RESTORATION PLAN

May 2006

Conewago Creek

Dauphin, Lancaster and Lebanon Counties
Pennsylvania

Tri-County Conewago Creek Association
P.O. Box 107
Elizabethtown, PA 17022
conewagocreek@yahoo.com
www.conewagocreek.net

Prepared by:
RETTEW Associates, Inc.
3020 Columbia Ave.
Lancaster, PA 17603

RETTEW
We answer to you.

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This plan was developed for use by the Tri-County Conewago Creek Association.

"A nonprofit volunteer organization committed to monitoring, preserving, enhancing and promoting the Conewago Creek Watershed through education, community involvement and watershed improvement projects."

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.

This plan was prepared by RETTEW Associates, Inc.

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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
TCCCA	Tri-County Conewago Creek Association
RETTEW	Rettew Associates, Inc.

I. INTRODUCTION

The Tri-County Conewago Creek Association (TCCCA) is a nonprofit volunteer organization committed to monitoring, preserving, enhancing and promoting the Conewago Creek Watershed through education, community involvement and watershed improvement projects. Founded in January 2002, TCCCA has quickly developed into an industrious and capable organization. The group has worked with interested landowners throughout the Conewago Creek Watershed to conduct stream cleanups, riparian buffer plantings and stream monitoring. It has also spearheaded various educational and outreach initiatives. TCCCA's active membership includes farmers and other landowners, environmental professionals, college professors and municipal representatives.

TCCCA was founded by a group of individuals concerned about declining water quality of the Conewago Creek. From its inception, one of TCCCA's primary objectives has been to restore the Conewago and its tributaries to a healthier state. Restoration of the Conewago has many benefits: better water quality so that the waters of the Conewago can continue to be safely used for drinking water and recreational activities such as swimming and fishing; a diverse, stable fishery; and good habitat to support a healthy aquatic life community, including fish, aquatic insects, salamanders, frogs, turtles, birds and other water dependent species.

With help from a local scout troop, TCCCA volunteers plant a riparian buffer along the Conewago at a Hershey Trust farm in Mt. Joy Township, Lancaster County.

Presently, the Conewago is not a healthy stream. In many places, its water quality is poor and it is too polluted to support the variety of fish and other aquatic life it could support if it were a healthy stream. In 1994 and again in 1997, biologists for the Susquehanna River Basin Commission (SRBC) and the Pennsylvania Department of Environmental Protection (PADEP) conducted stream studies of the Conewago and its tributaries. The results of the studies showed the stream to be polluted to such an extent that it is **impaired** for its aquatic life uses. The pollution sources causing the impairment are excess sediment and nutrients (particularly phosphorus), which enter the stream as runoff, primarily from agricultural activities throughout the watershed.

To meet its objective of restoring the Conewago, TCCCA seeks to work cooperatively with willing farmers and other landowners to conduct voluntary stream restoration projects that improve water quality. Such projects may include stream bank fencing, riparian buffer planting and stream bank stabilization.

During the first year of its existence, TCCCA decided that it was necessary to develop a comprehensive restoration plan for the Conewago Creek Watershed. The plan would include an assessment of the watershed and the identification of potential stream improvement projects. With such a plan in place, TCCCA could use it as a blueprint to implement restoration projects with willing landowners, and as a springboard to pursue grants needed to fund such projects.

In the fall of 2002, TCCCA solicited proposals from environmental consulting firms to conduct the assessment and restoration plan. RETTEW Associates, Inc., a Lancaster County based engineering and environmental consulting firm, was chosen to undertake the task. RETTEW worked closely with members of TCCCA to develop a project work plan and funding proposal to be submitted to PADEP. PADEP, implementing the United States Environmental Protection Agency (EPA) Section 319 Grant Program, awarded a grant to fund the restoration plan for the Conewago Creek.

Under the federal Clean Water Act, if a state determines a stream to be impaired, it must list that stream on what is called the **303(d) list**. The 303(d) list must be reported to EPA once every two years. Once streams are placed on the 303(d) list, the Clean Water Act then requires states to develop allowable pollution limits for meeting water quality goals called **Total Maximum Daily Loads**, or **TMDLs**. A TMDL sets a target goal for the total amount of pollution that can safely enter a stream while still having that stream support its aquatic life uses. It then distributes load allocations to all pollution sources in the watershed necessary to meet the target goal.

Because of the stream studies conducted by SRBC and PADEP in the mid-1990s, portions of the Conewago Creek Watershed were listed as impaired on Pennsylvania's 1996 303(d) list. Additional stream segments were added to the list in 1998. In 2001, the Pennsylvania State University Environmental Resources Research Institute, on behalf of PADEP, developed a TMDL for the Conewago Creek Watershed.

The agencies funding this Conewago Creek Restoration Plan determined that the 2001 TMDL provided an adequate baseline assessment of general sources of impairment, and sufficient goals for improving water quality within the watershed. TCCCA, through the technical assistance of RETTEW, was asked by EPA and PADEP to further refine the assessment of agricultural-related pollution sources and develop a restoration plan for working with willing landowners to reduce nutrient and sediment pollution to the Conewago.

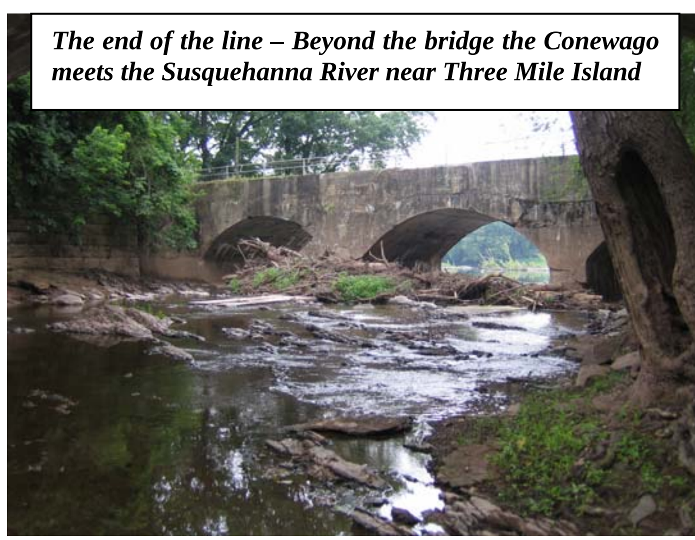
RETTEW began collecting field data in the spring of 2004 and completed data collection by March of 2005. Data was processed and modeled using PADEP's "PRedICT" modeling tool in late March of 2005. This restoration plan was finalized in May of 2006.

II. BACKGROUND

The Conewago Creek Watershed is located in Dauphin, Lancaster and Lebanon Counties within the Piedmont Physiographic Province. The watershed comprises 53.2-square miles and is a drainage to the Susquehanna River, entering the river north of the Village of Falmouth (very near Three Mile Island Nuclear Facility).

The headwaters are situated in Lebanon County in and around State Game Lands No. 145 and the wooded Borough of Mount Gretna. The stream generally flows in a southwestern direction, intersecting with several highway systems; the larger including US Interstate 76 (Pennsylvania Turnpike), Pennsylvania Route 283 and Pennsylvania Route 230.

The end of the line – Beyond the bridge the Conewago meets the Susquehanna River near Three Mile Island



Commonwealth designated protective uses include water supply, recreation and aquatic life. The designated use for aquatic life is Trout Stocked Fishery (TSF). Portions of the upper Conewago Creek are stocked with trout by the Pennsylvania Fish and Boat Commission. Generally the upper reaches of the watershed support a cold water fishery which gives way to a cool/warm water fishery in the middle and lower portions of the watershed. The lower portion of the watershed supports a rather unique population of Chain pickerel (*Esox niger*).

The majority of the watershed is in agricultural production (approximately 53%) 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).

A view of Conewago farmland looking east from the village of Deodate. The predominant land use in the Conewago Creek Watershed is agriculture.

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.

It is important to remember there are other sources of sediment and nutrients within the watershed including individual on-lot septic systems, point source discharges such as sewage treatment plants, residential, commercial and industrial development, and groundwater. These sources are all taken into account in the 2001 TMDL. However, the 2001 TMDL does not allocate any loading reductions to non-agricultural sources, as the loads allocated to those sources are small in comparison with agricultural sources. In terms of specific restoration projects, this plan, therefore, only addresses ways to reduce agricultural related sources and sources from stream channel conditions (i.e. stream bank erosion). Ways to reduce loading from non-agricultural sources are briefly discussed below, which would reduce the expected load reductions from agriculture to some degree.

Table 1 303(d) Sub-List gives an accounting of impaired stream reaches within the watershed.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 7-Conewago Creek Watershed								
Year	SWP	Miles	Segment ID	DEP Stream Code	Stream Name	Desig -nated Use	Data Source	EPA 305(b) Cause Code
1996	07-G	10.0		09217	Conewago	TSF	305(b) Report	Nutrients
1998		15.8	6432	09217	Conewago	TSF	305(b) Report	Nutrients
1998	07-G	0.9	6434*	09217	Conewago	TSF	305(b) Report	Organic enrichment/ Low D.O. and Suspended solids
1998	07-G	5.1	970626-0830-SAW**	09217	Conewago	TSF	305(b) Report	Habitat alterations
1998	07-G	3.6	970701-0745-SAW	09217	Conewago	TSF	305(b) Report	Nutrients/Siltation
1998	07-G	5.7	970701-1035-SAW	09267	Hoffer Run	TSF	305(b) Report	Nutrients/Siltation/ Habitat alterations
1998	07-G	11.2	970626-1200-SAW	09232	Lynch Run	TSF	305(b) Report	Siltation/Turbidity

Trout Stocking = TSF
Hoffer Creek and Lynch Run are tributaries of Conewago Creek.
* Listing was for Municipal Point Source. TMDL completed for discharger in 1998.
** This TMDL does not address any 303(d) listings for the category of flow alterations. TMDLs are not the appropriate mechanism to address this type of stream impairment. TMDLs are designed to address pollutant loadings that cause exceedance of water quality standards. There is no pollutant loading to address for this type of impairment.

With respect to nutrients, the Conewago TMDL only addresses phosphorus because it was determined that phosphorus was the limiting nutrient. Phosphorus is generally held to be the limiting nutrient in a stream when the nitrogen/phosphorus ratio exceeds 10 to 1. In the Conewago, the ratio is 21 to 1. (*TMDL Study of 2001 p. 9-10*).

Agricultural Sources and BMPs to Address Them

As stated above, because the TMDL allocated all load reductions within the Conewago Creek to agricultural sources, this restoration plan is primarily concerned with reducing sediment and phosphorus inputs from agricultural sources. Focus is also given to stabilizing exposed and eroding stream banks in agricultural and non-agricultural areas throughout the watershed. The plan concentrates on prescribing various, appropriate agricultural “best management practices” (BMPs) to discovered potential project areas throughout the watershed. The prescribed BMPs fall into four main categories, these being:

- **Soil conservation farming practices**
- **Pastureland management practices**
- **Nutrient management practices**
- **Riparian corridor management practices**

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.

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

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.

Riparian corridor management practices include the establishment of forest and vegetative buffers, stream bank fencing and stream bank stabilization. It should be noted that the lack of buffers and the presence of eroding stream banks occur throughout the watershed irrespective of whether the lands are being actively farmed. Such conditions are often the result of historic land use practices. Thus these particular BMPs are not necessarily "agricultural" BMPs in a strict sense, although TCCCA will seek to work with willing farmers to voluntarily implement such BMPs on their properties.

Stoffel farm riparian buffer project, South Londonderry Township, Lebanon County. Native grasses and young trees replace what was once a thicket of multi-flora rose.

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.

In preparation of the restoration 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 blueprint for TCCCA, a grassroots watershed association that seeks to work with farmers and other landowners willing to voluntarily undertake restoration activities.

Cattle crossings are often installed as part of stream bank fencing and riparian buffer projects. These concrete crossings allow cattle to access or cross the stream without damaging stream banks and vegetation.

TCCCA is an organization comprised of volunteer stakeholders from the watershed who simply wish to improve and protect their local stream. Its membership includes many farmers and other landowners in the watershed. The organization provides education and assistance to landowners who live along the Conewago and its tributaries. Historically, watershed associations have been very successful in 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. Thus this plan proposes that TCCCA concentrate on projects within their capabilities and interest, such as stream bank fencing, riparian buffer plantings and stream bank stabilization projects.

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 Conewago ***(see Tables 3 and 4)***. For phosphorus, these sources include natural forest conditions, groundwater, urban stormwater runoff, point sources (such as sewage treatment plants) and septic systems. For sediment, non-agricultural sources include forests and urban stormwater runoff. And, as stated previously, exposed, 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 Conewago, 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 the Conewago.

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 Conewago 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.

Point sources and septic systems have been identified in the 2001 TMDL as additional contributors of nutrient loadings to the Conewago. The TMDL lists only four point sources in the watershed—one industrial treatment facility and three sewage treatment facilities. The permitted total phosphorus limit for each of these point sources was shown as 2 mg/l. (2001 TMDL p. 23) Although PADEP, as part of its Chesapeake Bay Tributaries Strategy, is currently imposing more stringent nutrient limits on "significant point source dischargers" (design flow of 0.4 million gallons per day or greater) throughout the Bay watershed, none of the Conewago point sources are large enough to be deemed "significant." It is unrealistic to expect further reductions in loadings from point sources in the Conewago beyond existing limits, as neither the TMDL nor the Tributaries Strategy require more stringent limits.

Septic systems have been allocated a small percentage of the overall loading of 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. Some municipalities in the watershed have enacted on lot disposal system ordinances that require periodic pumping of tanks and/or inspections of systems to ensure their functionality.

Chesapeake Bay Tributary Strategy

The Conewago 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 Conewago. 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 Conewago is located within the Lower Susquehanna East Watershed Area. Table 2 lists the BMPs to be implemented in this watershed area. Definitions of each BMP can be found in Appendix C of the Tributary Strategy at www.depweb.state.pa.us/chesapeake/lib/chesapeake/pdfs/tribstrategy.pdf. Table A-39 on page 81 of the Tributary Strategy further lists the 2010 implementation goals for each BMP.

TABLE 2 Tributary Strategy BMPs for Lower Susquehanna East Watershed

AGRICULTURE BMPs	**MIXED OPEN BMPs**
Animal Waste Management Systems	Abandoned Mined Land Reclamation
Carbon Sequestration	Dirt & Gravel Road Practices
Conservation (Farm) Plans	Forest Buffers
Conservation Tillage	Non-Urban Stream Restoration
Cover Crops (early)	Nutrient Management
Forest Buffers	Tree Planting
Grass Buffers	**URBAN BMPs**
Land Retirement	Erosion & Sediment Controls
Managed Precision Agriculture	Forest Buffers
Mortality Composters	Grass Buffers
Non-Urban Stream Restoration	Septic Denitrification
No-Till	Street Sweeping
Nutrient Management	Stormwater Management-Filtration
Off Stream Watering with Fencing	Stormwater Management-Infiltration Practices
Off Stream Watering without Fencing	Stormwater Management-Wet Ponds & Wetlands
Precision Rotational Grazing	Urban Stream Restoration
Rotational Grazing	Urban Sprawl Reduction
Horse Pasture Management	Urban Nutrient Management
Tree Planting	**FOREST BMPs**
Yield Reserve	Dirt & Gravel Road Practices
Ammonia Emission Reductions-Poultry	Forest Harvesting Practices

Ammonia Emission Reductions-Swine	**MULTIPLE LAND USE BMPs**
Ammonia Emission Reductions-Dairy	Wetland Restoration
Precision Feeding-Dairy	
Phytase Feed Additive-Swine	
Phytase Feed Additive-Poultry	

All of the BMPs listed in Table 2 are designed to reduce sediment and/or nutrient loading to surface waters. Therefore, as TCCCA and its partner organizations and agencies (such as conservation districts) seek to implement the recommendations of this restoration plan, it will look to partner with willing Conewago landowners to install appropriate BMPs identified and described in the Tributary Strategy. Improving water quality of the Conewago through implementation of this restoration plan will go a long way toward ongoing efforts to restore the Chesapeake Bay.

III. DATA COLLECTION

RETTEW began collection of field data in the Spring of 2004. Because of monetary constraints related to this project and others like it, it is vital 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 110-miles of stream corridors, RETTEW was faced with a challenging task.

Knowing the previously established thresholds established by the 2001 TMDL, 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 TCCCA felt it very important to have seen and assessed the actual sites where BMPs were proposed rather than relying heavily on documents such as 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 coupled with an adequate amount of ground truthing. RETTEW collected their own aerial footage thus insuring the sought after photography was properly captured.

Prior to doing so, the methodology was introduced to the funders for consideration. RETTEW had prior utilized similar methodology in preparing other state and federal funded watershed assessments.

Before flying, flight plans were prepared by RETTEW environmental staff 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 (***See Figure 1)*** and previously scouted locations determined by RETTEW environmental staff.

The flight crew was given specific instruction and descriptions of what to look for and photograph. When the flight crew recognized potential project opportunities, several passes from different angles were taken in order to insure proper capture of the area. 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.

Because the bottom portion of the watershed is within the airspace of the Three Mile Island Nuclear Facility, special arrangements were made with the appropriate state agencies to be able to complete the flight. Scheduling these flights while coordinating with anticipated weather conditions proved challenging, but the end result was well worth the effort. In total, some 110-miles of stream corridors within the watershed were flown and video taped.

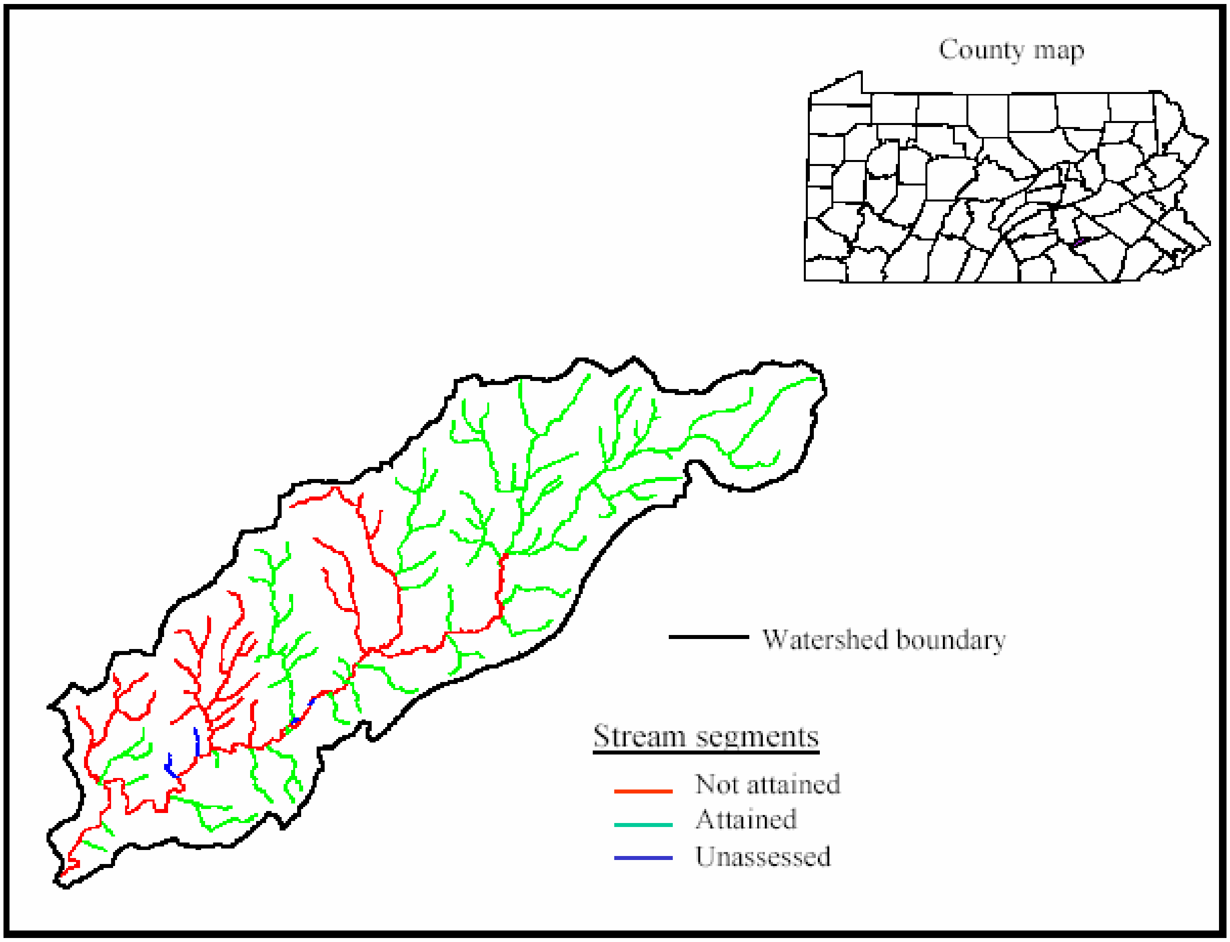


Figure 1 – Impaired Conewago Stream Segments in RED

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 four different DVD disks.

At the same time, RETTEW staff combined the known flight paths with GIS technology, enabling a flight path layer to be "turned on" while using ArcView. The flight paths simply depict and indicate where the helicopter flew. Utilizing other ArcView available functions, RETTEW staff used 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 allowed staff to earmark a potential project site, typically indicated by drawing a line or polygon along or around the area.

Once a potential project site was created, still other ArcView functions were 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 potential project area could be determined and modeled. The data sheet allowed the RETTEW watershed specialist to record information about the site, including existing land use and management conditions described as applicable BMP categories. The BMP categories established for the data sheets correlate with those used in the modeling process discussed later in this report.

The aerial video footage and data sheet compilation was used as an initial assessment of the watershed and a means of determining potential project opportunities. Using this information, RETTEW staff conducted field studies from area roads to field verify (ground truth) what were thought to be potential project areas. Data sheets for the areas were then appropriately revised as necessary with verified field conditions. RETTEW staff did not field visit every earmarked project opportunity. Rather 40% of the sites were visited to confirm the aerial assessment procedure.

In total, 129 potential project sites were recorded where specific BMPs, if implemented, would achieve significant sediment and phosphorous reduction.

In order to stabilize eroded stream banks, TCCCA volunteers installed black willow live stakes at the Hess farm along the Little Conewago Creek. A year and a half after installation, many of the stakes have taken root and are helping to minimize bank erosion.

IV. MODELING

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 to accomplish 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.

The general approach in such projects is 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 unimpaired reference watershed that exhibits similar landscape, development and agricultural patterns, 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 Conewago Watershed.

Because an unimpaired reference watershed could not be found for the entire Conewago Creek Watershed, the 2001 TMDL subdivided the Conewago into two subbasins, Subbasin "A" and Subbasin "B", for modeling purposes. The modeling conducted for this restoration plan follows the same subbasin delineation.

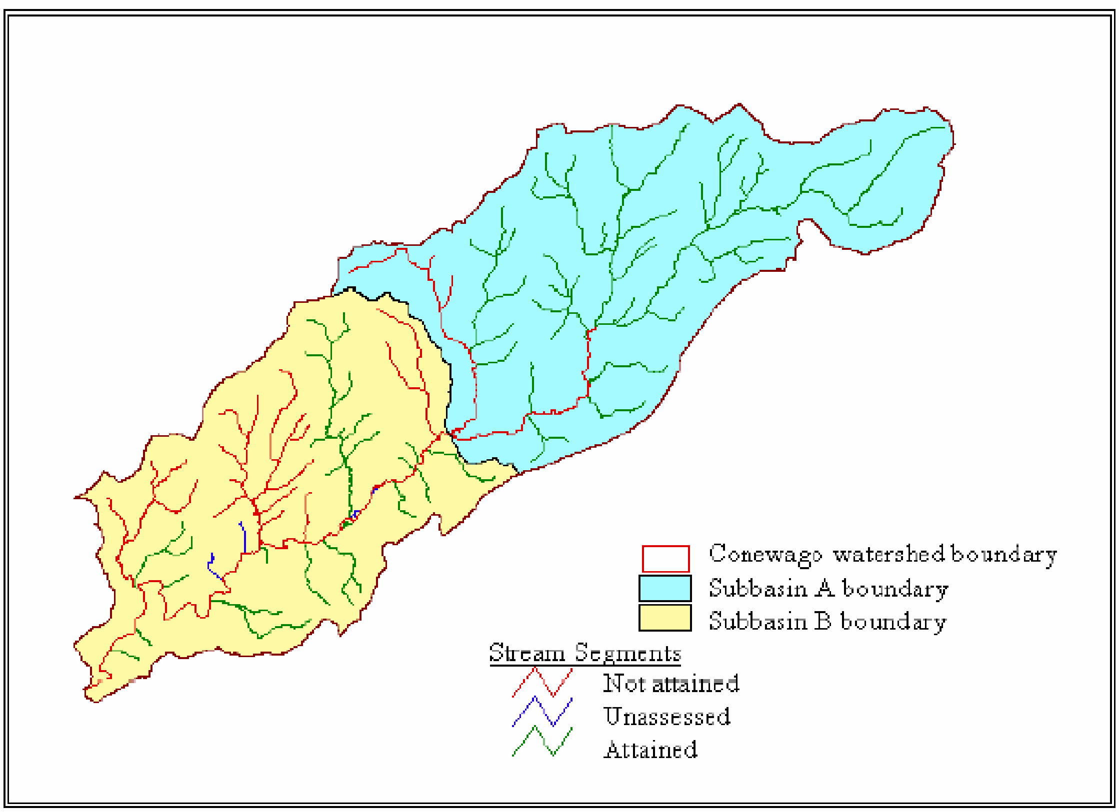


Figure 2 – Conewago Creek Watershed showing Subbasin boundaries

Subbasin "A" is roughly the upper half of the Conewago Creek Watershed, from headwaters to and including the confluence of Hoffer Creek and the main stem. Subbasin "B" is generally the bottom half of the Conewago Creek Watershed, from just below the Hoffer Creek confluence to the mouth (***See Figure 2)***.

The 2001 TMDL established **pollutant load reductions** for both Subbasins "A" and "B" based on pollutant loading rates for phosphorus and sediment found within the unimpaired reference watersheds. Likewise, the modeling for this restoration plan shows anticipated reduction rates for phosphorus and sediment in Subbasin "A" and Subbasin "B", assuming full implementation of all 129 potential projects identified in the plan.

Severe stream bank erosion on an impaired reach of the Conewago's main stem

V. RESULTS

Assuming full restoration plan implementation (completion of the 129 recommended sites), the nutrient and sediment reductions as described in the second column of ***Tables 3* and *4*** can be anticipated. It is important to keep in mind these reductions are the result of only working to improve conditions on agricultural areas within the riparian corridor and within stream channels of the Conewago and its tributaries. If additional agricultural BMPs were to be implemented on other active farms within the watershed, further reductions could be expected (as shown in the third column of ***Tables 3 and 4*** entitled "Hypothetical anticipated loading rate"). The "Hypothetical anticipated loading rate" found in the third column of ***Tables 3 and 4*** is a summation of the recommended 129 sites described specifically in this plan and additional, hypothetical agricultural BMP work not currently, site specifically planned. Moreover, as previously described in this report, there are other non-agricultural sources that account for phosphorus and sediment loading. Addressing some of these sources may mean that fewer reductions need to be met through agricultural BMP projects.

Anticipated reductions are compared to the target loading rates established by the TMDL (last column). (Note, however, that reductions for non-agricultural sources are not depicted in the tables because of limitations in the model used to estimate anticipated load reductions).

TABLE 3 – Subbasin "A"

PHOSPHORUS				
	Existing loading rate in lbs/yr as listed in TMDL	Anticipated loading rate in lbs/yr with completed restoration plan	Hypothetical anticipated loading rate in lbs/yr	TMDL target loading rate in lbs/yr
Agricultural related sources				
Hay/Pasture	450	433 (4% reduction)	304 (32% reduction)	344 (24% reduction)
Cropland/Row Crops	5,391	3,235 (40% reduction)	1,948 (64% reduction)	1,103 (80% reduction)
Stream channel source *The TMDL does not specifically account for this source, however improvements are credited in this table. A* **23 lbs/yr** *reduction is anticipated.*				
Other sources not addressed by this restoration plan				
Coniferous Forest	2	2	2	2
Mixed Forest	2	2	2	2
Deciduous Forest	250	250	250	250
Low Density Urban	15	15	15	15
High Density Urban	68	68	68	68
Groundwater	1,001	1,001	1,001	1,001
Point Sources	404	404	404	404
Septic Systems	69	69	69	69
All sources total				
	7,652	*5,479 minus 23 for stream channel improvements equals* 5,456 (29% reduction)	*4,063 minus 23 for stream channel improvements equals* 4,040 (48% reduction)	4,071 (47% reduction)
SEDIMENT				
Agricultural related sources				
Hay/Pasture	352,346	351,430 (1% reduction)	311,122 (12 % reduction)	309,006 (12% reduction)
Cropland/Row Crops	5,502,731	3,134,853 (40% reduction)	2,210,092 (60% reduction)	2,203,151 (60% reduction)
Stream channel source *The TMDL does not specifically account for this source, however improvements are credited in this table. A* **80,799 lbs/yr** *reduction is anticipated*				
Other sources not addressed by this restoration plan				
Coniferous Forest	1,909	1,909	1,909	1,909
Mixed Forest	1,943	1,943	1,943	1,943
Deciduous Forest	268,909	268,909	268,909	268,909
Low Density Urban	14,162	14,162	14,162	14,162
High Density Urban	12,085	12,085	12,085	12,085
All sources total				
	6,154,085	*3,785,291 minus 80,799 for stream channel improvements equals* 3,704,492 (40% reduction)	*2,820,222 minus 80,799 for stream channel improvements equals* 2,739,423 (55.5% reduction)	2,811,165 (54% reduction)

TABLE 4 – Subbasin "B"

PHOSPHORUS				
	Existing loading rate in lbs/yr as listed in TMDL	Anticipated loading rate in lbs/yr with completed restoration plan	Hypothetical anticipated loading rate in lbs/yr	TMDL target loading rate in lbs/yr
Agricultural related sources				
Hay/Pasture	844	827 (2% reduction)	709 (16% reduction)	723 (14% reduction)
Cropland/Row Crops	10,701	6,288 (41% reduction)	5,055 (53% reduction)	4,312 (60% reduction)
Stream channel source *The TMDL does not specifically account for this source, however improvements are credited in this table. A* **18 lbs/yr** *reduction is anticipated.*				
Other sources not addressed by this restoration plan				
Coniferous Forest	3	3	3	3
Mixed Forest	5	5	5	5
Deciduous Forest	102	102	102	102
Low Density Urban	30	30	30	30
High Density Urban	158	158	158	158
Groundwater	1,019	1,019	1,019	1,019
Point Sources	204	204	204	204
Septic Systems	135	135	135	135
All sources total				
	13,201	*8,771 minus 18 for stream channel improvements equals* 8,753 (33.7% reduction)	*7,420 minus 18 for stream channel improvements equals* 7,402 (44% reduction)	7,308 (45% reduction)
SEDIMENT				
Agricultural related sources				
Hay/Pasture	453,754	452,574 (1% reduction)	430,159 (6% reduction)	420,181 (7% reduction)
Cropland/Row Crops	8,218,248	4,374,074 (47% reduction)	3,695,174 (55% reduction)	5,258,659 (36% reduction)
Stream channel source *The TMDL does not specifically account for this source, however improvements are credited in this table. A* **16,645 lbs/yr** *reduction is anticipated*				
Other sources not addressed by this restoration plan				
Coniferous Forest	1,935	1,935	1,935	1,935
Mixed Forest	3,333	3,333	3,333	3,333
Deciduous Forest	81,701	81,701	81,701	81,701
Low Density Urban	13,952	13,952	13,952	13,952
High Density Urban	11,441	11,441	11,441	11,441
All sources total				
	8,784,364	*4,939,010 minus 16,645 for stream channel improvements equals* 4,922,365 (44% reduction)	*4,237,695 minus 16,645 for stream channel improvements equals* 4,221,050 (52% reduction)	5,791,202 (34% reduction)

As can be seen from ***Tables 3* and *4,*** implementation of the 129 potential projects identified in Section VI of this restoration plan will result in significant reductions in phosphorus and sediment loadings and therefore significant improvement of water quality in the Conewago and its tributaries. In particular, sediment in Subbasin "B" will be reduced to below the target established in the 2001 TMDL. Reductions of sediment in Subbasin "A" and phosphorus in both Subbasins "A" and "B" fall short of TMDL targets, but nonetheless represent significant progress toward eliminating pollution sources and improving water quality.

In order to meet the 2001 TMDL target reductions across the board, additional reductions are needed. One possibility for meeting TMDL goals is that additional agricultural BMPs could be implemented or changed at other farms in the watershed. After modeling to determine anticipated reductions from the 129 potential project sites identified in this report, RETTEW utilized the model to hypothetically demonstrate that substantial, additional BMP measures would be necessary on cropland, row crops, hay and pastureland to meet TMDL objectives for both Subbasin "A" and Subbasin "B" as follows in ***Tables 5-8:***

TABLE 5 - SUBBASIN "A" – BMP PERCENTAGE OF CROPLAND & ROW CROPS ACREAGE

BMP	CURRENT CONDITION INCLUDING THE PROPOSED 129 BMP SITES	HYPOTHETICAL CHANGE IN BMP INSTALLATION/USE
BMP #1 Crop residue management & cover crops	13%	2% increase to 15% total
BMP #2 Stripcropping & contour farming	16%	19% increase to 35% total
BMP #3 Crop rotation & cover crops	11%	No change - 11%
BMP #4 Crop rotation & crop residue management	12%	18% increase to 30% total
BMP #5 Terraces & diversions	3%	6% increase to 9% total
BMP #6 Nutrient management	10%	80% increase to 90% total

*** Note: BMP's #1 through #5 cannot equal over 100%. Likewise BMP #6 cannot equal over 100%

TABLE 6 - SUBBASIN "A" - BMP PERCENTAGE OF HAY & PASTURELAND ACREAGE

BMP	CURRENT CONDITION INCLUDING THE PROPOSED 129 BMP SITES	HYPOTHETICAL CHANGE IN BMP INSTALLATION/USE
BMP #6 Nutrient management	11%	1% reduction to 10% total
BMP #7 Grazing land management	2%	88 % increase to 90% total

*** Note: BMP's #6 and #7 cannot equal over 100%

TABLE 7 - SUBBASIN "B" – BMP PERCENTAGE OF CROPLAND & ROW CROPS ACREAGE

BMP	CURRENT CONDITION INCLUDING THE PROPOSED 129 BMP SITES	HYPOTHETICAL CHANGE IN BMP INSTALLATION/USE
BMP #1 Crop residue management & cover crops	14%	1% increase to 15% total
BMP #2 Stripcropping & contour farming	15%	10% increase to 25% total
BMP #3 Crop rotation & cover crops	10%	1% increase to 11% total
BMP #4 Crop rotation & crop residue management	14%	11% increase to 25% total
BMP #5 Terraces & diversions	12%	No change - 12%
BMP #6 Nutrient management	8%	32% increase to 40% total

*** Note: BMP's #1 through #5 cannot equal over 100%. Likewise BMP #6 cannot equal over 100%

TABLE 8 - SUBBASIN "B" - BMP PERCENTAGE OF HAY & PASTURELAND ACREAGE

BMP	CURRENT CONDITION INCLUDING THE PROPOSED 129 BMP SITES	HYPOTHETICAL CHANGE IN BMP INSTALLATION/USE
BMP #6 Nutrient management	5%	5% increase to 10% total
BMP #7 Grazing land management	2%	38% increase to 40% total

*** Note: BMP #6 and #7 cannot equal over 100%

Another possible method to achieve additional loading reductions is by addressing some of the non-agricultural sources, such as stormwater runoff, point sources or septic systems. However, because the model used to estimate loading reductions for this restoration plan was limited to agricultural BMP categories, no anticipated loading reductions could be calculated for implementation of non-agricultural BMPs.

As discussed above, this restoration plan is to serve as a restoration blueprint for TCCCA, a grassroots watershed association. TCCCA is comprised of volunteers, many of whom are farmers or other landowners within the Conewago Creek Watershed. TCCCA 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, TCCCA 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 restoration plan, RETTEW was careful to propose the types of projects that TCCCA 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 project identified in this restoration plan will require significant time and financial resources. Based on PADEP's implementation cost estimates for the types of BMPs proposed (fencing, vegetative buffer, bank stabilization), the cost estimate to install all proposed BMPs is $2.7 million for Subbasin "A" and $1.6 million for Subbasin "B", for a total of $4.3 million. Additional administrative and maintenance costs, as well as inflationary concerns, are ultimately likely to make the price tag even higher. Even if TCCCA were to receive grants in the amount of $250,000 per year to fund restoration projects, under present cost estimates it would take 18 years to fully implement this restoration plan. Clearly, land use practices will change over the next 18 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, as the Conewago is but one of a multitude of impaired waters in Pennsylvania competing for the same limited funding sources, it is unrealistic to expect that quarter-million dollar grants will be award to TCCCA on an annual basis over an 18 year period.

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.

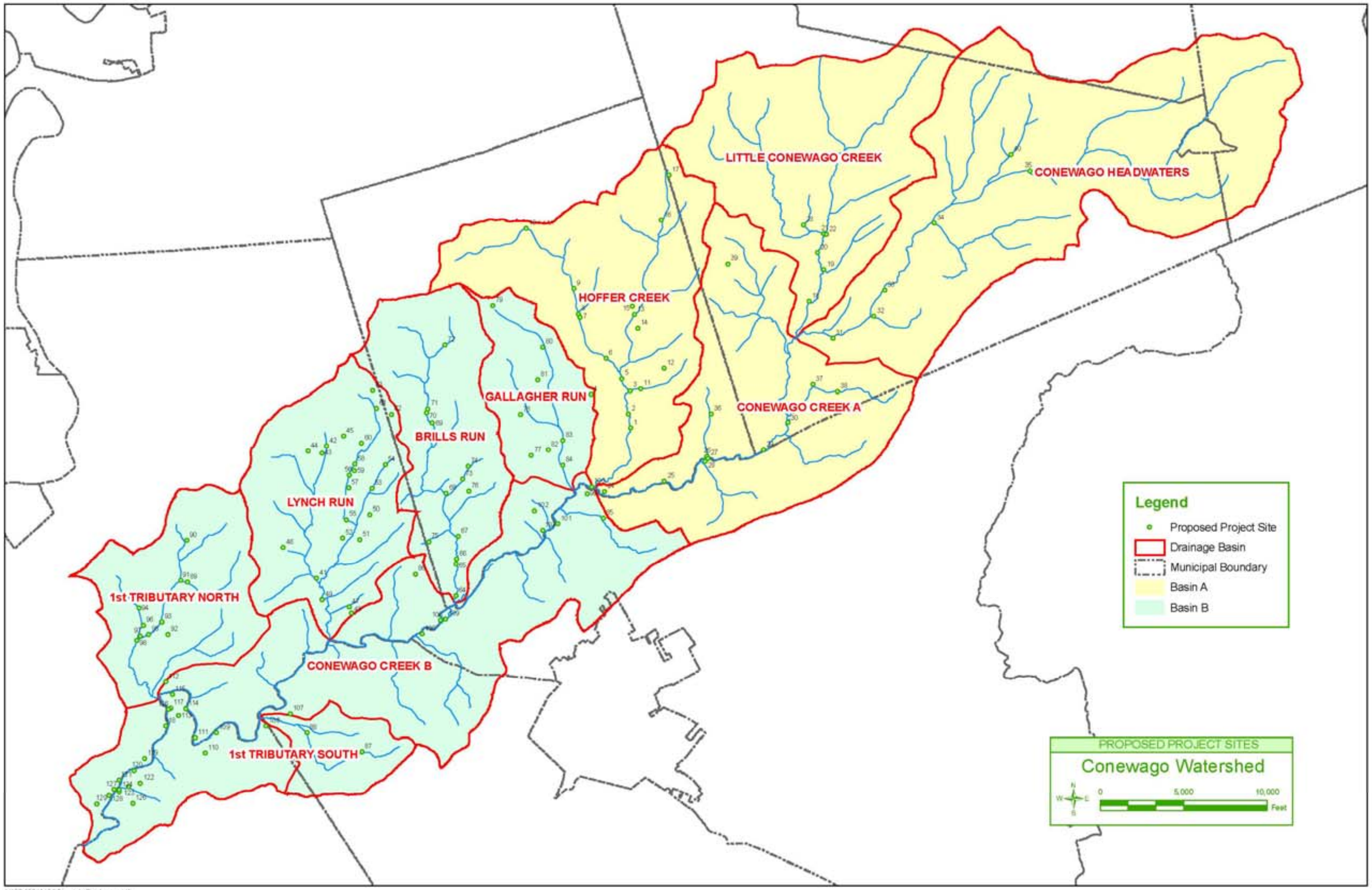
Even though future land use changes may dictate an adaptive implementation approach, this restoration plan sets forth an excellent blueprint for achieving significant improvement in water quality in the Conewago Creek Watershed. Phosphorus and sediment loadings within Subbasin "A" will result in 29% and 40% reductions, respectively. Phosphorus and sediment loadings within Subbasin "B" will result in 30% and 44% reductions, respectively.

Stream bank stabilization projects such as this one involving stream bank fencing, riparian forest buffer plantings, the installation of two rock deflectors and rip-rapping combined with live stake plantings stopped the erosion in this cattle pasture without taking valued grazing acreage.

Of particular note, first and second order tributaries will greatly improve with the implementation of this plan. Field work results indicate that many tributaries are in need of major riparian corridor improvements in the form of stream bank fencing, buffer establishment and stream bank stabilization. Cropland within many of the tributaries, particularly in the upper and middle watershed, is fairly well managed with little improvement being necessary, and thus the stream improvement projects proposed in this plan should result in great water quality gains on the tributaries which, in turn, will improve the water quality of the main stem.

VI. RESTORATION RECOMMENDATIONS

The following is a complete list and associated mapping of the 129 project opportunities identified in this plan.

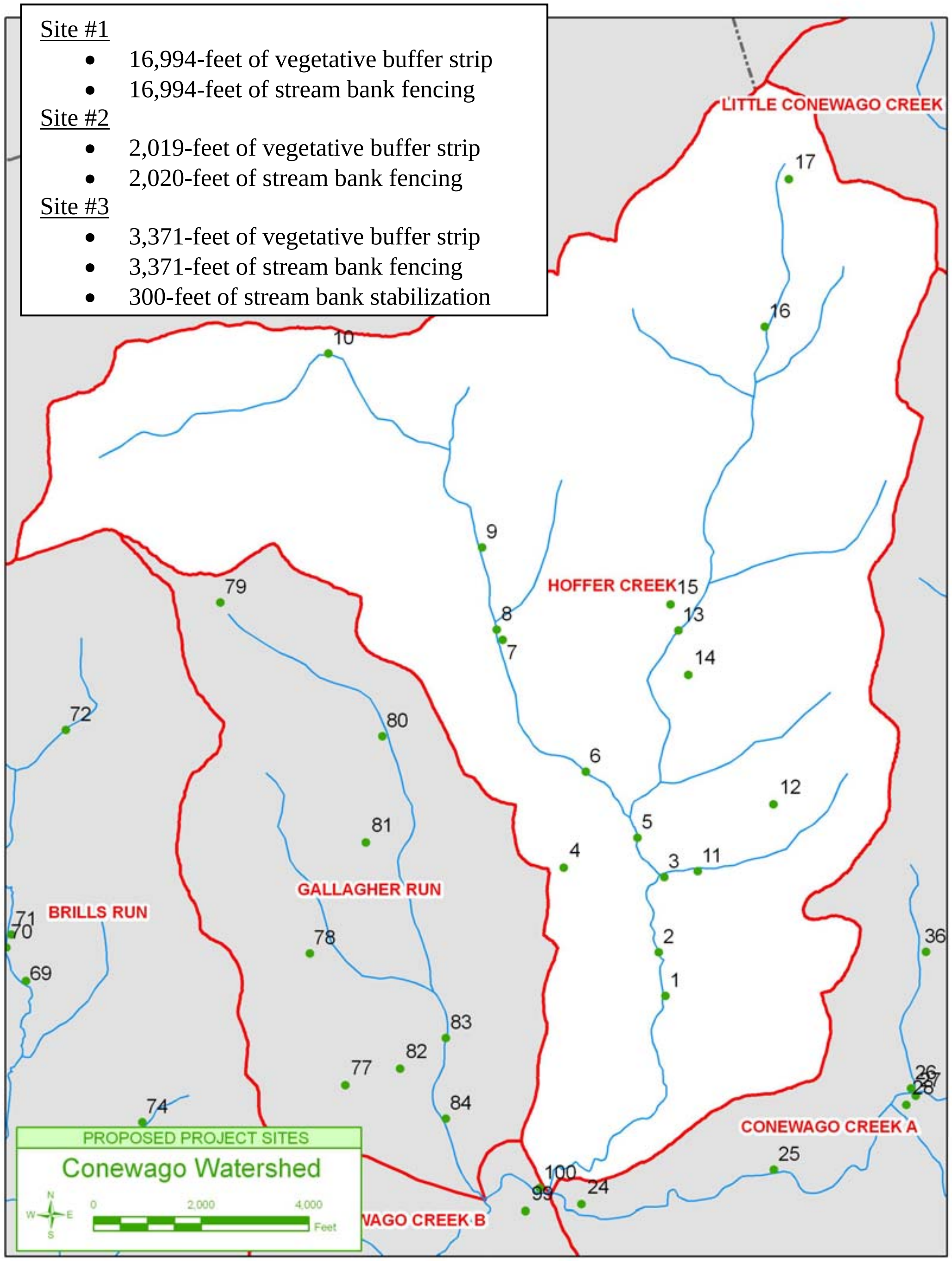


Subbasin “A”

Site #1
- 16,994-feet of vegetative buffer strip
- 16,994-feet of stream bank fencing

Site #2
- 2,019-feet of vegetative buffer strip
- 2,020-feet of stream bank fencing

Site #3
- 3,371-feet of vegetative buffer strip
- 3,371-feet of stream bank fencing
- 300-feet of stream bank stabilization



Hoffer Creek

Site #4
- 91.18-acres requiring terraces and/or diversions

Site #5
- 2,056-feet of vegetative buffer strip
- 2,057-feet of stream bank fencing
- 200-feet of stream bank stabilization

Site #6
- 6,725-feet of vegetative buffer strip
- 6,726-feet of stream bank fencing
- 1,000-feet of stream bank stabilization

Site #7
- 2,958-feet of vegetative buffer strip
- 2,959-feet of stream bank fencing
- 500-feet of stream bank stabilization

Site #8
- 339-feet of stream bank stabilization

Site #9
- 620-feet of stream bank stabilization

Site #10
- 4,914-feet of vegetative buffer strip
- 4,915-feet of stream bank fencing
- 2,000-feet of stream bank stabilization

Site #11
- 4,320-feet of vegetative buffer strip
- 4,320-feet of stream bank fencing
- 4,320-feet of stream bank stabilization

Site #12
- 44-acres requiring terraces and/or diversions

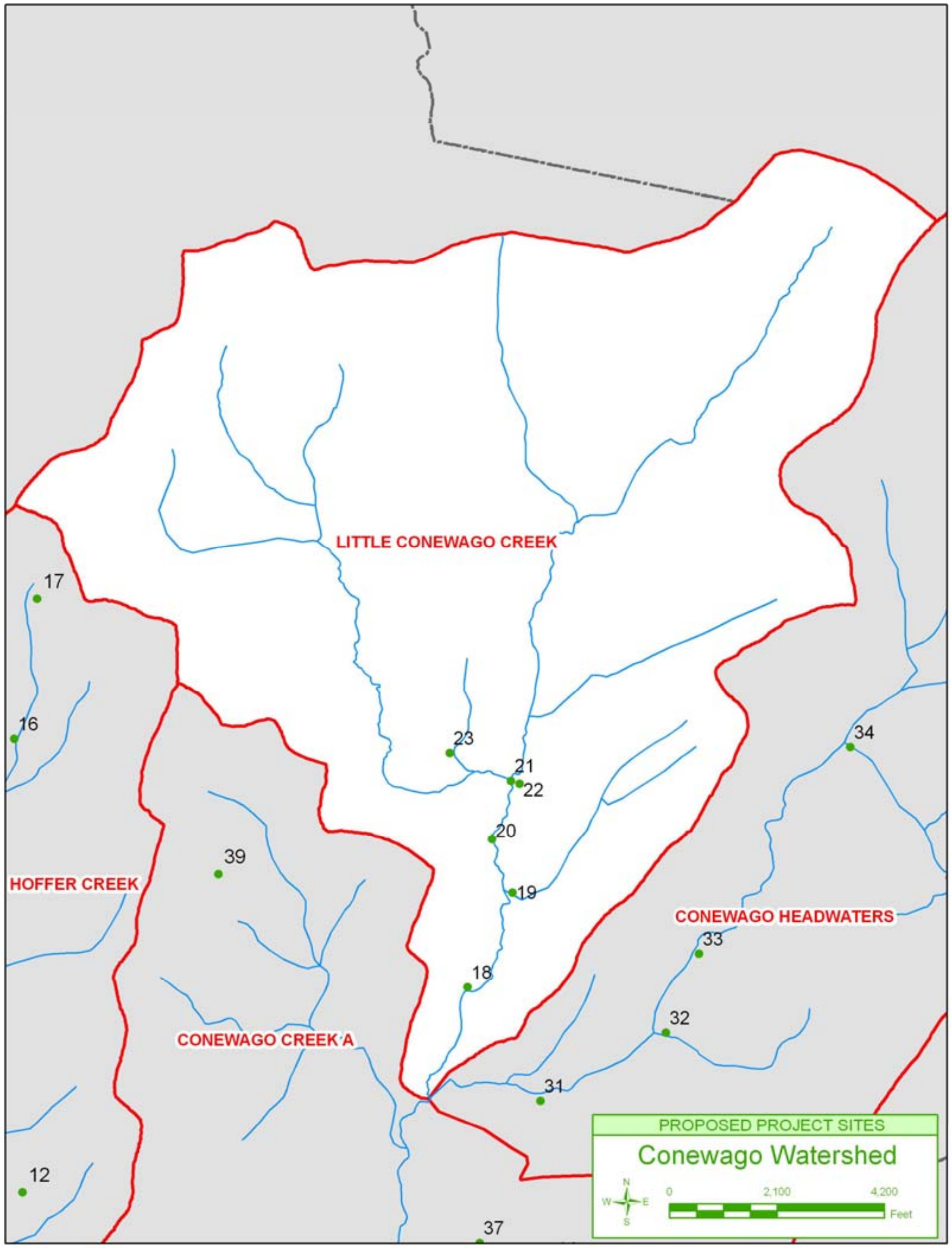
Site #13
- 6,192-feet of vegetative buffer strip
- 6,192-feet of stream bank fencing
- 3,000-feet of stream bank stabilization

Site #14
- 18-acres requiring terraces and/or diversions

Site #15
- 14-acres requiring terraces and/or diversions

Site #16
- 4,312-feet of vegetative buffer strip
- 4,312-feet of stream bank fencing

Site #17
- 1.5-acres requiring nutrient management – barnyard area



Little Conewago Creek

Site #18

- 5,250-feet of vegetative buffer strip
- 5,250-feet of stream bank fencing
- 5,250-feet of stream bank stabilization

Site #19

- 4,213-feet of vegetative buffer strip
- 4,213-feet of stream bank fencing
- 4,213-feet of stream bank stabilization

Site #20

- 2,618-feet of vegetative buffer strip
- 2,618-feet of stream bank fencing
- 2,618-feet of stream bank stabilization

Site #21

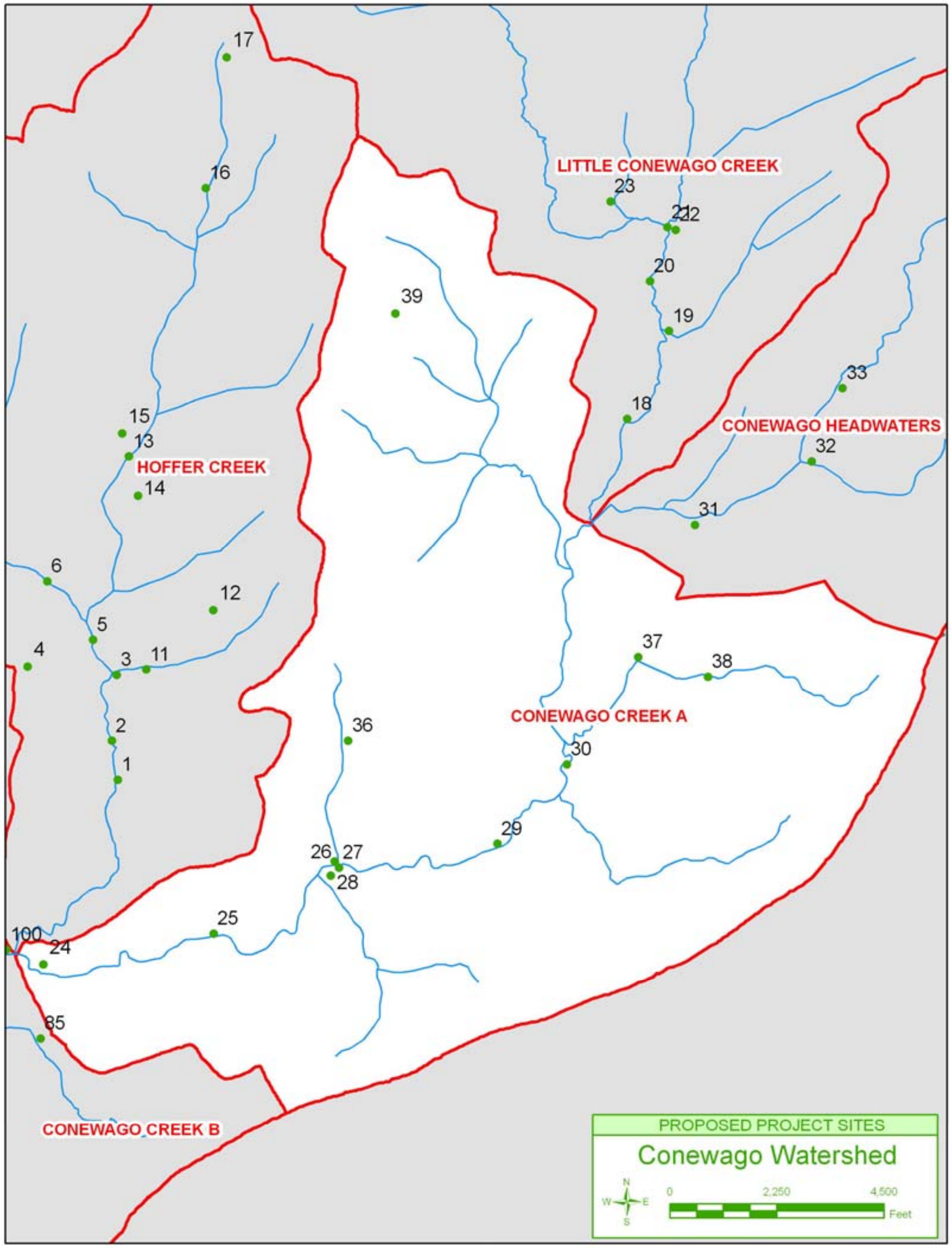
- 2,599-feet of vegetative buffer strip
- 2,599-feet of stream bank fencing
- 2,599-feet of stream bank stabilization

Site #22

- 5,965-feet of vegetative buffer strip
- 5,965-feet of stream bank fencing
- 5,965-feet of stream bank stabilization

Site #23

- 11,185-feet of vegetative buffer strip
- 11,185-feet of stream bank fencing
- 11,185-feet of stream bank stabilization



Conewago Creek A

Site #24
- 24-acres requiring grazing land management

Site #25
- 2,543-feet of vegetative buffer strip
- 2,544-feet of stream bank fencing
- 2,543-feet of stream bank stabilization

Site #26
- 1,847-feet of vegetative buffer strip
- 1,847-fet of stream bank fencing
- 1,847-feet of stream bank stabilization

Site #27
- 1,454-feet of vegetative buffer strip
- 1,454-feet of stream bank fencing
- 1,454-feet of stream bank stabilization

Site #28
- 1.2-acres requiring grazing land management

Site #29
- 3,027-feet of vegetative buffer strip
- 3,027-feet of stream bank fencing
- 3,027-feet of stream bank stabilization

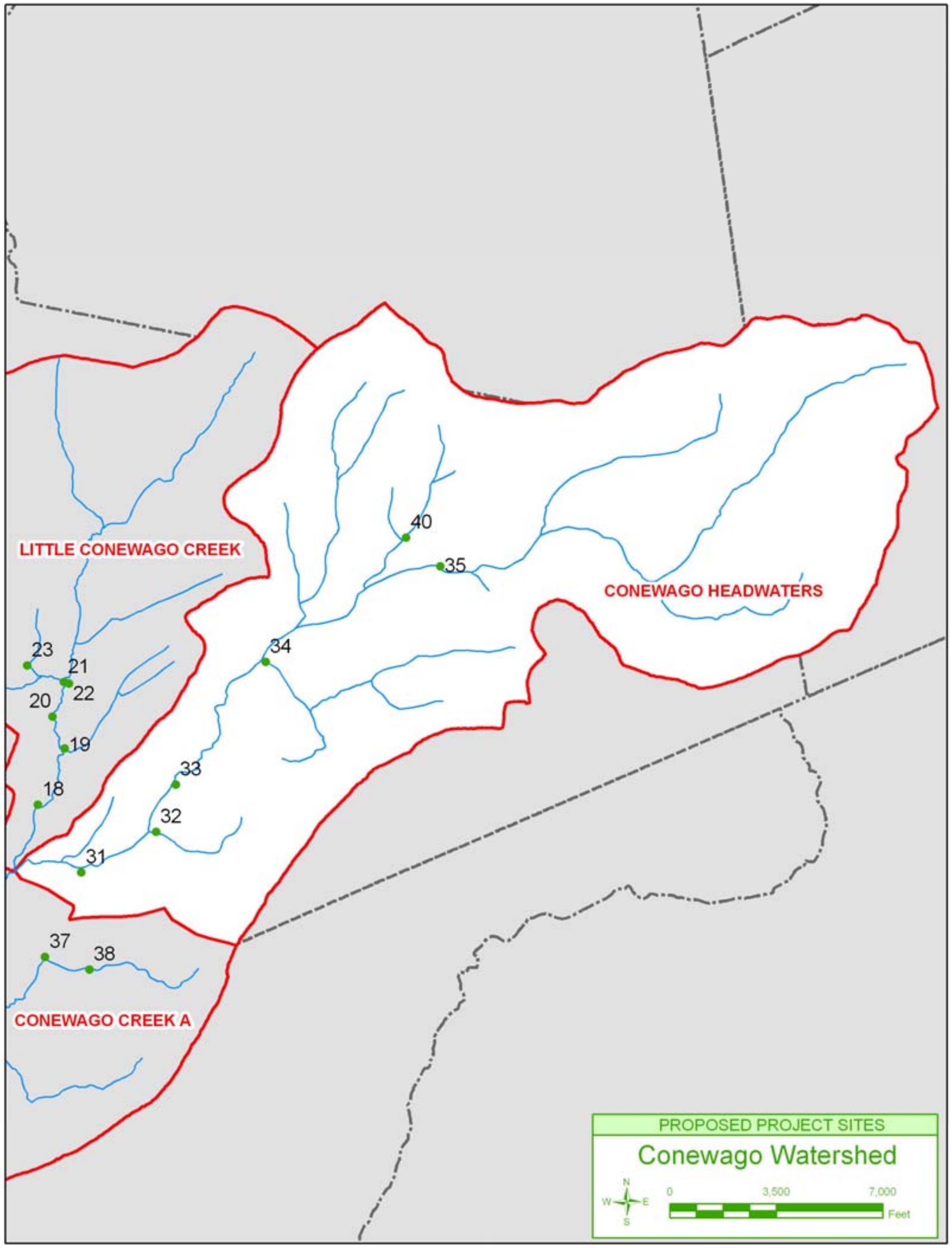
Site #30
- 1,341-feet of vegetative buffer strip
- 1,341-feet of stream bank fencing
- 1,341-feet of stream bank stabilization

Site #36
- 5,340-feet of vegetative buffer strip
- 5,340-feet of stream bank fencing

Site #37
- 4,590-feet of vegetative buffer strip
- 4,590-feet of stream bank fencing

Site #38
- 1,909-feet of vegetative buffer strip
- 1,909-feet of stream bank fencing

Site #39
- 36-acres requiring terraces and/or diversion



Conewago Headwaters

Site #31

- 3,746-feet of vegetative buffer strip
- 3,746-feet of stream bank fencing
- 3,746-feet of stream bank stabilization

Site #32

- 6,043-feet of vegetative buffer strip
- 6,043-feet of stream bank fencing
- 6,043-feet of stream bank stabilization

Site #33

- 3,955-feet of vegetative buffer strip
- 3,955-feet of stream bank fencing
- 3,955-feet of stream bank stabilization

Site#34

- 2,688-feet of vegetative buffer strip
- 2,688-feet of stream bank fencing
- 2,688-feet of stream bank stabilization

Site #35

- 1,758-feet of vegetative buffer strip
- 1,758-feet of stream bank fencing
- 1,758-feet of stream bank stabilization

Site #40

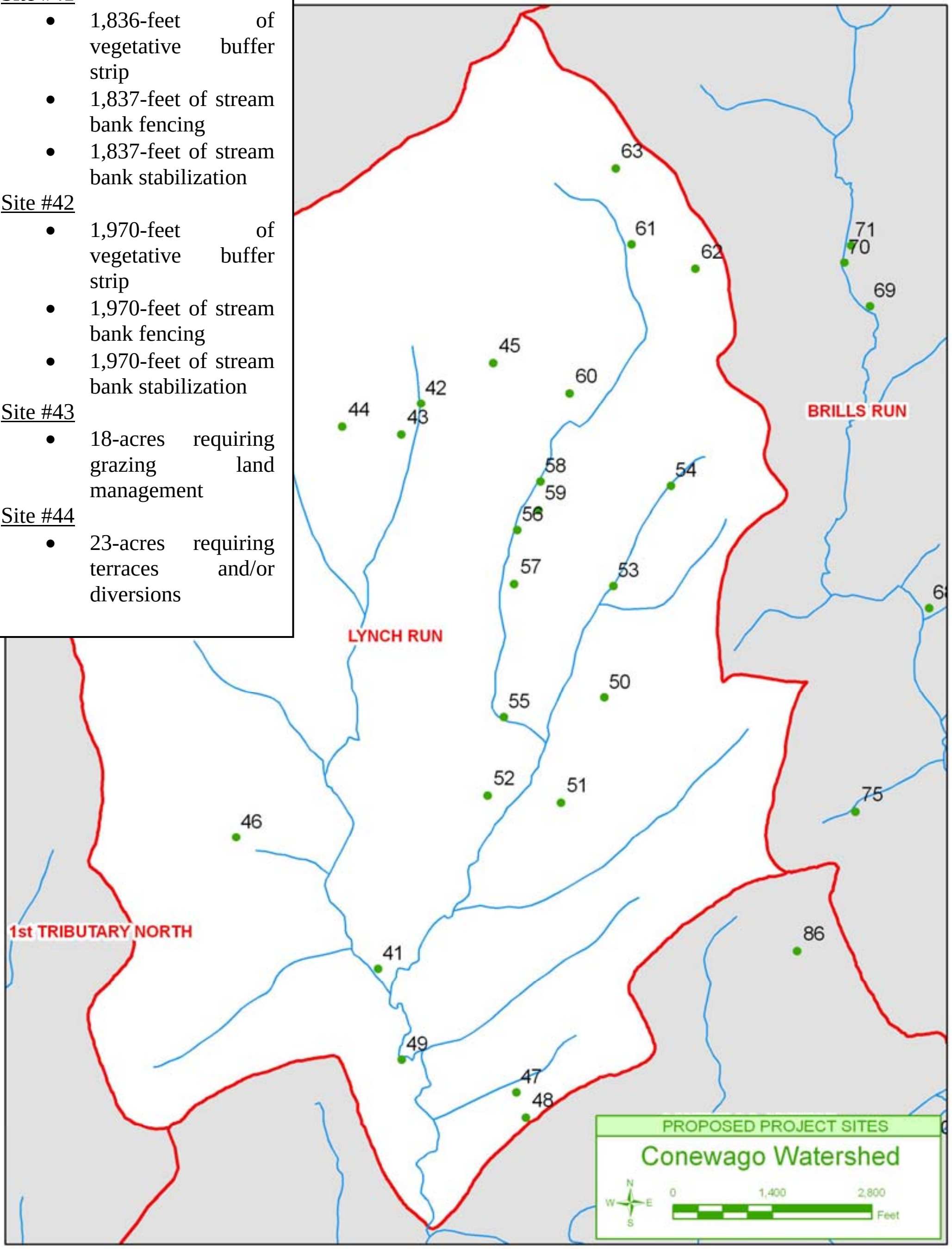
- 4,501-feet of vegetative buffer strip
- 4,501-feet of stream bank fencing

Site #41
- 1,836-feet of vegetative buffer strip
- 1,837-feet of stream bank fencing
- 1,837-feet of stream bank stabilization

Site #42
- 1,970-feet of vegetative buffer strip
- 1,970-feet of stream bank fencing
- 1,970-feet of stream bank stabilization

Site #43
- 18-acres requiring grazing land management

Site #44
- 23-acres requiring terraces and/or diversions



Subbasin "B" Lynch Run

Site #45
- 31-acres requiring terraces and/or diversions

Site #46
- 1,593-feet of vegetative buffer strip

Site #47
- 1,899-feet of vegetative buffer strip

Site #48
- 43-acres requiring terraces and/or diversions

Site #49
- 5,487-feet of vegetative buffer strip
- 5,487-feet of stream bank fencing
- 2,500 feet of stream bank stabilization

Site #50
- 6,188-feet of vegetative buffer strip
- 6,188-feet of stream bank fencing
- 3,500-feet of stream bank stabilization

Site #51
- 31-acres requiring terraces and/or diversions

Site #52
- 16-acres requiring terraces and/or diversions

Site #53
- 3,294-feet of vegetative buffer strip
- 3,294-feet of stream bank fencing

Site #54
- 3,275-feet of vegetative buffer strip
- 3,275-feet of stream bank fencing

Site #55
- 1,296-feet of vegetative buffer strip
- 1,296-feet of stream bank fencing

Site #56
- 3,552-feet of vegetative buffer strip

Site #57
- 19-acres requiring terraces and/or diversions

Site #58
- 1,526-feet of vegetative buffer strip

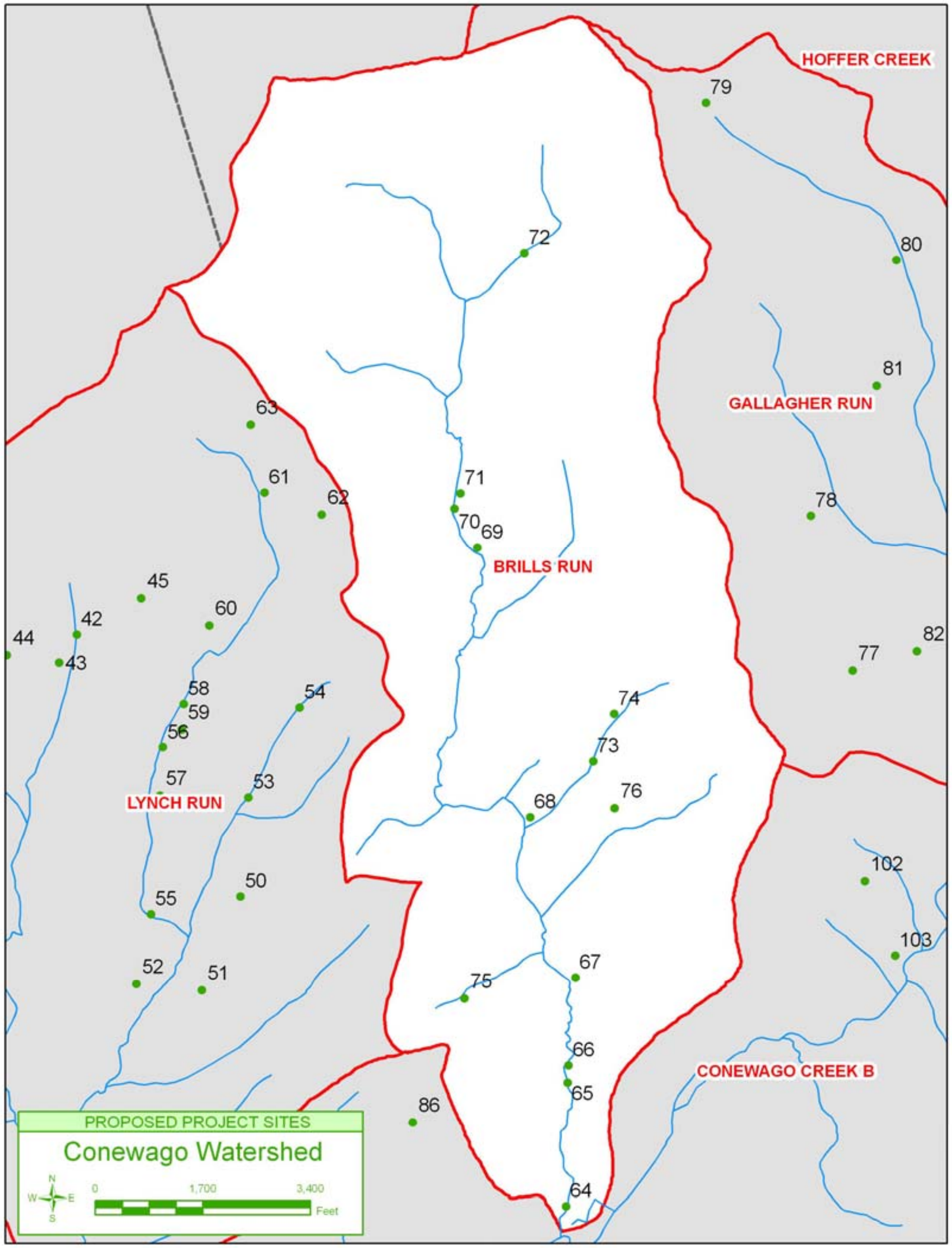
Site #59
- 12-acres requiring terraces and/or diversions

Site #60
- 15-acres requiring terraces and/or diversions

Site #61
- 4,203-feet of vegetative buffer strip
- 4,203-feet of stream bank fencing

Site #62
- 61-acres requiring terraces and/or diversions

Site #63
- 8-acres requiring terraces and/or diversions



Brills Run

Site #64

- 1,006-feet of vegetative buffer strip
- 500-feet of stream bank stabilization

Site #65

- 3,680-feet of vegetative buffer strip
- 3,680-feet of stream bank fencing

Site #66

- 2,323-feet of vegetative buffer strip
- 2,323-feet of stream bank fencing

Site #67

- 2,301-feet of vegetative buffer strip
- 2,302-feet of stream bank fencing

Site #68

- 3,646-feet of vegetative buffer strip
- 3,646-feet of stream bank fencing
- 400-feet of stream bank stabilization

Site #69

- 4,755-feet of vegetative buffer strip
- 4,755-feet of stream bank fencing

Site #70

- 1,833-feet of vegetative buffer strip
- 1,833-feet of stream bank fencing

Site #71

- 2,981-feet of vegetative buffer strip
- 2,981-feet of stream bank fencing

Site #72

- 2,411-feet of vegetative buffer strip
- 2,411-feet of stream bank fencing
- 500-feet of stream bank stabilization

Site #73

- 2,336-feet of vegetative buffer strip

Site #74

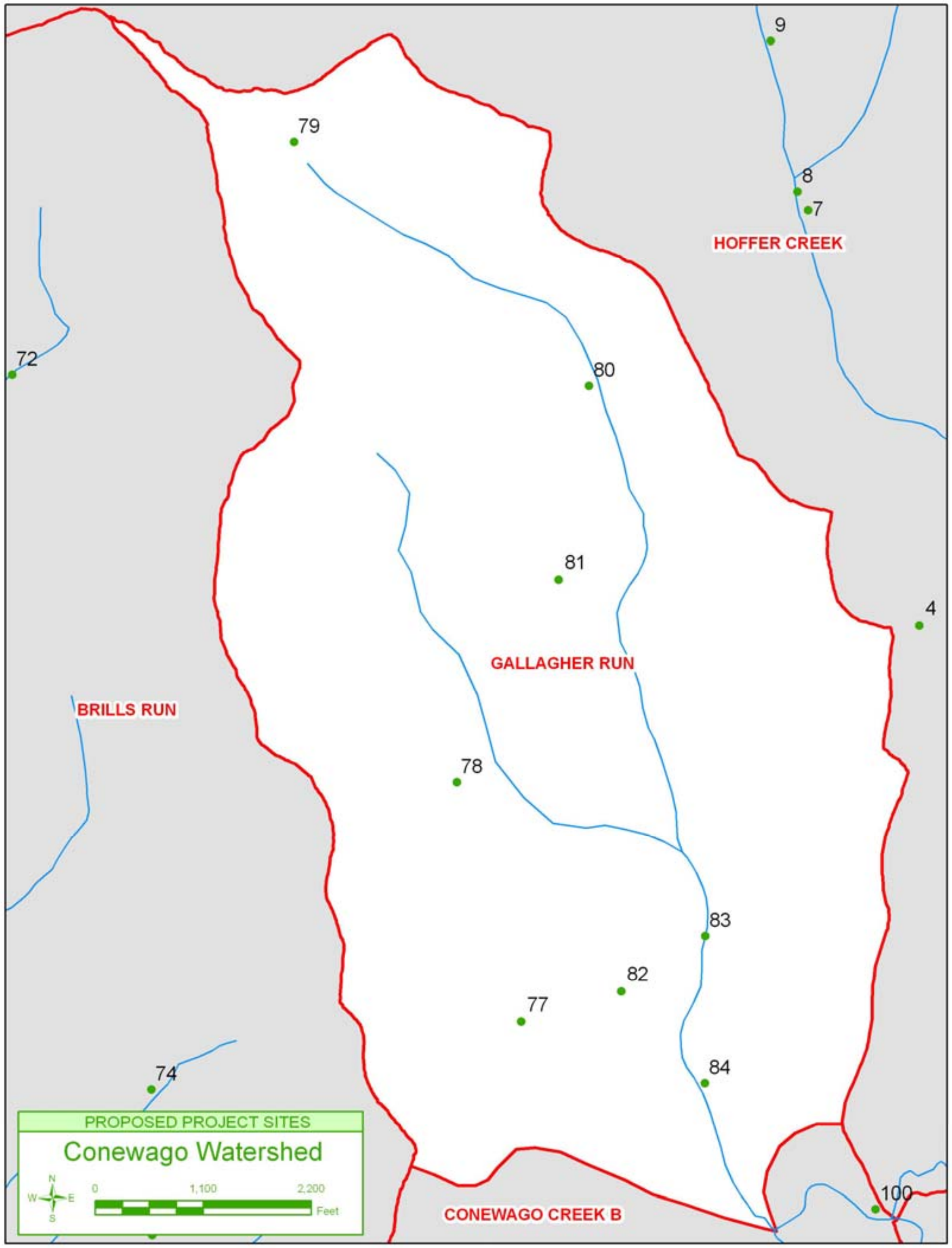
- 464-feet of vegetative buffer strip

Site #75

- 117-acres requiring terraces and/or diversions

Site #76

- 46-acres requiring terraces and/or diversions



Gallagher Run

Site #77

- 21-acres requiring terraces and/or diversions

Site #78

- 2,847-feet of vegetative buffer strip
- 2,847-feet of stream bank fencing

Site #79

- 3,780-feet of vegetative buffer strip
- 3,781-feet of stream bank fencing

Site #80

- 2,295-feet of vegetative buffer strip
- 2,295-feet of stream bank fencing

Site #81

- 24-acres requiring terraces and/or diversions

Site #82

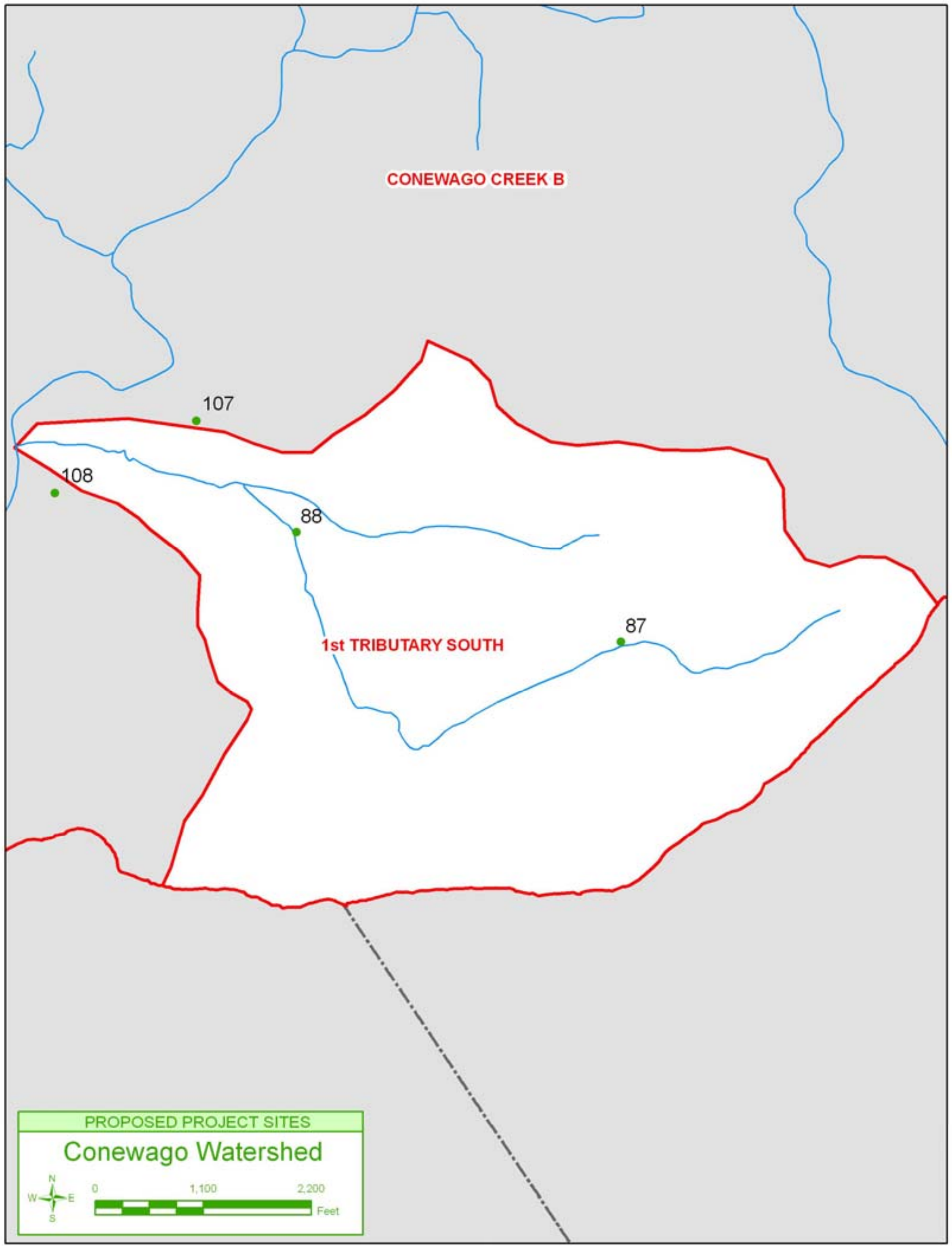
- 25-acres requiring terraces and/or diversions

Site #83

- 3,636-feet of vegetative buffer strip
- 3,636-feet of stream bank fencing

Site #84

- 3,933-feet of vegetative buffer strip
- 3,933-feet of stream bank fencing



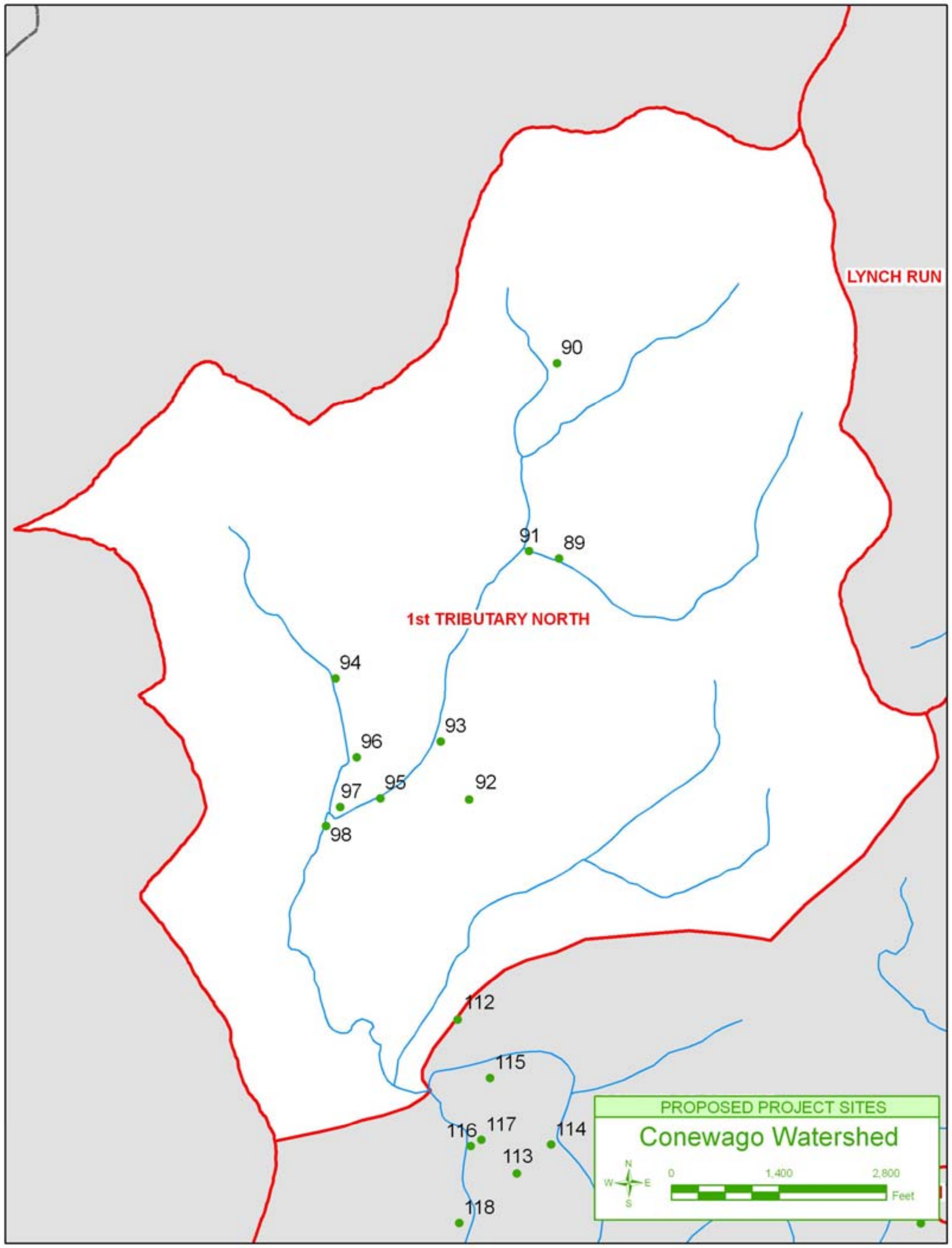
1st Tributary South

Site #87

- 4,933-feet of vegetative buffer strip
- 4,933-feet of stream bank fencing
- 2,000-feet of stream bank stabilization

Site #88

- 589-feet of vegetative buffer strip



1st Tributary North

Site #89
- 664-feet of vegetative buffer strip
- 664-feet of stream bank stabilization

Site #90
- 3,691-feet of vegetative buffer strip
- 3,691-feet of stream bank fencing
- 500-feet of stream bank stabilization

Site #91
- 2,234-feet of vegetative buffer strip
- 2,234-feet of stream bank fencing

Site #92
- 54-acres requiring terraces and/or diversions

Site #93
- 2,390-feet of vegetative buffer strip
- 2,390-feet of stream bank fencing
- 2,390-feet of stream bank stabilization

Site #94
- 2,156-feet of vegetative buffer strip
- 2,156-feet of stream bank fencing
- 2,156-feet of stream bank stabilization

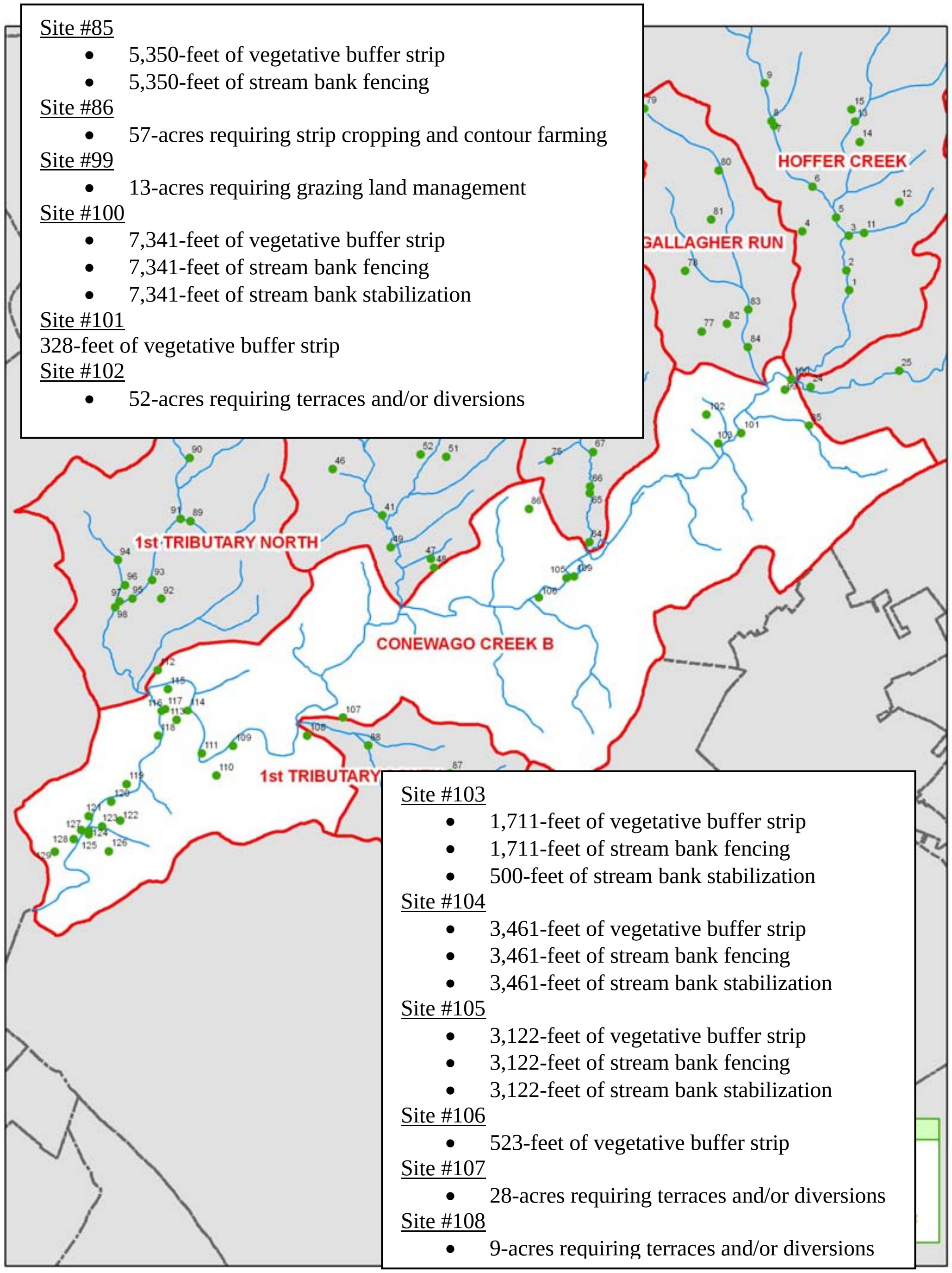
Site #95
- 1,004-feet of vegetative buffer strip
- 1,004-feet of stream bank fencing
- 1,004-feet of stream bank stabilization

Site #96
- 1,541-feet of vegetative buffer strip
- 1,541-feet of stream bank fencing
- 1,541-feet of stream bank stabilization

Site #97
- 834-feet of vegetative buffer strip
- 834-feet of stream bank fencing
- 834-feet of stream bank stabilization

Site #98
- 2,052-feet of vegetative buffer strip
- 2,052-feet of stream bank stabilization
- 2,052-feet of stream bank stabilization

Conewago Creek B



Site #85
- 5,350-feet of vegetative buffer strip
- 5,350-feet of stream bank fencing

Site #86
- 57-acres requiring strip cropping and contour farming

Site #99
- 13-acres requiring grazing land management

Site #100
- 7,341-feet of vegetative buffer strip
- 7,341-feet of stream bank fencing
- 7,341-feet of stream bank stabilization

Site #101

328-feet of vegetative buffer strip

Site #102
- 52-acres requiring terraces and/or diversions

Site #103
- 1,711-feet of vegetative buffer strip
- 1,711-feet of stream bank fencing
- 500-feet of stream bank stabilization

Site #104
- 3,461-feet of vegetative buffer strip
- 3,461-feet of stream bank fencing
- 3,461-feet of stream bank stabilization

Site #105
- 3,122-feet of vegetative buffer strip
- 3,122-feet of stream bank fencing
- 3,122-feet of stream bank stabilization

Site #106
- 523-feet of vegetative buffer strip

Site #107
- 28-acres requiring terraces and/or diversions

Site #108
- 9-acres requiring terraces and/or diversions

Site #109
- 1,201-feet of vegetative buffer strip

Site #110
- 32-acres requiring terraces and/or diversions

Site #111
- 1,071-feet of vegetative buffer strip

Site #112
- 16-acres requiring terraces and/or diversions

Site #113
- 61-acres requiring terraces and/or diversions

Site #114
- 2,409-feet of vegetative buffer strip

Site #115
- 1,240-feet of vegetative buffer strip

Site #116
- 482-feet of stream bank stabilization

Site #117
- 455-feet of vegetative buffer strip
- 455-feet of stream bank stabilization

Site #118
- 1,223-feet of vegetative buffer strip

Site #119
- 23-acres of grazing land management

Site #120
- 1,223-feet of vegetative buffer strip

Site #121
- 1,043-feet of vegetative buffer strip
- 500-feet of stream bank stabilization

Site #122
- 6,488-feet of vegetative buffer strip
- 2,500-feet of stream bank fencing

Site #123
- 7-acres requiring grazing land management

Site #124
- 384-feet of vegetative buffer strip

Site #125
- 3-acres requiring grazing land management

Site #126
- 3,606-feet of vegetative buffer strip

Site #127
- 217-feet of vegetative buffer strip

Site #128
- 715-feet of vegetative buffer strip

Site #129
- 16-acres requiring crop rotation, crop residue management and strip cropping

VII. PRIORITIES FOR IMPLEMENTATION

Stream Restoration Projects

Following identification of the 129 potential project sites set forth in Section VI, TCCCA evaluated the sites to establish priorities for implementing this restoration plan. Using data available from the modeling, TCCCA determined expected sediment load reduction, cost and "efficiency" (sediment load reduction per cost) of each potential project. (For purposes of setting restoration priorities, TCCCA analyzed anticipated sediment load reduction only, since phosphorus readily links to sediment). TCCCA then considered the following factors to determine project implementation priorities:

- anticipated sediment load reduction
- estimated cost
- "efficiency" (load reduction per cost)
- watershed location (headwaters, tributary, main stem)
- landowner identity
- number of landowners per subwatershed
- size of subwatershed
- 303(d) list status (impaired or attaining)
- public visibility of project site
- general knowledge of watershed and condition of subwatershed (from visual assessment and volunteer stream monitoring data)

The following general assumptions were made in considering these factors:

- Projects with a large anticipated load reduction are higher priority that those expected to achieve minimal reductions.
- Projects with lower cost values are higher priority than those with higher costs, particularly if the "efficiency" determination is also high (thus allowing for greater load reduction per cost, maximizing "bang for the buck").
- Restoration projects in headwaters or tributaries are higher priority than those in the lower main stem.
- Projects on land owned by landowners who have expressed or are anticipated to express a willingness to partner with TCCCA on a project are high priority.
- Subwatersheds where fewer individual landowners are involved in implementing all prospective projects in the subwatershed are higher priority than those with many landowners. Similarly, subwatersheds which are of smaller size and fewer total projects are higher priority than subwatersheds involving many stream miles and many potential projects.
- Projects on stream segments listed as impaired are higher priority than projects on stream segments that are not impaired.
- Projects in areas of high visibility are high priority.
- Projects in areas where water quality is poor and/or sediment contributions are high (based on TCCCA members' general knowledge and observations of the watershed and volunteer stream monitoring data) are high priority.

TCCCA evaluated all of these factors collectively to determine a roadmap for implementation in the watershed. Because of the large number of potential implementation projects and the many and various factors considered, it was infeasible to establish a definitive site-by-site priority listing. Moreover, as the factors were evaluated, it became clear that certain subwatersheds are of higher priority than others. Thus, with the exception of the top priority project, TCCCA has established implementation priorities on a subwatershed basis, as discussed in detail below.

Priority One: Site #100

Site #100 is a 97-acre site which includes over 3,000 linear feet of the main stem Conewago and approximately 2,000 linear feet of an unnamed tributary. In March 2006, TCCCA submitted a Growing Greener/Section 319 application to fund project design and permitting for a major restoration project for this property. The project involves restoration of the main stem Conewago Creek using fluvial geomorphology methods and habitat enhancement measures, including planting riparian vegetative buffers; restoration of approximately 20 acres of floodplain lowland wetlands adjacent to the Conewago; and restoration and/or relocation of approximately 1,249 linear feet of an unnamed tributary to the Conewago which flows across the property.

This project was determined to be TCCCA's highest priority project for a number of reasons. First, the proposed restoration work is expected to result in significant sediment load reductions. Specifically, the project would reduce sediment contributions from the site an estimated 56.5 % considering efficiency values for proposed BMPs according to PRedICT watershed modeling as calculated by RETTEW, which equates to a sediment load reduction of 3,976 lbs. per year or 1.98 tons per year, the largest anticipated sediment load reduction of the 60 total stream restoration projects identified in Conewago Subbasin "B."

Second, the main stem Conewago Creek is listed as impaired in the area of site #100.

Third, the proposed project allows TCCCA to work directly with the largest landowner in the watershed. Many additional potential project sites owned by this landowner have been identified in the restoration plan, several of which are high priority sites. By working cooperatively with this landowner on the project, TCCCA hopes to establish a positive working relationship that will result in the implementation of future projects that will significantly improve water quality in the Conewago Creek Watershed.

Fourth, the site contains substantial floodplain acreage that, if restored, may serve to alleviate downstream flooding and settle out upstream sediment loads during times of high flow, to the great benefit of downstream stream reaches and properties.

Finally, the project site is situated in an area of high public visibility, adjacent to and visible from public highways and the heavily used Conewago Recreational Trail, owned and maintained by the County of Lancaster. In a future phase of this project, TCCCA, in partnership with the County, will seek funding from the Pennsylvania Department of Conservation and Natural Resources (DCNR) to construct an observatory deck accessible from the Trail that provides views of the site and wildlife and bird watching opportunities. The deck will display educational signage to promote and explain the project.

Priority Two: Hoffer Creek and Gallagher Run

Two tributaries flow into the Conewago in the vicinity of Site #100—Hoffer Creek and Gallagher Run. Both of these tributaries are highly impaired and listed on the 303(d) list. Gallagher Run is a small tributary (approximately 2.5 miles from source to mouth). It contains good instream habitat and forested cover near its headwaters, but quickly degrades as it flows to the Conewago, suffering from eroding stream banks and siltation. The five potential stream restoration projects on Gallagher Run identified in this report would involve only two landowners. These factors combine to give this tributary a high priority for implementation, as full restoration of the entire subwatershed may be feasible.

Hoffer Creek also receives high priority. This subwatershed is bigger than Gallagher Run, requires implementation of at least 12 stream restoration projects, and requires cooperation from nine individual landowners. However, water quality of Hoffer Creek is extremely poor and the contributing sediment load is large. Implementation of all 12 stream restoration projects for Hoffer Creek would result in the greatest sediment load reduction of any of the ten subwatersheds identified in the report (27,802 pounds per year, as calculated using figures from PRedICT modeling). Most Hoffer Creek projects also achieve a high efficiency ranking (load reduction per cost).

Implementation of projects on both of these tributaries should be of high priority. TCCCA proposes to attempt to implement projects in either subwatershed as it becomes successful in securing landowner cooperation and obtaining necessary funding.

Priority Three: Little Conewago Creek

Little Conewago Creek is the other major tributary of Subbasin "A." Restoration of this subwatershed is of high priority for several reasons. Although Little Conewago Creek is not officially listed on the current Section 303(d) list, preliminary information from studies being conducted by the Dauphin County Conservation District indicates that all or parts of this stream may be impaired. Numbers calculated by TCCCA for purposes of establishing priorities bear this out—implementation of all Little Conewago Creek restoration projects identified in the report would yield a sediment load reduction of 24,169 pounds per year, second only to anticipated load reductions from restoring heavily impaired Hoffer Creek. Also of note is that the main stem Conewago does not become impaired until just after receiving the significant pollutant loadings from the Little Conewago.

Moreover, implementation of the Little Conewago projects would require working with only four different landowners, one of whom has already implemented the recommended project through the CREP program and volunteer assistance from TCCCA. Each project identified in the report is of significant size, requiring restoration of several thousand linear feet of stream. Implementation of just one or two projects in this subwatershed could result in dramatic onsite and downstream water quality improvements.

Priority Four: Conewago Headwaters and Conewago Creek A

In general, restoration work should begin in headwaters and tributaries so that completed downstream projects are not damaged or negated by problems upstream. Following this principle, TCCCA proposes to establish as its fourth priority area the headwaters and upper reaches of the main stem Conewago. Several significant and high profile potential projects are identified in this area. Many of these upper stretches of the Conewago Creek are visible from Routes 241 and 117 in the Lawn and Colebrook areas of Lebanon County, as well as the popular Lebanon Valley Rails-to-Trails. The ability to work cooperatively with a landowner to implement a project in this area would enhance TCCCA's profile and open doors to new partnerships with Conewago landowners.

In addition, the water quality benefits from implementing the proposed projects in this area are great. Although the headwaters are not impaired, the Conewago Creek A subwatershed (main stem Conewago after the confluence with Little Conewago Creek) is listed as impaired. Implementing all 14 stream restoration projects identified for Conewago Headwaters and Conewago Creek A would result in a total sediment reduction of 28,826 pounds per year.

Priority Five: Lynch Run

Lynch Run is a tributary in the lower Conewago Creek Subbasin "B." It is the highest priority subwatershed in Subbasin "B" because it is listed on the 303(d) list as impaired and implementation of the 12 stream restoration projects identified in the report will result in the greatest sediment load reduction of any of the lower tributaries (4,098 pounds per year). Most Lynch Run projects also rank high in terms of efficiency (load reduction per cost). Challenges to implementation exist as the proposed projects require cooperation from eight different landowners. In addition, 11 more sites have been identified for agriculture management and conservation enhancement projects. Close cooperation with the county conservation district in this subwatershed will be required to achieve significant water quality improvements.

Priority Six: Brills Run

Brills Run is another Subbasin "B" tributary. It is not presently listed on the 303(d) list and anticipated sediment load reductions are not as great as those projected for Lynch Run, and it thus ranks lower in terms of implementation priorities.

There are factors, however, that support Brills Run as an important restoration objective. As is true for the Little Conewago Creek, preliminary information from Dauphin County Conservation District stream sampling indicates that all or parts of Brills Run may be impaired. Volunteer macroinvertebrate sampling conducted on behalf of TCCCA by the Lower Dauphin High School Ecology Club in November 2005 near the mouth of Brills Run also brings into question the health of this stream, as blood red midge larvae were the dominant taxa. Finally, although restoring Brills Run requires working with nine different landowners, TCCCA has existing working relationships with some of these landowners and others have recently implemented CREP projects.

Priority Seven: 1st Tributary North

The unnamed tributary designated as "1st Tributary North" is an impaired segment in the lower reaches of the Conewago Creek Watershed. Anticipated load reductions resulting from implementation of the nine stream restoration projects identified in the report are surprisingly high for a small tributary (2,583 pounds per year), thus justifying its priority ranking over the last two subwatersheds.

Priority Eight: Conewago Creek B

This subwatershed consists of the main stem Conewago Creek downstream from project Site #100, TCCCA's top implementation priority. The report identifies 17 different potential stream restoration projects. These projects involve 11 different landowners. With the exception of the Site #100 project (which will generate the largest sediment load reduction of any project in Subbasin B), anticipated load reductions from each project are not that great (a project average of 165 pound per year). For these reasons, stream restoration projects in this subwatershed are of lower priority.

Priority Nine: 1st Tributary South

Only two proposed projects are identified for this small unnamed tributary. The tributary has not been listed as impaired and total anticipated sediment reductions from implementation the two projects are only 708 pounds per year. Thus this subwatershed is not a high priority for implementation.

Land Management and Conservation Projects

Of the 129 potential projects identified in the report, 36 are non-stream restoration projects that involve implementation of conservation measures on agricultural lands (i.e., terracing, crop rotation, grazing management). Existing farm agencies such as the county conservation districts, NRCS and the Farm Service Agency (FSA) can provide support and assistance to farmers in implementing such projects to improve soil conservation, water quality and agricultural production. TCCCA proposes to collaborate with such agencies to implement the projects identified in this report.

Most of the potential sites for these management and conservation projects (28 of 36) are located in Subbasin B. Thus it is anticipated that most priority implementation will occur in the lower portions of the Conewago Creek Watershed. Precise prioritization of management and conservation projects is beyond the scope of this report, as future collaboration among TCCCA, county conservation districts and other farm agencies and farmers is necessary.

Anticipated Timeline

It is difficult to establish a precise timeline for achieving full implementation of restoration objectives identified in this report. There are 129 total projects to implement. Outreach to landowners and establishing working relationships often takes years, as does identifying and obtaining necessary funding. As all projects are predicated on willingness of landowner cooperation, available funding and the time and resources of an all-volunteer organization and agricultural agencies with limited staff, the goals of even a general timeline are likely to be in flux.

Nonetheless, assuming full landowner support, sufficient funding and successful collaboration between TCCCA and other partner entities (as discussed in Section VIII), it is possible that all restoration priorities may be achieved in 35 years as follows:

Within 5 years: Complete implementation Site #100 project and stream restoration projects for Gallagher Run. Begin implementation of Hoffer Creek stream restoration projects. Partner with county conservation districts, NRCS and FSA to facilitate implementation of management and conservation projects throughout the Conewago Creek Watershed. Priorities and timelines for these projects are anticipated to be established by the conservation districts, NRCS and/or FSA as the case may be.

Within 10 years: Complete implementation of Hoffer Creek stream restoration projects. Begin implementation of stream restoration projects in Little Conewago Creek and Conewago Headwaters and Conewago A.

Within 15 years: Complete implementation of Little Conewago Creek stream restoration projects. Continue implementation of stream restoration projects in Conewago Headwaters and Conewago A.

Within 20 years: Complete implementation of stream restoration projects in Conewago Headwaters and Conewago A. Begin implementation of stream restoration projects in Lynch Run and Brills Run.

Within 25 years: Complete implementation of stream restoration projects in Lynch Run. Continue implementation of stream restoration projects in Brills Run.

Within 30 years: Complete implementation of stream restoration projects in Brills Run and 1st Tributary North. Begin implementation of stream restoration projects in Conewago Creek B and 1st Tributary South.

Within 35 years: Complete implementation of stream restoration projects in Conewago Creek B and 1st Tributary South.

Flexibility and Adaptation

Even though the above priority list and anticipated timeline sets forth a logical road map for implementation of this report, it is of utmost importance that TCCCA and other participating partners remain flexible and adaptive in achieving restoration goals. Opportunities to work with a landowner may arise unexpectedly as a result of community outreach and education efforts. Landowner cooperation or funding opportunities may suddenly become available for projects that are not identified as "high" priority in this report.

TCCCA subscribes to the view that such opportunities need to be seized where they present themselves, even though they may not fall neatly into existing priority rankings or timelines. Implementation of just one project and development of a good working relationship with just one farmer can create momentum that leads to many future projects and increased landowner cooperation throughout the watershed.

VIII. PARTNERS AND FUNDING

TCCCA is the only existing watershed organization for the Conewago Creek. As such, it is expected that much of the work in implementing the restoration plan will be done by that group, as landowner cooperation and funds are secured.

There are, however, several other entities with which TCCCA will partner to implement this plan. These include the Dauphin, Lancaster and Lebanon County Conservation Districts, U.S. Department of Agriculture's local service offices for the Natural Resources Conservation Service and the Farm Service Agency, the Pennsylvania Department of Agriculture 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. TCCCA is privileged to have a strong working relationship with the 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.

Regardless of the number of willing partners and landowners, however, project implementation requires funding. The present cost estimate for implementation of all projects identified in this plan stands at $4.3 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

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 TCCCA, though amounts are unlikely to be sufficient to fund larger projects.

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

IX. PUBLIC PARTICIPATION AND INVOLVEMENT

TCCCA is a volunteer watershed organization made up of Conewago Creek landowners and other stakeholders interested in the Conewago Creek Watershed. As such, TCCCA 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.

TCCCA is actively engaged in outreach and publicity work to educate landowners about watershed protection and restoration issues. TCCCA members speak at local civic organizations and schools, sponsor guest presentations, and run display booths at local events such as community fairs and wild game dinners. Brochures on the importance of stream bank fencing and riparian buffers are distributed at these events. Through this work, TCCCA has the opportunity to meet landowners and discuss the possibility of working with them on stream improvement projects. TCCCA will continue to use these community outreach and educational events as tools to develop partnerships with landowners on potential projects.

TCCCA 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 TCCCA can assist Conewago landowners interested in participating in voluntary stream improvement projects.

TCCCA member Hal Royer installs Black willow live stakes to stabilize an eroded stream bank.

TCCCA also maintains a website at www.conewagocreek.net. The website provides information regarding stream bank fencing and riparian buffers, TCCCA's existing riparian buffer projects, and this restoration plan project. Upon finalization of the plan, TCCCA will update its website to provide more information regarding the restoration plan and the opportunities for Conewago landowners to partner with TCCCA on restoration projects.

TCCCA holds monthly meetings at the Lawn Fire Hall in South Londonderry Township, Lebanon County. Meetings are held the last Wednesday of each month, starting at 7:00 p.m. and are open to the public. Once this restoration plan is finalized, TCCCA will feature a presentation and public discussion of the plan at one of its future meetings. The meeting will be publicized in advance using the TCCCA newsletter and website, as well as press releases to local newspapers, inviting all Conewago landowners to attend.

X. MONITORING RESTORATION PROGRESS

Monitoring Implementation

The 129 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, TCCCA will collaborate with the county conservation districts and USDA local farm agency offices for implementation. It is anticipated that the districts and agencies will establish their own priorities and interim goals consistent with their respective capabilities and missions.

TCCCA will track all projects using these measurables. Interim goals coincide with the priority subwatersheds and anticipated timetables set forth in Section VII. See ***Table 9*** for a summary of the interim milestones for implementation of stream restoration measures.

TABLE 9 Interim Milestones for Implementation

Year	Subwatershed	Milestones
5	main stem project #100	7,341 feet of stream bank restored
	Gallagher Run	16,493 feet of stream bank restored
10	Hoffer Creek	54,825 feet of stream bank restored
15	Little Conewago Creek	31,830 feet of stream bank restored
20	Conewago Headwaters and Conewago Creek A	44,743 feet of stream bank restored
25	Lynch Run	36,120 feet of stream bank restored
30	Brills Run	27,737 feet of stream bank restored
	1^{st} Tributary North	16,565 feet of stream bank restored
35	Conewago Creek B and 1^{st} Tributary South	42,817 feet of stream bank restored

Monitoring Water Quality Improvement

As this restoration plan is implemented, water quality in the Conewago Creek Watershed should improve. Water quality monitoring will be conducted on a regular basis to determine and track progress. Although chemical sampling will be a part of standard monitoring, macroinvertebrate sampling will play the more critical role, is it is the stronger indicator of long term water quality and stream health.

Sampling will consist of the following elements: periodic sampling by PADEP; volunteer stream monitoring by TCCCA; and selected upstream and downstream monitoring at specific restoration sites.

PADEP Sampling. Since excess sediment is the primary cause of benthic biodegradation in the Conewago, 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. Macroinvertebrate sampling will also be conducted, but is not expected to show significant improvement until stream substrate is reestablished.

The initial stream assessments of the Conewago Creek conducted by PADEP and SRBC consisted of sampling at 15 monitoring points throughout the watershed. Once implementation of this restoration plan is underway, PADEP will return to selected monitoring points at least once every five years to measure water quality improvement. Improvement will be demonstrated by reductions in sediment depth, increases in pebble count and, ultimately, reappearance of a diverse macroinvertebrate population at monitoring points throughout the watershed.

TCCCA Volunteer Monitoring Program. TCCCA began monitoring the Conewago in April 2002 by hosting an event known as the Watershed Snapshot. The Watershed Snapshot program is sponsored by PADEP's Citizens Volunteer Monitoring Program whereby volunteer stream monitors from all across the state participate in a day of stream sampling. The Snapshot has become one of TCCCA's most popular activities, drawing wide interest from kids and adults alike. The program was repeated in April 2003 and May 2004. Points sampled at past Snapshots include the main stem Conewago at Aberdeen Mills, Old Hershey Road and Lawn Community Park, and the Little Conewago Creek at Gingrich Road.

TCCCA member Dan Helm and Dauphin County Conservation District watershed specialist Andy McAllister survey macroinvertebrates along the Conewago as part of TCCCA's volunteer monitoring program

In October 2004, TCCCA expanded the Snapshot program by initiating its volunteer stream monitoring program. In partnership with Elizabethtown College and the Dauphin, Lancaster and Lebanon County Conservation Districts, TCCCA has established six monitoring points on the main stem Conewago at the following locations:

- Lawn Community Park
- Prospect Road Bridge
- Aberdeen Mills
- Upstream of Deodate Road Bridge

- Hillsdale Road
- Mouth at Route 441

Each point is monitored twice a year (spring and fall) using PADEP's Watershed Snapshot monitoring protocol. Each point is monitored for temperature, pH, dissolved oxygen, conductivity and alkalinity. In addition, macroinvertebrate samples are taken in order to assess aquatic insect diversity. Habitat assessments involving surveys of riparian cover, adjacent land use, stream channel and substrate are also conducted. Fish surveys are taken at select points when equipment and weather permits.

High school biology students from Milton Hershey School (MHS) also monitor portions of the stream in the spring of each year, following the same sampling protocol. MHS stations are established at the Route 743 bridge and along Old Hershey Road. In November 2005, the Lower Dauphin High School Ecology Club began monitoring Brills Run near its confluence with the Conewago.

Because of uncertainty concerning landowner participation, funding and many other factors, neither TCCCA nor RETTEW can guarantee or commit to any of the specific implementation projects that are recommended in this restoration plan. However, through its continued volunteer monitoring program, TCCCA will be able to gather data necessary to evaluate the future success of any of such projects that are implemented. As the interim implementation goals set forth above are met, it is expected that water quality monitoring results will improve.

Site Specific Monitoring. TCCCA, in cooperation with Elizabethtown College, anticipates establishing site specific stream monitoring at project site #100, the first project to be implemented under this plan. Elizabethtown College students currently conduct stream monitoring downstream of the project area. An additional point is expected to be established upstream of the project. Both points will be monitored prior to and after project implementation on at least an annual basis. Such sampling should provide a good indication whether the project is resulting in water quality improvements. If time and resources allow, TCCCA may seek to conduct additional site specific monitoring at other project locations as they are implemented.

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