# Watershed Implementation Plan

For

# South Branch Plum Creek

Stream Code – 46577

Indiana County, PA (17-E)

Prepared by

Crooked Creek Watershed Association

And

Indiana County Conservation District

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# I. INTRODUCTION

The Crooked Creek Watershed Association (CrCWA) was established in 1981 with the mission to improve the water quality of Crooked Creek and its tributaries, preserve and enhance natural habitats in the watershed, and increase public awareness and education. Since its inception, CrCWA has worked with numerous partners on Abandoned Mine Drainage (AMD) treatment, streambank restoration, and fish habitat improvement projects. CrCWA has also partnered to build public boat launches and handicapped fishing piers, conduct watershed cleanups, and initiate education and public outreach events.

A grassroots nonprofit organization, CrCWA was founded by a group of concerned volunteers interesting in increasing the ecological health of the watershed and quality of life in the community in which they live. The benefits of improving the water quality and condition of the natural habitats of Crooked Creek are: cleaner, safer drinking water for residents; improved recreational opportunities such as fishing, swimming, and boating; and increased ecological health and biodiversity.

The South Branch Plum Creek, the largest tributary to Crooked Creek, is presently polluted throughout most of the watershed and experiencing a reduction in aquatic life. Streams within were identified in Pennsylvania's 2006 Integrated Water Quality Monitoring and Assessment Report as being impaired by siltation resulting primarily from agriculture. The impaired stream segments in the watershed and causes for impairment are shown in Table 1 and Figure 1.

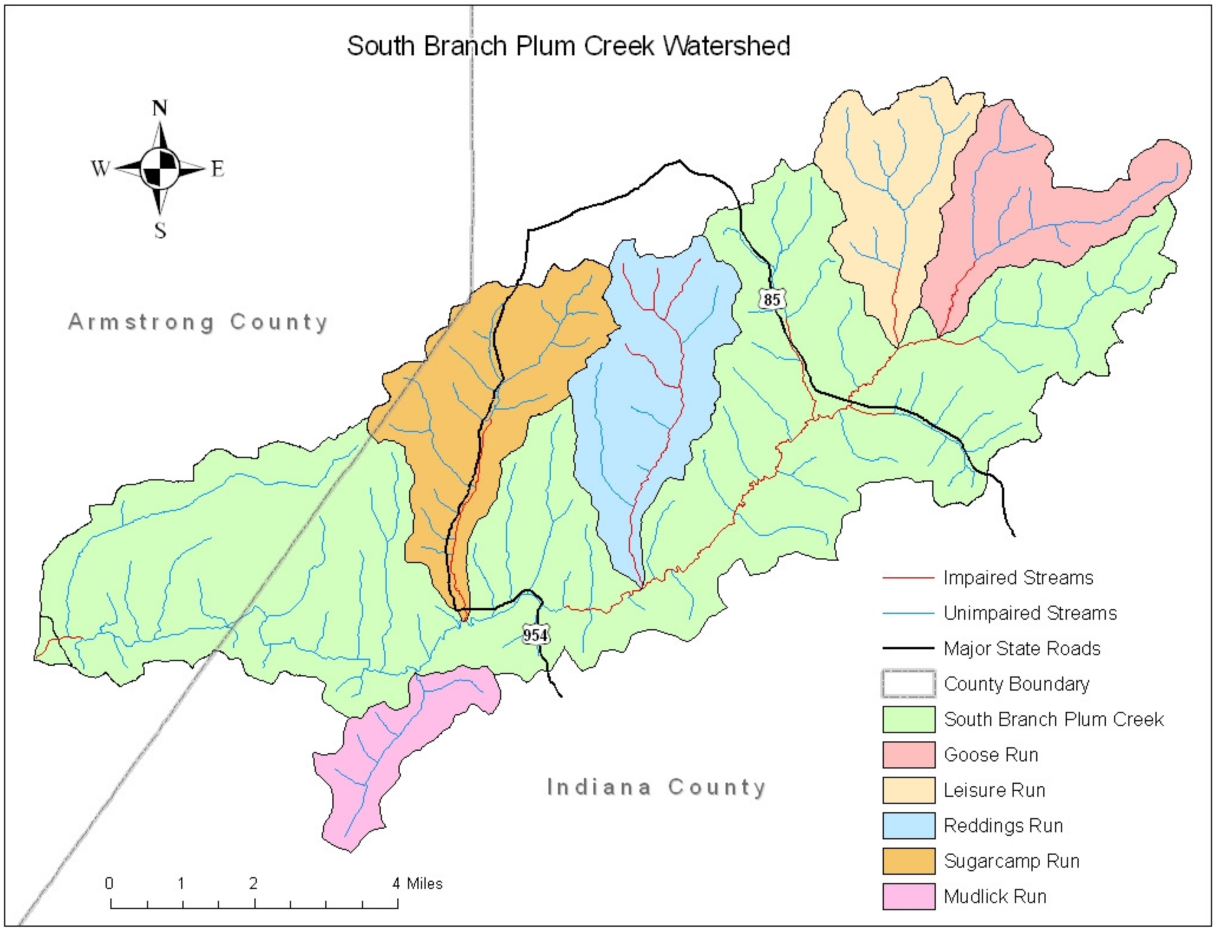
Despite the impaired status of the South Branch Plum Creek, it is designated as one of the few High Quality Cold Water Fisheries in Indiana County and has been identified as a priority watershed for Growing Greener funding by the Pennsylvania Department of Environmental Protection (PADEP).

To accomplish its mission of restoring the Crooked Creek Watershed, CrCWA seeks to work in cooperation with interested farmers and landowners to reduce sediment pollution by conducting restoration projects to improve water quality. These projects, called Best Management Practices (BMPs), may include streambank protection, riparian buffer planting, and streambank fencing.

CrCWA needed to develop a plan for restoring for South Branch Plum Creek Watershed. This Watershed Implementation Plan (WIP) would include an assessment of the watershed and identify potential restoration projects. With a WIP developed, CrCWA could use it to work with landowners to implement BMPs and to pursue grants need to fund projects.

In March 2008, CrCWA partnered with the Indiana County Conservation District (ICCD) and were funded through a Section 319(h) Nonpoint Source Management Grant to develop a WIP for the South Branch Plum Creek.

**Figure 1. South Branch Plum Creek Streams and Sub-watersheds**




Under the Clean Water Act, if a state determines a stream to be impaired, it must be listed on the Section 303(d) list and must be reported to the Environmental Protection Agency (EPA) every two years. Once streams are placed on the 303(d) list, the Clean Water Act then requires states to develop allowable pollution limits for meeting water quality goals called Total Maximum Daily Loads (TMDLs).

The TMDL process is a nationwide effort to inventory and improve the health of surface waters, requiring a study be completed to determine how to restore impaired water bodies. A TMDL sets a target goal for the total amount of a pollutant that can safely enter a stream while still supporting its designated aquatic life uses, and then works to meet the target goal by distributing load allocations to all pollution sources in the watershed.

The PADEP Southwest Regional Office began developing a Sediment TMDL for the South Branch Plum Creek in 2006, with a final draft completed in 2008. Although the TMDL was never finalized and remains in draft form, it served as a guideline to developing the WIP.

The WIP used the TMDL as a guideline to identify BMP projects to reduce pollutant-loading, working towards the goal of eventually delisting of the impaired stream segments in the watershed. The WIP was developed by collecting and compiling relevant information from existing studies and previously published plans for the watershed. These plans include: the Crooked Creek Watershed Nonpoint Source Pollution Assessment, prepared by CWM Environmental Inc. for CrCWA in 2005; the Upper Crooked Creek Rivers Conservation Plan, prepared by Mackin Engineering Co. for the Indiana County Office of Planning and Development through the Pennsylvania Department of Conservation and Natural Resources Rivers Conservation Program in 2001; and the Assessment of Nonpoint Source Pollution for Crooked Creek and Cowanshannock Creek Watershed, prepared by the Armstrong and Indiana County Conservation Districts in 1994. An Agricultural Assessment for the entire Crooked Creek Watershed has been drafted by the Armstrong and Indiana County Conservation Districts.

CrCWA and ICCD will utilize the WIP to apply for funds to work with landowners to implement restoration projects outlined in the plan.

## II. BACKGROUND

The Crooked Creek Watershed, located within the Pittsburgh Low Plateau Section of the Appalachian Plateau, drains approximately 292 square miles of Indiana and Armstrong Counties of Pennsylvania into the Allegheny River. Crooked Creek's two largest tributaries, the North and South Branches of Plum Creek, are found in the northern portion of the watershed.

The South Branch Plum Creek is an approximately 40 square mile watershed, containing about 103 miles of stream, located in mid-eastern Armstrong County and mid-western Indiana County. It flows southwesterly for approximately 17 miles before its confluence with the North Branch of Plum Creek to form Plum Creek. Major tributaries to the South Branch include Sugarcamp Run, Reddings Run, Leisure Run, and Goose Run. Elevation ranges from 1000 to 1560 feet above sea level. The two underlying geology consists of interbedded sedimentary rocks, and the Casselman and Glenshaw Formation bedrock groups. The Glenshaw Formation, which is dominant, primarily consists of sandstones and mudrocks, with thin limestone and coal seams. Soil associations in the watershed include Gilpin-Wharton-Ernest, Monongahela-Philo-Atkins, and Gilpin-Weikert-Ernest. The dominant hydrologic soil group is C, which is characterized as having a slow infiltration rate when thoroughly wetted.

The South Branch Plum Creek basin exhibits the dendritic drainage pattern characteristic of streams in the Allegheny River. The topography is highly variable, but it is dominated by wide bottomland floodplains extending up to 1000 feet from the stream margin. This feature has led to many of the floodplains in the watershed to be converted to agricultural use.

During PADEP's TMDL development, the estimated dominant land use categories of the South Branch Plum Creek are: Agriculture – 45%; Forest – 53%; Other – 2%.

The water quality impairments of the South Branch Plum Creek can be linked to the large amount of agricultural land use in the watershed. Nonpoint agricultural sources provide a major contribution to the siltation water quality impairment.

South Branch Plum Creek and several of its tributaries were determined to be impaired by siltation, but listings for organic enrichment/low dissolved oxygen are no longer valid (Table 1). Recent sampling found no evidence of low dissolved oxygen; as no excessive algal growth was observed, and measurements taken from previous sampling sites were above 8.0 mg/L. There are currently no point sources of pollution contributing to the listed causes of impairment in the watershed. (TMDL)

**Table 1. Current Impairments of South Branch Plum Creek**

| Stream Name | Miles | Segment ID | Stream Code | Designated Use | Source | Cause |
|---|---|---|---|---|---|---|
| South Branch Plum Creek | 2.7 | 20020801-1230-ALF | 46577 | HQ-CWF | Grazing Related Agric, Removal of Vegetation | Siltation |
| South Branch Plum Creek | 1.0 | 20020801-1100-ALF | 46577 | HQ-CWF | Grazing Related Agric | Siltation; Organic Enrichment/Low DO |
| South Branch Plum Creek | 3.3 | 20020801-0900-ALF | 46577 | HQ-CWF | Grazing Related Agric | Siltation; Organic Enrichment/Low DO |
| South Branch Plum Creek | 0.8 | 20090417-1115-dcounahan | 46577 | CWF | 1) Bank Modifications<br>2) Other | 1) Siltation<br>2) Exotic Species |
| UNT 46636 | 0.7 | 20020731-0930-ALF | 46636 | HQ-CWF | On Site Wastewater | Organic Enrichment/Low DO |
| UNT 46636 | 0.5 | 20020731-1130-ALF | 46636 | HQ-CWF | Removal of Vegetation | Siltation |
| UNT 46643 | 0.5 | 20020731-1330-ALF | 46643 | HQ-CWF | Construction | Siltation |
| Goose Run | 1.0 | 20030514-1100-ALF | 46659 | HQ-CWF | Grazing Related Agric | Siltation |
| Leisure Run | 0.2 | 20020731-1630-ALF | 46652 | HQ-CWF | On Site Wastewater | Organic Enrichment/Low DO |
| Sugarcamp Run | 3.8 | 2002-0722-0945-ALF | 46598 | CWF | AMD | Metals; Siltation |
| Reddings Run | 6.1 | 2009-0513-1000-dcounahan | 46620 | CWF | 1) Agriculture<br>2) Small Residential Runoff<br>3) Bank Modification<br>4) Removal of Vegetation<br>5) Road Runoff | 1) Siltation; Nurtients<br>2) Siltation<br>3) Siltation<br>4) Siltation<br>5) Siltation |

* HQ-CWF = High Quality Cold Water Fishery; CWF = Cold Water Fishery; AMD = Abandoned Mine Drainage

Best Management Practices (or BMPs) are structural and non-structural approaches used to prevent or reduce pollutant loads in watersheds to meet water quality goals. BMPs are techniques that can be employed by landowners to either reduce the production of a pollutant, or prevent a pollutant from entering a waterbody.

The TMDL suggests the following BMPs to meet the required sediment reductions in the South Branch of Plum Creek: 1) Pasture Land Management, 2) Vegetated Buffer Strips, and 3) Streambank Protection.

Pasture Land Management refers to the utilization of practices to prevent excessive erosion due to over-grazing and overuse by ensuring adequate vegetative cover. Rotational grazing is a common practice of this type used by farmers seeking to reduce feeding costs. An example of this practice is periodically moving livestock among fenced pastures or paddocks to prevent overuse of any feeding area and allowing vegetation to recover. Planting hay or legumes as part of crop rotations provides feed for livestock, protects land areas from excessive erosion, and adds needed nitrogen to the soil.

Vegetated Buffer Strips are a type of structural BMPs suggested in the South Branch TMDL for implementation in the watershed. They are areas of land containing permanent vegetation that trap pollutants contained in surface runoff from adjacent land, usually cropland or confined animal facilities. Infiltration, deposition, and other natural processes remove pollutants from runoff. Types of vegetated buffer strips include: 1) permanently vegetated strips located between larger strips of crops on sloping land, 2) strips of permanent vegetation established at the edges of agricultural fields, and 3) areas of permanent vegetation adjacent to streams, ponds, or wetlands.

Streambank Protection is a collective term referring to several practices that can be implemented to reduce streambank erosion and decay. The most commonly used practice is streambank fencing, which prohibits cattle from trampling banks and streambeds, removing riparian vegetation, and adding excess nutrients through defecation and urination. Developments of springs and off-stream drinking water sources are often employed in tandem with fencing. Streambank protection also includes developing stable livestock crossings, which allows animals to move across the stream with minimal disturbance to the streambed and banks. The most effective practice of streambank protection, in terms of sediment reduction efficiencies, is streambank stabilization. This practice involves using structural methods to remedy unstable banks by physically reinforcing them with rocks, logs, vegetation, or other protective surfaces. Examples of these practices include traditional stabilization methods, such as rip-rap and gabion walls; and more ecologically beneficial methods such as natural stream design and fish habitat improvement structures (FHIS).

FHIS are constructed using natural materials, such as rock and stone, and include deflectors, vanes, cross-vanes, and mudsill cribbing. FHIS provide protective cover for fish and work by directing the force of the stream flow away from the banks into the stream channel, helping to create and maintain pool habitat. By absorbing some of the force of the stream flow, FHIS help reduce the potential for flood damage during storms. FHIS not only stop sediment from being stripped from the streambanks, they also allow sediment from upstream to be deposited in desirable areas and can actually help rebuild the streambanks they are protecting.

All the BMPs described above are designed to reduce the sediment load reaching streams in the watershed. Therefore, CrCWA and its partners will look to partner with landowners in the South Branch Plum Creek to implement the restoration recommendations outlined in this plan.

## DATA COLLECTION

As previously stated, numerous assessments have already been conducted and reports published for the South Branch Plum Creek. After compiling relevant information from these previously published documents, a plan for collecting missing data was developed. Detailed field assessments of current conditions were needed, due to the age of past assessments. Due to limiting funding for this project, a cost-effective strategy for assessing the over 100 miles of stream corridors had to be determined.

Based on PADEP's 2008 TMDL, it was known that a significant amount sediment reducing BMPs would need to be identified for implementation. We determined the best strategy for assessment was to utilize aerial photography and GIS data using ArcMap GIS software. To verify the accuracy of the GIS data and aerial photography, field assessments were conducted to collect data on current conditions of riparian areas.

CrCWA, along with ICCD and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) staff, began field assessments of existing BMPs in the watershed in September 2009. These existing BMPs were mostly implemented through the Conservation Reserve Enhancement Program (CREP) from 2006-2009. These BMPs were assessed to determine if they were functioning properly and if any repairs were necessary. Unfortunately, most of the existing BMPs in the watershed were cool-season grass and wildlife food plots in areas with little sediment reduction efficiencies.

Field assessments to verify the accuracy of the GIS data and aerial photography were conducted in tandem with public outreach efforts were conducted from June to August 2010. The public outreach efforts consisted of door-to-door visits to watershed residents to distribute a public outreach handout, containing information about the WIP, sedimentation issues, and BMPs. American Highbush Cranberry seedlings were also distributed with the handouts, with residents being encouraged to plant them in riparian areas. During this time, the riparian corridors were assessed to determine if streambank stabilization, fencing, and/or vegetated buffer were needed.

Using ArcMap, the entire South Branch Plum Creek Watershed was mapped by major sub-watersheds. Maps were created containing stream, state and local road, and county tax parcel boundary GIS data layers. Duplicate maps were also created containing the previously mentioned data overlaid onto USDA National Agriculture Imagery Program's (NAIP) aerial photography layer. Using the photos as a reference, verification of the actual current conditions was accomplished, riparian buffers were classified, and required BMPs were determined. Notes, observations, and sketches were drawn on the maps in the field, and then converted into GIS data layers later in the office.

The TMDL determined that the majority of the sedimentation in the South Branch Plum Creek comes from streambank erosion. Accordingly, the majority of the BMPs proposed for implementation require streambank protection. During field assessments, banks and riparian areas were analyzed for specific streambank protection BMPs needed. These BMPs include vegetated buffers, streambank fencing, and streambank stabilization. Based on the field assessments and aerial photography, lengths and sizes of these BMPs were determined using the ArcMap software for each potential project site.

In the summer and fall of 2010, CrCWA and ICCD collected water quality data at several points in the South Branch Plum Creek through a PADEP Surface Waters Assessment grant. The data was collected following PADEP's Instream Comprehensive Evaluation and includes field measurements, water and benthic macroinvertebrates samples analyzed by DEP-certified laboratories, and visual habitat assessments. Laboratory water samples were analyzed by Standard Analysis Code 907, which includes pH, biochemical oxygen demand, residue, total suspended solids, ammonia, nitrate, nitrite, and phosphorus. Field measurements were taken including, temperature, pH, alkalinity, dissolved oxygen, and conductivity, using handheld meters and field kits. The results are shown in Table 2. It should be noted that Pennsylvania does not currently have state water quality standards for sediments and nutrients.

Samples were taken at sites on the lower portion of the impaired sections of Leisure Run, Goose Run, and UNT 46636, and on two sites on the impaired section of the mainstem of the South Branch Plum Creek. The locations of these sample points are shown on Figure 2.

**Table 2. Recent Waters Quality Sampling in South Branch Plum Creek**

| Station_ID | Date | Latitude | Longitude | Nitrate (mg/L) | Nitrite (mg/L) | pH | TDS (mg/L) | TSS (mg/L) | Ammonia Nitrogen (mg/L) | BOD (mg/L) | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SBPlumD | 7/12/2010 | 40.73059 | 79.18404 | < 0.50 | < 0.010 | 7.0 | 103 | < 5 | < 0.05 | < 3 | < 0.03 |
| SBPlumD* | 9/28/2010 | 40.73059 | 79.18404 | < 0.50 | < 0.010 | 6.5 | 141 | 10 | < 0.05 | < 3 | < 0.03 |
| SBPlumM | 7/12/2010 | 40.74871 | 79.15465 | < 0.50 | < 0.010 | 7.3 | 125 | < 5 | < 0.05 | < 3 | < 0.03 |
| SBPlumM* | 9/28/2010 | 40.74871 | 79.15465 | < 0.50 | < 0.010 | 6.8 | 142 | 22 | < 0.05 | < 4 | 0.06 |
| UNTSBPlum | 7/12/2010 | 40.76132 | 79.14677 | 0.5 | < 0.010 | 7.3 | 229 | < 5 | 0.49 | < 3 | 0.15 |
| UNTSBPlum* | 9/28/2010 | 40.76132 | 79.14677 | < 0.50 | < 0.010 | 6.9 | 267 | 6 | 0.19 | < 4 | 0.1 |
| Leisure | 7/12/2010 | 40.76955 | 79.12952 | < 0.50 | < 0.010 | 7.4 | 112 | 5 | < 0.05 | < 3 | 0.04 |
| Leisure* | 9/28/2010 | 40.76955 | 79.12952 | < 0.50 | < 0.010 | 7.1 | 128 | < 5 | < 0.05 | 4 | 0.03 |
| Goose | 7/12/2010 | 40.77008 | 79.12073 | 0.6 | < 0.010 | 7.5 | 107 | < 5 | < 0.05 | < 3 | 0.05 |
| Goose* | 9/28/10 | 40.77008 | 79.12073 | < 0.50 | < 0.010 | 7.2 | 115 | 5 | < 0.05 | < 3 | < 0.03 |

* Samples taken during elevated flows after storm events

As shown in Table 1, Sugarcamp Run is the only stream in the South Branch Watershed that is impaired by AMD. More research and sampling is needed to characterize the discharges, but Table 3 showing recent sampling results upstream and downstream on the discharges.

**Table 3. Recent Instream AMD Sampling in Sugarcamp Run**

| Date | Time | Site | Acidity (mg/L) | Alkalinity (mg/L) | pH | Iron (mg/L) | Manganese (mg/L) | Zinc (mg/L) |
|---|---|---|---|---|---|---|---|---|
| 3/22/2010 | 15:40 | SugarcU | 1 | 28 | 6.5 | 1.05 | 0.16 | <0.005 |
| 3/22/2010 | 16:00 | SugarcD | -1 | 30 | 6.4 | 0.99 | 0.16 | <0.005 |
| 4/19/2010 | 12:30 | SugarcU | -12 | 33 | 6.5 | 0.24 | 0.28 | <0.005 |
| 4/19/2010 | 12:40 | SugarcD | -14 | 35 | 6.5 | 0.97 | 0.36 | 0.013 |
| 6/2/2010 | 16:45 | SugarcU | -32 | 57 | 6.9 | 1.39 | 0.29 | 0.006 |
| 6/2/2010 | 17:00 | SugarcD | -20 | 43 | 6.7 | 2.37 | 0.29 | 0.012 |
| 7/12/2010 | 10:00 | SugarcU | -68 | 84 | 7.6 | 0.4 | 0.52 | <0.005 |
| 7/12/2010 | 10:30 | SugarcD | -25 | 41 | 6.8 | 5.29 | 0.92 | 0.061 |
| 8/23/2010 | 9:50 | SugarcU | -48 | 77 | 6.5 | 0.36 | 0.41 | <0.005 |
| 8/23/2011 | 10:20 | SugarcD | -11 | 47 | 6.1 | 8.31 | 1.06 | 0.073 |
| 10/4/2010 | 9:15 | SugarcU | -37 | 63 | 6.8 | 0.26 | 0.63 | <0.005 |
| 10/4/2010 | 9:35 | SugarcD | -1 | 32 | 6.2 | 9.76 | 1.1 | 0.08 |
| 10/25/2010 | 9:40 | SugarcU | -117 | 141 | 7.8 | 0.4 | 0.61 | <0.005 |
| 10/25/2010 | 10:10 | SugarcD | -28 | 49 | 6.6 | 5.38 | 0.54 | 0.038 |
| 11/8/2010 | 7:45 | SugarcU | -27 | 48 | 6.5 | 0.24 | 0.44 | <0.005 |
| 11/8/2010 | 8:00 | SugarcD | -20 | 45 | 6.4 | 5.59 | 0.88 | 0.038 |

Benthic macroinvertebrates samples were taken in the fall of 2010 for laboratory analysis and visible habitat assessments were also conducted. Macroinvertebrate samples result are show in Tables 4 and 5, and habitat scores are shown in Table 6. The results for Goose and Leisure Runs indicate that these sub-watersheds are close to reaching aquatic life attainment thresholds. These sub-watersheds are priorities for project implementation. Results from Sugarcamp Run, a lower priority sub-watershed, show that physical habitat and aquatic life are still impaired.

Table 5 shows the macroinvertebrate sampling results from a 2009 assessment by PADEP on Reddings Run and a lower segment of the South Branch Plum Creek in Armstrong County. This assessment indicated that these portions of the watershed are now also impaired by siltation.

**Table 4. Fall 2010 Goose and Leisure Run Macroinvertebrate Sampling Results**

| | Goose Run | | Leisure Run | |
|---|---|---|---|---|
| **Metric Names** | **Raw Metric Values** | **Freestone Riffle-Run (2009 small)** | **Raw Metric Values** | **Freestone Riffle-Run (2009 small)** |
| Total Richness | 26 | 78.8 | 25 | 75.8 |
| EPT Richness (PTV 0-4) | 6 | 31.6 | 6 | 10.5 |
| Beck's Index (v. 3) | 4 | 10.5 | 4 | 10.5 |
| Hilsenhoff Biotic Index | 6.18 | 47.1 | 6.43 | 44.1 |
| % Intolerant Individuals (PTV 0-3) | 10.9 | 12.9 | 8.8 | 10.4 |
| Shannon Diversity | 2.4 | 83.9 | 2.48 | 86.6 |
| **IBI Score** | **-** | **44.1** | **-** | **43.2** |

* EPT = Ephemeroptera, Plecoptera, Trichoptera; PTV = Pollution Tolerance Value; IBI = Index of Biological Integrity

**Table 5. Fall 2010 Sugarcamp Run Macroinvertebrate Sampling Results**

| | Sugarcamp Run | | | |
|---|---|---|---|---|
| | SugarcD | | SugarcU | |
| **Metric Names** | **Raw Metric Values** | **Freestone Riffle-Run (2009 small)** | **Raw Metric Values** | **Freestone Riffle-Run (2009 small)** |
| Total Richness | 25 | 75.8 | 19 | 57.6 |
| EPT Richness (PTV 0-4) | 5 | 26.3 | 5 | 26.3 |
| Beck's Index (v. 3) | 0 | 0 | 1 | 2.6 |
| Hilsenhoff Biotic Index | 5.77 | 52.2 | 5.95 | 50 |
| % Intolerant Individuals (PTV 0-3) | 1.8 | 2.2 | 2.2 | 2.6 |
| Shannon Diversity | 2.05 | 71.6 | 1.51 | 52.8 |
| **IBI Score** | **-** | **38.0** | **-** | **32.0** |

**Table 6. 2009 PADEP Assessment Macroinvertebrate Sampling Results**

| | Reddings Run | | Lower S. Br. Plum Creek | |
|---|---|---|---|---|
| **Metric Names** | **Raw Metric Values** | **Freestone Riffle-Run (2009 small)** | **Raw Metric Values** | **Freestone Riffle-Run (2009 small)** |
| Total Richness | 13 | 39.4 | 19 | 57.6 |
| EPT Richness (PTV 0-4) | 6 | 31.6 | 10 | 52.6 |
| Beck's Index (v. 3) | 6 | 15.8 | 8 | 21.1 |
| Hilsenhoff Biotic Index | 5.73 | 52.7 | 5.11 | 60.2 |
| % Intolerant Individuals (PTV 0-3) | 7.2 | 8.5 | 20.2 | 23.9 |
| Shannon Diversity | 1.07 | 37.5 | 1.63 | 57.0 |
| **IBI Score** | **-** | **30.9** | **-** | **45.4** |

**Table 7. Visual Physical Habitat Assessment Scores**

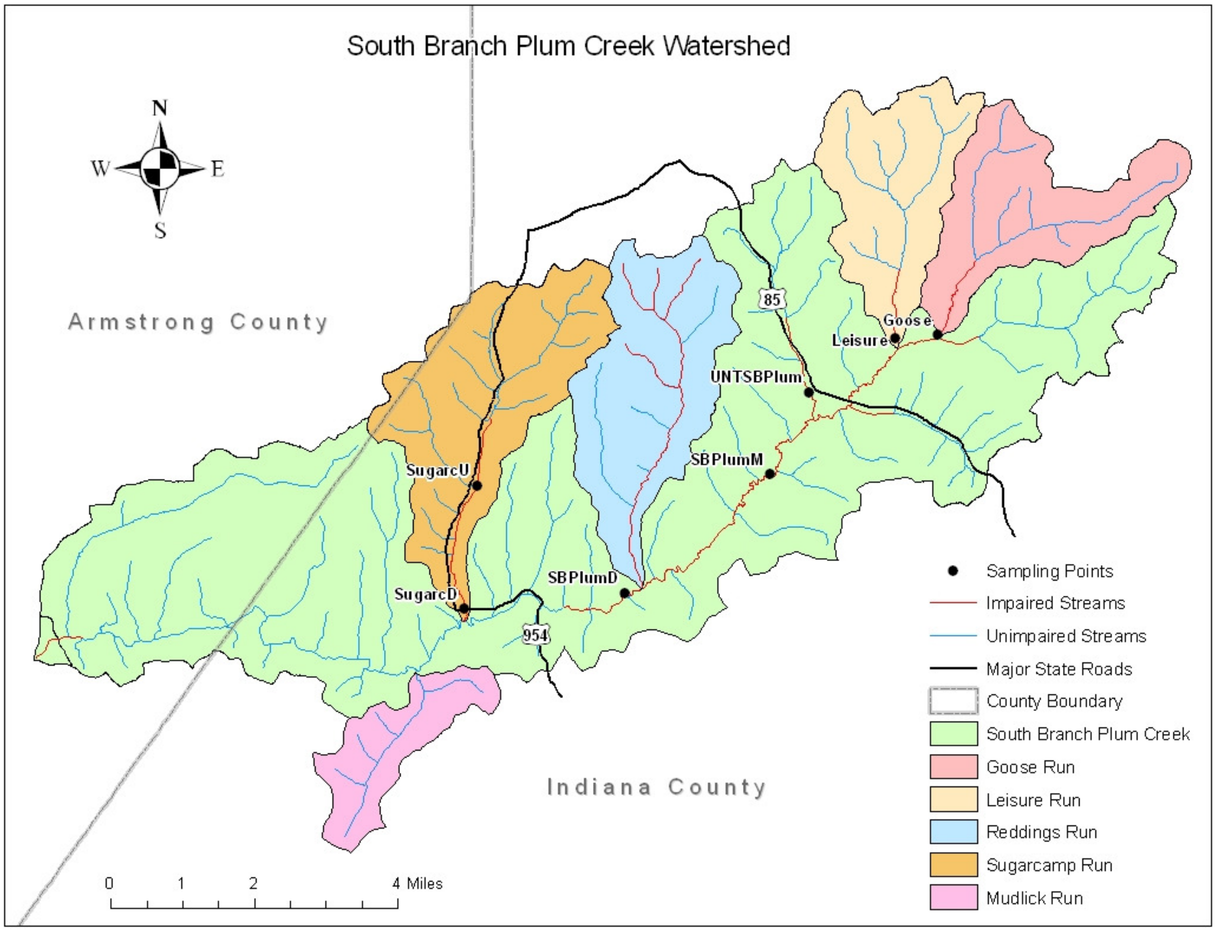
| **Site** | SugarcD | SugarcU | SBrPlumD | SBrPlumM | UNTSBrPlum | Leisure | Goose |
|---|---|---|---|---|---|---|---|
| **Date Sampled** | 3/24/2010 | 3/24/2010 | 10/22/2010 | 10/22/2010 | 10/22/2010 | 10/22/2010 | 10/22/2010 |
| **1. Instream Cover** | 6 | 9 | 18 | 16 | 11 | 18 | 16 |
| **2. Epifaunal Substrate** | 11 | 12 | 12 | 10 | 11 | 12 | 12 |
| **3. Embeddedness** | 1 | 1 | 13 | 5 | 9 | 8 | 5 |
| **4. Velocity/Depth Regimes** | 15 | 13 | 19 | 15 | 14 | 13 | 14 |
| **5. Channel Alteration** | 15 | 13 | 19 | 18 | 13 | 16 | 15 |
| **6. Sediment Deposition** | 1 | 1 | 10 | 5 | 10 | 6 | 5 |
| **7. Frequency of Riffles** | 10 | 16 | 11 | 8 | 11 | 10 | 12 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **8. Channel Flow Status** | 19 | 19 | 10 | 13 | 15 | 15 | 15 |
| **9. Condition of Banks** | 12 | 11 | 3 | 7 | 10 | 11 | 16 |
| **10. Bank Vegetative Protection** | 12 | 10 | 10 | 11 | 10 | 12 | 18 |
| **11. Grazing or Other Disruptive Pressure** | 8 | 12 | 11 | 11 | 6 | 14 | 19 |
| **12. Riparian Vegetative Width** | 3 | 11 | 10 | 11 | 3 | 11 | 13 |
| **Total Score** | **113** | **128** | **146** | **130** | **123** | **146** | **160** |

In the spring of 2011, ICCD staff conducted visual assessments of the agricultural operations in the watershed to collect animal number data, and assess the need for barnyard, cropland, and pastureland BMPs. These BMPs include roof and barnyard runoff controls, covered manure stacking areas, dry ponds, spring developments, and prescribed grazing. The data was recorded in the field using the same aerial photography/GIS map reference approach used during the prior riparian corridor assessment. The data was again converted into GIS layers at the office.

Since the TMDL has not been finalized and the stream assessments that led to the impaired status of watershed were conducted in 2002, the sediment loading rates had to be remodeled utilizing the best available modeling software. In order to model the changes in sediment loads from 2002 to the present, more detailed data needed to be compiled on changes in land use and rural land BMPs. To accomplish this, ArcMap was used to create a geodatabase of all the row crop and hay/pasture land in each sub-watershed. By comparing older NAIP aerial photography layers with the newest available Microsoft Bing Maps layer, along with data collected in the field, rural land BMPs percentages were estimated. This data was used to model the reductions in sediment loads due to changes in land use and BMP utilization from 2002 to the present.

**Figure 2. Sampling Points in South Branch Plum Creek.**




The recent water quality samples indicate that nutrient pollution levels are not exceeding impairment thresholds, although visual habitat assessments show that embeddedness and sediment deposition are limiting factors for aquatic life.

Benthic macroinvertebrates samples were also taken on Leisure, Goose, and Sugarcamp Runs during this assessment. The results indicate that the biota is still impaired in the lower segments of these streams.

## MODELING

PADEP primarily utilizes GIS technology to collect the data needed to develop watershed assessments, such as TMDLs. Penn State University Institutes of Energy and the Environment assist PADEP in developing GIS-based watershed assessment programs to complete these tasks.

The TMDL for the South Branch Plum Creek was developed using the Generalized Watershed Loading Function (GWLF) model to estimate land use in the South Branch Plum Creek Watershed. Since the TMDL has not been finalized, and there have been both changes in land use in the watershed and updates to the modeling programs, new models were developed to complete this plan.

PADEP took the lead in modeling sediment loads in the watershed using GWLF, and then assisted ICCD in modeling the sediment load reductions anticipated by the implementation on this plan. To accomplish this task, a version of GLWF model called the Pollution Reduction Impact Comparison Tool (PRedICT) was used to estimate sediment load reductions and BMP costs.

## RESULTS

During ICCD's visual assessment of the watershed, we found that the amount of row crop agriculture had diminished. Farms had been purchased by members of the Plain Sect community whose methods of agriculture tend to limit herd size and amount of ground under cultivation. A large 200-cow dairy farm, which was identified as a major pollution source in the TMDL, has ceased operation. Most of the animal agriculture exists in the sub watersheds or upper reaches of the mainstem. Many former pasturelands are beginning to revert to meadows due to lack of grazing. The sediment reductions from this agricultural land retirement are shown in the following model inputs at BMP 8. Table 8 shows which BMPs are used as modeling inputs.

**Table 8. Agricultural Land BMPs Used in PRedICT**

| BMP # | Description |
|---|---|
| BMP 1 | Cover Crops |
| BMP 2 | Conservation Tillage |
| BMP 3 | Strip-cropping/Contour Farming |
| BMP 4 | Conservation Plan |
| BMP 5 | N/A (no BMP specified) |
| BMP 6 | Nutrient Management |
| BMP 7 | Grazing Land Management |
| BMP 8 | Agricultural Land Retirement |

Although, the TMDL was not finalized, the draft TMDL serves to provide a quantitative goal for sediment load reductions. Since the South Branch Plum Creek TMDL only focused on a targeted portion of the watershed, a watershed model was developed for the same area. The results of this model were then compared to the TMDL allocation. The results confirm that the sediment load will be reduced below TDML levels, assuming full project implementation in the target watershed, as shown in Table 9.

The following model in this section (pages 14-16) shows the results of that scenario. Also shown are agricultural land BMPs, efficiencies, and cost estimates.

**Table 9. TMDL Targeted Load vs. WIP Implementation Load**

| Parameter | Sediment (tons/year) |
|---|---|
| Targeted TMDL Load | 3310.1 |
| WIP Implementation Load | 2946.5 |

*TMDL TARGETED WATERSHED WIP IMPLEMENTATION LOAD REDUCTION SCENARIO*

## Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 4200.79197 | % Existing | 1 | 0 | 77 | 77 | 0 | 2 | | 23 |
| | | % Future | 70 | 70 | 80 | 77 | 0 | 20 | | 23 |
| Hay/Pasture | 4025.3471289 | % Existing | | | | 60 | 0 | 0 | 0 | 40 |
| | | % Future | | | | 60 | 0 | 0 | 0 | 40 |

| | | |
|---|---|---|
| Agricultural Land on Slope > 3% | 7,566 | Acres |
| Streams in Agricultural Areas | 30.7 | Miles |
| Total Stream Length | 77.0 | Miles |
| Unpaved Road Length | 37.0 | Miles |
| | Existing | Future |
| Stream Miles with Vegetated Buffer Strips | 0.6 | 22.1 |
| Stream Miles with Fencing | 1.1 | 7.8 |
| Stream Miles with Stabilization | 0.1 | 16.8 |
| Unpaved Road Miles w/E & S Controls | 2.5 | 10.4 |
| | % Existing | % Future |
| AWMS (Livestock) | 0.0 | 100.0 |
| AWMS (Poultry) | 0.0 | 0.0 |
| Runoff Control | 0.0 | 100.0 |
| Phytase in Feed | 0.0 | 0.0 |

## Rural and Urban BMP Load Reduction Efficiency Editor

| BMP Type | Nitrogen | Phosphorus | Sediment | Pathogens |
|---|---|---|---|---|
| BMP 1 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilization | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 | | |

## 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |

## Estimated Load Reductions

| | Existing (lbs) | | |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| Row Crops | 8758966 | 33662 | 4506 |
| Hay/Pasture | 961215 | 8900 | 983 |
| High Density Urban | 24251 | 906 | 95 |
| Low Density Urban | 2205 | 71 | 7 |
| Unpaved Roads | 363763 | 1418 | 198 |
| Other | 198416 | 1446 | 101 |
| STREAMBANK EROSION | 2128367 | 1067 | 183 |
| GROUNDWATER/SUBSURFACE | | 111644 | 1850 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 2284 | 77 |
| FARM ANIMALS | | 7529 | 3587 |
| TOTALS | **12437182** | **168927** | **11587** |
| | **Future (lbs)** | | |
| LAND EROSION/RUNOFF | **Total Sed (lbs)** | **Total N (lbs)** | **Total P (lbs)** |
| Row Crops | 2992781 | 16871 | 1487 |
| Hay/Pasture | 961215 | 8900 | 983 |
| High Density Urban | 24251 | 906 | 95 |
| Low Density Urban | 2205 | 71 | 7 |
| Unpaved Roads | 166104 | 1412 | 198 |
| Other | 198416 | 1446 | 101 |
| STREAMBANK EROSION | 1548056 | 795 | 133 |
| GROUNDWATER/SUBSURFACE | | 103607 | 1817 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 2284 | 77 |
| FARM ANIMALS | | 3533 | 967 |
| TOTALS | **5893028** | **139823** | **5865** |
| PERCENT REDUCTIONS | 52.6 | 17.2 | 49.4 |
| TOTAL SCENARIO COST | $5,964,332.52 | | |
| Ag BMP Cost (%) | 4.1 | | |
| WW Upgrade Cost (%) | 0.0 | | |
| Urban BMP Cost (%) | 0.0 | | |
| Stream Protection Cost (%) | 78.7 | | |
| Unpaved Road Protection Cost (%) | 7.8 | | |

The following results (pages 17-18) show the estimated load reduction by each sub-watershed assuming full project implementation.

*GOOSE RUN ESTIMATED LOAD REDUCTIONS*

| | Existing (lbs) | | |
|---|---|---|---|
| GOOSE RUN | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| TOTALS | 871401 | 22227 | 1462 |
| | Future (lbs) | | |
| TOTALS | 203740 | 15514 | 505 |
| PERCENT REDUCTIONS | 76.6 | 30.2 | 65.5 |
| TOTAL SCENARIO COST | $1,207,027.53 | | |

*LEISURE RUN ESTIMATED LOAD REDUCTIONS*

| | Existing (lbs) | | |
|---|---|---|---|
| LEISURE RUN | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| TOTALS | 997437 | 16215 | 1023 |
| | Future (lbs) | | |
| TOTALS | 398316 | 12969 | 675 |
| PERCENT REDUCTIONS | 60.1 | 20.0 | 34.1 |
| TOTAL SCENARIO COST | $653,911.23 | | |

*MAINSTEM/UNTS ESTIMATED LOAD REDUCTIONS*

| | Existing (lbs) | | |
|---|---|---|---|
| MAINSTEM/UNTS | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| TOTALS | 7921535 | 122601 | 7516 |
| | Future (lbs) | | |
| TOTALS | 4396490 | 107159 | 4318 |
| PERCENT REDUCTIONS | 44.5 | 12.6 | 42.6 |
| TOTAL SCENARIO COST | $3,382,459.65 | | |

*REDDINGS RUN ESTIMATED LOAD REDUCTIONS*

| | Existing (lbs) | | |
|---|---|---|---|
| REDDINGS RUN | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| TOTALS | 1877512 | 27756 | 1887 |
| | Future (lbs) | | |
| TOTALS | 822401 | 21209 | 886 |
| PERCENT REDUCTIONS | 56.2 | 23.6 | 53.1 |

| | |
|---|---|
| TOTAL SCENARIO COST | $1,012,490.54 |

*SUGARCAMP RUN ESTIMATED LOAD REDUCTIONS*

| | Existing (lbs) | | |
|---|---|---|---|
| SUGARCAMP RUN | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| TOTALS | 1717039 | 20364 | 1402 |
| | Future (lbs) | | |
| TOTALS | 631390 | 16595 | 717 |
| PERCENT REDUCTIONS | 63.2 | 18.5 | 48.9 |
| TOTAL SCENARIO COST | $1,412,026.42 | | |

*MUDLICK RUN ESTIMATED LOAD REDUCTIONS*

| | Existing (lbs) | | |
|---|---|---|---|
| MUDLICK RUN | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| TOTALS | 356141 | 3148 | 216 |
| | Future (lbs) | | |
| TOTALS | 77134 | 2550 | 119 |
| PERCENT REDUCTIONS | 78.3 | 19.0 | 45.2 |
| TOTAL SCENARIO COST | $172,946.66 | | |

Complete modeling results are shown in the Appendix starting on page 49.

**Sub-Watershed Load Reductions Summary**

| | Sediment Load (lbs) | | |
|---|---|---|---|
| **Sub-watershed** | **Existing** | **Future** | **% Reduction** |
| Goose Run | 871401 | 203740 | 76.6 |
| Leisure Run | 997437 | 398316 | 60.1 |
| Mainstem/UNTs | 7921535 | 4396490 | 44.5 |
| Reddings Run | 1877512 | 822401 | 56.2 |
| Sugarcamp Run | 1717039 | 631390 | 63.2 |
| Mudlick Run | 356141 | 77134 | 78.3 |
| **Totals** | **13741065** | **6529471** | **52.5** |

## RESTORATION RECOMMENDATIONS

Tables 10 and 11 and Figures 3-11 include all 191 potential project sites identified for implementation in this plan.

**Table 10. Potential Agriculture Project Sites**

| Ag BMP Project # | Priority Rank | Cover Crops | Conservation Tillage | Strip crop/Contour | Conservation Plan | Nutrient Mgmt | Grazing Land Mgmt | Curbed Manure Storage | Roof Gutters | Barnyard Buffers/ Diversions | Lane Stabilization | Spring Developments | Dry Ponds | Stream crossings | Watershed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Acres (approx.) | | | | | | # of BMPs | | | | | | | |
| 1 | 1 | 63 | 63 | 28 | 115 | 115 | 53 | 1 | 1 | 1 | 2 | 1 | 0 | 2 | Leisure Run |
| 2 | 1 | 78 | 78 | 41 | 122 | 0 | 44 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | Leisure Run |
| 3 | 1 | 7 | 7 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Leisure Run |
| 4 | 1 | 78 | 78 | 0 | 118 | 118 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | Leisure Run |
| 5 | 1 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Leisure Run |
| 6 | 1 | 57 | 57 | 0 | 13 | 13 | 13 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | Leisure Run |
| 7 | 1 | 81 | 81 | 0 | 0 | 110 | 30 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | Leisure Run |
| 8 | 1 | 14 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | Leisure Run |
| 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Leisure Run |
| 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | Leisure Run |
| 12 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Leisure Run |
| 13 | 1 | 0 | 0 | 0 | 4 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Leisure Run |
| 14 | 1 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Leisure Run |
| 15 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | Leisure Run |
| 16 | 1 | 77 | 77 | 0 | 0 | 84 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | Goose Run |
| 17 | 1 | 15 | 15 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |
| 18 | 1 | 118 | 118 | 0 | 0 | 143 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 1 | 187 | 187 | 0 | 0 | 231 | 44 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | Goose Run |
| 20 | 1 | 31 | 31 | 31 | 31 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |
| 21 | 1 | 64 | 64 | 0 | 31 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |
| 22 | 1 | 48 | 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |
| 23 | 1 | 22 | 22 | 0 | 28 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | Mainstem Headwaters |
| 24 | 1 | 119 | 119 | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |
| 25 | 1 | 39 | 39 | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Goose Run |
| 26 | 1 | 91 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 27 | 1 | 57 | 57 | 0 | 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 28 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | Goose Run |
| 29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | Goose Run |
| 30 | 1 | 47 | 47 | 47 | 107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 31 | 1 | 139 | 139 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 32 | 1 | 66 | 66 | 0 | 100 | 100 | 34 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Mainstem Headwaters |
| 33 | 1 | 119 | 119 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 34 | 1 | 28 | 28 | 0 | 28 | 28 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 3 | Mainstem Headwaters |
| 35 | 1 | 31 | 31 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 36 | 1 | 0 | 0 | 0 | 0 | 104 | 104 | 2 | 1 | 0 | 0 | 3 | 3 | 3 | Mainstem Headwaters |
| 37 | 1 | 37 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 38 | 1 | 42 | 42 | 0 | 42 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 39 | 1 | 108 | 108 | 0 | 0 | 152 | 44 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | Mainstem Headwaters |
| 40 | 1 | 118 | 118 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 41 | 1 | 207 | 207 | 90 | 491 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 42 | 2 | 35 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UNT 46643 |
| 43 | 2 | 34 | 34 | 9 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 44 | 1 | 44 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 45 | 2 | 38 | 38 | 0 | 0 | 0 | 205 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 46 | 5 | 69 | 69 | 0 | 0 | 136 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Lower Mainstem |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | 5 | 52 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Lower Mainstem |
| 48 | 5 | 82 | 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Lower Mainstem |
| 49 | 5 | 223 | 223 | 0 | 0 | 223 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Lower Mainstem |
| 50 | 2 | 53 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 51 | 1 | 10 | 10 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 52 | 2 | 91 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UNT 46643 |
| 53 | 2 | 24 | 24 | 0 | 67 | 67 | 43 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | Reddings Run |
| 54 | 2 | 47 | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 55 | 1 | 102 | 102 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 56 | 2 | 70 | 70 | 0 | 0 | 89 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 57 | 2 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UNT 46636 |
| 58 | 2 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 59 | 2 | 78 | 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UNT 46636 |
| 60 | 2 | 33 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UNT 46636 |
| 61 | 1 | 25 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 62 | 1 | 28 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 63 | 2 | 0 | 0 | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 64 | 2 | 58 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem |
| 65 | 1 | 79 | 158 | 0 | 0 | 0 | 0 | 3 | 3 | 1 | 1 | 0 | 0 | 0 | Mainstem |
| 66 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Mainstem Headwaters |
| 67 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 1 | Mainstem |
| 68 | 1 | 0 | 0 | 0 | 33 | 33 | 33 | 0 | 1 | 1 | 0 | 2 | 3 | 2 | Reddings Run |
| 69 | 3 | 30 | 30 | 0 | 36 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Reddings Run |
| 70 | 2 | 60 | 60 | 0 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Reddings Run |
| 71 | 3 | 51 | 51 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Reddings Run |
| 72 | 1 | 0 | 0 | 0 | 0 | 279 | 168 | 1 | 2 | 2 | 0 | 3 | 0 | 6 | Reddings Run |
| 73 | 3 | 0 | 0 | 0 | 62 | 62 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Reddings Run |
| 74 | 5 | 23 | 23 | 23 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mudlick Run |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75 | 4 | 226 | 226 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Sugarcamp Run |
| 76 | 4 | 69 | 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Sugarcamp Run |
| 77 | 4 | 46 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Sugarcamp Run |
| 78 | 1 | 112 | 112 | 0 | 112 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Mainstem Headwaters |
| 79 | 3 | 0 | 0 | 0 | 0 | 144 | 79 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | Reddings Run |
| 80 | 4 | 0 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Sugarcamp Run |

**Table 10(b). Agriculture Project Sites BMP Totals by Sub Watershed**

| Watershed | Cover Crops | Conservation Tillage | Strip crop/Contour | Conservation Plan | Nutrient Mgmt | Grazing Land Mgmt | Curbed Manure Storage | Roof Gutters | Barnyard Buffers/Diversions | Lane Stabilization | Spring Developments | Dry Ponds | Stream crossings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Acres (approx.)** | | | | | | **# of BMPs** | | | | | | |
| Goose Run | 698 | 698 | 31 | 274 | 520 | 68 | 2 | 2 | 2 | 0 | 5 | 4 | 6 |
| Leisure Run | 370 | 370 | 69 | 379 | 360 | 211 | 5 | 2 | 5 | 2 | 9 | 4 | 8 |
| Lower Mainstem | 426 | 426 | 0 | 0 | 359 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mainstem | 740 | 819 | 99 | 525 | 89 | 233 | 3 | 3 | 2 | 1 | 0 | 2 | 1 |
| Mainstem Headwaters | 1094 | 1094 | 47 | 521 | 384 | 182 | 7 | 3 | 3 | 2 | 8 | 4 | 10 |
| Mudlick Run | 23 | 23 | 23 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reddings Run | 165 | 165 | 0 | 282 | 609 | 391 | 1 | 4 | 4 | 0 | 5 | 5 | 10 |
| Sugarcamp Run | 341 | 341 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| UNT 46636 | 120 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| UNT 46643 | 126 | 126 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **4103** | **4182** | **269** | **2008** | **2321** | **1172** | **18** | **14** | **16** | **5** | **28** | **19** | **35** |

**Figure 3. Upper South Br Plum Creek Agriculture BMP Project Sites**

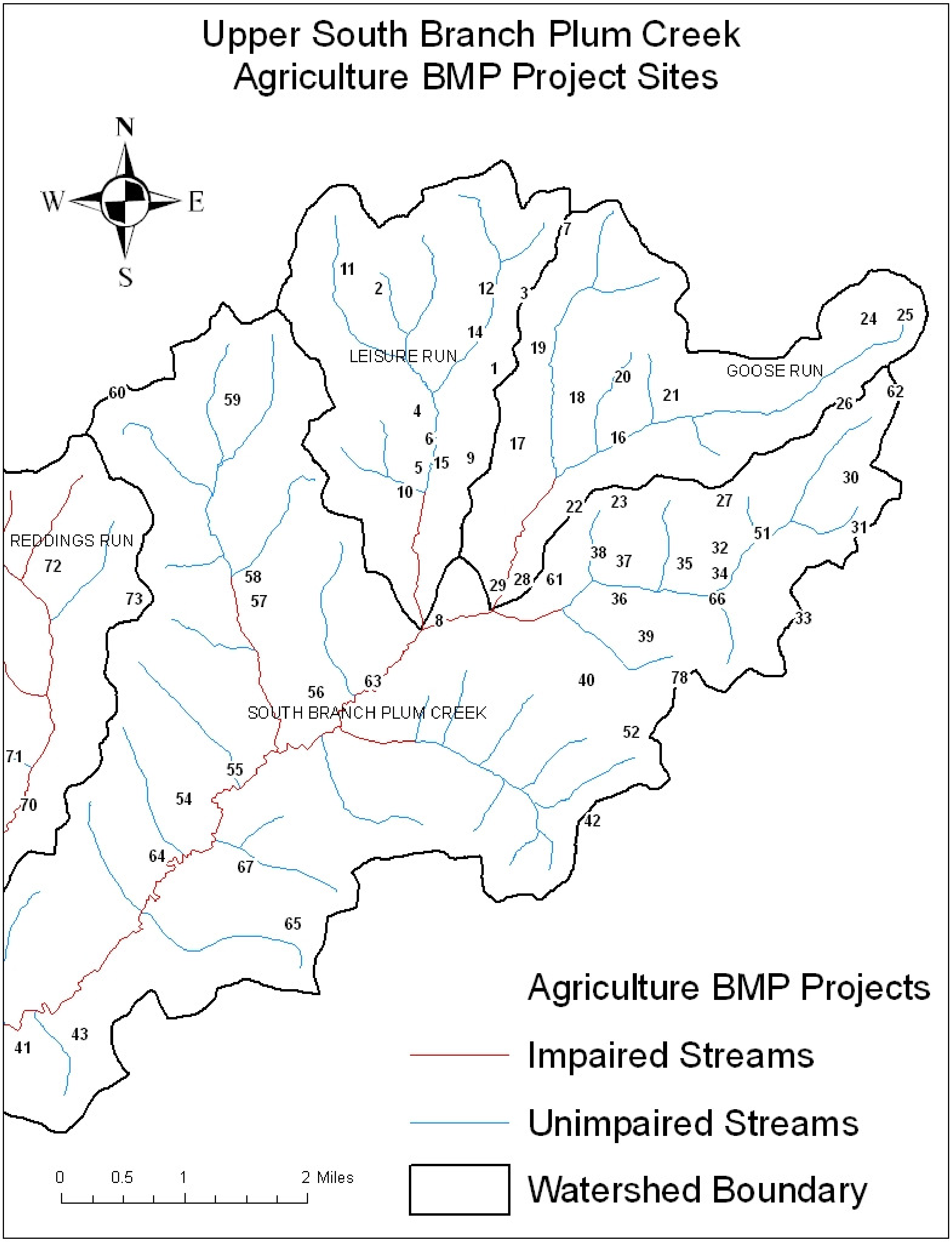


**Figure 4. Lower South Branch Plum Creek Agriculture BMP Project Sites**

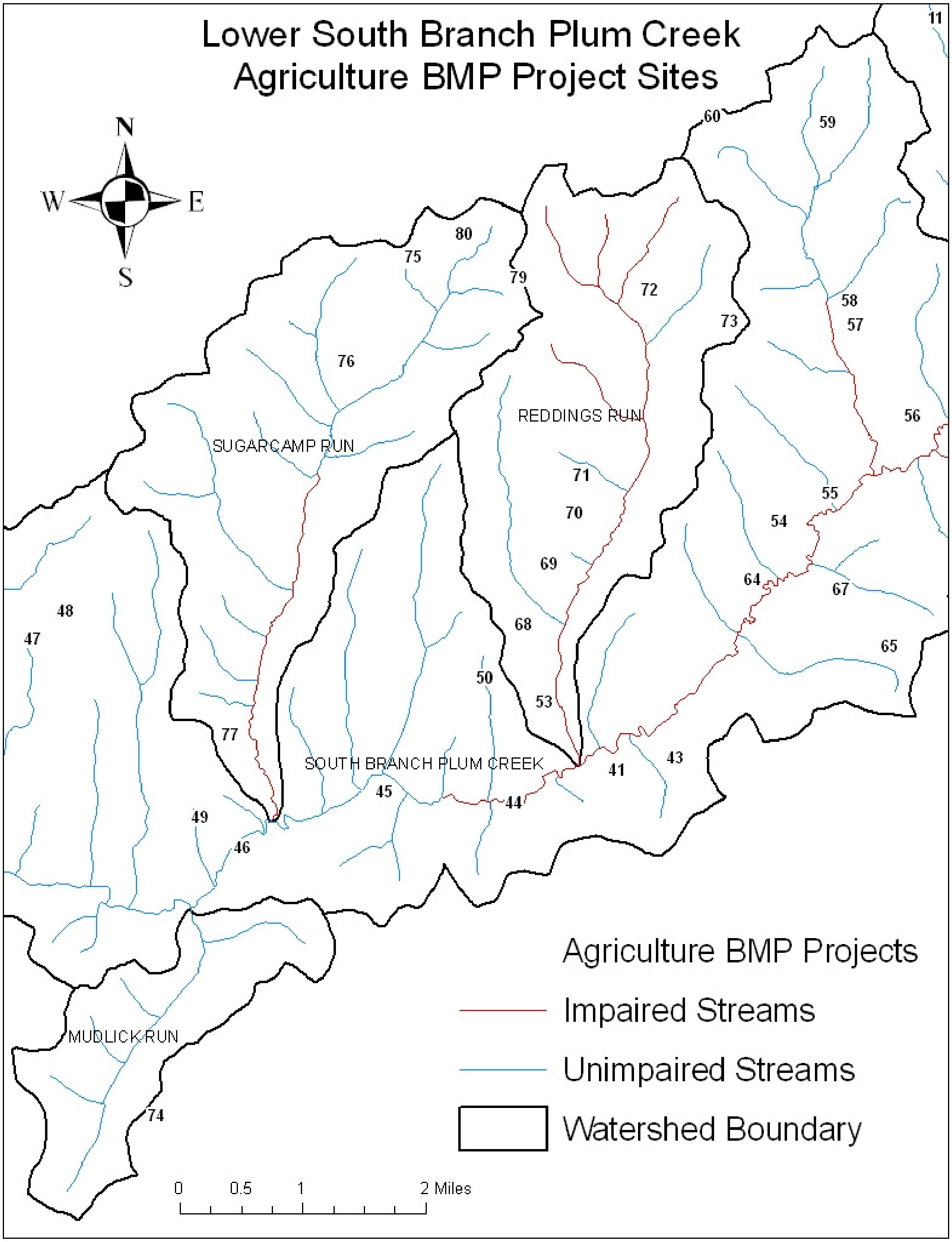


**Table 11. Potential Stream Restoration Projects**

| Stream Restoration Project # | Priority Rank | Streambank Fencing (feet) | Streambank Stabilization (feet) | Vegetated Buffer Strips (feet) | Watershed |
|---|---|---|---|---|---|
| 4 | 1 | 1958 | 1958 | 1958 | Leisure Run |
| 5 | 1 | 1008 | 1008 | 1008 | Leisure Run |
| 6 | 1 | 529 | 529 | 529 | Leisure Run |
| 7 | 1 | 477 | 0 | 477 | Leisure Run |
| 8 | 1 | 0 | 2565 | 1964 | Mainstem Headwaters |
| 10 | 1 | 0 | 216 | 1461 | Leisure Run |
| 11 | 1 | 262 | 262 | 676 | Leisure Run |
| 12 | 1 | 345 | 0 | 0 | Leisure Run |
| 13 | 1 | 177 | 177 | 177 | Leisure Run |
| 14 | 1 | 2256 | 0 | 1297 | Leisure Run |
| 16 | 1 | 6749 | 6749 | 6749 | Goose Run |
| 18 | 1 | 1445 | 1445 | 1445 | Goose Run |
| 19 | 1 | 3073 | 3073 | 3073 | Goose Run |
| 24 | 1 | 220 | 0 | 220 | Goose Run |
| 26 | 1 | 0 | 0 | 1091 | Mainstem Headwaters |
| 28 | 1 | 527 | 527 | 527 | Goose Run |
| 29 | 1 | 373 | 373 | 373 | Goose Run |
| 34 | 1 | 1362 | 1362 | 1362 | Mainstem Headwaters |
| 35 | 1 | 0 | 0 | 1120 | Mainstem Headwaters |
| 36 | 1 | 1635 | 1635 | 1635 | Mainstem Headwaters |
| 39 | 1 | 1848 | 1848 | 1848 | Mainstem Headwaters |
| 41 | 1 | 0 | 3944 | 4947 | Mainstem |
| 43 | 2 | 0 | 0 | 1550 | Mainstem |
| 44 | 1 | 0 | 2668 | 2668 | Mainstem |

| | | | | | |
|---|---|---|---|---|---|
| 51 | 1 | 0 | 0 | 437 | Mainstem Headwaters |
| 53 | 2 | 0 | 2140 | 2140 | Reddings Run |
| 54 | 2 | 0 | 479 | 479 | Mainstem |
| 55 | 1 | 0 | 1944 | 4619 | Mainstem |
| 56 | 2 | 0 | 1564 | 0 | Mainstem |
| 58 | 2 | 1094 | 1460 | 312 | Mainstem |
| 63 | 2 | 0 | 2057 | 2157 | Mainstem |
| 64 | 2 | 0 | 3059 | 0 | Mainstem |
| 66 | 1 | 362 | 362 | 362 | Mainstem Headwaters |
| 68 | 1 | 3481 | 1549 | 3481 | Reddings Run |
| 70 | 2 | 0 | 1972 | 1972 | Reddings Run |
| 71 | 3 | 0 | 0 | 2268 | Reddings Run |
| 72 | 1 | 6610 | 0 | 6610 | Reddings Run |
| 73 | 3 | 0 | 0 | 358 | Reddings Run |
| 76 | 4 | 0 | 1481 | 1481 | Sugarcamp Run |
| 77 | 4 | 0 | 1790 | 1790 | Sugarcamp Run |
| 79 | 3 | 0 | 0 | 1205 | Reddings Run |
| 80 | 4 | 1068 | 1068 | 1068 | Sugarcamp Run |
| 81 | 1 | 0 | 432 | 432 | Goose Run |
| 82 | 1 | 0 | 372 | 372 | Goose Run |
| 83 | 1 | 0 | 1487 | 1487 | Goose Run |
| 84 | 1 | 0 | 1508 | 1508 | Goose Run |
| 85 | 1 | 497 | 0 | 497 | Goose Run |
| 86 | 1 | 678 | 0 | 678 | Goose Run |
| 87 | 1 | 0 | 218 | 0 | Leisure Run |
| 88 | 1 | 0 | 2450 | 0 | Leisure Run |
| 89 | 1 | 0 | 272 | 0 | Leisure Run |

| | | | | | |
|---|---|---|---|---|---|
| 90 | 1 | 0 | 1124 | 0 | Leisure Run |
| 91 | 1 | 0 | 204 | 204 | Leisure Run |
| 92 | 1 | 0 | 0 | 1695 | Leisure Run |
| 93 | 1 | 0 | 0 | 100 | Leisure Run |
| 94 | 1 | 0 | 0 | 221 | Leisure Run |
| 95 | 1 | 911 | 0 | 911 | Leisure Run |
| 96 | 1 | 458 | 458 | 458 | Mainstem Headwaters |
| 97 | 1 | 0 | 0 | 206 | Mainstem Headwaters |
| 98 | 1 | 0 | 0 | 651 | Mainstem Headwaters |
| 99 | 1 | 0 | 2271 | 2271 | Mainstem Headwaters |
| 100 | 1 | 0 | 841 | 0 | Mainstem Headwaters |
| 101 | 2 | 0 | 172 | 0 | Mainstem |
| 102 | 2 | 0 | 464 | 464 | Mainstem |
| 103 | 2 | 0 | 494 | 494 | Mainstem |
| 104 | 1 | 1853 | 1853 | 1853 | UNT 46643 |
| 105 | 2 | 0 | 618 | 618 | UNT 46643 |
| 106 | 2 | 0 | 1172 | 1172 | UNT 46643 |
| 107 | 2 | 748 | 647 | 0 | UNT 46643 |
| 108 | 2 | 0 | 712 | 0 | Mainstem |
| 109 | 2 | 0 | 769 | 0 | Mainstem |
| 110 | 2 | 0 | 401 | 401 | UNT 46636 |
| 111 | 2 | 0 | 392 | 392 | UNT 46636 |
| 112 | 2 | 0 | 252 | 252 | UNT 46636 |
| 113 | 2 | 0 | 209 | 209 | UNT 46636 |
| 114 | 2 | 0 | 565 | 0 | UNT 46636 |
| 115 | 2 | 0 | 577 | 245 | UNT 46636 |
| 116 | 2 | 0 | 826 | 424 | UNT 46636 |
| 117 | 2 | 0 | 471 | 471 | UNT 46636 |

| | | | | | |
|---|---|---|---|---|---|
| 118 | 2 | 0 | 0 | 1547 | UNT 46636 |
| 119 | 2 | 0 | 886 | 599 | Mainstem |
| 120 | 2 | 0 | 2140 | 2140 | Mainstem |
| 121 | 2 | 0 | 500 | 500 | Mainstem |
| 122 | 2 | 0 | 274 | 274 | Mainstem |
| 123 | 2 | 0 | 0 | 1841 | Mainstem |
| 124 | 2 | 0 | 513 | 0 | Mainstem |
| 125 | 2 | 0 | 391 | 0 | Mainstem |
| 126 | 2 | 0 | 1671 | 0 | Mainstem |
| 127 | 1 | 0 | 2740 | 1329 | Mainstem |
| 128 | 2 | 0 | 196 | 465 | Mainstem |
| 129 | 2 | 0 | 0 | 297 | Mainstem |
| 130 | 2 | 0 | 168 | 168 | Mainstem |
| 131 | 2 | 0 | 99 | 99 | Mainstem |
| 132 | 2 | 0 | 1932 | 0 | Mainstem |
| 133 | 2 | 0 | 1699 | 1699 | Mainstem |
| 134 | 2 | 0 | 0 | 1778 | Mainstem |
| 135 | 2 | 0 | 0 | 769 | Mainstem |
| 136 | 2 | 0 | 1255 | 1255 | Reddings Run |
| 137 | 3 | 0 | 308 | 308 | Reddings Run |
| 138 | 3 | 0 | 213 | 213 | Reddings Run |
| 139 | 3 | 0 | 839 | 839 | Reddings Run |
| 140 | 3 | 0 | 254 | 254 | Reddings Run |
| 141 | 3 | 0 | 0 | 363 | Reddings Run |
| 142 | 3 | 0 | 0 | 788 | Reddings Run |
| 143 | 3 | 0 | 749 | 749 | Reddings Run |
| 144 | 3 | 0 | 305 | 305 | Reddings Run |
| 145 | 3 | 0 | 201 | 201 | Reddings Run |

| | | | | | |
|---|---|---|---|---|---|
| 146 | 3 | 0 | 287 | 287 | Reddings Run |
| 147 | 2 | 0 | 1680 | 1880 | Reddings Run |
| 148 | 3 | 0 | 0 | 2091 | Reddings Run |
| 149 | 3 | 0 | 0 | 864 | Reddings Run |
| 150 | 3 | 0 | 0 | 313 | Reddings Run |
| 151 | 3 | 0 | 0 | 75 | Reddings Run |
| 152 | 3 | 0 | 0 | 262 | Reddings Run |
| 153 | 3 | 0 | 0 | 843 | Reddings Run |
| 154 | 3 | 0 | 0 | 1760 | Reddings Run |
| 155 | 3 | 0 | 0 | 1318 | Reddings Run |
| 156 | 3 | 0 | 0 | 1258 | Reddings Run |
| 157 | 4 | 1948 | 913 | 913 | Sugarcamp Run |
| 158 | 4 | 0 | 700 | 700 | Sugarcamp Run |
| 159 | 4 | 0 | 1285 | 1285 | Sugarcamp Run |
| 160 | 4 | 0 | 2159 | 2159 | Sugarcamp Run |
| 161 | 4 | 0 | 1200 | 1200 | Sugarcamp Run |
| 162 | 4 | 0 | 119 | 119 | Sugarcamp Run |
| 163 | 4 | 0 | 698 | 698 | Sugarcamp Run |
| 164 | 4 | 0 | 65 | 65 | Sugarcamp Run |
| 165 | 4 | 0 | 1459 | 1459 | Sugarcamp Run |
| 166 | 4 | 0 | 492 | 492 | Sugarcamp Run |
| 167 | 4 | 0 | 528 | 528 | Sugarcamp Run |
| 168 | 4 | 0 | 975 | 975 | Sugarcamp Run |
| 169 | 4 | 0 | 732 | 732 | Sugarcamp Run |
| 170 | 4 | 0 | 687 | 687 | Sugarcamp Run |
| 171 | 4 | 0 | 1215 | 1215 | Sugarcamp Run |
| 172 | 4 | 0 | 927 | 927 | Sugarcamp Run |

| | | | | | |
|---|---|---|---|---|---|
| 173 | 2 | 0 | 3145 | 3145 | Sugarcamp Run |
| 174 | 4 | 0 | 537 | 537 | Sugarcamp Run |
| 175 | 4 | 385 | 385 | 0 | Sugarcamp Run |
| 176 | 4 | 0 | 315 | 0 | Sugarcamp Run |
| 177 | 4 | 0 | 912 | 912 | Sugarcamp Run |
| 178 | 4 | 0 | 0 | 1904 | Sugarcamp Run |
| 179 | 4 | 0 | 622 | 1197 | Sugarcamp Run |
| 180 | 4 | 0 | 259 | 259 | Sugarcamp Run |
| 181 | 4 | 0 | 492 | 492 | Sugarcamp Run |
| 182 | 4 | 0 | 0 | 666 | Sugarcamp Run |
| 183 | 4 | 0 | 0 | 858 | Sugarcamp Run |
| 184 | 4 | 0 | 0 | 209 | Sugarcamp Run |
| 185 | 4 | 0 | 0 | 712 | Sugarcamp Run |
| 186 | 4 | 0 | 0 | 659 | Sugarcamp Run |
| 187 | 4 | 800 | 800 | 800 | Sugarcamp Run |
| 188 | 5 | 0 | 591 | 591 | Mudlick Run |
| 189 | 5 | 0 | 813 | 813 | Mudlick Run |
| 190 | 5 | 0 | 1111 | 1111 | Mudlick Run |
| 191 | 5 | 0 | 777 | 777 | Mudlick Run |

**Figure 5. Goose Run Stream Restoration Projects**

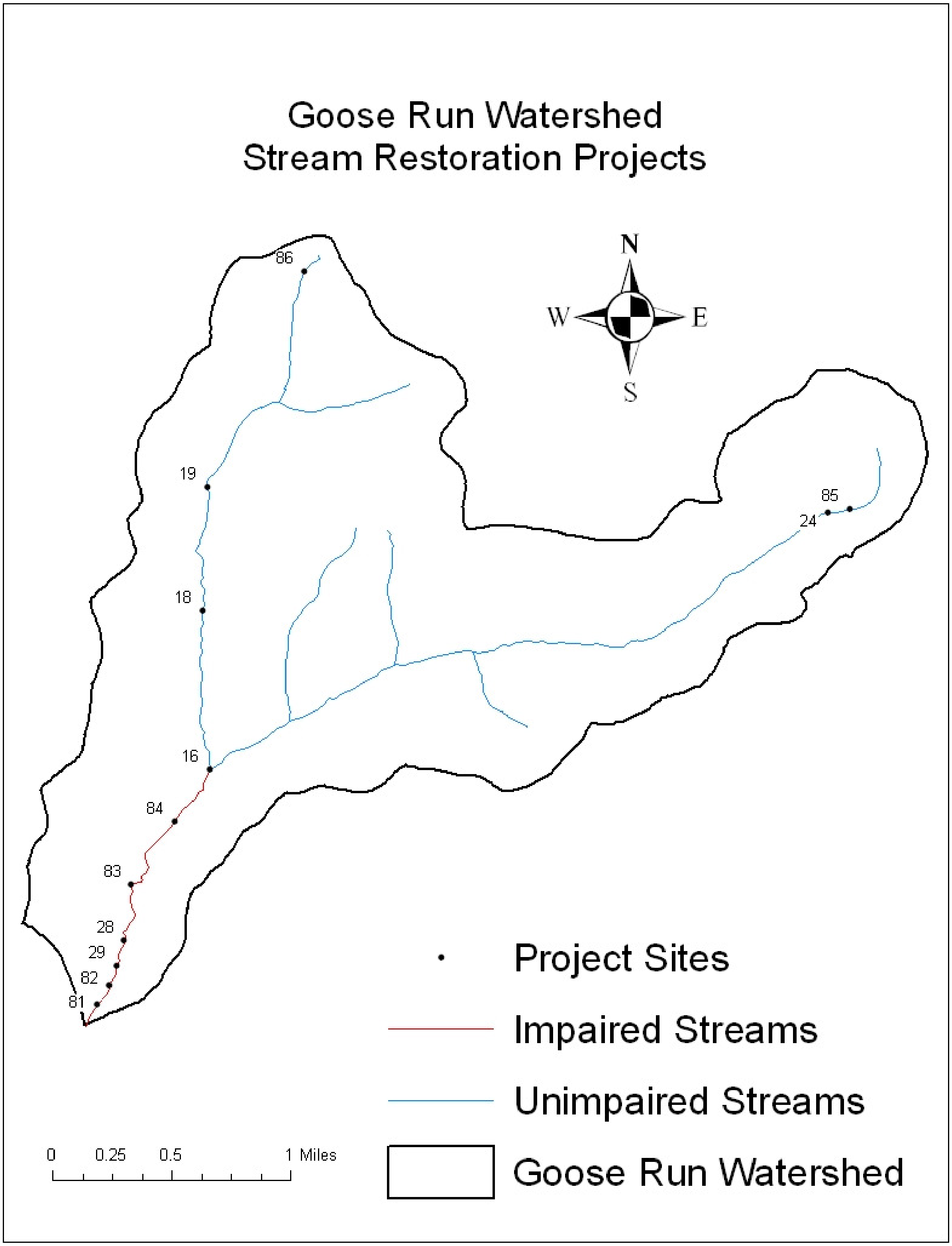


**Figure 6. Leisure Run Stream Restoration Projects**

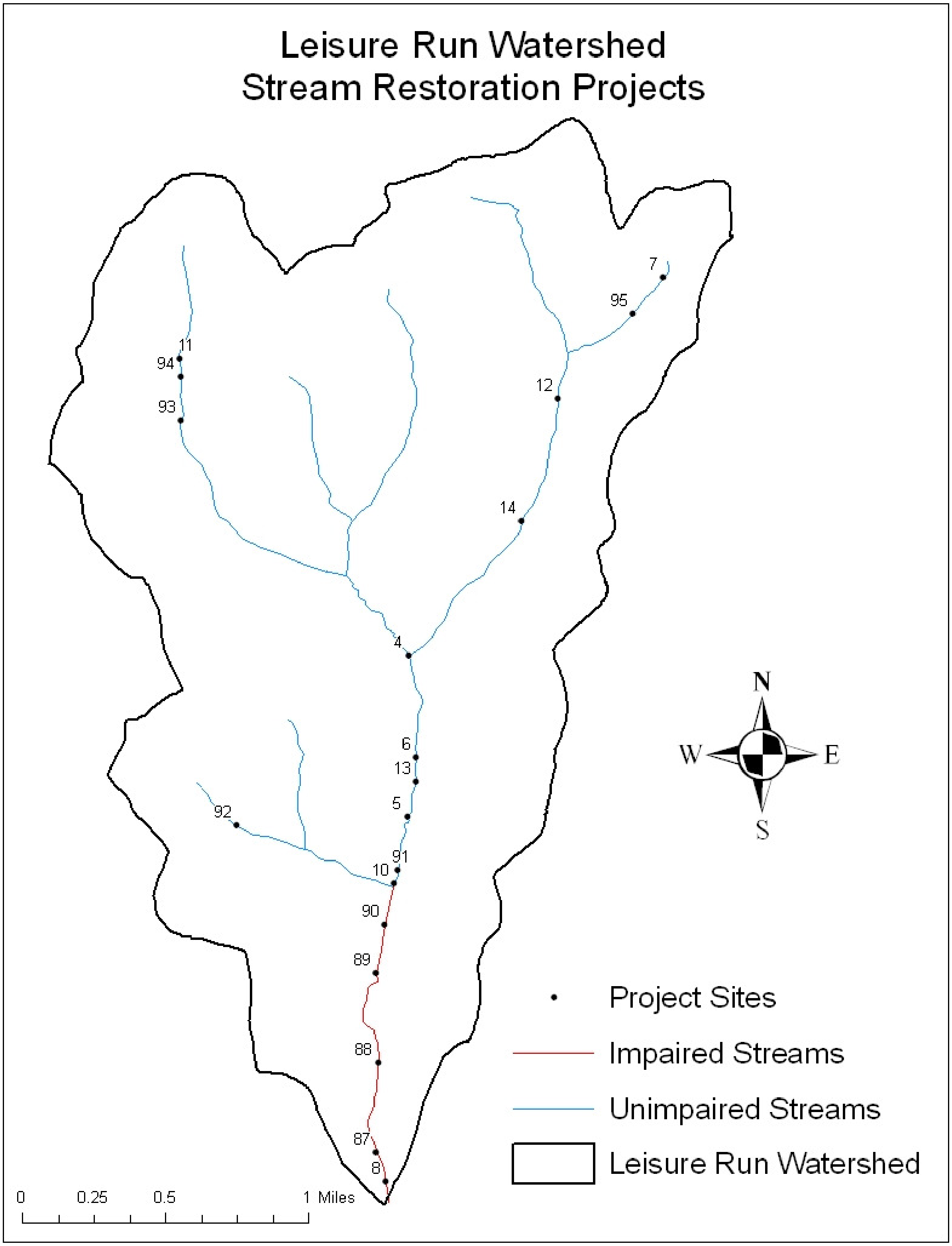


**Figure 7. Upper Mainstem and UNTs Stream Restoration Projects**

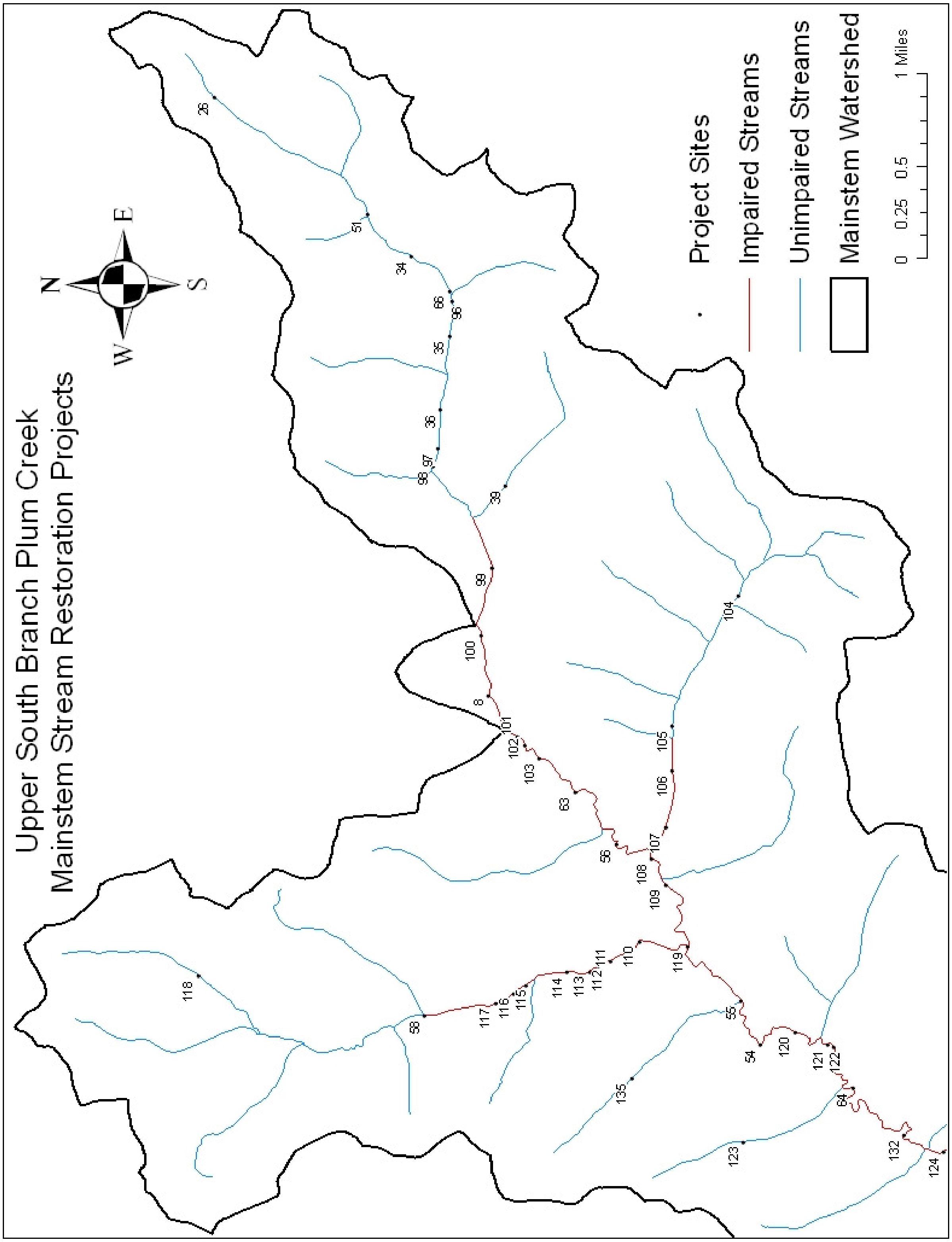


**Figure 8. Lower Mainstem and UNTs Stream Restoration Projects**

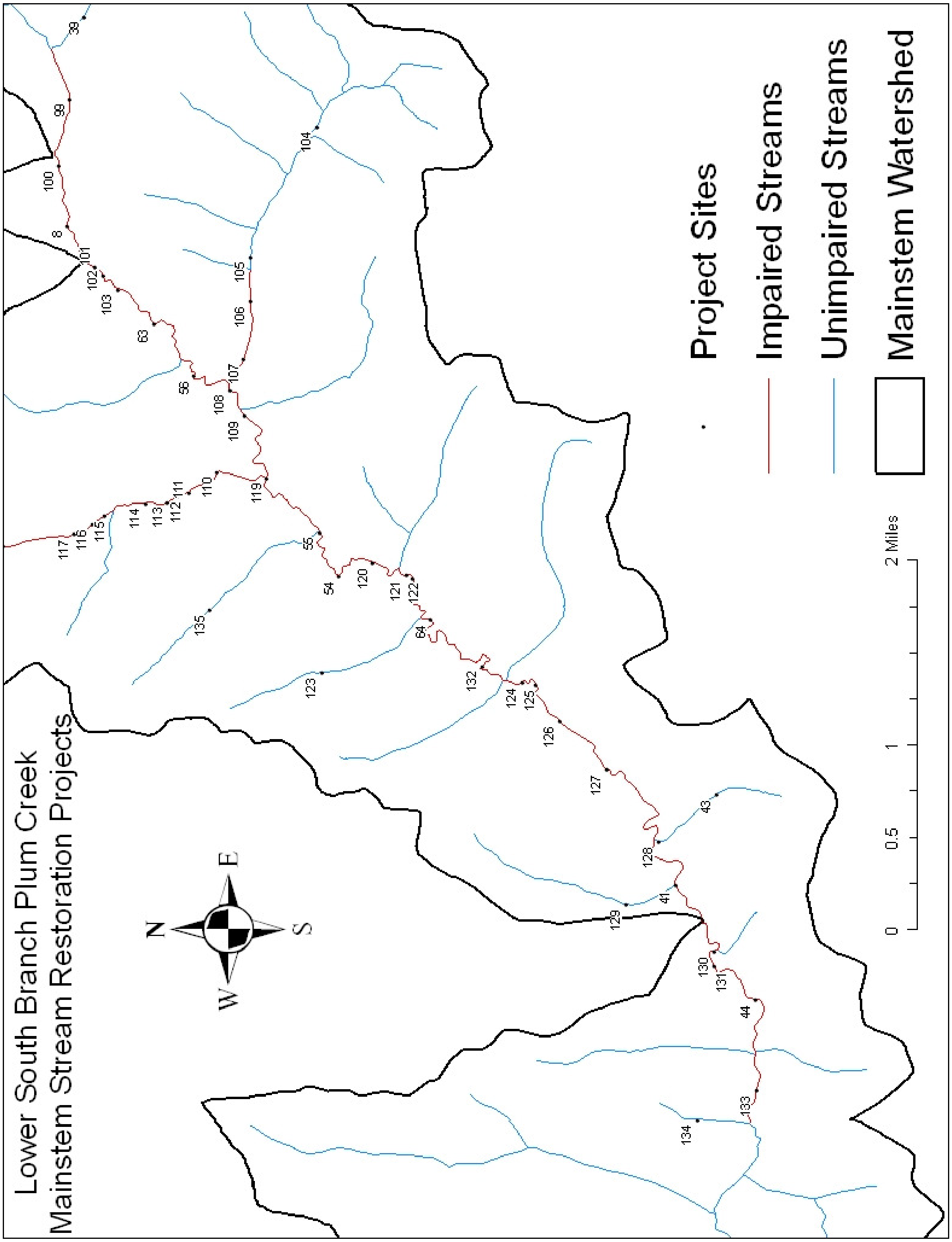


**Figure 9. Reddings Run Stream Restoration Projects**

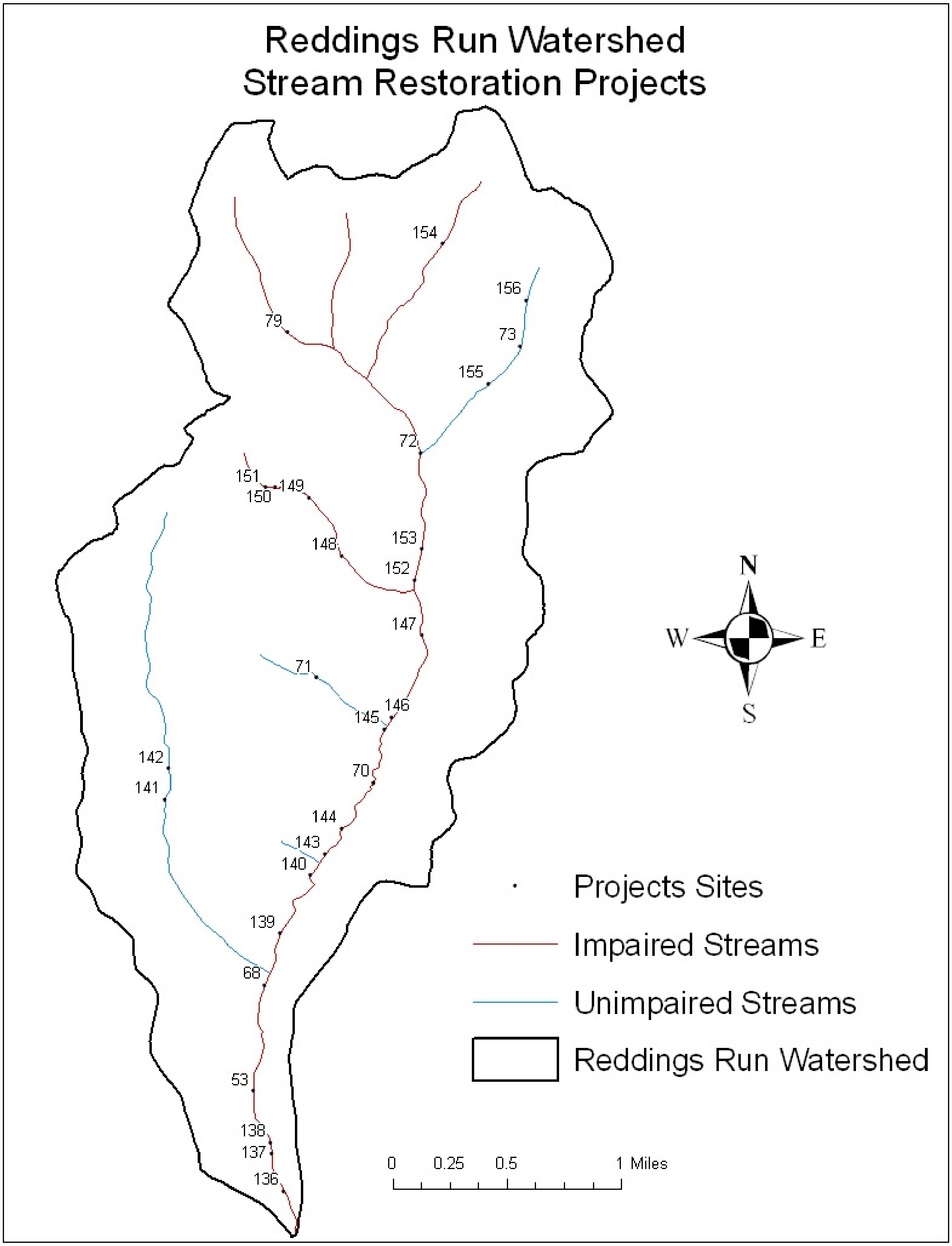


**Figure 10. Sugarcamp Run Stream Restoration Projects**

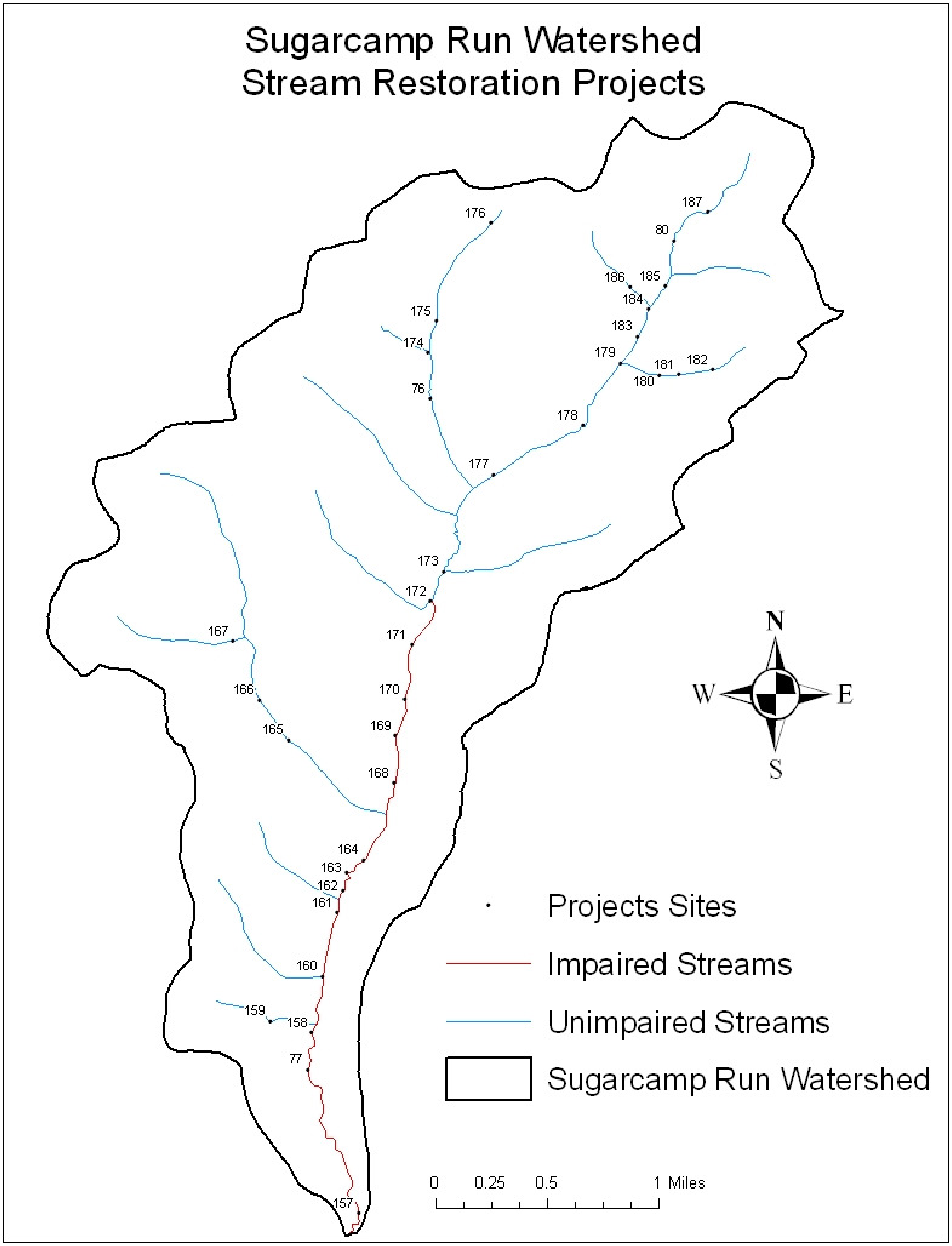


**Figure 11. Mudlick Run Stream Restoration Projects**

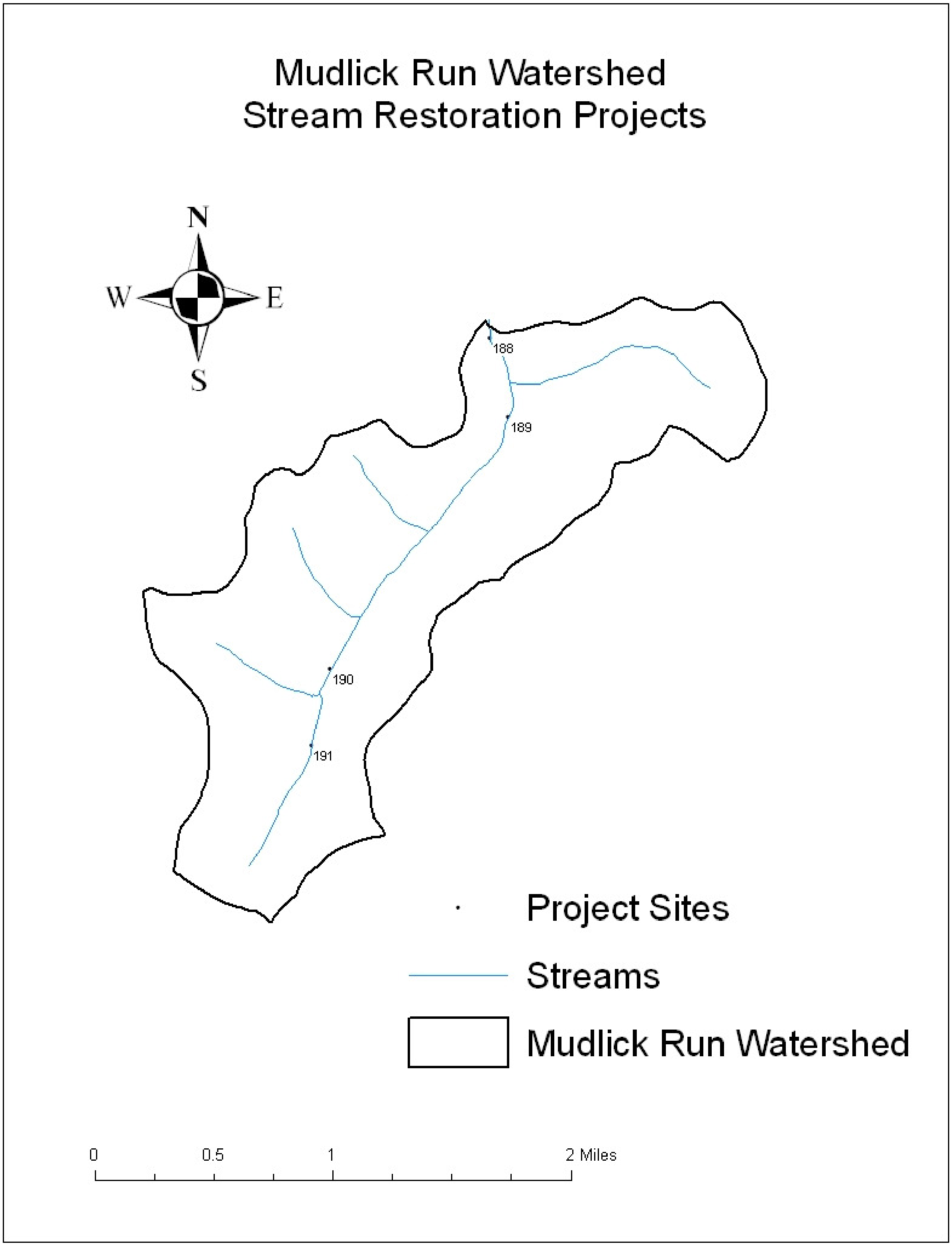


**Table 11(b). Stream Restoration Projects Totals by Sub-Watershed**

| Watershed | Streambank Fencing (feet) | Streambank Stabilization (feet) | Vegetated Buffer Strips (feet) |
|---|---|---|---|
| Goose Run | 13562 | 15966 | 17361 |
| Leisure Run | 7923 | 8418 | 10714 |
| Mainstem | 1094 | 32995 | 29648 |
| Mainstem Headwaters | 5665 | 11342 | 13405 |
| Mudlick Run | 0 | 3292 | 3292 |
| Reddings Run | 10091 | 11752 | 34260 |
| Sugarcamp Run | 4201 | 25960 | 30843 |
| UNT 46636 | 0 | 3693 | 3941 |
| UNT 46643 | 2601 | 4290 | 3643 |
| **Total** | **45137** | **117708** | **147107** |

*ROADS SYSTEMS WITHIN THE WATERSHED*

The majorities of the township roads in the watershed are dirt and gravel with periodic private lanes accessing homes, farm fields, and gas wells. Accelerated erosion is evident on most. The road systems, public and private, impact the watershed in two ways. By directly contributing sediments from the erosion of the road surface, and indirectly as the road system changes the overall hydrology within the watershed. Road ditches promote channelization of storm water increasing the overall runoff coefficient. Storm events that had resulted in little short term change in stream flows are now producing faster and more frequent changes in stream elevation. This stream dynamic, coupled with the loss of riparian habitat, promotes streambank erosion. To reduce channelization, BMPs need to be implemented that convert channelized flow into sheet flow and ultimately promote infiltration. The installation of additional cross culverts that divert concentrated ditch flows to filter areas is a cost-effective solution. The vegetated filter areas will capture any road sediments and promote groundwater infiltration. By more frequent direction of ditch flow to filtering areas, we will reduce erosion in the road ditch and any road sediments generated will be captured in the filtering areas. By evaluating the road ditches and cross culvert outlets for erosion we can determine where additional practices are needed.

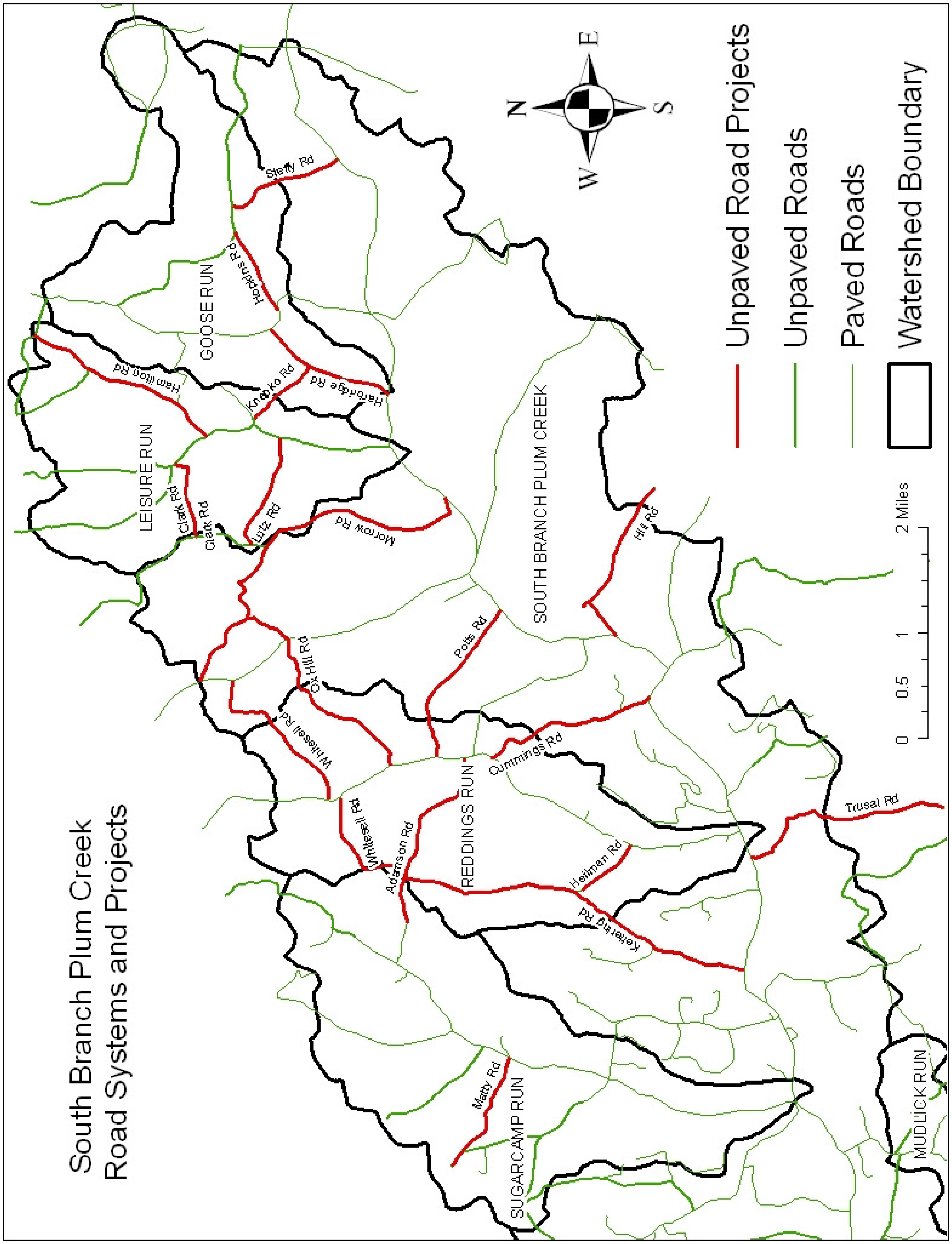
In situations where roads are next to streams and filtering areas are not available, we are proposing to stabilize the road surface with a compacted limestone aggregate mix that will produce a durable road surface less likely to generate sediments that would be deposited in the stream.

For private drives and farm lanes we will be producing a brochure that will illustrate BMPs that landowners can implement.

Table 12. Required Unpaved Road BMPs in the South Branch Plum Creek Watershed

| Road Name | Sub-watershed | Township | Crosspipes (#) | Surface Stabilization (ft) | Other |
|---|---|---|---|---|---|
| Trusal | Mainstem | Washington | 0 | 300 | _ |
| Kettering | Mainstem | Washington | 10 | 0 | _ |
| Heilman | Redding | Washington | 3 | 0 | _ |
| Cummings | Mainstem | Washington | 5 | 0 | 48" stream culvert |
| Adamson | Mainstem | Washington | 3 | 0 | 36" stream culvert |
| Hill | Mainstem | Washington | 5 | 300 | 48" stream culvert, 500’ under drain |
| Potts | Reddings | Washington | 3 | 0 | _ |
| Oxhill | Reddings | South Mahoning | 8 | 0 | _ |
| Whitesell | Reddings | South Mahoning | 3 | 0 | _ |
| Morrow | Mainstem | South Mahoning | 8 | 0 | _ |
| Harbridge | Goose | South Mahoning | 2 | 0 | _ |
| Hopkins | Goose | South Mahoning | 3 | 0 | _ |
| Steffy | Goose | East Mahoning | 8 | 300 | _ |
| Knapko | Goose | South Mahoning | 4 | 200 | _ |
| Lutz | Leisure | South Mahoning | 2 | 300 | 36" stream culvert |
| Clark | Leisure | South Mahoning | 2 | 0 | _ |
| Matty | Sugarcamp | Washington | 2 | 0 | _ |
| Hamilton | Leisure | South Mahoning | 12 | 0 | 1600’ under drain |
| **Totals** | | | **83** | **1200** | _ |

**Figure 12. South Branch Plum Creek Unpaved Road Projects**



*ABANDONED MINE DRAINAGE WITHIN THE WATERSHED*

Although the most of the South Branch Plum Creek is impaired by sedimentation, one sub-watershed, Sugarcamp Run, is impaired by Abandoned Mine Drainage (AMD). Since the TMDL was developed for sediment only, it focused on a target area which did not include Sugarcamp Run. Further studies needs to be conducted to characterize the discharges in this sub-watershed and determine if treatment is feasible.

Although AMD is listed as the cause for impairment in Sugarcamp Run, sedimentation is obvious. Eroding banks are a problem along the majority of the stream due to lack of riparian vegetation, mostly from residents mowing their lawns up to the streambanks.

## PRIORITIES FOR IMPLEMENTATION

Due to the large number of potential projects identified in this plan, establishing a prioritized list for each of the 191 individual project sites was not a simple task. To accomplish this, ICCD identified project priorities by "top-to-bottom" of the watershed approach, focusing on the headwaters and sub-watersheds first. Sub-watersheds and stream sections were ranked on a one-to-five scale, based on their location in the watershed. Table 13 shows the priority rank assigned to each section:

**Table 13. Watershed Priority Ranks**

| Sub-watershed | Watershed Rank |
|---|---|
| Mainstem Headwaters (US of Leisure Run), and Goose and Leisure Runs | 1 |
| Mainstem, and UNT's 46636 and 46643 | 2 |
| Reddings Run | 3 |
| Sugarcamp Run | 4 |
| Mainstem (DS of Sugarcamp Run) and Mudlick Run | 5 |

* US=Upstream, DS=Downstream

The second major consideration for prioritizing individual stream restoration project sites was project size and sediment reduction efficiency. This was determined by multiplying the length of the proposed BMP by reduction efficiency assigned to that practice. The resulting values from each proposed BMP were then summed to determine a "size-efficiency total" for each project.

Each stream restoration project was also scored on a one-to-three scale based on the impairment status of the stream segment the project was located on. Projects located on impaired stream sections were given a score of one. A score of two was given to projects on unimpaired stream sections that are located upstream of impaired sections, while a score of three was assigned to projects on unimpaired sections below impaired sections. The justification for this scoring system can be easily understood by examining the cases of the Mainstem Headwaters and Goose Run, which are impaired by Grazing Related Agriculture. The impairment of those sub-watersheds is limited to the lower sections of stream downstream of any tributaries, even though the sources of pollutants are from land use above the impaired sections. Therefore, even though the headwaters of those sub-watersheds are listed as unimpaired, they are in need of restoration and the recovery of downstream, impaired segments depends on projects being implemented there.

A final priority ranking of all stream restoration projects was then determined by sorting the potential project database by watershed priority rank, “size-efficiency total”, and then by impairment status score. Using this sorted database as a guideline, each project site was assigned a final priority rank on a one-to-five scale, while also considering landowner interest and project visibility to the public as incentives. Also, projects ranking in the top 10% in the highest “size-efficiency total” list were automatically assigned a top priority ranking, regardless of watershed priority. These rankings are shown in Table 10 on pages 20-23 .

Any agriculture BMP projects that didn’t require stream restoration were also sorted by watershed priority, project size, and by field scores. Field scores were determined when converting data collected in the field during visual assessment into GIS layers. Each crop and hay/pasture field was given a score from one-to-three, depending on its proximity to the stream. Fields were given a score of one if the stream flowed directly through it, while fields given a score of three were located near the top of the watershed and had no direct impact on the stream. From this sorted list, these projects were also given a final priority rank on a one-to-five scale with the same considerations as the stream restoration projects.

While stream bank erosion has been identified as the major source of sediments impairments, addressing this component will not be our first task. Activities in the upstream sub-watersheds have altered storm water runoff rates and volumes that ultimately lead to excessive stream bank erosion along the mainstem. ICCD would like to first devote its efforts in the upstream sub-watersheds where we will implement practices that promote storm water infiltration and increase the retention time relative to the mainstem. Increased infiltration will reduce volume spikes during storm events, and the establishment of vegetated buffers that will reduce velocities, capture sediments, and increase stormwater retention times to the mainstem.

Our initial objective for the sub-watersheds is to increase storm water infiltration and to capture sediments from the road system and agricultural operations before they reach the stream channel. As we work to implement BMP projects, we will continue to encourage landowners to change their current stream management practices (mowing) and promote the establishment of natural riparian buffers.

Although, we intend to focus our work addressing stormwater issues in the upper reaches of the headwaters first, streambank stabilization projects on impaired sections of the watershed with severe bank erosion are also a high priority due to the high sediment reduction efficiency of those BMPs. Also, landowner interest will play a major role in the implementation schedule for this plan. If landowners on high priority project sites are not willing or interested in completing projects, then lower priority sites may be implemented first based on landowner interest.

## PARTNERS AND FUNDING

As landowners become interested in BMP projects and funds are secured, CrCWA and ICCD will do most of the work in implementing this plan. However, there are many other partnering agencies that will assist CrCWA in the implementation of the plan other than ICCD. As the majority of the impairments and BMPs to address them are agriculture related, the USDA's local service offices for the NRCS and Farm Service Agency (FSA) will also play an important role in project implementation. These agencies already have well-established relationships with many farmers in the watershed, the expertise to provide technical assistance, and programs to help with financial assistance in implementing agricultural BMPs. These programs, such as USDA's Conservation Reserve Program (CRP), CREP, and Environmental Quality Incentives Program (EQIP), are all potential funding sources for implementing this plan.

The major source of funds that will be utilized in putting the WIP into action will be through the EPA Section 319 Program and PADEP Growing Greener. These larger funding sources will be integral in funding projects due to the significant cost of total watershed restoration.

According to the TMDL, the major contributor of sediment in the watershed is streambank erosion. Accordingly, a considerable amount of the BMPs proposed in this plan involve streambank stabilization. Often the most cost-effective and ecologically beneficial method of bank stabilization is with fish habitat improvement structures. CrCWA has successfully implemented many of these types of projects in Plum Creek and other Crooked Creek tributaries in the past, through the expertise of Armstrong Conservation District's (ACD) Watershed Specialist, a CrCWA board member, who has a wealth of knowledge and experience in project design and construction.

ACD and CrCWA have completed multiple phases of streambank stabilization projects on Plum Creek and South Branch Plum Creek in Armstrong County, and continuing this restoration remains a priority. Though specific projects are not identified in this plan for lower portion of the watershed due to focusing on the TMDL targeted area and the "top-to-bottom" implementation strategy, projects in this area are also integral in restoring the South Branch to a viable coldwater fishery.

A recent assessment by PADEP in 2009 has found a segment of the lower South Branch in Armstrong County to also be impaired by siltation. ACD will take the lead in identifying specific projects and seeking funding for the restoration on this segment of stream.

CrCWA and ICCD will remain open and willing to seek other partnerships and any other potential funding sources that may become available in the future.

## PUBLIC INFORMATION AND INVOLVEMENT

### *PAST AND CURRENT EFFORTS*

CrCWA and ICCD have conducted many public outreach activities since the inception of this project. Soon after receiving the grant to develop the WIP, CrCWA hosted its first public meeting in 2008. The event was held at the Plum Valley Grange, a small historic meeting site located on the banks of the South Branch Plum Creek and near the approximate geographic center of the watershed. This meeting included presentations from CrCWA, ICCD, and PADEP about the goals of developing the WIP and served as an initial introduction and public notice about the project.

In 2009, ICCD received a Pennsylvania Association of Conservation Districts (PACD) Mini-Grant to conduct additional public outreach in the watershed. ICCD used the funds to print invitations to another public meeting, also held at the Grange. The invitations were distributed door-to-door by hanging them on resident's doorknobs throughout the watershed. A door hanger was distributed to approximately 200 residents with streamside property. The meeting again featured presentations by ICCD and a public discussion followed.

In 2010, with remaining funds from the PACD Mini-Grant, ICCD developed a public outreach newsletter highlighting the District's efforts to implement the WIP, along with some BMPs landowners could do on their own. As previously mentioned in the Data Collection section, while collecting field data ICCD individually visited each household in the watershed, providing them with the newsletter along with American Highbush Cranberry seedlings, donated by a local nursery, which they could plant along their riparian corridor. We also discussed some BMPs that could be implemented on each property along with cost-share ICCD may be able to offer. Altogether, approximately 250 newsletters and 1000 seedlings were distributed. A survey to assess landowners' interest in restoring the watershed was also distributed with the newsletter. There was a 20% return rate for the surveys, with the majority of residents willing to implement some form of conservation practice. Townships have indicated a willingness to implement stormwater management practices for their road systems and Letters of Commitment to install conservation practices have been obtained from some farmers.

In another attempt to educate the public and gain support for restoring the South Branch, ICCD partnered with the local newspaper, the Indiana Gazette, to publish an article in the paper highlighting BMPs already installed in the watershed and to increase public awareness about the WIP.

### *FUTURE EFFORTS*

Public outreach and involvement will continue in the watershed through the Public Outreach/Monitoring Database Project established with funding from a S.319 WIP Outreach/Education Mini-Grant. Through this Mini-Grant, CrCWA will conduct public outreach and establish a monitoring program in the South Branch Plum Creek Watershed. CrCWA, under the supervision of ICCD, will work to establish community support for the WIP by visiting farms and distributing educational materials about BMPs that reduce erosion and sedimentation, and the programs available to fund these BMPs. The ultimate objective of this education and outreach project is to make landowners in this watershed aware of the benefits of sediment-reducing BMPs and the programs available to help implement them. We will distribute copies of our public outreach publication to residents in the watershed, and educate all major agricultural producers with projects identified in the WIP.

## MONITORING RESTORATION PROGRESS

A monitoring program will be used to track changes in water quality as restoration projects are completed. The monitoring program will rely heavily on volunteers to regularly take samples and make assessments. Fortunately, Indiana County has a very active chapter of the Pennsylvania Senior Environmental Corps (PASEC) that currently monitors streams throughout the county. The PASEC chapter has recently partnered with the Indiana University of Pennsylvania (IUP) to develop a new publicly accessible, online Western Pennsylvania Water Quality Database. The database is in its infancy, but should be fully functional by early 2012.

The majority of restoration progress monitoring will be accomplished using a GIS database, that will include project implementation details and detailed project construction records. The database will include:

- Changes in land use
- Acres crop, grazing, and nutrient management implemented
- Feet of stream restored
- Miles of unpaved road protected
- Specific structural BMPs implemented
- Sediment and nutrient load reductions achieved

ICCD has already established a rudimentary geodatabase during the data collection process, which will be enhanced and expanded in late 2011-early 2012 through a S.319 Mini-grant Monitoring Database Project.

Through the Monitoring Project, CrCWA and ICCD will compile all the existing assessment data for the watershed and add it to ICCD's internal database and also to the online Western Pennsylvania Water Quality Database hosted by IUP.

Currently, no state water quality standards exist in Pennsylvania for sediments and nutrients. This presents a challenge in evaluating water quality improvements and load reductions for sediments.

ICCD and CrCWA will partner with PASEC to set up the Volunteer Monitoring Program for the South Branch Plum Creek. A schedule for regular water quality sampling is being planned, as well as macroinvertebrate surveys, visual habitat assessments, stream channel cross-section surveys, and pebble counts. They key water quality parameters that the monitoring will focus on are turbidity, total suspended solids, dissolved oxygen, nitrates, phosphates, pH, conductivity, and temperature.

Monitoring points will be established in relation to each approved projected site before any work begins. These points will be monitored for up to a year prior to project construction, where possible, and will continue for at least two years after project completion. In addition to project-related monitoring, monitoring of the previously established long-term sampling points (Figure 2) will continue regularly. Temporal water quality improvement should be shown using this combination of project-related and long-term monitoring.

In addition to monitoring water quality improvements, computer modeling of sediment load reductions will continue to account for estimated load reductions from project completion. Penn State's PRedICT GIS-based modeling program will again be used to estimate sediment load reductions. These modeling results used in tandem with monitoring data should accurately show the achieved load reductions.

Once a significant amount of projects are completed and improvements are shown through monitoring, an instream comprehensive evaluation reassessment should be conducted by PA DEP to see if any sub-watersheds or stream segments could be removed from the State's impaired waters list.

*IMPROVEMENT MILESTONES*

CrCWA and ICCD hope to achieve the improvement milestones through the implementation of this plan:

- By implementing 10% of the projects in this plan, we hope to achieve a 5% increase in total macroinvertebrate richness. This should take approximately 5 years to achieve.

- By implementing 25% of the projects in this plan, we hope to achieve a 10% increase in macroinvertebrate EPT Richness. This should take approximately 10 years to achieve.

- By implementing 50% of the projects in this plan, we hope to achieve a 25% reduction in sediment loading in the watershed. This should take approximately 20 years to achieve.

*REMEDIAL ACTIONS*

The goal of this plan is to provide a guideline for reducing achieving the load reduction to meet the TMDL and restore the aquatic life in the South Branch Plum Creek. As implementation of the plan begins, changes in land use or ownership, improvements in modeling software, results from monitoring, and other unforeseen circumstances may require the plan to be altered. If significant water quality improvements are not seen after implementation of projects in this plan, actions will be taken to address these issues.

However, when dealing with a pollutant like sediment and the types of BMPs needed to alleviate its impacts, it will take time before improvements are seen in the stream biota. It will take time for farmers to improve their levels of management and adopt better conservation practices. Effective vegetated buffer take time to become established and banks take time to stabilize. It will also take time for the hydrology of the stream to improve after being laden with sediment. Despite these challenges, ICCD and CrCWA are confident that the implementation of this plan will result in restoration of the South Branch Plum Creek Watershed.

## REFERENCES

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CWM Environmental Inc. 2005. Crooked Creek Watershed Nonpoint Source Pollution Assessment. Crooked Creek Watershed Association.

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Armstrong and Indiana County Conservation Districts. 1994. Assessment of Nonpoint Source Pollution for Crooked Creek and Cowanshannock Creek Watershed

Armstrong and Indiana County Conservation Districts. 2010. Crooked Creek Watershed Nonpoint Pollution Assessment (Draft).

## APPENDIX

***PRediCT MODELING RESULTS:***

*TMDL TARGETED WATERSHED WIP IMPLEMENTATION LOAD REDUCTION SCENARIO*

### Mean Annual Load Data Editor

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 8758966 | 33662 | 4506 |
| Hay/Pasture | 961215 | 8900 | 983 |
| High Density Urban | 24251 | 906 | 95 |
| Low Density Urban | 2205 | 71 | 7 |
| Unpaved Road | 363763 | 1418 | 198 |
| Other | 198416 | 1446 | 101 |
| STREAMBANK EROSION | 2128367 | 1067 | 183 |
| GROUNDWATER/SUBSURFACE | | 111644 | 1850 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 2284 | 77 |
| | | | |
| **TOTAL** | 12437182 | 168927 | 11587 |
| | | | |
| BASIN AREA | 18748 | Acres | |

### Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 4200.79197 | % Existing | 0 | 0 | 85 | 75 | 0 | 0 | | 15 |
| | | % Future | 0 | 0 | 85 | 75 | 0 | 0 | | 15 |
| Hay/Pasture | 4025.3471289 | % Existing | | | | 15 | 0 | 0 | 0 | 30 |
| | | % Future | | | | 15 | 0 | 0 | 0 | 30 |

| | | |
|---|---|---|
| Agricultural Land on Slope > 3% | 7,566 | Acres |
| Streams in Agricultural Areas | 30.7 | Miles |
| Total Stream Length | 77.0 | Miles |
| Unpaved Road Length | 37.0 | Miles |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.6 | 22.1 |
| Stream Miles with Fencing | 1.1 | 7.8 |

| | | | |
|---|---|---|---|
| Stream Miles with Stabilization | 0.1 | 16.8 | |
| Unpaved Road Miles w/E & S Controls | 2.5 | 10.4 | |
| | | | |
| | % Existing | % Future | |
| AWMS (Livestock) | 0.0 | 100.0 | |
| AWMS (Poultry) | 0.0 | 0.0 | |
| Runoff Control | 0.0 | 100.0 | |
| Phytase in Feed | 0.0 | 0.0 | |

## Urban Land BMP Scenario Editor

| High Density Urban | | | | | |
|---|---|---|---|---|---|
| | | Acres | 4200 | % Impervious Surface | 50 |
| Constructed Wetlands | | Bioretention Areas | | Detention Basins | |
| % Existing | 0 | % 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 | 93 | % 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 | .745645428 | 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 | .372822714 | 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 | 643 | | |
| | Future | 643 | | |
| 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 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |

| Urban Cost Editor | |
|---|---|
| Constructed Wetlands (per acre) | $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 | 8758966 | 33662 | 4506 |
| Hay/Pasture | 961215 | 8900 | 983 |
| High Density Urban | 24251 | 906 | 95 |
| Low Density Urban | 2205 | 71 | 7 |
| Unpaved Roads | 363763 | 1418 | 198 |
| Other | 198416 | 1446 | 101 |
| STREAMBANK EROSION | 2128367 | 1067 | 183 |
| GROUNDWATER/SUBSURFACE | | 111644 | 1850 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 2284 | 77 |
| FARM ANIMALS | | 7529 | 3587 |
| TOTALS | **12437182** | **168927** | **11587** |
| | **Future (lbs)** | | |
| LAND EROSION/RUNOFF | **Total Sed (lbs)** | **Total N (lbs)** | **Total P (lbs)** |
| Row Crops | 5507510 | 23996 | 3244 |
| Hay/Pasture | 961215 | 8900 | 983 |
| High Density Urban | 24251 | 906 | 95 |
| Low Density Urban | 2205 | 71 | 7 |
| Unpaved Roads | 166104 | 1412 | 198 |
| Other | 198416 | 1446 | 101 |
| STREAMBANK EROSION | 1548056 | 795 | 133 |
| GROUNDWATER/SUBSURFACE | | 106036 | 1850 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 2284 | 77 |
| FARM ANIMALS | | 3533 | 967 |
| TOTALS | **8407757** | **149377** | **7654** |
| PERCENT REDUCTIONS | 32.4 | 11.6 | 33.9 |
| TOTAL SCENARIO COST | $5,719,212.75 | | |
| Ag BMP Cost (%) | 0.0 | | |
| WW Upgrade Cost (%) | 0.0 | | |
| Urban BMP Cost (%) | 0.0 | | |
| Stream Protection Cost (%) | 82.1 | | |
| Unpaved Road Protection Cost (%) | 8.1 | | |

| Pathogen Loads | | |
|---|---|---|
| **Source** | **Existing (orgs/month)** | **Future (orgs/month)** |
| Farm Animals | 9.346e+14 | 4.386e+14 |
| WWTP | 0.000e+00 | 0.000e+00 |
| Septic Systems | 0.000e+00 | 0.000e+00 |
| Urban Areas | 2.628e+10 | 2.628e+10 |
| Wildlife | 3.589e+12 | 3.589e+12 |
| Totals | 9.383e+14 | 4.422e+14 |
| PERCENT REDUCTIONS | | 52.87 |
| TOTAL SCENARIO COST | $5,719,212.75 | |

*GOOSE RUN ESTIMATED LOAD REDUCTIONS*

### Mean Annual Load Data Editor

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 707684 | 3530 | 392 |
| Hay/Pasture | 52911 | 840 | 82 |
| High Density Urban | 0 | 0 | 0 |
| Low Density Urban | 0 | 0 | 0 |
| Unpaved Road | 57320 | 181 | 22 |
| Other | 13228 | 110 | 7 |
| STREAMBANK EROSION | 40259 | 20 | 2 |
| GROUNDWATER/SUBSURFACE | | 15626 | 214 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 198 | 13 |
| | | | |
| **TOTAL** | 871401 | 22227 | 1462 |
| | | | |
| BASIN AREA | 1888 | Acres | |

### Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 610.3503627 | % Existing | 0 | 0 | 87 | 67 | 0 | 0 | | 3 |
| | | % Future | 97 | 97 | 87 | 95 | 0 | 63 | | 3 |
| Hay/Pasture | 434.9055216 | % Existing | | | | 33 | 0 | 0 | 0 | 52 |
| | | % Future | | | | 42 | 0 | 18 | 17 | 52 |

| | | | |
|---|---|---|---|
| Agricultural Land on Slope > 3% | 917 | Acres | |
| Streams in Agricultural Areas | 3.3 | Miles | |
| Total Stream Length | 7.1 | Miles | |
| Unpaved Road Length | 5.6 | Miles | |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.0 | 3.3 |
| Stream Miles with Fencing | 0.0 | 2.5 |
| Stream Miles with Stabilization | 0.0 | 3.0 |
| Unpaved Road Miles w/E & S Controls | 0.8 | 2.2 |

| | % Existing | % Future |
|---|---|---|
| AWMS (Livestock) | 0.0 | 100.0 |
| AWMS (Poultry) | 0.0 | 0.0 |
| Runoff Control | 0.0 | 100.0 |
| Phytase in Feed | 0.0 | 0.0 |

## Urban Land BMP Scenario Editor

### High Density Urban

| | | | | | |
|---|---|---|---|---|---|
| | | Acres | 610 | % Impervious Surface | 50 |
| **Constructed Wetlands** | | **Bioretention Areas** | | **Detention Basins** | |
| % Existing | 0 | % 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 | 0 | % 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 | 56 | | |
| | Future | 56 | | |
| 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 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 |

**Pathogen Loads**

## 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |

| Urban Cost Editor | |
|---|---|
| Constructed Wetlands (per acre) | $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 | 707684 | 3530 | 392 |
| | Hay/Pasture | 52911 | 840 | 82 |
| | High Density Urban | 0 | 0 | 0 |
| | Low Density Urban | 0 | 0 | 0 |
| | Unpaved Roads | 57320 | 181 | 22 |
| | Other | 13228 | 110 | 7 |
| STREAMBANK EROSION | | 40259 | 20 | 2 |
| GROUNDWATER/SUBSURFACE | | | 15626 | 214 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 198 | 13 |
| FARM ANIMALS | | | 1722 | 730 |
| TOTALS | | 871401 | 22227 | 1462 |
| | | Future (lbs) | | |

| LAND EROSION/RUNOFF | | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|---|
| | Row Crops | 107999 | 1067 | 47 |
| | Hay/Pasture | 49493 | 756 | 71 |
| | High Density Urban | 0 | 0 | 0 |
| | Low Density Urban | 0 | 0 | 0 |
| | Unpaved Roads | 19967 | 180 | 22 |
| | Other | 13228 | 110 | 7 |
| STREAMBANK EROSION | | 13054 | 8 | 1 |
| GROUNDWATER/SUBSURFACE | | | 12576 | 191 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 198 | 13 |
| FARM ANIMALS | | | 619 | 154 |
| TOTALS | | **203740** | **15514** | **505** |
| PERCENT REDUCTIONS | | 76.6 | 30.2 | 65.5 |
| TOTAL SCENARIO COST | | $1,207,027.53 | | |
| Ag BMP Cost (%) | | 9.3 | | |
| WW Upgrade Cost (%) | | 0.0 | | |
| Urban BMP Cost (%) | | 0.0 | | |
| Stream Protection Cost (%) | | 73.7 | | |
| Unpaved Road Protection Cost (%) | | 7 | | |

| Source | Existing (orgs/month) | Future (orgs/month) |
|---|---|---|
| Farm Animals | 2.008e+14 | 4.861e+13 |
| WWTP | 0.000e+00 | 0.000e+00 |
| Septic Systems | 0.000e+00 | 0.000e+00 |
| Urban Areas | 0.000e+00 | 0.000e+00 |
| Wildlife | 2.944e+11 | 2.944e+11 |
| Totals | 2.011e+14 | 4.891e+13 |
| PERCENT REDUCTIONS | | 75.68 |
| TOTAL SCENARIO COST | $1,207,027.53 | |

*LEISURE RUN ESTIMATED LOAD REDUCTIONS*

## Mean Annual Load Data Editor

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 802483 | 3316 | 335 |
| Hay/Pasture | 59525 | 877 | 75 |
| High Density Urban | 0 | 15 | 2 |

| | | | |
|---|---|---|---|
| Low Density Urban | 0 | 4 | 0 |
| Unpaved Road | 79366 | 260 | 26 |
| Other | 13228 | 141 | 7 |
| STREAMBANK EROSION | 42836 | 22 | 2 |
| GROUNDWATER/SUBSURFACE | | 10593 | 181 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 192 | 11 |
| | | | |
| **TOTAL** | 997437 | 16215 | 1023 |
| | | | |
| BASIN AREA | 1826 | Acres | |

## Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 467.0292249 | % Existing | 0 | 0 | 71 | 5 | 0 | 0 | | 29 |
| | | % Future | 67 | 67 | 71 | 56 | 0 | 37 | | 29 |
| Hay/Pasture | 370.658115 | % Existing | | | | 6 | 0 | 0 | 0 | 31 |
| | | % Future | | | | 38 | 0 | 29 | 44 | 31 |

| | | |
|---|---|---|
| Agricultural Land on Slope > 3% | 726 | Acres |
| Streams in Agricultural Areas | 2.9 | Miles |
| Total Stream Length | 7.0 | Miles |
| Unpaved Road Length | 7.8 | Miles |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.0 | 2.1 |
| Stream Miles with Fencing | 0.0 | 1.5 |
| Stream Miles with Stabilization | 0.0 | 1.7 |
| Unpaved Road Miles w/E & S Controls | 1.2 | 1.6 |

| | % Existing | % Future |
|---|---|---|
| AWMS (Livestock) | 0.0 | 0.0 |
| AWMS (Poultry) | 0.0 | 100.0 |
| Runoff Control | 0.0 | 100.0 |
| Phytase in Feed | 0.0 | 0.0 |

## Urban Land BMP Scenario Editor

| High Density Urban | | | | |
|---|---|---|---|---|
| | Acres | 467 | % Impervious Surface | 50 |
| **Constructed Wetlands** | **Bioretention Areas** | | **Detention Basins** | |

| | | | | | |
|---|---|---|---|---|---|
| % Existing | 0 | % 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 | 7 | % 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 | 54 | | |
| | Future | 54 | | |
| Spetic systems 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 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |

| | | | | |
|---|---|---|---|---|
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 |

**Pathogen Loads**

## 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |
| **Urban Cost Editor** | |
| Constructed Wetlands (per acre) | $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 | 802483 | 3316 | 335 |
| | Hay/Pasture | 59525 | 877 | 75 |
| | High Density Urban | 0 | 15 | 2 |
| | Low Density Urban | 0 | 4 | 0 |
| | Unpaved Roads | 79366 | 260 | 26 |
| | Other | 13228 | 141 | 7 |
| STREAMBANK EROSION | | 42836 | 22 | 2 |
| GROUNDWATER/SUBSURFACE | | | 10593 | 181 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 192 | 11 |
| FARM ANIMALS | | | 794 | 384 |
| TOTALS | | 997437 | 16215 | 1023 |

| | | Future (lbs) | | |
|---|---|---|---|---|
| LAND EROSION/RUNOFF | | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| | Row Crops | 240177 | 1518 | 93 |
| | Hay/Pasture | 49572 | 698 | 57 |
| | High Density Urban | 0 | 15 | 2 |
| | Low Density Urban | 0 | 4 | 0 |
| | Unpaved Roads | 69652 | 260 | 26 |
| | Other | 13228 | 141 | 7 |
| STREAMBANK EROSION | | 25686 | 14 | 1 |
| GROUNDWATER/SUBSURFACE | | | 9514 | 169 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 192 | 11 |
| FARM ANIMALS | | | 613 | 308 |
| TOTALS | | 398316 | 12969 | 675 |
| PERCENT REDUCTIONS | | 60.1 | 20.0 | 34.1 |
| TOTAL SCENARIO COST | | $653,911.23 | | |
| Ag BMP Cost (%) | | 16.7 | | |
| WW Upgrade Cost (%) | | 0.0 | | |
| Urban BMP Cost (%) | | 0.0 | | |
| Stream Protection Cost (%) | | 78.0 | | |
| Unpaved Road Protection Cost (%) | | 3.4 | | |

| Source | Existing (orgs/month) | Future (orgs/month) |
|---|---|---|
| Farm Animals | 6.435e+13 | 3.679e+13 |
| WWTP | 0.000e+00 | 0.000e+00 |
| Septic Systems | 0.000e+00 | 0.000e+00 |
| Urban Areas | 4.905e+08 | 4.905e+08 |
| Wildlife | 3.393e+11 | 3.393e+11 |
| Totals | 6.469e+13 | 3.713e+13 |
| PERCENT REDUCTIONS | | 42.60 |
| TOTAL SCENARIO COST | $653,911.23 | |

*MAINSTEM/UNTS ESTIMATED LOAD REDUCTIONS*

## Mean Annual Load Data Editor

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 5346210 | 22500 | 3203 |
| Hay/Pasture | 597453 | 7004 | 739 |

| | | | |
|---|---|---|---|
| High Density Urban | 17637 | 694 | 73 |
| Low Density Urban | 2205 | 49 | 4 |
| Unpaved Road | 185188 | 805 | 121 |
| Other | 202825 | 1475 | 112 |
| STREAMBANK EROSION | 1570018 | 789 | 150 |
| GROUNDWATER/SUBSURFACE | | 83956 | 1534 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 1962 | 51 |
| | | | |
| **TOTAL** | 7921535 | 122601 | 7516 |
| | | | |
| BASIN AREA | 15679 | Acres | |

## Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 3098.7018414 | % Existing | 2 | 0 | 77 | 77 | 0 | 4 | | 23 |
| | | % Future | 70 | 70 | 77 | 77 | 0 | 20 | | 23 |
| Hay/Pasture | 3034.4544348 | % Existing | | | | 60 | 0 | 0 | 0 | 40 |
| | | % Future | | | | 60 | 0 | 6 | 11 | 40 |

| | | |
|---|---|---|
| Agricultural Land on Slope > 3% | 5,397 | Acres |
| Streams in Agricultural Areas | 19.3 | Miles |
| Total Stream Length | 64.2 | Miles |
| Unpaved Road Length | 22.0 | Miles |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.6 | 10.3 |
| Stream Miles with Fencing | 1.4 | 3.2 |
| Stream Miles with Stabilization | 0.5 | 10.2 |
| Unpaved Road Miles w/E & S Controls | 1.7 | 4.8 |

| | % Existing | % Future |
|---|---|---|
| AWMS (Livestock) | 0.0 | 100.0 |
| AWMS (Poultry) | 0.0 | 0.0 |
| Runoff Control | 0.0 | 100.0 |
| Phytase in Feed | 0.0 | 0.0 |

## Urban Land BMP Scenario Editor

| High Density Urban | | | | |
|---|---|---|---|---|
| | Acres | 3098 | % Impervious Surface | 50 |

| Constructed Wetlands | | Bioretention Areas | | Detention Basins | |
|---|---|---|---|---|---|
| % Existing | 2 | % 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 | 86 | % 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 | .683508309 | 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 | .497096952 | 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 | 552 | | |
| | Future | 552 | | |
| 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 | 0.29 | 0.50 | 0.35 | |

| | | | | |
|---|---|---|---|---|
| BMP 2 | 0.08 | 0.22 | 0.30 | |
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 |

**Pathogen Loads**

**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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |
| **Urban Cost Editor** | |
| Constructed Wetlands (per acre) | $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 | 5346210 | 22500 | 3203 |
| | Hay/Pasture | 597453 | 7004 | 739 |
| | High Density Urban | 17637 | 694 | 73 |
| | Low Density Urban | 2205 | 49 | 4 |
| | Unpaved Roads | 185188 | 805 | 121 |
| | Other | 202825 | 1475 | 112 |
| STREAMBANK EROSION | | 1570018 | 789 | 150 |
| GROUNDWATER/SUBSURFACE | | | 83956 | 1534 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| SEPTIC SYSTEMS | | | 1962 | 51 |
| FARM ANIMALS | | | 3366 | 1528 |
| TOTALS | | 7921535 | 122601 | 7516 |
| | | Future (lbs) | | |
| LAND EROSION/RUNOFF | | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| | Row Crops | 2171579 | 12749 | 1206 |
| | Hay/Pasture | 572479 | 6655 | 695 |
| | High Density Urban | 17637 | 694 | 73 |
| | Low Density Urban | 2205 | 49 | 4 |
| | Unpaved Roads | 118489 | 802 | 121 |
| | Other | 202825 | 1475 | 112 |
| STREAMBANK EROSION | | 1311276 | 664 | 125 |
| GROUNDWATER/SUBSURFACE | | | 80449 | 1505 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 1962 | 51 |
| FARM ANIMALS | | | 1660 | 424 |
| TOTALS | | 4396490 | 107159 | 4318 |
| PERCENT REDUCTIONS | | 44.5 | 12.6 | 42.6 |
| TOTAL SCENARIO COST | | $3,382,459.65 | | |
| Ag BMP Cost (%) | | 9.2 | | |
| WW Upgrade Cost (%) | | 0.0 | | |
| Urban BMP Cost (%) | | 0.0 | | |
| Stream Protection Cost (%) | | 78.1 | | |
| Unpaved Road Protection Cost (%) | | 5.4 | | |

| Source | Existing (orgs/month) | Future (orgs/month) |
|---|---|---|
| Farm Animals | 3.787e+14 | 2.130e+14 |
| WWTP | 0.000e+00 | 0.000e+00 |
| Septic Systems | 0.000e+00 | 0.000e+00 |
| Urban Areas | 3.279e+10 | 3.279e+10 |
| Wildlife | 3.215e+12 | 3.215e+12 |
| Totals | 3.819e+14 | 2.162e+14 |
| PERCENT REDUCTIONS | | 43.39 |
| TOTAL SCENARIO COST | $3,382,459.65 | |

*REDDINGS RUN ESTIMATED LOAD REDUCTIONS*

**Mean Annual Load Data Editor**

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|

| | | | |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 1516780 | 5531 | 723 |
| Hay/Pasture | 180779 | 1634 | 170 |
| High Density Urban | 0 | 0 | 0 |
| Low Density Urban | 0 | 15 | 2 |
| Unpaved Road | 81571 | 249 | 33 |
| Other | 26455 | 190 | 13 |
| STREAMBANK EROSION | 71926 | 35 | 7 |
| GROUNDWATER/SUBSURFACE | | 18905 | 271 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 306 | 9 |
| | | | |
| **TOTAL** | 1877512 | 27756 | 1887 |
| | | | |
| BASIN AREA | 2432 | Acres | |

## Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 553.5161184 | % Existing | 0 | 0 | 29 | 29 | 0 | 0 | | 71 |
| | | % Future | 29 | 29 | 29 | 29 | 0 | 29 | | 71 |
| Hay/Pasture | 657.3003906 | % Existing | | | | 69 | 0 | 0 | 0 | 26 |
| | | % Future | | | | 74 | 0 | 42 | 42 | 26 |

| | | |
|---|---|---|
| Agricultural Land on Slope > 3% | 1,097 | Acres |
| Streams in Agricultural Areas | 4.8 | Miles |
| Total Stream Length | 9.1 | Miles |
| Unpaved Road Length | 6.3 | Miles |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.0 | 4.8 |
| Stream Miles with Fencing | 0.0 | 1.9 |
| Stream Miles with Stabilization | 0.0 | 2.2 |
| Unpaved Road Miles w/E & S Controls | 0.0 | 1.8 |

| | % Existing | % Future |
|---|---|---|
| AWMS (Livestock) | 0.0 | 100.0 |
| AWMS (Poultry) | 0.0 | 0.0 |
| Runoff Control | 0.0 | 100.0 |
| Phytase in Feed | 0.0 | 0.0 |

## Urban Land BMP Scenario Editor

| High Density Urban | | | | | |
|---|---|---|---|---|---|
| | | Acres | 553 | % Impervious Surface | 50 |
| Constructed Wetlands | | Bioretention Areas | | Detention Basins | |
| % Existing | 0 | % 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 | 27 | % 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 | 1.677702213 | Stream miles in low density urban areas w/buffers | 0 | 2.7 |
| | | Low Density Urban Streambank Stabilization | 0 | 0 |

## Septic Systems and Point Source Discharge Scenario Editor

| | | | | |
|---|---|---|---|---|
| Number of persons on septic systems | Existing | 86 | | |
| | Future | 86 | | |
| 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 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 |

**Pathogen Loads**

**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 | 0.56 | 0.60 |

| | | |
|---|---|---|
| Treatment | | |
| 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |

| Urban Cost Editor | |
|---|---|
| Constructed Wetlands (per acre) | $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 | $250.00 |

| | |
|---|---|
| Treatment (per capita) | |
| 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 | 1516780 | 5531 | 723 |
| | Hay/Pasture | 180779 | 1634 | 170 |
| | High Density Urban | 0 | 0 | 0 |
| | Low Density Urban | 0 | 15 | 2 |
| | Unpaved Roads | 81571 | 249 | 33 |
| | Other | 26455 | 190 | 13 |
| STREAMBANK EROSION | | 71926 | 35 | 7 |
| GROUNDWATER/SUBSURFACE | | | 18905 | 271 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 306 | 9 |
| FARM ANIMALS | | | 891 | 659 |
| TOTALS | | 1877512 | 27756 | 1887 |
| | | Future (lbs) | | |
| LAND EROSION/RUNOFF | | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| | Row Crops | 578508 | 2668 | 299 |
| | Hay/Pasture | 151927 | 1254 | 121 |
| | High Density Urban | 0 | 0 | 0 |
| | Low Density Urban | 0 | 9 | 1 |
| | Unpaved Roads | 21847 | 248 | 33 |
| | Other | 26455 | 190 | 13 |
| STREAMBANK EROSION | | 43664 | 23 | 4 |
| GROUNDWATER/SUBSURFACE | | | 16151 | 250 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 306 | 9 |
| FARM ANIMALS | | | 360 | 155 |
| TOTALS | | 822401 | 21209 | 886 |
| PERCENT REDUCTIONS | | 56.2 | 23.6 | 53.1 |
| TOTAL SCENARIO COST | | $1,012,490.54 | | |
| Ag BMP Cost (%) | | 15.4 | | |
| WW Upgrade Cost (%) | | 0.0 | | |
| Urban BMP Cost (%) | | 0.0 | | |

| | | |
|---|---|---|
| Stream Protection Cost (%) | 66.0 | |
| Unpaved Road Protection Cost (%) | 10.5 | |

| Source | Existing (orgs/month) | Future (orgs/month) |
|---|---|---|
| Farm Animals | 1.546e+14 | 4.793e+13 |
| WWTP | 0.000e+00 | 0.000e+00 |
| Septic Systems | 0.000e+00 | 0.000e+00 |
| Urban Areas | 6.083e+08 | 1.825e+08 |
| Wildlife | 4.178e+11 | 4.178e+11 |
| Totals | 1.550e+14 | 4.834e+13 |
| PERCENT REDUCTIONS | | 68.82 |
| TOTAL SCENARIO COST | $1,012,490.54 | |

*SUGARCAMP RUN ESTIMATED LOAD REDUCTIONS*

## Mean Annual Load Data Editor

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 1305137 | 4687 | 758 |
| Hay/Pasture | 182984 | 1537 | 185 |
| High Density Urban | 4409 | 201 | 22 |
| Low Density Urban | 0 | 2 | 0 |
| Unpaved Road | 68343 | 209 | 33 |
| Other | 41888 | 276 | 24 |
| STREAMBANK EROSION | 114279 | 57 | 11 |
| GROUNDWATER/SUBSURFACE | | 12897 | 258 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 359 | 7 |
| | | | |
| **TOTAL** | 1717039 | 20364 | 1402 |
| | | | |
| BASIN AREA | 2775 | Acres | |

## Agricultural Land BMP Scenario Editor

| Land Use | Acres | | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 447.2607921 | | % Existing | 0 | 0 | 89 | 85 | 0 | 46 | | 9 |
| | | | % Future | 87 | 87 | 89 | 91 | 0 | 55 | | 9 |
| Hay/Pasture | 600.4661463 | | % Existing | | | | 21 | 0 | 2 | 0 | 17 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | % Future | | 25 | 0 | 8 | 12 | 17 |

| | | | |
|---|---|---|---|
| Agricultural Land on Slope > 3% | 946 | Acres | |
| Streams in Agricultural Areas | 4.5 | Miles | |
| Total Stream Length | 11.9 | Miles | |
| Unpaved Road Length | 5.3 | Miles | |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.4 | 4.5 |
| Stream Miles with Fencing | 0.0 | 0.8 |
| Stream Miles with Stabilization | 0.0 | 4.9 |
| Unpaved Road Miles w/E & S Controls | 0.0 | 0.2 |

| | % Existing | % Future |
|---|---|---|
| AWMS (Livestock) | 0.0 | 100.0 |
| AWMS (Poultry) | 0.0 | 0.0 |
| Runoff Control | 0.0 | 100.0 |
| Phytase in Feed | 0.0 | 0.0 |

## Urban Land BMP Scenario Editor

### High Density Urban

| | | | | | |
|---|---|---|---|---|---|
| | | Acres | 447 | % Impervious Surface | 50 |
| **Constructed Wetlands** | | **Bioretention Areas** | | **Detention Basins** | |
| % Existing | 0 | % 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 | 4 | % 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 | .186411357 | 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 | 101 | | |
| | Future | 101 | | |
| Spetic systems 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 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 |

**Pathogen Loads**

## 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |
| **Urban Cost Editor** | |
| Constructed Wetlands (per acre) | $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 | 1305137 | 4687 | 758 |
| | Hay/Pasture | 182984 | 1537 | 185 |
| | High Density Urban | 4409 | 201 | 22 |
| | Low Density Urban | 0 | 2 | 0 |
| | Unpaved Roads | 68343 | 209 | 33 |
| | Other | 41888 | 276 | 24 |
| STREAMBANK EROSION | | 114279 | 57 | 11 |
| GROUNDWATER/SUBSURFACE | | | 12897 | 258 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 359 | 7 |
| FARM ANIMALS | | | 139 | 104 |
| TOTALS | | **1717039** | **20364** | **1402** |
| | | **Future (lbs)** | | |

| LAND EROSION/RUNOFF | | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|---|
| | Row Crops | 284797 | 1922 | 169 |
| | Hay/Pasture | 174640 | 1456 | 174 |
| | High Density Urban | 4409 | 201 | 22 |
| | Low Density Urban | 0 | 2 | 0 |
| | Unpaved Roads | 62192 | 209 | 33 |
| | Other | 41888 | 276 | 24 |
| STREAMBANK EROSION | | 63464 | 33 | 6 |
| GROUNDWATER/SUBSURFACE | | | 12077 | 255 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 359 | 7 |
| FARM ANIMALS | | | 61 | 26 |
| TOTALS | | 631390 | 16595 | 717 |
| PERCENT REDUCTIONS | | 63.2 | 18.5 | 48.9 |
| TOTAL SCENARIO COST | | $1,412,026.42 | | |
| Ag BMP Cost (%) | | 4.0 | | |
| WW Upgrade Cost (%) | | 0.0 | | |
| Urban BMP Cost (%) | | 0.0 | | |
| Stream Protection Cost (%) | | 94.4 | | |
| Unpaved Road Protection Cost (%) | | .8 | | |

| Source | Existing (orgs/month) | Future (orgs/month) |
|---|---|---|
| Farm Animals | 2.440e+13 | 9.367e+12 |
| WWTP | 0.000e+00 | 0.000e+00 |
| Septic Systems | 0.000e+00 | 0.000e+00 |
| Urban Areas | 1.074e+10 | 1.074e+10 |
| Wildlife | 5.844e+11 | 5.844e+11 |
| Totals | 2.499e+13 | 9.962e+12 |
| PERCENT REDUCTIONS | | 60.14 |
| TOTAL SCENARIO COST | $1,412,026.42 | |

*MUDLICK RUN ESTIMATED LOAD REDUCTIONS*

## Mean Annual Load Data Editor

| Load Data Type | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
|---|---|---|---|
| UPLAND EROSION/RUNOFF | | | |
| Row Crops | 291010 | 911 | 104 |
| Hay/Pasture | 26455 | 267 | 24 |
| High Density Urban | 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| Low Density Urban | 0 | 2 | 0 |
| Unpaved Road | 8818 | 33 | 4 |
| Other | 13228 | 112 | 7 |
| STREAMBANK EROSION | 16629 | 9 | 0 |
| GROUNDWATER/SUBSURFACE | | 1687 | 75 |
| POINT SOURCE DISCHARGE | | 0 | 0 |
| SEPTIC SYSTEMS | | 128 | 2 |
| | | | |
| **TOTAL** | 356141 | 3148 | 216 |
| | | | |
| BASIN AREA | 956 | Acres | |

## Agricultural Land BMP Scenario Editor

| Land Use | Acres | | BMP1 | BMP2 | BMP3 | BMP4 | BMP5 | BMP6 | BMP7 | BMP8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Row Crops | 93.9000558 | % Existing | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| | | % Future | 100 | 100 | 100 | 100 | 0 | 0 | | 0 |
| Hay/Pasture | 111.1974345 | % Existing | | | | 27 | 0 | 0 | 0 | 64 |
| | | % Future | | | | 31 | 0 | 0 | 0 | 64 |

| | | |
|---|---|---|
| Agricultural Land on Slope > 3% | 185 | Acres |
| Streams in Agricultural Areas | 0.9 | Miles |
| Total Stream Length | 3.9 | Miles |
| Unpaved Road Length | 0.9 | Miles |

| | Existing | Future |
|---|---|---|
| Stream Miles with Vegetated Buffer Strips | 0.0 | 0.6 |
| Stream Miles with Fencing | 0.0 | 0.0 |
| Stream Miles with Stabilization | 0.0 | 0.6 |
| 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 | 93 | % Impervious Surface | 50 |
| Constructed Wetlands | Bioretention Areas | | Detention Basins | |

| | | | | | |
|---|---|---|---|---|---|
| % Existing | 0 | % 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 | 4 | % 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 | .062137119 | 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 | 36 | | |
| | Future | 36 | | |
| 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 | 0.29 | 0.50 | 0.35 | |
| BMP 2 | 0.08 | 0.22 | 0.30 | |

| | | | | |
|---|---|---|---|---|
| BMP 3 | 0.07 | 0.10 | 0.17 | |
| BMP 4 | 0.05 | 0.10 | 0.16 | |
| BMP 5 | 0.00 | 0.00 | 0.16 | |
| BMP 6 | 0.29 | 0.44 | | |
| BMP 7 | 0.30 | 0.30 | 0.38 | |
| BMP 8 | 0.95 | 0.95 | 0.95 | |
| Vegetated Buffer Strips | 0.41 | 0.40 | 0.53 | 0.70 |
| Streambank Fencing | 0.56 | 0.78 | 0.76 | 1.00 |
| Streambank Stabilizatio | 0.95 | 0.95 | 0.95 | |
| Unpaved Roads (lbs/ft) | 0.01 | 0.0024 | 1.71 | |
| 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 |

### Pathogen Loads

### 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) | $1,500.01 |
| Terraces and Diversions (per acre) | $5,000.00 |
| 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) | $0.00 |
| Unpaved Roads (per foot) | $5.58 |
| Ag to Forest Conversion (per acre) | $10.00 |
| **Urban Cost Editor** | |
| Constructed Wetlands (per acre) | $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 | 291010 | 911 | 104 |
| | Hay/Pasture | 26455 | 267 | 24 |
| | High Density Urban | 0 | 0 | 0 |
| | Low Density Urban | 0 | 2 | 0 |
| | Unpaved Roads | 8818 | 33 | 4 |
| | Other | 13228 | 112 | 7 |
| STREAMBANK EROSION | | 16629 | 9 | 0 |
| GROUNDWATER/SUBSURFACE | | | 1687 | 75 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 128 | 2 |
| FARM ANIMALS | | | 0 | 0 |
| TOTALS | | **356141** | **3148** | **216** |

| | | Future (lbs) | | |
|---|---|---|---|---|
| LAND EROSION/RUNOFF | | Total Sed (lbs) | Total N (lbs) | Total P (lbs) |
| | Row Crops | 14551 | 337 | 6 |
| | Hay/Pasture | 26455 | 267 | 24 |
| | High Density Urban | 0 | 0 | 0 |
| | Low Density Urban | 0 | 2 | 0 |
| | Unpaved Roads | 8818 | 33 | 4 |
| | Other | 13228 | 112 | 7 |
| STREAMBANK EROSION | | 14081 | 7 | 0 |
| GROUNDWATER/SUBSURFACE | | | 1663 | 75 |
| POINT SOURCE DISCHARGE | | | 0 | 0 |
| SEPTIC SYSTEMS | | | 128 | 2 |
| FARM ANIMALS | | | 0 | 0 |
| TOTALS | | **77134** | **2550** | **119** |
| PERCENT REDUCTIONS | | 78.3 | 19.0 | 45.2 |
| TOTAL SCENARIO COST | | $172,946.66 | | |
| Ag BMP Cost (%) | | 4.1 | | |
| WW Upgrade Cost (%) | | 0.0 | | |
| Urban BMP Cost (%) | | 0.0 | | |
| Stream Protection Cost (%) | | 95.9 | | |
| Unpaved Road Protection Cost (%) | | 0 | | |

| 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 | 5.113e+07 | 5.113e+07 |
| Wildlife | 2.644e+11 | 2.644e+11 |
| Totals | 2.645e+11 | 2.645e+11 |
| PERCENT REDUCTIONS | | 0.00 |
| TOTAL SCENARIO COST | $172,946.66 | |