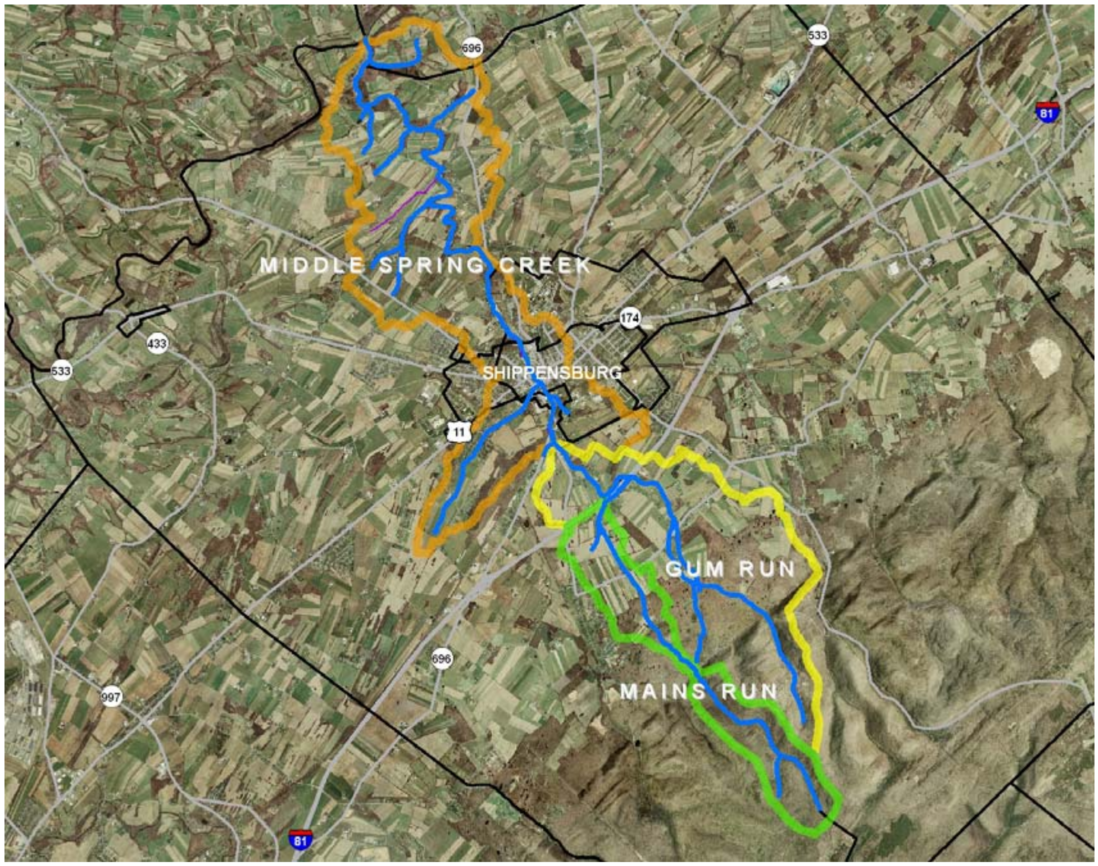
WATERSHED IMPLEMENTATION PLAN

December 2009

Middle Spring Creek
Gum Run & Mains Run

Cumberland and Franklin Counties, Pennsylvania



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Cumberland County Conservation District

RETTEW We answer to you.

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This plan was prepared for the Cumberland County Conservation District.

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

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ACRONYMS LISTING

TMDL(s)	Total Maximum Daily Load(s)
BMP(s)	Best Management Practice(s)
GIS	Geographic Information Systems
GPS	Global Positioning System
EPA	United States Environmental Protection Agency
PFBC	Pennsylvania Fish and Boat Commission
PADEP	Pennsylvania Department of Environmental Protection
CCCD	Cumberland County Conservation District
MSWA	Middle Spring Watershed Association
RETTEW	Rettew Associates, Inc.
ICE Protocol	PADEP's "Instream Comprehensive Evaluation Surveys" protocol

I. INTRODUCTION

Study areas discussed in this watershed implementation plan include the majority of the Middle Spring Creek Watershed and tributaries Gum Run and Mains Run. However tributaries Burd Run (a tributary to Middle Spring Creek), Thomson Creek (a tributary to Burd Run), Furnace Run (a tributary to Middle Spring Creek) and Shirley Run (a tributary to Furnace Run) are not discussed in this plan.

Burd Run, Thomson Creek, Furnace Run and Shirley Run are excluded because they are not impaired and were purposely excluded from the December 2000 Total Maximum Daily Loads (TMDLs) for the Conodoguinet Creek Watershed.

TMDLs have been developed for Middle Spring Creek, Gum Run and Mains Run. As noted above, these TMDLs were developed as part of a larger effort concerning the Conodoguinet Creek Watershed.

Middle Spring Creek at Middle Spring

To clarify stream order, Mains Run is a tributary to Gum Run, Gum Run is a tributary to Middle Spring Creek, and Middle Spring Creek is a tributary to Conodoguinet Creek. Mains Run, Gum Run and Middle Spring Creek are located in both Cumberland and Franklin Counties, Pennsylvania.

According to Pennsylvania's 1998 303 (d) List of Impaired Waters, 5.87 miles of Middle Spring Creek are impaired; likewise 7.79 miles of Gum Run and 5.28 miles of Mains Run are impaired. Biological surveys indicate the impairment is due to siltation caused by agriculture, stormwater runoff from urban areas, and habitat modification. Therefore sediment introduction and channel erosion are of utmost concern when considering restoration of these streams. Established TMDLs for the subject watersheds focus on reducing sediment loading rates on an annual basis. Please note the December 2000 TMDL was based on the 1998 303 (d) List of Impaired Waters, however the 2008 303 (d) List of Impaired Waters identifies the same impaired reaches within the Middle Spring Creek Watershed.

In August of 2008, Cumberland County Conservation District (CCCD) entered into contractual agreement with RETTEW Associates, Inc. (RETTEW), a Lancaster County based engineering and environmental consulting firm, to prepare a watershed implementation plan (this very plan) for the subject watersheds. Funding for plan preparation was provided by the Pennsylvania Department of Environmental Protection (PADEP) and the United States Environmental Protection Agency (EPA) through the Section 319 Program under the Federal Clean Water Act. RETTEW began collecting field data in September of 2008 and completed data collection by

March of 2009. Data was processed and modeled using PADEP's "Predict" modeling tool in March of 2009 and the watershed implementation plan was finalized in December of 2009.

II. BACKGROUND

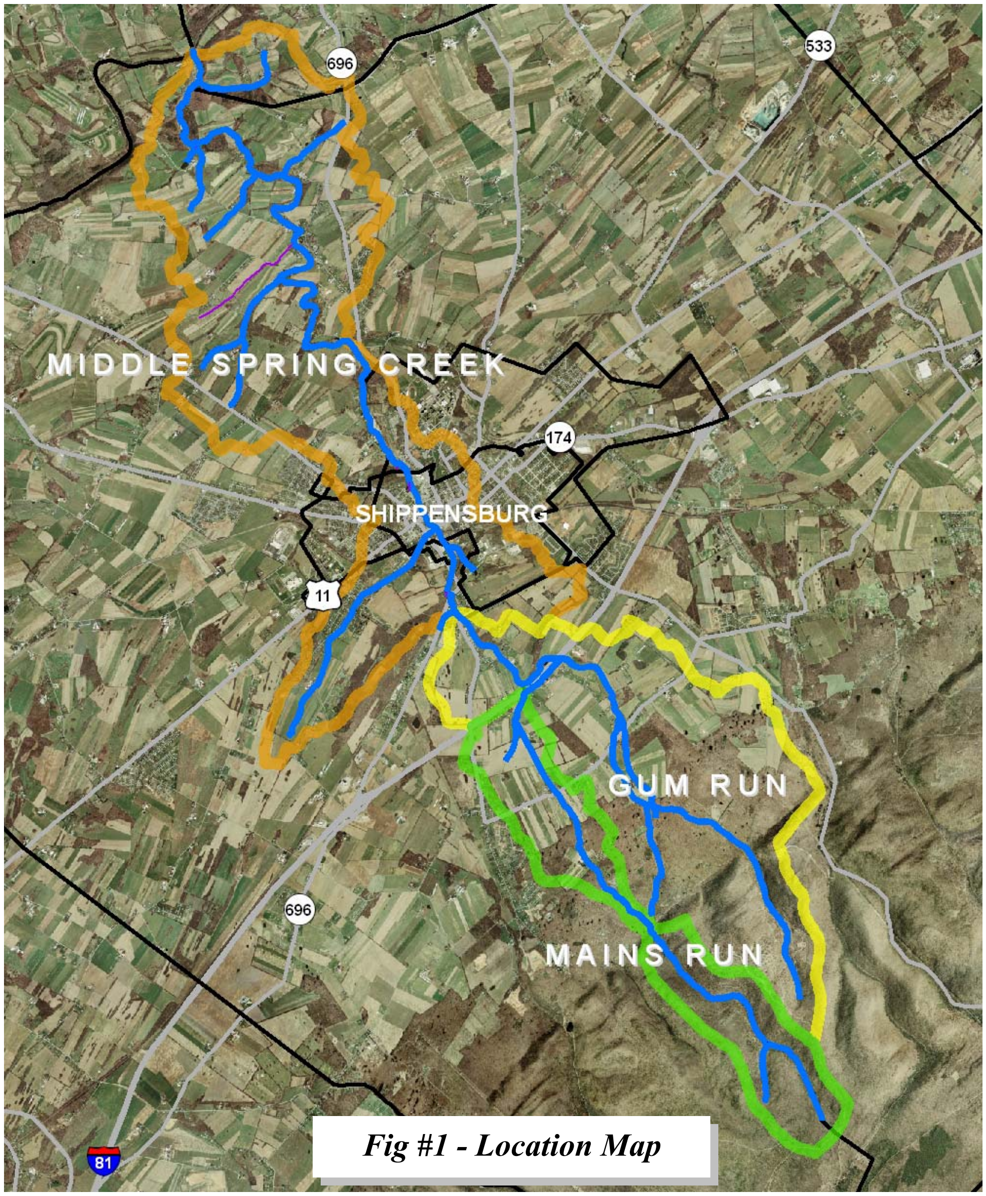

Fig #1 - Location Map

Middle Spring Creek, Gum Run and Mains Run are located in both Cumberland and Franklin Counties, Pennsylvania. The main stem of Middle Spring Creek, a portion of Gum Run's main stem and the main stem of Mains Run actually serve as the boundary line separating the two counties. The headwaters of Gum Run and Mains Run are situated within the Michaux State Forest. These streams generally flow in a northerly direction with their confluence occurring near interstate highway 81 with Mains Run flowing into Gum Run. From there, Gum Run continues in a northerly direction and enters into the south side of the Borough of Shippensburg. Gum Run flows into Middle Spring Creek in the southern half of Shippensburg just south of U.S. route 11. From there Middle Spring Creek continues to flow in a northerly direction through Shippensburg more or less paralleling the west side of state road 696 as it makes its way to the Conodoguinet Creek. See ***Fig #1 – This page.***

Pennsylvania does not have established water quality standards for sediment, however Chapter 93 of the PA Code does classify "water use". Middle Spring Creek (which in the case of the Chapter 93 listing includes Gum Run and Mains Run) has the designated water use of CWF meaning "cold water fishes". CWF streams are those to be maintained for the propagation of cold water fish species, including the family Salmonidae (trout and salmon), and additional flora and fauna indigenous to cold water habitats.

Middle Spring Creek along McClays Mill Road

The Pennsylvania Fish and Boat Commission (PFBC) regulates Middle Spring Creek as an approved trout water meaning it is stocked with trout. Trout stocking takes place in the main stem of Middle Spring Creek. The PFBC also lists the upper reaches of Middle Spring Creek (the headwaters of Gum Run and Mains Run) as supporting a wild population of Brown trout (*Salmo trutta).*

Approximately 81% of the Middle Spring Creek Watershed is in agricultural production, while approximately 40% of Gum Run/Mains Run Watersheds are in agricultural production (the balance being mostly forested). Agricultural production mainly involves corn, soybeans, alfalfa, dairy, beef cattle and poultry. Most floodplain pasturelands grazing dairy and beef cattle lack adequate riparian buffer zones (i.e. livestock has free access to the stream). ***See Fig #2 - Landuse Map next page.***

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 are credited as being the most significant cause of water quality impairment***. Table #1*** as seen on page 7 designates these impairments.

Therefore this watershed implementation plan is mainly concerned with reducing sediment inputs from agricultural sources; however several urban problems are discussed within the Borough of Shippensburg. This plan concentrates on prescribing various, appropriate agricultural "best management practices" (BMPs) to discovered problem areas within the subject watersheds. The prescribed BMPs fall into three main categories, these being: soil conservation farming practices, pastureland management practices, and riparian corridor management practices. Mentioned urban related BMPs are associated with stormwater management, streambank stabilization and forest buffer establishment.

Examples of soil conservation farming practices include strip cropping, no till, crop rotation, residue management, terracing, farming on the contour, winter cover crops and other methods that serve to preserve the soil resource and arrest its erosion and migration to watercourses.

Examples of pastureland management practices include rotational grazing and other methods that help preserve the integrity of the vegetative cover; which in turn controls soil loss and nutrients attached to the soil particles such as phosphorous.

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

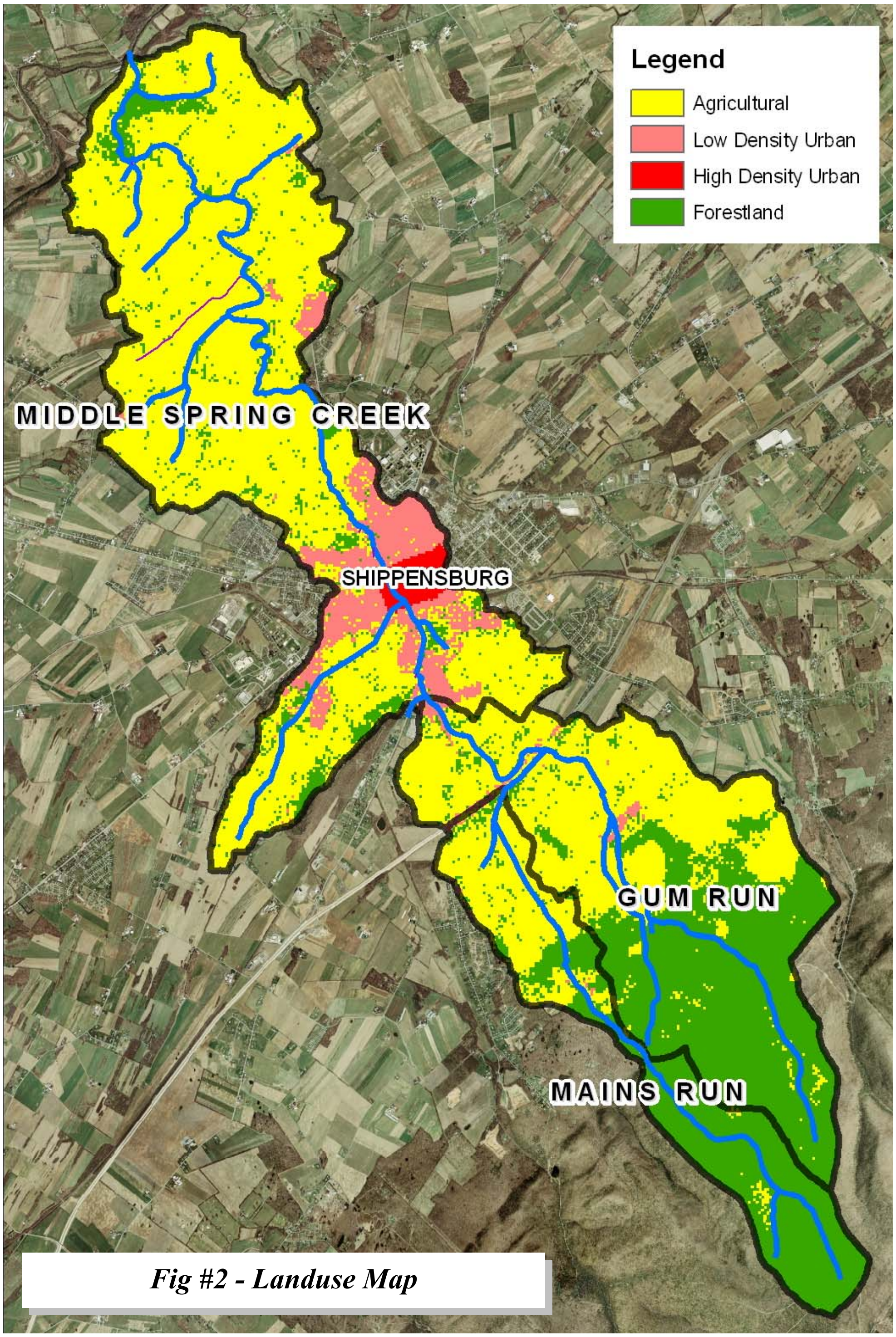

Fig #2 - Landuse Map

Table #1 – Pennsylvania's 1998 303(d) List of Impaired Waters
(A portion of the 303(d) list specific to this plan)

Stream Name	PA County	Watershed Area (mi^2)	Stream Use	Miles Impaired	Cause
Middle Spring Creek	56% Franklin 44% Cumberland	8.06	CWF	5.87	Suspended Solids – Urban Runoff/Storm Sewers, Agriculture
Gum Run	8% Franklin 92% Cumberland	5.10	CWF	7.79	Siltation – Agriculture, Habitat Modification
Mains Run	61% Franklin 39% Cumberland	2.25	CWF	5.28	Siltation - Agriculture, Habitat Modification

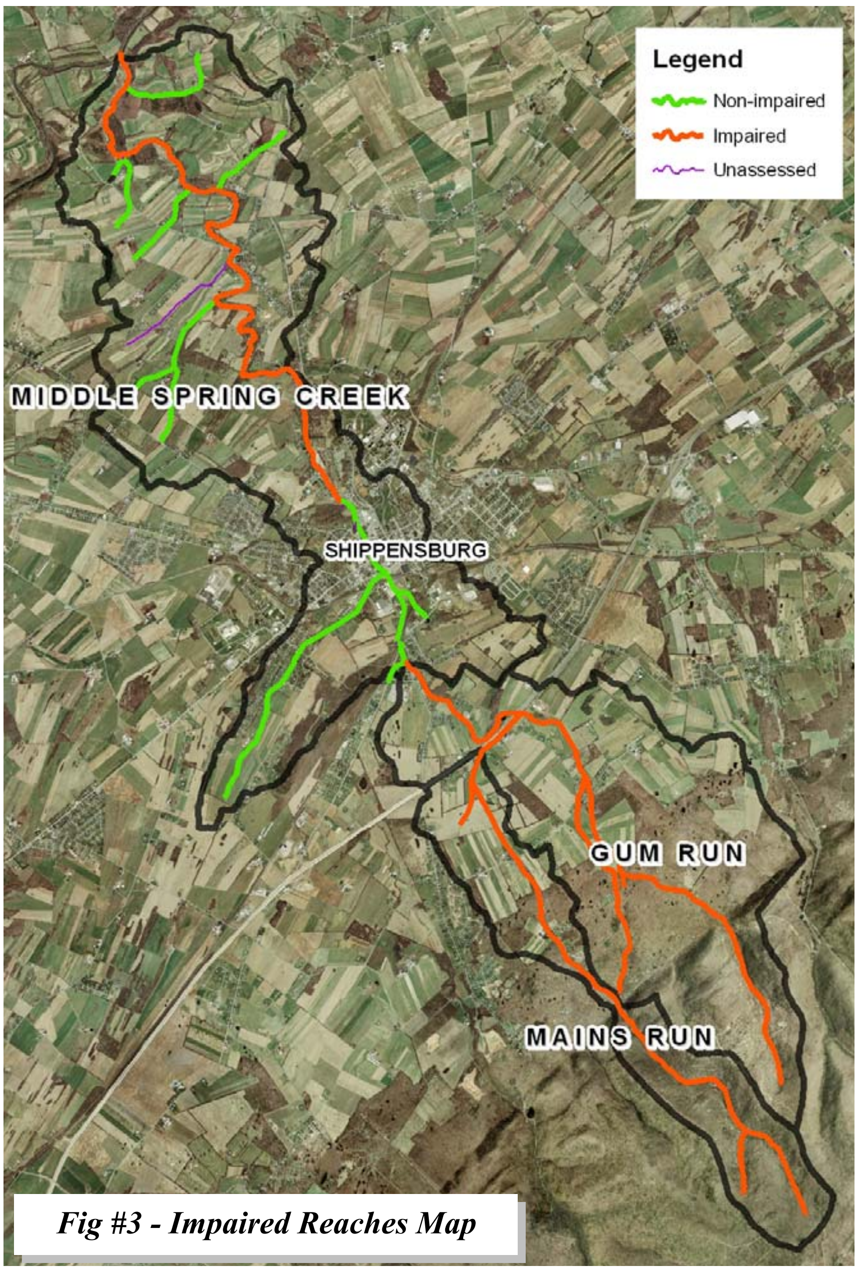

Fig #3 - Impaired Reaches Map

To assist the reader in the comprehension of ***Table #1 – Pennsylvania's 1998 303(d) List of Impaired Waters***, we have also provided ***Fig #3 - Impaired Reaches Map***.

The color **RED** denotes impairment, while **GREEN** indicates a non-impaired condition. However, it should be understood that even though a stream segment (reach) appears green and non-impaired, it doesn't mean that problems don't exist within that segment of stream. On the contrary, field inspections reveal many significant physical problems within the green sections of this map, but collectively these individual locations are too few and sporadically spaced to render a complete segment of stream impaired.

Non-Agricultural Sediment Sources

Even though Pennsylvania's 1998 303(d) List of Impaired Waters emphasizes sediment loadings from agricultural lands, it does recognize that stormwater runoff from urban areas and habitat modifications also contribute to the impairment of Middle Spring Creek, Gum Run and Mains Run. Eroding streambanks within urbanized areas and dams of various sizes and construction both serve as sources and entrapment of sediment not necessarily linked to agricultural practices.

Legacy Sediment

Since about 2001, there has also been increasing awareness within Pennsylvania about "legacy sediment". Legacy sediment is a term used to describe an unnatural rate of deposition typically due to a dam within a stream channel and related floodplain. During the early settlement of Pennsylvania and the construction of literally hundreds of mill operations, damming streams as a source of hydraulic power was common practice. Present day finds many of these historic dams still in place on many Pennsylvania streams. Very few still serve their original purpose, while the majority serve only as a historical reminder of days gone by. However the sediment that built up over the years behind these dams is proving to be a significant problem in regards to stream restoration endeavors. The artificially stacked up sediment is easily eroded when dams are breached or removed. In some cases, streams have re-routed around dams, and the erosion of these previously stacked up legacy sediments yields tons of sediment loading to downstream reaches.

Case in point, RETTEW has identified two (2) of these old dams within the subject watersheds, which at best may serve as an aesthetic icon or possibly a family heirloom of sorts. And possibly the owners might not even care about the dam, but never spent the time, money and effort to remove them. Whatever the case, both dams RETTEW identified are causing a problem in an environmental sense. One is intact and still impounding water, thus causing localized sedimentation and thermal pollution problems. The other is partially breached and the process of eroding legacy sediments has resulted.

It is out of the scope of this study to thoroughly investigate the two (2) dams, and because dam removal can be rather complex, this watershed implementation plan does not further elaborate on the cost of their removal nor provides any pollutant reduction value associated with their removal. But generally speaking, it has been RETTEW's experience that smaller dam removal projects (dam less than 5-feet high and 80-feet long) cost approximately $15,000.00 for design and permit application preparation and $30,000.00 in demolition and site restoration work. Larger dams (dam between 5 to 10-feet in height and 80 to 200-feet long) cost approximately $25,000.00 to $35,000.00 for design and permit application preparation and $40,000.00 to $70,000.00 in demolition and site restoration work. Keep in mind these are rough cost estimates and each dam removal project will vary in difficulty. Dams that impound a large amount of sediment that will need to be removed are more expensive undertakings than dams that have been partially breached. Difficulties in accessing the dam site for surveying and demolition also increase removal costs.

Stormwater

Stormwater runoff from urban development is another contributor of sediment. According to Title 25 of the PA Code, Chapter 102 Regulations, Section 102.5(a-e), other than agricultural plowing or tilling, timber harvesting activities, or road maintenance activities, a person proposing an earth disturbance activity that will result in a point source discharge to surface waters of the Commonwealth of Pennsylvania involving 1 to 5 acres, or an earth disturbance on any portion, part, or during any stage of, a larger common plan of development or sale that involves 5 acres or more of earth disturbance over the life of the project shall obtain a General NPDES Permit for Stormwater Discharges Associated with Construction Activities prior to commencing the earth disturbance activity. Additionally, if said earth disturbance is to occur in a high quality or exceptional value watershed, an Individual NPDES Permit for Stormwater Discharges Associated with Construction Activities is required. 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.

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 streambanks is prevented. PADEP now has 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 loadings and stream channel erosion.

Commercial Development along Route 81 near Mains Run

Municipal stormwater conveyances within Middle Spring Creek, Gum Run and Mains Run 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 reductions in sediment and stream channel erosion.

Several BMP strategies that CCCD can strive to educate urban landowners about include: (1) erosion & sediment controls, (2) forested buffers, (3) grass buffers, (4) street sweeping, (5) stormwater management-filtration, (6) stormwater management-infiltration practices, (7) stormwater management-wet ponds & wetlands, and (8) urban stream restoration.

The urban BMP strategies listed above are designed to reduce sediment and stream channel erosion. Therefore, as CCCD and its partner organizations and agencies (such as the Franklin County Conservation District) seek to implement the recommendations of this plan, they will look to partner with willing landowners to install appropriate BMPs. Improving the water quality of Middle Spring Creek, Gum Run and Mains Run through implementation of this watershed implementation plan will go a long way in restoring not only these streams but also downstream receiving waterbodies.

In preparation of this watershed implementation plan, RETTEW was ever cognizant of the necessity of keeping the plan realistic. One needs to keep in mind the plan was prepared to serve as a restoration strategy for the CCCD.

III. DATA COLLECTION

RETTEW began collecting field data in September of 2008 and completed data collection by March of 2009. Because of monetary constraints related to this study and others like it, it is vital the best effort be put forth to collect as much site specific data as possible utilizing the most cost effective means available.

Knowing the previously noted impaired reaches listed in the Pennsylvania's 1998 303 (d) List of Impaired Waters, it was understood that a substantial amount of various BMPs would need to be prescribed to have any significant reductions in sediment and stream channel erosion.

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

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

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

Before flying, flight plans were prepared by RETTEW environmental staff so as to insure capture of the correct stream corridors and anticipated impaired reaches. Emphasis was placed upon those previously determined impaired stream segments as identified by PADEP and previously scouted 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 problem areas, several passes from different angles were taken in order to insure proper capture of the area in question. Typically, this involved lower altitude passes.

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

After the flights were completed, collected video footage was post-processed. This involved dividing out the various sub-watersheds using the associated time code and collected GPS coordinates. Once adequately post-processed, the video footage was placed on a DVD disk for viewing at any time. All 28-miles of collected stream corridor video are on the DVD.

Example of aerial footage clip

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

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

And so the aerial video footage and the data sheet completion process was used as a first reconnaissance of the subject watersheds and a means of determining potential problem areas and future improvement work locations. With this information in hand, RETTEW staff then took to the field to field verify (ground truth) what were thought to be potential problem areas. Data sheets for the areas of concern were then appropriately revised as necessary with found field conditions. RETTEW staff did not field visit every earmarked problem area. Rather 40% or 24 of the problem areas were visited to confirm the aerial assessment procedure.

In total 60 problems (at 40 different sites/properties) were recorded where specific BMPs should be implemented in order to achieve significant sediment loading reduction. ***See Fig #4, page 16.*** Site specific data sheets that were prepared for these problem areas are not included within the pages of the public report for confidentiality reasons. However CCCD has the data sheets and will use them as guidance when approaching landowners in the future.

IV. MODELING AND RESULTS

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

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

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

Existing landuse, management schemes and already installed/practiced BMPs for modeling purposes were derived through field reconnaissance and use of GIS to establish various acreages and linear distances. Additionally, consulting firm Tetra Tech, Inc. had used GWLF to determine current pollutant loadings on an annual basis when they prepared the "December 2000 Total Maximum Daily Loads (TMDLs) for the Conodoguinet Creek Watershed" report for PADEP; thus establishing sediment reduction allocations for the subject watersheds.

Since these sediment reductions have already been calculated and target sediment reduction allocations approved by PADEP and EPA, RETTEW can then utilize a version of the AVGWLF model known as "PRedICT" to run prescribed BMP simulations of the subject watersheds. BMPs that were installed since the initial PADEP biological surveys (that had lead to various stream segments/reaches being identified as being impaired) were considered in the model runs. If all 60 identified problem areas are "fixed" according to the prescribed BMPs found within this watershed implementation plan, the significant reductions described in the following ***Table #2 - Anticipated Reductions*** can be expected.

Table #2 - Anticipated Reductions

Watershed	Annual Loading Rate per 2000 TMDL	Anticipated Annual Loading Rate with the Prescribed 60 BMPs (Implementation of this plan)	Target Reduction per 2000 TMDL with 10% "Margin of Safety"	Anticipated Reduction with the Prescribed 60 BMPs (Implementation of this plan)
Middle Spring Creek	2,785,986 lbs/yr	2,154,767 lbs/yr	589,802 lbs/yr	631,219 lbs/yr
Gum Run/Mains Run Combined	2,124,970 lbs/yr	1,531,451 lbs/yr	506,573 lbs/yr	593,519 lbs/yr

Therefore as one can see above, if the watershed implementation plan is implemented in its entirety, 2000 TMDL target sediment reductions for Middle Spring Creek, Gum Run and Mains Run **will be achieved**.

Table #3 – Summary of Existing and Proposed BMPs provides a breakdown of the various BMPs prescribed in this watershed implementation plan. As can be seen, there is a proposed increase in some BMP usage on cropland but nothing too dramatic. The majority of farmers already use adequate soil conservation practices on their crop fields. However the stream segments flowing through many of these farms are severely damaged due to poor barnyard management and free livestock access to the stream.

Table #3 – Summary of Existing and Proposed BMPs

BMP	Existing verses Proposed
	*** *PRedICT model rounds to nearest percentage*
Middle Spring Creek Watershed	
Cropland Protection	To remain at 25% (approx. 581 acres)
Conservation Tillage	To remain at 10 % (approx. 232 acres)
Stripcropping and Contour Farming	To remain at 50% (approx. 1,162 acres)
Terraces and Diversions	To increase from 3% to 4 % (approx. 70 to 93 acres)
Ag Land to Wetland Conversion	7 acres to be converted
Grazing Land Management	To increase from 2% to 8% (approx. 37 to 148 acres)
Agricultural Stream Segments	An additional 4.4 miles of vegetated buffer/forest buffer An additional 3.2 miles of stream side fencing An additional 2.0 miles of streambank stabilization
Urban Stream Segments	An additional 0.5 miles of vegetated buffer/forest buffer An additional 0.2 miles of streambank stabilization
Urban Stormwater Retrofits	24 acres of impervious area to be treated with new bio-retention areas, basins and/or infiltration or combination thereof
Dam Removals	2 dams to be removed

Table #3 – Summary of Existing and Proposed BMPs (continued)

BMP	Existing verses Proposed
	*** *PRedICT model rounds to nearest percentage*
Gum Run / Mains Run Watersheds	
Cropland Protection	To remain at 25% (approx. 312 acres)
Conservation Tillage	To increase from 10% to 13% (approx. 124 to 162 acres)
Stripcropping and Contour Farming	To remain at 50% (approx. 624 acres)
Terraces and Diversions	To increase from 1% to 3% (approx. 12 to 37 acres)
Grazing Land Management	To increase from 2% to 12% (approx. 13 to 159 acres)
Agricultural Stream Segments	An additional 3.0 miles of vegetated buffer/forest buffer An additional 0.3 miles of stream side fencing An additional 1.5 miles of streambank stabilization
Unpaved road with proper erosion control maintenance	Assume continued maintenance of 3.0 miles of dirt and gravel roads by Department of Natural Resources in Michaux State Forest. Roads currently well maintained in part due to Pennsylvania's "Dirt and Gravel Road" program.

BMP implementation on agricultural land is responsible for the majority of the anticipated load reductions, however improvements to stream channels within the urban areas also provides a significant reduction in sediment.

Site observation revealed that most farmers are practicing some method of soil conservation on their croplands. Very few fields exhibited accelerated erosion in the form of evident rill and gully erosion. Occasionally a headland or farm lane showed signs of erosion, but the majority of cropland acreage likely meets "T" (meaning soil loss that does occur is annually replaced).

RETTEW maintains that a significant amount of sediment within the stream channels is a result of bank erosion and the continued transport and re-entrapment of sediment already in the system. Dams located in the main stem of Middle Spring Creek interfere with the stream's ability to adequately transport its sediment load. Stormwater runoff from Shippensburg provides short periods of high energy flow which scours previously deposited sediment only to redeposit it back into the system. Unstable banks from livestock trampling and bare loafing areas along the streams add to the sediment load. It was also observed that many landowners in urban locations use the edge of the stream as a depository for lawn clippings and tree debris only to have those materials washed into the stream with the next flood; though these materials may seem "natural" they none the less add to the overall siltation dilemma.

It is important to understand land use within Middle Spring Creek, Gum Run and Mains Run is not static. 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 watersheds.

The following chapter (Restoration Recommendations) specifically identifies problem areas, their prescribed BMP solutions, estimated costs and a schedule for implementation.

V. RESTORATION RECOMMENDATIONS

For confidentiality reasons, landowner names are not listed in this plan; rather 40 proposed project locations (where the 60 problems exist, some on the same properties) are identified by a project site number. ***See Fig. #4 Project Locations Map, page 16.*** The CCCD has been provided data sheets specifically identifying proposed project locations that correspond to the site number seen on the Project Locations Map.

It is best to begin restoration activities in the headwaters and first and second order tributaries. ***Table #4 – Project Implementation Schedule, page 17*** outlines the recommended sequence for the 40 proposed project sites.

Table #4 strategically groups identified potential project areas/tasks so that restoration activities are implemented in a logical fashion; generally undertaking work in smaller watersheds and then progressing downstream into the bottom reaches of the main stem. In other words, work will begin at the top and proceed downstream. It is rather illogical to skip haphazardly around the entire watershed doing various projects, only to have “fixed” problem areas still being negatively impacted from upstream problem areas. It is far more rewarding from both a psychological and biological viewpoint to complete work in a sub-watershed knowing that it is taken care of and no longer negatively influences the overall health of the entire watershed.

Example of a forested buffer within a pasture

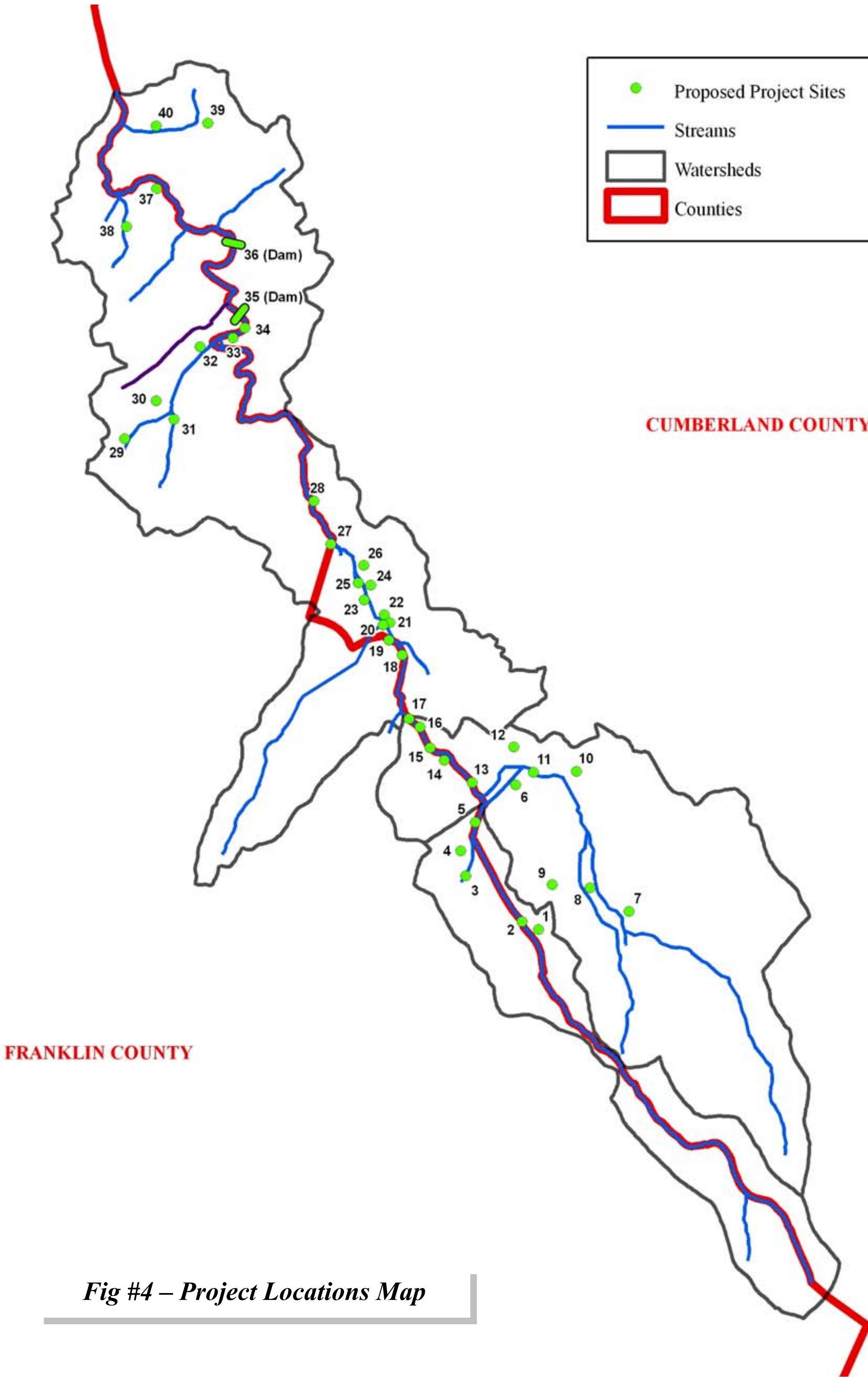

Fig #4 – Project Locations Map

Table #4 – Project Implementation Schedule

(Brief description of proposed project sites, estimated cost, anticipated sediment reduction and implementation schedule)

Mains Run **2010-2013** **Estimated cost - $72,000.00 (design and construction)** **Estimated load reduction for sediment – 267,084 lbs. / year**	
Site 1	Approx. 19.7 acre field with erosion patterns – could use a waterway to transport water through lower portion of field to road gutter.
Site 2	Approx. 956 feet of stream in small pasture that should have streamside fencing and adequate buffer planting.
Site 3	Approx. 4,754 feet of recently planted forest buffer – possibly a CREP project – survival looks to be excellent with most tree tubes sprouting trees – simple maintenance of buffer is all that is needed in this location.
Site 4	Approx. 27.3 acre field with erosion patterns – should have a waterway and possibly diversions to transport stormwater down slope – also 1,071 feet buffer opportunity.
Site 5	Approx. 618 feet of proposed forest buffer.
Site 6	Approx 1,233 feet of stream in pasture setting requiring streamside fencing, a better buffer and about 400 feet of eroded bank that needs to be stabilized.
Gum Run **2013-2018** **Estimated cost - $243,800.00 (design and construction)** **Estimated load reduction for sediment – 326,435 lbs. / year**	
Site 7	Includes approximately 2.6 acre of pasture requiring rotational grazing, 13.4 acres of field requiring terraces and/or diversions, and 1,631 feet of stream channel requiring an adequate buffer and bank stabilization.
Site 8	Approx. 12.3 acre pasture with 1,629 feet of stream – requires better grazing land management such as rotational grazing and buffer, fencing and stabilization of stream channel.
Site 9	Approx 6.7 acre pasture that could benefit from rotational grazing – also includes about 824 feet of stream channel that should have fencing and a better buffer.
Site 10	Approx. 14.3 acre field with erosion patterns requiring either terraces or diversions, 2,666 feet of stream within same field requiring adequate buffer.
Site 11	Approx. 18.9 acre pasture that could benefit from rotational grazing, same pasture contains 3,335 feet of stream requiring a buffer and bank stabilization.
Site 12	Approx. 30.7 acre rye/winter wheat field with erosion patterns – no till or diversions necessary, also 996 feet of stream channel needing a buffer and bank stabilization.
Site 13	Approx. 20.7 acres of pasture – rough barnyard/loafing area – need for buffer along stream, bank stabilization and rotational grazing – about 5,600-feet of stream needing better protection – Mains Run enter Gum Run on this farm.
Site 14	Approx. 6.9 acre field adjacent to stream – field contains a ditch and may be a drained wetland in some portions of the field – lacks buffer along 1,060 feet of the stream.
Site 15	Approx. 1,051 foot opportunity for improved forest buffer and 600 feet of bank stabilization work on several private residential lots – mowing to edge of stream, various

eroding, vertical banks. Piles of lawn clippings, leaves, etc. piled along banks.

Site 16 Approx. 1,613 foot opportunity for improved forest buffer and bank stabilization work on several private residential lots – mowing to edge of stream, various eroding, vertical banks. Piles of lawn clippings, leaves, etc. piled along banks.

Site 17 Approx. 667 foot opportunity for improved forest buffer and bank stabilization work on private residential lot – mowing to edge of stream, various eroding, vertical banks.

Upper Reach of Middle Spring Creek at Shippensburg
2018-2028

Estimated cost - $1,791,000.00 (design and construction)
Estimated load reduction for sediment – 2,602 lbs. / year

Site 18 General area of baseball fields – lack of adequate riparian buffer and noted bank erosion where lawn areas are mowed right up to the streambank. Opportunity for establishing approximately 842 feet of buffer and necessary bank stabilization.

Site 19 Approx. 5.1 acre concrete plant consisting of buildings, parking areas, material stockpiles such as sand – appears to have no stormwater management – significant amount of dust generated from operation – stockpiles immediately adjacent to stream – opportunity to better management stormwater – possible capture stormwater in cisterns for use in manufacturing concrete (they may already do this?? – unknown).

Site 20 Approx. 1.3 acre impervious area consisting of buildings and parking lot – lacks adequate buffer and stormwater control – no stormwater detention – appears to have adequate room in rear of property to install basin.

Site 21 Approx. 2.0 acres of semi-impervious to impervious building and parking area – much of area is stoned or bare soil – no obvious stormwater control – sediment entering stream in back of premises – sort of a junk yard in back of building, lots of parked trucks and equipment storage – concern over petroleum products mixing with stormwater runoff – great opportunity for stormwater retrofit including basin installation, stabilization of parking areas, and oil separation inlets.

Site 22 Approx. 2.3 acre impervious area consisting of building and parking lot – lacks adequate buffer and stormwater control – no stormwater detention – direct inlet/pipe discharge to stream – good opportunity for stormwater retrofit and 643 feet of buffer installations.

Site 23 Approx. 2.1 acre impervious area consisting of building and parking lot immediately adjacent to stream - no stormwater detention – direct inlet/pipe discharge to stream – good opportunity for stormwater retrofit.

Site 24 Approx. 4.3 acre impervious area consisting of building and parking lot immediately adjacent to stream - no stormwater detention – direct inlet/pipe discharge to stream – good opportunity for stormwater retrofit.

Site 25 Approx. 1.7 acre impervious area consisting of building and parking lot immediately adjacent to stream - no stormwater detention – direct inlet/pipe discharge to stream – good opportunity for stormwater retrofit.

Site 26 Large 9.4 acre expanse of building and parking lot – lacks adequate buffer and stormwater control – no stormwater detention – direct inlet/pipe discharge to stream – good opportunity for stormwater retrofit and 1,130 feet of buffer installations.

Site 27 Approx. 1.3 acre building and parking lot immediately adjacent to stream, no buffer, no evident stormwater retention in form of basin – good opportunity for stormwater retrofit in form of wet pond/basin.

Site 28	Approx. 2,439 feet of proposed forest buffer on opposite side of stream from sewer treatment plant.

Lower Reach of Middle Spring Creek
2028-2034

Estimated cost - $280,930.00 (Design and Construction – Does not include dam removal costs)
Estimated load reduction for sediment – 628,617 lbs. / year

Site 29	Approx. 17 acre pasture containing wetlands that could benefit from rotational grazing and further paddock subdivision – also approx. 3,072 feet of stream corridor requiring streamside fencing and adequate buffer and 1,000 feet of bank stabilization.
Site 30	10.5 acre field with gully erosion patterns, requires diversions and possibly waterways to break up the slope length and safely transport stormwater runoff. Receives a significant amount of stormwater from upslope fields.
Site 31	Approx. 48 acre pasture that could benefit from rotational grazing and further paddock subdivision – also approx. 3,907 feet of stream corridor requiring streamside fencing and adequate buffer and 1800 feet of bank stabilization.
Site 32	Approx. 10 acre field with gully erosion patterns, requires diversions to break up the slope length – also same farm has a pasture with a stream - the stream requires approx. 2,495 feet of buffer and streamside fencing, also 900 feet of bank stabilization.
Site 33	Approx. 9.3 acre pasture that could benefit from rotational grazing and further paddock subdivision – also approx. 2,252 feet of stream corridor requiring streamside fencing and adequate buffer.
Site 34	Previous pasture area lacking adequate buffer – appears land is no longer pastured, but may be cropped in the future – either way a 1,004 foot buffer is proposed.
Site 35	This is a **very large, concrete dam** that is still intact – apparently American Rivers, PADEP and PA Turnpike Commission are in the midst of planning for the removal of this dam as part of a PA Turnpike Commission mitigation project – it is understood consulting firm KCI is developing the dam removal plans – this problem area may therefore be resolved in the near future.
Site 36	This is an **old dam site** – the dam is breached, but the remaining portions of the dam serve to braid the stream – the dam should be properly removed and the stream channel restored.
Site 37	Approx. 7.3 acres of what appears to be previously drained and tiled wetland that is currently in crop production – converting the field back into a wetland, especially a forested wetland is suggested – this would be a candidate for the CREP program.
Site 38	26 acre pasture that could benefit from rotational grazing and further paddock subdivision – also approx. 5,530 feet of stream corridor that needs streamside fencing, an adequate buffer, and bank stabilization.
Site 39	Three (3) different pastures on the same farm (totaling approx. 13 acres) that could benefit from better rotational grazing and further paddock subdivision – worn cattle paths and loafing areas yielding sediment – stream either in or in very close proximity to the pastures – portions of the stream have been fenced and planted in trees – tree tubes installed along the stream channel but not maintained – appears to be high mortality of planted trees judging from roadside view – many tubes are laying on the ground – a ford crossing and the cattle lane leading to it from the barnyard are of concern in that manure

	and sediment are entering the stream – barnyard improvements in the form of curbing and better handling of roof generated stormwater runoff being diverted away from the cattle lane and ford crossing would be of benefit.
Site 40	4.6 acre field with gully erosion patterns, requires diversions and possibly a waterway to break up the slope length and safely transport stormwater runoff.

VI. PUBLIC PARTICIPATION AND INVOLVEMENT

At this time, the Cumberland County Conservation District (CCCD) is leading the effort to implement this watershed implementation plan with assistance from the Franklin County Conservation District. Additionally there are several other entities with which CCCD will partner with to implement this plan. These include the Middle Spring Watershed Association (MSWA), Natural Resources Conservation Service, Chesapeake Bay Foundation and the various municipalities.

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. CCCD is privileged to have a strong working relationship with the Franklin County Conservation District and their watershed specialist, and anticipates a successful and growing partnership with all area farm agencies that will aid in implementation of this plan.

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

However regardless of the number of willing partners and landowners, project implementation requires funding. The present cost estimate for implementation of all projects identified in this plan stands at $2,387,730.00 (not including dam removal costs). 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
- Pennsylvania Fish and Boat Commission’s “Adopt a Stream” program

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

Recently the MSWA has been actively engaged in outreach and publicity work to educate landowners about watershed protection and restoration issues. Their members speak at local civic organizations and schools, sponsor guest presentations, and run display booths at local events such as community fairs and fund raising dinners. MSWA holds monthly meetings which are open to the public. They will continue to use these community outreach and educational events as tools to develop partnerships with landowners on potential projects.

In order to thoroughly involve the MSWA, RETTEW and CCCD met with the MSWA during their September 14, 2009 meeting to review this watershed implementation plan. A power point presentation which highlighted aspects of this plan and how they as a watershed organization could be involved was presented.

Since October 2008, the MSWA has been monitoring Middle Spring Creek in two locations on a monthly basis. They are willing to expand this monitoring effort in coordination with this watershed implementation plan and future implementation projects. ***See Chapter VII Monitoring Restoration Progress for more details.***

MSWA also maintains a website at **www.middlespringwatershed.org.** The website provides information regarding their restoration projects, and a newsletter is also available. Contact information is as follows:

Middle Spring Watershed Association
P.O. Box 309
Shippensburg, PA 17257
Phone: (717) 477-8835
Email: **info@middlespringwatershed.org**

VII. MONITORING RESTORATION PROGRESS

Monitoring BMP Implementation

The 40 project opportunities identified in ***Table #4*** set forth precise goals for BMP implementation and identify those BMPs for each project area, down to the linear foot and acre. The installation of BMPs recommended for each project will serve as measurables to track interim progress as this plan is implemented. They include:

1. Feet of riparian corridor management practices, including the establishment of forest and vegetative buffers, streamside fencing and streambank stabilization.
2. Acres of soil conservation farming practices, including strip cropping, crop rotation, residue management, terracing, farming on the contour and other prescribed methods that serve to preserve the soil resource and arrest its erosion and migration to watercourses
3. Acres of pastureland management practices, including rotational grazing and other methods that help preserve the integrity of the vegetative cover; which in turn controls soil loss and nutrients attached to the soil particles such as phosphorous.

4. Acres of urban landscape treated with stormwater management practices including basins, wet ponds, bio-retention areas, infiltration and oil trapping.
5. Number of dam removals

These completed BMPs will be tracked on a sub-watershed basis and can be analyzed by using the PRedICT model in order to determine the planned load reductions are being achieved within the established timeframe **(see below).**

Goals & Milestones for Sediment Loading Reductions

Milestones are based on implementing BMPs within the sub-watershed drainage areas defined in this plan. Implementing these BMPs will result in a reduction of sediment; and in many cases the additional reduction of nitrogen and phosphorous loading. As well, this anticipated reduction is listed and planned on a sub-watershed basis. Therefore as the recommended BMPs are completed in a sub-watershed within the assigned timeframe (period of years typically) it is assumed the corresponding reductions of sediment are well on the way to being achieved; thus the "milestone" for that sub-watershed has been achieved or has been achieved to some degree. In order to quantify the progress made in each sub-watershed, the sub-watersheds will be analyzed by using the PRedICT model (see below listing). If it is found an adequate number of BMPs haven't been installed within the established timeframe for each sub-watershed, then the CCCD will make revisions to this plan in order to secure the balance of the necessary sediment loading reductions. Additionally, the MSWA will be conducting macroinvertebrate and water quality sampling in coordination with the CCCD and these established sub-watershed sediment reduction goals (described elsewhere in this plan).

The following goals or milestones are derived from ***Table #4 – Project Implementation Schedule*** of this watershed implementation plan. If project implementation goes according to this schedule, the CCCD will be able to analyze progress made in terms of sediment loading reduction as expressed in pounds.

Mains Run - 2010-2013
Estimated load reduction for sediment 267,084 lbs. / year
***Use PRedICT to calculate new sediment loadings based on installed BMPs – December 2013
Gum Run - 2013-2018
Estimated load reduction for sediment 326,435 lbs. / year
***Use PRedICT to calculate new sediment loadings based on installed BMPs – December 2018
Upper Reach of Middle Spring Creek at Shippensburg - 2018-2028
Estimated load reduction for sediment 2,602 lbs. / year
***Use PRedICT to calculate new sediment loadings based on installed BMPs – December 2028
Lower Reach of Middle Spring Creek - 2028-2034
Estimated load reduction for sediment 628,617 lbs. / year
***Use PRedICT to calculate new sediment loadings based on installed BMPs – December 2034

TOTAL LOAD REDUCTION 1,224,738 lbs / year
***Use PRedICT to calculate new sediment loadings based on installed BMPs – December 2034

Monitoring Water Quality Improvement

As this plan is implemented, water quality in the Middle Spring Creek, Gum Run and Mains Run will improve. In addition to monitoring sediment load reductions, water quality monitoring will be conducted on a sub-watershed basis as defined in ***Table #4 – Project Implementation Schedule (and as listed above on page 22***). Water quality monitoring of streambank profiles, streambed composition, aquatic habitat, and macroinvertebrate numbers and diversity should produce a measurable understanding of how the streams are responding to installed BMPs.

It is not necessary to monitor each and every BMP installation, but rather monitor strategic locations within each sub-watershed to track recovery. Monitoring locations are positioned at the downstream end of the sub-watersheds and several midpoints within the sub-watersheds (where various tributaries intersect so as to allow for further dissecting of recovery or lack of it within the sub-watershed).

MSWA will conduct sampling of the macroinvertebrate community and will monitor streambank profiles and conduct pebble counts prior to the installation of larger stream channel restoration projects.

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

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

As was previously stated, the MSWA currently monitors Middle Spring Creek in two locations.
See Figure #5 MSWA Monitoring Locations Map.

Current water quality parameters include: (1) water temperature, (2) pH, (3) dissolved oxygen, (4) conductivity, (5) nitrate, (6) transparency, and (7) orthophosphate.

In light of this watershed implementation plan, the MSWA is interested in beginning to monitor macroinvertebrates in addition to the above listed water quality parameters. Strategic locations for doing so are depicted in ***Figure #5 MSWA Monitoring Locations Map***. These locations are located so as to monitor sub-watershed sections as expressed in this watershed implementation plan. Macroinvertebrate monitoring would follow PADEP's "ICE Protocol" (Instream Comprehensive Evaluation Surveys). This protocol is available at PADEP's website as follows:

http://www.depweb.state.pa.us/watersupply/lib/watersupply/2009assessmentmethodology/ice_2009am.pdf

PADEP's ICE Protocol describes criteria for analyzing macroinvertebrates. Biological metrics are calculated, complied and compared to a composite benchmark threshold score. These metrics include : EPT, %EPT, # of Mayflies, Beck's Index, and Modified (PA) Hilsenhoff Index. A composite metric score of 45 or lower indicates impairment for moderate gradient streams such as Middle Spring Creek and its tributaries.

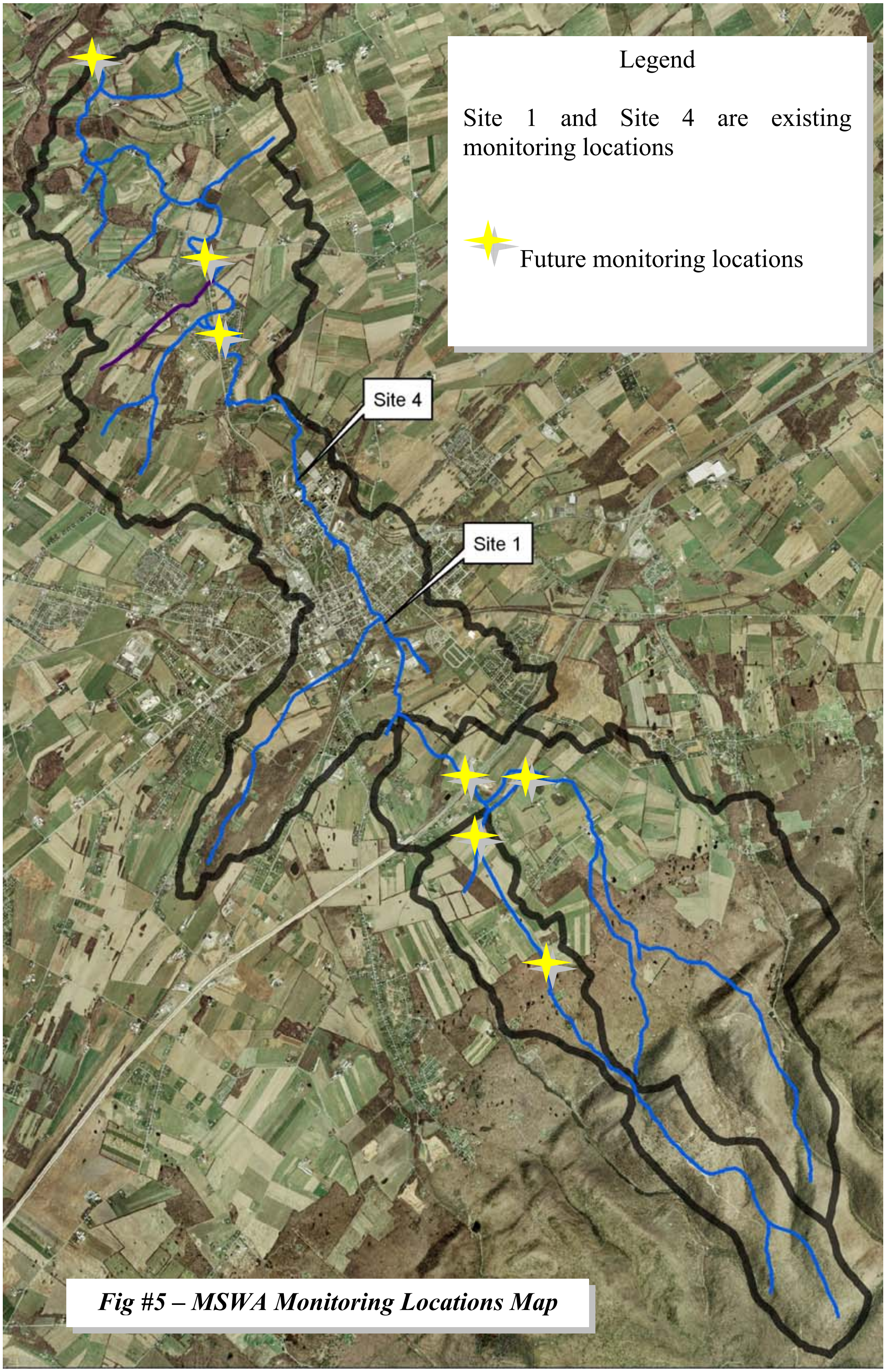

Fig #5 – MSWA Monitoring Locations Map

RESOURCE LITERATURE

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

Penn State Institutes of Energy and the Environment. February 2008. PRedICT version 7.1 users guide. The Pennsylvania State University. University Park, PA.

Tetra Tech, Inc. December 2000. Total Maximum Daily Load for the Conodoguinet Creek Watershed. Fairfax, VA.

PADEP (Pennsylvania Department of Environmental Protection). 1998. 1998 303(d) List. Pennsylvania Department of Environmental Protection, <**http://www.dep.state.pa.us**>.

MAINS - GUM FINAL MODEL RUN 3-6-09

TARGET REDUCTION 589,802 lb/YR

MODEL REDUCTION 593,518 lb/YR

Mean Annual Load Data Editor

Load Data Type	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
UPLAND EROSION/RUNOFF			
Row Crops	1367949	0	0
Hay/Pasture	84244	0	0
High Density Urban	22	0	0
Low Density Urban	1607	0	0
Unpaved Road	8327	0	0
Other	0	0	0
STREAMBANK EROSION	662820	0	0
GROUNDWATER/SUBSURFACE		0	0
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		0	0
TOTAL	2124969	0	0
BASIN AREA	4653	Acres	

NUTRIENTS NOT MODELED - NOT A TMDL IMPAIRMENT FACTOR

Agricultural Land BMP Scenario Editor

Land Use	Acres		BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8
Row Crops	1248	% Existing	25	10	50	0	0	0		1
		% Future	25	13	50	0	0	0		3
Hay/Pasture	588	% Existing				0	0	0	2	0
		% Future				0	0	0	12	0

Agricultural Land on Slope > 3%	1,634 Acres
Streams in Agricultural Areas	5.0 Miles
Total Stream Length	14.0 Miles
Unpaved Road Length	3.0 Miles

	Existing	Future
Stream Miles with Vegetated Buffer Strips	0.0	3.0
Stream Miles with Fencing	0.0	0.3
Stream Miles with Stabilization	0.0	1.5
Unpaved Road Miles w/E & S Controls	0.0	3.0

	% Existing	% Future
AWMS (Livestock)	0.0	0.0

AWMS (Poultry)	0.0	0.0
Runoff Control	0.0	0.0
Phytase in Feed	0.0	0.0

Urban Land BMP Scenario Editor

High Density Urban

	Acres	1248	% Impervious Surface	50

Constructed Wetlands		Bioretention Areas		Detention Basins	
% Existing	25	% Existing	0	% Existing	0
% Future	0	% Future	0	% Future	0
% Drainage Area Used	5	% Drainage Area Used	6	% Drainage Area Used	3
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.0	DB Acres Required	0.0

Low Density Urban

	Acres	59	% Impervious Surface	25

Constructed Wetlands		Bioretention Areas		Detention Basins	
% Existing	0	% Existing	0	% Existing	0
% Future	0	% Future	0	% Future	0
% Drainage Area Used	3	% Drainage Area Used	6	% Drainage Area Used	2
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.0	DB Acres Required	0.0

Vegetated Stream Buffers

			Existing	Future
Stream miles in high density urban areas	0	Stream miles in high density urban areas w/buffers	0	0
		High Density Urban Streambank Stabilization	0	0
Stream miles in low density urban areas	0	Stream miles in low density urban areas w/buffers	0	0
		Low Density Urban Streambank Stabilization	0	0

Septic Systems and Point Source Discharge Scenario Editor

Number of persons on septic systems	Existing	0		
	Future	0		
Spetic systrems converted by treatment type %	Secondary	0	Tertiary	0
	Existing Point Source Load		No	

		Primary	Secondary	Tertiary
Distribution of pollutant discharge by treatment type %	Existing	0	0	0
	Future	0	0	0

		Primary to Secondary	Primary to Tertiary	Secondary to Tertiary
Distribution of treatment upgrades %		0	0	0

Rural and Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
BMP 1	0.25	0.36	0.35	
BMP 2	0.50	0.38	0.64	
BMP 3	0.23	0.40	0.41	
BMP 4	0.95	0.94	0.92	
BMP 5	0.96	0.98	0.92	
BMP 6	0.70	0.28		
BMP 7	0.43	0.34	0.13	
BMP 8	0.44	0.42	0.71	
Vegetated Buffer Strips	0.64	0.52	0.58	0.70
Streambank Fencing	0.56	0.78	0.76	1.00
Streambank Stabilizatio	0.95	0.95	0.95	
Unpaved Roads (lbs/ft)	0.02	0.0035	2.55	
AWMS (Livestock)	0.75	0.75		0.75
AWMS (Poultry)	0.14	0.14		0.14
Runoff Control	0.15	0.15		0.15
Phytase in Feed		0.21		

Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
Constructed Wetlands	0.53	0.51	0.88	0.71
Bioretention Areas	0.46	0.61	0.10	0.82
Detention Basins	0.40	0.51	0.93	0.71

Wastewater BMP Load Reduction Efficiency Editor

	Nitrogen	Phosphorus
Conversion of Septic Systems to Secondary Treatment Plant	0.14	0.10
Conversion of Septic Systems to Tertiary Treatment Plant	0.56	0.60
Conversion of Primary Treatment to Secondary Treatment	0.14	0.10
Conversion of Primary Treatment to Tertiary Treatment	0.56	0.60
Conversion of Secondary Treatment to Tertiary Treatment	0.42	0.50

BMP Cost Editor

Agricultural Cost Editor	
Conservation Tillage (per acre)	$30.00
Cropland Protection (per acre)	$25.00
Grazing Land Management (per acre)	$360.00
Streambank Fencing (per acre)	$10.00
Streambank Fencing (per mile)	$15,000.00
Streambank Stabilization (per foot)	$25.00
Vegetated Buffer Strip (per mile)	$1,500.00
Terraces and Diversions (per acre)	$500.00
AWMS Livestock (per AEU)	$1,250.00
AWMS Poultry (per AEU)	$520.00
Runoff Control (per AEU)	$300.00
Phytase in Feed (per AEU)	$2.50
Nutrient Management (per acre)	$110.00
Ag to Wetland Conversion (per acre)	$5,000.00
Unpaved Roads (per foot)	$5.58
Ag to Forest Conversion (per acre)	$5,000.00

Urban Cost Editor		
Constructed Wetlands (per acre)	* VARIES PER SITE	$13,400.00
Bioretention Areas (per acre)	"	$8,000.00
Detention Basins (per acre)	"	$10,700.00

Septic System and Point Source Upgrades	
Conversion of Septic Systems to Centralized Sewage Treatment (per home)	$15,000.00
Conversion From Primary to Secondary Sewage Treatment (per capita)	$250.00
Conversion From Primary to Tertiary Sewage Treatment (per capita)	$300.00
Conversion From Secondary to Tertiary Sewage Treatment (per capita)	$150.00

Estimated Load Reductions

	Existing (lbs)		
UPLAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	1367949	0	0
Hay/Pasture	84244	0	0
High Density Urban	22	0	0
Low Density Urban	1607	0	0
Unpaved Roads	8327	0	0
Other	0	0	0
STREAMBANK EROSION	662820	0	0
GROUNDWATER/SUBSURFACE		0	0
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		0	0
FARM ANIMALS		0	0
TOTALS	**2124969**	**0**	**0**

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	862113	0	0
Hay/Pasture	83149	0	0
High Density Urban	22	0	0
Low Density Urban	1607	0	0
Unpaved Roads	0	0	0
Other	0	0	0
STREAMBANK EROSION	584560	0	0
GROUNDWATER/SUBSURFACE		0	0
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		0	0
FARM ANIMALS		0	0
TOTALS	**1531451**	**0**	**0**
PERCENT REDUCTIONS	27.9	100.0	100.0
TOTAL SCENARIO COST	~~$625,545.60~~ $315,800.00		
Ag BMP Cost (%)	5.6		
WW Upgrade Cost (%)	0.0		
Urban BMP Cost (%)	0.0		
Stream Protection Cost (%)	66.2		

CALCULATED SEPARATELY BECAUSE OF SITE VARIABILITY

Unpaved Road Protection Cost (%)	28.3

Pathogen Loads		
Source	**Existing (orgs/month)**	**Future (orgs/month)**
Farm Animals	0.000e+00	0.000e+00
WWTP	0.000e+00	0.000e+00
Septic Systems	0.000e+00	0.000e+00
Urban Areas	0.000e+00	0.000e+00
Wildlife	0.000e+00	0.000e+00
Totals	1.000e-06	0.000e+00
PERCENT REDUCTIONS		100.00
TOTAL SCENARIO COST	~~$625,545.60~~	

$315,800.00

- SEE PAGE 6

MIDDLE SPRING FINAL MODEL RUN 3-9-09

TARGET REDUCTION 506,573 lb/YR

MODEL REDUCTION 631,220 lb/YR

Mean Annual Load Data Editor

Load Data Type	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
UPLAND EROSION/RUNOFF			
Row Crops	2556660	0	0
Hay/Pasture	216533	0	0
High Density Urban	3792	0	0
Low Density Urban	6346	0	0
Unpaved Road	0	0	0
Other	0	0	0
STREAMBANK EROSION	2656	0	0
GROUNDWATER/SUBSURFACE		0	0
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		0	0
TOTAL	2785987	0	0
BASIN AREA	5095 Acres		

NUTRIENTS NOT MODELED - NOT A TMDL IMPAIRMENT FACTOR

Agricultural Land BMP Scenario Editor

Land Use	Acres		BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8
Row Crops	2325	% Existing	25	10	50	0	0	0		3
		% Future	25	10	50	0	1	0		4
Hay/Pasture	1856	% Existing				0	0	0	2	0
		% Future				0	0	0	8	0

Agricultural Land on Slope > 3%	3,414 Acres
Streams in Agricultural Areas	11.0 Miles
Total Stream Length	14.0 Miles
Unpaved Road Length	0.0 Miles

	Existing	Future
Stream Miles with Vegetated Buffer Strips	0.0	4.4
Stream Miles with Fencing	0.0	3.2
Stream Miles with Stabilization	0.0	2.0
Unpaved Road Miles w/E & S Controls	0.0	0.0

	% Existing	% Future
AWMS (Livestock)	0.0	0.0

AWMS (Poultry)	0.0	0.0	
Runoff Control	0.0	0.0	
Phytase in Feed	0.0	0.0	

Urban Land BMP Scenario Editor

High Density Urban

		Acres	2325	% Impervious Surface	50
Constructed Wetlands		**Bioretention Areas**		**Detention Basins**	
% Existing	25	% Existing	0	% Existing	0
% Future	0	% Future	8	% Future	0
% Drainage Area Used	5	% Drainage Area Used	6	% Drainage Area Used	3
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.8	DB Acres Required	0.0

Low Density Urban

		Acres	250	% Impervious Surface	25
Constructed Wetlands		**Bioretention Areas**		**Detention Basins**	
% Existing	0	% Existing	0	% Existing	0
% Future	0	% Future	8	% Future	0
% Drainage Area Used	3	% Drainage Area Used	6	% Drainage Area Used	2
Impervious Acres Drained	0.0	Impervious Acres Drained	5.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	1.2	DB Acres Required	0.0

Vegetated Stream Buffers

			Existing	Future
Stream miles in high density urban areas	2	Stream miles in high density urban areas w/buffers	0	.1
		High Density Urban Streambank Stabilization	0	0
Stream miles in low density urban areas	1	Stream miles in low density urban areas w/buffers	0	.4
		Low Density Urban Streambank Stabilization	0	.2

Septic Systems and Point Source Discharge Scenario Editor

Number of persons on septic systems	Existing	0		
	Future	0		
Spetic systrems converted by treatment type %	Secondary	0	Tertiary	0
	Existing Point Source Load		No	
		Primary	**Secondary**	**Tertiary**
Distribution of pollutant discharge by treatment type %	Existing	0	0	0
	Future	0	0	0
		Primary to Secondary	**Primary to Tertiary**	**Secondary to Tertiary**
Distribution of treatment upgrades %		0	0	0

Rural and Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
BMP 1	0.25	0.36	0.35	
BMP 2	0.50	0.38	0.64	
BMP 3	0.23	0.40	0.41	
BMP 4	0.95	0.94	0.92	
BMP 5	0.96	0.98	0.92	
BMP 6	0.70	0.28		
BMP 7	0.43	0.34	0.13	
BMP 8	0.44	0.42	0.71	
Vegetated Buffer Strips	0.64	0.52	0.58	0.70
Streambank Fencing	0.56	0.78	0.76	1.00
Streambank Stabilizatio	0.95	0.95	0.95	
Unpaved Roads (lbs/ft)	0.02	0.0035	2.55	
AWMS (Livestock)	0.75	0.75		0.75
AWMS (Poultry)	0.14	0.14		0.14
Runoff Control	0.15	0.15		0.15
Phytase in Feed		0.21		

Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
Constructed Wetlands	0.53	0.51	0.88	0.71
Bioretention Areas	0.46	0.61	0.10	0.82
Detention Basins	0.40	0.51	0.93	0.71

Wastewater BMP Load Reduction Efficiency Editor

	Nitrogen	Phosphorus
Conversion of Septic Systems to Secondary Treatment Plant	0.14	0.10
Conversion of Septic Systems to Tertiary Treatment Plant	0.56	0.60
Conversion of Primary Treatment to Secondary Treatment	0.14	0.10
Conversion of Primary Treatment to Tertiary Treatment	0.56	0.60
Conversion of Secondary Treatment to Tertiary Treatment	0.42	0.50

BMP Cost Editor

Agricultural Cost Editor		
Conservation Tillage (per acre)		$30.00
Cropland Protection (per acre)		$25.00
Grazing Land Management (per acre)		$360.00
Streambank Fencing (per acre)		$10.00
Streambank Fencing (per mile)		$15,000.00 2.85'
Streambank Stabilization (per foot)		$25.00
Vegetated Buffer Strip (per mile)		$1,500.00 .128
Terraces and Diversions (per acre)		$500.00
AWMS Livestock (per AEU)		$1,250.00
AWMS Poultry (per AEU)		$520.00
Runoff Control (per AEU)		$300.00
Phytase in Feed (per AEU)		$2.50
Nutrient Management (per acre)		$110.00
Ag to Wetland Conversion (per acre)		$5,000.00
Unpaved Roads (per foot)		$5.58
Ag to Forest Conversion (per acre)		$5,000.00
Urban Cost Editor		
Constructed Wetlands (per acre)	* VARIES PER SITE	$13,400.00
Bioretention Areas (per acre)	"	$8,000.00
Detention Basins (per acre).	"	$10,700.00
Septic System and Point Source Upgrades		
Conversion of Septic Systems to Centralized Sewage Treatment (per home)		$15,000.00
Conversion From Primary to Secondary Sewage Treatment (per capita)		$250.00
Conversion From Primary to Tertiary Sewage Treatment (per capita)		$300.00
Conversion From Secondary to Tertiary Sewage Treatment (per capita)		$150.00

Estimated Load Reductions

	Existing (lbs)		
UPLAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	2556660	0	0
Hay/Pasture	216533	0	0
High Density Urban	3792	0	0
Low Density Urban	6346	0	0
Unpaved Roads	0	0	0
Other	0	0	0
STREAMBANK EROSION	2656	0	0
GROUNDWATER/SUBSURFACE		0	0
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		0	0
FARM ANIMALS		0	0
TOTALS	**2785987**	**0**	**0**

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	1930331	0	0
Hay/Pasture	214844	0	0
High Density Urban	3653	0	0
Low Density Urban	4104	0	0
Unpaved Roads	0	0	0
Other	0	0	0
STREAMBANK EROSION	1834	0	0
GROUNDWATER/SUBSURFACE		0	0
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		0	0
FARM ANIMALS		0	0
TOTALS	**2154767**	**0**	**0**
PERCENT REDUCTIONS	22.7	100.0	100.0
TOTAL SCENARIO COST	~~$899,464.60~~	$ 2,071,930.00	
Ag BMP Cost (%)	18.7	CALCULATED SEPARATELY	
WW Upgrade Cost (%)	0.0	BECAUSE OF SITE	
Urban BMP Cost (%)	4.4	VARIABILITY	
Stream Protection Cost (%)	76.9		

Unpaved Road Protection Cost (%)	0

Pathogen Loads		
Source	Existing (orgs/month)	Future (orgs/month)
Farm Animals	0.000e+00	0.000e+00
WWTP	0.000e+00	0.000e+00
Septic Systems	0.000e+00	0.000e+00
Urban Areas	0.000e+00	0.000e+00
Wildlife	0.000e+00	0.000e+00
Totals	1.000e-06	0.000e+00
PERCENT REDUCTIONS		100.00
TOTAL SCENARIO COST	~~$899,464.60~~	

$2,071,930.00
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Middle Spring Monitoring Data

Site	Month	Year	Water Temp	pH	DO	Conductivity	Nitrate	Transparency	orthophosphate
1	Oct	2008							
1	Nov	2008							
1	Dec	2008							
1	Jan	2009							
1	Feb	2009	48	7.25	10.3		0.08	55	0.055
1	Mar	2009	54	7.5	8.2	348	0.7	60	0.04
1	Apr	2009	59	6.8	10		3	60	0.08
1	May	2009	57	6.25	9.8		0.8	37.5	0.16
1	Jun	2009	56	6.7	8.6		0.9	12	0.2
1	jul	2009	62	7.5	9.8		5.9	60	0.08
1	Aug	2009	63	7.25	7.2		0.2	50	0.22
1	Sep	2009	58	7.75	7.4	300	3.8	60	0.08
Site 1	**Average**		**57.1**	**7.1**	**8.9**	**324.0**	**1.9**	**49.3**	**0.11**
	Minimum		**48**	**6.25**	**7.2**	**300**	**0.08**	**12**	**0.04**
	Maximum		**63**	**7.75**	**10.3**	**348**	**5.9**	**60**	**0.22**

Site	Month	Year	Water Temp	pH	DO	Conductivity	Nitrate	Transparency	orthophosphate
4	Oct	2008							
4	Nov	2008	60	7.5	8.8	550	5.8	58	0.053
4	Dec	2008							
4	Jan	2009	48	7	10.7	470	5.5	56	0.1
4	Feb	2009							
4	Mar	2009	50	7	10	541	5	60	0.05
4	Apr	2009	52	7.5	9.9	525	3	60	0.16
4	May	2009	60	7.2	9.2		2.4	60	0.2
4	Jun	2009	60	7.5	8	447	0.86	60	0.13
4	Jul	2009	62	7.5	8.6	460	2.5	60	0.22
4	Aug	2009							
4	Sep	2009	63	7.5	7.9	300	1.9	60	0.21
Site 4	**Average**		**56.9**	**7.3**	**9.1**	**470.4**	**3.4**	**59.3**	**0.14**
	Minimum		**48**	**7**	**7.9**	**300**	**0.86**	**56**	**0.05**
	Maximum		**63**	**7.5**	**10.7**	**550**	**5.8**	**60**	**0.22**

Site	Month	Year	Water Temp	pH	DO	Conductivity	Nitrate	Transparency	orthophosphate
Site 1	**Average**		**57.1**	**7.1**	**8.9**	**324.0**	**1.9**	**49.3**	**0.1**
	Minimum		**48**	**6.25**	**7.2**	**300**	**0.08**	**12**	**0.04**
	Maximum		**63**	**7.75**	**10.3**	**348**	**5.9**	**60**	**0.22**
Site 4									
	Average		**56.88**	**7.34**	**9.14**	**470.43**	**3.37**	**59.25**	**0.14**
	Minimum		**48**	**7**	**7.9**	**300**	**0.86**	**56**	**0.05**
	Maximum		**63**	**7.5**	**10.7**	**550**	**5.8**	**60**	**0.22**
	Common *Flowing Water Parameters*		***< 68***	***6.5 - 8.2***	***> 8 mg/l***		***< 5 mg/l***	***> 54***	***< .01 mg/L***