Sediment
Total Maximum Daily Load (TMDL)

Crosskill Creek (stream code 09919)
Berks and Lebanon Counties

Pennsylvania Department of Environmental Protection
Southcentral Regional Office, Water Management Program

September 30, 2004

I. Summary of the Crosskill Creek TMDLs

1. This TMDL was developed for a portion of Crosskill Creek, in SWP 07D (Swatara Creek), located in Berks and Lebanon Counties, Pennsylvania. Access to the watershed is available by traveling north from Harrisburg on Interstate 81 and east on Interstate 78 to the Frystown Exit. Crosskill Creek originates north of I-78 in Bethel Township and flows in a southeasterly direction for approximately 4.7 miles before its confluence with Little Swatara Creek near Crosskill Mills. The 18.8 square mile watershed contains a total of 25.7 miles of streams. The entire basin is currently designated as Cold Water Fishes (CWF) under §93.9o in Title 25 of the Pa. Code (Commonwealth of Pennsylvania, 2003). This TMDL report covers only that portion of the watershed located above unnamed tributary 09929, which enters Crosskill Creek southeast of Meckville.

2. A TMDL for the upper Crosskill Creek watershed was developed to address use impairments caused by turbidity and suspended solids. Crosskill Creek first appeared on Pennsylvania's 303(d) list in 1996, when 0.6 miles were listed as impaired by turbidity/suspended solids emanating from upstream agricultural activities. A sediment TMDL was developed to address the impairments identified in the Department's current 305b database. In order to ensure attainment and maintenance of water quality standards in the upper Crosskill Creek watershed, mean annual loading of sediment will need to be limited to 1,790,801 lbs./yr.

   The major components of the Crosskill Creek watershed sediment TMDL are summarized below:

Component	Sediment (lbs./yr.)
TMDL (Total Maximum Daily Load)	**1,790,881**
WLA (Wasteload Allocation)	**0**
MOS (Margin of Safety)	**179,088**
LA (Load Allocation)	**1,611,793**

3. The current mean annual sediment loading to the upper Crosskill Creek is estimated to be 2,133,904 lbs./yr. and will require a 16% overall reduction to meet the TMDL.

4. There are no known point sources of sediment located in the Crosskill Creek watershed; therefore the TMDL does not include a Waste Load Allocations (WLA). Load Allocations (LA) for sediment were made to the following nonpoint sources: hay and pasture lands; croplands; coniferous forest, deciduous forest, mixed forest; transition, low intensity development and stream bank erosion.

5. The sediment TMDL includes a nonpoint source LA of 1,611,793 lbs./yr. Allocations to sources receiving reductions (hay/pasture, cropland, transition, and stream bank erosion) add up to 1,316,993 lbs./yr. Sediment loadings from all other nonpoint sources were maintained at 294,800 lbs./yr. Allocations of sediment to all nonpoint sources in the upper Crosskill Creek watershed are summarized below:

Load Allocations for Sources of Sediment			
Source	**Current Loading (lbs./yr.)**	**Load Allocation (lbs./y.)**	**% Reduction**
Hay and Pasture	55,600	39,815	28%
Cropland	776,200	555,841	28%
Transition	955,400	684,167	28%
Stream Bank Erosion	51,904	37,169	28%
NPS Loads Not Reduced	294,800	294,800	0
Total	2,133,904	1,611,793	24%

6. Ten percent of the Crosskill Creek sediment TMDL was set-aside as a margin of safety (MOS). The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The MOS for the sediment was set at 179,088 lbs./yr.

7. The continuous simulation model used for developing the Crosskill Creek TMDL considered seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions accounts for seasonal variability.

II. Introduction

A. Watershed Description

Crosskill Creek is part of State Water Plan subbasin 07D (Swatara Creek) and is located primarily in western Berks County, Pennsylvania (Figure 1). A very small portion of the watershed drains part of northern Lebanon County. Access to the watershed is available by traveling north from Harrisburg on Interstate 81 and east on Interstate 78 to the Frystown Exit (Rte. 645). Crosskill Creek originates north of I-78 in Bethel Township and flows in a southeasterly direction for approximately 4.7 miles before its confluence with Little Swatara Creek near Crosskill Mills. The 18.8 square mile watershed contains a total of 25.7 miles of streams. This TMDL report covers only that portion of the watershed located above unnamed tributary 09929, which enter Crosskill Creek southeast of Meckville. The upper Crosskill Creek watershed covered by this TMDL consist of 4.5 square miles and 5.1 miles of streams, including Meck Creek.

B. Topography & Geology

The upper Crosskill Creek watershed drains land located in Appalachian Mountain and Great Valley Sections of the Ridge and Valley physiographic province. The Appalachian Mountain Section consists of numerous, long, narrow mountain ridges separated by narrow to wide valleys. The tops of the ridges are always several hundred feet higher than the adjacent valley, and some ridges are more than a thousand feet higher than the adjacent valley. Very tough sandstones occur at the crests of the ridges. Relatively soft shales and siltstones occur in most of the valleys. Some of the valleys are underlain by limestone and dolomite. The shales and siltstones are eroded more easily than the sandstones. As erosion proceeds, the slowly eroded sandstones form ridges while the shales and siltstones are eroded more rapidly to form the lowlands.

The Great Valley Section consists of a very broad lowland area lying south of Blue Mountain in southeastern Pennsylvania. The lowland is characterized by gently undulating hills eroded into shales and siltstones on the north side of the valley and a lower elevation, flatter landscape developed on limestones and dolomites on the south side. The Crosskill Creek watershed is located on the northern edge of the Great Valley. Elevations in the portion of the basin covered by this TMDL ranges from 1,420 feet along the Berks and Schuylkill County lines to 480 feet at the confluence with UNT 09929.

C. Land Use

Land use in the portion of the Crosskill Creek watershed covered by this TMDL report is dominated by forest (57%) and agriculture (40%). Approximately 3.3 miles of streams in the covered watershed flow through agricultural land use. Other land uses, including development, waterbodies and transitional lands account for roughly 3% of the watershed area. Single family homes on fairly large lots (> 5 acres) are becoming increasingly more prevalent in the more heavily forested portions of the watershed.

D. Surface Water Quality

Protected uses of the Crosskill Creek watershed include aquatic life, water supply, and recreation. The entire basin is currently designated as Cold Water Fishes in Title 25 Pa. Code Department of Environmental Protection Chapter 93, Section 93.9o (Commonwealth of Pennsylvania, 2003). A total of 0.7 miles of Crosskill Creek appeared on the Department's 1996-303d list (Table 1). These impairments were identified as being caused by turbidity/suspended solids and bacteria/pathogens emanating from agricultural activities in the watershed and for dissolved oxygen/biological oxygen demand associated with a point source. Portions of the Crosskill Creek watershed are included in the 2004 Integrated List of all Waters as still impaired by suspended solids, dissolved oxygen/biological oxygen demand and pathogens. The old 305b/303d database used to produce the 303d list in the past contained the following statement regarding the point source related impairments to GIS segment 1425 – "TTMA STP DISCHARGE CAUSING ELEVATED BOD IMMEDIATELY BELOW DISCHARGE POINT". "TTMA" is associated with NPDES Permit #PA0070360 (All American Travel Plaza) which discharges to UNT 09921 (UNT to Crosskill Creek) and not the portion of the basin for which this TMDL is being developed. Recent biological surveys have documented impairment from agricultural activities (seg ID 981124-1000-MSE) in the UNT 09921 basin, but

not from point sources. There are no known NPDES permitted facilities located in the portion of the Crosskill Creek watershed covered by GIS segment 1425 or this TMDL.

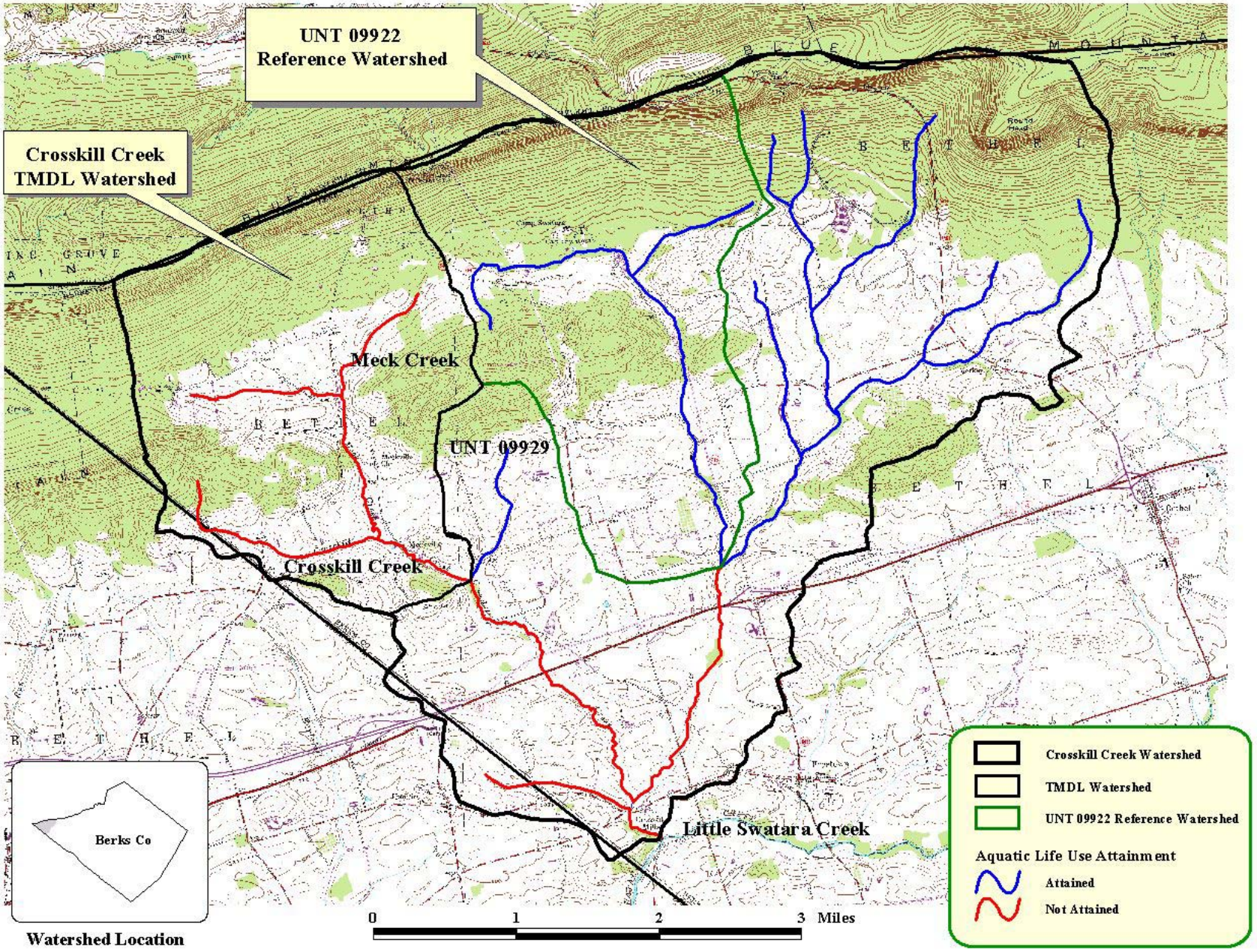
Table 1 - 1996 303(d) and 2004 Integrated Water Quality Monitoring and Assessment Report Listings for Streams in the Crosskill Creek Watershed

1996 303(d) LIST - Crosskill Creek UNT t UNT			
STREAM CODE	**SOURCE**	**CAUSE**	**MILES**
09919	Agriculture	Turbidity/Suspended. Solids Bact/Pathogens	0.6
	Other Point Sources	DO/BOD	0.1

2004 Integrated Water Quality Monitoring and Assessment Report - Crosskill Creek Watershed				
STREAM NAME STREAM CODE	**GIS KEY**	**MILES**	**SOURCE**	**CAUSE**
Crosskill Creek 09919	1425	0.8	Agriculture	Suspended Solids
			Municipal Point Source*	DO/BOD*
	1425b	1.5	Agriculture	Pathogens
	20031028-0004-KRK	2.2	Source Unknown	Pathogens
Meck Creek 09930	20031028-0004-KRK	2.9	Source Unknown	Pathogens

* There are no NPDES permitted discharges located in the portion of the Crosskill Creek basin covered by segment 1425. This source appears to be an error in the 305b/303d database.

Figure 1 - Crosskill Creek Watershed
Berks and Lebanon Counties



III. Approach to TMDL Development

A. Pollutants & Sources

Turbidity/suspended solids and pathogens have been identified as pollutants causing designated use impairments in the portion of the Crosskill Creek watershed above unnamed tributary 09929. Based on information contained in the Department's 305(b) report database and visual observations made during field visits, agricultural activities and streambank erosion appear to be the primary source of the pollutants causing impairment.

B. TMDL Endpoints

In an effort to address impairments in the upper Crosskill Creek watershed caused by turbidity/suspended solids, a Total Maximum Daily Loads (TMDL) was developed for sediment. The pathogen impairments in the portion of the Crosskill Creek watershed covered by this TMDL (GIS segment 1425b) will be addressed as part of a future TMDL developed in response to the 2004 GIS segment 20031028-0004-KRK listing.

C. Reference Watershed Approach

The TMDL developed for the Crosskill Creek watershed addresses sediment. Because neither Pennsylvania nor EPA has instream numerical water quality criteria for this pollutant, a method was developed to implement the applicable narrative criteria. The method employed for the TMDL development is termed the "Reference Watershed Approach." Meeting the water quality objectives specified by these TMDLs will result in the impaired stream segment attaining its designated uses.

The Reference Watershed Approach compares two watersheds, one attaining its uses and one that is impaired based on biological assessments. Both watersheds must have similar land use/cover distributions. Other features such as base geologic formation should be matched to the extent possible; however, most variations can be adjusted in the model. The objective of the process is to reduce the loading rate of pollutants in the impaired stream segment to a level equivalent to, or slightly lower than, the loading rate in the non-impaired, reference segment. This load reduction will result in conditions favorable to the return of a healthy biological community to the impaired stream segments.

D. Selection of the Reference Watershed

In general, three factors are considered when selecting a suitable reference watershed. The first factor is to use a watershed that the Department has assessed and determined to be attaining water quality standards. The second factor is to find a watershed that closely resembles the impaired watershed in physical properties such as land cover/land use, physiographic province, and geology. Finally, the size of the reference watershed should be within 40% of the impaired watershed area. The search for a reference watershed for Crosskill Creek that would satisfy the above characteristics was done by means of a desktop screening using several GIS coverages, including the Multi-Resolution Land Characteristics (MRLC), Landsat-derived land cover/use grid, the Pennsylvania's 305(b) assessed streams database, and geologic rock types

UNT 09922 was selected as the reference watershed for developing the Crosskill Creek sediment TMDL. UNT 09922 is part of the Crosskill Creek watershed, located just east of the portion for which the sediment TMDL was developed (Figure 1). The watershed is part of State Water Plan subbasin 07D. UNT 09922 is identified in the 2004 Integrated List of all Waters as attaining its designated uses, based on sampling done by the Department in 1998 (segment ID 981124-1200-MSE), as part of its ongoing Statewide Surface Water Assessment program.

Drainage area, land use, and other physical characteristics of the upper Crosskill Creek watershed were compared to the UNT 09922 watershed (Table 2). An analysis of value counts for each pixel of the MRLC grid revealed that while land cover/use distributions are not an exact match, both watersheds are similar. Forest and agriculture are the dominant land use in both watersheds. Surficial geology in the upper Crosskill Creek and UNT 09922 watersheds was also compared. Shale makes up 93% of the surface geology in both watersheds. The remainder of the upper Crosskill Creek watershed consists of sandstone (6%) and interbedded sedimentary rocks (1%). The remainder of the reference watershed is comprised of sandstone (7%).

Bedrock geology primarily affects surface runoff and background sediment loads through its influences on soils, landscape, fracture density, and directional permeability. The upper Crosskill Creek and UNT 09922 watersheds are nearly identical in terms of soil types, soil K factor, precipitation, and average runoff (Table 2).

Table 2 - Comparison Between Upper Crosskill Creek and UNT 09922 Watersheds

ATTRIBUTE	WATERSHED	
	Upper Crosskill Creek	**UNT 09922 Reference**
Physiographic Province	Great Valley Section (70%) Appalachian Mountain Section (30%)	Great Valley Section (72%) Appalachian Mountain Section (28%)
Area (ac)	2,861	2,864
Land Use	Forest (57%) Agriculture (40% Development (1%) Waterbodies/Wetlands (1%) Other (1%)	Forest (60%) Agriculture (38%) Waterbodies/Wetlands (1%) Other (1%)
Geology	Shale (93%) Sandstone (6%) Interbedded Sedimentary (1%)	Shale (93%) Sandstone (7%)
Soils	Hazleton-Dekalb-Buchanan - PA022 (90%) Berks-Weikert-Bedington - PA033 (10%)	Hazleton-Dekalb-Buchanan - PA022 (70%) Berks-Weikert-Bedington - PA033 (30%)
Dominant HSG	C (53%) B (42%) D (4%) A (2%)	C (53%) B (36%) D (10%) A (1%)
K Factor	0.23	0.24
23-Yr Ave Rainfall (in)	43.12	43.12
23-Year Ave Runoff (in)	3.55	3.54

IV.Watershed Assessment and Modeling

The sediment TMDL for the upper Crosskill Creek watershed was developed using the ArcView Generalized Watershed Loading Function (AVGWLF) model as described in Appendix B. The AVGWLF model was used to establish existing loading conditions for the upper Crosskill Creek watershed and the UNT 09922 reference watershed. All modeling outputs have been attached to this TMDL as Appendices C and D. DEP staff conducted a field visit to the Crosskill Creek watershed to get a better understanding of existing conditions in the upper and reference basins that might influence the AVGWLF model. No adjustments were made to specific parameters used in the AVGWLF model based on observations made while touring the watersheds. General observations of the individual watershed characteristics include:

Upper Crosskill Creek Watershed

-Limited riparian buffers, particularly in the lower 1/3 of the drainage.
-Livestock densities appeared to be low, but with unrestricted access to stream banks and riparian areas.
-Minor streambank erosion present throughout the basin.

UNT 09922 Reference Watershed

-Strip cropping (corn & soybean) fairly common.
-Woody riparian buffers fairly prevalent throughout the watershed.
-No unrestricted livestock access to streambanks observed.
-Fairly stable streambanks present throughout the watershed.

The AVGWLF model produced information on watershed size, land use, and sediment loading (Tables 3). The sediment loads represent an annual average over the 23 years simulated by the model (1975 to 1998). This information was then used to calculate existing unit area loading rates for the Crosskill Creek and the UNT 09922 reference watersheds.

Unit area loading rates for sediment were estimated for each watershed by dividing the mean annual loadings (lbs./yr.) by the total area (acres). Unit area load estimates for sediment in the upper Crosskill Creek and UNT 09922 watersheds are 752.89 lbs./acre/yr. and 631.86 lbs./acre/yr., respectively (Table 3).

Table 3 - Existing Sediment Loads for the Crosskill Creek and Reference Watersheds

	Upper Crosskill Creek			UNT 09922 Reference		
Pollutant Source	**Area (ac)**	**Mean Annual Loading (lbs./yr.)**	**Unit Area Loading (lbs./ac./yr.)**	**Area (ac)**	**Mean Annual Loading (lbs./yr.)**	**Unit Area Loading (lbs./ac./yr.)**
HAY/PAST	402.8	55,600.0	138.03	328.6	28,400.0	86.43
CROPLAND	738.8	776,200.0	1,050.62	756.1	826,200.0	1,092.71
CONIF_FOR	32.1	400.0	12.46	14.8	-	-
MIXED_FOR	34.6	400.0	11.56	46.9	200.0	4.26
DECID_FOR	1,564.2	292,400.0	186.93	1,648.2	194,000.0	117.70
UNPAVED_RD	-	-	-	2.5	14,400.0	5,760.00
TRANSITION	27.2	955,400.0	35,125.00	34.6	675,800.0	19,531.79
LO_INT_DEV	34.6	1,600.0	46.24	4.9	-	-
Stream Bank		51,904.2			53,324.0	
Total	**2,834.3**	**2,133,904.2**	**752.89**	**2,836.6**	**1,792,324.00**	**631.86**

V. TMDL

The sediment TMDL for the upper Crosskill Creek watershed was established based on the estimated loading rate for sediment in the UNT 09922 reference watershed. UNT 09922 is currently designated as a Cold Water Fishery (CWF) and the latest Statewide Surface Water Assessment Program activity has determined that the basin is attaining its designated uses. Reducing the loading rate of sediment in the upper Crosskill Creek basin to a level equal to, or less than, that of the UNT 09922 reference watershed, will provide conditions favorable for the reversal of current use impairments.

A. Background Pollutant Conditions

There are two separate considerations of background pollutants within the context of this TMDL. First, there is the inherent assumption of the reference watershed approach that because of the similarities between the reference and impaired watershed, the background pollutant contributions will be similar. Therefore, the background pollutant contributions will be considered when determining the loads for the impaired watershed that are consistent with the loads from the reference watershed. Second, the AVGWLF model implicitly considers background pollutant contributions through the soil and the groundwater component of the model process.

B. Targeted TMDL

The targeted TMDL value for sediment (1,790,880.80 lbs/yr) was determined by multiplying the total area of the upper Crosskill Creek watershed (2,834.30 acres) by the appropriate unit area loading rates for the UNT 09922 reference watershed (631.86 lbs/ac/yr).

Targeted TMDL = 2,834.3 acres x 631.86 lbs/ac/yr = 1,790,880.80 lbs/yr

This targeted TMDL value was then used as the basis for load allocations and reductions in the upper Crosskill Creek watershed, using the following two equations:

1. TMDL = WLA + LA + MOS
2. LA = ALA - LNR

where:

TMDL = Total Maximum Daily Load
WLA = Waste Load Allocation (point sources)
LA = Load Allocation (nonpoint sources)
ALA = Adjusted Load Allocation
LNR = Loads not Reduced

C. Wasteload Allocation

The waste load allocation (WLA) portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. Reviewing the Department's permitting files identified no point source discharges of sediment in the Crosskill Creek watershed; therefore WLA was set at zero.

D. Margin of Safety

The margin of safety (MOS) is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for sediment was reserved as the MOS. Using 10% of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of Crosskill Creek. The MOS for the sediment TMDL was set at 179,088.08 lbs./yr.

MOS = 1,790,880.80 lbs./yr. (TMDL) x 0.1 = 179,088.08 lbs./yr.

E. Load Allocation

The load allocation (LA) is that portion of the TMDL that is assigned to nonpoint sources. Since there are no point sources present in the Crosskill Creek watershed, the load allocation for sediment was computed by subtracting the MOS value from the targeted TMDL value. The Load Allocations sediment was 1,611,792.72 lbs./yr.

LA = 1,790,880.80 lbs./yr. (TMDL) – 179,088.08 lbs./yr. (MOS) = 1,611,792.72 lbs./yr.

F. Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those non-point source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Since the Crosskill Creek watershed TMDL was developed to address impairments resulting from agricultural activities and streambank erosion, only these sources were considered for reductions. Sediment reductions were applied to HAY/PASTURE, CROPLAND, TRANSITION and Stream Bank erosion sources. Those land uses/sources for which existing loads were not reduced (CONIF_FOR, MIXED_FOR, DECID_FOR, and LO_INT_DEV) were carried through at their existing loading values (Table 4). The ALA for sediment was 1,316,992.72 lbs./yr.

Table 4 - Load Allocations, Loads Not Reduced, and Adjusted Load Allocations for Crosskill Creek Sediment TMDL	
NPS Allocation	**Sediment (lbs./yr.)**
Load Allocation	**1,611,792.72**
Loads Not Reduced	**294,800.00**
CONIF_FOR	400.0
MIXED_FOR	400.0
DECID_FOR	292,400.0
LO_INT_DEV	1,600.0
Adjusted Load Allocation	**1,316,992.72**

G. TMDLs

The sediment TMDL established for the Crosskill Creek watershed consists of a Load Allocation (LA) and a Margin of Safety (MOS). The individual components of the TMDL are summarized in Table 5.

Table 5 - TMDL, WLA, MOS, LA, LNR, and ALA for Crosskill Creek Watershed	
Component	**Sediment (lbs./yr.)**
TMDL (Total Maximum Daily Load)	1,790,880.80
WLA (Wasteload Allocation)	0
MOS (Margin of Safety)	179,088.08
LA (Load Allocation)	1,611,792.72
LNR (Loads Not Reduced)	294,800.00
ALA (Adjusted Load Allocation)	1,316,992.72

VI. Calculation of Sediment Load Reductions

The adjusted load allocation established in the previous section represents the sediment load that is available for allocation between contributing sources in the Crosskill Creek watershed. Data needed for load reduction analyses, including land use distribution, were obtained by GIS analysis. The Equal Marginal Percent Reduction (EMPR) allocation method (Appendix E) was used to distribute the ALA between the appropriate contributing land uses.

The load allocation and EMPR procedures were performed using MS Excel and results are presented in Appendix F. Table 6 contains the results of the EMPR for sediment for the appropriate contributing land uses in Crosskill Creek watershed. The load allocation for each land use is shown, along with the percent reduction of current loads necessary to reach the targeted LA.

Table 6 - Sediment Load Allocations & Reductions for the Crosskill Creek Watershed						
Pollutant Source	Acres	Unit Area Loading Rate (lbs./ac./yr.)		Pollutant Loading (lbs./yr.)		% Reduction
		Current	Allowable	Current	Allowable (LA)	
HAY/PASTURE	402.80	138.03	98.85	55,600.00	39,815.47	28%
CROPLAND	738.80	1,050.62	752.36	776,200.00	555,841.13	28%
TRANSITION	27.20	35,125.00	25,153.21	995,400.00	684,167.24	28%
Stream Bank	-	-	-	51,904.20	37,168.89	28%
Total				**1,839,104.20**	**1,316,992.72**	**28%**

VII. Consideration of Critical Conditions

The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads, based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading calculations.

VIII. Consideration of Seasonal Variations

The continuous simulation model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

IX.Recommendations for Implementation

TMDLs represent an attempt to quantify the pollutant load that may be present in a waterbody and still ensure attainment and maintenance of water quality standards. The Crosskill Creek TMDL identifies the necessary overall load reduction for the pollutant currently causing use impairments and distributes that reduction goal to the appropriate nonpoint sources. Reaching the reduction goal established by this TMDL will only occur through changes in current land use practices, including the incorporation of more agricultural "best management practices" (BMPs). BMPs that would be helpful in lowering the amount of sediment reaching Crosskill Creek include stream bank fencing, riparian buffer strips, strip cropping, contour plowing, and heavy use area protection, among many others.

The Natural Resources Conservation Service maintains a National Handbook of Conservation Practices (NHCP), which provides information on a variety of BMPs. The NHCP is available online at http://www.ncg.nrcs.usda.gov/nhcp_2.html. Many of the practices described in the handbook could be used on agricultural lands in the Crosskill Creek watershed to help limit sediment loading to the creek. Determining the most appropriate BMPs, where they should be installed, and actually putting them into practice, will require the development and implementation of a comprehensive watershed restoration plan. Development of any restoration plan will involve the gathering of site-specific information regarding current land uses and existing conservation practices. The required level of detail is outside the scope of this TMDL document and is an activity best accomplished at the local level. Successful implementation of the activities necessary to address current use impairments to Crosskill Creek will require local citizens taking an active interest in the watershed and the enthusiastic cooperation of local landowners.

By developing the sediment TMDL for the Crosskill Creek watershed, the Department has set the stage for local citizens to design and implement restoration plans to correct current use impairments. The Department will support local efforts to develop and implement watershed restoration plans based on the reduction goals specified in this TMDL. Interested parties should contact the appropriate Watershed Manager in the Department's Southcentral Regional Office (717-705-4700) for information regarding technical and financial assistance currently available. Individuals and/or local watershed groups

interested in "fixing" the identified problems in the Crosskill Creek watershed are strongly encouraged to avail themselves of funding sources available through DEP and other state and federal agencies (e.g., Growing Greener or 319 Program).

X. Public Participation

A notice of availability for comments on the draft Crosskill Creek watershed TMDLs was published in the PA Bulletin on August 14, 2004 and on the Department's web page shortly thereafter. In addition, a public meeting was held on August 31, 2004 in the Bethel Township Community Center Bethel, PA to address any outstanding concerns regarding the draft TMDL. A notice on the public meeting was published in the Reading Eagle newspaper on August 16, 2004. A 30-day period (ending on September 13, 2004) was provided for the submittal of comments. Only a single set of comments were received on the draft TMDL report during the comment period. These comments and the Departments response are included in Appendix G.

Notice of final TMDL approval will be posted on the Department's website and published in the PA Bulletin.

Appendix A - Information Sheet for Crosskill Creek Watershed Sediment TMDL

What is being proposed?

A Total Maximum Daily Load (TMDL) has been developed to improve water quality in the Crosskill Creek watershed.

Who is proposing the plans? Why?

The Pennsylvania Department of Environmental Protection (PADEP) is proposing to submit the plans to the U.S. Environmental Protection Agency (U.S. EPA) for review and approval as required by federal regulation. In 1995, U.S. EPA was sued for not developing TMDLs when Pennsylvania failed to do so. PADEP has entered into an agreement with U.S. EPA to develop TMDLs for certain specified waters over the next several years. This TMDL was developed in compliance with the state/U.S. EPA agreement.

What is a TMDL?

A TMDL sets a ceiling on the pollutant loads that can enter a waterbody so that it will meet water quality standards. The Clean Water Act requires states to list all waters that do not meet their water quality standards even after pollution controls required by law are in place. For these waters, the state must calculate how much of a substance can be put in the water without violating the standard, and then distribute that quantity to all sources of the pollutant on that water body. A TMDL plan includes waste load allocations for point sources, load allocations for nonpoint sources, and a margin of safety. The Clean Water Act requires states to submit their TMDLs to U.S. EPA for approval. Also, if a state does not develop the TMDL, the Clean Water Act states that U.S. EPA must do so.

What is a water quality standard?

The Clean Water Act sets a national minimum goal that all waters are to be "fishable" and "swimmable." To support this goal, states must adopt water quality standards. Water quality standards are state regulations that have two components. The first component is a designated use, such as "warm water fishes" or "recreation." States must assign a use, or several uses to each of their waters. The second component relates to the instream conditions necessary to protect the designated use(s). These conditions or "criteria" are physical, chemical, or biological characteristics such as temperature and minimum levels of dissolved oxygen, and maximum concentrations of toxic pollutants. It is the combination of the "designated use" and the "criteria" to support that use, which make up a water quality standard. If any criteria are being exceeded, then the use is not being meet and the water is said to be in violation of water quality standards.

What is the purpose of the TMDL?

Turbidity and suspended solids impair Crosskill Creek. This TMDL includes a calculation of the sediment loadings that will meet water quality objectives.

Why was Crosskill Creek watershed selected for TMDL development?

In 1996, Pa. DEP listed a portion of the Crosskill Creek watershed under Section 303(d) of the federal Clean Water Act as impaired due to turbidity and suspended solids resulting from agricultural activities.

What pollutants does this TMDL address?

The proposed TMDL provides a calculation of the stream's total capacity to accept sediment.

Where do the pollutants come from?

The sediment related impairments in the Crosskill Creek watershed come from nonpoint sources (NPS) of pollution, primarily overland runoff from agricultural land uses and stream bank erosion.

How was the TMDL developed?

PADEP used a reference watershed approach to estimate the necessary sediment loading that would be needed to restore a healthy aquatic community. The reference watershed approach is based on selecting a non-impaired watershed that has similar land use characteristics and determining the current loading rates for the pollutant of interest. This is done by modeling the loads that enter the stream, using precipitation and land use characteristic data. For this analysis, PADEP used the AVGWLF model (the Environmental Resources Research Institute of the Pennsylvania State University's ArcView based version of the Generalized Watershed Loading Function model developed by Cornell University). This modeling process uses loading rates in the non-impaired watershed as a target for load reductions in the impaired watershed. The impaired watershed is modeled to determine the current loading rates and determine what reductions are necessary to meet the loading rates of the non-impaired watershed. The reference stream approach was used to set allowable loading rates in the affected watershed because neither Pennsylvanian nor U.S. EPA has water quality criteria for sediment.

How much pollution is too much?

The allowable amount of pollution in a water body varies depending on several conditions. TMDLs are set to meet water quality standards at the critical flow condition. For a free flowing stream impacted by nonpoint source pollution loading of sediment, the TMDL is expressed as an annual loading. This accounts for pollution contributions over all stream flow conditions. PADEP established the water quality objectives for sediment by using the reference watershed approach. This approach assumes that the impairment is eliminated when the impaired watershed achieves loadings similar to the reference watershed. Reducing the current loading rate for sediment in the impaired watershed, to the current loading rate in the reference watershed, will result in meeting the water quality objectives.

What are the major components of this TMDL?

The major components of the Crosskill Creek watershed sediment TMDL are summarized below:

Component	Sediment (lbs./yr.)
TMDL (Total Maximum Daily Load)	**1,790,881**
WLA (Wasteload Allocation)	**0**
MOS (Margin of Safety)	**179,088**
LA (Load Allocation)	**1,611,793**

How will the loading limits be met?

Best Management Practices (BMPs) will be encouraged throughout the watershed to achieve the necessary load reductions.

How can I get more information on the TMDL?

To request a copy of the full report, contact Joseph P. Hepp at 717-705-4788 during the business hours of 8:00 a.m. to 3:00 p.m., Monday through Friday. One may also contact Mr. Hepp by mail at the Water Management Program, SCRO PADEP, 909 Elmerton Avenue Harrisburg, PA 17110 or by e-mail at jhepp@.state.pa.us.

How can I comment on the proposal?

You may provide e-mail or written comments postmarked no later than September 13, 2004 to the above addresses.

Appendix B - AVGWLF Model Overview & GIS-Based Derivation of Input Data

TMDLs for the Crosskill Creek watershed were developed using the Generalized Watershed Loading Function or GWLF model. The GWLF model provides the ability to simulate runoff, sediment, and nutrient (N and P) loadings from watershed given variable-size source areas (e.g., agricultural, forested, and developed land). It also has algorithms for calculating septic system loads, and allows for the inclusion of point source discharge data. It is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment and nutrient loads, based on the daily water balance accumulated to monthly values.

GWLF is a combined distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios. Each area is assumed to be homogenous in regard to various attributes considered by the model. Additionally, the model does not spatially distribute the source areas, but aggregates the loads from each area into a watershed total. In other words, there is no spatial routing. For sub-surface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for sub-surface flow contributions. Daily water balances are computed for an unsaturated zone as well as a saturated sub-surface zone, where infiltration is computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

GWLF models surface runoff using the Soil Conservation Service Curve Number (SCS-CN) approach with daily weather (temperature and precipitation) inputs. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation (USLE) algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (e.g., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss erosion (K), the length slope factor (LS) the vegetation cover factor (C) and conservation practices factor (P). A sediment delivery ratio based on watershed size and transport capacities based on average daily runoff are applied to the calculated erosion to determine sediment yield for each source area. Surface nutrient losses are determined by applying dissolved N and P coefficients to surface runoff and a sediment coefficient to the yield portion for each agricultural source area. Point source discharges can also contribute to dissolved losses to the stream and are specified in terms of kilograms per month. Manured areas, as well as septic systems, can also be considered. Urban nutrient inputs are all assumed to be solid-phase, and the model uses an exponential accumulation and washoff function for these loadings. Sub-surface losses are calculated using dissolved N and P coefficients for shallow groundwater contributions to stream nutrient loads, and the sub-surface sub-model only considers a single, lumped-parameter contributing area. Evapotranspiration is determined using daily weather data and a cover factor dependent upon land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values. All of the equations used by the model can be viewed in GWLF Users Manuel, available from the Department's Bureau of Watershed Conservation, Division of Assessment and Standards.

For execution, the model requires three separate input files containing transport-, nutrient-, and weather-related data. The transport (TRANSPRT.DAT) file defines the necessary parameters for each source area to be considered (e.g., area size, curve number, etc.) as well as global parameters (e.g., initial storage, sediment delivery ratio, etc.) that apply to all source areas. The nutrient (NUTRIENT.DAT) file specifies the various loading parameters for the different source areas identified (e.g., number of septic systems, urban source area accumulation rates, manure concentrations, etc.). The weather (WEATHER.DAT) file contains daily average temperature and total precipitation values for each year simulated.

The primary sources of data for this analysis were geographic information system (GIS) formatted databases. A specially designed interface was prepared by the Environmental Resources Research Institute of the Pennsylvania State University in ArcView (GIS software) to generate the data needed to run the GWLF model, which was developed by Cornell University. The new version of this model has been named AVGWLF (ArcView Version of the Generalized Watershed Loading Function)

In using this interface, the user is prompted to identify required GIS files and to provide other information related to "non-spatial" model parameters (e.g., beginning and end of the growing season, the months during which manure is spread on agricultural land and the names of nearby weather stations). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.DAT, NUTRIENT.DAT and WEATHER.DAT input files needed to execute the GWLF model. For use in Pennsylvania, AVGWLF has been linked with statewide GIS data layers such as land use/cover, soils, topography, and physiography; and includes location-specific default information such as background N and P concentrations and cropping practices. Complete GWLF-formatted weather files are also included for eighty weather stations around the state. The following table lists the statewide GIS data sets and provides an explanation of how they were used for development of the input files for the GWLF model.

GIS Data Sets	
DATASET	DESCRIPTION
Censustr	Coverage of Census data including information on individual homes septic systems. The attribute *usew_sept* includes data on conventional systems, and *sew_other* provides data on short-circuiting and other systems.
County	The County boundaries coverage lists data on conservation practices, which provides C and P values in the Universal Soil Loss Equation (USLE).
Gwnback	A grid of background concentrations of N in groundwater derived from water well sampling.
Landuse5	Grid of the MRLC that has been reclassified into five categories. This is used primarily as a background.
Majored	Coverage of major roads. Used for reconnaissance of a watershed.
MCD	Minor civil divisions (boroughs, townships and cities).
Npdespts	A coverage of permitted point discharges. Provides background information and cross check for the point source coverage.
Padem	100-meter digital elevation model. This used to calculate landslope and slope length.
Palumrlc	A satellite image derived land cover grid that is classified into 15 different landcover categories. This dataset provides landcover loading rate for the different categories in the model.
Pasingle	The 1:24,000 scale single line stream coverage of Pennsylvania. Provides a complete network of streams with coded stream segments.
Physprov	A shapefile of physiographic provinces. Attributes *rain_cool* and *rain_warm* are used to set recession coefficient
Pointsrc	Major point source discharges with permitted N and P loads.
Refwater	Shapefile of reference watersheds for which nutrient and sediment loads have been calculated.
Soilphos	A grid of soil phosphorous loads, which has been generated from soil sample data. Used to help set sediment and sediment values.
Smallsheds	A coverage of watersheds derived at 1:24,000 scale. This coverage is used with the stream network to delineate the desired level watershed.
Statsgo	A shapefile of generalized soil boundaries. The attribute *mu_k* sets the k factor in the USLE. The attribute *mu_awc* is the unsaturated available capacity., and the *muhsg_dom* is used with landuse cover to derive curve numbers.
Strm305	A coverage of stream water quality as reported in the Pennsylvania's 305(b) report. Current status of assessed streams.
Surfgeol	A shapefile of the surface geology used to compare watersheds of similar qualities.
T9sheds	Data derived from a DEP study conducted at PSU with N and P loads.
Zipcode	A coverage of animal densities. Attribute *aeu_acre* helps estimate N & P concentrations in runoff in agricultural lands and over manured areas.
Weather Files	Historical weather files for stations around Pennsylvania to simulate flow.

GWLF Transport Summary for CrosskillCr_Apr08_

Period of analysis: 23 years, from Apr 1975 to Mar 1998

	Units in Inches				
Month	Precip	Evapotrans	Gr. Wat. Flow	Runoff	Streamflow
APR	3.68	0.57	3.02	0.31	3.33
MAY	4.42	2.30	2.34	0.21	2.55
JUN	3.73	4.50	1.08	0.08	1.16
JUL	4.55	5.51	0.34	0.18	0.51
AUG	3.32	3.80	0.10	0.09	0.18
SEP	3.84	2.49	0.04	0.34	0.38
OCT	3.46	1.25	0.43	0.25	0.67
NOV	3.64	0.51	1.17	0.32	1.49
DEC	3.08	0.16	2.10	0.38	2.48
JAN	3.47	0.05	1.90	0.57	2.47
FEB	2.46	0.09	2.27	0.44	2.71
MAR	3.47	0.30	3.20	0.39	3.58
Total	43.12	21.54	17.99	3.55	21.53

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GWLF Nutrient Summary for CrosskillCr_Apr08_04

Period of analysis: 23 years, from Apr 1975 to Mar 1998

	Tons		Nutrient Loads (Pounds)			
Month	Erosion	Sediment	Dis. Nitr.	Tot. Nitr.	Dis. Phos.	Tot. Phos
APR	728.41	24.78	2442.03	2591.09	60.43	92.51
MAY	938.03	33.08	1834.97	2033.77	57.78	100.53
JUN	686.10	25.71	833.24	987.72	24.79	58.00
JUL	1065.83	50.47	402.43	705.37	28.47	93.52
AUG	646.79	21.60	164.34	293.98	7.78	35.62
SEP	427.29	79.85	372.67	851.84	23.39	126.26
OCT	332.91	82.31	570.69	1064.62	23.73	129.77
NOV	299.06	105.37	1161.15	1793.54	37.68	173.47
DEC	191.31	137.16	1810.20	2633.48	75.83	252.63
JAN	98.51	166.25	1822.39	2820.20	95.08	309.34
FEB	69.77	154.63	1988.04	2916.10	86.14	285.43
MAR	204.37	158.72	2660.49	3613.17	69.09	273.69
Total	5688.37	1039.92	16062.66	22304.88	590.19	1930.76

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GWLF Total Loads for CrosskillCr_Apr08_04

Period of analysis: 23 years, from Apr 1975 to Mar 1998

Source	(Acres) Area	(in) Runoff	(Tons) Erosion	(Tons) Sediment	Total Loads (Pounds) Dis. Nitr.	Tot. Nitr.	Dis. Phos.	Tot. Phos.
HAY/PAST	402.8	3.16	151.90	27.80	765.97	932.76	85.09	120.90
CROPLAND	738.8	5.30	2120.72	388.09	2364.53	4693.09	260.11	759.97
CONIF_FOR	32.1	2.73	1.08	0.20	3.77	4.95	0.12	0.37
MIXED_FOR	34.6	2.73	1.24	0.23	4.06	5.42	0.13	0.42
DECID_FOR	1564.2	2.73	798.90	146.20	183.60	1060.79	5.80	194.10
TRANSITION	27.2	7.89	2610.21	477.67	140.85	3006.86	9.71	624.95
LO_INT_DEV	34.6	5.72	4.32	0.79	0.00	0.10	0.00	0.01
Stream Bank				25.95		2.60		1.14
Groundwater					12572.51	12572.51	229.23	229.23
Point Sources					0.00	0.00	0.00	0.00
Septic Syst.					27.37	27.37	0.00	0.00
Totals	2834.3	3.50	5688.4	1067.0	16062.66	22306.45	590.19	1931.10

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Source	Area (ac)	Runoff (in)	Erosion (in)	Sed (tons)	Sed (lbs/yr))	Dis N (lbs/yr)	Tot N (lbs/yr)	Dis P (lbs/yr)	Tot P (lbs/yr)
HAY/PAST	402.80	3.16	151.90	27.80	55,600.00	766.00	932.80	85.10	120.90
CROPLAND	738.80	5.30	2,120.72	388.10	776,200.00	2,364.50	4,693.10	260.10	760.00
CONIF_FOR	32.10	2.73	1.08	0.20	400.00	3.80	5.00	0.10	0.40
MIXED_FOR	34.60	2.73	1.24	0.20	400.00	4.10	5.40	0.10	0.40
DECID_FOR	1,564.20	2.73	798.90	146.20	292,400.00	183.60	1,060.80	5.80	194.10
TRANSITION	27.20	7.89	2,610.21	477.70	955,400.00	140.90	3,006.90	9.70	625.00
LO_INT_DEV	34.60	5.72	4.32	0.80	1,600.00	-	0.10	-	-
Stream Bank				25.95	51,904.20		2.60		1.14
Groundwater						12,572.50	12,572.50	229.20	229.20
Point Source						-	-	-	-
Septic Systems						27.40	27.40	-	-
Total	**2,834.30**	**30.26**	**5,688.37**	**1,066.95**	**2,133,904.20**	**16,062.80**	**22,306.60**	**590.10**	**1,931.14**
				Reducable	831,800.00		5,625.90		880.90
				LNR	1,302,104.20		16,680.70		1,050.24
				Total	2,133,904.20		22,306.60		1,931.14

GWLF Transport Summary for UNT09922_Ref_Ap

Period of analysis: 23 years, from Apr 1975 to Mar 1998

	Units in Inches				
Month	Precip	Evapotrans	Gr. Wat. Flow	Runoff	Streamflow
APR	3.68	0.52	3.06	0.31	3.36
MAY	4.42	2.25	2.39	0.21	2.60
JUN	3.73	4.45	1.11	0.08	1.19
JUL	4.55	5.54	0.35	0.18	0.52
AUG	3.32	3.83	0.10	0.09	0.19
SEP	3.84	2.50	0.04	0.34	0.38
OCT	3.46	1.24	0.42	0.25	0.67
NOV	3.64	0.49	1.18	0.32	1.50
DEC	3.08	0.16	2.10	0.38	2.48
JAN	3.47	0.04	1.90	0.57	2.47
FEB	2.46	0.08	2.28	0.44	2.72
MAR	3.47	0.27	3.21	0.39	3.60
Total	43.12	21.38	18.15	3.54	21.69

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GWLF Nutrient Summary for UNT09922_Ref_Apr_08_04

Period of analysis: 23 years, from Apr 1975 to Mar 1998

	Tons		Nutrient Loads (Pounds)			
Month	Erosion	Sediment	Dis. Nitr.	Tot. Nitr.	Dis. Phos.	Tot. Phos
APR	611.74	20.70	2468.28	2592.86	60.78	85.70
MAY	787.78	27.63	1870.19	2036.30	58.03	91.22
JUN	576.20	21.48	854.02	983.10	25.02	50.80
JUL	895.12	42.15	410.14	663.13	28.29	78.74
AUG	543.20	18.04	167.46	275.77	7.82	29.42
SEP	358.86	66.68	367.02	767.17	23.02	102.80
OCT	279.59	68.74	566.46	978.97	23.57	105.81
NOV	251.16	88.02	1164.94	1693.26	37.58	142.93
DEC	160.67	114.58	1812.71	2500.50	74.95	212.13
JAN	82.73	138.88	1822.09	2655.67	93.54	259.77
FEB	58.59	129.15	1990.93	2766.15	85.16	239.77
MAR	171.63	132.52	2673.36	3468.87	69.19	227.85
Total	4777.27	868.58	16167.59	21381.76	586.95	1626.95

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GWLF Total Loads for UNT09922_Ref_Apr_08_04

Period of analysis: 23 years, from Apr 1975 to Mar 1998

Source	(Acres) Area	(in) Runoff	(Tons) Erosion	(Tons) Sediment	Total Loads (Pounds) Dis. Nitr.	Tot. Nitr.	Dis. Phos.	Tot. Phos.
HAY/PAST	328.6	3.16	77.85	14.17	625.00	710.00	69.43	86.38
CROPLAND	756.1	5.30	2269.69	413.08	2419.89	4898.39	266.20	760.25
CONIF_FOR	14.8	2.73	0.12	0.02	1.74	1.87	0.05	0.08
MIXED_FOR	46.9	2.73	0.70	0.13	5.51	6.27	0.17	0.33
DECID_FOR	1648.2	2.73	532.79	96.97	193.46	775.27	6.11	122.08
UNPAVED_RD	2.5	7.89	39.43	7.18	12.80	55.86	0.88	9.47
TRANSITION	34.6	7.89	1856.46	337.88	179.27	2206.52	12.36	416.46
LO_INT_DEV	4.9	5.72	0.23	0.04	0.00	0.00	0.00	0.00
Stream Bank				26.66		2.67		1.17
Groundwater					12729.92	12729.92	231.73	231.73
Point Sources					0.00	0.00	0.00	0.00
Septic Syst.					0.00	0.00	0.00	0.00
Totals	2836.8	3.50	4777.3	896.2	16167.59	21386.78	586.95	1627.95

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Source	Area (ac)	Runoff (in)	Erosion (in)	Sed (tons)	Sed (lbs/yr))	Dis N (lbs/yr)	Tot N (lbs/yr)	Dis P (lbs/yr)	Tot P (lbs/yr)
HAY/PAST	328.60	3.16	77.85	14.20	28,400.00	625.00	710.00	69.40	86.40
CROPLAND	756.10	5.30	2,269.69	413.10	826,200.00	2,419.90	4,898.40	266.20	760.30
CONIF_FOR	14.80	2.73	0.12	-	-	1.70	1.90	0.10	0.10
MIXED_FOR	46.90	2.73	0.70	0.10	200.00	5.50	6.30	0.20	0.30
DECID_FOR	1,648.20	2.73	532.79	97.00	194,000.00	193.50	775.30	6.10	122.10
UNPAVED_RD	2.50	7.89	39.43	7.20	14,400.00	12.80	55.90	0.90	9.50
TRANSITION	34.60	7.89	1,856.46	337.90	675,800.00	179.30	2,206.50	12.40	416.50
LO_INT_DEV	4.90	5.72	0.23	-	-	-	-	-	-
Stream Bank				26.66	53,324.00		2.67		1.17
Groundwater					-	12,729.90	12,729.90	231.70	231.70
Point Source					-	-	-	-	-
Septic Systems					-	-	-	-	-
Total	**2,836.60**	**38.15**	**4,777.27**	**896.16**	**1,792,324.00**	**16,167.60**	**21,386.87**	**587.00**	**1,628.07**

Appendix E - Equal Marginal Percent Reduction Method

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing nonpoint sources. The load allocation and EMPR procedures were performed using MS Excel and results are presented in Appendix F. The 5 major steps identified in the spreadsheet are summarized below:

Step 1: Calculation of the TMDL based on impaired watershed size and unit area loading rate of reference watershed.

Step 2: Calculation of Adjusted Load Allocation based on TMDL, Margin of Safety, and existing loads not reduced.

Step 3: Actual EMPR Process:

a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of EMPR.

b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

Step 4: Calculation of total loading rate of all sources receiving reductions.

Step 5: Summary of existing loads, final load allocations, and % reduction for each pollutant source.

Appendix F - Equal Marginal Percent Reduction Calculations for Crosskill Creek

Sediment

Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (TMDL total load - MOS) - uncontrollable						
	Load = Sed loading rate in ref. * Acres					1,316,992.72	1,316,992.72					
	1,790,880.80							WLA =	-			
								MOS =	179,088.08			
								LA =	1,611,792.72			
								ALA =	1,316,992.72			
Step 3:		Annual Average Load	Load Sum	Check	Initial Adjust	Recheck	% reduction allocation	Load Reduction	Initial LA	Acres	Allowable Loading Rate	% Red.
	Hay/Past.	55,600.00	1,839,104.20	good	55,600.00	ADJUST	0.03	15,784.53	39,815.47	402.80	98.85	28%
	Cropland	776,200.00		good	776,200.00	522,111.48	0.42	220,358.87	555,841.13	738.80	752.36	28%
	Transition	955,400.00		good	955,400.00		0.52	271,232.76	684,167.24	27.20	25,153.21	28%
	Stream Bank	51,904.20		good	51,904.20		0.03	14,735.31	37,168.89			28%
		1,839,104.20			1,839,104.20		1.00		1,316,992.72	1,168.80		
Step 4:	All NPS Loading Rate	521.77										
Step 5:		Acres	Allowable (Target) Loading	Final LA	Current Loading Rates	Current Load	% Red.					
	Final Hay/Past. LA	402.80	98.85	39,815.47	138.03	55,600.00	28%					
	Final Cropland LA	738.80	752.36	555,841.13	1,050.62	776,200.00	28%					
	Transition	27.20	25,153.21	684,167.24	35,125.00	955,400.00	28%					
	Stream Bank	-	-	37,168.89	-	51,904.20	28%					
	Total	1,168.80	-	1,316,992.72	-	1,839,104.20	28%					

Commentor:
Honorable Shelia Miller
State Representative
129th legislative district

Comment:

Thanks you for providing me with the opportunity to dialogue with you on the designation of Crosskill Creek (09919) in Berks and Lebanon counties as an impaired tributary to the Swatara Creek. I appreciated your comments that this stream will not take Herculean efforts to reduce sediment pollution in order to lift the impaired status that was determined in the late 1990's.

I am concerned that the conservation efforts are being focused predominantly on the agricultural community, even though sedimentation and pollution are also attributed to other land uses in the watershed. While I understand it is far easier to identify and target the farmers, the forestland owners should also be encouraged to to develop management plans for their acreage. Single-family homeowners, as well, should be educated on the on lot septic tank management and conservation practices that can be applied to their properties.

I also encourage the Department to make funding available directly to farmers for implementing best management practices on their land. Many may already be cooperators with the county conservation district and federal programs for soil conservation. Because this watershed has been selected for impairment reduction and the farm community is being asked to provide the greatest effort in this goal, I feel it is important to prioritize the Growing Greener grant to these individuals for direct application of conservation on the land.

I am requesting that Mary Golab provide my office with information on the application process and the necessary paperwork that would have to be completed. I am also suggesting this process be made as simple as possible for landowners to complete apply for grant funding. I will be doing my part to inform these landowners of the availability of funding for best management practices through the Department of Environmental Protection.

Response:

We appreciate your interest and enthusiasm in making improvements in the Crosskill Creek Watershed.

As we worked on and subsequently completed our analysis of the sediment problem in Crosskill Creek, we have determined that agricultural inputs of sediment are the predominant reason for the impairment seen in the stream. We do acknowledge that the stream receives sediment input from other sources, particularly from transitional land uses. Therefore, the final version of the sediment TMDL includes a load reduction for transitional lands. However, other land uses such as forested areas are providing loading to the stream at levels much lower than the agricultural and transitional land uses and within an acceptable range for that land cover. Agricultural and transitional lands are contributing a much larger loading per unit area (lbs/acre), and if reduced in the amount we have described, should show a significant improvement in water quality in the Crosskill Creek.

We understand your interest in making funding available directly to farmers for implementing best management practices on their land. Your request has been passed along to the appropriate DEP watershed manager, who will contact you to see what can be done to help the farmers work their way through the various grant programs. The Department looks forward to establishing a partnership with your constituents.