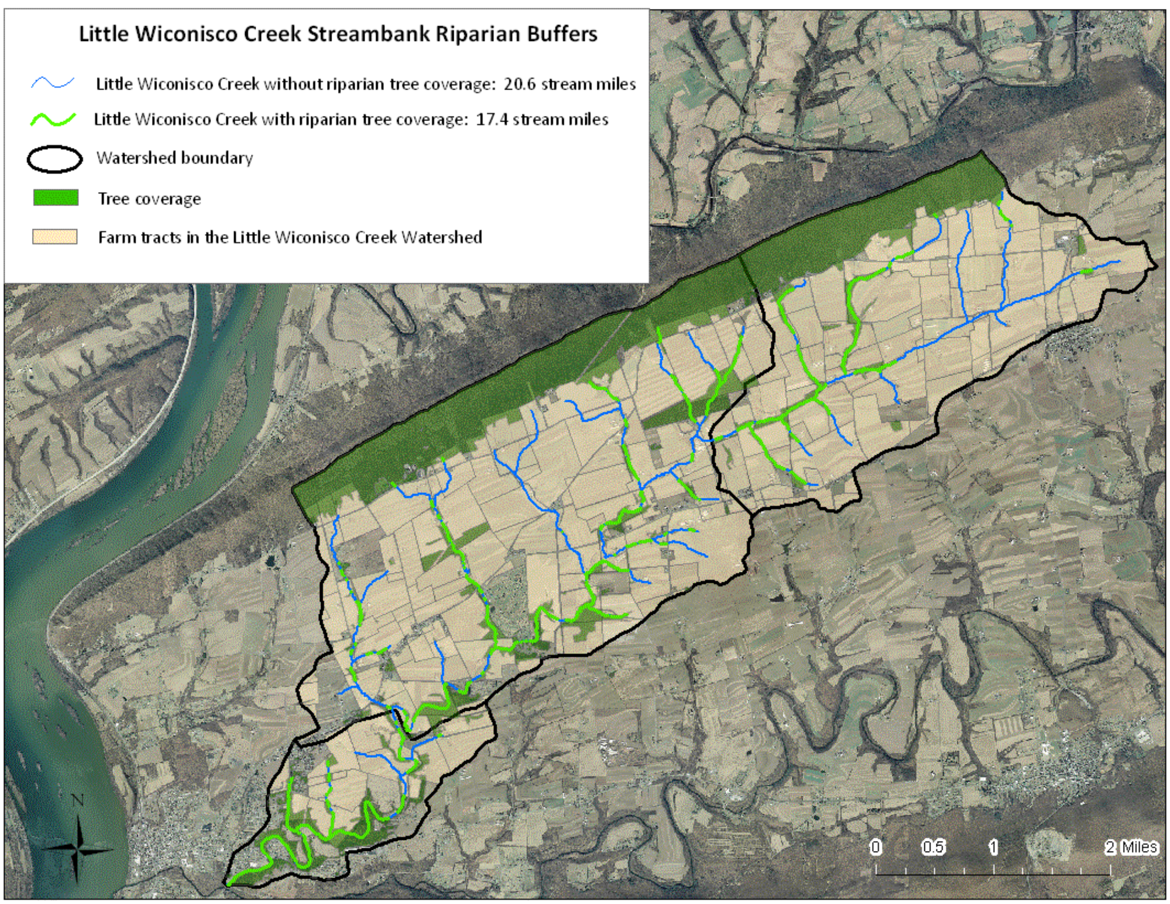


Figure 6. *Streams represented with riparian buffer vs. streams without riparian buffer in the LWCW. Land cover shapefile accessed from PASDA, contributed by PSU and DCNR.*

D. Dirt and Gravel Roads Program

In 1997, Act 3 section 9106 of the PA Motor Vehicle Code was signed into law as the Dirt and Gravel Road Maintenance Program (Administering the Dirt and Gravel Road Maintenance Program, 2007). The 2008 TMDL lists the Little Wiconisco Creek watershed as having 17 acres of unpaved roads (private and municipal). The Dirt and Gravel Roads GIS recognizes 5.14 miles of municipal roads qualifying for D&G funding. During 2003, three sites were completed totaling just under a mile of roadwork. Then in 2009, 721 feet of roadwork was completed.

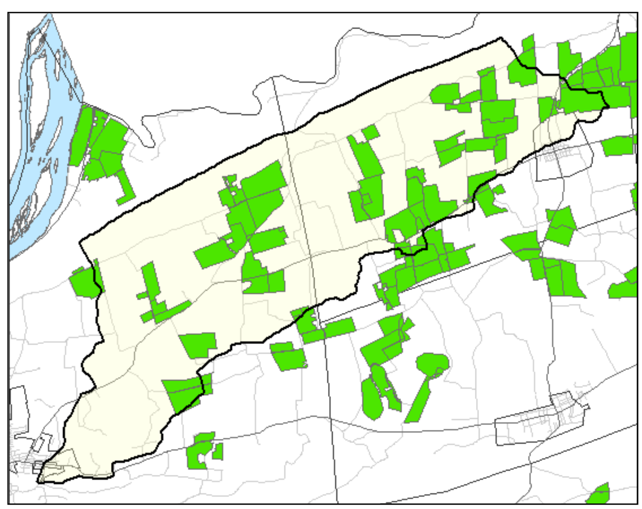
E. Planning

The LWCW is cited as a priority watershed in the Dauphin County Conservation Districts Chesapeake Bay Tributary Strategy Plan, completed in 2005: "Eighty percent of the work (in agriculture) will be concentrated in the approximately 146.74 stream miles impaired by activities associated with agriculture". More than a fifth of the agriculture-impaired stream miles in Dauphin County are in the LWCW. Also, this strategy prioritized all watersheds with agriculture-related impairments and placed the LWCW in the highest priority category.

The Dauphin County Strategic Plan, prepared in 2003, cites the LWCW as an impaired stream and an area that needs to be addressed. In the "Agriculture Critical Issues/Actions/Measurable Results" section, the Strategic Plan states that "Several of our streams are listed on the Department of Environmental Protection's impaired stream list with agricultural sediment and nutrients as a primary cause. The impaired streams are the Little Wiconisco… We need to work with the agricultural community to mitigate the causes of these impairments." An action step listed under this issue states, "Sediment and nutrient pollution resulting from agriculture can be mitigated through implementation of good conservation and nutrient management plans and the installation of BMPs. Each impaired steam should be addressed from a watershed approach with a comprehensive education, technical assistance and funding effort."

The Wiconisco Creek Watershed Conservation Plan, prepared by the Conservation District in 2004 cites the LWCW as a being "particularly plagued by sedimentation" and recommends the development of a remediation plan.

The Dauphin County Agricultural Land Preservation Program has been operating since the Pennsylvania State Farmland Preservation Program began in 1989. The first Dauphin County conservation easement was purchased in 1991. Landowners with more than 50 acres of currently farmed land can apply to enter the program if a Conservation Plan has been followed related to conservation best management practices. Each year farms are scored on parameters related to conservation practices and productivity of land in order to be accepted into the program, thus selling a conservation easement to the County so that the land may be preserved in perpetuity. To date, 32 preserved conservation easements are found within the Little Wiconisco Creek Watershed. A requirement of the program



Green tracts represent Ag Easements, as a part of the Ag Land Preservation Program. The border and light yellow represent LWCW's drainage basin.

is that the Conservation Plan must be followed up-to-date, promoting proper conservation of land and water.

F. Water Quality Monitoring

Water Quality monitoring is important in evaluating the effects of current and future conservation practices. Various methods of monitoring can be employed to observe changes over time when monitoring is performed on a frequent basis. As conservation practices are installed throughout the LWCW, the effects of protected waterways and buffered streams will be seen in water quality monitoring results. Within the Little Wiconisco Creek watershed, the following monitoring programs have been underway to document baseline conditions that are able to be analyzed over a long-term timeline.

i. *Nutrient Monitoring*

Excess nutrients are common in agricultural areas. The LWCW has been farmed for many generations, which allows fertilizing nitrates and phosphates to accumulate over time. Streambank soil, along with sediment as runoff then heightens levels in streams, especially during storm events. For this reason, a baseline study of nitrate and phosphate concentrations was conducted in November of 2006. Fifteen sites in the watershed were assessed to find areas with the highest concentrations.

November 2006: Baseline nitrate study

Results of this effort indicate that nutrient levels are significantly elevated. Nitrate concentrations are routinely in the 5 – 10 mg/L (nitrate-N) range during base flow conditions in the upper half of the watershed, with some base flow measurements in excess of 15 mg/L nitrate-N. These concentrations are very high in a watershed without carbonate bedrock. Similarly, phosphate levels are elevated, with average concentrations during base flow conditions slightly over 0.10 mg/L. While no in-stream criteria exist for phosphorus, total phosphorus levels over 0.10 mg/L are commonly cited as being detrimental to stream health. In studying phosphate levels shown in Figure 7, it is clear that the Little Wiconisco Creek exceeds this threshold. Results from this baseline study provided guidance in establishing a long-term nutrient monitoring program, discussed in Section VII: *Evaluation of Implementation Progress*.

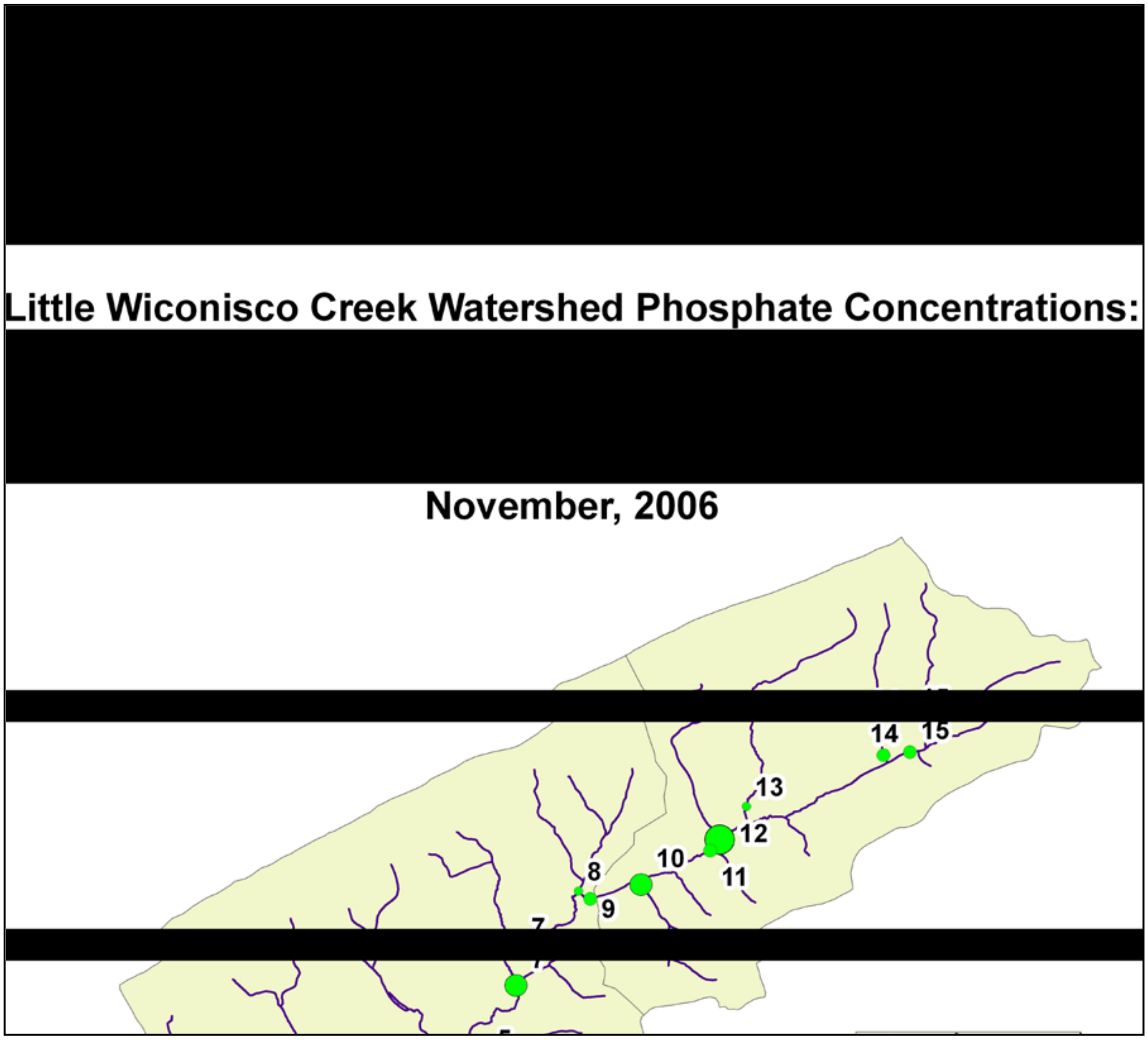


__Figure 7.__ Baseline phosphate concentrations in the Little Wic and its tributaries: Collected November of 2006.

ii. Macroinvertebrate Sampling

Macroinvertebrate collection and analysis is an efficient means of obtaining a general indication of stream health. Macroinvertebrate communities respond to pollutant stressors in stream water, and will rebound just as quickly when improvements are made to clean water quality. Taxon groups are rated by sensitivity to stressors, where some types are more tolerant to sediment and pollution than others. Diverse communities of pollution tolerant and pollution sensitive taxa make up a healthy stream.

EPA's Rapid Bio-Assessment Protocol serves as guidance in collection and analysis of 200 individuals. PA DEP recently established protocol for metric analysis to obtain an index of biotic integrity (IBI) as an overall health score. A baseline macroinvertebrate study was done within the LWCW in 2005, involving 15 sample sites. Sample sites covered the main stem of the creek along with its perennial tributaries. Results from the macroinvertebrate baseline study were not intensive, but provided guidance in placement of stations for the

Countywide Stream Assessment Program (CSAP), which provided detailed metric analysis. Results from the CSAP within the LWCW are discussed in Section VII. B.

V. WATERSHED MODELING AS A POLLUTION REDUCTION PREDICTOR

Water quality improvements were predicted by utilizing The Pollution Reduction Impact Comparison Tool (PRedICT) model. PRedICT was developed for evaluating both rural and urban pollution reduction strategies at a watershed level, and allows for the comparison of past, current, and future conditions.

MapShed version 1.0 was used to create a VGWLF file scenario. MapShed allows the user to load data layers into the model for a specific watershed. The following data layers are clipped from a statewide file and compared to create an accurate picture of the Little Wiconisco Creek watershed: The LWCW basin shapefile, soil test P, Digital Elevation Model, groundwater N, land use, soils, counties, roads, unpaved roads, streams, point source data, and weather station data. The combined data can then be loaded into the PRedICT model where best management practices are entered by percentage in each subwatershed. Animal totals by count and weight are then related to the cumulative total.

This tool allows the user to create various "scenarios" in which current landscape conditions and pollutant loads (both point and non-point) can be compared against "future" conditions that reflect the use of different pollution reduction strategies such as agricultural and urban best management practices (BMPs), stream protection activities, the conversion of septic systems to centralized wastewater treatment, and upgrading of treatment plants from primary to secondary to tertiary. It includes pollutant reduction coefficients for nitrogen, phosphorus, and sediment (Evans et al. 2008).

This implementation plan concentrates on the beneficial effects of agricultural BMPs on nitrogen, phosphorus, and sediment reduction within the LWCW. The application of the PRedICT model considered only agricultural BMPs. No BMPs for non-agricultural land were studied.

Animal waste production was tallied up for each subwatershed. DCCD Ag staff sorted through Nutrient Management Plans to find the types of livestock, along with counts of each. In addition, each farm without a Nutrient Management Plan was accounted for through documentation of past field visits. Average weights were assigned to calculate an Animal Unit (AU), and an Animal Equivalent Unit (AEU) was then calculated depending on the amount of time livestock is located on the farm in an average year.

Agricultural BMPs were pooled into one of eight generic types: 1) Crop Land Protection (Rotational and Cover Crop), 2) Conservation Tillage (No Till), 3) Strip and Contour Farming, 4) Ag to Forest, 5) Ag to Wetland, 6) Nutrient Management Plans, 7) Grazing Land Management, or 8) Terrace and Diversions.

Four scenarios were analyzed and compared: 1) watershed condition in 1997 (year of DEP assessment), 2) current watershed condition (includes all BMPs installed through 2010), 3) five-year plan (includes all BMPs to be installed by 2015), 4) best case scenario (includes all possible BMP practices, currently included in conservation plans and practices that are not currently installed, followed watershed-wide).

A. Model Results

Four different watershed scenarios or stages of BMP installations were identified and compared for each of the 3 Little Wiconisco Creek subwatersheds. This consisted of two known statuses on BMP installation: 1) Year of LWCW Assessment by PA DEP (1997), 2) Current status of all BMPs installed (2010), and two predicted scenarios of BMPs within the watershed (a five-year and fifteen-year plan). The five year plan consists of all BMPs that have been identified within the Conservation Plan and are considered to run through the year 2015. The fifteen-year plan is a best case scenario that predicts maximum pollution reductions as if all possible BMPs in the watershed were installed.

PredICT results are separated into three categories; 1) nitrate reduction, 2) phosphate reduction, and 3) sediment reduction, with all three categories showing significant pollution reductions within the watershed under the modeling scenarios. The model was run in each of the three subwatersheds for these scenarios and totaled accordingly. The subwatershed locations are shown in Figure 8.

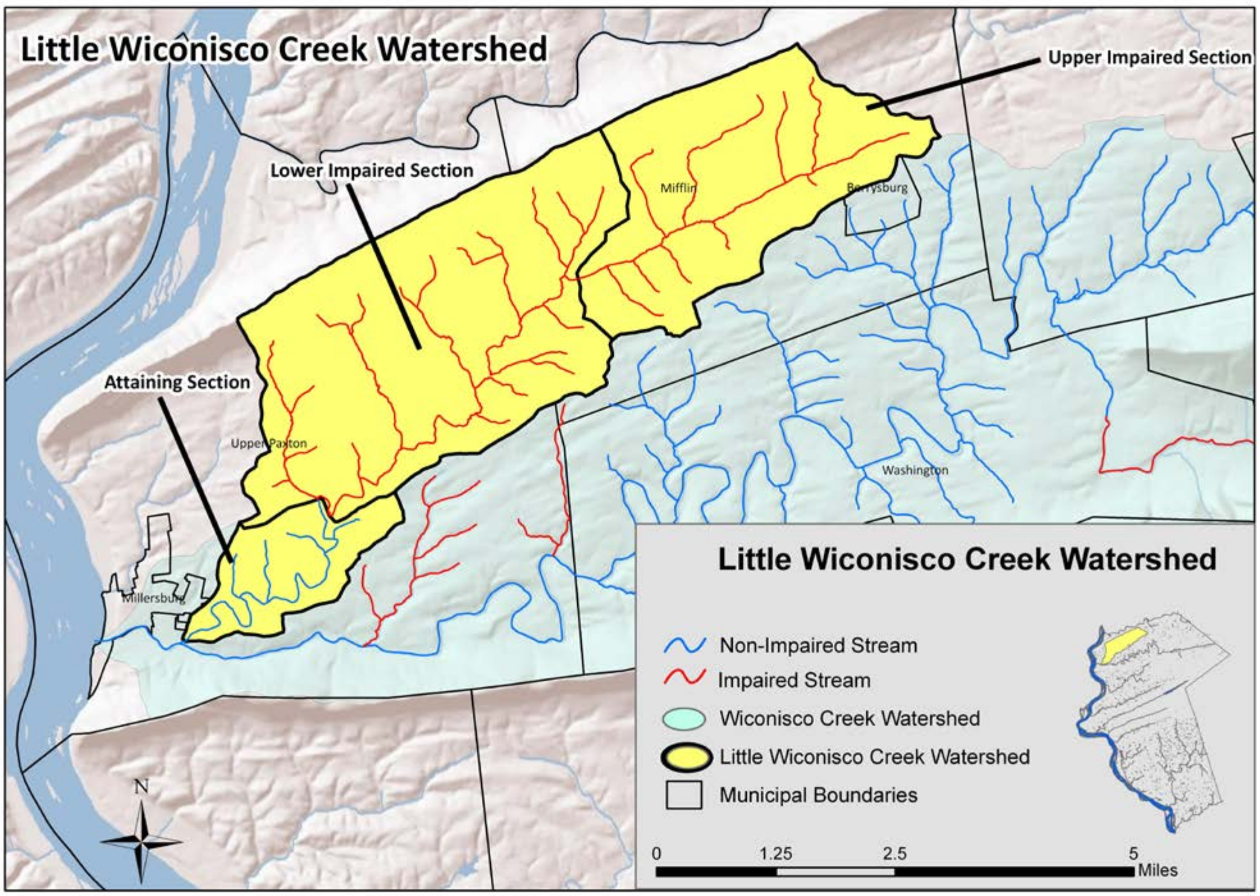


Figure 8. *Subwatersheds that make up the Little Wiconisco Creek watershed. The subwatersheds provided a more concentrated look at BMP placement within the LWCW, allowing priority areas to standout in PRedICT model output results. Emphasis can then be placed on subwatersheds of interest.*

1997

A scenario of pollution reduction was performed in order to document BMP pollution reductions through the years. Since 1997, much effort and money has gone into installing BMPs throughout the Little Wiconisco Creek watershed. 1997 was also the year of the initial water quality assessment performed by SRBC, documenting its impaired characteristics. The 1997 scenario for each of the three subwatersheds of Little Wiconisco Creek acts as a baseline for pollution reduction and BMP installation, and a starting point to build on. The following PRedICT scenario output files are shown for each subwatershed in the LWCW:

Attaining Subwatershed

	Existing (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	136687	635	148
Hay/Pasture	63934	924	141
High Density Urban	13228	254	29
Low Density Urban	0	7	0
Unpaved Roads	6614	24	7
Other	4409	33	4
STREAMBANK EROSION	80054	42	15
GROUNDWATER/SUBSURFACE		6770	82
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		150	2
FARM ANIMALS		3973	1486
TOTALS	**304926**	**12811**	**1914**
PERCENT REDUCTIONS	0.0	0.0	0.0
TOTAL SCENARIO COST	$0.00		

Lower Impaired Subwatershed

	Existing (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	1631421	7419	1944
Hay/Pasture	202825	3810	591
High Density Urban	8818	234	26
Low Density Urban	0	7	0
Unpaved Roads	13228	49	13
Other	22046	161	24
STREAMBANK EROSION	185155	93	44
GROUNDWATER/SUBSURFACE		34269	388
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		710	7
FARM ANIMALS		9445	3759
TOTALS	**2063494**	**56194**	**6797**
PERCENT REDUCTIONS	0.0	0.0	0.0
TOTAL SCENARIO COST	$0.00		

Upper Impaired Subwatershed

	Existing (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	1437414	7505	1828
Hay/Pasture	121113	2909	428
High Density Urban	6614	194	20
Low Density Urban	0	4	0
Unpaved Roads	24251	95	26
Other	17637	146	20
STREAMBANK EROSION	152767	77	35
GROUNDWATER/SUBSURFACE		30857	362
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		650	9
FARM ANIMALS		13901	5385
TOTALS	**1759796**	**56337**	**8113**

2010

Between 1997 and 2010, a large portion of potential BMP installation was accomplished within the LWCW. Grant funding discussed in Section IV. A., contributed to the increased BMP totals entered into the model, and the resulting reductions are seen in the output table below.

Attaining Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	79620	367	60
Hay/Pasture	60411	853	128
High Density Urban	13228	254	29
Low Density Urban	0	7	0
Unpaved Roads	6614	24	7
Other	4409	33	4
STREAMBANK EROSION	72604	39	14
GROUNDWATER/SUBSURFACE		5712	77
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		150	2
FARM ANIMALS		3714	1399
TOTALS	**236886**	**11152**	**1720**
PERCENT REDUCTIONS	22.3	13.0	10.1

Lower Impaired Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	982631	4392	809
Hay/Pasture	191650	3516	537
High Density Urban	8818	234	26
Low Density Urban	0	7	0
Unpaved Roads	13228	49	13
Other	22046	161	24
STREAMBANK EROSION	161118	84	38
GROUNDWATER/SUBSURFACE		27299	343
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		710	7

FARM ANIMALS		7671	2742
TOTALS	**1379491**	**44122**	**4540**
PERCENT REDUCTIONS	33.2	21.5	33.2

Upper Impaired Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	863606	4435	759
Hay/Pasture	116656	2737	397
High Density Urban	6614	194	20
Low Density Urban	0	4	0
Unpaved Roads	24251	95	26
Other	17637	146	20
STREAMBANK EROSION	130386	69	30
GROUNDWATER/SUBSURFACE		24561	313
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		650	9
FARM ANIMALS		11700	4286
TOTALS	**1159150**	**44590**	**5860**
PERCENT REDUCTIONS	34.2	21.8	29.6

5-Year Prediction: 2015

Predicting the amount of BMPs that will be installed in the next 5 years is a task that considered multiple angles. In order to estimate BMPs that might be installed within the next 5 years, each type of BMP (1-8) above, was totaled in the last 5 years, assuming that the next 5 years will be similar. This provided a starting point, which was then studied and edited according to specific case-by-case trends by the Ag Staff. For example, conservation practices can be un-documented in the NRCS and DCCD Farm application databases due to landowners implementing practices on their own. DCCD Ag staff considered this as predictions were listed for each of the BMPs (1-8). New regulations also attributed to higher percentages for certain BMPs, such as Nutrient Management Plans. As much of the potential work has already been done in the LWCW, the 5-year prediction was carefully considered in its slight increase to higher BMP percentages. Tables found in the attachments document installed BMPs in the LWCW, and proposed BMPs for future funding, which was considered in the prediction process. The following PRedICT scenario output files document pollution reduction in the LWCW

Attaining Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	75902	345	53
Hay/Pasture	57860	651	84
High Density Urban	13228	254	29
Low Density Urban	0	7	0
Unpaved Roads	6614	24	7
Other	4409	33	4
STREAMBANK EROSION	72604	39	14
GROUNDWATER/SUBSURFACE		5577	65
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		150	2
FARM ANIMALS		3385	1225
TOTALS	**230617**	**10465**	**1483**
PERCENT REDUCTIONS	24.4	18.3	22.5

Lower Impaired Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	888180	3978	689
Hay/Pasture	183557	2683	351
High Density Urban	8818	234	26
Low Density Urban	0	7	0
Unpaved Roads	13228	49	13
Other	22046	161	24
STREAMBANK EROSION	153106	81	36
GROUNDWATER/SUBSURFACE		26022	287
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		710	7
FARM ANIMALS		7447	2678
TOTALS	**1268935**	**41371**	**4113**
PERCENT REDUCTIONS	38.5	26.4	39.5

Upper Impaired Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	779798	4013	646
Hay/Pasture	111730	2088	259
High Density Urban	6614	194	20
Low Density Urban	0	4	0
Unpaved Roads	24251	95	26
Other	17637	146	20
STREAMBANK EROSION	122925	66	28
GROUNDWATER/SUBSURFACE		23354	267
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		650	9
FARM ANIMALS		11367	4175
TOTALS	**1062955**	**41978**	**5451**
PERCENT REDUCTIONS	39.7	26.4	34.5

Best Case Scenario: 15-Year Prediction for the Year 2025

The best case scenario model output was created in order to predict pollution reductions within the watershed if every potential BMP was installed. To create a best case scenario, the results were limited to the constraints of the model. In this case, increasing the model BMP percentage with the highest reduction efficiency would show the highest reductions in a best case scenario. The hope is to compare its results with the recommended Total Maximum Daily Load. TMDL limits should be met for sediment and phosphorus loads when predicting the best case scenario. The following model reductions were achieved, considering the best case scenario:

Attaining Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	72985	314	44
Hay/Pasture	55431	593	73
High Density Urban	13228	254	29
Low Density Urban	0	7	0
Unpaved Roads	6614	24	7
Other	4409	33	4
STREAMBANK EROSION	72604	39	14
GROUNDWATER/SUBSURFACE		5310	61
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		150	2
FARM ANIMALS		3317	1088
TOTALS	225271	10042	1322
PERCENT REDUCTIONS	26.1	21.6	30.1

Lower Impaired Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	713944	3182	504
Hay/Pasture	175850	2486	315
High Density Urban	8818	234	26
Low Density Urban	0	7	0
Unpaved Roads	13228	49	13
Other	22046	161	24
STREAMBANK EROSION	137081	75	32
GROUNDWATER/SUBSURFACE		23119	269
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		710	7
FARM ANIMALS		6697	2372
TOTALS	1070966	36718	3563
PERCENT REDUCTIONS	48.1	34.7	47.6

Upper Impaired Subwatershed

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	666207	3352	493
Hay/Pasture	107039	1905	226
High Density Urban	6614	194	20
Low Density Urban	0	4	0
Unpaved Roads	24251	95	26
Other	17637	146	20
STREAMBANK EROSION	108005	61	25
GROUNDWATER/SUBSURFACE		21042	246
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		650	9
FARM ANIMALS		10506	3814
TOTALS	**929752**	**37954**	**4879**
PERCENT REDUCTIONS	47.2	33.5	41.4

i. Sediment and Nutrient Reductions

The PredICT results indicated that the best case scenario could reduce sediment loads by 48.1% (Table 7) in the lower impaired subwatershed of LWCW. This is a decrease from 2,063,494 lbs/year to 1,070,966 lbs per year, or an overall decrease of over 992,528 pounds of sediment. Phosphate reductions were predicted to be 47.6% in the best case scenario, which was reduced from an initial load of 6,797 lbs/year in 1997 to a potential 3,563 lbs/year in 2025.

In the interest of analyzing the accumulated load reduction of the 3 subwatersheds, Little Wiconisco Creek watershed as a whole is discussed in Section V. B.: Comparison of TMDL. The following table illustrates the increasing percent reduction for each subwatershed as BMPs are installed between 1997 and the future best case scenario date of 2025.

Watershed	Year	Percent Reduction: Sediment	Percent Reduction: Phosphorus
Attaining	1997	0	0
	2010	22.3	10.1
	2015	24.4	22.5
	2025	26.1	30.1
Lower Impaired	1997	0	0
	2010	33.2	33.2
	2015	38.5	39.5
	2025	48.1	47.6
Upper Impaired	1997	0	0
	2010	34.2	29.6
	2015	39.7	34.5
	2025	47.2	41.4

Table 7. *Breakdown of percent reductions from 1997-2025 for each subwatershed of the Little Wiconisco Creek watershed. The highest reductions for both sediment and phosphorus loads were seen in the lower impaired subwatershed.*

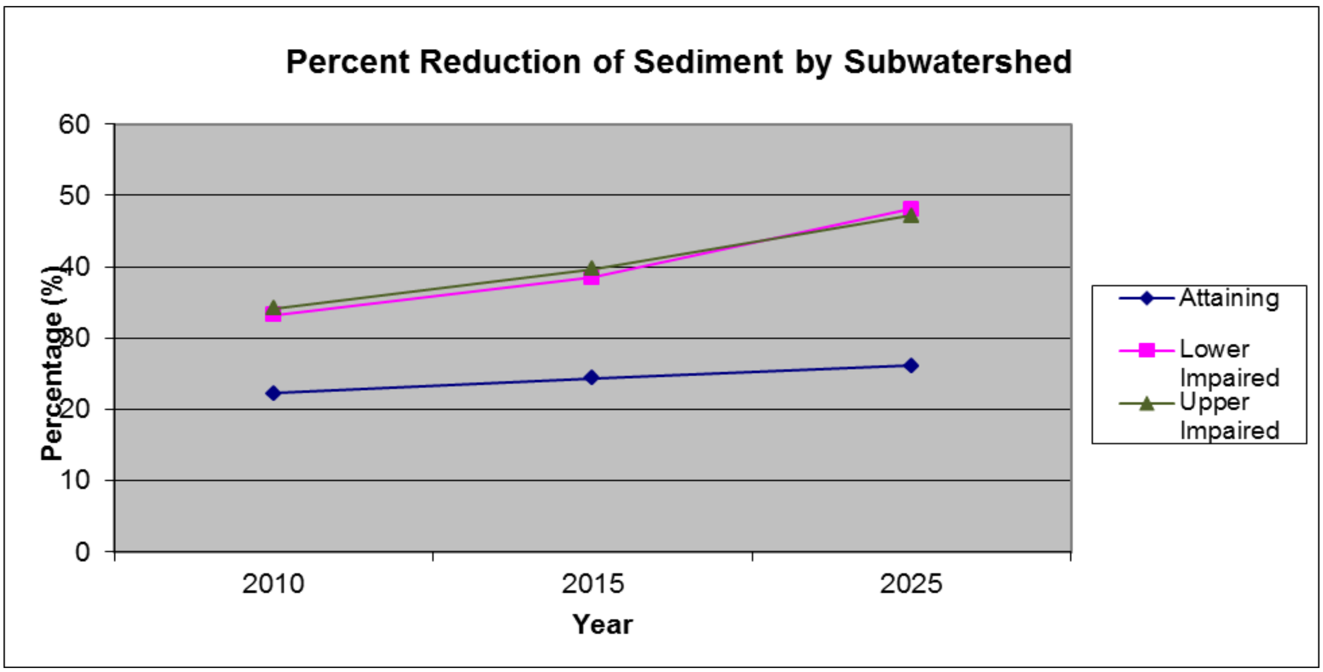


Figure 9. *Predicted percent reductions of sediment are shown for each subwatershed of the Little Wiconisco Creek Watershed. The lower impaired and upper impaired watersheds are predicted to follow closely, with the lower impaired watershed achieving slightly higher reductions by the year 2025. The low, slightly increasing reduction of the attaining subwatershed may be attributed to the lower number of proposed BMPs that benefit sediment conservation in that area.*

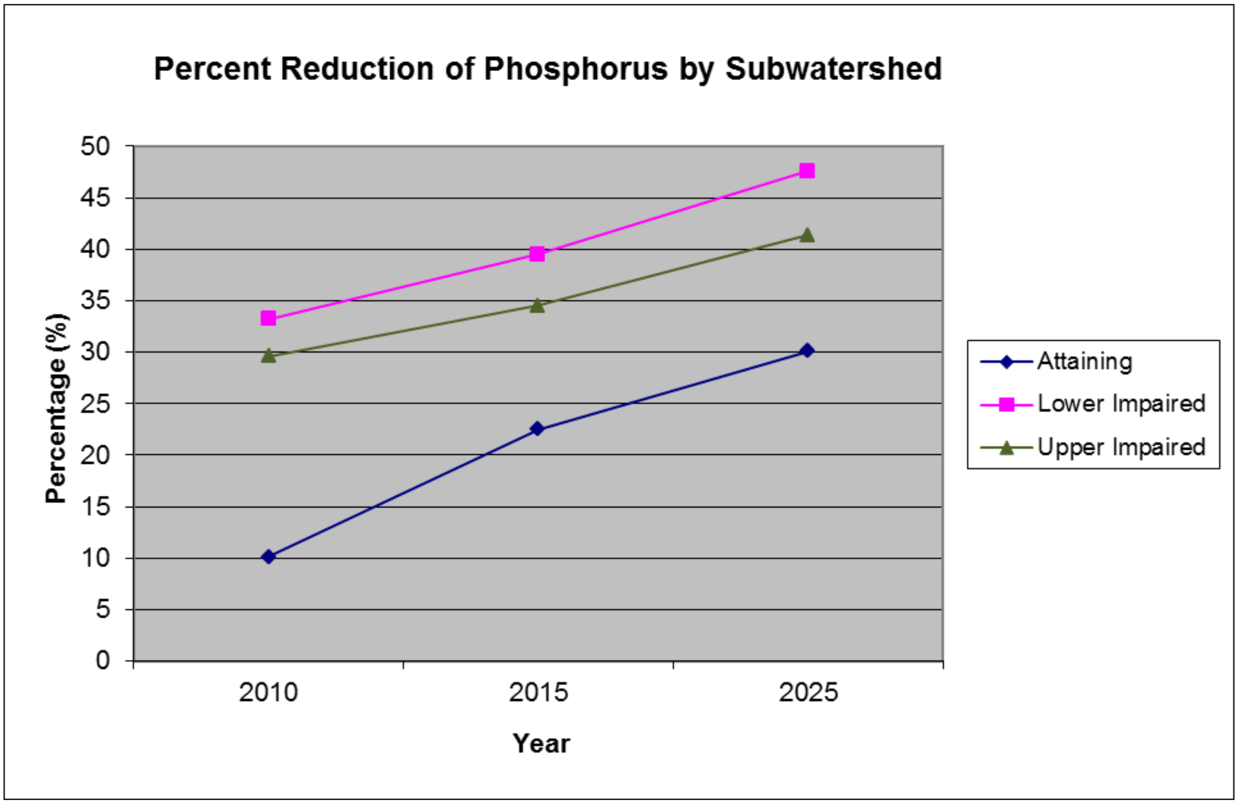


Figure 10. *Close to a 50% phosphorus reduction between the years of 1997 and 2025 can be predicted for the lower impaired LWCW subwatershed. The upper impaired subwatershed follows closely in trend, but at a slightly lower percentage. The reduction over time in the attaining subwatershed is predicted to increase steeply, and more gradually increasing after 2015 due to the type of BMPs to be proposed.*

Totals: Entire Little Wiconisco Creek Watershed			
Total Sediment Efficiencies	Total Phosphorus Efficiencies	Total Animal Contribution Reduction	Total Cost
1,902,227 lbs/yr	6,960 lbs/yr	3,256	$4,014,076.82
5,211 lbs/day	19.07 lbs/day		

Table 8. *PRedICT model generated Costs associated with implementation of BMPs from 1997 to 2012 and from 1997 to best case scenario. Total cost for the entire Little Wiconisco Creek Watershed, made up of each of the 3 subwatersheds comes to $4,014,076.*

B. Comparison of TMDL

When comparing PRedICT model scenario outputs and TMDL model outputs, it is important to keep in mind that many updates and considerations have been taken into account since the TMDL model was created. For example, datasets for animal phosphorus loads have become much more detailed. Attention to detail has revealed that phosphorus loads are estimated to be much higher than what was originally modeled in the TMDL. With this in mind, the TMDL goal of 11 lbs/day of phosphorus being transported within the Little Wiconisco Creek watershed is realistically out of reach. The percent reduction, however, can be used to base model predictions. The TMDL estimated that phosphorus must be reduced by 42% in order to reach its allowable load. As documented in Table 11, phosphorus loads can potentially be reduced from 46 lbs/day to 26 lbs/day, which is a reduction of 42%, meeting the requirements of the TMDL. The disparity, particularly in terms of Phosphorous, in the TMDL loads and PRedICT loads is likely due to the inherent difficulties in using reference watersheds and in modeling.

Sediment load estimates and algorithms have not made substantial changes through the years since the TMDL and can be assumed correct. The TMDL estimated that 19,973 lbs/day needed to be reduced by 6% to 18,755 lbs/day. Estimates from the PRedICT potentially reduce sediment load by 46% by the year 2025, transporting 6,098 lbs/day compared to 11,310 lbs/day. The comparison of TMDL results to the PRedICT model results are documented below in Tables 10 and 11.

	Sediment lbs/day	Phosphorus lbs/day
Current Load at time of TMDL Development (2008)	19,973.84	19
TMDL Load	18,755.82	11
Needed Reduction	6%	42%

Table 9. *TMDL calculations indicate a need for reducing phosphorus by 42% and sediment by 6% to achieve its goals. .*

Sum of 3 Subwatersheds	Sediment lbs./year	Phosphorus lbs./year	Sediment lbs/day	Phosphorus lbs/day
Starting scenario	4,128,216	16,824	11,310.20	46.09
Best Case scenario	2,225,989	9,764	6,098.60	26.75
TOTAL % REDUCTION:	46%	42%	46%	42%

Table 10. *PRedICT model outputs were added together to total the load estimates for the entire watershed, in order to compare results to the TMDL. Reductions are predicted to be 42% for phosphorus loads and 46% for sediment loads, meeting the percent reductions listed in the TMDL by 2025.*

An in depth analysis and discussion of the model differences is beyond the scope of this plan and is not needed for these purposes. By implementing the objectives of this plan, the sediment and phosphorus loads to the Little Wic will be reduced by 46% and 42% respectively, which amounts in a reduction in pollutant transport of 2,225,989 lbs of sediment per year, and 9,764 lbs of phosphorus per year. Improvements to the water quality in the Little Wic will be manifested through indicators of water quality such as abundance and diversity of the macroinvertebrate community. Rather than achieving a given reduction in pollutant loads or reducing loads to the TMDL levels, the goal of the plan is to reduce pollutants to a level where macroinvertebrate samples indicate that the Little Wic is meeting its designated use and can be considered for removal from the list of impaired waters.

VI. IMPLEMENTATION

A. Target Areas for BMP Implementation

Figure 11 delineates target areas for BMP implementation efforts to be focused. These are areas of the LWCW where the stream has little or no riparian buffers. Most of the outlined target area is within the headwaters of the watershed or of tributaries of the Little Wiconisco. Watershed protection or the lack thereof, in the headwaters would have far-reaching effects throughout the watershed.

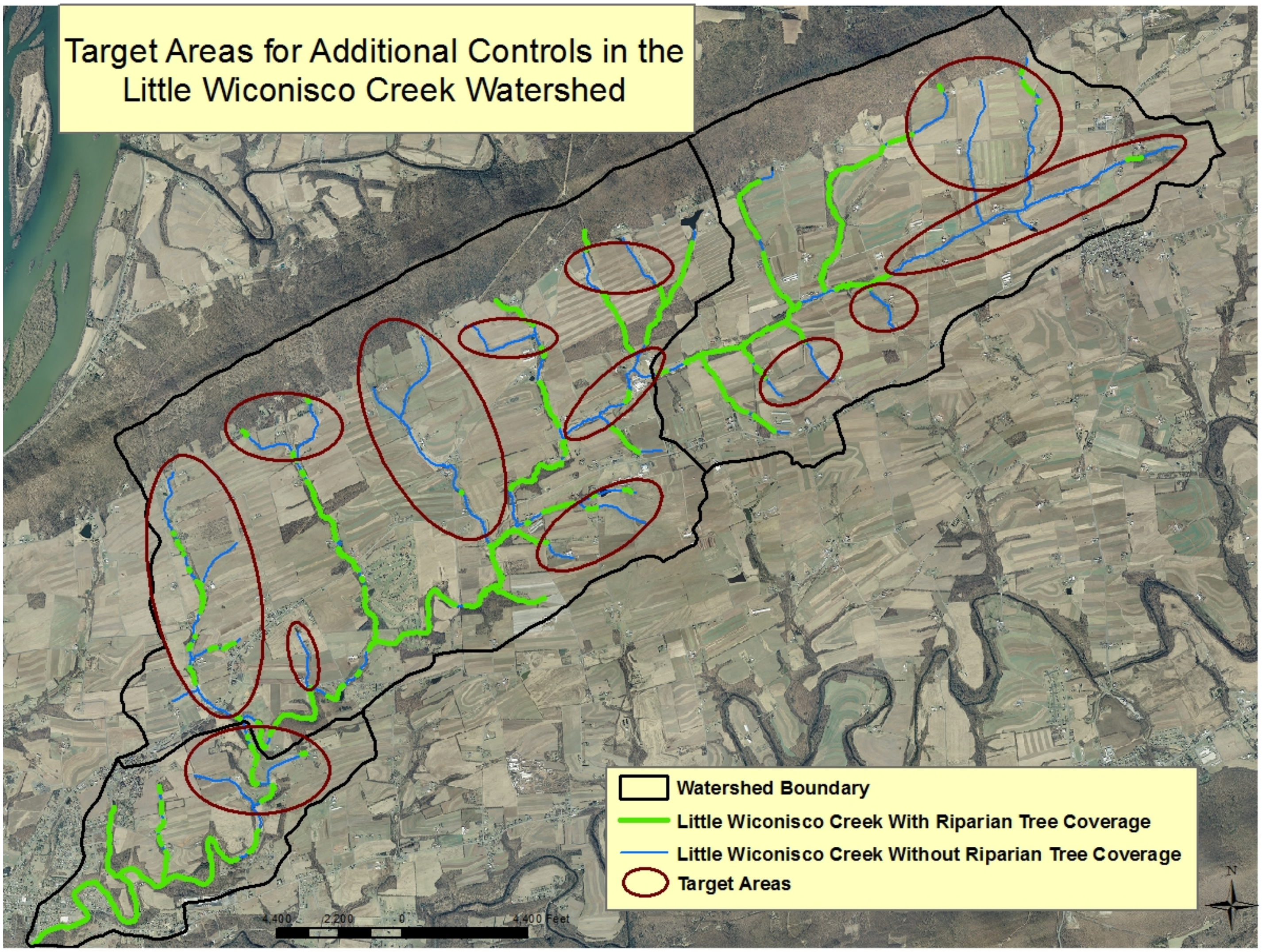


Figure 11. Target areas for BMPs in the LWCW

B. Implementation Schedule and Milestones

It is evident that there is a tremendous amount of mitigation work to be performed and, as indicated by the model, a significant amount of funding will be needed to achieve the reductions. Without a watershed implementation plan, restoration efforts will continue without a clear understanding of the total scope of work, associated costs, and accurate predictions of water quality improvements. Ultimately, the residents and landowners in the LWCW will be responsible for implementing the proposed BMPs on their property in order to meet the milestones set forth in this plan. DCCD and NRCS will be able to assist landowners in the watershed by providing technical assistance and identifying potential funding sources, as well as monitoring and reporting watershed restoration efforts.

Proposed best managements practices (BMPs) compiled from Conservation Plans were prioritized according to the proximity of the field to the stream, land use, and type of BMP. Priority was given to proposed BMPs within fields that are located in the target areas, or near stream reaches that have little or no riparian tree cover and in the headwaters of the watershed. The three milestone dates used for BMP installation are 2015, 2020, and 2025. The year 2025 is used for the end date in order to be consistent with the Chesapeake Bay TMDL which calls for all BMPs to be implemented by 2025.

Attachment I includes maps of each of the three subwatersheds with the sites of the proposed best management indicated as well as the implementation timeframes. Associated tables display the site details, including which BMPs are planned according to the conservation plans. There are 388 sites included in the attached maps and tables. The sites on the maps are color coded according to their expected completion date – 2015, 2020, or 2025. The red triangular sites are the highest priority and are therefore planned to be completed within the first five years, since they are in the target areas and are closer to the stream. BMPs that are displayed as yellow circles are of moderate priority and are scheduled to be completed by 2020. Lastly, the blue square sites on the map indicate BMPs that are to be completed by 2025.

The following trends indicated in Figures 12 and 13 represent milestone loads for sediment and phosphorus within the LWCW. Assuming proposed best management practices are implemented as scheduled, the following reduction trend in transport load will be seen. That is not to say that reductions cannot be increased from additional streamside conservation practices.

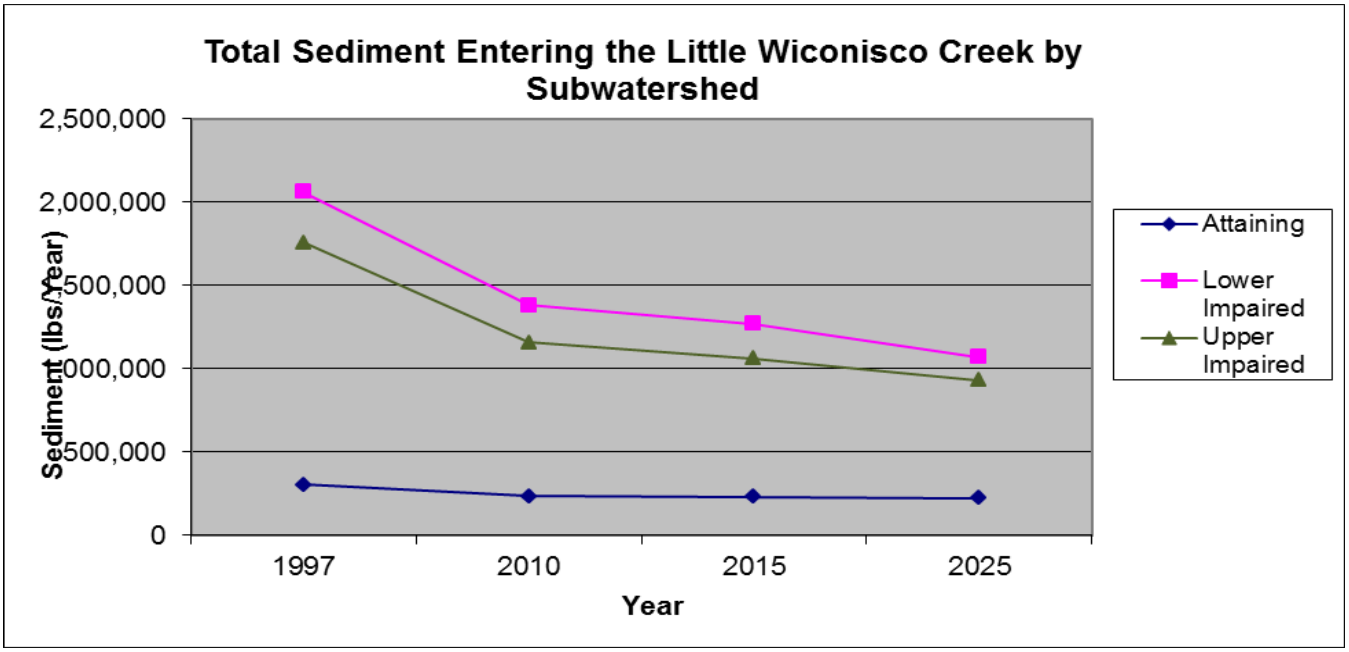


__Figure 12.__ PRedICT model outputs were added together to total the load estimates for the entire watershed. In terms of lbs/year, the Little Wiconisco Creek sees a steep decline in sediment loads between 1997 and 2010. During this time period, much effort was put into installing conservation BMPs in the watershed. The amount to be installed hereafter declines, which is seen in the gradual decline in sediment load after2010.

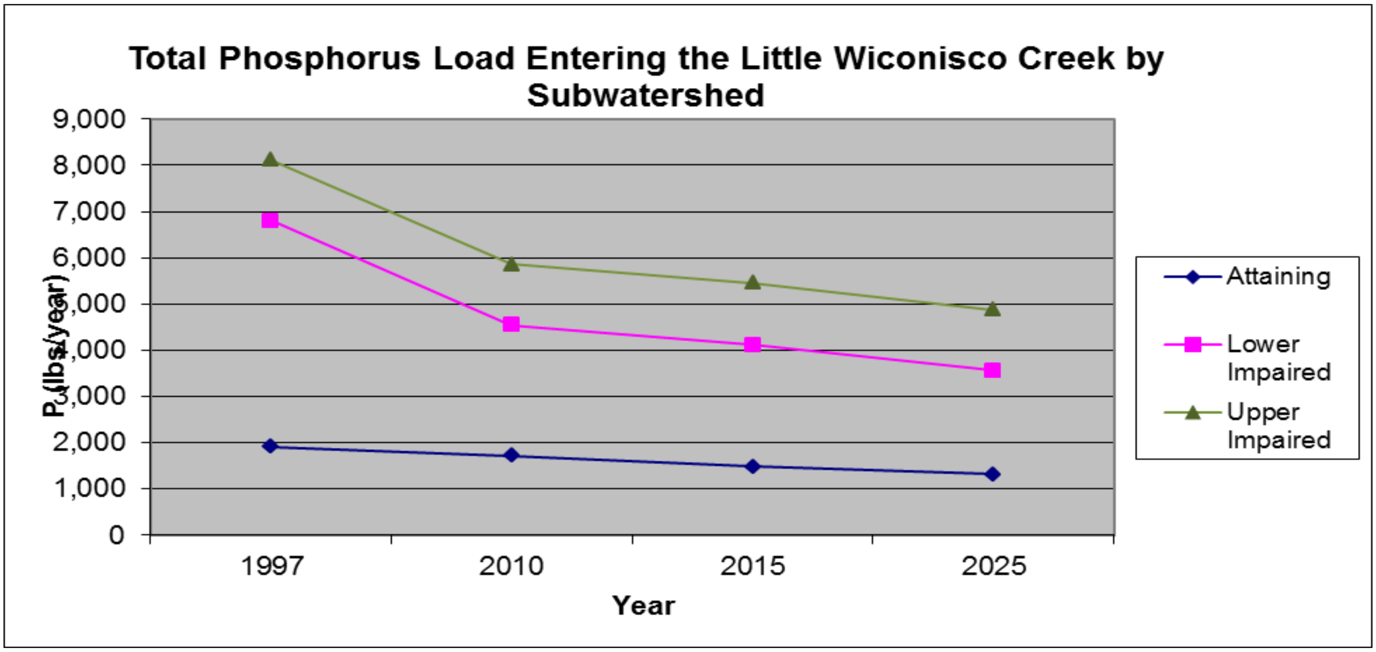


__Figure 13.__ PRedICT model outputs were added together to total the load estimates for the entire watershed. In terms of lbs/year, the Little Wiconisco Creek sees a steep decline in phosphorus loads between 1997 and 2010 within the upper and lower impaired sections. During this time period, much effort was put into installing conservation BMPs in the watershed. The amount to be installed hereafter declines, which is seen in the gradual decline in sediment load after2010. The amount of conservation BMPs installed and proposed to be installed in the attaining section is small in comparison to the upper and lower sections, reflected in its load reduction trend.

Watershed	Year	Total Sediment Load (lbs/yr)	Total Phosphorus Load (lbs/yr)
	1997	304,926	1,914
	2010	236,886	1,720
	2015	230,617	1,483
Attaining	2025	225,271	1,322
	1997	2,063,494	6,797
	2010	1,379,491	4,540
	2015	1,268,935	4,113
Lower Impaired	2025	1,070,966	3,563
	1997	1,759,796	8,113
	2010	1,159,150	5,860
	2015	1,062,955	5,451
Upper Impaired	2025	929,752	4,879

__Table 11.__ Breakdown of phosphorus and sediment load reductions between 1997 and 2025 for each of Little Wiconisco Creek's subwatersheds. Data values and their reduction curves are illustrated in Figures 12 and 13, above.

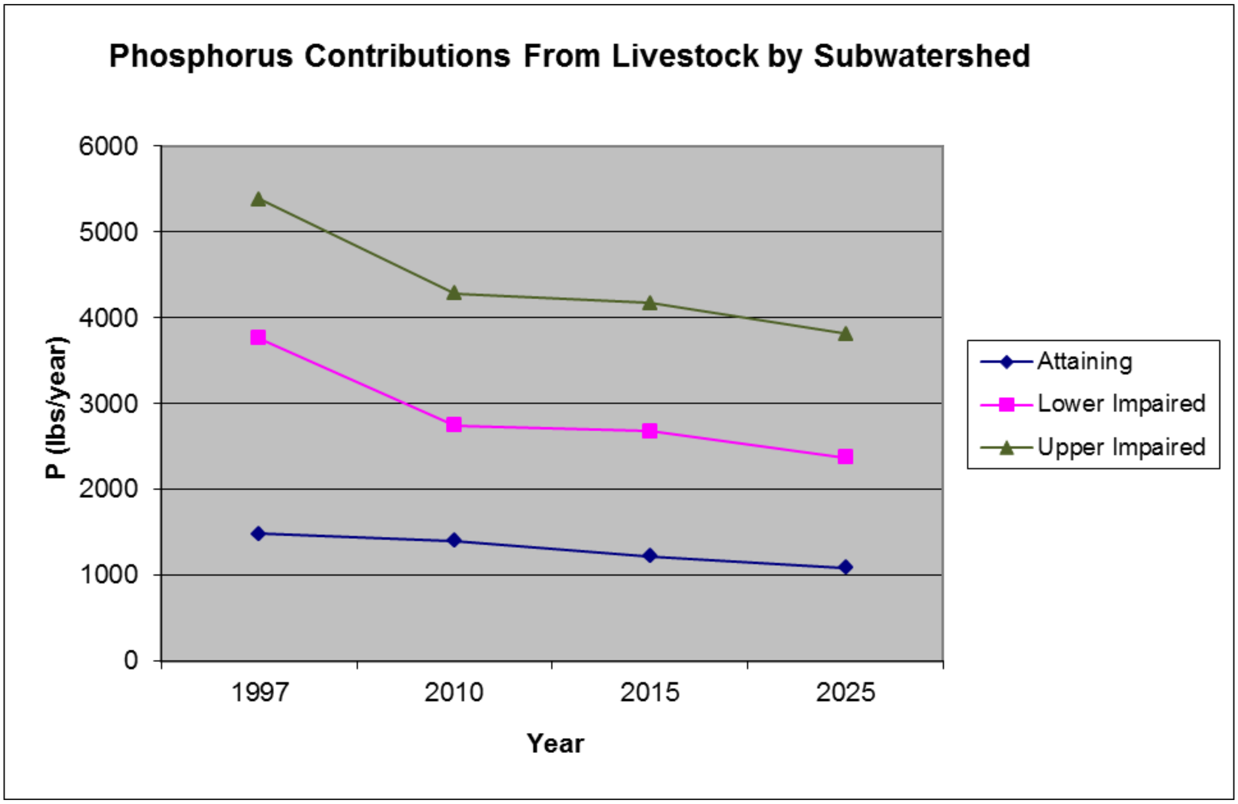


Figure 14. *Breakdown of phosphorus contributed by livestock for each subwatershed in Little Wiconisco Creek watershed. Animal load estimates are shown to be a significant contribution to the total phosphorus loads seen in Figure 13. Datasets involved in determining animal contributions have greatly improved since the TMDL was created, as discussed above.*

C. Cost Predictions

Each LWCW subwatershed varies in landuse, number of farms, number of farms with proposed BMPs, types of BMPs proposed, as well as the size of the area that is taken up. All of these factors contribute to the cost associated with achieving conservation milestones. Below, Table 9 illustrates the difference in cost associated with each type of BMP. These costs are directly incorporated into the calculation of predicted conservation practices.

Total cost is significant, emphasizing the need for additional project funds. A great deal of grant and match funding has been put into the LWCW to date, and much more is needed in order to improve water quality. As grant programs grow more competitive, funding is becoming harder to come by. However, DCCD will continue to work with landowners and partners to identify sources of funding, which may include grants from EPA, Pa DEP, Growing Greener, the Chesapeake Bay Program, the National Fish and Wildlife Foundation, and private foundations. Depending upon the specific project and landowner, many of the proposed BMPs may qualify for various programs offered by NRCS.

In addition to the pollutant reductions discussed above, the PRedICT model also contains calculators for predicting cost based on BMP and input cost for the BMP. Costs used for each of the BMPs were obtained from NRCS's Environmental Quality Incentives Program. Table 12 shows the predicted costs for installation of BMPs under future scenarios.

BMP	NRCS CODE	DESIGN AND CONSTRUCTION COSTS	ANNUAL MAINTENANCE COST (4% OF CONSTRUCTION)	PRIORITY RANKING
CONTOUR FARMING	330	$20.00/ACRE	$0.80/acre	3
DIVERSION	362	$2.60/LINEAR FOOT	$0.10/ linear ft	3
FENCING (3 OR 4 STRAND)	382	$1.25/LINEAR FOOT	$0.05/ linear ft	3
FILTER STRIP	393	$670.00/ACRE	$26.80/acre	3
GRASSED WATERWAY	412	$2,080.00/ACRE	$83.20/acre	3
LINED WATERWAY (ROCK)	468	$2.30/SQUARE FOOT	$0.09/square ft	3
HEAVY USE AREA PROTECTION NON BARNYARD	561	$1.20/SQUARE FOOT	$0.05/ square ft	3
STREAM BANK PROTECTION (RIP RAP)	580	$55.00/LINEAR FOOT	$2.20/linear ft	3
STRIP CROPPING	585	$20.00/ACRE	$0.80/acre	3
WATER CONTROL STRUCTURE	587	$655.00 EACH	$26.20	3
TERRACE	600	$26.00/LINEAR FOOT	$1.04/linear ft	3
CRITICAL AREA PLANTING	342	$335.00/ACRE	$13.40/ acre	2
WASTE TRANSFER LOT RUNOFF	561	$3,900.00 EACH	$156	2
PASTURE/HAYLAND PLANTING (NATIVE)	512	$185.00/ACRE	$7.40/acre	2
PRESCRIBED GRAZING	528	$10.00/ACRE	$0.40/acre	2
ANIMAL TRAILS/WALKWAYS	575	$0.85/SQUARE FOOT	$0.03/square ft	2
WATERING FACILITY	614	$1,040.00 EACH	$41.60	2
UNDERGROUND OUTLET (8" OR LESS)	620	$2.75/LINEAR FOOT	$0.11/linear ft	2
WATER/SEDIMENT CONTROL BASIN	638	$2,290.00/ACRE	$91.60/acre	2
WASTE STORAGE STRUCTURE	313	$1.32/CUBIC FOOT	$0.05/cubic ft	1
COMPOSTING FACILITY	318	$3.55/SQUARE FOOT	$0.14/ square ft	1
WASTE TRANSFER	634	$25.00/LINEAR FOOT	$1.00/ linear ft	1
PIPELINE (GRAZING)	516	$1.95/LINEAR FOOT	$0.08/ linear ft	1
ROOF RUNOFF MANAGEMENT	558	$7.80/LINEAR FOOT	$0.31/ linear ft	1
SPRING DEVELOPMENT	574	$1,820.00 EACH	$72.80	1
SUBSURFACE DRAINAGE (6" TILE)	606	$2.20/LINEAR FOOT	$0.09/ linear ft	1
UPLAND WILDLIFE MANAGEMENT	645	$85.00/ACRE	$3.40/acre	1

Table 12. *Design and construction costs for selected BMPs factor into the PRedICT model output.*

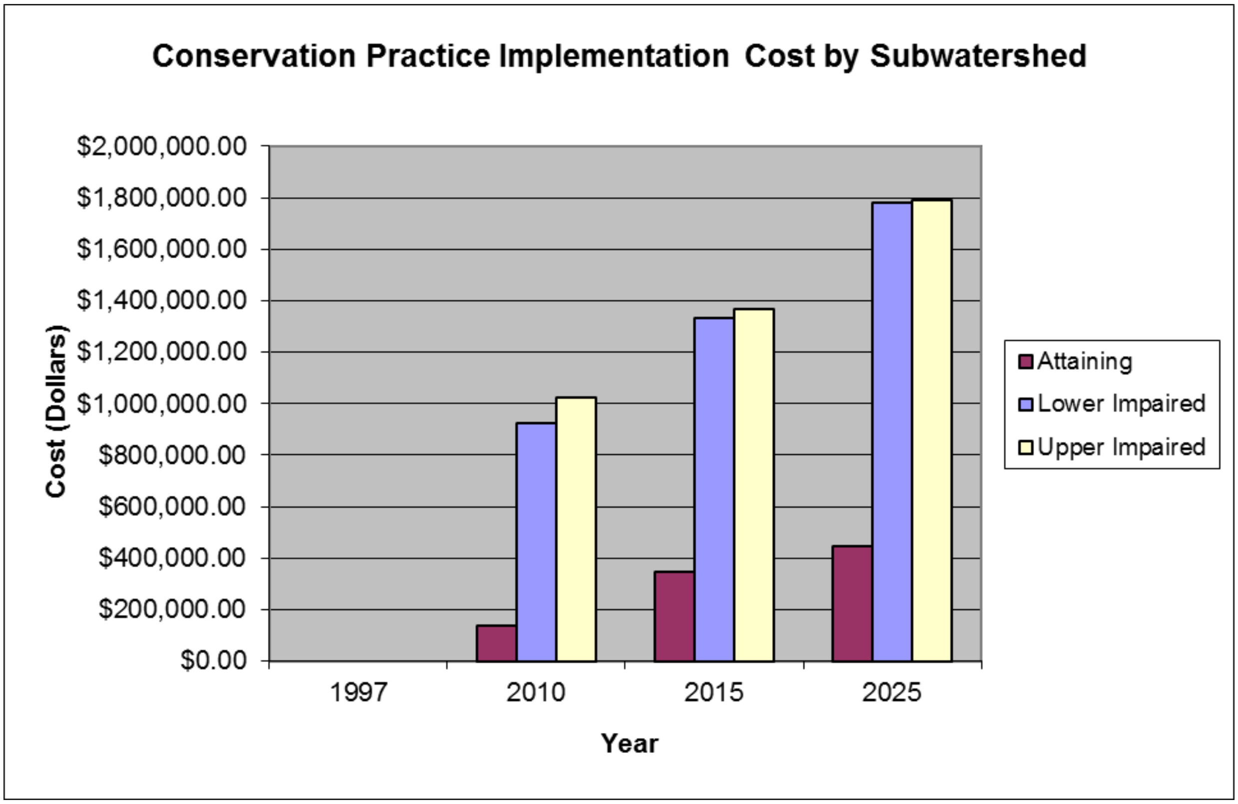


Figure 15. *The time scale of costs associated with the prediction of conservation practices to be installed in the Little Wiconisco Creek subwatersheds by the years 2010, 2015, and 2025. Practices were installed before 1997, but the model assumes 1997 as the baseline due to a water quality assessment within the watershed in 1997.*

D. Public Information and Participation

Upon completion and approval of the Little Wiconisco Creek Watershed Implementation Plan, DCCD will work with the Wiconisco Creek Restoration Association to hold a public meeting to inform stakeholders in the watershed of current water quality conditions, areas of concern, and the plan to implement BMPs to further reduce nutrient and sediment loading in the watershed. DCCD will identify and invite all landowners within the LWCW to the public meeting, with an emphasis on those associated with proposed BMPs. Press releases will be sent to all relevant media outlets to advertise the meeting and information will be displayed on the DCCD website. Recently completed BMPs will be showcased at the meeting and DCCD will encourage attendees to be actively involved in the implementation of the Watershed Implementation Plan.

As water monitoring continues within the watershed, data will be displayed for the public on an interactive map on DCCD's website. This allows landowners, and other stakeholders in the watershed, to follow water quality improvements over time. There will also be continued outreach by the DCCD staff to educate landowners about BMPs that they can implement on their property and the Dauphin County Ag Committee will continue to meet monthly to discuss current projects and to determine future projects.

VII. EVALUATION OF IMPLEMENTATION PROGRESS

A. Nutrient Monitoring

Under the guidance of USGS hydrogeologists, the Conservation District has established three long-term nutrient monitoring stations in the LWCW. These stations were decided upon after analysis of the baseline monitoring conducted in 2006. Since then, water samples are collected to measure nitrate and orthophosphate levels with the goal of documenting long-term trends in these parameters. Samples within Little Wiconisco Creek watershed, along with 11 other stations around the County are collected 6 times per year at baseflow conditions. Without a continuous flow measurement system, accurate assumptions regarding changes in nutrient concentrations could take roughly 10 years. The current stations have been monitored regularly since 2006, and will need to be collected for at least 5 more years before a full analysis can be done.

In 2009-2010, the DCCD received funding for samples to be analyzed by a certified lab. Samples were collected at each of the three regularly monitored stations, eight times in a 12 month period. To provide current data, results from lab analyzed collections in 2009-2010 are shown below. Phosphate concentrations below 0.02 mg/L are under the reporting detection limit, therefore, documented as not detected (ND = 0 mg/L) in Figure 16.

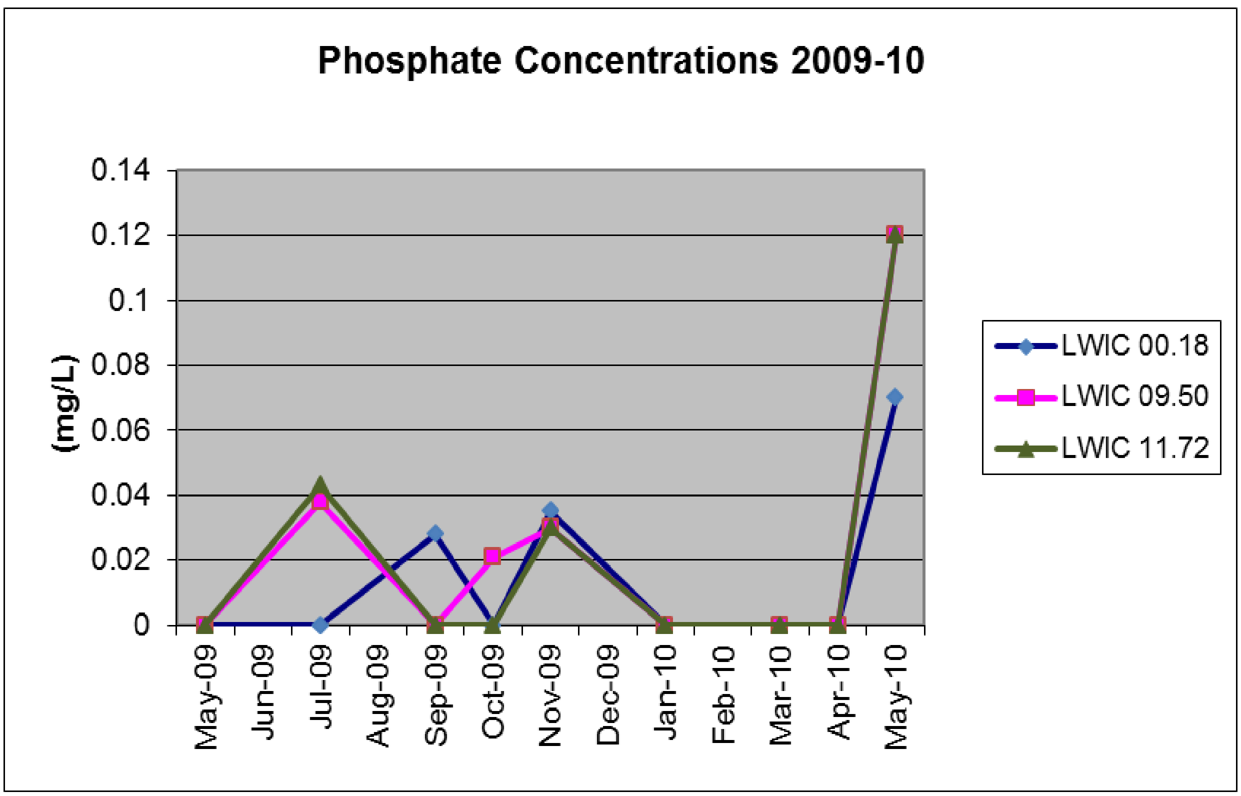


Figure 16. *Orthophosphate concentrations at baseflow between May of 2009 and May of 2010 located at 3 sample sites.*

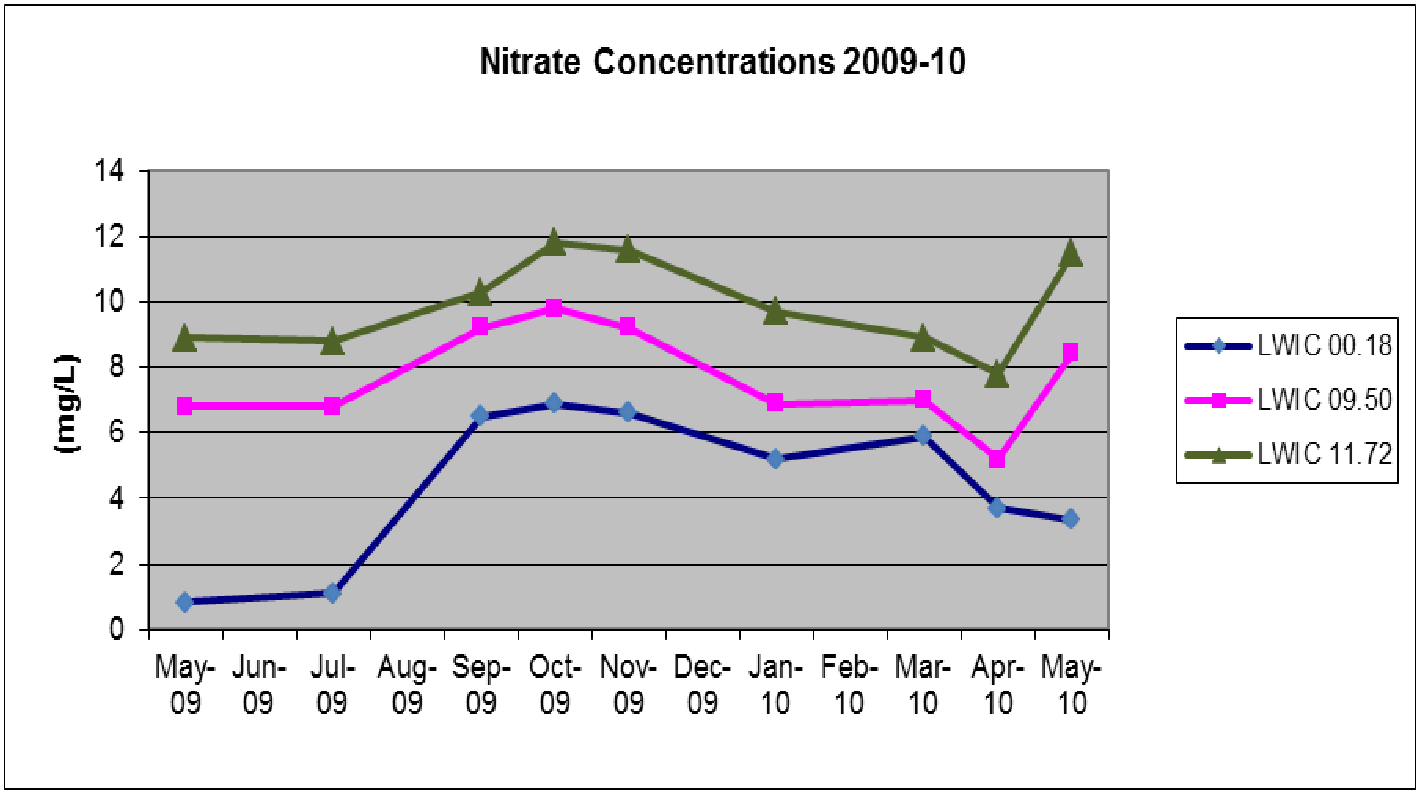
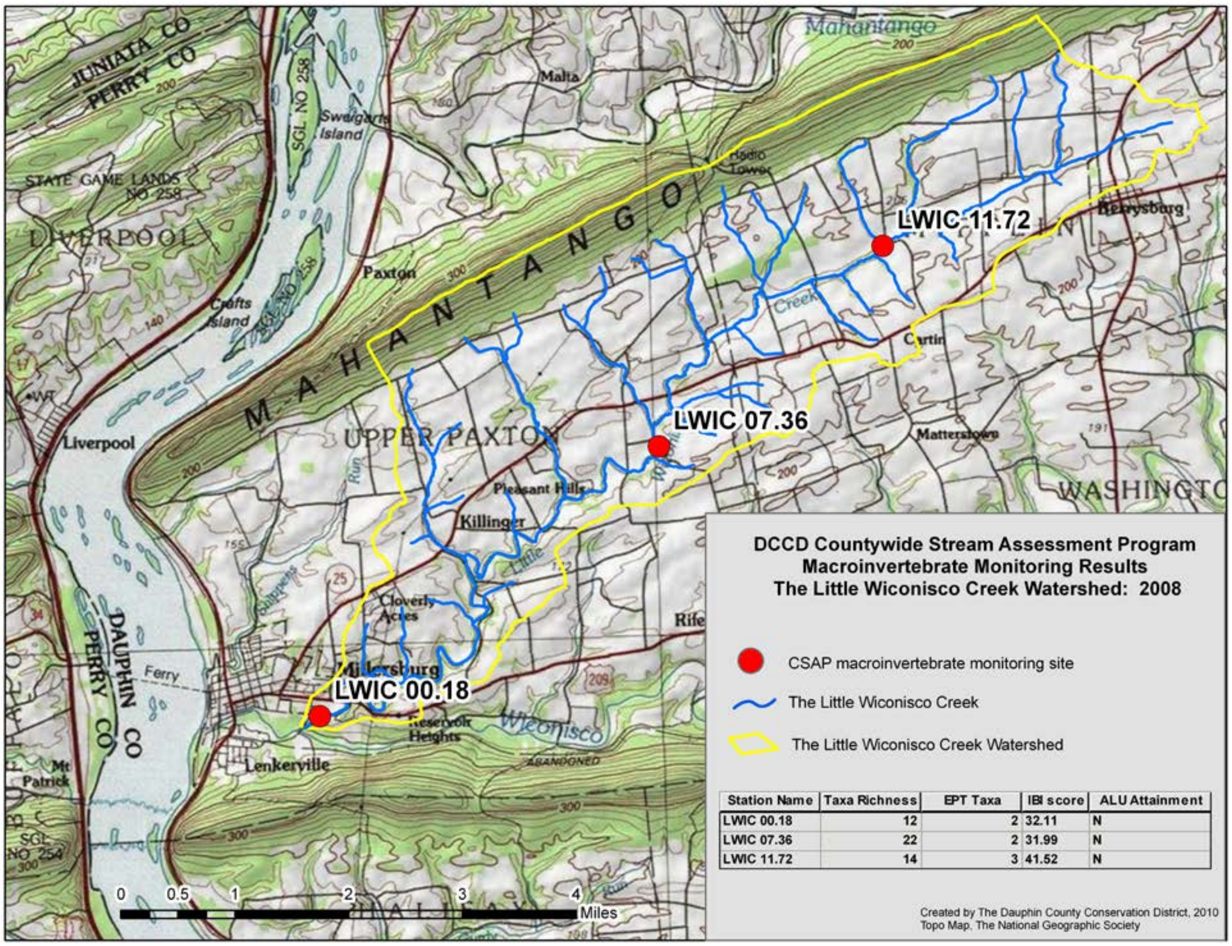


Figure 17. *Nitrate concentrations at baseflow between May of 2009 and May of 2010 located at 3 sample sites.*

B. Macroinvertebrate Monitoring

Data collected in the 2005 study allowed the District to establish sampling stations that will be collected at the same locations every 5 years. Of the 15 sites sampled in 2005 (shown in Figure 7), 3 sites were chosen to be a part of the Countywide Stream Assessment Program based on health scores, stream access, and location within the Little Wiconisco watershed. Since 2004, the Program has included roughly 100 sites that are to be monitored for macroinvertebrate communities on a 5-year rotating basis. Sites within Little Wiconisco Creek watershed were collected and analyzed in 2008. The findings were reported in Dauphin County's report entitled, "Dauphin County Streams: A Health Report." Metric Results and each site's Index of Biotic Integrity (IBI) can be found below. An IBI of 63 or above is required to remove a stream from the Impaired Streams List. A map of the overall health scores of these three sites can be found in Figure 18.



Station Name	Taxa Richness	EPT Taxa	IBI score	ALU Attainment
LWIC 00.18	12	2	32.11	N
LWIC 07.36	22	2	31.99	N
LWIC 11.72	14	3	41.52	N

Figure 18. *Macroinvertebrate results within LWCW from DCCD's Countywide Stream Assessment Program. Samples were collected in 2008 and reported in the Dauphin County Stream Health Report, 2010.*

C. Monitoring Milestones

DCCD will be responsible for conducting water monitoring to evaluate the effectiveness of completed projects and reporting the water quality trends. The Countywide Stream Assessment Program is currently in the second rotation of its 5-year cycle, with LWCW sites to be monitored again in 2013. As conservation best management practices are carried out, it is hopeful that benefits will be seen in diversity of aquatic organisms. Although much work is being done, the effects of sediment and siltation within the LWCW may not be seen for years to come. This is one of the reasons the program cycles every 5 years. The optimistic outcome would be to see small improvements each 5 year cycle. Sample Locations from the 2008 CSAP study will be used for future monitoring efforts (Figure 18).

Additionally, DCCD's nutrient monitoring efforts will continue in the LWCW 6 times per year. Figures 16 and 17 indicate concentrations during 2009-2010. Nutrient monitoring will continue in order to analyze long-term trends after 5-10 years of data have been documented. In these early stages of data collection, milestones are unable to be set. Water Quality improvements will, however, be documented in macroinvertebrate communities.

DEP's Instream Comprehensive Evaluation (ICE) protocol suggests that a stream section should produce an IBI score of 63 or higher to be considered attaining aquatic life use. Between scores of 50-63, other parameters will be considered in order to determine if the stream section is impaired or non-impaired. LWCW's 3 sites scored considerably low, each were between 30 and 45. Sediment is a major factor in macroinvertebrate diversity and pollution sensitive taxa types because it covers gravel habitat of clinging, sensitive organisms. Silt covered streambeds often support burrowing, tolerant organisms. Therefore, reducing sediment and phosphorus loads to the Little Wic should directly correlate to improved diversity within the aquatic community, as well as increasing the amount of pollution sensitive macroinvertebrates found in the creek.

When considering improvement goals in the next 5 years, it is important to reach within realistic increments. The three subwatersheds within the Little Wiconisco Creek watershed must reach monitoring milestones overtime, each of which has a sample site located within its boundaries to monitor progress. Improvements will be seen as BMPs are installed and sediment and phosphorus loads decrease. This relationship between BMP installation and water quality monitoring milestones is connected through a similar timeline (5-year, 10-year, and 25-year). The best case scenario will suggest that each monitoring location improves to support aquatic life use, which in IBI, is related to a score of 63. 5 and 10 year IBI milestones are related to time lapse and previous IBI score. The following milestones are suggested toward the improvement of IBI scores, which should reflect in water quality:

Monitoring Milestones	**Attaining Subwatershed (LWIC 00.18)**	**Lower Impaired Subwatershed (LWIC 07.36)**	**Upper Impaired Subwatershed (LWIC 11.72)**
2008 Macroinvertebrate IBI:	32.11	31.99	41.52
5-year (2013) IBI:	38	38	46
10-year (2018) IBI:	45	45	50
Best Case Scenario 25-year (2033) IBI:	63	63	63

Table 13. *Water Quality Monitoring milestones for sample sites within the 3 subwatersheds of the LWCW.*

An important consideration when analyzing macroinvertebrate assessments is that sediment and phosphorus loads often have a lag between the time conservation practices are implemented and when improvements are seen in water quality. Embedded streambeds that are deeply entrenched will hold sediment for long periods of time. Storm events will eventually carry sediment and phosphorus downstream, as well as depositing it on the floodplain during high water events. Although the above changes may not be visible right away, small improvements along the way are a step in the right direction.

Water quality monitoring efforts are stored in the Dauphin County Water Quality Geodatabase, which are related to the spatial location of each sample site. The information is publicly available in the form of an interactive map on the Water Resources page of the DCCD website. Viewers can select a site and view monitoring results listed by date. This allows stream improvement progress to be seen as it is taking place. Progress will also be documented in future Countywide Stream Health Report Updates.

D. Remedial Action

The goal of developing the Little Wiconisco Creek Watershed Implementation Plan is to meet the sediment and phosphorus TMDL, supporting a healthier watershed. If improvement is not evident as implementation of BMPs occurs, actions will need to take place to alter the improvement strategy. The breakdown of pollution loads in the Little Wiconisco TMDL, model predictions, BMP installation, and water quality monitoring milestones are all interconnected. Each will be analyzed while studying the progress of improvement. Alterations in method and review in each of these components will be made as necessary in order to achieve the most accurate data.

With so much of LWCW's streambanks unprotected by riparian shrubs and trees, coupled with deeply embedded streambeds, drastic water quality improvements would likely not be seen for years even in a fictional scenario where all streambanks were planted with seedlings today. Streambanks will take time to stabilize with mature trees and shrubs. Likewise, accumulated sediment and nutrients in streambeds will slowly move downstream, intensified by storm events. As DCCD's agricultural BMP geodatabase is updated with newly installed practices and water quality monitoring proceeds as scheduled, it is only a matter of time until modeling results show sediment and nutrient loads within the designated TMDL limits, thus improving stream health.

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