AUGHWICK CREEK STREAMBANK STABILIZATION AND FENCING TO REDUCE THE EFFECTS OF EROSION AND NUTRIENT LOADING

Western Pennsylvania Conservancy – Jennifer Farabaugh, Watershed Manager

September 23, 2009 – March 31, 2013

Grant #: NRCS 69-3A75-9-153

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Deliverables:

- Protect 8,000 linear feet of agriculture streambanks through the installation of streambank fencing;
- Stabilize and create habitat through the installation of 32 in-stream structures;
- Document water quality improvement after the installation of streambank fencing and in-stream structures, which will reduce nutrient and sediment loading;
- Provide all participating producers with written reports of water quality improvement, macroinvertebrate presence, and fish habitat institution;
- Provide partners with an annual report, as well as, a final report expressing sediment and nutrient reduction, while demonstrating habitat improvement for macroinvertebrates and fish species;
- Write a scientific paper using the resulting data that is collected and pursing publication;
- Attend at least one NRCS CIG Showcase or comparable NRCS event during the period of the grant.

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Executive Summary

The goal of this project was to improve the ecological quality of Aughwick Creek, located in Huntingdon and Fulton Counties Pennsylvania, by implementing agricultural best management practices (BMPs), streambank stabilization, and instream habitat enhancement, which would result in the reduction of sedimentation and nutrient runoff and improve water quality. Through funds received by NRCS CIG, Pennsylvania's Growing Greener Program and the Foundation for Pennsylvania Watersheds, the Western Pennsylvania Conservancy (WPC) was able to accomplish the goal of improving water quality and decreasing sediment and nutrient runoff. This was accomplished by engaging 10 agricultural landowners and installing 16,424 feet of streambank fencing, six stabilized stream crossings, and seven alternative watering systems. We also stabilized 920 feet of eroding streambank with 26 structures designed to also provide in-stream habitat. A map of project locations can be found in Appendix A.

All of our objectives were met or exceeded, except for installing 32 in-stream habitat structures. Only 26 structures were installed; however, funds that were earmarked for in-stream habitat structures were used to install additional streambank fencing. The rest of the project funds were spent as anticipated.

This project took slightly longer than originally anticipated. The timeframe of the project was extended by six months, because we were waiting on a permit authorization from the state to complete work at our last project site.

This project resulted in improved water quality and a decrease in sediment and nutrient concentrations in the Aughwick Creek watershed. Average nitrate-nitrogen and phosphate concentration decreased by 67% and 52% mg/L, respectively. Turbidity decreased by 77% after conservation practices were installed.

Funds for this project were obtained from NRCS Conservation Innovation Grant (CIG), the Foundation for Pennsylvania Watersheds (FPW), and the Pennsylvania Department of Environmental Protection (DEP) Growing Greener Program. The combined funds from all three sources equaled $176,000. Construction and stream monitoring averaged $16,000 for each farm that implemented conservation practices. County conservation districts, county NRCS offices, and local watershed groups can all use this project as a model to implement additional conservation practices.

The major recommendation from this project is to use a varied approach when addressing nutrient and sediment runoff. By combining traditional agricultural BMPs with streambank stabilization, we were able to reduce sedimentation to area waterways. Another recommendation from this project is to work with a diverse group of partners. Our partners were instrumental in reaching our goals for the project. These partners included the Pennsylvania Fish and Boat Commission (PFBC), Huntingdon County Conservation District (HCCD), Huntingdon NRCS, Fulton County Conservation District (FCCD), and local landowners.

Introduction

In 2009, WPC began its Aughwick Creek Streambank Stabilization and Fencing to Reduce the Effects of Erosion and Nutrient Loading. The Aughwick Creek watershed encompasses 446 square miles and is located in Huntingdon and Fulton Counties, Pennsylvania. The purpose of this project was to reduce the amount of nutrient and sediment runoff entering Aughwick Creek and its tributaries. This was accomplished by constructing streambank fencing to exclude cattle from streams and by installing streambank stabilization devices to reduce in-stream erosion. In total, 10 agricultural landowners installed 16,424 feet of streambank fencing, six stabilized stream crossings, and seven alternative watering systems. We also stabilized 920 feet of eroding streambank with 26 structures designed to also provide in-stream habitat. This project was completed by WPC staff working with project partners to install conservation practices and evaluate the effectiveness of these practices by performing water quality monitoring before and after practice installation.

The following WPC personnel were involved with the project:

- Jennifer Farabaugh, Watershed Manager, Juniata and Potomac Region: 11 years of experience in the conservation field and has worked on numerous farms installing BMPs and conducting numerous scientific studies;
- Carolyn Itle-Sherry, Watershed Scientist: nine years of experience in the conservation field and has worked with farmers and in the installation of in-stream bank stabilization and fish habitat enhancement structures, as well as numerous scientific studies;
- Eric Chapman, Director of Aquatic Science: 14 years of experience in the professional science field, is a professional malocologist with extensive expertise in macroinvertebrates, fish, and hellbender salamanders. He has published numerous scientific peer-reviewed papers on the above listed topics;
- Brian Neal, Watershed Projects Manager: five years of experience in the conservation field specializing in BMP construction management.

The primary goal of this project was to reduce sediment and nutrient loading of Aughwick Creek by partnering with farmers in the watershed. This was accomplished by meeting the following objectives:

- Protect 8,000 linear feet of agriculture streambanks through the installation of streambank fencing;
- Stabilize and create habitat through the installation of 32 in-stream structures;
- Document water quality improvement after the installation of streambank fencing and in-stream structures, which will reduce nutrient and sediment loading;
- Provide all participating producers with written reports of water quality improvement, macroinvertebrate presence, and fish habitat institution;
- Provide partners with an annual report, as well as, a final report expressing sediment and nutrient reduction, while demonstrating habitat improvement for macroinvertebrates and fish species;
- Write a scientific paper using the resulting data that is collected and pursing publication;
- Attend at least one NRCS CIG Showcase or comparable NRCS event during the period of the grant.

The scope of work included meeting with all partners, which included HCCD, PFBC, Huntingdon NRCS, and FCCD. Our partners were able to direct us to interested landowners within the watershed. WPC staff met with landowners to gauge their interest and determine the type of conservation practice that the landowner would need. Conservation practices included streambank fencing, stabilized stream crossings, alternative watering systems, and streambank stabilization/in-stream fish habitat devices. All landowners signed a contract agreeing to maintain conservation practices for at least 20 years from construction.

Monitoring took place before and after construction of conservation practices (Appendix B). Quarterly water quality samples were done in-field and included water temperature, dissolved oxygen, nitrate-nitrogen, orthophosphates, total dissolved solids, conductivity, pH, and turbidity. Macroinvertebrate sampling was completed in the spring and fall and followed PA DEP's instream comprehensive evaluation protocol (PA DEP 2009). All organisms were identified to the family taxa level. Annual fish surveys were completed at all in-stream fish habitat sites. All fish were identified to the species taxa level. Raw data can be found in Appendix C. All data was compiled into a report that was sent to all participating landowners and partners (Appendix D).

Partner relationships were integral to completing this project. HCCD provided in-kind support by suggesting possible project locations and attending site visits. FCCD provided in-kind support by suggesting possible project locations, attending site visits, and helping with fish surveys and construction of conservation practices. Huntingdon County NRCS provided in-kind support by suggesting possible project locations, attending site visits, and aiding in the design of BMPs. PFBC provided in-kind support by designing in-stream bank stabilization devices and helping with construction.

This project was funded by monies from NRCS CIG, DEP Growing Greener Program, FPW, and WPC. In-kind contributions were provided by PFBC. Complete budget information can be found in Appendix E.

Background

This project was intended to reduce nutrient and sediment pollution in the Aughwick Creek watershed. WPC first identified Aughwick Creek as a priority watershed through a comprehensive scientific study of Pennsylvania's regional water sources. This study identified Aughwick Creek as a biologically rich and simultaneously at risk watershed within the Juniata River drainage. This project was the first attempt by WPC to solve nutrient and sediment reduction within the Aughwick Creek watershed.

Nutrient and sediment pollution on agricultural lands is usually dealt with by implementing traditional agricultural BMPs. While these BMPs address nutrient and sediment runoff, they do not typically address streambank erosion.

This project benefited farmers in the Aughwick Creek watershed, and addressed nutrient and sediment pollution in area waterways. Nutrient and sediment pollution has numerous negative effects on the environment. Excess nutrients in a stream can cause excessive algal growth in the stream. As the algae decompose, they consume the oxygen in the stream, which can affect aquatic communities and lead to fish kills. Sediment in a stream can cause the stream to become embedded, and decrease habitat for benthic macroinvertebrates. Suspended sediment can also make the stream turbid, which in turn doesn't allow light to filter to the bottom of the stream.

Nutrient and sediment pollution can also negatively impact the producer's economic welfare. Eroding streambanks can cause farmers to lose portions of their crop and pasture fields. Additionally, livestock that drink or wallow in polluted water have a chance of increased health problems.

Review of Methods
This project is innovative in its approach because it combines traditional agricultural BMPs that are aimed at reducing nutrient and sediment loading, with streambank stabilization and instream habitat improvement. By combing these different types of conservation practices, not only were we able to reduce sediment runoff from pastures, but also were able to reduce sediment loading from eroding streambanks. Traditional agricultural BMP projects in the Aughwick Creek watershed cost, on average, $11,400, while streambank stabilization practices cost only $3,700.

The producers were able to implement these conservation practices without any changes to their operation or labor. The producers are responsible for maintaining all practices for at least 20 years.

Project events included pre-implementation monitoring, construction of the conservation practices, and post-implementation monitoring (Table 1). There were no adverse events such as storms or equipment failure that affected the project.

Table 1: Schedule of Events

Landowner ID	Pre-Implementation Monitoring	Conservation Practice	Project Completion Date	Post-Implementation Monitoring
1	No data due to dry stream	Streambank fence, crossings, watering systems	5/15/2012	No data due to dry stream
2	Fall 2010 – Summer 2011	Streambank fence, crossings, watering systems, bank stabilization	7/21/2011	Fall 2011 – Fall 2012
3	Fall 2010 - Summer 2011	Bank stabilization, crossing	7/21/2011	Fall 2011 - Fall 2012
4	Fall 2010 – Spring 2012	Streambank fence, crossing	6/2/2012	Summer 2012 – Fall 2012
5	Summer 2011 – Summer 2012	Streambank fence, watering systems	8/15/2012	Fall 2012
7	Fall 2011 – Spring 2012	Bank stabilization	5/22/2012	Summer 2012 – Fall 2012
8	Summer 2011 – Summer 2012	Bank stabilization	8/7/2012	Fall 2012
12	Summer 2011 – Summer 2012	Bank stabilization	8/7/2012	Fall 2012
13	No data	Streambank fence	8/17/2012	No data
17	No data due to dry stream	Streambank fence, crossing, watering systems	3/30/2013	No data due to dry stream

A map of the location of all project sites can be found in Appendix A. Appendix F shows the site plans for each project site.

All projects progressed according to plan. The only exception was that sometimes it took a little longer for a permit to be authorized than originally thought. If we were to start this project today, the only thing that would be done differently is to perhaps submit the permits earlier, so that there are no delays in the project.

Discussion of Quality Assurance

Water quality monitoring was conducted at each project site, except where the stream reach to be sampled was dry. A grab sample was taken in the middle of the project site. A map of all project locations can be found in Appendix A. Sampling at each project site consisted of a visual assessment and chemical and biological sampling. The visual assessment was based off of USDA's Steam Visual Assessment Protocol (Appendix G). Chemical and biological sampling was conducted according to WPC's sampling protocol (Appendix B).

For this project, the completeness goal for all samples was 70%. Table 2 shows precision and accuracy goals for each parameter.

Table 2: Precision and Accuracy Goals

Parameter	Accuracy	Precision	Detection Limit
pH	±0.1	±0.1	0.0 – 14.0 SU
TDS	±1%	±1%	0-2000 ppm
Dissolved Oxygen	±0.3 mg/L	±0.3 mg/L	0-20 mg/L
Nitrate-Nitrogen	±1.7 mg/L	±1.7 mg/L	0-30.0 mg/L
Phosphate	±0.05 mg/L	±0.05 mg/L	0-2.50 mg/L
Turbidity	±2 FAU	±2 FAU	0-1000 FAU
Conductivity	±1%	±1%	0-2000 µS/cm
Temperature	±0.3° C	±0.3° C	-5° to 45° C
Invertebrate (sorting)	±10%	±10%	-----
Invertebrate (ID)	±5%	±5%	-----

Water samples were collected for field analyses quarterly. Water sample preservation methods are presented in Table 3. Surface-water samples for analysis of concentrations of total constituents were collected as grab samples. All field equipment was cleaned and calibrated in WPC's Juniata and Potomac office in Hollidaysburg, PA, prior to conducting fieldwork. In the field, all water sampling and processing equipment were rinsed with deionized water between samplings. A portion of the sample water also was rinsed through the equipment prior to collecting final samples. Water samples were analyzed for the physical characteristics and chemical constituents needed to characterize each site. All samples were analyzed using standard methods, which employ EPA-approved techniques.

Table 3: Preservation Methods, Holding Times, and Reporting Units.

Parameter	Preservation	Quantity of Sample to be Collected	Max Holding Time	Reference Method	Reporting Units
pH	Field	------	ASAP	Oakton Basic pH Testr	SU
TDS	Field	------	7 days	Oakton TDS Testr 11	ppm
Dissolved Oxygen	Field	------	ASAP	YSI 550A DO Instrument	mg/L
Nitrate-Nitrogen	Field	10 mL	48 hours	Hach Method 8039	mg/L
Phosphate	Field	10 mL	28 days	Hach Method 8048	mg/L
Turbidity	Field	10 mL	48 hours	Hach Method 8237	FAU
Conductivity	Field	------	28 days	Oakton ECTestr 11	µS/cm
Temperature	Field	------	ASAP	YSI 550A DO Instrument	°C

Macroinvertebrates were collected using EPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition. For smaller streams that have one habitat type, the single habitat approach was used for collection. For streams that are larger and have multiple habitat types, the multi-habitat approach was used. All samples were collected from a 100 meter reach at each site and preserved in 95% reagent alcohol. Samples were taken back to the lab and subsampled, sorted, and identified according to PA DEP Instream Comprehensive Evaluation (ICE).

Fish surveys were conducted in accordance with Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition. All fish species were identified in-field from a 100 meter section at each site. Unknown fish species were preserved in alcohol and taken back to the lab for identification.

One or more quality assurance (QA) samples, including blanks and duplicates were analyzed as blind samples with each set of samples to check for contamination, accuracy, and precision of analytical results. Approximately 10 percent of the total samples for the project were QA samples. Field blanks were collected at the greater frequency of one per sampling day or per twenty samples to check for contamination resulting during sample collection and analysis. Field blanks were used to assess potential for contamination of samples from exposure to sampling equipment.

For macroinvertebrates, 10 percent of the sorted samples in each lot were examined by a qualified co-worker. The QC worker examined the grids chosen and tray used for sorting and looked for organisms missed by the sorter.

After laboratory processing was complete for a given sample, all sieves, pans, trays, etc., that came in contact with the sample were rinsed thoroughly, examined carefully, and picked free of organisms or debris; organisms found were added to the sample residue. Twenty percent of samples were spot checked by a second taxonomist.

Analytical data, including field and laboratory analysis results and corresponding sample identification, were entered into the WPC database (Microsoft Access 2003) by project personnel. Results below detection limit were entered as "0" and missing values were left blank. Approximately quarterly, data for the project were retrieved from the databases and checked by project personnel to verify that data are correctly entered.

All chemical data was analyzed using Microsoft Excel 2003. Sites will be compared before and after BMP implementation.

Macroinvertebrate data was analyzed using the pollution tolerance index. Fish data were analyzed using the New Jersey DEP's Fish IBI.

All data was reported to project partners and participating landowners in the form of a written report.

Findings

Nitrate-nitrogen and phosphate levels showed a notable decrease (67%and 52%, respectively) due to the protection of streambank soils and the exclusion of livestock from waterways (Figures 1 and 2). This finding supports our goal of decreasing nutrient run-off into Aughwick Creek.

Figure 1: Nitrate-Nitrogen Concentrations for Project Sites in Aughwick Creek

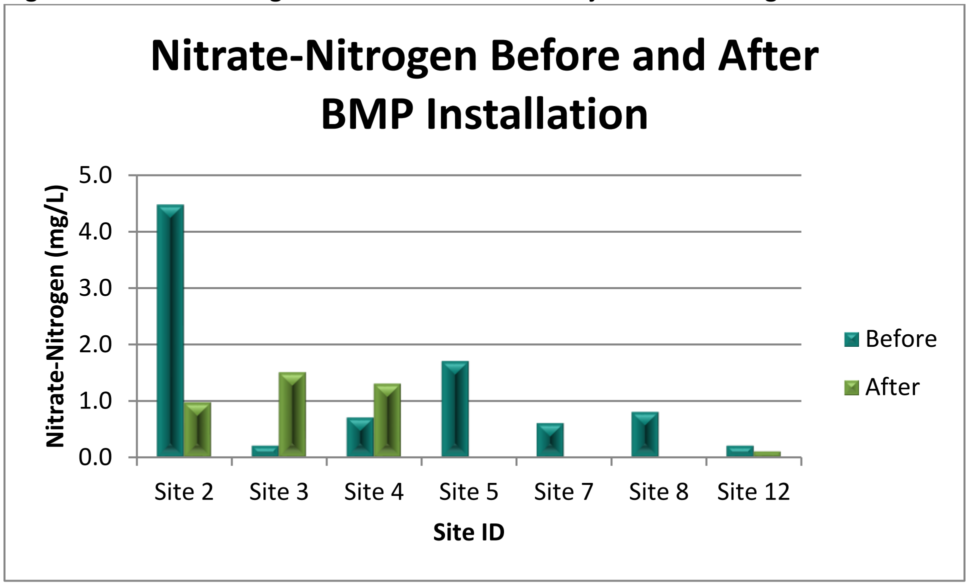
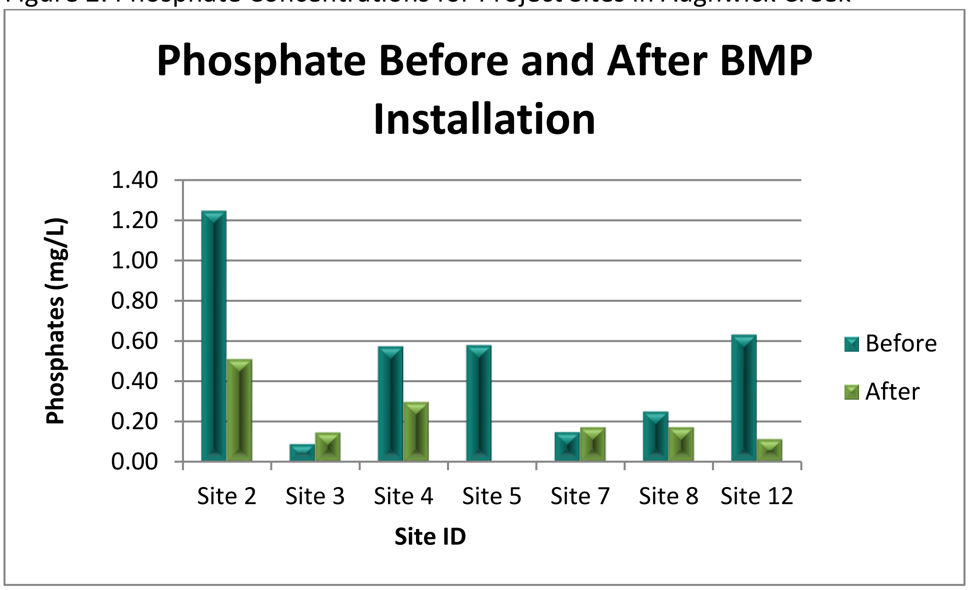


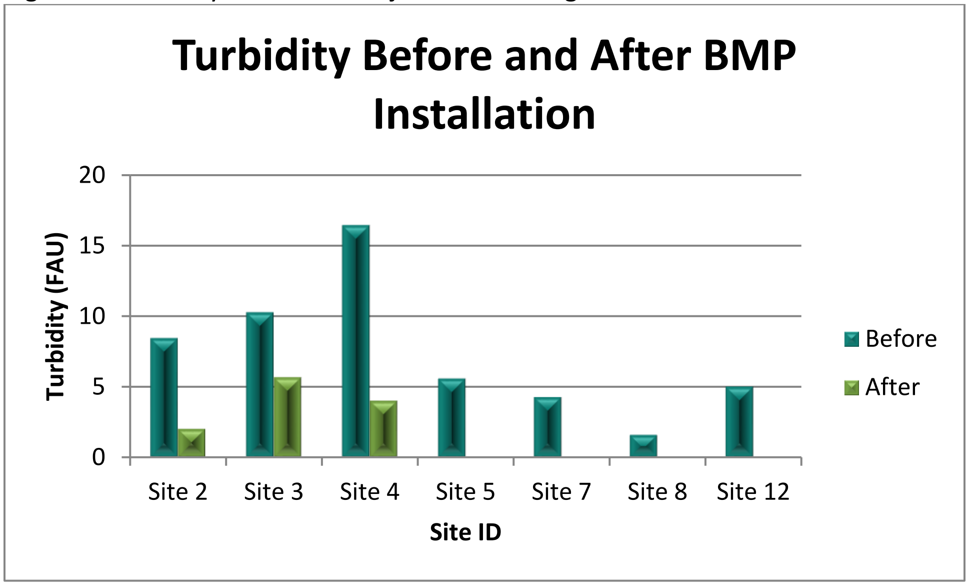
Figure 2: Phosphate Concentrations for Project Sites in Aughwick Creek



Turbidity levels also showed a notable decrease; levels decreased by 77% compared to before BMPs were installed (Figure 3). Turbidity is the measure of the cloudiness of the water. An increased level, cloudy water, does not allow sunlight to penetrate, causing a reduction in periphyton, reducing food resources for fish and macroinvertebrates. Suspended sediment can also have detrimental effects on fish species by coating their gills and eggs, reducing the ability for respiration and reproduction. The positive impact of reducing contaminants has a substantial impact upon the health of the waterway through improved water quality.

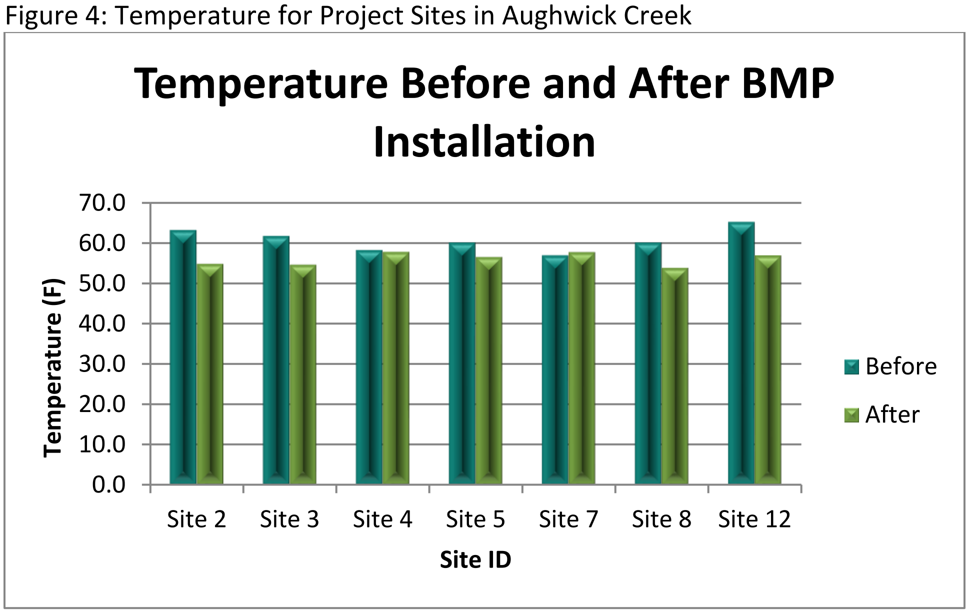
We used the Great Lakes Basin for Soil Erosion and Sediment Control Estimated Soil Savings Calculations for GLBP Projects 2005 Application to estimate total sediment reduction for the streambank stabilization projects (Appendix H). We calculated that over a projected lifespan of 10 years, we will save over 850 tons of sediment from entering the stream. Both the decrease in turbidity and the decrease in soil loss support our goal of reducing sediment in the Aughwick Creek watershed.

Figure 3: Turbidity Levels for Project Sites in Aughwick Creek



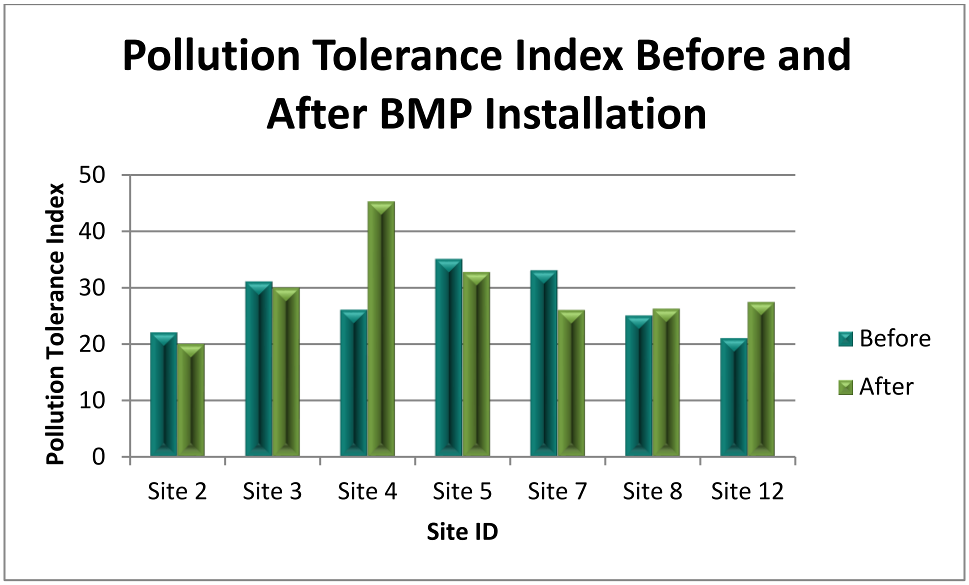
We also saw a 3% reduction in pH levels and a 5% reduction in water temperature (Figure 4). The reduction in water temperature and pH indicates an improvement in water quality and will benefit aquatic organisms in Aughwick Creek.

Figure 4: Temperature for Project Sites in Aughwick Creek



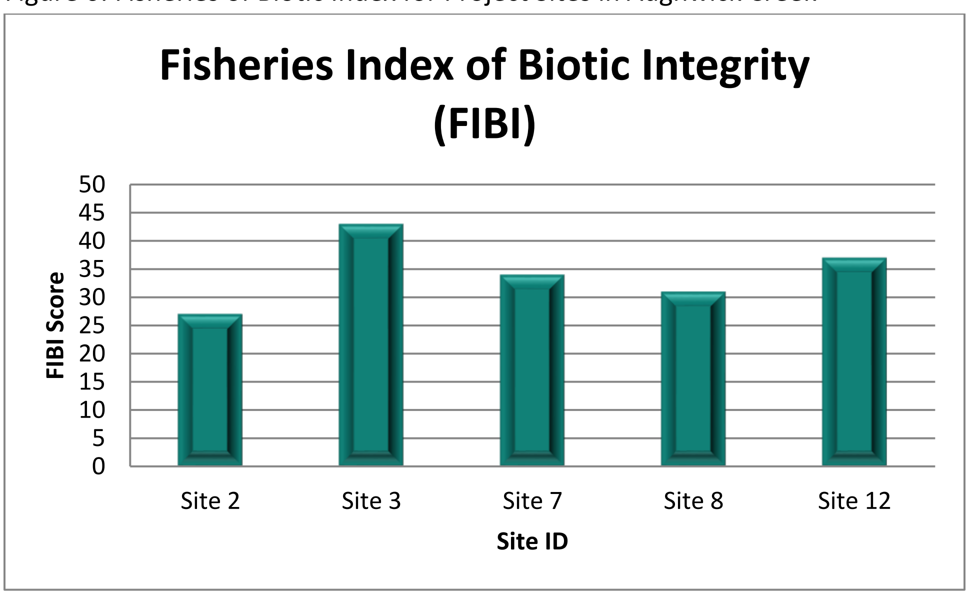
Macroinvertebrate data shows that 71% of the project sites had excellent water quality after conservation practices were installed (Figure 5). Water quality was determined using the pollution tolerance index, which uses the tolerance values of macroinvertebrates to indicate water quality.

Figure 5: Pollution Tolerance Index for Project Sites in Aughwick Creek



The fisheries of biotic integrity (FIBI) scores show that all sites, except for Site 2, had fair water quality (Figure 6). Site 2 FIBI scores indicate poor water quality. Although fish analysis shows water quality to be poor or fair, this may not be indicative of the actual water quality. Only one fish survey was completed per site, with the exception of site 2 and site 3, where two surveys were completed. This is not enough data to assess the condition of the stream. Additionally, only one pass was made with the fish shocking unit. A three pass survey would be needed to adequately quantify the fish species present at the project site.

Figure 6: Fisheries of Biotic Index for Project Sites in Aughwick Creek



Conclusions and Recommendations

In 2009, WPC was awarded the USDA NRCS CIG grant for restoration work to be completed in the Aughwick Creek watershed. Other funds were leveraged from FPW and DEP Growing Greener. The combined funds from all three sources equaled $176,000. These monies aided in serving 10 landowners in the Aughwick Creek watershed. Instream habitat enhancement and bank stabilization projects occurred along 920 feet of streambank at five sites. Agriculture conservation practices were implemented at seven project sites. This included 16,424 feet of streambank fencing, six stabilized livestock crossings, and seven alternative watering systems.

This conservation project model has proven valuable methodology and positive resulting impacts. This project was completed through strong relationships with partnering agencies, sound interactions with landowners, implementation by skilled WPC staff, and quality conservation practice implementation affiliated with quantitative monitoring. All project goals were accomplished to improve water resources adjacent to agricultural areas and improve the ecological quality of Aughwick Creek and its tributaries by implementing streambank stabilization and instream habitat enhancement, which resulted in the reduction of sedimentation, improvement of water quality, and development of habitat for fisheries and other instream communities. These quality projects implemented across Pennsylvania’s Commonwealth illustrate the potential to greatly reduce nitrates, phosphates, and decrease sedimentation in the Chesapeake Bay while enhancing smaller scale waterways.