TMDL

IMPLEMENTATION PLAN

September 2006

Conowingo Creek

Lancaster County
Pennsylvania

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RETTEW
We answer to you.

Conowingo Creek
TMDL Implementation Plan
September 2006

This plan was developed for use by the Donegal Chapter of Trout Unlimited

"Dedicated to conserving, protecting and restoring the trout streams and watershed of Lancaster County"

DONEGAL TROUT UNLIMITED

This plan was developed with technical and financial support of the Pennsylvania Department of Environmental Protection and the United States Environmental Protection Agency through the section 319 program under the federal Clean Water Act.

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ACRONYMS LISTING

TMDL	Total Maximum Daily Loads
BMP(s)	Best Management Practice(s)
GIS	Geographic Information Systems
GPS	Global Positioning System

EPA	United States Environmental Protection Agency
PADEP	Pennsylvania Department of Environmental Protection
Donegal TU	Donegal Chapter of Trout Unlimited
RETTEW	Rettew Associates, Inc.

I. INTRODUCTION

This report is only concerned with those portions of the Conowingo Creek Watershed occupying the Commonwealth of Pennsylvania.

Total Maximum Daily Loads (TMDL) for the Conowingo Creek Watershed were developed by the Susquehanna River Basin Commission on behalf of the Pennsylvania Department of Environmental Protection (PADEP) in March of 2001.

The establishment of the TMDL was necessary to address the stream's listing on Pennsylvania's 1996 and 1998 Clean Water Act Section 303(d) list of impaired waters, and the 2000 305(b) report. Sixteen miles of the main stem were placed on the 1996 303(d) list based on data compiled for the 1996 305(b) report. In 1999, as part of PADEP's Unassessed Waters Program, an additional 15 miles were added to the year 2000 305(b) report. PADEP biological surveys indicated impairment due to excessive amounts of sediments and nutrients, organic enrichment, and low dissolved oxygen.

In March of 2004, the Donegal Chapter of Trout Unlimited (Donegal TU) solicited proposals from environmental consulting firms in the interest of completing a TMDL Implementation Plan based on findings from the previously prepared TMDL study of 2001. RETTEW Associates, Inc. (RETTEW), a Lancaster County based engineering and environmental consulting firm, was chosen to complete the task. Funding for designing the plan was provided by the PADEP and the United States Environmental Protection Agency (EPA) through the Section 319 Program under the Federal Clean Water Act.

Because of already known impairments previously identified in the TMDL study of 2001, the TMDL Implementation Plan was to focus on agricultural related non-point source pollution. Specifically, Donegal TU and RETTEW were to develop a TMDL Implementation Plan designed to reduce sediment and phosphorous inputs.

RETTEW began collecting field data in April of 2005 and completed data collection by November of 2005. Data was processed and modeled using PADEP's "Predict" modeling tool in December of 2005 and the TMDL Implementation Plan was finalized in July of 2006.

II. BACKGROUND

The Conowingo Creek Watershed is located in Lancaster County, Pennsylvania and Cecil County, Maryland. The watershed comprises 34-square miles and is a drainage to the Susquehanna River. Pennsylvania municipalities occupying a portion of the watershed include Providence Township, East Drumore Township, Drumore Township, Little Britain Township and Fulton Township. The stream generally flows in a southerly direction from its headwaters near the Village of Buck to its discharge into the Susquehanna River just above Conowingo Dam. Significant highway systems include Pennsylvania Routes 272 and 222. ***See Fig #1 - Location Map below.***

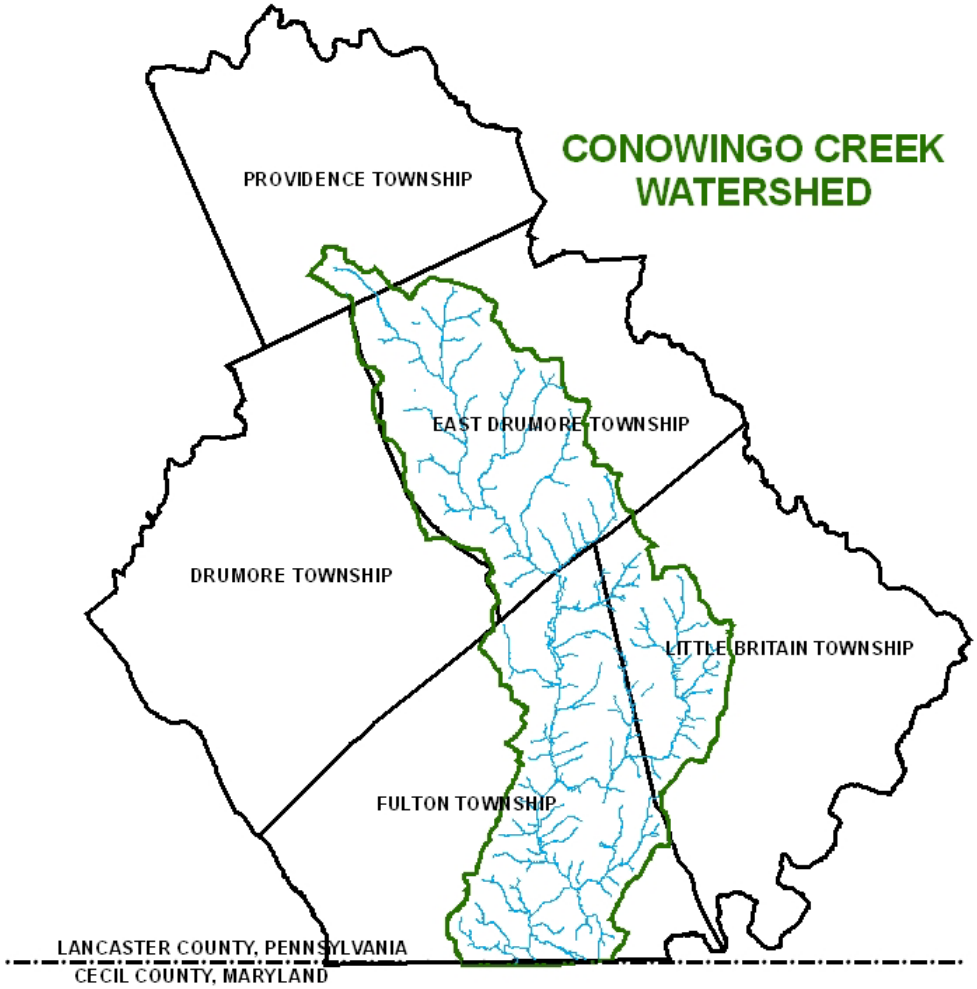


Fig #1 - Location Map

The Commonwealth does not have established water quality standards for sediment and phosphorous; however Chapter 93 of the PA Code classifies stream uses, including "aquatic life". Generally the upper reaches of the watershed support a coldwater fishery which gives way to a coolwater fishery in the center and bottom portions of the main stem. Some of the smaller, first and second order tributaries are known to support wild populations of Brown trout (Salmo

trutta) and are designated as Class A wild trout waters by the Pennsylvania Fish and Boat Commission.

The majority of the watershed is in agricultural production (approximately 83%) with many of the main stem and tributary floodplains actively pastured or cultivated for crop production. Major crops include corn, soybeans and alfalfa. Livestock includes dairy cattle, beef cattle, poultry and hogs. Most pastureland grazing dairy and beef cattle lack adequate riparian buffer zones (i.e. livestock has free access to the stream). ***See Fig #2 - Landuse Map below.***

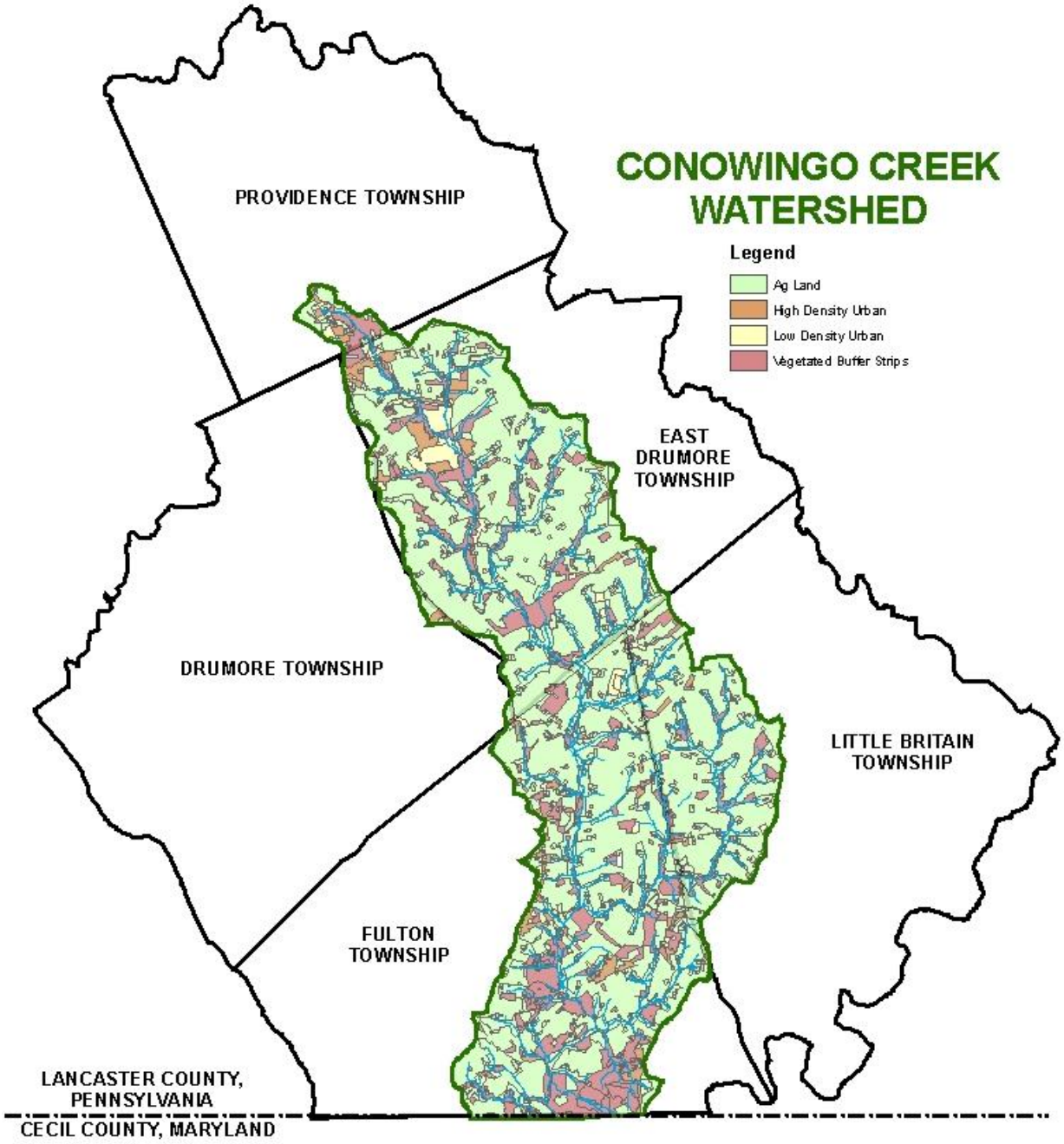


Fig #2 - Landuse Map

Because of the predominating, intense agricultural land use, it stands to reason that water quality impairments are heavily linked to non-point agricultural sources. Excessive loadings of sediment and nutrients are credited as being significant causes of water quality impairment. ***Table #1*** as seen below designates these impairments.

Table #1

List of Impaired Streams with Designated Allocation Units (as stated in 2001 TMDL)

Segment ID	*Stream Code*	*Year Listed*	*Stream Name (Designated Use)*	*Source Code*	*Cause Code*	*Miles Degraded*	*Allocation Unit*
6326	7162	1996	Conowingo Creek (CWF)	Agriculture	Nutrients Suspended Solids	12.64	6
6326	7171	1998	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Agriculture	Nutrients Suspended Solids	0.12	1
990629-1155-BPG	7171	2000	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Crop/Grazing Related Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	1.45	1
6326	7172	1998	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Agriculture	Nutrients Suspended Solids	1.16	1
990629-1155-BPG	7173	2000	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Crop/Grazing Related Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	1.33	1
990629-1155-BPG	7174	2000	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Crop/Grazing Related Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	0.56	1
990707-1105-BPG	7186	2000	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	2.77	5
990707-1105-BPG	7187	2000	Conowingo Creek/Unnamed Tributary (HQ-CWF)	Agriculture	Nutrients Organic Enrichment/Low D.O.	1.61	5

					Siltation		
990629-1420-BPG	7176	2000	Little Conowingo Creek (HQ-CWF)	Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	5.81	3
990629-1420-BPG	7177	2000	Little Conowingo Creek (HQ-CWF)	Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	1.59	3
990629-1420-BPG	7178	2000	Little Conowingo Creek (HQ-CWF)	Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	1.05	3
990629-1420-BPG	7179	2000	Little Conowingo Creek (HQ-CWF)	Agriculture	Nutrients Organic Enrichment/Low D.O. Siltation	0.82	3

The TMDL study of 2001 states the need to reduce sediment loading by 18% and phosphorous loading by 59%. Considering a 10% "Margin of Safety", the TMDL study of 2001 recommends reducing the sediment loading by 26% and phosphorous loading by 63%. ***See Table #2 below.***

TMDL Endpoints for the Conowingo Creek Watershed			
Pollutant	**Current Loading (lbs/yr)**	**TMDL (lbs/yr)**	**Percent Reduction in Loads Needed to Meet TMDL**
Sediment	27,301,403	22,514,862 20,263,376	18% 26% with 10% "Margin of Safety"
Phosphorous	52,374	21,338 19,203	59% 63% with 10% "Margin of Safety"

Table #2

Therefore this TMDL Implementation Plan is concerned with reducing sediment and phosphorus inputs from agricultural sources. The plan concentrates on prescribing various, appropriate agricultural "best management practices" (BMPs) to discovered problem areas throughout the watershed. The prescribed BMPs fall into four main categories, these being: soil conservation farming practices, pastureland management practices, nutrient management practices, and riparian corridor management practices.

Examples of soil conservation farming practices include strip cropping, crop rotation, residue management, terracing, farming on the contour and other methods that serve to preserve the soil resource and arrest its erosion and migration to watercourses.

Examples of pastureland management practices include rotational grazing and other methods that help preserve the integrity of the vegetative cover; which in turn controls soil loss.

Examples of nutrient management practices include manure storages, balanced application rates of manure and commercial fertilizers and barnyard and feedlot controls that assist in the gathering of animal wastes so as to allow their collection for proper application rather than uncontrolled release.

Examples of riparian corridor management practices include the establishment of forest and vegetative buffers, stream bank fencing and stream bank stabilization.

It should be noted that phosphorous readily links to soil particles. Therefore controlling soil erosion not only reduces sediment input to a watercourse, but also reduces the introduction of phosphorus.

Non-Agricultural Sources and Ways to Address Them

Although the 2001 TMDL does not allocate any nutrient or sediment load reductions to non-agricultural sources, it does recognize that such sources contribute nutrient and sediment loads to the Conowingo. For phosphorus, these sources include natural forest conditions, groundwater, urban stormwater runoff. For sediment, non-agricultural sources include forests and urban stormwater runoff. Also eroding stream banks are another source of both sediment and phosphorus not necessarily linked to agricultural practices.

Some level of nutrient and sediment contribution to surface waters is a natural occurrence. For example, forest conditions contribute both sediment and phosphorus to the Conowingo, and groundwater can contribute nutrient loadings as baseflow to the creek. It is not realistic to reduce loadings to levels below background contributions of nutrients or sediment to streams under natural conditions. It should be noted, however, that nutrient concentrations in groundwater can be elevated by human activities such as agriculture, lawn fertilizers and malfunctioning septic systems. Thus addressing these practices through implementing BMPs to reduce direct loadings to surface waters may also reduce loadings to groundwater and, therefore, reduce the nutrient groundwater contribution to Conowingo Creek.

Stormwater runoff from development is another contributor of nutrients and sediment to streams. All earth disturbance of one acre or more must obtain an NPDES permit for stormwater discharges associated with construction activities. As part of this permit process, developers must submit and implement an erosion and sediment control plan to control runoff during construction, as well as a post-construction stormwater management plan to provide long term control of runoff once construction is completed. Nutrient and sediment loadings from stormwater runoff can be reduced by ensuring that these plans maximize infiltration BMPs to the extent possible and control volume, rate and quality of runoff so that water quality is protected

and the physical degradation of streams and stream banks is prevented. PADEP is in the process of finalizing a new statewide Stormwater BMP Manual, which contains detailed technical guidance on how to manage stormwater runoff to protect water quality. The Manual places a strong emphasis on low impact site design and use of existing site conditions and infiltration to replicate the natural hydrologic cycle. As such, use of the Manual in land development planning should help reduce sediment and nutrient loadings from stormwater.

Many of the municipalities located in the Conowingo Creek Watershed are considered "municipal separate storm sewer systems" or "MS4s". MS4 municipalities hold NPDES permits that regulate stormwater discharges within their municipal-wide storm sewer systems through the application of six minimum control measures. Thus the MS4 permitting program can also lead to sediment and nutrient loading reductions from stormwater.

Although not accounted for in the 2001 TMDL, one needs to assume failing septic systems on private lots play a role in introducing phosphorus to the watershed. Septic system owners can play a role in protecting water quality be ensuring that systems are up-to-date and functioning properly.

Chesapeake Bay Tributary Strategy

The Conowingo Creek, as a tributary to the Susquehanna River, is within the Chesapeake Bay Watershed. The Chesapeake suffers from the same excess sediment and nutrient problems that exist in the Conowingo. On June 28, 2000, EPA, the Chesapeake Bay Commission and the Bay states of Pennsylvania, Maryland, Virginia and Washington D.C. signed the Chesapeake 2000 Agreement. In this agreement, the states agreed to meet established sediment and nutrient reduction goals by 2010.

In December 2004, PADEP released the Pennsylvania Chesapeake Bay Tributary Strategy, which is a comprehensive plan for meeting Pennsylvania's Chesapeake 2000 Agreement sediment and nutrient reduction goals. The Tributary Strategy establishes strategies for reducing both point and nonpoint sources of pollution to the Bay. With respect to nonpoint sources, it divides Pennsylvania's portion of the Bay watershed into 13 watershed areas, and then sets forth a comprehensive list of BMPs to be implemented in each area, along with implementation goals for 2010.

The Pennsylvania Chesapeake Bay Tributary Strategy lists several urban BMP strategies that can be employed in the Conowingo Creek Watershed. These include (1) Erosion & Sediment Controls, (2) Forest Buffers, (3) Grass Buffers, (4) Septic Denitrification, (5) Street Sweeping, (6) Stormwater Management-Filtration, (7) Stormwater Management-Infiltration Practices, (8) Stormwater Management-Wet Ponds & Wetlands, and (9) Urban Stream Restoration. The Pennsylvania Chesapeake Bay Tributary Strategy can be found at the following link - www.depweb.state.pa.us/chesapeake/lib/chesapeake/pdfs/tribstrategy.pdf

The urban BMP strategies listed above are designed to reduce sediment and/or nutrient loading to surface waters. Therefore, as Donegal TU and its partner organizations and agencies (such as the Lancaster County Conservation District) seek to implement the recommendations of this plan, it will look to partner with willing Conowingo landowners to install appropriate BMPs identified and described in the Tributary Strategy. Improving water quality of the Conowingo through implementation of this restoration plan will go a long way toward ongoing efforts to restore the Chesapeake Bay.

In preparation of the TMDL Implementation Plan, RETTEW was ever cognizant of the necessity of keeping the plan realistic. One needs to keep in mind the plan was prepared to serve as a restoration strategy for Donegal TU.

Donegal TU is an organization comprised of local, volunteer stakeholders who simply wish to improve and protect a local trout stream. The organization has no law enforcement capability, but rather works on the premise of educating and cooperatively working with landowners. The group focuses heavily on the stream corridors and landuse immediately adjacent to those corridors. Historically, watershed associations have been very successful implementing stream bank fencing, stream bank stabilization and forest buffer planting projects throughout Pennsylvania, while relying on the local county conservation districts to undertake conservation measures on crop fields.

III. DATA COLLECTION

RETTEW began collecting field data in April of 2005 and completed data collection by November of 2005. Because of monetary constraints related to this project and others like it, it is vital the best effort be put forth to collect as much site specific data as possible utilizing the most cost effective means available. Considering the size of this watershed and its some 108-miles of stream corridors, RETTEW was faced with a challenging task.

Knowing the previously established TMDL thresholds established by the TMDL study of 2001, it was understood that a substantial amount of various BMPs would need to be prescribed to have any significant reductions in sediment and phosphorous loading when modeled.

Both RETTEW and Donegal TU felt it very important to have seen and assessed the actual sites where BMPs were proposed rather than relying heavily on planned but possibly not implemented or maintained conservation plans for the farms or aged aerial photography flown from too high an altitude to allow for proper analysis of ground conditions.

Therefore it was vital to collect real time data of actual ground conditions on sites where BMPs would be prescribed. Considering the above, RETTEW chose to utilize low altitude colored aerial video footage as a first reconnaissance, followed by an adequate amount of ground truthing. RETTEW collected their own aerial footage thus insuring the sought after photography was properly captured.

Example of aerial footage clip

Prior to doing so, the methodology was approved by the PADEP and the EPA. RETTEW had previously utilized similar methodology in preparing other state and federal funded watershed assessments.

Before flying, flight plans were prepared by RETTEW environmental staff so as to insure capture of the correct stream corridors and anticipated impaired reaches. Emphasis was placed

upon those previously determined impaired stream segments as identified by PADEP and previously scouted locations determined by RETTEW environmental staff. ***See Fig #3 - Impaired Stream Segment Map below.***

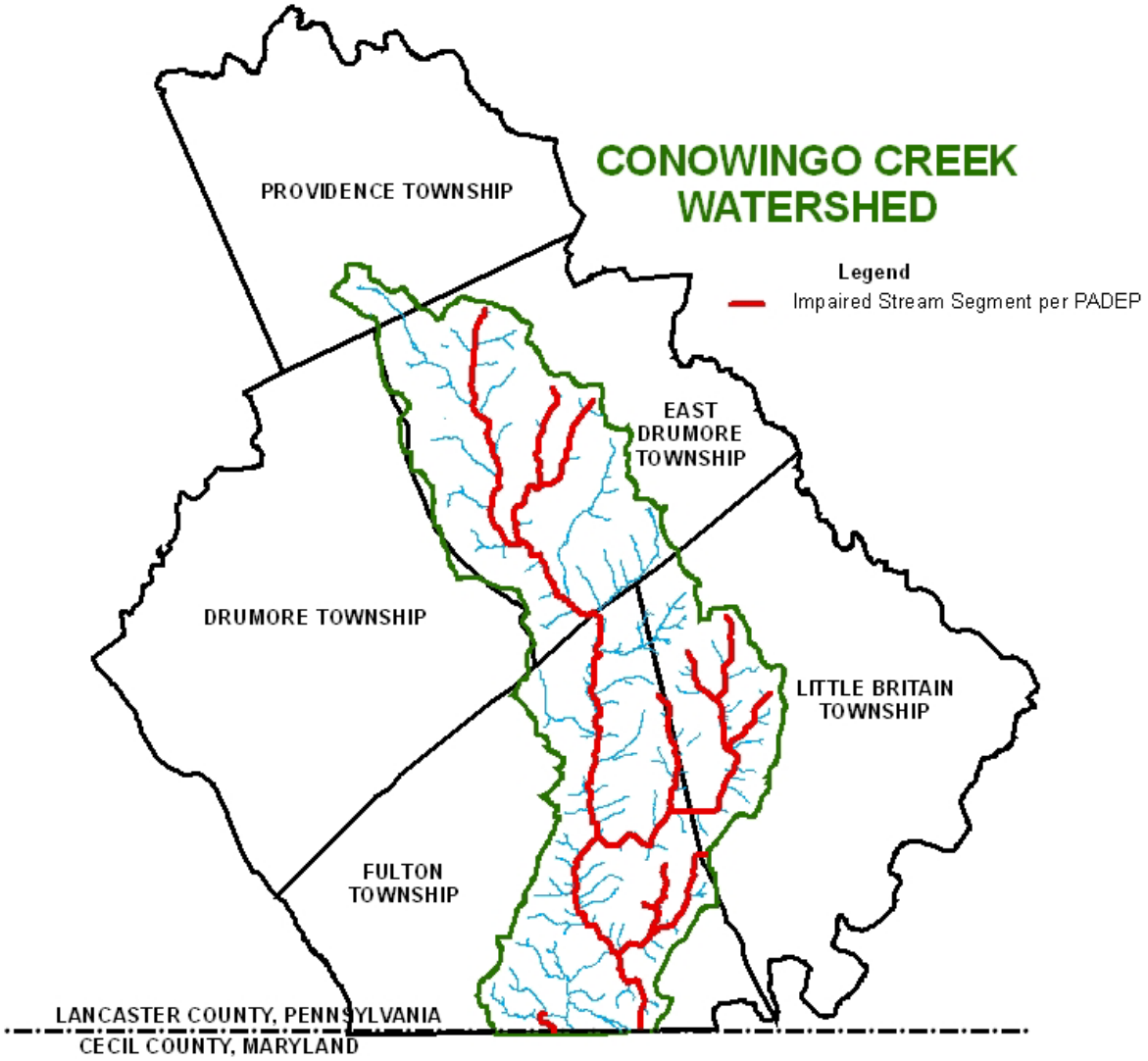


Fig #3 - Impaired Stream Segment Map

The flight crew was given specific instruction and descriptions of what to look for and photograph. When the flight crew recognized potential problem areas, several passes from different angles were taken in order to insure proper capture of the area in question. Typically, this involved lower altitude passes.

Most aerial videoing took place from an altitude between 400 – 600 feet above the ground. The video was time coded and linked to a GPS unit so that site locations could be known and in turn linked to GIS programming for further analysis and planning.

After the flights were completed, collected video footage was post-processed. This involved dividing out the various sub-watersheds using the associated time code and collected GPS

coordinates. Once adequately post-processed, the video footage was placed on a DVD disk for viewing at any time. All 108-miles of collected stream corridor video are on the DVD.

At the same time, RETTEW staff combined the known flight paths with GIS technology; thus a flight path layer can be "turned on" while using ArcView. The flight paths simply depict and indicate where the helicopter flew. Using other ArcView available functions, a user can use the time code viewed on the video clips to find that exact point within the GIS program mapping by selecting the proper flight path. This then allows the user to earmark the potential problem site, typically indicated by drawing a line or polygon along or around the area of concern.

Once a potential problem site is created, still other ArcView functions are utilized to bring up a data sheet for that particular site. RETTEW IT staff set up the programming to automatically generate the data sheet with already known information concerning the particular location. A linear distance or acreage was also automatically generated, so the size or length of a problem area is known and can be modeled. The data sheet allows the user (in this case a RETTEW watershed specialist) to record information about the potential problem site. The user can describe existing land use and management conditions by writing descriptions and selecting from a provided listing of BMP categories. The BMP categories on the data sheet are the very same as those used in the modeling process discussed later in this report. ***See Fig #4 - Sample Data Sheet below.***

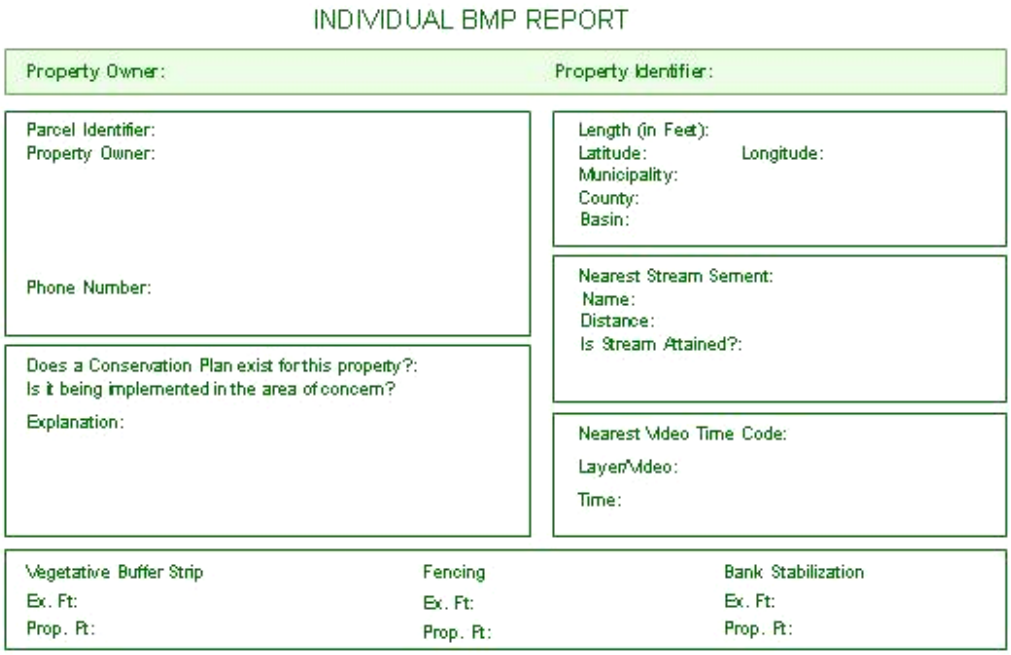


Fig #4 - Sample Data Sheet

And so the aerial video footage and the data sheet completion process was used as a first reconnaissance of the watershed and a means of determining potential problem areas and future improvement work locations. With this information in hand, RETTEW staff then took to the field to field verify (ground truth) what were thought to be potential problem areas. Data sheets for the areas of concern were then appropriately revised as necessary with found field conditions.

RETTEW staff did not field visit every earmarked problem area. Rather 40% of the sites were visited to confirm the aerial assessment procedure.

In total 126 problem sites were recorded where specific BMPs should be implemented in order to achieve significant sediment and phosphorous reduction. ***See Fig #5, page 15.*** Site specific data sheets that were prepared for these problem areas are not included within the pages of the public report for confidentiality reasons. However Donegal TU has the data sheets and will use them as guidance when approaching watershed landowners in the future. Again, it is important to note Donegal TU is working to improve the watershed on a volunteer oriented basis.

A raw Conowingo bank on a cold winter's day

IV. MODELING AND RESULTS

In recent years, PADEP has relied heavily upon GIS technology for collecting and organizing watershed data. The Pennsylvania State University Environmental Resources Research Institute has been assisting PADEP on developing GIS based technology for its watershed management programs. There exists a variety of GIS-based watershed assessment tools given the task at hand.

One such tool facilitates the use of the GWLF (Generalized Watershed Loading Function) model via a GIS software (ArcView) interface. This tool (called AVGWLF) has recently been selected by PADEP to help support ongoing TMDL projects within Pennsylvania.

As per the PADEP and Penn State's model user guide, the model serves to: 1) derive input data for GWLF for use in an "impaired" watershed, 2) simulate nutrient and sediment loads within the impaired watershed, 3) compare simulated loads within the impaired watershed against loads simulated for a nearby "reference" watershed that exhibits similar landscape, development and agricultural patterns, but which also has been deemed to be unimpaired, and 4) identify and evaluate pollution mitigation strategies that could be applied in the impaired watershed to achieve pollutant loads similar to those calculated for the reference watershed.

RETTEW, with assistance from PADEP and Penn State, utilized a version of the AVGWLF model known as "PRedICT" to run prescribed BMP simulations of the Conowingo Creek Watershed. ***See Appendix A for the PRedICT model runs***

If all 126 identified problem areas are "fixed" according to the prescribed BMPs found within this TMDL Implementation Plan, the following reductions as described in the following ***Table #3 - Anticipated Reductions*** can be anticipated.

	CURRENT LOADING	PLANNED LOADING WITH 126 BMP IMPLEMENTATIONS	TARGET LOADING PER TMDL 2001
SEDIMENT	**27,301,403 lbs.**	**19,551,210 lbs.**	**20,263,376 lbs.**
PHOSPHORUS	**52,374 lbs.**	**30,265 lbs.**	**19,203 lbs.**

Table #3 - Anticipated Reductions

As can be seen from above, implementing the planned 126 BMPs will result in achieving targeted sediment loading. Unfortunately, phosphorus reductions will not meet or exceed targeted phosphorus loading as set in the 2001 TMDL.

In order to address the 2001 TMDL target reductions for phosphorous, the EPA asked that hypothetical BMP scenarios be modeled in addition to the planned 126 problem sites where specific BMPs have been proposed. This modeling work was completed in March of 2006.

Anticipated reduction in phosphorous related to the implementation of the BMPs associated with the identified 126 problem sites yielded a reduction of 42%. The target value for phosphorous reduction per the 2001 TMDL is 63%. In order to hypothetically meet this reduction, modeling demonstrated that substantial, additional BMP measures would be necessary on cropland, row crops, hay and pastureland as described in ***Table #4 – Hypothetical Reductions*** below:

BMP PERCENTAGE OF CROPLAND & ROW CROPS ACREAGE		
BMP	CURRENT CONDITION INCLUDING THE PROPOSED 126 BMP SITES	HYPOTHETICAL CHANGE IN BMP INSTALLATION
BMP #1 Crop residue management & cover crops	15%	10% decrease to 5% total
BMP #2 Stripcropping & contour farming	30%	48% increase to 78% total
BMP #3 Crop rotation & cover crops	15%	10% decrease to 5% total
BMP #4 Crop rotation & crop residue management	2%	No change - 2%
BMP #5 Terraces & diversions	15%	5% decrease to 10% total
BMP #6 Nutrient management	60%	38% increase to 98% total
Note: BMPs #1 through #5 cannot equal over 100%. Likewise BMP #6 cannot equal over 100%		
BMP PERCENTAGE OF HAY & PASTURELAND ACREAGE		
BMP	CURRENT CONDITION INCLUDING THE PROPOSED 126 BMP SITES	HYPOTHETICAL INCREASE OR CHANGE IN BMP INSTALLATION
BMP #6 Nutrient management	40%	38% decrease to 2% total
BMP #7 Grazing land management	60%	38% increase to 98% total
Note: BMPs #6 and #7 cannot equal over 100%		
RESULTING LOADINGS		
	CURRENT LOADING	HYPOTHETICAL LOADING	TARGET LOADING PER TMDL 2001
SEDIMENT	27,301,403 lbs.	17,597,662 lbs.	20,263,376 lbs.
PHOSPHORUS	52,374 lbs.	19,165 lbs.	19,203 lbs.

Table 4 - Hypothetical Reductions

As can be seen in ***Table #4 – Hypothetical Reductions***, a very significant increase in nutrient management for cropland and row crops is necessary to meet the necessary phosphorous reduction. Given this entire approach to restoring the Conowingo Creek is based in voluntary cooperation, it is very doubtful that 98% of the agricultural community will voluntarily comply with implementing a sound nutrient management plan. As previously noted in this writing, it is

outside the abilities of the Donegal TU to write and coordinate the review and implementation of nutrient management plans – rather that work is best performed by the Lancaster County Conservation District and the local Natural Resources Conservation Service.

As discussed above, this TMDL Implementation Plan is to serve as a restoration blueprint for Donegal TU. Donegal TU seeks to improve water quality by working with willing landowners to install BMPs and conduct stream improvement projects. As such, the group focuses its outreach, education and project assistance on stream corridors and the lands adjacent to them. Feasible projects include working with farmers to install stream bank fencing, plant riparian buffers, or conduct stream bank stabilization activities. As a nonprofit 501(c)(3) organization, Donegal TU is eligible to apply for grants to fund projects on behalf of interested landowners, thus providing a valuable service to interested farmers and other landowners who may simply lack the time or resources to develop project plans, research funding opportunities and write grant applications.

In developing this TMDL Implementation Plan, RETTEW was careful to propose the types of projects that Donegal TU could feasibly implement, given its nature as an all-volunteer grassroots organization. There was no logical basis to propose projects or BMPs that will never feasibly be implemented by the group.

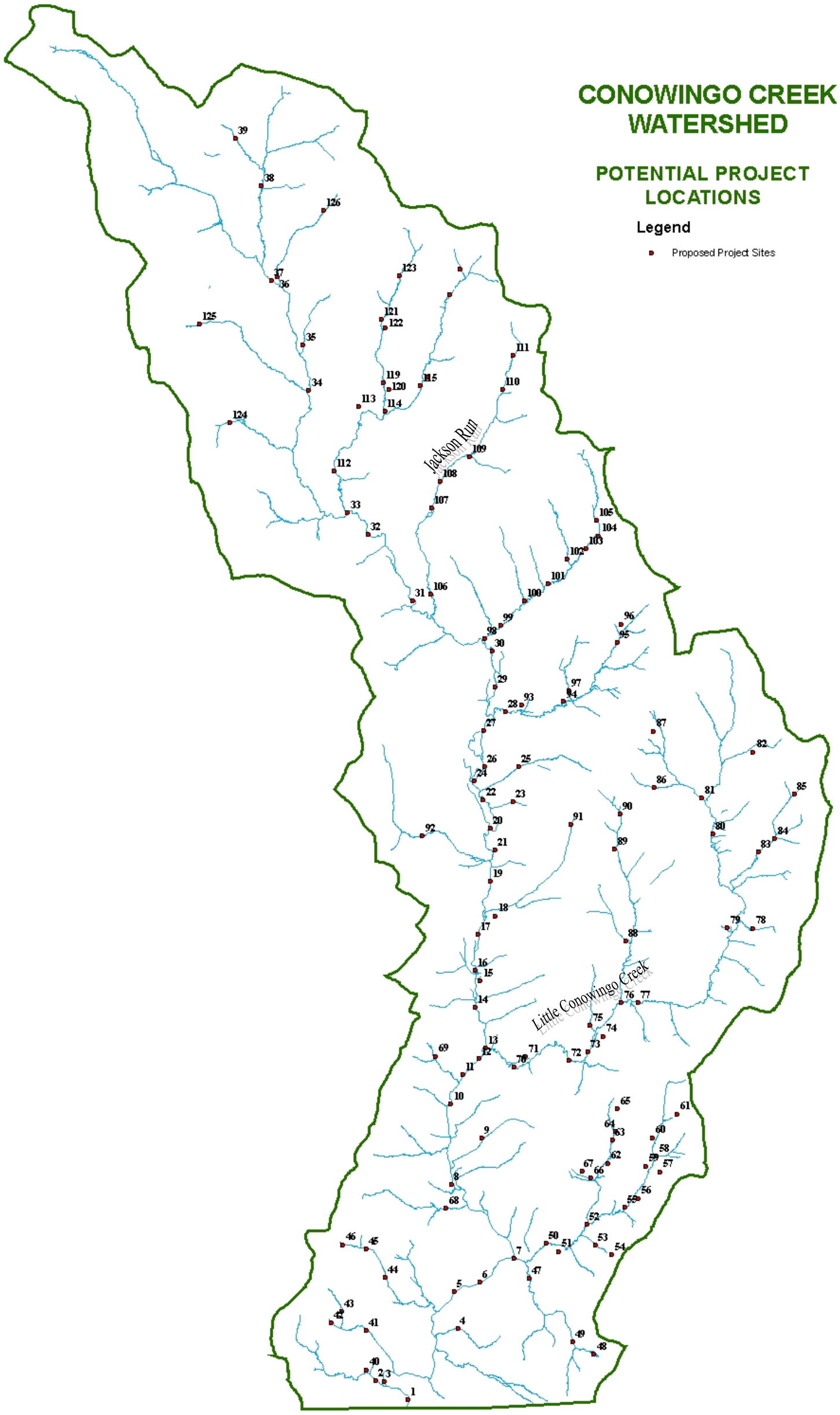
Nonetheless, implementation of all proposed projects identified in this TMDL Implementation Plan will require significant time and financial resources. Based on PADEP's implementation cost estimates derived from the PRedICT model, the cost estimate to install all proposed BMPs is $2,244,602.00. ***See Appendix A for the PRedICT model runs.*** The PRedICT model calculates costs by using established Chesapeake Bay program costs per acre and/or mile of each particular prescribed BMP. Additional administrative and maintenance costs, as well as inflationary concerns, are ultimately likely to make the price tag even higher. Even if Donegal TU were to receive grants in the amount of $130,000 per year to fund restoration projects, under present cost estimates it would take at least 15 years to fully implement this plan. Clearly, land use practices will change over the next 15 years, requiring continuing adaptation and modification of the BMPs proposed in this plan. Reaching agreements with landowners to embark on projects often takes years of outreach and partnership building. In addition, the Conowingo is but one of a multitude of impaired waters in Pennsylvania competing for the same limited funding sources.

As stated, land use within the watershed is not static. Presently, much land within the watershed remains in agricultural use. However, recent trends in this region show an increased conversion of farmland to residential or commercial development. As this trend continues, new threats to water quality will arise, such as stormwater runoff from developed impervious surfaces and over application of lawn chemicals and fertilizers. These new threats will, in many cases, require implementation of different BMPs to address them. Moreover, given expected future land use trends, it must be anticipated that existing landowners may wish to preserve the development potential of their lands, and thus implementation of BMPs may be restricted to areas in and along riparian corridors, floodplains and wetlands where development may already be difficult or prohibited because of local ordinances or state or federal regulations. For all of these reasons, this plan will have to be reconsidered and modified as land use changes within the watershed.

V. RESTORATION RECOMMENDATIONS

For confidentiality reasons, landowner names are not listed in this report, rather proposed project locations are identified by a site number. ***See Project Locations Map below.*** The Donegal TU has been provided with a landowner listing corresponding to the site number as well as the data sheets that go along with each site.

Fig #5



Project Locations Map

It is best to begin restoration activities in the headwaters and first and second order tributaries. ***Table #5 – Project Implementation Schedule*** outlines the recommended sequence for the 126 planned BMP sites.

Table #5 strategically groups identified potential project areas/tasks so that restoration activities are implemented in a logical fashion; generally undertaking work in smaller sub-watersheds and then progressing downstream into the bottom reaches of the main stem. In other words, work will begin at the top and proceed downstream. It is rather illogical to skip haphazardly around the entire watershed doing various projects, only to have "fixed" problem areas still being negatively impacted from upstream problem areas. It is far more rewarding from both a psychological and biological viewpoint to complete work in a sub-watershed knowing that it is taken care of and no longer negatively influences the overall health of the entire watershed.

While undertaking this study, Donegal TU completed a study of the fishery and macro-invertebrate community. Several landowners participated in the electro-fishing that was accomplished by Donegal TU and RETTEW and were thrilled and happily surprised by the results. Several of these landowners, many of whom are farmers, wondered when Donegal TU would be doing restoration work on their property. Donegal TU sees these willing landowners and their properties as prime locations to do "pilot projects" – a springboard of sorts to get things going and make an overall good impression in the watershed. Accomplishing a few good projects with the right landowners who have good standing with their neighbors will serve to promote the overall restoration effort. The best strategy Donegal TU can employ to win people over is to have locals in the watershed saying good things about Donegal TU and the work they are doing!

With this in mind, Donegal TU is planning pilot projects in 2006-2007 at the following locations:

1. Tanglewood Golf Course upstream of Scotland Rd – fish habitat and bank stabilization
2. Cardinal Rd – bank stabilization
3. Conowingo Rd/Spring Valley Rd – fish habitat, bank stabilization and forest buffer planting
4. Hensel Rd/Fulton Dr – fish habitat and bank stabilization

Donegal TU is currently seeking funding to complete these pilot projects. Completing the first listed pilot project at Tanglewood Golf Course will be the perfect lead in to starting work scheduled in the headwaters of the main stem situated around the golf course for 2006-2008 as listed below.

Table #5 – Project Implementation Schedule

HEADWATERS OF MAIN STEM – AREA OF TANGLEWOOD GOLF COURSE 2006-2008 **Estimated cost - $41,749.60** **Estimated load reduction for sediment – 1.8% - 144,153.59 lbs.** **Estimated load reduction for phosphorous – 1.9% - 411.23 lbs.**	
Site #34	146.26-feet of bank stabilization
Site #35	5,500.00-feet of bank stabilization

	7,955.82-feet of stream fencing 7,955.82-feet of vegetated buffer
Site #36	4,239.37-feet of vegetated buffer
Site #37	200.00-feet of bank stabilization 796.28-feet of vegetated buffer
Site #38	1,500.00-feet of bank stabilization 3,314.51-feetof vegetated buffer
Site #39	3,789.42-feet of bank stabilization 3,789.42-feet of stream fencing 3,789.42-feet of vegetated buffer
Site #124	1,500.00-feet of bank stabilization 3,893.46-feet of stream fencing 3,893.46-feet of vegetated buffer
Site #125	800.00-feet of bank stabilization 2,479.70-feet of stream fencing 2,479.70-feet of vegetated buffer
Site #126	4,291.37-feet of stream fencing 4,291.37-feet of vegetated buffer
UN-NAMED TRIBUTARY TO MAIN STEM – AREA OF CARDINAL ROAD 2008 – 2009 Estimated cost - $174,230.04 Estimated load reduction for sediment – 7.7% - 601,414.98 lbs. Estimated load reduction for phosphorous – 7.8% - 1,715.66 lbs.	
Site #112	4,000.00-feet of bank stabilization 8,115.75-feet of stream fencing 8,115.75-feet of vegetated buffer
Site #113	12.78-acres of grazing land management
Site #114	7,117.15-feet of bank stabilization 7,117.15-feet of stream fencing 7,117.15-feet of vegetated buffer
Site #115	8,760.84-feet of bank stabilization 8,760.84-feet of stream fencing 8,760.84-feet of vegetated buffer
Site #116	38.12-acres of grazing land management
Site #117	4,399.27-feet of stream fencing 4,399.27-feet of vegetated buffer
Site #118	4,879.66-feet of stream fencing 4,879.66-feet of vegetated buffer
Site #119	450.00-feet of bank stabilization 956.18-feet of stream fencing 956.18-feet of vegetated buffer
Site #120	6.00-acres of grazing land management
Site #121	1,000.00-feet of bank stabilization (completed since TMDL of 2001) 2,243.35-feet of stream fencing (completed since TMDL of 2001) 2,243.35-feet of vegetated buffer (completed since TMDL of 2001)
Site #122	7.74-acres of grazing land management

Site #123	2,500.00-feet of bank stabilization 5,738.81-feet of stream fencing 5,738.81-feet of vegetated buffer
JACKSON RUN 2009 Estimated cost - $50,054.62 Estimated load reduction for sediment – 2.3% - 172,829.30 lbs. Estimated load reduction for phosphorous – 2.2% - 493.03 lbs.	
Site #106	4,700.36-feet of bank stabilization 4,700.36-feet of stream fencing 4,700.36-feet of vegetated buffer
Site #107	2,500.00-feet of bank stabilization 5,027.21-feet of stream fencing 5,027.21-feet of vegetated buffer
Site #108	500.00-feet of bank stabilization 1,726.04-feet of stream fencing 500.00-feet of vegetated buffer
Site #109	5,000.00-feet of bank stabilization 7,885.12-feet of stream fencing 7,885.12-feet of vegetated buffer
Site #110	600.00-feet of bank stabilization 3,971.34-feet of stream fencing 3,971.34-feet of vegetated buffer
Site #111	2,500.00-feet of bank stabilization 4,495.02-feet of stream fencing 4,495.02-feet of vegetated buffer
MAIN STEM – UPPER REACH – AREA OF SPRING VALLEY ROAD 2010 Estimated cost - $31,424.43 Estimated load reduction for sediment – 1.5% - 108,502.70 lbs. Estimated load reduction for phosphorous – 1.4% - 309.53 lbs.	
Site #31	6,127.83-feet of bank stabilization 6,127.83-feet of stream fencing 6,127.83-feet of vegetated buffer
Site #32	2,293.07-feet of bank stabilization 2,293.07-feet of stream fencing 2,293.07-feet of vegetated buffer
Site #33	7,000.00-feet of bank stabilization 9,020.54-feet of stream fencing 9,020.54-feet of vegetated buffer
UN-NAMED TRIBUTARIES TO MIDDLE REACH OF MAIN STEM AND MIDDLE REACH OF MAIN STEM 2010 – 2013 Estimated cost - $318,833.48 Estimated load reduction for sediment – 14.1% - 1,100,527.41 lbs. Estimated load reduction for phosphorous – 14.2% - 3,139.48 lbs.	

Site #14	4,922.87-feet of bank stabilization 4,922.87-feet of stream fencing 4,922.87-feet of vegetated buffer
Site #15	2.89-acres of nutrient management
Site #16	342.24-feet of bank stabilization 342.24-feet of stream fencing 342.24-feet of vegetated buffer
Site #17	3,000.00-feet of bank stabilization 6,320.24-feet of stream fencing 6,320.24-feet of vegetated buffer
Site #18	10.45-acres of conservation tillage
Site #19	500.00-feet of bank stabilization 1,937.51-feet of stream fencing
Site #20	5,000.00-feet of bank stabilization 7,894.12-feet of stream fencing 7,894.12-feet of vegetated buffer
Site #21	1,177.82-feet of field lane improvement
Site #22	500.00-feet of bank stabilization 1,008.48-feet of vegetated buffer
Site #23	1,508.61-feet of bank stabilization 1,508.61-feet of stream fencing 1,508.61-feet of vegetated buffer
Site #24	916.47-feet of bank stabilization 916.47-feet of vegetated buffer
Site #25	1,500.00-feet of bank stabilization 3,140.52-feet of stream fencing 3,140.52-feet of vegetated buffer
Site #26	275.28-feet of bank stabilization 275.28-feet of vegetated buffer
Site #27	4,000.00-feet of bank stabilization 7,453.49-feet of stream fencing 7,453.49-feet of vegetated buffer
Site #28	4,182.58-feet of bank stabilization 4,182.58-feet of stream fencing 4,182.58-feetof vegetated buffer
Site #29	2,778.86-feet of bank stabilization 2,778.86-feet of stream fencing 2,778.86-feet of vegetated buffer
Site #30	2,000.00-feet of bank stabilization 4,861.58-feet of stream fencing 4,861.58-feet of vegetated buffer
Site #91	1,430.54-feet of bank stabilization 1,430.54-feet of stream fencing 1,430.54-feet of vegetated buffer
Site #92	1,300.00-feet of bank stabilization 2,323.38-feet of stream fencing

	2,323.38-feet of vegetated buffer
Site #93	1,054.18-feet of field lane improvement
Site #94	3,000.00-feet of bank stabilization 5,735.05-feet of stream fencing 5,735.05-feetof vegetated buffer
Site #95	2,844.54-feet of bank stabilization 2,844.54-feet of stream fencing 2,844.54-feet of vegetated buffer
Site #96	9.31-acres of grazing land management
Site #97	Location of piles of dead pigs – improper disposal of deceased livestock
Site #98	500.00-feet of bank stabilization 902.11-feet of stream fencing 902.11-feet of vegetated buffer
Site #99	3,174.18-feet of bank stabilization 3,174.18-feet of vegetated buffer
Site #100	5,126.13-feet of bank stabilization 5,126.13-feet of stream fencing 5,126.13-feet of vegetated buffer
Site #101	3,952.95-feet of bank stabilization 3,952.95-feet of stream fencing 3,952.95-feet of vegetated buffer
Site #102	3,000.00-feet of bank stabilization 6,593.39-feet of stream fencing 6,593.39-feet of vegetated buffer
Site #103	3,214.89-feet of bank stabilization 3,214.89-feet of stream fencing 3,214.89-feet of vegetated buffer
Site #104	1.93-acres of grazing land management
Site #105	2,563.37-feet of bank stabilization 2,563.37-feet of stream fencing 2,563.37-feet of vegetated buffer
LITTLE CONOWINGO CREEK 2013 – 2015 Estimated cost - $321,751.47 Estimated load reduction for sediment – 14.4% - 1,110,602.66 lbs. Estimated load reduction for phosphorous – 14.3% - 3,168.22 lbs.	
Site #13	1,500.00-feet of bank stabilization 4,787.78-feet of stream fencing 4,787.78-feet of vegetated buffer
Site #70	4807.70-feet of bank stabilization 4807.70-feet of stream fencing 4807.70-feet of vegetated buffer
Site #71	18.15-acres of grazing land management
Site #72	500.00-feet of bank stabilization 1,944.51-feet of stream fencing 1,944.51-feet of vegetated buffer

Site #73	5,845.28-feet of bank stabilization 5,845.28-feet of stream fencing 5,845.28-feet of vegetated buffer
Site #74	8.99-acres of conservation tillage
Site #75	911.84-feet of bank stabilization 911.84-feet of vegetated buffer
Site #76	5,150.01-feet of bank stabilization 5,150.01-feet of stream fencing 5,150.01-feet of vegetated buffer
Site #77	2,135.42-feet of bank stabilization (completed since TMDL of 2001) 2,135.42-feet of stream fencing (completed since TMDL of 2001) 2,135.42-feet of vegetated buffer (completed since TMDL of 2001)
Site #78	12.75-acres of grazing land management
Site #79	9.66-acres of grazing land management
Site #80	4,000.00-feet of bank stabilization 6,856.74-feet of stream fencing 6,856.74-feet of vegetated buffer
Site #81	4,342.10-feet of bank stabilization 4,342.10-feet of stream fencing 4,342.10-feet of vegetated buffer
Site #82	131.37-acres of conservation tillage
Site #83	4,129.61-feet of bank stabilization 4,129.61-feet of stream fencing 4,129.61-feet of vegetated buffer
Site #84	3,000.00-feet of bank stabilization 5,062.92-feet of stream fencing 5,062.92-feetof vegetated buffer (some forest buffer planted since TMDL of 2001)
Site #85	1,500.00-feet of bank stabilization 3,775.16-feet of stream fencing 3,775.16-feet of vegetated buffer
Site #86	7,071.69-feet of stream fencing 7,071.69-feet of vegetated buffer
Site #87	23.37-acres of grazing land management
Site #88	2,000.00-feet of bank stabilization 4,016.40-feet of stream fencing 4,016.40-feet of vegetated buffer
Site #89	1,500.00-feet of bank stabilization 2,009.43-feet of stream fencing 2,009.43-feet of vegetated buffer
Site #90	500.00-feet of bank stabilization 4,484.38-feet of stream fencing 4,484.38-feet of vegetated buffer

UN-NAMED TRIBUTARIES TO LOWER REACH OF MAIN STEM AND LOWER REACH OF MAIN STEM TO STATE LINE 2015 – 2022 **Estimated cost - $1,306,558.36** **Estimated load reduction for sediment – 58.2% - 4,510,612.33 lbs.** **Estimated load reduction for phosphorous – 58.2 – 12,867.44 lbs.**	
Site #1	699.83-feet of bank stabilization
Site #2	1,158.09-feet of bank stabilization
Site #3	3,031.44-feet of stream fencing 3,031.44-feet of vegetated buffer
Site #4	2,380.75-feet of stream fencing 2,380.75-feet of vegetated buffer
Site #5	2,500.00-feet of bank stabilization 5,337.28-feet of stream fencing 5,337.28-feet of vegetated buffer
Site #6	675.28-feet of bank stabilization
Site #7	3,000.00-feet of bank stabilization 5,071.29-feet of stream fencing 5,071.29-feet of vegetated buffer
Site #8	3,004.83-feet of bank stabilization 3,004.83-feet of stream fencing 3,004.83-feet of vegetated buffer
Site #9	6,798.01-feet of bank stabilization 6,798.01-feet of stream fencing 6,798.01-feet of vegetated buffer
Site #10	372.78-feet of bank stabilization
Site #11	4,182.70-feet of bank stabilization 4,182.70-feet of stream fencing 4,182.70-feet of vegetated buffer
Site #12	85.90-feet of bank stabilization
Site #40	8.82-acres of agricultural land to wetland conversion
Site #41	2,045.18-feet of bank stabilization 2,045.18-feet of stream fencing 2,045.18-feet of vegetated buffer
Site #42	1,162.86-feet of bank stabilization 1,162.86-feet of stream fencing 1,162.86-feet of vegetated buffer
Site #43	500.00-feet of bank stabilization 1,421.26-feet of stream fencing 1,421.26-feet of vegetated buffer
Site #44	400.00-feet of bank stabilization 1,521.36-feet of vegetated buffer
Site #45	2,000.00-feet of bank stabilization 4,022.23-feet of stream fencing 4,022.23-feet of vegetated buffer
Site #46	1.44-acres of grazing land management

Site #47	1,322.34-feet of bank stabilization 1,322.34-feet of stream fencing 1,322.34-feet of vegetated buffer
Site #48	2.06-acres of grazing land management
Site #49	514.27-feet of vegetated buffer
Site #50	1,000.00-feet of bank stabilization 2,509.20-feet of stream fencing 2,509.20-feet of vegetated buffer
Site #51	2.14-acres of grazing land management
Site #52	8,746.26-feet of bank stabilization 8,746.26-feet of stream fencing 8,746.26-feet of vegetated buffer
Site #53	2,769.07-feet of bank stabilization 2,769.07-feet of stream fencing 2,769.07-feet of vegetated buffer
Site #54	13.84-acres of grazing land management
Site #55	7,811.44-feet of bank stabilization 7,811.44-feet of stream fencing 7,811.44-feet of vegetated buffer
Site #56	10.54-acres of grazing land management
Site #57	21.93-acres of conservation tillage
Site #58	5,885.69-feet of bank stabilization 5,885.69-feet of stream fencing 5,885.69-feet of vegetated buffer
Site #59	12.87-acres of grazing land management
Site #60	5.24-acres of grazing land management
Site #61	32.21-acres of conservation tillage
Site #62	5.89-acres of grazing land management
Site #63	1,870.78-feet of bank stabilization 1,870.78-feet of stream fencing 1,870.78-feet of vegetated buffer
Site #64	5.02-acres of grazing land management
Site #65	12.06-acres of conservation tillage
Site #66	5,240.95-feet of bank stabilization 5,240.95-feet of stream fencing 5,240.95-feet of vegetated buffer
Site #67	26.02-acres of grazing land management
Site #68	1,799.71-feet of stream fencing 1,799.71-feet of vegetated buffer
Site #69	12.48-acres of grazing land management

Table #5 – Project Implementation Schedule

VI. PUBLIC PARTICIPATION AND INVOLVEMENT

At this time, Donegal TU is the only existing watershed organization for the Conowingo Creek. As such, it is expected that much of the first steps taken in implementing the TMDL Implementation Plan will be done by the group as landowner cooperation and funds are secured.

There are, however, several other entities with which Donegal TU will partner to implement this plan. These include the Lancaster County Conservation District, Natural Resources Conservation Service and the Chesapeake Bay Foundation (CBF).

All of these entities will play a critical role in implementation of the restoration projects set forth in this plan. As this plan addresses agricultural sources, the assistance of farm agencies such as those listed above is invaluable. These agencies have established relationships with area farmers, have the expertise to provide necessary technical assistance and have the staff and resources to facilitate the implementation of agricultural BMPs to improve water quality. Donegal TU is privileged to have a strong working relationship with the Lancaster County Conservation Districts and CBF, and anticipates a successful and growing partnership with all area farm agencies that will aid in implementation of this plan.

However with that being said, Donegal TU is currently in the midst of trying to establish a Conowingo Watershed group to take the lead. To date, three (3) different landowner meetings have been held within the watershed to make stakeholders aware of Donegal TU's undertaking. Donegal TU's Conservation Committee sponsored the first landowner/stakeholder meeting on March 14, 2005 at Little Britain Township's municipal building, with subsequent meetings being held on July 14, 2005 at Providence Township, and March 3, 2006 again at Little Britain Township. Approximately 50 people attended these meetings. In addition, Donegal TU visited with over 40 different landowners to date; the majority of which exhibited favorable attitudes towards the project and what Donegal TU is trying to accomplish.

Some of the more active and concerned landowners to date have been those who own property where electro-fishing studies have occurred. Some of these landowners were pleasantly surprised to find out they own a section of stream that harbors a wild trout population. They were also somewhat surprised that the stream holds such a variety of different fish species.

It is currently thought that the basis for forming a local Conowingo Watershed group is likely comprised of some of these key landowners. As previously mentioned in this report, Donegal TU is planning several pilot projects on properties owned by these willing landowners.

In general, Donegal TU has no problem convincing landowners and other stakeholders that a healthy stream is a good thing – obviously no landowner wants a polluted creek! So it really comes down to what is exactly being proposed on their property, and how it might affect them. For example eroding streambanks are in no one's interest, and landowners are very open to having them stabilized. However installing BMPs such as streambank fencing and a wide forest buffer may raise concerns about weed growth and the perceived loss in pastureland. These kind of conservation measures will take some education effort on the part of Donegal TU and the hopeful, future Conowingo Watershed group.

However regardless of the number of willing partners and landowners, project implementation requires funding. The present cost estimate for implementation of all projects identified in this plan stands at $2.2 million. Potential funding sources include the following:

- EPA Section 319 Program
- Pennsylvania Growing Greener I and II
- USDA's CRP, CREP and Environmental Quality Incentives Programs
- National Fish and Wildlife Foundation Chesapeake Bay Small Watersheds Grant Program
- Pennsylvania Fish and Boat Commission's "Adopt a Stream" program

The federal Farm Bill, slated for passage in 2007, may provide additional funding sources for restoration and conservation projects. Permit mitigation money or private fundraising may also provide additional funding to Donegal TU, though amounts are unlikely to be sufficient to fund larger projects.

As with project implementation, Donegal TU will be flexible in considering funding sources and willing to seek new funding sources as they become available.

A beautiful winter time photo of an Amish Conowingo Farmstead

Donegal TU is a Lancaster County-wide volunteer watershed organization. As such, Donegal TU is well positioned to identify landowners and other individuals and organizations who may be interested in the implementation of the potential stream improvement projects identified in this restoration plan.

Donegal TU is actively engaged in outreach and publicity work to educate landowners about watershed protection and restoration issues. Donegal TU members speak at local civic organizations and schools, sponsor guest presentations, and run display booths at local events such as community fairs and fund raising dinners. Donegal TU will continue to use these community outreach and educational events as tools to develop partnerships with landowners on potential projects.

Donegal TU develops and distributes a newsletter on a periodic basis. A future edition of the newsletter will be mailed to all riparian landowners along the creek and will include a feature article on this plan and how Donegal TU can assist Conowingo landowners interested in participating in voluntary stream improvement projects.

Donegal TU also maintains a website at www.donegaltu.org. The website provides information regarding Donegal TU's many existing restoration projects, and this restoration plan project. Upon finalization of the plan, Donegal TU will update its website to provide more information regarding the restoration plan and the opportunities for Conowingo landowners to partner with Donegal TU on restoration projects.

A typical wild Brown trout fingerling fairly common in Conowingo headwaters

VII. MONITORING RESTORATION PROGRESS

Monitoring Implementation

The 126 project opportunities identified in this report set forth precise goals for BMP implementation and identify those BMPs for each project area, down to the linear foot and acre. The BMPs recommended for each project will serve as measurables to track interim progress as this plan is implemented. They include:

- feet of stream bank restored
- acres of terraces and/or diversions installed
- acres of nutrient management implemented
- acres of grazing management implemented
- acres of crop management implemented

With respect to the first item, stream bank restoration may consist of one or more necessary riparian BMPs: stream bank fencing, riparian buffer planting or stream bank stabilization. In some cases where active grazing is occurring, all three may be required. With respect to the remaining four items, as explained above, Donegal TU will collaborate with the Lancaster County Conservation District and USDA local farm agency offices for implementation. It is anticipated that the District and agencies will establish their own priorities and interim goals consistent with their respective capabilities and missions. Donegal TU and/or the Conowingo Creek Watershed group will maintain oversight of project implementation and will track restoration progress.

Besides implementing the identified 126 projects over a period of some 16 years, Donegal TU has the following interim goals planned that serve as additional milestones. They are as follows:

2006-2007 Establish a local Conowingo Creek Watershed group to oversee implementation of this plan

2006-2007 Complete pilot projects at the following key locations:
- Tanglewood Golf Course upstream of Scotland Rd – fish habitat and bank stabilization
- Cardinal Rd – bank stabilization
- Conowingo Rd/Spring Valley Rd – fish habitat, bank stabilization and forest buffer planting
- Hensel Rd/Fulton Dr – fish habitat and bank stabilization

2006-2008 Undertake restoration work in the headwaters of the main stem in the area of the Tanglewood Golf Course

2008 and on Proceed with remaining restoration work as scheduled

Monitoring Water Quality Improvement

As this plan is implemented, water quality in the Conowingo Creek Watershed will improve. Water quality monitoring will be conducted on a sub-watershed basis as defined in *Table #5 – Project Implementation Schedule.* Monitoring the macroinvertebrate and fish community, and the condition of the sediment load on the substrate via pebble counts should produce a measurable understanding of how the creek is responding to installed BMPs. Since excess sediment is the primary cause of benthic biodegradation in the Conowingo, pebble counts and in-stream sediment levels will be used to demonstrate progress in the stream's recovery. PADEP is currently developing protocols for this type of monitoring.

Donegal TU and/or the Conowingo Creek Watershed group will conduct sampling of the macroinvertebrate and fish community and will conduct pebble counts prior to the installation of BMP projects, and bi-annually thereafter to record recovery of stream reaches.

Once implementation of this restoration plan is underway, PADEP will return to selected monitoring points on a sub-watershed basis at least once every five years to measure water quality improvement. Improvement will be demonstrated by reductions in sediment depth, increases in pebble counts and, ultimately, reappearance of a diverse macroinvertebrate population at monitoring points throughout the watershed.

When stream reaches are thought to be successfully recovered, PADEP will be invited to conduct an official re-assessment of the stream condition; with the ultimate goal being that of removing currently impaired stream segments from the Commonwealth's 303(d) listing of impaired waters.

Donegal TU and/or the Conowingo Creek Watershed group will also seek the assistance of the Lancaster County Conservation District's Watershed Specialist to provide guidance and quality control of this monitoring and additionally will seek partnership with the Senior Environmental Corps and their established monitoring program within Lancaster County.

Because of uncertainty concerning landowner participation, funding and many other factors, Donegal TU cannot guarantee or commit to any of the specific implementation projects that are recommended in this plan. However, through its continued volunteer monitoring program, Donegal TU will be able to gather data necessary to evaluate the future success of any of such projects that are implemented.

Donegal TU and/or the Conowingo Creek Watershed group will meet on an annual, year end basis to determine the status of plan implementation and progress being made towards meeting goal nutrient and sediment reduction. If it is deemed timely, adequate progress is not being achieved; adjustments in overall plan implementation will be made. Such adjustments could involve improving landowner contact and communication, seeking other funding sources and in-kind contributions, improvements to or use of new BMPs, and possibly changes to the priorities set forth in the implementation plan.

LITERATURE CITED

Commonwealth of Pennsylvania. 1999. Pennsylvania Code. Title 25 Environmental Protection. Department of Environmental Protection. Chapter 93. Water Quality Standards. Harrisburg, PA.

Pennsylvania State University Environmental Resources Research Institute. 2003. AVGWLF, version 5.0 users guide. The Pennsylvania State University. University Park, PA.

Susquehanna River Basin Commission. 2001. Total Maximum Daily Loads (TMDLs) Plan for Conowingo Creek Watershed. Department of Environmental Protection. Harrisburg, PA.