SOUTH SANDY CREEK
WATERSHED ASSESSMENT / RESTORATION PLAN

Prepared for:

South Sandy Creek Watershed Association

Prepared by:

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February 2009

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INTRODUCTION

Coal mining has been conducted in western Pennsylvania, as well as much of the Appalachian Coal Basin, for more than 150 years. With Pennsylvania's coal reserves playing a major role in the Industrial Revolution, the United States became a modern developed nation and major world power. This historical utilization of coal to heat our homes and to fuel our industries, however, resulted in a legacy of severe environmental impacts and public safety issues. The majority of these impacts are associated with mines operational prior to the federal Surface Mining Control and Reclamation Act of 1977 and Pennsylvania's legislative efforts including the Surface Mining Conservation and Reclamation Act of 1945.

Small towns and villages of western Pennsylvania and Appalachia, which were once bustling coal communities supporting the steel industry and electricity generation for such cities as Pittsburgh (PA), Wheeling (WV), and Johnstown (PA), are now often non-existent ghost towns left with only scarred landscapes characterized by dangerous highwalls, barren coal refuse piles, and, polluted mine drainage. According to the Pennsylvania Integrated Water Quality Monitoring and Assessment Report (PA DEP, 2006), these pollutive discharges, commonly referred to as abandoned mine drainage (AMD), are the largest source of stream degradation in the Commonwealth, with over 4,600 miles of streams impacted. Furthermore, 45 of Pennsylvania's 67 counties are impacted with over 250,000 acres of unreclaimed mine lands, 2.6 billion cubic yards of abandoned coal refuse, and about 7,800 abandoned underground mines. In many cases, entire watersheds have been completely decimated by AMD.

The South Sandy Creek Watershed Association (SSCWA) is an independent, non-profit organization formed in 2004 to provide a structure and focal point for the improvement of the environmental quality of the South Sandy Creek Watershed. Membership and partners of the association include concerned citizens, conservation groups, sportsmen's associations, government agencies, and private business representatives. SSCWA, in partnership with the Venango County Conservation District, is initiating this study in an effort to establish a framework for future remediation and development within the watershed. All readily available information was compiled in order to determine the locations, types, extent and impacts of non-point source/point source (NPS/PS) pollution in the study area. This assessment report offers general solutions associated with water quality impacts in the project area, and for future remediation projects within the watershed. In addition to the assessment, this project also included an outreach/education effort aimed at increasing the involvement of Venango County municipal leaders and residents in environmental issues. Major tributaries in the watershed are Williams Run and Lyons Run.

L. Robert Kimball & Associates is a multidiscipline engineer consulting firm with more than 50 years of experience in performing water quality and mining-related assessments. Kimball provided the oversight of data entry into a database and the geographic information system (GIS) program design.

Purpose

The purpose of the assessment was to create a comprehensive Watershed Assessment and Restoration Plan for the South Sandy Creek Watershed, with respect to both Non-Point Sources (NPS) and any identified Point Source (PS) locations of pollution in the $26^{\pm}$ square mile watershed. The watershed contains significant abandoned mine land (AML) discharges, and the intent of this project was to establish a comprehensive, holistic approach toward assessment and eventual pollution abatement and remediation of the existing water quality problems. The Watershed Assessment / Restoration Plan will provide a framework for future efforts by the SSCWA for prioritizing and coordinating restoration/planning activities with citizens and local and state agencies. The final assessment report will serve as a working template/framework to guide future remediation/planning and monitoring efforts and will assist in setting remediation priorities. Priority identification will assist in planning and performing a more efficient restoration of identified NPS outfalls and related impacts and will provide the means for efficient use of already limited funding.

The final Watershed Assessment / Restoration Plan will become the property of the SSCWA to guide future remediation/planning efforts and to provide a central depository for additional information and data gathered for the study area.

Limitations of the Study

This assessment was based on existing and readily available data generated as a result of previous studies within the watershed, data held by local, state and federal government agencies and one year of sampling conducted for this assessment at a limited number of locations.

This assessment did not address discharges from permitted active mining operations, and other permitted discharges such as sewage/wastewater treatment plants, and miscellaneous discharges regulated by local, state, or federal government agencies. In addition, this assessment focused on the main impairments of the streams within the watershed, namely acid mine drainage from abandoned mine lands. As such, water quality parameters evaluated were generally limited to metals and other parameters associated with acid mine drainage. Other parameters such as volatile or other organics were not assessed as the majority of the watershed consists of State Game Lands, other forested lands, and rural residential and agricultural land uses with only limited light industrial activities. The potential for other parameters to become significant impairments within the watershed are greatly outweighed by the current acid mine drainage problem.

Objectives

The assessment report will serve as a Watershed Restoration Plan for future remediation projects sponsored by the SSCWA, and will be available as a public document to all entities desiring to work within the watershed.

The first objective of this study was to identify major NPS discharges within the South Sandy Creek watershed, obtain existing analytical/physical data associated with the discharges, and develop a working Geographic Information System (GIS) database of the data collected. The created database will be used to compile existing data from various sources, identify gaps in data collection, perform data analysis in regard to watershed restoration and planning, and serve as a depository for data gathered in the future.

The second objective was to utilize the GIS database to evaluate the impacts of NPS discharges in regard to water quality and to generate a current priority list of NPS sources for which general remediation strategies would be developed.

Since funding may not be available to remediate or address every problem, attacking them on a priority basis would eliminate those problems that are too small or costly. While the underlying goal is cleaner water, there are several specific improvements to the watershed and surrounding communities as determined by the SSCWA.

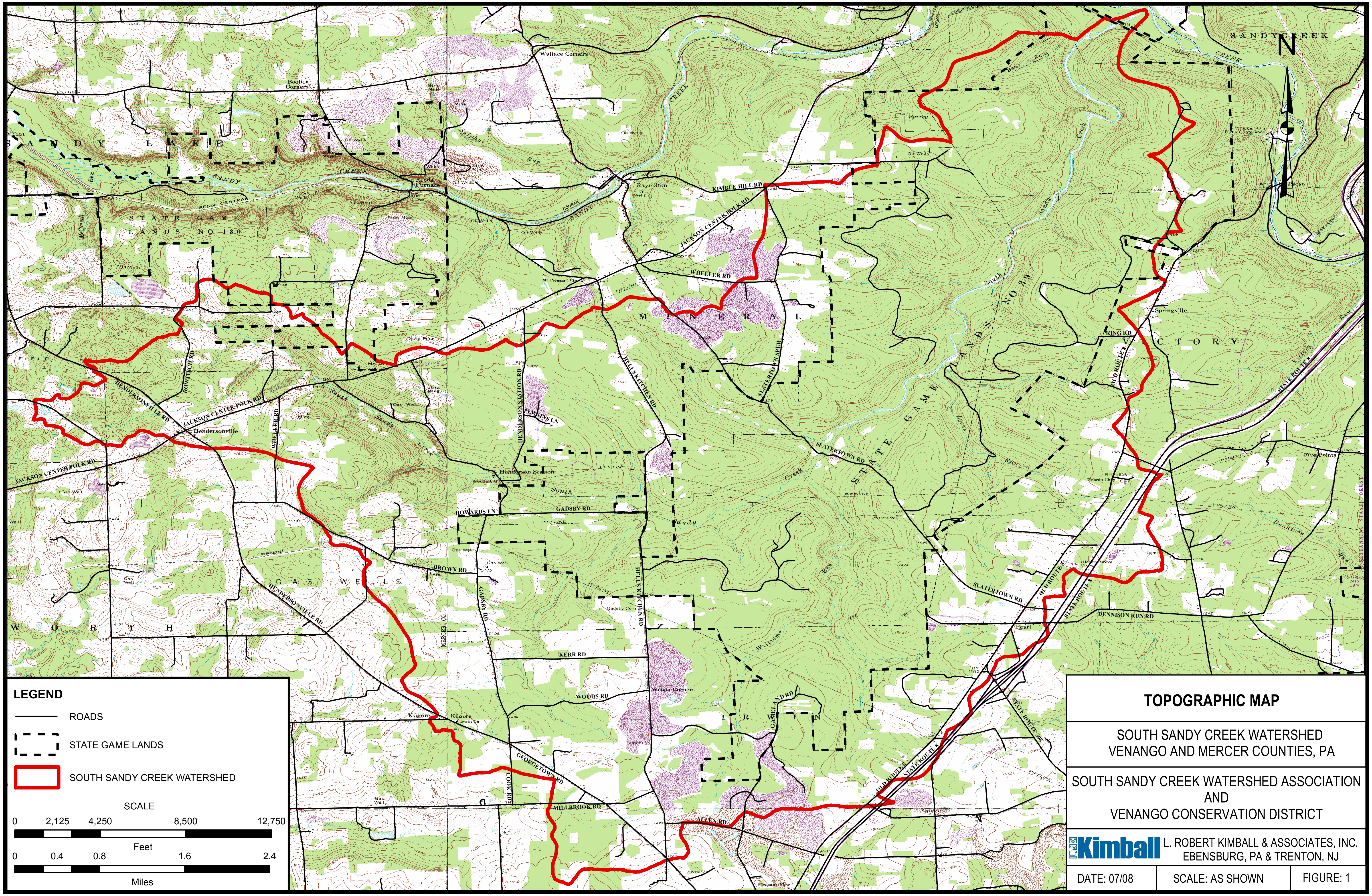
Study Area

South Sandy Creek (DEP Stream Code 51341, Basin 16-G) is a relatively large tributary to and sub-watershed of Sandy Creek in the Ohio River Basin in northwestern Pennsylvania. Subbasin number 16 has a total drainage area of 4474 square miles. Known as the Upper Allegheny Subbasin, it includes the uppermost portion of the Allegheny River before it flows into New York and the portion of the Allegheny River between New York and Emlenton. The subbasin encompasses all of Warren County, much of McKean, Crawford, Venango, Forest, and Erie Counties, and portions of Potter, Elk, Cameron, Mercer, Clarion, and Butler Counties. Watershed G has a total drainage area of 445 square miles. Known as the Sandy Creek Watershed, its major stream is Sandy Creek.

The South Sandy Creek Watershed is primarily located within Victory, Mineral and, Irwin Townships of Venango County with a portion of the headwaters located in Sandy Lake and Worth Townships of Mercer County. The watershed encompasses approximately 26-square miles (16,640 acres) with approximately 321,200 feet (60.8 miles) of streams that flow in a generally northern direction. Approximately half of the watershed (approximately 8,300 acres) is located within State Game Lands #39 beginning at approximately the Mercer/Venango county line to the mouth at Sandy Creek. In addition, a small portion of the northwest corner of the watershed is located in State Game Lands #130.

The major watershed boundary is shown on the topographic map identified as **Figure 1**. Stream flow is roughly west to east-northeast into Sandy Creek. Major sub-watersheds of the South Sandy Creek Watershed include the South Sandy Creek, Williams Run (DEP Stream Code 51362) and Lyons Run (DEP Stream Code 51354). Sub-watershed boundaries are presented on **Figure 2**.

The South Sandy Creek headwaters are characterized by spring and wetland fed tributaries. Surface elevations range from about 1200 to 1600 feet and contain, relatively flat, rural and forested lands with gently rolling hills of low relief in the headwaters to steep forested ravines



TOPOGRAPHIC MAP

SOUTH SANDY CREEK WATERSHED
VENANGO AND MERCER COUNTIES, PA

SOUTH SANDY CREEK WATERSHED ASSOCIATION
AND
VENANGO CONSERVATION DISTRICT

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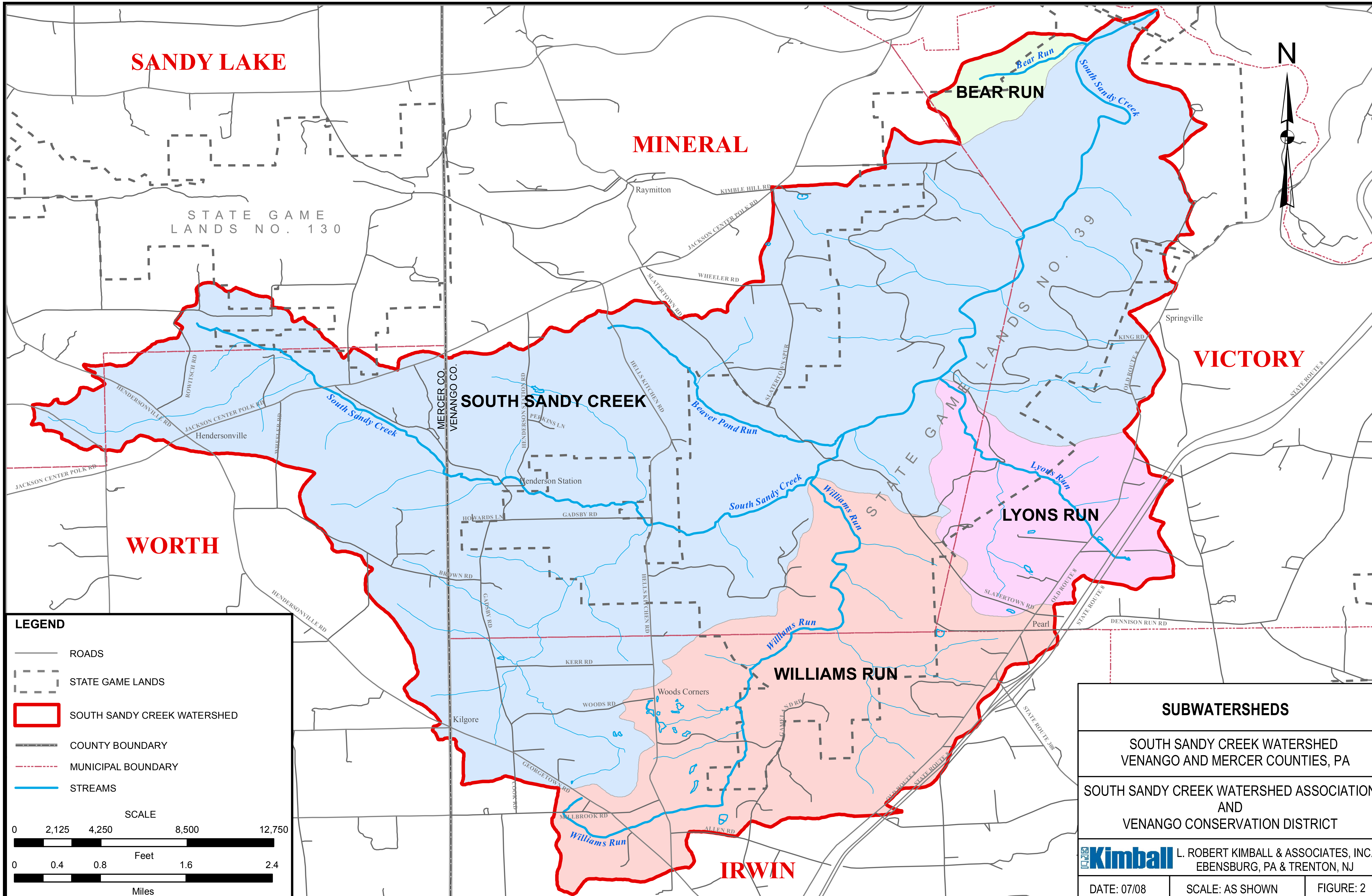
EBENSBURG, PA & TRENTON, NJ

DATE: 07/08	SCALE: AS SHOWN	FIGURE: 1



SANDY LAKE
MINERAL
VICTORY
WORTH
IRWIN
STATE GAME LANDS NO. 130
STATE GAME LANDS NO. 39
BEAR RUN
SOUTH SANDY CREEK
LYONS RUN
WILLIAMS RUN
MERCER CO.
VENANGO CO.
South Sandy Creek
Bear Run
Beaver Pond Run
Williams Run
Lyons Run
Raymitton
Hendersonville
Henderson Station
Springville
Pearl
Woods Corners
Kilgore
KIMBLE HILL RD
JACKSON CENTER POLK RD
WHEELER RD
SLATERTOWN RD
HELLS KITCHEN RD
HENDERSONVILLE RD
HOWARDS LN
GADSBY RD
BROWN RD
KERR RD
WOODS RD
GEORGETOWN RD
MILLBROOK RD
ALLEN RD
KING RD
OLD ROUTE 8
STATE ROUTE 8
DENNISON RUN RD
STATE ROUTE 308
N
LEGEND
ROADS
STATE GAME LANDS
SOUTH SANDY CREEK WATERSHED
COUNTY BOUNDARY
MUNICIPAL BOUNDARY
STREAMS
SCALE
0 2,125 4,250 8,500 12,750
Feet
0 0.4 0.8 1.6 2.4
Miles
SUBWATERSHEDS
SOUTH SANDY CREEK WATERSHED
VENANGO AND MERCER COUNTIES, PA
SOUTH SANDY CREEK WATERSHED ASSOCIATION
AND
VENANGO CONSERVATION DISTRICT
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FIGURE: 2

through State Game Lands #39. South Sandy Creek enters Sandy Creek about 1.3 miles east-southeast of Polk, PA.

The South Sandy Creek watershed is underlain by sedimentary rock formations such as sandstone, shale, and siltstone. The lowest lying of these formations is the Pennsylvanian age Pottsville Group consisting of thick sandstones and shales. Overlying the Pottsville group is the lower part of the Pennsylvanian age Allegheny Group consisting of shale, some clay and sandstone, and the Vanport limestone. Coal beds of the Allegheny group include the Middle Kittanning, Lower Kittanning and Clarion coal beds with the majority of the commercial coal being mined from the Clarion.

Mining within the south Sandy Creek watershed has been relatively limited with the majority of the mining activity located in the southern portions of the watershed near Woods Corners within the Williams Run sub-watershed and areas north of the main stem of South Sandy Creek in Mineral Township. Numerous abandoned mine features such as surface mining pits, highwalls and spoil areas can be found in these locations along with a number of reclaimed surface mines. There are no coal mines currently in operation within the watershed.

In addition to coal mining, Venango County has had a long history of economic mineral recovery. The earliest of these was the mining of limestone used to produce agricultural lime. The discovery of siderite nodules and layers associated with the limestone lead to the development of the iron manufacturing industry within the county. With the discovery of oil in the mid to late 1800s, Venango County developed a thriving oil industry helping western Pennsylvania supply over half the world's oil supply by 1880. Numerous historic, as well as more recent, oil wells, pumping facilities, storage tanks, and piping systems are commonly observed within portions of the watershed.

Approximately 50% (~8,300 acres) of the South Sandy Creek Watershed is located within State Game Lands #39. As such, much of the watershed is forested, open land used for wildlife habitat and recreation. Abandoned mine lands account for approximately 4% (~630 acres) of the land use and are generally found near Woods Corners within the Williams Run sub-watershed and north of the South Sandy main stem in Mineral Township. The remaining land use within the watershed is a mix of forested lands, rural residential, agricultural and light industry.

Stream Classification

Pennsylvania Code Title 25, Chapter 93 lists the established water quality goals for all streams within the Commonwealth. Water uses to be protected are established for each stream, as well as specific water criteria necessary to protect these uses. These criteria are to be used to establish waste discharge permit limits. "Exceptional Value Waters" (EV) designation refers to streams that are relatively pristine, with little or no development or access and are an outstanding natural resource. In a "High Quality" (HQ) stream, the water quality can be lowered only if a discharge is the result of necessary social or economic development, and all the existing uses of the stream are protected. "Cold Water Fishery" (CWF) designation refers to a stream capable of maintaining or propagating, or both, fish species including the Salmonidia and additional flora and fauna that are indigenous to a cold water habitat. "Trout Stocking Fishery" (TSF) designation refers to a stream capable of maintaining stocked trout from February 15 to July 31 and capable of maintaining or propagating, or both, fish species and additional flora and fauna that are indigenous to a warm water habitat. "Warm Water Fishery" (WWF) designation refers to streams capable of maintaining or propagating, or both, fish species and additional flora and fauna that are indigenous to a warm water habitat.

Pennsylvania Code Title 25, Chapter 93 designates the South Sandy Creek Basin as a Cold Water Fishery with the following water quality criteria:

- Alkalinity - Min. 20 mg/L as $CaCO_3$, except where natural conditions are less…
- Dissolved Oxygen - For flowing waters, min. daily average 6.0mg/l…
- Iron - 30-day avg. 1.5 mg/L as total recoverable
- Osmotic Pressure - Max. 50 milliosmoles/kg
- pH - From 6.0 to 9.0 inclusive
- Total Dissolved Solids - 500 mg/L as a monthly avg. value; max. 750 mg/L

Established TMDLs

The Pennsylvania Department of Environmental Protection (PADEP) is required to develop Total Maximum Daily Loads (TMDLs) for streams in the Commonwealth to address nonpoint source pollution in water bodies that are deemed to be "water quality impaired". These are water bodies that do not meet PADEP standards for their designated use. TMDLs are simply the implementation of rules included in Section 303(d) of the Clean Water Act of 1972. Today, TMDLs are an integral part of the watershed approach to water quality management. The perspective is that all point and nonpoint source pollution in a watershed, as well as the physical characteristics of the water body itself, cannot be disentangled. As a result, TMDLs aims at managing all sources of pollution which affects beneficial uses of water, covering both point and nonpoint sources. TMDLs have not been completed for the watershed and are not scheduled for completion until at least 2017.

Trout Stocked Streams and Lakes

The Fish and Boat Commission classifies streams and lakes as "approved trout waters" for stocking. No streams within the South Sandy Creek Watershed have been classified as such by the Fish and Boat Commission.

Impaired Streams

According to the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, the entire main stem of South Sandy Creek is in attainment for all intended uses (Refer to **Figure 3**). In addition, all unnamed tributaries, with the exception of segment codes Unt 51375 and Unt 51382, identified on **Figure 3** are also in attainment. The majority of stream miles impaired within the watershed are located within the Williams Run sub-watershed.

Several miles of streams within the Williams Run sub-watershed are impacted by AMD which limits the recreational, economic and social values of the communities within the watershed. The poor aesthetics associated with the discolored and polluted water of the streams detract from the area's potential for growth and development. It also affects the recreational opportunities available for the region. **Table 1** presents a summary of the impaired streams as reported in the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report.

Table 1 - Impaired Streams Requiring TMDLs

STREAM	IMPAIRMENT	MILES
South Sandy Creek (Unt 51375)	Abandoned Mine Drainage/Metals	1.86
South Sandy Creek (Unt 51382)	Abandoned Mine Drainage/Metals	0.55
Williams Run (51362)	Abandoned Mine Drainage/Metals, pH	5.61
Williams Run (Unt 51370)	Abandoned Mine Drainage/Metals, pH	0.39
Williams Run (Unt 51371	Abandoned Mine Drainage/Metals, pH	0.57
Williams Run (Unt 51372)	Abandoned Mine Drainage/Metals, pH	0.18
Williams Run (Unt 51373)	Abandoned Mine Drainage/Metals, pH	0.72

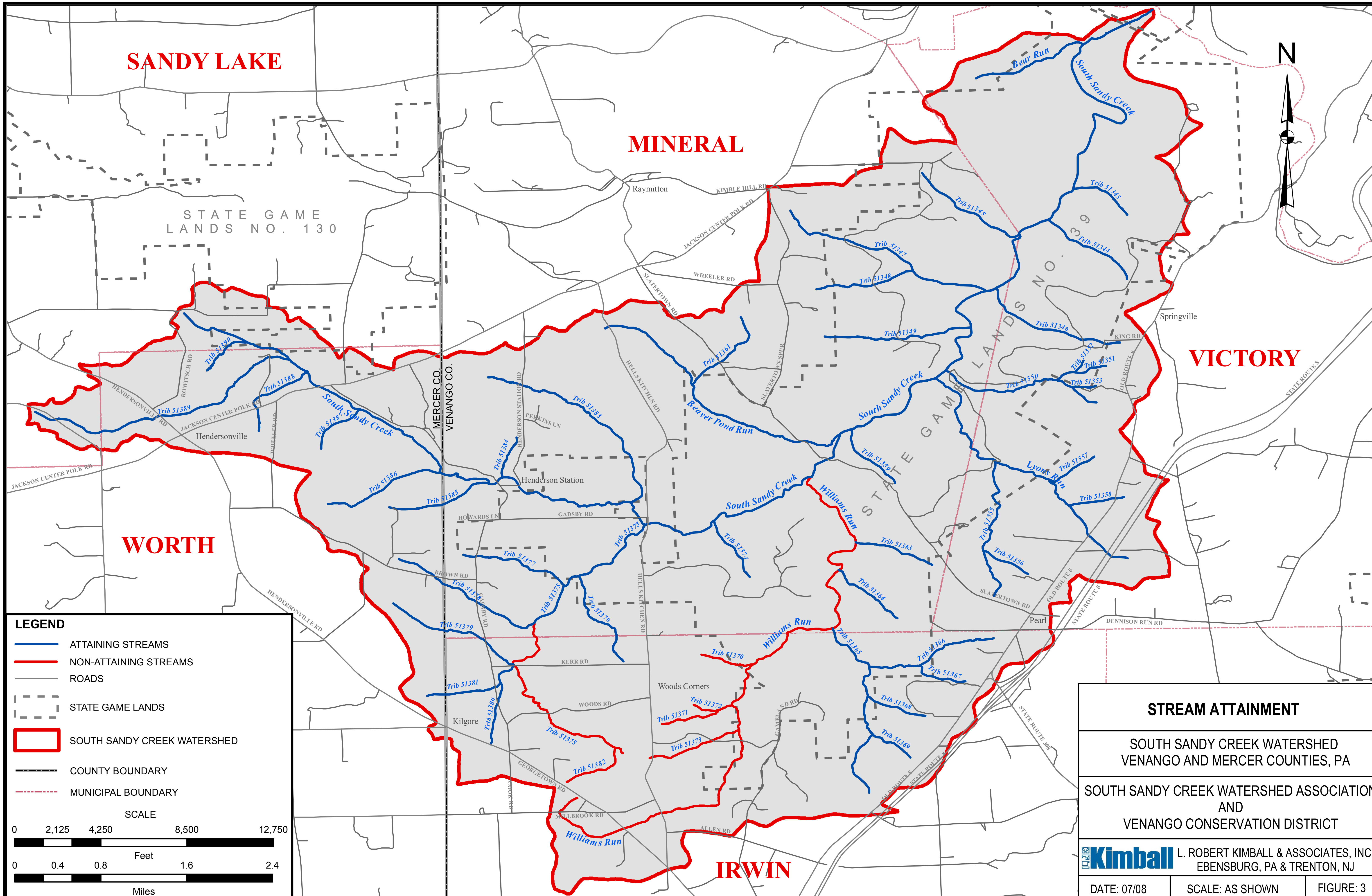
Previous Assessments

An assessment of the Williams Run sub-watershed was completed for the South Sandy Creek Watershed Association in 2006. The Assessment was completed by Jennifer Hedglin, Wildlife Biologist, through a grant provided by the Coldwater Heritage Partnership. Results of the assessment were presented in a report dated August 2007 (**Appendix A**).

An earlier assessment of the South Sandy Creek watershed was conducted in 2001 through a PADEP Technical Assistance Grant (TAG). Water quality data associated with this assessment has been obtained; however, a report documenting the sample locations and procedures was not available at the time of this report.

A semi-comprehensive macroinvertebrate study is currently being completed by Derek Smith of the PADEP/Division of Watershed Management. Derek is the water pollution biologist, who collected the site data and is preparing an assessment of the results, and a copy of the raw data is included in **Appendix B**. Based on preliminary evaluations of this study, the current stream classification of the main stem of South Sandy Creek may be elevated to a more protected status.

In addition, data associated with the Macro-invertebrate Surveys conducted in 2006 and the PA Fish & Boat Commission are included as **Appendices C** and **D**, respectively.


SANDY LAKE
MINERAL
VICTORY
WORTH
IRWIN
STATE GAME LANDS NO. 130
STATE GAME LANDS NO. 39
MERCER CO.
VENANGO CO.
Raymitton
Hendersonville
Henderson Station
Springville
Pearl
Woods Corners
Kilgore
South Sandy Creek
Bear Run
Beaver Pond Run
Williams Run
Lyons Run
Trib 51343
Trib 51344
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KIMBLE HILL RD
JACKSON CENTER POLK RD
WHEELER RD
SLATERTOWN RD
HELLS KITCHEN RD
SLATERTOWN SPUR
KING RD
OLD ROUTE 8
STATE ROUTE 8
DENNISON RUN RD
HENDERSONVILLE RD
ROWITSCH RD
HENDERSON STATION RD
PERKINS LN
HOWARDS LN
GADSBY RD
BROWN RD
KERR RD
WOODS RD
GEORGETOWN RD
MILLBROOK RD
ALLEN RD
STATE ROUTE 308
N
LEGEND
ATTAINING STREAMS
NON-ATTAINING STREAMS
ROADS
STATE GAME LANDS
SOUTH SANDY CREEK WATERSHED
COUNTY BOUNDARY
MUNICIPAL BOUNDARY
SCALE
0 2,125 4,250 8,500 12,750
Feet
0 0.4 0.8 1.6 2.4
Miles
STREAM ATTAINMENT
SOUTH SANDY CREEK WATERSHED
VENANGO AND MERCER COUNTIES, PA
SOUTH SANDY CREEK WATERSHED ASSOCIATION
AND
VENANGO CONSERVATION DISTRICT
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FIGURE: 3

Past and Current Reclamation

A large portion of the abandoned mine lands within the watershed have been reclaimed over the years. At the time of this report, no maintained AMD treatment systems were located within the watershed. However, at least two land reclamation and/or passive treatment systems were planned or in construction:

Woods Corner Reclamation – BAMR is currently in the process of reclaiming several dangerous highwalls in the vicinity of Woods Corner within the Williams Run sub-watershed. The project will involve the removal of dangerous highwalls on and around the Woods, Fleming and Gadsby properties. In addition, the project will include the construction of an inclined limestone bed passive treatment system to treat a seep emanating from behind the Woods residence.

Woods Upper Pond – The SSCWA has received a grant to include the construction of an inclined limestone bed to treat the discharge from the upper Woods pond. Design of the system has been completed and construction should begin in 2008. Successful completion of this system will greatly improve the water quality in Williams Run.

WATERSHED ASSESSMENT

The assessment of the South Sandy Creek watershed was completed through the compilation and review of existing data obtained from within the watershed, visual inspection of the watershed to identify major contributors to stream impairment, and a comprehensive water quality sampling effort to fill identified data gaps and provide more current chemistry of discharges and streams. Collected data were compiled into a water quality database for evaluation.

Data sources

The Pennsylvania Department of Environmental Protection (PADEP), Bureau of Abandoned Mine Reclamation (BAMR), Cambria County Office, provided or made available a significant portion of the current assessment database. Water quality data associated with several discharges and streams within Williams Run were provided spanning the time frame between March 2004 and October 2007. The data set is made of samples collected by BAMR and members of the SSCWA. The majority of the data provided by BAMR was collected as part of the Williams Run Assessment as documented in the Williams Run Assessment Report dated August 2007.

The remainder of the water quality data used in the current watershed assessment was provided as a result of visual inspections, assessments and water quality sampling conducted by the Venango County Conservation District. Monthly and quarterly sampling was conducted at major discharges and selected stream locations within the South Sandy and Williams Run sub-watersheds by the VCD between May 2007 and April 2008. In addition, the SSCWA and Mineral Township also participated in the assessment with manpower and personal equipment.

The Venango County Conservation District (VCD) also provided GIS layers associated with the watershed in Venango County. Other data sources contacted regarding pertinent data included various internet data clearing houses such as PASDA. Data downloaded from these and other similar sites generally consisted of data layers for use in the final assessment GIS such as area geology, rivers and streams, roads, mined areas and municipalities.

Watershed Inspection

Inspections of the watershed completed by the VCD, BAMR and Jennifer Hedglin (Williams Run Assessment) identified 22 discharge locations ranging from small seeps with average flows less than 5 gallons per minute to large discharges of over 100 gallons per minute. Of the 22 discharges identified, sampling at five locations (SGL2, SGL3, SGL4, BPR3A and WRL4) was either not conducted or halted based on the size of the discharge or evaluation of preliminary data indicating the seeps were of negligible impact to stream water quality. The remaining 17 identified discharges, which represent the major impact to the watershed, are generally found within the central portion of the watershed east of Henderson Station to the bridge where Slatertown Road crosses South Sandy Creek.

Visual inspections and field water quality measurements of the watershed conducted by the VCD at locations downstream of the Slatertown bridge and Mercer County Conservation District and

VCD in the headwaters above Henderson Station found no stream impairments and generally good water quality. Field Assessment Forms completed as part of the inspection of the headwaters area in Venango and Mercer Counties are provided in **Appendix E**. Based in part on these inspections, water quality sampling efforts for this assessment were targeted toward the identified AMD locations. **Table 2** presents a listing and description of the AMD discharges identified within the watershed.

Table 2 - AMD Discharges South Sandy Creek Watershed

DISCHARGE	NAME	DESCRIPTION
Tipple	Tipple Site	Sample collected downstream of Tipple coal fines throughout streambed, Upstream of Woods Road Site
Woods Rd	Woods Road Site	Water wells up from ground, Possible old well, Downstream from Tipple Site
SGL1	State Game Lands #1	Two seeps from hillside, discharge directly to South Sandy
SGL2	State Game Lands #2	**No Samples Collected at this Site** Small Seep, Below mouth of Williams Run, minimal impact
SGL3	State Game Lands #3	**No Samples Collected at this Site** Small Seep - minimal impact
SGL4	State Game Lands #4	Small seeps discharge directly to South Sandy Creek, Upstream of SGL #3, **sampling halted** due to low flow and minimal impact
BPR1	Beaver Pond Run #1	Small seep along road, no evidence of mining, downstream of in-stream sample, near mouth of Beaver Pond Run
BPR2	Beaver Pond Run #2	Small seep along road, no evidence of mining, downstream of in-stream sample
BPR3	Beaver Pond Run #3	Old well casing, discharge to Beaver Pond Run water bubbles
BPR3A	Beaver Pond Run #3A	Small upwelling near BPR#4 and BPR#5, **sampling halted** due to low flow and minimal impact
BPR4	Beaver Pond Run #4	Upwelling in cattails, possible old well, no visible casing
BPR5	Beaver Pond Run #5	Discharge in stream bank, old well in area, Upstream of BPR 4
Reagleman1	Reagleman #1	Discharge in deep cut channel, wells up from ground, East of Slatertown Road
Reagleman2	Reagleman #2	Discharge in deep cut channel, wells up from ground, West of Slatertown Road
Mamula1	Mamula #1	Discharge from bank out of old strip mine, Above Mamula #2
Mamula2	Mamula#2	20 foot diameter pit in old strip, water wells up in pit, downstream from Mamula #1
Fleming	Fleming Site	Seep out of highwall on Fleming property
WOODS, WOODS2	Woods and Woods2	Discharge to and from Chuck Woods Upper Pond
WRR5	Williams Run Right #5	Fifth Sample Location Right of Williams Run Main Stem, Discharge from Gadsby Pond.
ARS	Allen Road Site	Discharge from mine spoils along Allen Road
WRL4	Williams Run Left #4	Small Seep Discharge to Williams Run, **sampling halted** due to low flow and minimal impact
WRL7	Williams Run Left #7	Discharge from old strip mine pit left of Williams Run looking upstream.

Water Quality Sampling

As part of this assessment, water quality data were obtained by the VCD and the PADEP/BAMR through the collection of stream and discharge water samples. At each location, water quality samples collected were analyzed for specific conductance, pH, alkalinity, acidity, iron, manganese, aluminum, sulfate, and total suspended solids. Samples collected as part of this assessment were submitted to the PADEP laboratory for analysis.

Twenty-one total locations were sampled either monthly or quarterly over a twelve month period in order to provide additional information for the current assessment and fill known data gaps within the watershed. Fifteen discharges and six stream locations were sampled for the assessment. Raw analytical data for each sample location are provided in **Appendix F**. Specific monitoring locations are presented in **Table 3**, below.

Table 3 – Watershed Monitoring Locations

Watershed	Type	Location ID	Sample Date Range		No. of Samples	Notes
South Sandy	Discharge	BPR1	5/29/07	3/25/08	6	Sampled Quarterly Starting 9/07
Creek	Discharge	BPR2	5/29/07	3/25/08	6	Sampled Quarterly Starting 9/07
	Discharge	BPR3	5/31/07	4/30/08	7	Sampled Quarterly Starting 9/07
	Discharge	BPR3A	5/31/07	6/28/07	2	Sampling Discontinued
	Discharge	BPR4	5/30/07	4/29/08	12	
	Discharge	BPR5	5/30/07	4/29/08	12	
	Discharge	Mamula1	5/31/07	3/25/08	11	No Sample 4/08
	Discharge	Mamula2	5/31/07	4/30/08	10	No sample 9/07 and 10/07
	Discharge	Reagleman1	5/30/07	4/29/08	12	
	Discharge	Reagleman2	5/30/07	4/29/08	8	Sampled Quarterly Starting 9/07
	Discharge	SGL1	5/29/07	4/28/08	12	
	Discharge	SGL4	5/29/07	6/27/07	2	Sampling Discontinued
	Discharge	Tipple	5/29/07	4/28/08	11	No Sample 9/07
	Discharge	Woods Rd	5/29/07	4/28/08	12	
	Stream	Woods Rd In stream	5/29/07	4/28/08	7	Sampled Quarterly Starting 9/07
	Stream	STB in stream	5/29/07	3/25/08	6	Sampled Quarterly Starting 9/07
	Stream	BPR in stream	6/28/07	4/30/08	6	Sampled Quarterly Starting 9/07
Williams	Discharge	Fleming	6/26/07	4/28/08	10	No Sample 5/07, Frozen 2/07
Run	Stream	Ag Site	5/29/07	7/30/07	3	Sampling Discontinued, Sampled by BAMR
	Stream	Williams Run	6/27/07	3/26/08	5	Sampled Quarterly Starting 9/07
	Stream	Mouth of WR	5/29/07	5/29/07	1	Sampling Discontinued, Sampled by BAMR

Stream Water Quality

Tables 4 and **5** characterize the water quality of the main streams, primary tributaries and unnamed tributaries contributing to the South Sandy Creek Watershed. The location of each segment, as well as the sub-watershed boundaries and the sampling points (as discussed above) are provided on **Figure 4**.

Most of the South Sandy Creek Watershed tributaries have acceptable water quality, and only those segments which exhibited water quality issues were sampled. As such, the following discussion will only discuss those tributaries and main streams for which data were actually collected, with the assumption that those tributaries not sampled are not impaired, based on the main stream sampling, as well as visual observations.

The majority of the stream segments that exhibit unacceptable water quality are impaired by coal mining, and/or abandoned oil wells, and it appears that the limits of this impairment have been well-documented by the recent sampling events. As such, it is assumed herein that the Watershed characterization, as summarized above and on **Tables 4** and **5**, adequately describe the current water quality status of the overall Watershed, as well as the sub-watersheds, and that additional comprehensive sampling to further characterize the system is not necessary. (This does not intend to imply that additional sampling of specific pollutant sources should not be conducted to develop additional design data, just that additional Watershed-wide comprehensive characterization does not appear to be necessary.)

The data in **Tables 4** and **5** are subdivided into the two primary stream branches (South Sandy Creek and Williams Run), with the data formatted such that the most upstream sampling points are shown at the top, and the data progresses downstream with each line. Tributaries to the two main streams that were sampled are shown at the appropriate location between upstream and downstream sampling locations.

For each sample, those tested parameters which, on average, exceed the Water Quality Criteria noted at the bottom of Table 4 have been highlighted for identification. The Water Quality Criteria used for each parameter of interest are those which are typically used to develop TMDL values for AMD-impaired waters throughout Pennsylvania.

<u>South Sandy Creek</u>

For instance, the upper portion of **Table 4** begins with data associated with sample SS3, which represents the most upstream stream sampling location on South Sandy Creek, roughly 6,000 feet east of Henderson Station. Sample SS3 shows apparently unimpaired stream water quality, with no average tested parameters exceeding the stream concentration Water Quality Criteria noted above.

The next lines on **Tables 4** and **5** represent the data collected within the sub-watershed associated with Unnamed Tributary 1 Left, which has a confluence with South Sandy Creek just

Table 4 - South Sandy Creek Watershed
Stream Water Quality

		FLOW (gpm)				pH (Std. units)				Alkalinity (mg/l)				Hot Acidity (mg/l)				Calculated Acidity (mg/l)				Iron (mg/l)				Manganese (mg/l)				Aluminum (mg/l)				SO4 (mg/l)			
Stream/Tributary	Site ID	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max	Avg.	No.	Min.	Max.	Avg.
South Sandy	SS3	1	866.81	866.81	866.81	3	7.30	7.50	7.37	3	22.60	54.00	36.53	3	-7.80	27.20	11.73	3	1.18	4.00	2.88	3	0.30	1.16	0.81	3	0.05	0.17	0.12	3	0.10	0.30	0.22	3	20.00	25.40	15.13
Unnamed Trib1 Left	Woods Rd In stream	11	223.88	8468.75	1458.41	12	3.20	4.10	3.55	7	0.00	3.00	0.43	7	23.60	95.40	52.14	7	17.70	74.75	39.23	7	2.42	7.47	5.04	7	0.87	2.06	1.51	7	0.77	4.69	2.17	7	45.40	172.00	102.19
	UNNAMED	1	402.84	402.84	402.84	3	6.80	7.40	7.03	3	15.00	33.80	23.27	3	6.20	44.20	28.20	3	2.16	18.21	8.06	3	0.15	9.23	3.42	3	0.22	0.27	0.24	3	0.23	0.33	0.27	3	25.50	58.40	38.37
South Sandy	SS4	1	1567.52	1567.52	1567.52	3	7.10	7.20	7.13	3	19.20	47.20	30.60	3	-2.80	37.00	19.73	3	1.54	3.57	2.75	3	0.41	0.96	0.71	3	0.13	0.21	0.18	3	0.10	0.27	0.21	3	20.00	26.30	20.17
South Sandy	SS2	1	1524.01	1524.01	1524.01	4	6.80	7.70	7.23	4	18.40	46.60	34.45	4	-4.00	33.60	13.85	4	1.26	4.23	2.49	4	0.28	1.09	0.55	4	0.05	0.18	0.10	4	0.10	0.35	0.24	4	20.00	36.70	22.88
WILLAMS RUN ENTERS SOUTH SANDY CREEK																																					
South Sandy	STB in stream	8	4605.84	29431.22	13665.35	14	6.40	7.80	7.01	10	11.80	34.40	23.20	10	-13.20	53.20	15.06	10	1.79	8.42	4.32	10	0.15	0.94	0.36	10	0.46	0.91	0.64	10	0.07	0.91	0.45	10	46.60	71.50	61.06
Trib1 Right	BPR in stream	11	169.43	3315.46	1347.21	11	6.40	7.80	7.16	6	27.60	78.00	52.63	6	-53.00	-16.00	-31.40	6	1.84	5.73	3.44	6	0.32	1.46	0.96	6	0.33	1.53	0.64	6	0.10	0.10	0.10	6	88.70	224.00	151.82

Williams Run	Ag Site					12	6.50	8.00	7.18	10	23.60	103.40	44.94	12	-84.00	35.20	-9.25	12	1.75	9.65	4.28	12	0.15	2.07	0.97	12	0.05	0.91	0.36	12	0.24	0.77	0.34	12	20.00	38.40	24.54
WR Unnamed Trib5 Left	AARS	5	2.00	5.00	3.80	13	6.80	7.70	7.42	13	72.60	154.60	115.57	13	-132.80	-26.80	-84.12	13	1.71	13.14	4.57	13	0.15	0.87	0.41	13	0.03	0.88	0.33	13	0.25	2.09	0.58	13	20.40	96.40	55.38
Williams Run	WR2	9	83.93	2918.83	1126.17	27	2.90	4.70	3.86	24	0.00	13.00	2.80	24	20.40	147.00	53.72	24	14.94	69.26	33.48	24	0.72	20.60	3.26	24	1.28	6.11	3.47	24	0.89	5.24	2.35	24	61.30	391.40	231.33
WR Unnamed Trib3 Right	WRR4					10	3.40	4.00	3.74	10	0.00	2.40	0.52	10	37.80	85.80	58.04	10	24.79	60.32	40.27	10	0.78	2.45	1.45	10	1.90	5.25	3.44	10	2.62	5.52	3.82	10	78.90	313.90	172.11
WR Unnamed Trib4 Left	WRL6					1	5.90	5.90	5.90	1	7.80	7.80	7.80	1	9.80	9.80	9.80	1	0.98	0.98	0.98	1	0.11	0.11	0.11	1	0.09	0.09	0.09	1	0.10	0.10	0.10	1	20.00	20.00	10.00
WR Unnamed Trib2 Right	WRR3					10	3.10	3.80	3.30	10	0.00	0.00	0.00	10	73.40	164.60	132.08	10	64.20	137.90	112.85	10	3.94	9.93	6.42	10	6.85	9.75	8.09	10	6.28	12.80	10.64	10	505.60	782.10	587.38
Williams Run	Williams Run In Stream	10	529.14	6325.42	2039.38	10	2.80	3.80	3.38	5	0.00	0.00	0.00	5	46.60	77.80	59.24	5	36.06	62.71	49.58	5	1.43	3.93	2.12	5	3.68	5.79	4.53	5	2.62	5.69	4.18	5	242.80	391.40	301.40
WR Unnamed Trib1 Right	WRR2					1	5.00	5.00	5.00	1	6.80	6.80	6.80	1	12.20	12.20	12.20	1	3.52	3.52	3.52	1	0.05	0.05	0.05	1	0.24	0.24	0.24	1	0.45	0.45	0.45	1	20.00	20.00	10.00
Williams Run	WRR1					1	4.00	4.00	4.00	1	1.00	1.00	1.00	1	49.80	49.80	49.80	1	30.69	30.69	30.69	1	2.07	2.07	2.07	1	2.21	2.21	2.21	1	3.23	3.23	3.23	1	152.80	152.80	152.80
WR Unnamed Trib3 Left	WRL5					1	6.60	6.60	6.60	1	11.40	11.40	11.40	1	24.20	24.20	24.20	1	0.97	0.97	0.97	1	0.16	0.16	0.16	1	0.06	0.06	0.06	1	0.10	0.10	0.10	1	20.00	20.00	10.00
WR Unnamed Trib2 Left	WRL3					1	5.80	5.80	5.80	1	7.80	7.80	7.80	1	8.80	8.80	8.80	1	0.80	0.80	0.80	1	0.06	0.06	0.06	1	0.03	0.03	0.03	1	0.10	0.10	0.10	1	20.00	20.00	10.00
WR Unnamed Trib1 Left	WRL2					1	6.40	6.40	6.40	1	9.00	9.00	9.00	1	6.40	6.40	6.40	1	0.69	0.69	0.69	1	0.06	0.06	0.06	1	0.01	0.01	0.01	1	0.10	0.10	0.10	1	20.00	20.00	10.00
WR Unnamed Trib1 Left	WRL1					1	5.90	5.90	5.90	1	7.60	7.60	7.60	1	7.60	7.60	7.60	1	0.75	0.75	0.75	1	0.01	0.01	0.01	1	0.06	0.06	0.06	1	0.10	0.10	0.10	1	20.00	20.00	10.00
Williams Run	WR1	3	230.50	11909.17	6274.13	21	4.00	5.90	4.90	20	1.00	10.60	7.21	20	6.40	83.50	37.42	20	3.21	25.87	9.96	20	0.15	1.05	0.32	20	0.56	2.57	1.21	20	0.25	2.76	1.13	20	44.70	170.30	96.68

NOTES:

- (yellow) - Indicates value above Water Quality Crieria
- mg/l - Milligrams per liter
- gpm - Gallons per minute
- std. units - Standard Units

Water Quality Criteria

Iron (Fe)	1.5 mg/l
Manganese (Mn)	1.0 mg/l
Aluminum (Al)	0.75 mg/l
pH	6.0 to 9.0 standard units

Table 5 - South Sandy Creek Watershed
Stream Loading

	Stream/Tributary	Site ID	Samples	Alkalinity Loading Min.	Alkalinity Loading Max.	Alkalinity Loading Avg.	Acid Loading Min.	Acid Loading Max.	Acid Loading Avg.	Iron Loading Min.	Iron Loading Max.	Iron Loading Avg.	Manganese Loading Min.	Manganese Loading Max.	Manganese Loading Avg.	Aluminum Loading Min.	Aluminum Loading Max.	Aluminum Loading Avg.	TOTAL FE, MN, AL Min.	TOTAL FE, MN, AL Max.	TOTAL FE, MN, AL Avg.
Downstream ↓	South Sandy	SS3	1	561.69	561.69	561.69	-81.13	-81.13	-81.13	10.22	10.22	10.22	1.77	1.77	1.77	2.60	2.60	2.60	14.59	14.59	14.59
	Unnamed Trib1 Left	Woods Rd In stream	6	0.00	304.88	50.81	143.72	2398.35	687.05	16.01	245.93	72.51	4.80	88.01	22.73	2.65	142.88	37.52	23.46	476.82	132.76
		UNNAMED	1	163.39	163.39	163.39	29.97	29.97	29.97	0.73	0.73	0.73	1.31	1.31	1.31	1.21	1.21	1.21	3.24	3.24	3.24
	South Sandy	SS4	1	887.84	887.84	887.84	-52.67	-52.67	-52.67	14.39	14.39	14.39	3.95	3.95	3.95	4.70	4.70	4.70	23.04	23.04	23.04
	South Sandy	SS2	1	852.23	852.23	852.23	-73.15	-73.15	-73.15	7.50	7.50	7.50	0.91	0.91	0.91	4.57	4.57	4.57	12.98	12.98	12.98
	WILLAMS RUN ENTERS SOUTH SANDY CREEK (See Below)																				
	South Sandy	STB in stream	4	1901.29	4063.29	2861.52	309.51	919.27	678.07	15.75	82.73	45.50	34.69	150.40	75.63	14.95	192.28	61.19	65.39	425.42	182.32
	Trib1 Right	BPR in stream	6	190.64	946.62	607.99	-649.43	-116.35	-366.30	3.81	33.78	12.42	2.08	18.77	8.08	0.45	3.43	1.47	6.33	55.99	21.97

	Stream/Tributary	Site ID	Samples	Alkalinity Loading Min.	Alkalinity Loading Max.	Alkalinity Loading Avg.	Acid Loading Min.	Acid Loading Max.	Acid Loading Avg.	Iron Loading Min.	Iron Loading Max.	Iron Loading Avg.	Manganese Loading Min.	Manganese Loading Max.	Manganese Loading Avg.	Aluminum Loading Min.	Aluminum Loading Max.	Aluminum Loading Avg.	TOTAL FE, MN, AL Min.	TOTAL FE, MN, AL Max.	TOTAL FE, MN, AL Avg.
Downstream ↓	WR Unnamed Trib5 Left	AARS	5	3.58	8.90	5.11	-7.97	-1.61	-3.40	0.00	0.04	0.02	0.01	0.04	0.02	0.01	0.13	0.04	0.02	0.20	0.08
	Williams Run	WR2	6	0.00	0.00	0.00	50.16	1681.25	592.13	2.79	721.53	128.65	4.00	134.50	46.18	1.08	109.98	37.30	7.87	966.02	212.13
	Williams Run	Williams Run In Stream	5	0.00	0.00	0.00	494.01	1681.25	969.56	11.11	91.91	41.76	36.77	134.50	75.00	33.27	133.09	70.70	81.15	359.50	187.46
	Williams Run	WR1	1	21.02	21.02	21.02	93.49	93.49	93.49	0.41	0.41	0.41	4.12	4.12	4.12	2.71	2.71	2.71	7.25	7.25	7.25

NOTES:
All calculated loadings in pounds/day


SANDY LAKE
MINERAL
VICTORY
WORTH
IRWIN
STATE GAME LANDS NO. 130
STATE GAME LANDS NO. 39
MERCER CO.
VENANGO CO.
N
South Sandy Creek
Beaver Pond Run
Williams Run
Lyons Run
Bear Run
Raymitton
Hendersonville
Henderson Station
Woods Corners
Kilgore
Springville
Pearl
KIMBLE HILL RD
JACKSON CENTER POLK RD
WHEELER RD
SLATERTOWN RD
HELLS KITCHEN RD
HENDERSON STATION RD
HENDERSONVILLE RD
PERKINS LN
HOWARDS LN
GADSBY RD
BROWN RD
KERR RD
WOODS RD
GEORGETOWN RD
MILLBROOK RD
ALLEN RD
COOK RD
GAMEL RD
KING RD
OLD ROUTE 8
STATE ROUTE 8
STATE ROUTE 308
DENNISON RUN RD
ROWITSCH RD
WHEELER RD
LEGEND
DISCHARGE SAMPLE LOCATION
STREAM SAMPLE LOCATION
ROADS
STATE GAME LANDS
SOUTH SANDY CREEK WATERSHED
COUNTY BOUNDARY
MUNICIPAL BOUNDARY
STREAMS
SCALE
0 1,000 2,000 4,000 6,000 8,000
Feet
0 0.25 0.5 1 1.5
Miles
WATERSHED MAP
SOUTH SANDY CREEK WATERSHED
VENANGO AND MERCER COUNTIES, PA
SOUTH SANDY CREEK WATERSHED ASSOCIATION
AND
VENANGO CONSERVATION DISTRICT
Kimball
L. ROBERT KIMBALL & ASSOCIATES, INC.
EBENSBURG, PA & TRENTON, NJ
DATE: 07/08
SCALE: AS SHOWN
FIGURE: 4

downstream from SS3. Seven water quality stream samples were collected at the "Woods Road In-stream" location (roughly 3500 feet northwest of the Tipple Site, and three stream water quality samples were obtained at the Unnamed site, just upstream of the confluence with South Sandy Creek. The Woods Road In-stream samples indicate that the average Water Quality Criteria are exceeded for Fe, Mn and Al and that the stream pH is lower than Criteria. However, the 3 samples at the Unnamed sampling location indicate that the average water quality has improved for all parameters other than Fe, which still exceeds stream concentration criteria within Unnamed Tributary 1 Left.

Data associated with Sample SS4 is shown next on the Tables, representing South Sandy Creek stream samples obtained just downstream from the confluence with Unnamed Tributary 1 Left. This data indicates that the combined flow (representing the upper portion of South Sandy Creek and the sub-watershed associated with Unnamed Tributary 1 Left) meets stream concentration Water Quality Criteria on average for all parameters tested. It was reported by SSCWA members that this is the only location within the upper watershed where wild, native trout were found.

Sample SS2, located just upstream from the confluence with Williams Run, is shown next on **Tables 4** and **5**, and the data indicates again that the combined flow meets stream concentration Water Quality Criteria on average for all parameters tested.

Sample STB In-Stream, which was collected at the Slatertown Road bridge over South Sandy Creek, represents the combined flow associated with the upper South Sandy Creek and Williams Run Watersheds. The average data at this location indicate that, although there appears to be some degradation from water entering South Sandy Creek from Williams Run, none of the average water quality data exceed stream concentration Water Quality Criteria.

The final sample entry on the upper portion of **Tables 4** and **5** represents data from BPR In-Stream, located roughly 5,000 feet upstream of the confluence of Beaver Pond Run with South Sandy Creek. This sampling point represents the combined flow from the upper watershed, including source discharges at Mamula 1 and 2, Reagleman 1 and 2, and BPR 3, 3A, 4 and 5. The average water quality results at this sampling location indicate that none of the average water quality data exceed stream concentration Water Quality Criteria.

Since samples from STB In-Stream and BPR In-Stream showed that the data met stream concentration Water Quality Criteria on average for all parameters tested, additional downstream samples were not collected.

<u>Williams Run</u>

Similarly, the lower portion of **Tables 4** and **5** represents the stream sampling data collected within the Williams Run Watershed, beginning at the Ag Site at the upstream end of the Unnamed Tributary to Williams Run. The data at this location indicates that the average of the 12 water quality sample tests meets stream concentration Water Quality Criteria for all parameters tested.

The average of the 13 water quality sample tests at the AARS site, located in the small Unnamed Tributary 5 Left, also meets stream concentration Water Quality Criteria for all parameters tested, indicating non-impaired conditions.

Continuing downstream along Williams Run, the next sampling point is WR2, which is composed of flow from the southern portion of the sub-watershed, including source points WRR5 and WRL7. The average concentrations at the WR2 sample location showed Water Quality Criteria exceedances for Fe, Mn and Al, plus pH levels well below criteria.

Sample point WRR4 represents the downstream end of a small tributary (WR Unnamed Trib 3 Right), and was sampled just upstream from the confluence with Williams Run. The average concentration data indicate that flow in this tributary exceeds Water Quality Criteria for Mn and Al, and that the pH is well below criteria.

WRL6, located in another small tributary (WR Unnamed Trib 4 Left), was only sampled once, and that sample showed all test parameters within acceptable Water Quality Criteria levels, except for the pH, which was slightly low (5.9).

Farther downstream, the WRR3 sample is collected in a slightly larger tributary (WR Unnamed Trib 2 Right) which collects flow from the Fleming Site, Woods and Woods II AMD source locations. These source discharges result in degradation of the tributary, resulting in Water Quality Criteria exceedances for Fe, Mn and Al, and pH levels well below Criteria.

The Williams Run In-Stream sample was collected in the main stream channel, just downstream from the confluence of the WR Unnamed Trib 2 Right with Williams Run, and represents the cumulative effects of all flows upstream of that location. The data at this location indicates that the average of the 5 water quality sample tests exceeds stream concentration Water Quality Criteria for Fe, Mn and Al, and that the pH level is well below Criteria.

Sample point WRR2 was collected at a small tributary (WR Unnamed Trib 1 Right), which had no identified AMD sources within the sub-watershed. The collected data from the single sampling event indicates that the stream concentration water quality results for all parameters tested were within acceptable Criteria limits, with the exception of pH (5.0 Standard units).

Roughly 3500 feet downstream from the confluence of the WR Unnamed Trib 1 Right with Williams Run, sample point WRR1 indicates that the main stream water quality concentrations exceed Water Quality Criteria for Fe, Mn and Al, and that the pH is well below criteria.

Extending for roughly 5000 feet downstream from stream sample point WRR1, there are 3 small tributaries that enter Williams Run from the east (WR Unnamed Tribs 3, 2, and 1 Left). A total of 4 sampling locations were identified near the confluences of each of these Tribs with Williams Run (there were two samples collected at different times along WR Unnamed Trib 1 Left), although only one sample was collected at each location. The average of the test results for these 4 locations indicate that the stream concentration water quality results for all parameters tested were within acceptable Criteria limits, with the exception of pH, which was slightly low (5.8 and 5.9) for two of the locations.

The final stream sampling location along Williams Run was collected just upstream from the confluence with South Sandy Creek. The average of the 20 samples collected at this location indicates that the water quality results exceed Water Quality Criteria for Mn and Al, and that the pH is well below criteria. However, the Fe level is below Criteria and the Mn and Al levels are only marginally above Criteria, indicating that the pollution from the numerous AMD sources along Williams Run do not result in substantial degradation of the main stream at points well downstream from the sources.

Stream AMD Parameter Loadings

Table 5 shows loadings computed (in pounds per day) for the in-stream sample locations, using the average of computed loadings for individual samples. Note that in many cases, flow values were not recorded for each sampling event. In those instances, loadings were computed only for those events where flow and water quality data were both available, and then the average of all loadings for each sampling location were computed.

Since the streams within the South Sandy Creek Watershed are either considered non-impaired, or are impaired by mining and/or oil well related site conditions, the loadings were computed only for typical AMD parameters (alkalinity, acidity, Fe, Mn, and Al). In addition, the total of the Fe, Mn and Al were summed to provide a "Total Fe, Mn, Al" value.

Since a TMDL for South Sandy Creek or Williams Run is not currently available, "Allowable Loadings" for each stream sampling location were estimated using the Water Quality Criteria values discussed above, and the average flow values developed for each sampling location. These Allowable Loadings were then used to estimate the "Reduction Needed", as well as the "% Reduction" required.

A summary table (**Table 6 - Load Reduction Table**) showing these estimates and Reductions is included on the following page.

Table 6 - Load Reduction Table

Stream/Tributary	Site ID	Samples	Avg Flow	Existing Loadings Fe	Existing Loadings Mn	Existing Loadings Al	Allowable Loadings Fe	Allowable Loadings Mn	Allowable Loadings Al	Reduction Needed Fe	Reduction Needed Mn	Reduction Needed Al	% Reduction Fe	% Reduction Mn	% Reduction Al
South Sandy	SS3	1	866.81	10.22	1.77	2.60	15.60	10.40	7.80	0.00	0.00	0.00	0%	0%	0%
Unnamed Trib1 Left	Woods Rd In stream	6	1458.41	72.51	22.73	37.52	26.25	17.50	13.13	46.26	5.23	24.40	64%	23%	65%
	UNNAMED	1	402.84	0.73	1.31	1.21	7.25	4.83	3.63	0.00	0.00	0.00	0%	0%	0%
South Sandy	SS4	1	1567.52	14.39	3.95	4.70	28.22	18.81	14.11	0.00	0.00	0.00	0%	0%	0%
South Sandy	SS2	1	1524.01	7.50	0.91	4.57	27.43	18.29	13.72	0.00	0.00	0.00	0%	0%	0%
WILLAMS RUN ENTERS SOUTH SANDY CREEK (See Below)															
South Sandy	STB in stream	4	13665.35	45.50	75.63	61.19	245.98	163.98	122.99	0.00	0.00	0.00	0%	0%	0%
Trib1 Right	BPR in stream	6	1347.21	12.42	8.08	1.47	24.25	16.17	12.12	0.00	0.00	0.00	0%	0%	0%
WR Unnamed Trib5 Left	AARS	5	3.80	0.02	0.02	0.04	0.07	0.05	0.03	0.00	0.00	0.01	0%	0%	21%
Williams Run	WR2	6	1126.17	128.65	46.18	37.30	20.27	13.51	10.14	108.38	32.67	27.16	84%	71%	73%
Williams Run	Williams Run In Stream	5	2039.38	41.76	75.00	70.70	36.71	24.47	18.35	5.05	50.52	52.35	12%	67%	74%
Williams Run	WR1	1	6274.13	0.41	4.12	2.71	112.93	75.29	56.47	0.00	0.00	0.00	0%	0%	0%

Note that in many cases, flow values were not recorded for each sampling event. In those instances, loadings were computed only for those events where flow and water quality data were both available, and then the average of all loadings for each sampling location were computed. For source sample WRR5, a total of 17 water quality samples were collected, but only one flow value was estimated. As such, only one set of loadings was computed for WRR5.

Discussion of South Sandy Creek Watershed Discharge Water Quality

The primary source of impairment to the watershed identified in the South Sandy Creek Watershed is metals from abandoned mine drainage. Other sources include sedimentation from the erosion of stream banks, poorly-vegetated lands, and dirt/gravel roads; as well as nutrients and pesticides from agriculture. Visual inspection for these potential sources indicated minimal impact.

Eighteen abandoned mine discharges exhibiting significant degradation and flow have been identified in the South Sandy Creek Watershed (Refer to **Figure 4**). Numerous other small seeps exist. In addition, ephemeral, intermittent or other discharges of minimal significance may exist within the watershed but remain unidentified. **Table 7** provides a general characterization of these abandoned mine discharges. The water quality varies from alkaline water with relatively low metal concentrations to very acidic water with high metal concentrations.

Loadings were also calculated for each of the discharges and are presented in **Table 8**. In many cases, flow values were not recorded for each sampling event. In those instances, loadings were computed only for those events where flow and water quality data were both available, and then the average of all loadings for each sampling location were computed. Since metals are the primary source of impairment to the watershed, the discharges were ranked based on total metal loadings. This ranking system was also used to help prioritize the restoration effort. Note that the top 4 discharges (excluding the Woods Site) account for over 75% of the metal loadings in the watershed. In contrast, the bottom 8 discharges account for only 6.8% of the metal loadings to the watershed.

For the AMD Source Discharges on **Table 8**, an additional column of data was computed showing the % of Total Contribution (i.e., the average "Total Fe, Mn, Al" loading for each source sample location, divided by the total average loading for all points). This value was then used in establishing remediation priorities, based on the total contribution of metal loadings from each Source Discharge.

Based on conclusions reached in the evaluation of the stream water quality data analysis and the final ranking based on contaminant loading, Kimball has compiled a priority list of impacted areas/sites, as presented on **Table 9**. In general, priorities were set to provide for reclamation of the greatest impacts or upstream sources while taking into consideration current or planned actions by the VCD and/or SSCWA, and others working in the watershed. Finally, several priority sites include two or more sources.

In each case, sites were selected for grouping based on proximity and likelihood of representing discharges from the same mining or other source. This strategy was used to provide the end users with options for addressing individual sites or groups of sites as appropriate. However, the site grouping does not necessarily represent that sites can be treated as a group. It is assumed that additional data will be accumulated prior to application for funding. Any treatment design would require additional site specific analysis.

Table 7 - South Sandy Creek Watershed
Discharge Water Quality

		FLOW (gpm)				pH (Std. units)				Alkalinity (mg/l)				Hot Acidity (mg/l)			
Site ID	Stream/Tributary	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.
Tipple	SS Unnamed Trib1 Left	8	5.00	814.11	153.36	12	2.80	5.10	3.58	11	0.00	8.40	0.76	11	-110.60	399.80	85.64
Woods Rd	SS Unnamed Trib1 Left	11	6.00	24.00	10.64	12	3.20	3.50	3.34	12	0.00	0.00	0.00	12	-145.40	86.60	34.53
SGL1	South Sandy	11	18.00	300.00	61.05	12	6.80	7.30	7.08	12	16.80	118.80	72.67	12	-85.60	26.80	-28.50
Mamula1	Beaver Pond Run	10	5.71	48.65	19.26	11	6.70	7.10	6.83	11	96.60	129.20	114.71	11	-93.40	-31.60	-69.80
Mamula2	Beaver Pond Run	9	0.54	31.53	13.64	12	6.10	6.50	6.23	10	77.20	102.20	87.56	10	-59.60	23.20	-16.88
Reagleman1	Beaver Pond Run	11	2.00	38.00	12.73	11	7.00	7.60	7.33	12	82.20	210.40	172.25	12	-187.00	-58.00	-123.37
Reagleman2	Beaver Pond Run	11	1.00	30.00	7.32	12	6.00	8.00	7.15	8	42.20	65.60	56.38	8	-39.60	-16.80	-29.78
BPR5	Beaver Pond Run	11	0.85	20.88	7.18	12	6.80	7.40	7.09	12	102.40	136.80	117.95	12	-102.20	-18.60	-68.32
BPR4	Beaver Pond Run	11	11.91	48.65	26.73	12	6.90	7.30	7.08	12	111.20	127.00	119.78	12	-106.60	-23.20	-72.95
BPR3	Beaver Pond Run	8	1.00	34.08	11.47	12	6.20	7.80	6.88	7	88.60	100.00	95.63	7	-81.00	24.20	-47.63
BPR2	Beaver Pond Run	7	0.25	11.15	3.93	11	6.30	7.50	6.80	6	22.20	35.80	30.30	6	-10.80	21.60	3.73
BPR1	Beaver Pond Run	10	1.00	40.06	9.45	11	6.20	7.70	7.25	6	52.60	111.40	92.90	6	-83.60	-15.00	-45.20
ARS	WR Unnamed Trib5 Left	6	5.00	15.00	9.17	23	2.40	6.90	3.23	23	0.00	775.00	56.15	23	-28.40	2526.00	653.34
WRR5	Williams Run	1	8.27	8.27	8.27	17	3.20	4.80	4.15	17	0.00	28.00	6.26	17	50.00	207.00	104.24
WRL7	Williams Run	12	13.00	243.00	68.60	20	4.00	4.90	4.45	20	2.00	8.60	5.30	20	13.80	77.40	46.16
WOODS	WR Unnamed Trib2 Right	4	22.00	43.00	31.50	15	3.00	3.50	3.33	16	0.00	55.00	7.38	16	197.60	431.00	266.16
WOODS2	WR Unnamed Trib2 Right	8	12.00	160.00	51.50	8	3.20	3.30	3.24	8	0.00	0.00	0.00	8	190.80	235.60	210.73
Fleming	WR Unnamed Trib2 Right	9	0.54	14.55	6.98	10	4.60	8.00	5.75	10	0.00	171.20	37.32	10	-51.20	110.80	44.06

		Calculated Acidity (mg/l)				Iron (mg/l)				Manganese (mg/l)				Aluminum (mg/l)				SO4 (mg/l)			
Site ID	Stream/Tributary	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max.	Avg.	No.	Min.	Max	Avg.	No.	Min.	Max.	Avg.
Tipple	SS Unnamed Trib1 Left	11	4.62	277.61	74.95	11	1.25	74.10	16.28	11	0.62	1.57	0.98	11	0.10	11.50	3.71	11	29.80	250.90	96.43
Woods Rd	SS Unnamed Trib1 Left	12	31.54	544.31	100.09	12	6.20	290.00	39.61	12	1.45	3.19	2.80	12	0.10	0.10	0.10	12	126.20	933.50	310.19
SGL1	South Sandy	12	6.15	29.45	17.20	12	2.02	15.30	8.59	12	0.14	0.89	0.57	12	0.10	0.41	0.14	12	20.00	81.90	38.72
Mamula1	Beaver Pond Run	11	8.20	19.60	13.76	11	2.85	9.19	5.26	11	1.36	2.63	2.05	11	0.10	0.21	0.11	11	105.30	215.90	138.77
Mamula2	Beaver Pond Run	10	40.78	141.65	66.05	10	16.60	72.60	30.27	10	0.07	8.94	6.19	10	0.10	0.10	0.10	10	73.10	312.80	202.04
Reagleman1	Beaver Pond Run	11	9.94	41.39	17.82	12	1.39	10.30	3.66	12	3.42	10.30	5.20	12	0.10	1.12	0.36	12	313.30	1073.00	908.92
Reagleman2	Beaver Pond Run	8	3.56	29.54	9.61	8	0.25	6.67	1.66	8	1.32	6.55	2.81	8	0.10	1.02	0.27	8	563.70	704.80	645.10
BPR5	Beaver Pond Run	12	9.17	32.52	15.75	12	2.50	14.30	5.42	12	2.27	3.63	2.89	12	0.10	0.59	0.14	12	132.60	196.50	157.06
BPR4	Beaver Pond Run	12	12.76	27.65	18.37	12	5.68	13.70	8.49	12	1.11	3.40	1.44	12	0.10	0.10	0.10	12	174.40	214.00	193.07
BPR3	Beaver Pond Run	7	26.35	31.82	28.76	7	12.80	15.70	13.99	7	1.58	2.00	1.73	7	0.10	0.10	0.10	7	15.00	20.90	10.84
BPR2	Beaver Pond Run	6	12.70	47.38	29.41	6	5.48	20.64	12.92	6	0.52	0.82	0.70	6	0.10	1.61	0.90	6	17.90	20.50	14.78
BPR1	Beaver Pond Run	6	4.05	34.26	18.11	6	1.56	17.20	8.21	6	0.38	1.04	0.69	6	0.10	0.91	0.39	6	15.00	49.80	16.22
ARS	WR Unnamed Trib5 Left	23	23.49	2044.48	498.86	23	10.40	502.30	122.52	23	0.19	15.71	4.26	23	0.00	165.02	34.17	23	1.36	3875.00	790.35
WRR5	Williams Run	17	26.57	116.89	88.09	17	2.59	20.60	14.99	17	3.45	13.29	6.91	17	2.27	12.80	7.75	17	100.00	836.00	592.34
WRL7	Williams Run	20	7.49	67.83	22.08	20	0.46	7.03	2.05	20	0.95	7.21	2.08	20	0.25	7.35	2.25	20	56.10	120.20	84.53
WOODS	WR Unnamed Trib2 Right	15	160.85	299.95	211.96	16	2.28	31.07	10.03	16	7.42	26.63	11.68	16	20.90	35.59	27.79	16	295.50	960.00	587.95
WOODS2	WR Unnamed Trib2 Right	8	162.31	204.31	181.30	8	3.67	9.87	5.94	8	7.79	8.85	8.28	8	19.20	25.30	22.75	8	440.40	540.60	500.75
Fleming	WR Unnamed Trib2 Right	10	12.32	128.11	73.14	10	1.18	20.50	5.63	10	1.83	17.30	10.69	10	1.12	13.90	7.75	10	414.20	1082.20	760.73

NOTES:
- mg/l - Milligrams per liter
- gpm - Gallons per minute
- std. units - Standard Units

Table 8 - South Sandy Creek Watershed
Discharge Loading

				Alkalinity Loading			Acid Loading			Iron Loading			Manganese Loading			Aluminum Loading			TOTAL FE, MN, AL			% of Total
Site ID	**Sub-Watershed**	**Stream/Tributary**	**Samples**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**	**Contribution**
Tipple	South Sandy Creek	SS Unnamed Trib1 Left	8	0.00	0.00	0.00	-32.65	675.79	149.95	0.08	125.25	28.67	0.05	15.30	2.56	0.15	19.44	5.84	0.3	160.0	37.1	34.0%
WOODS2	Williams Run	WR Unnamed Trib2 Right	8	0.0	0.0	0.0	27.5	372.5	127.4	0.7	8.3	3.4	1.3	15.5	5.1	2.8	40.5	13.9	4.7	64.3	22.3	20.5%
WOODS	Williams Run	WR Unnamed Trib2 Right	4	0.0	0.0	0.0	73.8	116.8	92.5	2.3	4.4	3.6	2.6	5.2	3.7	7.9	14.6	11.0	12.8	24.2	18.3	NA
ARS	Williams Run	WR Unnamed Trib5 Left	6	0.0	0.0	0.0	30.0	104.6	60.4	3.0	22.6	12.9	0.2	0.5	0.4	1.8	4.2	2.8	4.9	27.3	16.1	14.7%
Woods Rd	South Sandy Creek	SS Unnamed Trib1 Left	11	0.00	0.00	0.00	-24.43	10.31	1.69	0.52	48.72	6.28	0.22	0.50	0.33	0.01	0.03	0.01	0.8	49.3	6.6	6.1%
Mamula2	South Sandy Creek	Beaver Pond Run	9	0.59	30.27	13.94	-11.63	2.80	-2.70	0.20	11.69	4.72	0.01	3.38	1.10	0.00	0.04	0.02	0.2	15.1	5.8	5.4%
SGL1	South Sandy Creek	South Sandy	11	22.70	60.48	31.02	-26.48	6.48	-12.82	1.86	7.27	3.78	0.17	0.51	0.24	0.02	1.47	0.17	2.0	9.2	4.2	3.8%
WRL7	Williams Run	Williams Run	12	0.8	22.2	5.7	3.8	58.1	25.7	0.1	4.5	1.3	0.3	3.7	1.1	0.4	2.1	1.0	0.9	10.4	3.4	3.1%
BPR4	South Sandy Creek	Beaver Pond Run	11	18.15	71.57	38.34	-56.86	-6.95	-25.96	1.12	6.26	2.54	0.19	1.41	0.48	0.01	0.06	0.03	1.3	7.7	3.1	2.8%
WRR5	Williams Run	Williams Run	1	0.0	0.0	0.0	8.0	8.0	8.0	1.8	1.8	1.8	0.7	0.7	0.7	0.5	0.5	0.5	3.0	3.0	3.0	2.7%
Fleming	Williams Run	WR Unnamed Trib2 Right	9	0.00	16.68	3.89	-5.35	7.05	1.42	0.01	1.40	0.48	0.08	2.79	0.70	0.07	1.01	0.45	0.2	5.2	1.6	1.5%
Mamula1	South Sandy Creek	Beaver Pond Run	10	8.8	67.6	25.4	-54.5	-2.9	-18.2	0.2	2.2	1.1	0.1	0.8	0.4	0.0	0.1	0.0	0.3	3.1	1.5	1.4%
Reagleman1	South Sandy Creek	Beaver Pond Run	11	5.02	41.81	21.52	-35.32	-3.10	-16.97	0.05	1.55	0.59	0.11	2.06	0.76	0.00	0.39	0.09	0.2	4.0	1.4	1.3%
BPR3	South Sandy Creek	Beaver Pond Run	5	1.06	22.60	5.68	-16.86	0.29	-3.83	0.15	2.96	0.76	0.02	0.37	0.09	0.00	0.02	0.01	0.2	3.4	0.9	0.8%
BPR2	South Sandy Creek	Beaver Pond Run	3	0.4	2.9	1.4	-0.4	0.3	-0.1	0.1	1.4	0.7	0.0	0.1	0.0	0.0	0.2	0.1	0.1	1.7	0.8	0.7%
BPR5	South Sandy Creek	Beaver Pond Run	11	1.29	27.21	9.77	-22.05	-1.04	-6.87	0.07	1.08	0.34	0.03	0.64	0.23	0.00	0.03	0.01	0.1	1.7	0.6	0.5%
Reagleman2	South Sandy Creek	Beaver Pond Run	7	1.49	15.19	5.45	-6.65	-0.68	-2.90	0.01	0.64	0.14	0.03	1.15	0.34	0.00	0.10	0.02	0.0	1.9	0.5	0.5%
BPR1	South Sandy Creek	Beaver Pond Run	5	1.0	6.7	2.3	-3.4	-0.2	-1.1	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.1%
								TOTALS				**69.5**			**14.6**			**25.0**			**109.0**	**100.0%**

Notes:
All calculated loadings in pounds/day

Table 9
Prioritized Sites and General Recommendations

Priority Rank	Acid Loading Rank	Metals LoadingRank	Site Designation/Name	Subwatershed	Principal Problem's	Expected Reductions	Range of Flows (gpm)	Source Reduction	Aerobic Wetlands	Anaerobic Wetlands	Oxic LS Channel	Anoxic LS Trench	Vertical Flow Pond	Active Treatment	Comments
1	1	1	Tipple	South Sandy Creek	Variable flow, Acidic Variable pH 2.80 to 5.10 - Avg. 3.58 Avg. Fe - 16.28 mg/l Avg. Mn - 0.98 mg/l Avg. Al - 3.71 mg/l Total Metals Loading 37.1 lbs/day Acid Loading 150 lbs/day	95% to 100%	5 to 814 Avg. 153	X							High Fe / Low Al / Low to marinal pH / Variable Flow site reclamation, including removal of refuse, regrading of the spoil materials, and covering the site with soil and revegetating is the recommended solution this may be a good site to pass to BAMR for reclamation services, unless there is sufficient refuse to make it attractive to a power plant (Scrubgrass?)
2	6	4	Woods Road	South Sandy Creek	Moderate to low flow, Acidic Low pH 3.2 to 3.5 Avg. Fe - 39.6 mg/l Avg. Mn - 2.80 mg/l Avg. Al - 0.10 mg/l Total Metals Loading 6.6 lbs/day Acid Loading 1.69 lbs/day	95% to 100%	6 to 24 Avg. 10.6			X		X	X		High Fe / Low Al / Low pH / Low Flow recommend site investigation to determine the source of the AMD, which is assumed to be associated with the Tipple Site it is possible that the Woods Road site will dry up if the Tipple site is reclaimed, since there are no readily identifiable sources of the AMD other than the Tipple, so consider linking the two sites as one BAMR project
3	2	2	Woods Site (Woods and Woods II)	Williams Run	Variable flow, Acidic Low pH 3.2 to 3.3 Avg. Fe - 5.94 mg/l Avg. Mn - 8.28 mg/l Avg. Al - 22.75 mg/l Total Metals Loading 22.3 lbs/day Acid Loading 127.4 lbs/day	85% to 90%	12 to 160 Avg. 51.5								Low Fe / High Al / Low pH / Variable Flow it is understood that this site is currently being addressed by a project initiated by the South Sandy Creek Watershed Association, so no further recommendations are given here
4	3	3	ARS (Allen Road Site)	Williams Run	Moderate to low flow, Acidic Variable pH 2.40 to 6.90 - Avg. 3.23 Avg. Fe - 122.52 mg/l Avg. Mn - 4.26 mg/l Avg. Al - 34.17 mg/l Total Metals Loading 16.1 lbs/day Acid Loading 60.4 lbs/day	95% to 100%	5 to 15 Avg. 9	X					?	X	Very High Fe / High Al / Low pH / Low Flow given the extremely high Fe concentration, coupled with the high Al, this will be a difficult site to treat passively recommend including this site as a possible BAMR stip area recycling project, since the adjacent strip mine area appears to be the source of the seeps

Table 9
Prioritized Sites and General Recommendations

Priority Rank	Acid Loading Rank	Metals LoadingRank	Site Designation/Name	Subwatershed	Principal Problem's	Expected Reductions	Range of Flows (gpm)	Source Reduction	Aerobic Wetlands	Anaerobic Wetlands	Oxic LS Channel	Anoxic LS Trench	Vertical Flow Pond	Active Treatment	Comments
5	5	9	WRR5	Williams Run	Variable flow (recent rate of 227 gpm recorded), Acidic Low pH 3.2 to 4.8 Avg. Fe - 14.99 mg/l Avg. Mn - 6.91 mg/l Avg. Al - 7.75 mg/l Total Metals Loading 3.0 lbs/day Acid Loading 8.0 lbs/day	85% to 90%	8.3 (?)	X					X		Avg Fe / Avg Al / Low pH / Variable Flow further flow data is necessary to assess the huge range in flow data in limited samples it appears that this seep may be the result of infiltration from an upstream farm pond through existing mine spoil - resulting in generation of AMD as leachate if possible, this could best be addressed by elimination of the pond, or if that is not possible, lining the pond to limit infiltration
6	4	7	WRL7	Williams Run	Variable flow, Acidic Low pH 4.0 to 4.98 Avg. Fe - 2.05 mg/l Avg. Mn - 2.08 mg/l Avg. Al - 2.25 mg/l Total Metals Loading 3.4 lbs/day Acid Loading 25.7 lbs/day	95% to 100%	13 to 243 Avg. 69	X		X					Low Fe / Low Al / Low pH / Variable Flow the variable flow at this site will make the design of a passive treatment system problematic, so more data might help to define the design flow it is understood that this site has a potential landowner conflict, but that the best option may be to reclaim the adjacent areas
7	7	10	Fleming Site	Williams Run	Moderate to low flow, Acidic Variable pH 4.60 to 8.0 - Avg. 5.75 Avg. Fe - 5.63 mg/l Avg. Mn - 10.69 mg/l Avg. Al - 7.75 mg/l Total Metals Loading 1.6 lbs/day Acid Loading 1.4 lbs/day	85% to 90%	<1 to 14.5 Avg. 7	X					X		Low Fe / Avg Al / Variable pH / Low Flow the Flemming site is adjacent to a current project site that is being addressed by BAMR, and it is unclear if this site will be impacted by that project in spite of the moderate metal concentrations, the low flows result in very low metal and acid loading, making this a lower priority site

Table 9
Prioritized Sites and General Recommendations

Priority Rank	Acid Loading Rank	Metals LoadingRank	Site Designation/Name	Subwatershed	Principal Problem's	Expected Reductions	Range of Flows (gpm)	Source Reduction	Aerobic Wetlands	Anaerobic Wetlands	Oxic LS Channel	Anoxic LS Trench	Vertical Flow Pond	Active Treatment	Comments
8	na	5	Mamula 2	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 6.10 to 6.50 Avg. Fe - 30.27 mg/l Avg. Mn - 6.19 mg/l Avg. Al - 0.10 mg/l Total Metals Loading 5.8 lbs/day Acid Loading 0 lbs/day	85% to 90%	<1 to 32 Avg. 13.6		X						High Fe / Low Al / moderate pH / Low to Moderate Flow these 2 sites are poorly defined discharges associated with a large reclaimed strip mine area, and it would be best to combine the flows if possible to minimize cost if possible, it may be best to create an aerobic wetland treatment area in or adjacent to the intermittent stream channel downstream from Mamula #2, to act as a treatment facility for the entire reclaimed area (as opposed to focusing on the 2 seeps)
	na	11	Mamula1		Moderate to low flow, Alkaline Moderate pH 6.70 to 7.10 Avg. Fe - 5.26 mg/l Avg. Mn - 2.05 mg/l Avg. Al - 0.11 mg/l Total Metals Loading 1.5 lbs/day Acid Loading 0 lbs/day	85% to 90%	6 to 49 Avg 19								if considered a combined discharge, the wetland should be designed for a flow of 35 gpm or higher
9	na	6	SGL1	South Sandy Creek	Variable flow, Alkaline Moderate pH 6.80 to 7.30 Avg. Fe - 8.59 mg/l Avg. Mn - 0.57 mg/l Avg. Al - 0.14 mg/l Total Metals Loading 4.2 lbs/day Acid Loading 0 lbs/day	85% to 90%	18 to 300 Avg. 61	X	X						Avg Fe / Low Al / moderate pH / Variable Flow probable deep mine entrance location, so remediation should include sealing the mine opening to limit discharges this seep discharges directly to the stream channel so construction of an aerobic wetland will require installation in the intermittent stream or piping the flow to a more conveninent area, making source elimination a more attractive option
10	na	8	BPR4	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 6.90 to 7.30 Avg. Fe - 8.49 mg/l Avg. Mn - 1.44 mg/l Avg. Al - 0.10 mg/l Total Metals Loading 3.1 lbs/day Acid Loading 0 lbs/day	85% to 90%	12 to 49 Avg. 27		X						Avg Fe / Low Al / moderate pH / Low to Moderate Flow possibly combine flow with that from BPR5 to reduce overall costs, although this would require piping the BPR5 flow nearly 1000'

Table 9
Prioritized Sites and General Recommendations

Priority Rank	Acid Loading Rank	Metals LoadingRank	Site Designation/Name	Subwatershed	Principal Problem's	Expected Reductions	Range of Flows (gpm)	Source Reduction	Aerobic Wetlands	Anaerobic Wetlands	Oxic LS Channel	Anoxic LS Trench	Vertical Flow Pond	Active Treatment	Comments
11	na	13	Reagleman1	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 7.00 to 7.60 Avg. Fe - 3.66 mg/l Avg. Mn - 5.20 mg/l Avg. Al - 0.36 mg/l Total Metals Loading 1.4 lbs/day Acid Loading 0 lbs/day	85% to 90%	2 to 38 Avg. 13		X						Low Fe / Low Al / moderate pH / Low to Moderate Flow given the location of these seeps on either side of a road, it is recommended that the flows be combined to make a more cost-effective treatment facility with low flow and Al levels, and the relatively high pH, this is a good candidate for aerobic wetland treatment
	na	16	Reagleman2		Moderate to low flow, Alkaline Moderate pH 6.00 to 8.00 Avg. Fe - 1.66 mg/l Avg. Mn - 2.81 mg/l Avg. Al - 0.27 mg/l Total Metals Loading 0.5 lbs/day Acid Loading 0 lbs/day	85% to 90%	1 to 30 Avg. 7								
12	na	15	BPR-5	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 6.80 to 7.40 Avg. Fe - 5.42 mg/l Avg. Mn - 2.89 mg/l Avg. Al - 0.14 mg/l Total Metals Loading 0.6 lbs/day Acid Loading 0 lbs/day	85% to 90%	<1 to 21 Avg. 7		X						Low Fe / Low Al / moderate pH / Low to Moderate Flow possibly combine flow with that from BPR4, although that would require a 1000' long channel or pipeline which may not be cost-effective
13	na	13	BPR-3	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 6.20 to 7.80 Avg. Fe - 13.99 mg/l Avg. Mn - 1.73 mg/l Avg. Al - 0.10 mg/l Total Metals Loading 0.9 lbs/day Acid Loading 0 lbs/day	85% to 90%	1 to 34 Avg. 12	X							Avg Fe / Low Al / moderate pH / Low to Moderate Flow this flow is associated with a borehole, and it is recommended that the borehole be grouted to eliminate the flow

Table 9
Prioritized Sites and General Recommendations

Priority Rank	Acid Loading Rank	Metals Loading Rank	Site Designation/Name	Subwatershed	Principal Problem's	Expected Reductions	Range of Flows (gpm)	Source Reduction	Aerobic Wetlands	Anaerobic Wetlands	Oxic LS Channel	Anoxic LS Trench	Vertical Flow Pond	Active Treatment	Comments
14	na	14	BPR-2	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 6.30 to 7.50 Avg. Fe - 12.92 mg/l Avg. Mn - 0.70 mg/l Avg. Al - 0.90 mg/l Total Metals Loading 0.8 lbs/day Acid Loading 0 lbs/day	85% to 90%	<1 to 11 Avg. 4		X						Avg Fe / Low Al / moderate pH / Low to Moderate Flow seep is along edge of road, so finding a suitable location for treatment may require treating the flow on the south side of the road
15	na	17	BPR-1	South Sandy Creek	Moderate to low flow, Alkaline Moderate pH 6.20 to 7.70 Avg. Fe - 8.21 mg/l Avg. Mn - 0.69 mg/l Avg. Al - 0.39 mg/l Total Metals Loading 0.1 lbs/day Acid Loading 0 lbs/day	85% to 90%	1 to 40 Avg. 9.5		X						Avg Fe / Low Al / moderate pH / Low to Moderate Flow If suggested treatment systems are installed,

WATERSHED RESTORATION PLAN

Based on the goal of returning the South Sandy Creek Watershed to a viable fishery throughout all of its tributaries, a Watershed Restoration Plan has been developed, with focus on the restoration of AMD-impacted stream segments. This plan addresses the 18 AMD discharge locations identified previously, with an attempt to combine the discharges where possible to establish the most cost-effective restoration alternatives.

The passive systems recommended on the attached table were sized using the AMDTreat (version 4.1.c) software, developed as a cooperative effort by the US Office of Surface Mining Reclamation and Enforcement Division (OSMRE), the Pennsylvania Department of Environmental Protection (PADEP), and the West Virginia Department of Environmental Protection (WVDEP), in 2006. The prices listed herein, as computed by the AMDTreat software, are understood to be approximate, for use in assessing Watershed priorities. For the most part, software default values were used for the development of the cost estimates, including retention times and unit prices. It is recommended that detailed conceptual designs of each facility be completed before the preparation of remedial grant requests, including a revised assessment of the default values for site- and time-specific unit pricing.

In addition, as discussed herein, the AMDTreat software was used to size and value the treatment systems; however, additional costs associated with site access and preparation were more difficult to estimate, since in many areas these costs will depend on whether multiple small sites are addressed simultaneously or individually. An attempt was made to add these costs, but it should be noted that this aspect of the project cost will vary considerably depending on the approach taken to address regional problems.

For several of the identified AMD seepage locations, the recommended site remediation is to reclaim a refuse and/or strip mined area. It is anticipated that elimination of the AMD seepage will be accomplished at these sites by removal of the source materials. In that event, continued treatment at the sites will not be required, or will be incorporated into the reclamation project. As such, cost estimates for restoration of these sites is not included herein, except for comparison with an alternative passive treatment system (see the discussion of AMD discharge WRR5, which is recommended to be eliminated by removal or modification of the existing pond, but for which a Vertical Flow Pond was also sized and priced).

In addition, for several of the discharges that were recommended to be addressed with passive treatment, several alternative methodologies are viable to meet the existing water quality chemistry requirements. For these sites, alternative passive treatment technique sizing and pricing was completed for comparison purposes. Note that these comparisons are considered to be general comparisons of the various methodologies (see the discussion of AMD discharge for Woods Road, where 3 different methodologies were compared).

Note that the recommendations contained in this report, as well as the sizing and pricing estimates, are based on limited data developed by others for the Watershed. In the event that higher pollutant loadings than reflected in these samples are found at the individual sites, the passive treatment facilities may be undersized, leading to inadequate retention time.

In addition, all passive treatment facilities have been found to fluctuate in efficiency on a seasonal basis, and will tend to decrease in efficiency with time, when the capacity of the components has been exhausted. As such, for the final conceptual design of each facility, it is recommended that the passive treatment components be oversized, if possible, to account for fluctuating efficiencies.

In the following sections, general remediation strategies considered are discussed, followed by a more detailed summary of the Water Quality at individual sites, along with a discussion of the recommended restoration alternatives for each site.

General Remediation Strategies and Design Standards

As a first step in the recommendation of remediation alternatives for the prioritized sites, a series of broad goals have been established. These goals will be used to assist in the analysis of alternatives and ultimately to assess the performance of the remediation measures.

The first goal involves the specific chemistry associated with the discharges. This is difficult to summarize since the chemistry will vary with each location, even seasonally, and following precipitation events. However, the general goals for the treatment alternatives will be to achieve typical Pennsylvania Code Title 25, Chapter 93 standards for the following parameters at the discharge of each remediation system:

1. Reduction of iron concentrations to less than 1.5 mg/l
2. Reduction of aluminum concentration to less than 0.75 mg/l
3. Reduction of manganese concentrations to less than 1.0 mg/l
4. pH levels with the range of 6.0 – 9.0
5. Alkalinity exceeding acidity

The second goal is to increase public awareness of environmental issues and help to restore a sense of pride and community partnership within the watershed. Since the region has a long history of mining and the associated mine discharge problems, citizens have grown used to seeing orange streambeds devoid of life. Environmental change associated with remediation of mine discharge problems will result in an increase in local interest in the streams. A small (but noticeable) change can have a significant impact on community involvement. As such, it will be important to locate the proposed remediation sites in locations where the improvement will be highly visible to the residents.

The third goal is to establish a recreational corridor along the various waterways to take advantage of the improving environmental conditions in the streams. This will make the improvements more obvious to the public and further expand public awareness of the need for additional improvements. If possible, the remediation techniques should incorporate walking paths with informational placards describing the treatment methodologies. In addition, signs identifying those groups responsible for the remediation will pay dividends.

Awareness of these three goals will aid in the selection of remediation strategies for each of the prioritized sites. General strategies, which will be evaluated for each site, will include the following:

General Remediation Strategies – In general, there are three approaches to remediation of abandoned mine drainage (AMD) discharges. These are:

1. Elimination of the source of the discharge
2. Passive treatment of collected flows
3. Active treatment of collected flows

Examples of each of these techniques are discussed below:

Elimination of the source of discharge

Where possible, the most cost-effective means of dealing with AMD discharges is to eliminate the source of the discharge. This can involve: capping refuse piles to reduce infiltration through the waste materials, sealing mine openings, preventing upstream recharge of abandoned mines, and reclaiming abandoned sites to eliminate exposed highwalls and deep mine entries. Since these methods are very site-specific, it is difficult to assess their use in this report, and the remainder of the document will generally emphasize the use of passive and active treatment systems. However, it should be noted that these methods should be evaluated for certain sites, especially those where stream flow loss to deep mines has been noted.

Within the South Sandy Creek watershed, source elimination could be a major contributor to watershed restoration given the expansive spoil and refuse piles.

Passive treatment of collected flows

There are a host of passive treatment methodologies available for remediation of the discharges identified throughout the watershed. Passive treatment is accomplished primarily via contact with limestone, which tends to raise the pH and neutralize the acidity of the flows. In addition, some passive treatment methods utilize sulfate-reducing bacteria and wetland vegetation to assist with the removal of metals. The interaction of the limestone and bacteria can form a complex bio-chemical reaction, which results in a sulfate-reducing environment that promotes the oxidation and precipitation of dissolved metals in the drainage upon aeration. This same process can be achieved in stand-alone wetlands if the influent chemistry is appropriate.

The use of passive treatment is an evolving process, and although there is significant literature available regarding different methods, the systems still tend to be rather experimental in nature. As such, hard design standards have not been generated for these techniques, but various "rules-of-thumb" are included herein for use in sizing the structures, and cost estimates were based on the methods established in the "AMDTreat" software, discussed herein on page 21.

Passive treatment systems have been shown to be very effective on relatively small discharges, with space for creation of treatment systems identified as the critical issue. As such, for discharges with relatively large flows, or flows that tend to fluctuate dramatically during precipitation events, passive treatment may not be appropriate. In addition, passive treatment systems do tend to accumulate metal precipitate, which must be removed periodically, and portions of the treatment system may require cleaning or replacement to remove deposition. Some systems also require a considerable initial "breaking-in" period before the sulfate-reducing bacteria are present in sufficient quantity to aid in treating the influent. There is also frequently an initial BOD problem with the discharge, resulting from the compost material used within the treatment system, although this problem tends to decrease rapidly.

The following is a brief discussion of various passive treatment techniques, with special emphasis on the site conditions that are appropriate for use of these methods, as well as general design considerations for use.

<u>Aerobic Wetlands</u> - These systems are man-made pools or enhancements of existing swampy areas, which tend to be the simplest and least expensive treatment systems to establish. However, they require influent with a relatively high pH (over 6.0), impermeable bases to limit infiltration, an imported highly organic substrate (cow manure, hay, wood chips, etc.), and specific wetland vegetation capable of continuous submersion.

The principal function of these systems is the removal of certain metals resulting from the action of aerobic bacterial activity and oxidation. This results in the precipitation of the solution as a metal hydroxide sludge, which settles to the bottom of the wetland. Maintenance may be required periodically to prevent excessive clogging. The oxidation process results in increased acidity and decreased pH, and some form of limestone neutralization may be required at the outlet prior to discharge.

Aerobic wetland systems require influent pH ranges of between 6.0 and 8.0 and sufficient surface area and retention time for adequate oxidation to permit metal precipitation. Some systems utilize multiple ponds constructed in parallel to spread the flows over a larger area, which makes it easier to maintain the system. Aerobic wetlands are primarily used for the reduction of ferrous iron in concentrations up to 70 mg/l, but they have not been shown to be effective on aluminum or manganese concentrations.

Based on the equations presented in the text "The Science of AMD and Passive Treatment," the minimum wetland size is computed as follows:

> (Ac) = (Fe loading / 180) + (Mn loading / 90) + (Acidity / 60)
> (where loadings are listed as lb/day, and the 180, 90 and 60 represent typical lb/ac/day capacity values)

Loadings are computed by multiplying the flow (gpm) by the concentration (mg/l) and then by 0.012 to convert gpm and mg/l to pounds per day. Use of this equation results in a recommended aerial extent of aerobic wetland, although this value must be evaluated to include specific site conditions, including fluctuations in inflow rate, site topography, and site accessibility.

Anaerobic Wetlands – These systems are similar to aerobic wetlands, except that the bio-chemical activity takes place within the thick, oxygen-free organic substrate, consisting of composted organic materials containing high concentrations of iron-reducing bacteria. These bacteria break down the sulfates in the influent, raise the pH level and precipitate some dissolved metals.

They are suitable for use with influent pH as low as 3.0 without additional alkalinity being added to the system, but high dissolved oxygen levels in the influent can be problematic. These systems tend to work well with certain metals (including copper, lead, zinc, cadmium, and iron), but they are inadequate for large concentrations of aluminum or manganese.

Like aerobic systems, anaerobic wetlands are most effective when used to treat small AMD flows of moderate water quality. Hedin, et al ("Treatment of acid coal mine drainage with constructed wetlands," 1989) indicate that anaerobic wetland systems for the treatment of net acid influent can be sized based on using a factor of 3.5 grams of acidity/m2/day.

When used in combination with limestone, anaerobic wetlands are frequently sized to provide a minimum retention time in excess of six hours, but when used independently this value should probably be extended to roughly 24 hours. As such, for a flow of 100 gpm, the anaerobic wetland would be sized to contain roughly 19,250 cubic feet of submerged, composted materials. This would be equivalent to a pond with surface area of approximately 60' x 160' x 2' deep.

If aluminum concentrations are relatively high (greater than 1.0 mg/l), a vertical drain system, which incorporates anaerobic wetlands and limestone flow paths, may be more cost-effective. Since the anaerobic activity results in significant metal precipitate, these systems may require periodic cleaning, and the substrate may need to be replaced if the precipitate results in a decrease of bacterial action.

Oxic/Anoxic Limestone Trenches – For the treatment of low pH flows with limited metal content, Oxic (in the presence of atmospheric oxygen) channels are highly efficient and inexpensive. These systems utilize open channels filled with high-carbonate crushed limestone, which is less caustic than lime. Since limestone dissolves slowly, it cannot result in overdosing in the treatment system and tends to dissolve more rapidly in poor water quality conditions, which is desirable.

However, if the limestone treatment occurs when the metal content is relatively high, and atmospheric oxygen is present, a buildup of metallic hydroxide compounds results on the surface of the stone. This armoring reduces the limestone contact surfaces with a subsequent decrease in effectiveness. When working properly, oxic channels can function for 5-10 years before they require replacement, but if the metal content is fairly high, they may lose effectiveness much more rapidly.

For situations where the metal content is higher than recommended for oxic channels, anoxic limestone drains can be utilized. These systems typically utilize subsurface trenches, covered by an impermeable cap, to exclude atmospheric oxygen.

Anoxic trenches can be cheap and effective, but the life of the system is a direct function of the influent water quality and carbonate content of the limestone. When the stone has deteriorated to an extent that it has lost its effectiveness, the entire system must be dug up and replaced. If the influent has a significant dissolved oxygen content prior to introduction into the trench, anoxic trenches are less effective, so it is recommended that these trenches be connected directly with mine pools before the discharge has significant contact with the atmosphere.

There is little in the literature regarding sizing of oxic limestone channels since they are easily accessible, and maintenance involves merely replacing the deteriorated stone as required. Anoxic trench maintenance is more problematic since the system is buried throughout its entire length, so sizing is more critical. Based on the equations in "The Science of AMD and Passive Treatment," the mass of limestone required (M) is:

$$M\ (\text{tons}) = (Qpt/Vv) + (QCT/x),\ \text{where:}$$

Q = flow in m^3/day;
p = bulk density of limestone (approx. 145#/cf = 2.56 Tons/m^3);
t = retention time in days (generally 15 hours = 0.625 days);
Vv = bulk void ratio of limestone (use 0.48 based on experience);
C = effluent alkalinity concentration
T = design life of drain in days (25 years = 9125 days)
x = $CaCO_3$ content of limestone (use 0.90 for high quality stone)

Limestone Diversion Wells/Ponds - In addition to oxic channels and anoxic trenches, there are applications for other, similar systems. Diversion wells consist of a low dam, which is used to divert flow through a pipe into the top of a cylinder filled with limestone gravel. High velocity flows generated by dropping the flow 5 to 10 feet are flushed through this system to keep the armoring scoured and to encourage degradation of the limestone for very efficient treatment. However, these systems require high maintenance by the nature of the construction, and the gravel must be replaced frequently (as much as twice per month). These systems are best used in conjunction with a wetland or a settling pond to permit settlement of the oxidized metals, but they can be used mid-stream.

Other sites have used limestone ponds, in which seepage from a mine opening is forced to flow vertically upward through a crushed limestone layer to force anoxic conditions. These systems also generally discharge to a settling pond or wetland for deposition of the precipitated metals. Again, this can be a relatively high-maintenance arrangement, and the limestone may have to be replaced frequently.

Limestone treatment is ineffective in situations where the pH is higher than neutral, and armoring of the stones causes a dramatic reduction in the performance of the system if not cleaned periodically. When oxygen is present, or when iron levels are in excess of 5 mg/l, the systems tend to develop armoring rapidly. Armoring can occur even more rapidly if the sulfate levels are in excess of 2000 mg/l, wherein an insoluble gypsum precipitate occurs.

Vertical Flow Pond Systems – These treatment systems, which come in a variety of different types, including Successive Alkalinity-Producing Systems (SAPS), Vertical Drains, Vertical Flow Reactors (VFR), Sulfate Reducing Bacteria Systems (SRB) and limestone vertical upflow ponds, combine the bio-chemical properties of anaerobic wetlands and limestone ponds to produce very effective treatment systems. They are generally comprised of a series of ponds placed in series, including: a small settling pond used to drop large diameter suspended solids and attenuate peak runoff events; a "vertical drain" composed of perforated pipes placed at the bottom of a pond overlain with layers of limestone and compost; and a settling pond and/or aerobic wetland for the collection metal precipitate. (For the limestone vertical upflow ponds, the perforated pipes are used for both influent and effluent, with the discharge controlled by a siphon system which controls retention time within the limestone base. These systems typically do not use an organic zone, and do not attempt to utilize biological activity for AMD treatment.)

Regardless of which technique(s) is utilized, multiple systems can be constructed in series to permit cleaning (by taking one system "off-line") and to allow for peak inflows following precipitation events. If sufficient elevation difference is available between ponds, a flushing system can be incorporated to permit periodic cleaning of the perforated pipes and limestone layer (may not be required in limestone vertical upflow ponds). This permits use of VFR systems for influent conditions with low pH and high iron & aluminum contents without removal of the limestone for cleaning.

The general approach to sizing vertical drain systems is to create a series of ponds with sufficient volume to permit adequate retention times. The specific rules-of-thumb for design of these facilities continue to be updated as various systems are constructed and re-evaluated. A good source for sizing design can be found at the following web site: http://amdtreat.osmre.gov, where the software "AMDTreat" can be downloaded. This AMD abatement cost-estimating tool was developed cooperatively by the Pennsylvania Department of Environmental Protection, the West Virginia Department of Environmental Protection, and the Office of Surface Mining Reclamation and Enforcement (OSM), and is available free of charge.

As discussed in previous sections, limestone is a very efficient means of increasing pH values for acidic influent from AMD sites. However, it tends to deteriorate with time and does require long-term maintenance. The rules-of-thumb mentioned above are based on the creation of a system with an effective life of 20-25 years, at which time the limestone will probably require replacement. However, there are no existing systems that have been in place for more than 20 years, so this is speculation.

Vertical flow reactor systems can be very efficient for flows up to approximately 500 gpm, assuming that sufficient room is available to construct ponds large enough to meet the retention time requirements discussed above. The ponds can treat influent with very low pH and relatively high iron, aluminum, and sulfate levels, and if a flushing mechanism has been included in the design, armoring of the limestone and piping can be controlled for many years. The different types of VFRs have been shown to be effective for different types of AMD discharges, and the specific VFR technique should be selected based on a variety of factors, including: influent chemistry; variations in influent flow and chemistry; site topography; accessibility for construction and maintenance; availability of volunteers for periodic maintenance; etc.

However, the systems tend to be much more expensive than the more "passive" systems, due to the more complex construction methods, and will require periodic maintenance and eventual replacement of some components. In addition, they typically require some level of hands-on manipulation, at least initially, to achieve a workable system. This is partially a function of the need for sufficient bacteriological activity to develop a balance of the bio-chemical reactions, and frequent flushing may be required for some months. In addition, there is typically a high BOD discharge from the settling pond in the first few weeks until the compost becomes stabilized. Again, the limestone vertical upflow pond systems may not require the same level of initial maintenance, but there are few of these types of systems in operation, so the long-term maintenance needs are not well defined.

Active Treatment of collected flows

Active treatment of mine discharges has been on-going for hundreds of years with techniques ranging from dilution of the influent to the establishment of sophisticated treatment plants. These methods typically integrate components that employ chemical, biological, and physical processes.

The chemical components involve bringing the flows in contact with alkaline substances to neutralize the acid in the mine discharges through the buffering action of the alkaline materials. Raising the pH of the discharges is often essential for treatment since highly acidic discharges prevent the oxidation and precipitation of metals in settling ponds. Alkaline materials frequently used for pH adjustment include limestone, hydrated lime, quick lime, soda ash briquettes, caustic soda, and anhydrous ammonia. These additives tend to neutralize the acidity of the discharges and permit precipitation of dissolved metals, which can also be removed by application of potassium permanganate, other oxidizing agents, and physical aeration.

In addition to straight chemical reactions, some methods utilize bacteria-induced reduction so that the metal precipitates become stable and settle out. Physical aeration accelerates this process by exposure to large pool surface areas or by using of bubbler systems, waterfalls, or fountains. Larger systems may incorporate several of these techniques.

Since there are currently numerous packaged systems available involving hydrated lime treatment plants or water-wheel addition of caustic soda, which can be designed for specific flows and water quality conditions, it is difficult to recommend a general approach to active treatment of AMD sites.

It is recommended herein that both passive and active treatments be considered for each prioritized site. However, special emphasis should be given to possible remediation funding sources since active systems tend to require a relatively high annual operation and maintenance (O&M) cost, and this is typically not included in funding available to watershed groups. As such, relatively inexpensive active treatment systems may be very difficult to maintain as compared to passive systems, depending on the source of funding.

Based on the site descriptions, chemistry and discussions contained elsewhere in this report, we have prepared general remediation recommendations for the sites identified in each watershed.

Table 9 presents the general remediation recommendations for each site in the South Sandy Creek Watershed. It is assumed that additional data will be accumulated prior to application for funding, and the recommendations contained in the above tables are intended as a starting point for future engineering evaluations.

General Cost Estimates

The previous discussion is intended as a preliminary evaluation of possible remediation measures which can be undertaken at the sites identified as priorities within the watershed. Since these recommendations are considered preliminary, pending additional data collection at each of the sites, development of detailed cost estimates for the remediation measures was not possible.

However, to assist in the evaluation process, the following rules-of-thumb are offered as typical costs that can be anticipated for the remediation process. These costs are certainly not intended to be comprehensive, or to account for costs beyond the basic construction items, such as engineering and mapping, permit acquisition, contract administration, land acquisition and, utility relocation. These costs are offered herein merely for use in comparing different alternative remediation methodologies and for selecting funding prioritizes.

In general, it can be assumed that if an active treatment option is selected, it will result in the acquisition of a batch treatment plant, designed for the site-specific parameters in question. There are numerous manufacturers of batch plants, and it would be best to approach several of these companies to get accurate estimates. However, approximate estimates can be assumed to be roughly $100,000 per each 100gpm intended for treatment, for the initial capital expenditure. If extensive regrading or piping is required, this value could be substantially higher. In addition to the capital costs, active treatment plants require a substantial annual O&M cost, which can range from $10,000 to $50,000 per year depending on the system selected, and some plants may require a full-time operator. In the event that the plant is closed and removed at some point in the future, there is a possibility of some salvage value, but it is best to ignore this possibility for comparison purposes.

By their nature, passive treatment systems tend to have a slightly higher capital cost, but less annual O&M than active treatment plants. Since the funding for the selected remediation alternate will probably be obtained from a one-time government grant, this approach is generally more amenable. (It is frequently difficult to obtain continuing O&M funding for active treatment plants.) Costs associated with passive treatment can vary greatly, depending on the degree of earthwork required to shape the ponds, and whether raw materials for the construction are available in the excavation. However, for this analysis, a general assumption can be used that the capital cost will be roughly $150,000 per 100 gpm treated, with an annual O&M of approximately $1,000 to $5,000 per year (for general maintenance). There will probably be some degree of maintenance required initially, but this will become minimal in the later years. However, portions of the system may have to be completely replaced at the end of the service life (generally considered to be 25 years). Naturally, aerobic wetlands tend to be less expensive than vertical drain systems since they require less material and detailed earthwork.

When evaluating the different systems, it is important to consider the potential funding source, the capabilities of the personnel intended to oversee the installation and operation, the location and accessibility of the site, and the degree of community involvement anticipated. If the site is generally remote and it is anticipated that little local involvement will be forthcoming, it may be necessary to hire a part-time employee to assure continued operation of the treatment system.

Discussion of Individual Site Water Quality and Restoration Recommendation (in order of Priority)

As mentioned above, Kimball has compiled a priority list of impacted areas/sites, as presented on **Table 9**. In general, the main stem of South Sandy Creek currently meets water quality criteria for its intended use at all sampling points above and below the identified AMD discharges. Priorities were therefore set to provide for reclamation of the greatest impacts or upstream sources while taking into consideration current or planned actions by the VCD and/or SSCWA, and others working in the watershed. As such, priorities were aligned to address the major discharges along the impaired tributaries to the main stem of South Sandy Creek (specifically Unnamed Tributary 51375 and the main stem of and tributaries to Williams Run as depicted in **Figure 3**) as opposed to addressing minor seeps along the main stem which, based on current data, are not impacting the main stem to a point of impairment. By focusing on the main impairments first, it is anticipated that secondary priorities would address minor, low flow and minimally loading seeps along the main stem South Sandy Creek (SGL-1 through SGL-4) and Beaver Pond Run, if needed. Implementation of proposed remedies along the Unnamed Tributary 51375 first, followed by implementation of remedies along Williams Run would result in the entire watershed meeting water quality criteria for its intended use.

The following presents the restoration recommendations for each priority site within the watershed. In each case, sites were selected for grouping based on proximity and likelihood of representing discharges from the same mining or other source. This strategy was used to provide the end users with options for addressing individual sites or groups of sites as appropriate. However, the site grouping does not necessarily represent that sites can be treated as a group. It is assumed that additional data will be accumulated prior to application for funding. Any treatment design would require additional site specific analysis.

Group A: Note that Priorities #1 and #2, located near the headwaters of the Unnamed Tributary to South Sandy Creek, have been linked due to proximity and the probability that they are created by the same general source. Since the combined effluent from these two sources represents the largest metal loading within the entire watershed, they have been identified as the top two priorities, with the recommendation that they be treated as one large project. If the remedies outlined below are successfully implemented, a 95% to 100% reduction in metals and acid loading is anticipated (Refer to **Table 9**). This high reduction percentage is estimated based on the remedies proposed which would virtually eliminate the discharges. After successful implementation, all TMDL load reductions (approximately 65% at sample location Woods Road In-Stream) are expected to be achieved for the entire length of the Unnamed Tributary (Trib. 51375) to South Sandy Creek from the headwaters to the confluence with Williams Run (roughly 22,000 feet), reducing the total metal loadings to the stream by nearly 8 tons/year.

In the event that the VCD and/or SSCWA feel that these sites are too problematic, due to size, funding considerations or landowner issues, it is recommended that their initial work effort be shifted to Priority #3.

Priority #1: Tipple Site

The Tipple site is the source of the highest metals and acid loads in the South Sandy Creek watershed. The site represents runoff from the former tipple located near the headwaters of the unnamed tributary (Unnamed Trib1 Left) entering South Sandy Creek from the left looking upstream. The discharge from the tipple site can be characterized as highly acidic with high iron content, low manganese and relatively high aluminum with the majority of the metal loading being made up of iron. Problems associated with the tipple discharge in regard to reclamation are a very unstable and variable flow rate (5 to 814 gallons per minute recorded during the course of the assessment), and variable pH ranging from 2.8 to 5.10.

• Variable flow, Acidic – 5 to 814 gpm, average 153 gpm	• Avg. Al - 3.71 mg/l
• Variable pH 2.80 to 5.10 - Avg. 3.58	• Total Metals Loading 37.1 lbs/day
• Avg. Fe - 16.28 mg/l	• Acid Loading 150 lbs/day
• Avg. Mn - 0.98 mg/l	

These factors will make designing and maintaining a passive treatment system very challenging, and land reclamation of the upstream Tipple area should be considered as a viable remediation of this discharge.

With this in mind, the recommended alternative selected on **Table 9** is Source Reduction, implying that with complete site land reclamation, the source of the AMD (coal refuse and mine spoil) will have been eliminated or adequately capped, making this no longer a primary source of AMD contamination to the South Sandy Creek Watershed. Since the area is quite substantial, and there is a potential that the coal refuse material has potential value as a fuel source, it is recommended that the Venango Conservation District and South Sandy Creek Watershed Association encourage the PADEP/BAMR to select this site as a BAMR project. It is also recommended that the project include negotiations with coal refuse recovery companies since reuse of the material is preferable to burying. A detailed cost estimate for this effort has not been completed, since it is not within the scope of the current project; however, at a rough cost of $4,000/acre, the reclamation would be roughly $850,000.00.

Priority #2: Woods Road Site

The Woods Road site, located roughly 3000 feet downstream from the Tipple site, has the fourth highest metal load and the sixth highest acid load in the South Sandy Creek watershed. The site represents the only other significant contributor to the impairment of the unnamed tributary (Unnamed Trib1 Left) entering South Sandy Creek. The source of the discharge is believed to be an old oil well, since impaired water wells up from the ground proximate to the stream. No former mining activities are apparent in close proximity to the site. The other possibility is that water from the Tipple Site is discharging at the Woods Road Site via a buried pipeline or drain, or possibly flowing through refuse and mine spoil. If this is the case, it is possible that restoration of the Tipple Site will resolve the Woods Road Site discharge.

The discharge from the Woods Road site can be characterized as highly acidic with very high iron content, low manganese and very little to no aluminum. Treatment of the Woods Road site along with reclamation of the Tipple would represent a potential 40% reduction in metal loading to the watershed.

• Moderate to low flow, Acidic – 6 to 24 gpm, average 10.6 gpm	• Avg. Al - 0.10 mg/l
• Low pH 3.2 to 3.5	• Total Metals Loading 6.6 lbs/day
• Avg. Fe - 39.6 mg/l	• Acid Loading 1.69 lbs/day
• Avg. Mn - 2.80 mg/l	

Given the above discussion, it is recommended that, if possible, the Woods Road Site be included as part of the Tipple Site restoration project, potentially addressed by the PADEP/BAMR.

In the event that the Woods Road Site is addressed separately from the Tipple Site, there are several alternative passive treatment options that can be considered. With the very low Al concentrations observed, use of an **anaerobic wetland** or an **anoxic limestone drain (ALD)** or possibly a **vertical flow pond (VFP)** may be possible.

If an **anaerobic wetland** system is utilized, with a design flow of 10.64 gpm (representing the average flow), it is estimated that a wetland surface area of roughly 6,000 SF will be required, containing roughly 200 CY of organic matter and 230 tons of limestone, with an estimated 475 CY of excavation required. The total cost for this system was estimated by the AMDTreat software at roughly $13,200.00, with an additional cost of roughly $7,500.00 for site preparation and access road grading.

Alternatively, if an **anoxic limestone drain (ALD)** were used, the AMDTreat software estimated that to neutralize the average acidity, an ALD with dimensions of roughly 10' wide, and 40' long would be required. This ALD would require 84 CY of excavation, 139 SF of textile material, and 55 CY of limestone, at an estimated cost of $2,515.00. However, this design will result in a retention time of only 3.4 hours, which may not be adequate for complete treatment. If a retention time of 16 hours is defined, the cost for the unit would increase to roughly $11,570.00, which seems more reasonable. This cost would need to be increased by approximately $7,500.00 for site preparation and access road grading.

As a third option, the use of a **vertical flow pond (VFP)** was considered, which will require the addition of a second pond for settling of the treated water. Given the two pond configuration, the cost computed by AMDTreat for this system would be roughly $15,140.00, plus $7,500.00 for site preparation and access road grading, for a 16 hour retention time in the VFP, and 24 hour retention in the settling pond. The VFP surface area would be roughly 2640 SF, with 62 CY of organic substrate and 118 CY of limestone.

<u>Group B:</u> Note that Priorities #3 through #7 are located along Williams Run, and remediation of these 5 sites would eliminate nearly 8.5 tons of total metal loadings/year from the watershed. This stream segment extends for nearly 23,000 feet, from the Ag Site to the confluence with South Sandy Creek. These sites could be addressed as individual projects, or some or all of the areas lumped into one large project for a minor economy-of-scale cost savings, but have been addressed herein as individual projects. If the remedies outlined below are successfully implemented, an 85% to 100% reduction in metals and acid loading is anticipated (Refer to **Table 9**). This high reduction percentage is estimated based on certain remedies proposed (reclamation of sites ARS and WRL7) which would virtually eliminate the discharges. After successful implementation, all TMDL load reductions (approximately 85% at sample location WR2 and 75% reduction at sample location Williams Run In-Stream) are expected to be achieved for the entire length of Williams run from the headwaters to the confluence with South Sandy Creek.

<u>Priority #3: the Woods Site (Woods and WoodsII)</u>

The Woods Pond site is the second highest metal load and the second highest acid load in the South Sandy Creek Watershed, and the highest metal and acid load to Williams Run. The source of the discharge is from former strip mine activities which discharge to a pond located on Charles Woods' property. The discharge from the Woods Pond site can be characterized as highly acidic with a moderately high iron content, high manganese and very high aluminum.

• Variable flow, Acidic – 12 to 160 gpm, Avg. 51.5gpm	• Avg. Al - 22.75 mg/l
• Low pH 3.2 to 3.3	• Total Metals Loading 22.3 lbs/day
• Avg. Fe - 5.94 mg/l	• Acid Loading 127.4 lbs/day
• Avg. Mn - 8.28 mg/l	

It is understood that the SSCWA currently has plans to convert the abandoned surface mine pond owned by Charles Woods into a passive treatment system, which will include the construction of an inclined limestone bed to treat the impaired discharge water. Since this project was initiated prior to completion of the South Sandy Creek Watershed Report, we have not included a remediation recommendation on **Table 9**, or a cost estimate in this section.

<u>Priority #4: Allen Road Site (ARS)</u>

The Allen Road site produces the third highest metal load and the third highest acid load in the South Sandy Creek Watershed, and the second highest metal and acid load to Williams Run. The discharge is located in the headwaters of Williams Run. The source of the AMD is coal refuse and acidic spoil on abandoned mine lands parallel to Allen Road.

Testing of the coal refuse conducted by BAMR shows it to be of little to no fuel value in terms of BTU and is highly pyritic. Removal of the acid forming materials would most likely be the best reclamation option. The discharge from the Allen Road site can be characterized as highly acidic with a very high iron and aluminum content, with moderate to high manganese. The relatively low flow associated with this discharge prevents it from ranking higher as a major impairment to the watershed.

• Moderate to low flow, Acidic – 5 to 15 gpm, Avg. 9 gpm	• Avg. Al - 34.17 mg/l
• Variable pH 2.40 to 6.90 - Avg. 3.23	• Total Metals Loading 16.1 lbs/day
• Avg. Fe - 122.52 mg/l	• Acid Loading 60.4 lbs/day
• Avg. Mn - 4.26 mg/l	

Given the extremely high Fe concentration observed, the recommended alternative selected on **Table 9** is Source Reduction, implying that with complete site land reclamation, the source of the AMD (coal refuse and mine spoil) will have been eliminated or adequately capped, making this no longer a primary source of AMD contamination to the South Sandy Creek Watershed. Since the coal refuse material has been determined to have little value as a fuel source, it is recommended that the Venango Conservation District and South Sandy Creek Watershed Association encourage a partnership with the PADEP/BAMR to select this site as land reclamation, via burying and capping the refuse material using Title IV funding. A cost estimate for this effort has not been completed, since it is not within the scope of the current project.

However, in the event that this site is not selected for BAMR site reclamation, it was assessed for the possibility of AMD remediation via the use of a **vertical flow pond (VFP)**, with associated settling pond. Given the two pond configuration, the cost computed by AMDTreat for this system would be roughly $18,170.00, plus $7,500.00 for site preparation and access road grading, resulting in a 16 hour retention time in the VFP, and 24 hour retention in the settling pond. The VFP surface area would be roughly 3300 SF, with 81 CY of organic substrate and 166 CY of limestone. This surprisingly low cost for the VFP is the result of the relatively low flow into the system (15 gpm design flow); however, it is anticipated that a VFP pond used for this site would require maintenance at a much higher rate than others in the Watershed, given the very high Fe and high Al concentrations. In spite of the relatively low capital cost shown for this system, it is not recommended based on the anticipated high O&M that would be required, with frequent cleanings and organic zone replacement.

A third option for this site would be the use of an Active Treatment Plant, which has been suggested by the PADEP/BAMR personnel. Active Treatment typically has a relatively low capital cost, but will require significant annual expenditure for material and labor, so is not recommended at this site due to the low flows.

Priority #5: WRR5

The WRR5 site produces the ninth highest metal load and the fifth highest acid load in the South Sandy Creek watershed, and the fourth highest metal and acid load to Williams Run. This site was moved up in the rankings as a result of higher discharges in the latter stages of the sampling, which resulted in a wide range of flows. More data should be collected at this site prior to development of a final plan, in order to establish clear design standards. The discharge is located downstream of the Allen Road site and is the next major discharge to the main stem of Williams Run. Jon Smoyer of the PADEP, who collected many of the samples, noted that the WRR5 "discharge" is only monitored in-stream in that unnamed branch of Williams Run and, therefore, the "raw" chemistry and loading are not fully known for this discharge.

Also known as the Gadsby pasture site, the discharge from WRR5 can be characterized as highly acidic with a relatively high iron, aluminum and manganese content. A problem with the reclamation of this site is the variable flow rates observed. Loadings for this site were calculated using only one sample with recorded flow of over eighteen samples collected at the site. Recent flow measurements collected without the benefit of chemistry data indicate flows as high as 227 gpm. Based on this information, it is surmised that this site may be a more major contributor to the impairment of Williams Run and thus, the South Sandy Creek Watershed.

• Variable flow (recent rate of 227 gpm recorded), Acidic – 8.3 (?) gpm	• Avg. Al - 7.75 mg/l
• Low pH 3.2 to 4.8	• Total Metals Loading 3.0 lbs/day
• Avg. Fe - 14.99 mg/l	• Acid Loading 8.0 lbs/day
• Avg. Mn - 6.91 mg/l	

The source of the WRR5 AMD is not fully known. According to a recent assessment of Williams Run, the source is most likely pyritic spoil or buried coal refuse upgradient of the seep area. The pond located upslope of the seep area, from which there is no visible discharge, is suspected of being a constant source of recharge to what is assumed to be buried pyritic fill material. Exploratory drilling could help determine the source of the AMD as well as the source of the groundwater recharge generating the AMD. Land reclamation to remove or abate the source of the problem may be a viable remedy for this discharge.

Given the above description, it is recommended that a site exploration be undertaken to attempt to identify the source of the AMD, and to obtain additional flow data. In the event that it is found to be pyritic fill material below the existing pond (as suspected), it is recommended that the pond be eliminated and the surface capped, or the pond bottom lined, to minimize continued recharge of the leachate-generating materials. Since this alternative is not part of the current scope of services, and the pond size has not been investigated, a cost estimate for this alternative solution has not been developed.

The lack of sufficient flow data and the wide range of recorded flows (8.3 – 227 gpm) make it difficult to assess other alternatives for passive treatment of the WRR5 discharge; however, AMD remediation could be attempted via the use of a **vertical flow pond (VFP)**, with associated settling pond. Given the two pond configuration and a design flow of 227 gpm, the cost computed by AMDTreat for this system would be roughly $154,000.00 (plus $7,500.00 for site preparation and access road grading), for a 16 hour retention time in the VFP, and 24 hour retention in the settling pond. The VFP surface area would be roughly 28,660 SF, with 935 CY of organic substrate and 2510 CY of limestone. If the lower flow of 8.3 gpm is used in the AMDTreat software, the total cost for the 2 ponds would drop to $13,000.00 (plus $7,500.00 for site preparation and access road grading), indicating that more data is required before a cost estimate can be established with reasonable accuracy.

Priority #6: WRL7

The WRL7 site produces the seventh highest metal load and the fourth highest acid load in the South Sandy Creek watershed and the third highest metal and acid load to Williams Run.

The discharge is located downstream of the Allen Road and WRR5 sites and is the next major downstream discharge to the main stem of Williams Run. The discharge originates in the abandoned surface mine pits on SGL. No. 39 on property owned by John Clark. The discharge from WRL7 can be characterized as acidic with a relatively low iron, aluminum and manganese content.

• Variable flow, Acidic – 13 to 243 gpm, Avg. 69	• Avg. Al - 2.25 mg/l
• Low pH 4.0 to 4.98	• Total Metals Loading 3.4 lbs/day
• Avg. Fe - 2.05 mg/l	• Acid Loading 25.7 lbs/day
• Avg. Mn - 2.08 mg/l	

Problems associated with the reclamation of this site are the variable flow rates observed and property owner cooperation. The large variations in observed flow rates will make the design and maintenance of a passive treatment system challenging. In addition, the property owner has already stated his desire not to have the pit reclaimed. Water remediation in the pit without reclamation may be possible, but may also interfere with future reclamation of the physical hazard of the highwall and pit. In a recent assessment of Williams Run, it was suggested that this site should be the last site addressed in Williams Run until the property owner gives consent and the highwall and discharge can be addressed as a single project.

However, in the event that the property owner will not grant his consent to site reclamation, an **anaerobic wetland** passive system on SGL should be considered as the primary alternative to address this discharge, due to the low metal loadings but pH levels less than 6.0. Using the AMDTreat software, a cost of $34,527.00 was estimated, plus $7,500.00 for site preparation and access road grading, using a design flow of 68.6 gpm (which is considered the average flow). In the event that a design flow consistent with the maximum recorded flow (243 gpm) is used, the cost estimate would increase to $82,400.00 (plus $7,500.00), showing the importance of obtaining additional flow data prior to developing a conceptual design for this site.

Priority #7: Fleming Site

The Fleming site produces the tenth highest metal load and the seventh highest acid load in the South Sandy Creek watershed and the fifth highest metal and acid load to Williams Run. The discharge is located downstream of the Allen Road, WRR5 and WRL7 sites and joins with the discharge from the Woods Pond site before entering Williams Run. The discharge originates from an old strip mine and highwall on the Fleming property.

The discharge from the Fleming site can be characterized as acidic with a relatively low iron, and moderate to high aluminum and manganese content. In spite of the moderate metal concentrations, the total loadings from this site are relatively low due to the minimal flows recorded.

• Moderate to low flow, Acidic – <1 to 14.5 gpm, Avg. 7	• Avg. Al - 7.75 mg/l
• Variable pH 4.60 to 8.0 - Avg. 5.75	• Total Metals Loading 1.6 lbs/day
• Avg. Fe - 5.63 mg/l	• Acid Loading 1.4 lbs/day
• Avg. Mn - 10.69 mg/l	

The Fleming site is within or immediately adjacent to a reclamation being performed by BAMR to eliminate a highwall located along Hells Kitchen Road. The reclamation, in-progress at the time of this assessment, also includes the installation of an inclined limestone bed to treat a seep discharge emanating from behind the Charles Woods residence. According to Lance Bowes of the Venango Conservation District, the BAMR plans call for the Fleming discharge to be piped to the stream with no treatment.

Problems associated with the remediation of this site include a variable pH that will make design and maintenance of a passive treatment system challenging. In addition, remediation efforts must be coordinated with the current reclamation project being conducted by BAMR.

In the event that a passive treatment system is desired at this site, AMD remediation could be attempted via the use of a **vertical flow pond (VFP)**, with associated settling pond. Given the two pond configuration and a design flow of 14.55 gpm, the cost computed by AMDTreat for this system would be roughly $17,900.00, for a 16 hour retention time in the VFP, and 24 hour retention in the settling pond. The VFP surface area would be roughly 3240 SF, with 80 CY of organic substrate and 160 CY of limestone. This cost would need to be increased by approximately $7,500.00 for site preparation and access road grading.

<u>Group C:</u> The remaining 8 sites are located within the Beaver Pond Run Watershed, with the exception of site SGL1 located along the main stem of South Sandy Creek, and were notable for the relatively high pH levels and low metal concentrations. There are no stream impairments along the main stem of South Sandy Creek nor Beaver Pond Run associated with this group of discharges. Therefore, no corresponding TMDL load reductions exist nor can they be calculated. As a result, these sites have a low priority, and the VCD and/or SSCWA should give due consideration to the cost-benefit ratio associated with remediation of these sites. However, if the remedies outlined below are successfully implemented, an 85% to 90% reduction in metals loading is anticipated (Refer to **Table 9**). This lower reduction percentage is estimated based on the majority of the remedies proposed involve passive treatment of the discharges as opposed to reclamation and discharge elimination. Successful implementation would eliminate nearly 3.5 tons of total metal loadings/year from the watershed

Several of the sites might be best remediated as combined efforts (such as Mamula1/Mamula2, BPR#4/BPR#5 and Reagleman #1/Reagleman #2), to minimize the construction costs. For purposes of this report, we have combined Mamula1 and Mamula2 as one “site”, due to proximity and the relative ease of combining the two flows into one treatment system.

Priority #8: Mamula Sites (Mamula1 and Mamula2)

The Mamula1 and Mamula2 sites represent the eleventh and fifth highest metal loads to the South Sandy Creek Watershed and the third and first highest metal loads to the South Sandy Creek tributary known locally as Beaver Pond Run, respectively. The discharges are located at or near the headwaters of Beaver Pond Run and originate in an area of a reclaimed strip mine. Mamula1, the lesser of the two discharges, emanates as an upwelling or seep at the toe of the reclaimed strip mine. At this point it is unclear whether the flow is due to a single upwelling or seep or if several seeps add to the flow. The discharge flows south-southeast and eventually discharges in close proximity to the Mamula2 site.

The Mamula2 site discharge also emanates as an upwelling but within the area of reclamation. The original thought was the Mamula2 site was due to an old oil well, however the site is located within the original strip mine. The actual source of the discharge is currently unknown.

The discharge from Mamula1 can be characterized as alkaline with a relatively moderate iron and low aluminum and manganese content. Similarly, the Mamula2 site is alkaline with moderate to low manganese and low aluminum. However, the Mamula2 site exhibits a much higher, and relatively very high, overall iron content supporting the theory that the Mamula2 site emanates from a different source.

Mamula1

• Moderate to low flow, Alkaline – 6 to 49 gpm, Avg 19	• Avg. Al - 0.11 mg/l
• Moderate pH 6.70 to 7.10	• Total Metals Loading 1.5 lbs/day
• Avg. Fe - 5.26 mg/	• Acid Loading 0 lbs/day
• Avg. Mn - 2.05 mg/l	

Mamula2

• Moderate to low flow, Alkaline – <1 to 32 gpm, Avg. 13.6	• Avg. Al - 0.10 mg/l
• Moderate pH 6.10 to 6.50	• Total Metals Loading 5.8 lbs/day
• Avg. Fe - 30.27 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 6.19 mg/l	

Given the relatively moderate to low flows observed at these two sites and the proximity of the discharges, for the purposes of this plan it is assumed that both discharges can be treated with a single passive system. With pH values above 6.0 and minimal Al concentrations, a cost estimate was developed in AMDTreat for an **Aerobic Wetland** passive treatment system. The total cost was computed as $19,734.00, with a pond water surface area of 16,000 SF, 555 CY of organic matter and a retention time of 29 hours. In addition, an estimated $5,000.00 must be budget for site preparation.

Priority #9: SGL1

Site SGL1 (State Game Lands 1) produces the sixth highest metal load in the South Sandy Creek watershed. The discharge is the most up-stream discharge identified in the watershed, located just over one-half mile downstream (east) of Henderson Station. The site is located in a very narrow and steep walled channel that discharges directly to South Sandy Creek.

The source of the discharge observed at SGL1 is currently unknown, as no mining activities are evident in the vicinity of the discharge. However, field observations found evidence of possible small scale deep mine workings at the discharge point. The discharge from SGL1 can be characterized as alkaline with a relatively moderate to high iron content and low aluminum and manganese content.

• Variable flow, Alkaline – 18 to 300 gpm, Avg. 61	• Avg. Al - 0.14 mg/l
• Moderate pH 6.80 to 7.30	• Total Metals Loading 4.2 lbs/day
• Avg. Fe - 8.59 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 0.57 mg/l	

Given the probable deep mine entrance adjacent to the SGL1 seep, the primary recommendation for remediation is reclamation of the site and installation of a dry seal. This will probably require a geotechnical investigation of the site to determine the extent of the mining and the volume of the mine pool. It is recommended that the Venango Conservation District and South Sandy Creek Watershed Association encourage the PADEP/BAMR to select this site as a BAMR project. A cost estimate for this effort has not been completed, since it is not within the scope of the current project.

In the event that a passive treatment alternative for this site is desired, a cost estimate for an **Aerobic Wetland** system was developed using the AMDTreat software. Using an average flow of 61 gpm for the design, a cost of $6,677.00 was developed for the system, with a pond water surface area of 5621 SF, 185 CY of organic matter and a retention time of 5 hours. Note that if the design flow is increased to the maximum recorded flow (300 gpm) the cost of an aerobic wetland system would climb to $34,452.00. With such a large difference in cost, it will be critical to either obtain additional data regarding the actual flow from the mine opening, or to include the design of a surface water diversion structure so that only the seep is treated. This cost would need to be increased by approximately $7,500.00 for site preparation and access road grading.

Priority #10: BPR4

Site BPR4 (Beaver Pond Run 4) represents the fourteenth highest metal load to the South Sandy Creek Watershed and the second highest metal load to the South Sandy Creek tributary known locally as Beaver Pond Run. The discharge is located near the headwaters of Beaver Pond Run, downstream of the Mamula sites, close to the stream, and originates within a wetland area.

The actual source of the discharge is currently unknown but is suspected to be an old oil well as evidence of former oil field activity (piping, well casings, holding tanks, etc.) are within close proximity and no evidence of former mining activities is present.

The discharge from BPR4 can be characterized as alkaline with a relatively moderate to high iron content, moderate to low manganese content and very low aluminum.

• Moderate to low flow, Alkaline – 12 to 49 gpm, Avg. 27	• Avg. Al - 0.10 mg/l
• Moderate pH 6.90 to 7.30	• Total Metals Loading 3.1 lbs/day
• Avg. Fe - 8.49 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 1.44 mg/l	

A cost estimate for an **Aerobic Wetland** system was developed using the AMDTreat software. Using an average flow of 26.7 gpm for the design, a cost of $6,132.00 was developed for the system, with a pond water surface area of 5182 SF, 169 CY of organic matter and a retention time of 11 hours. This cost would need to be increased by approximately $6,000.00 for site preparation and access road grading.

Priority #11: Reagleman Sites (Reagleman1 and Reagleman2)

The Reagleman1 and Reaglema2 sites represent the twelfth and sixteenth highest metal loads to the South Sandy Creek Watershed, and the fourth and eighth highest metal loads to the South Sandy Creek tributary known locally as Beaver Pond Run, respectively. The discharges are located at or near the headwaters of Beaver Pond Run and originate in an area of a reclaimed strip mine. Both discharges emanate as upwellings at the edge of the reclaimed strip flowing south-southeast along each side of Slatertown Road.

The discharges from both the Reagleman1 and Reagleman2 sites can be characterized as alkaline with a relatively moderate to low iron and manganese content and low aluminum content with the Reagleman1 discharge exhibiting slightly higher metal concentrations.

Reagleman1

• Moderate to low flow, Alkaline – 2 to 38 gpm, Avg. 13	• Avg. Al - 0.36 mg/l
• Moderate pH 7.00 to 7.60	• Total Metals Loading 1.4 lbs/day
• Avg. Fe - 3.66 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 5.20 mg/l	

Reagleman2

• Moderate to low flow, Alkaline – 1 to 30 gpm, Avg. 7	• Avg. Al - 0.27 mg/l
• Moderate pH 6.00 to 8.00	• Total Metals Loading 0.5 lbs/day
• Avg. Fe - 1.66 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 2.81 mg/l	

Given the relatively moderate to low flows observed at these two sites and the proximity of the discharges, for the purposes of this plan it is assumed that both discharges can be treated with a single passive system.

A cost estimate for an **Aerobic Wetland** system was developed using the AMDTreat software. Using an average flow of 20.1 gpm for the design, a cost of $12,596.00 was developed for the system, with a pond water surface area of 10,360 SF, 352 CY of organic matter and a retention time of 31 hours. If the peak flow of 68 gpm is used, the revised cost estimate is $44,020.00, with a pond of 35,132 SF. This cost would need to be increased by approximately $7,500.00 for site preparation and access road grading.

<u>Priority #12: BPR5</u>

Site BPR5 (Beaver Pond Run 5) represents the fifteenth highest metal load to the South Sandy Creek Watershed and the seventh highest metal load to the South Sandy Creek tributary known locally as Beaver Pond Run. The discharge is located near the headwaters of Beaver Pond Run, close to the stream, and originates as seeps from the stream bank.

The actual source of the discharge is currently unknown but is suspected to be an old oil well as evidence of former oil field activity (piping, well casings, holding tanks, etc.) is within close proximity and no evidence of former mining activities is present.

The discharge from BPR5 can be characterized as alkaline with a relatively moderate to low iron content, moderate to low manganese content and very low aluminum.

• Moderate to low flow, Alkaline – <1 to 21 gpm, Avg. 7	• Avg. Al - 0.14 mg/l
• Moderate pH 6.80 to 7.40	• Total Metals Loading 0.6 lbs/day
• Avg. Fe - 5.42 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 2.89 mg/l	

A cost estimate for an **Aerobic Wetland** system was developed using the AMDTreat software. Using an average flow of 7.2 gpm for the design, a cost of $2,900.00 was developed for the system, with a pond water surface area of 2548 SF, 80 CY of organic matter and a retention time of 21 hours. This cost would need to be increased by approximately $5,000.00 for site preparation and access road grading.

<u>Priority #13: BPR3</u>

Site BPR3 (Beaver Pond Run 3) represents the thirteenth highest metal load to the South Sandy Creek Watershed and the fifth highest metal load to the South Sandy Creek tributary known locally as Beaver Pond Run. The discharge is located along Beaver Pond Run downstream of discharge sites BPR4 (priority site 10) and BPR5 (priority site 12). The discharge emanates from an old oil well near the stream, which is clearly visible at the source of the flow.

The discharge from BPR3 can be characterized as alkaline with a relatively high iron content, low manganese content and very low aluminum.

• Moderate to low flow, Alkaline – 1 to 34 gpm, Avg. 12	• Avg. Al - 0.10 mg/l
• Moderate pH 6.20 to 7.80	• Total Metals Loading 0.9 lbs/day
• Avg. Fe - 13.99 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 1.73 mg/l	

Proper sealing / abandonment of the old oil well should be the chosen remedy for this discharge. Note that there are well defined procedures for proper elimination of deep wells, and that improper sealing may result in a recurrence of the problem at a different location. Costs for sealing of this well have been estimated at $15,000.00, based on the Conservation District's experience with local drillers.

<u>Priority #14: BPR2</u>

Site BPR2 (Beaver Pond Run 2) represent the fourteenth highest metal load to the South Sandy Creek Watershed and the sixth highest metal load to the South Sandy Creek tributary known locally as Beaver Pond Run. The discharge is located near Slatertown Road where it crosses the stream. The discharge is close to the stream and originates as seeps from what appears to be a cut in the embankment for Slatertown Road. The actual source of the discharge is currently unknown as no evidence of previous mining exists in the vicinity of the seep.

The discharge from BPR2 can be characterized as alkaline with a relatively high iron content and low manganese and aluminum.

• Moderate to low flow, Alkaline – <1 to 11 gpm, Avg. 4	• Avg. Al - 0.90 mg/l
• Moderate pH 6.30 to 7.50	• Total Metals Loading 0.8 lbs/day
• Avg. Fe - 12.92 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 0.70 mg/l	

A cost estimate for an **Aerobic Wetland** system was developed using the AMDTreat software. Using an average flow of 3.9 gpm for the design, a cost of $960.00 was developed for the system, with a pond water surface area of 920 SF, 25 CY of organic matter and a retention time of 13 hours. Given this low cost for the treatment systems resulting from the very low flow, it is anticipated that the actual construction costs will be higher than predicted here, unless this project can be coupled with additional remediation efforts at one or more of the nearby sites. Assuming several days of dozer effort to prepare the site, the costs should be increased by a minimum of $3,000.00 for clearing and grubbing and access road construction.

<u>Priority #15: BPR1</u>

Site BPR1 (Beaver Pond Run 1) represents the seventeenth highest metal load to the South Sandy Creek Watershed and the ninth highest metal load to the South Sandy Creek tributary known locally as Beaver Pond Run. The discharge is located near the mouth of Beaver Pond Run and is the last discharge identified before the stream enters South Sandy Creek.

The discharge is close to the stream and originates as seeps. The actual source of the discharge is currently unknown as no evidence of previous mining exists in the vicinity of the seep. The discharge from BPR1 can be characterized as alkaline with similar chemistry to BPR2.

• Moderate to low flow, Alkaline –1 to 40 gpm, Avg. 9.5	• Avg. Al - 0.39 mg/l
• Moderate pH 6.20 to 7.70	• Total Metals Loading 0.1 lbs/day
• Avg. Fe - 8.21 mg/l	• Acid Loading 0 lbs/day
• Avg. Mn - 0.69 mg/l	

A cost estimate for an **Aerobic Wetland** system was developed using the AMDTreat software. Using an average flow of 9.5 gpm for the design, a cost of $1,041.00 was developed for the system, with a pond water surface area of 992 SF, 27 CY of organic matter and a retention time of 6 hours. Given this low cost resulting from the very low flow, it is anticipated that the actual construction costs will be higher than predicted here, unless this project can be coupled with additional remediation efforts at one or more of the nearby sites. Assuming several days of dozer effort to prepare the site, the costs should be increased by a minimum of $3,000.00 for clearing and grubbing and access road construction.

COST ESTIMATE SUMMARY

Implementation of all the remaining proposed passive systems is estimated to cost about $1,340,000 dollars as summarized as summarized in **Table 10**, below:

Table 10 – Estimated Costs

1	Tipple	Tipple Site	$850,000.00	Land Reclamation Recommended
2	Woods Road	Woods Road	$22,640.00	
3	Woods and Woods2	Woods	NA	System Construction in Progress
4	ARS	Allen Road	$25,670.00	Treatment Estimate, Land Reclamation Recommended
5	WRR5	Williams Run Right 5	$161,500.00	
6	WRL7	Williams Run Left 7	$89,900.00	
7	Fleming	Fleming Site	$25,400.00	
8	Mamula1 Mamula2	Mamula Sites	$24,734.00	
9	SGL1	State Game Lands 1	$41,952.00	
10	BPR4	Beaver Pond Run 4	$12,132.00	
11	Reagleman1 Reagleman2	Reagleman Sites	$51,520.00	
12	BPR5	Beaver Pond Run 5	$ 7,900.00	
13	BPR3	Beaver Pond Run 3	$15,000.00	Sealing of Oil Well Recommended
14	BPR2	Beaver Pond Run 2	$ 6,960.00	
15	BPR1	Beaver Pond Run 1	$ 7,041.00	

TECHNICAL AND FINANCIAL ASSISTANCE NEEDED FOR IMPLEMENTATION

Members of the SSCWA and VCD are not construction contractors and therefore probable project costs listed herein, as computed by the AMDTreat software, are understood to be approximate, and are based solely upon information from AMDTreat, experience with construction, and basic knowledge of the proposed sites. For the most part, software default values were used for the development of the cost estimates, including retention times and unit prices, for use in assessing Watershed priorities. This requires the SSCWA and VCD to make a number of assumptions as to actual conditions which will be encountered on each site; the specific decisions of other design professionals engaged; the means and methods of construction the contractor will employ; the cost and extent of labor, equipment, and materials that the contractor will employ; the contractor's techniques in determining prices and market conditions at the time; and other factors over which the SSWCA and VCD has no control. Given these assumptions, which must be made, it is recommended that detailed conceptual designs of each facility be completed before the preparation of remedial grant requests, including a revised assessment of the default values for site- and time-specific unit pricing.

For purposes of this plan, the following presents a list of technical and engineering assistance that may be needed for remediation of the discharges within the South Sandy Creek Watershed:

- Engineering for conceptual and final treatment system designs
- Engineering for bid package preparation and construction oversight
- Technical assistance to develop operation and maintenance plans

Table 11 presents a listing of possible funding sources available to the SSCWA and VCD in order to implement this restoration plan:

Table 11 – Funding Sources

PA DEP Growing Greener Program	PA DEP Grants Center RCSOB, 15th Floor 400 Market Street P.O. Box 8776 Harrisburg, PA 17105 717-705-5400	Watershed restoration implementation (construction) projects, O&M, education/outreach projects, watershed organization, and watershed assessment
US EPA Section 319 Nonpoint Source Program	PA DEP Grants Center RCSOB, 15th Floor 400 Market Street, P.O. Box 8776 Harrisburg, PA 17105 717-705-5400	Projects addressing nonpoint sources including AMD restoration (construction projects)
US OSM Appalachian Clean Streams Initiative	US OSM Harrisburg Field Office 415 Market Street, Suite 3 Harrisburg, PA 17101 717-782-2285	AMD restoration (construction projects) in the Appalachian Region
Western Pennsylvania Watershed Program	John Dawes RR#1, Box 152 Alexandria, PA 16611 814-669-4847 www.wpawp.org	Watershed restoration and preservation projects including AMD
The Heinz Endowment	The Heinz Endowments 30 Dominion Tower 625 Liberty Avenue Pittsburgh PA 15222-3115 http://www.heinz.org	Restore and protect watersheds, ecosystems and landscapes; decrease human impact (point and non-point) sources; encourage public awareness, empower grassroots organizations, and build partnerships
Richard King Mellon Foundation	Richard King Mellon Foundation One Mellon Bank Center 500 Grant Street, Suite 4106 Pittsburgh, PA 15219-2502	Protection and preservation of natural resources
PA DEP, Bureau of Abandoned Mine Reclamation	PA DEP, Bureau of Abandoned Mine Reclamation. Wilkes-Barre, PA.	Funding and/or technical assistance for engineering, construction, and monitoring of projects. Eligible recipients include: conservation districts, watershed associations, local governments, non-profits.
PA League of Women Voters Watershed Resource and Education Network (WREN)	WREN Resource Center, League of Women Voters of Pennsylvania, 226 Forster Street, Harrisburg, PA 17102. 1-800-692-7281	Funding for primarily non-point source educational projects.
National Fish and Wildlife Foundation Grant	NFWF Contact: www.nfwf.org	Potential funding for land acquisition.

PUBLIC INFORMATION AND PARTICIPATION

Outreach activities are a vital component of improving the overall health of the South Sandy Creek Watershed. As this plan outlines the restoration of an entire watershed, education and outreach will be a critical component in the remediation of the pollution problems of the prioritized sites. Public participation in the restoration plans and project implementation has always been encouraged by the SSCWA and VCD. Outreach activities will be focused on the general public, area businesses and landowners, farmers, and municipal officials. An overall educational mission will aim to inform these stakeholders of the causes, remediation, and prevention of pollution problems. The major stakeholders include everyone who lives within the watershed, especially the landowners who have property directly impacted by abandoned mine lands, people who use the watershed recreationally, those who work in the watershed, the SSCWA, the VCD, and PADEP. Progress relating to plan development has been discussed at the SSCWA meetings and has been published on the VCD website.

The VCD, through its various departments and programs, provides various forms of outreach to all stakeholders in the implementation of remedial actions of pollution problems in Venango County. The VCD has active educational and outreach programs promoting the remediation of pollution from agriculture, AMD, erosion and sedimentation, and storm water runoff. The VCD provides technical assistance for landowners, municipal officials, farmers, and the general public and assists the same in obtaining grant funding for educational and pollution remediation projects. Progress towards implementation of this restoration plan will continue to be posted on the VCD website.

The SSCWA is a citizens group concerned about the past, present, and future of the South Sandy Creek Watershed. Their mission is "*to preserve, maintain, and restore the land, air, and water through community involvement and education.*" Meetings of the SSCWA are held monthly and are open to the public. Public participation in the planning and restoration of the watershed has and will continue to be encouraged by the SSCWA.

IMPLEMENTATION SCHEDULE AND EVALUATION

The primary factor that will dictate the implementation schedule for this restoration plan will be the support of the local property owners. Fortunately, many property owners within the watershed are in favor of restoration activities and have been cooperative to date. It is expected however that issues will arise regarding property owner concerns as more details of the type and size of the proposed treatment systems or reclamation activities are developed. Funding is also a major factor in implementing restoration activities. All funding sources presented earlier in this plan should be researched as to availability of funds for each prioritized project. If funding sources receive less money than expected, then some of the proposed projects may not be funded according to schedule. In addition, competition for the limited grant funds increases every year as more watershed associations develop their own restoration plans and submit proposals for implementation projects. In these cases, the project proposals would be submitted again the following year, but the implementation schedules would have to be changed.

The SSCWA will generally act as administrator of grants and other funds made available for the restoration activities. Because the SSCWA is a totally volunteer organization, it will be likely that they will have to rely on other partner organizations to assist with tasks such as on-site management of construction activities. For example, as some of the priority sites will rely on land reclamation, coordination with partners such as BAMR will be necessary making overall watershed restoration scheduling difficult at best. These sites should remain on the implementation schedule but should not hinder progress on the remaining sites. In addition, the management of multiple projects may be very daunting for the volunteer organization depending on the size and scope of the treatment system. Existing relationships with the VCD may alleviate this concern but it must be considered in the overall implementation schedule.

Table 12 presents the proposed implementation schedule for the South Sandy Creek Watershed based on watershed priorities detailed above. As discussed above, the main stem of South Sandy Creek currently meets water quality criteria for its intended use at all sampling points above and below the identified AMD discharges. Priorities were therefore set to provide for reclamation of the greatest impacts or upstream sources while taking into consideration current or planned actions by the VCD and/or SSCWA, and others working in the watershed. As such, priorities were aligned to address the major discharges along the impaired tributaries to the main stem of South Sandy Creek, specifically Unnamed Tributary 51375 sites (Tipple and Woods Road) and Williams Run sites (Woods/Woods2, ARS, WRR5, WRL7 and Fleming) as opposed to addressing minor seeps along the main stem which, based on current data, are not impacting the stream to a point of impairment. By focusing on the main impairments first, it is anticipated that secondary priorities would address minor, low flow and minimally loading seeps along the main stem South Sandy Creek (SGL-1) and Beaver Pond Run (Mamula1&2, Regalman1&2, and BPR-1 thru 5). Implementation of proposed remedies along the Unnamed Tributary 51375 first, followed by implementation of remedies along Williams Run would result in the entire watershed meeting water quality criteria for its intended use.

The proposed schedule assumes funding will be available for each project at the time of implementation and property owner agreements and required partnerships will be in place. After completion of each project, an evaluation of the schedule is recommended in order to restore the South Sandy Creek Watershed in the most efficient and economical manner possible. Water quality milestones and progress evaluations detailed in the next section should be used to evaluate the progress of this restoration plan. The proposed schedule is to serve as a guide to implementation of restoration projects within the watershed and should be revised as needed.

WATER QUALITY MILESTONES AND PROGRESS EVALUATION

Water quality milestones will be used to evaluate the progress and degree of success in the implementation of the restoration plan. The projects planned for each year, as defined on the Proposed Implementation Schedule on the previous page, will serve as the implementation milestones of the restoration plan. When construction of a project is complete, the evaluation process will begin and the conceptual designs of the next project will be reconsidered to determine if changes should be made prior to submittal of a proposal for the next grant. Note

Table 12 – Proposed Implementation Schedule

Priority	Site	Apply for Funding		Design	Construction		Comments
1	Tipple	2/2009	10/2009	11/2009	4/2010	4/2011	Requires BAMR Partnership
2	Woods Road	2/2009	10/2009	11/2009	4/2010	4/2011	Concurrent with Tipple Site
3	Woods and Woods2	NA	NA	NA	NA	NA	Currently in Construction
4	ARS	2/2010	10/2010	11/2010	4/2011	4/2012	May Require BAMR Partnership
5	WRR5	2/2011	10/2011	11/2011	4/2012	4/2013	
6	WRL7	2/2011	10/2011	11/2011	4/2012	4/2013	
7	Fleming	2/2011	10/2011	11/2011	4/2012	4/2013	
8	Mamula1 Mamula2	2/2012	10/2012	11/2012	4/2013	4/2014	
9	SGL1	2/2012	10/2012	11/2012	4/2013	4/2014	
10	BPR4	2/2013	10/2013	11/2013	4/2014	4/2015	
11	Reagleman1 Reagleman2	2/2013	10/2013	11/2013	4/2014	4/2015	
12	BPR5	2/2014	10/2014	11/2014	4/2015	4/2016	Small Discharges to be Addressed Concurrently
13	BPR3	2/2014	10/2014	11/2014	4/2015	4/2016	
14	BPR2	2/2014	10/2014	11/2014	4/2015	4/2016	
15	BPR1	2/2014	10/2014	11/2014	4/2015	4/2016	

that upon completion of remediation of the top 5 priorities (excluding the Woods Sites, which are under construction), over 60% of the metal loadings within the watershed will have been addressed. When those priority sites have been addressed, the remaining sites will be reassessed to reconsider the priorities, and to assess the cost-effectiveness of continued remediation within the watershed.

Water monitoring will be conducted by SSCWA and its partners, which include, but are not limited to PADEP, VCD, and volunteers. When funding is available water samples should be collected and analyzed by a laboratory for standard mining parameters including flow, pH, alkalinity, acidity, iron, manganese, aluminum, sulfates, and suspended solids on a quarterly basis. Sampling procedures should follow those established by the VCD and SSCWA in collection of data for this Implementation Plan. If not already existing and if feasible, weirs should be constructed and maintained at each measurement point to help facilitate accurate flow measurements. If weir construct is not possible, stream cross-section methods as currently employed by the VCD, should be used. When funding is not available for laboratory analyses field measurements of pH, specific conductance and flow should be collected.

Monitoring should take place at in-stream sampling locations along the main stem and tributaries of South Sandy Creek which include Woods Road In-Stream, Mouth of Unnamed Trib 51375 (Unnamed), SS3, SS4, SS2, STB In-Stream, and BPR In-Stream. Monitoring should also take place at in-stream sampling locations along the main stem of Williams Run which include Ag Site, AARS, WR2, WRR3, Williams Run In-Stream, WRR1, and WR1. In addition, as each restoration project is completed, new monitoring points should be established at the influent and effluent for each passive treatment system as well as on the receiving stream above and below the final system effluent.

If performance of individual treatment systems is less than expected, SSCWA should seek funding to make adjustments to the treatment systems, as necessary, to try to improve results. If additional metals reductions or alkalinity increases are determined to be needed at some systems, an evaluation of the design parameters will be made, and changes such as enlargement of treatment ponds or adding treatment or settling ponds could be made.

Quarterly or once a year, at a minimum, the SSCWA will evaluate the available water quality data related to each newly installed treatment system and discuss the progress of the implementation plan. With each new passive treatment system installed, the degree of improvement to the impacted tributary and/or main branch of South Sandy Creek or Williams Run will be reported. In general, these improvements are expected to be reflected by increases in pH and alkalinity values and decreases in acidity, iron, manganese, and aluminum values. Implementation of the restoration plan shall continue until applicable prescribed reductions are achieved or water quality criteria have been met for all streams and tributaries of the South Sandy Creek Watershed. **Table 13** presents a general guide for in-stream reductions that should be observed after completion of each prioritized project and the cumulative reduction at specific sample points after completion of all projects. **Table 13** assumes projects are completed in the general order of priority with an average reduction of 95% for each sample location:

Table 13 - Anticipated Reduction Milestones at Specific Monitoring Points

Site/Project	Sample Location	Individual Project Reduction at Sample Location	Cumulative Reduction at Sample Location	Overall Watershed Reduction
Tipple	Woods Road In-Stream	74%	95%	40.1%
Woods Road		21%		
ARS	WR2	68%	95%	20.5%
WRR5		13%		
WRL7		14%		
Woods	Williams Run In-Stream	87%	95%	22.0%
Fleming		8%		
SGL1	SS2	95%	95%	3.8%
Mamula1 Mamula2	BPR In-Stream	47%	95%	13.5%
BPR4		20%		
Reagleman1 Reagleman2		12%		
BPR5		4%		
BPR3		6%		
BPR2		5%		
BPR1		1%		

Note that the Woods site was currently in construction at the time of this plan preparation.

If performance of individual treatment systems is less than expected, SSCWA should seek funding to make adjustments to the treatment systems, as necessary, to try to improve results. If additional metals reductions or alkalinity increases are determined to be needed at some systems, an evaluation of the design parameters will be made, and changes such as enlargement of treatment ponds or adding treatment or settling ponds could be made.

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Appendix A - Williams Run Watershed Assessment

Williams Run Watershed Assessment

Venango County, PA

Prepared for:
South Sandy Creek Watershed Association
August 2007

Prepared by:
Jennifer Hedglin
Wildlife Biologist

Funded by a grant from the
Coldwater Heritage Partnership

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Appendix

1. Water Sampling Data
2. Macro-Invertebrate Data Sheets

Special Thanks To:

South Sandy Creek Watershed Association
Pennsylvania Department of Environmental Protection – Bureau of Abandoned Mine Reclamation
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
Venango Chapter of Pennsylvania Senior Environmental Corps
Venango County Conservation District
Analytical Testing Services, Inc.
Best Printing of Oil City
Mineral Township
All private landowners

Photos were taken by Jennifer Hedglin.

Funding was provided by the Coldwater Heritage Partnership – a cooperative of the PA Council of Trout Unlimited, PA Department of Conservation and Natural Resources, PA Fish and Boat Commission, and the Western PA Watershed Program.

Overview

Newly formed in 2004, the South Sandy Creek Watershed Association (SSCWA) is a citizens group concerned about the past, present, and future of the South Sandy Creek Watershed. Their mission is "*to preserve, maintain, and restore the land, air, and water through community involvement and education*." Guided by a 7-member Board of Directors, the group has grown to include 50 members.

<u>Board of Directors</u>
Valerie Tarkowski, President
Chuck Woods, Vice President
Scott Fleming, Secretary
Richard McClung, Treasurer
Fred Krizinsky, Director
Larry Wheeler, Director
Steve Overholt, Director

To aide in accomplishing their mission, SSCWA was awarded a Coldwater Heritage Partnership (CHP) grant in 2006 to prepare a watershed assessment for the Williams Run Watershed, a sub-watershed to South Sandy Creek.

Goals

The goals of the Williams Run Watershed Assessment are:

- ✓ To collect water quality data
- ✓ To organize & compile data from previous sampling
- ✓ To identify all impacts affecting the watershed
- ✓ To inform & include the community of the work that is/will be done in the watershed
- ✓ To form & strengthen partnerships with various agencies
- ✓ To prepare a formal assessment that documents the findings & plans for the watershed

The plan will then be used to help prioritize and organize projects within Williams Run Watershed as work continues towards protection and remediation of this resource of both Venango County and the Commonwealth of Pennsylvania. This document should be an evolving plan of action for the Williams Run Watershed by updating the included information as projects are completed and more data is collected.

Sources of Data

The following groups and agencies have provided data for this study.

- Pennsylvania Department of Environmental Protection – Bureau of Abandoned Mine Reclamation (BAMR)
- Pennsylvania Fish and Boat Commission (PFBC)
- Venango Chapter of Pennsylvania Senior Environmental Corps (PaSEC)

Watershed Description

Location & Size

Williams Run Watershed is located in Venango County, Pennsylvania (see Map 1) and includes sections of Irwin, Mineral, and Victory Townships. The headwaters of Williams Run originate in Irwin Township, near the intersection of Georgetown and Millbrook Roads, and flows northeast for approximately 5.55 miles to its confluence with South Sandy Creek in State Game Lands (SGL) #39.

Williams Run Watershed drains approximately 4,010 acres with the majority of the watershed in Irwin Township (see Table 1 below).

Table 1. Township Drainage Within Williams Run Watershed

Township	Total Acres	Acres Included In Williams Run Watershed
Irwin	19,316.5	2,981.7
Mineral	14,366.0	891.2
Victory	13,235.8	137.2

Topography

The watershed is shown on the Polk and Barkeyville quadrangles of the United States Geological Survey (USGS) maps. While located in the Allegheny Plateau, topography of the watershed ranges from gently rolling hills at the headwaters to steep forested ravines through most of SGL #39. Elevations range from 1,540 feet to 1,160 feet, for a total vertical drop of approximately 380 feet over the length of Williams Run.

Geology

Sedimentary rocks, such as sandstone, shale, and siltstone, are located beneath Venango County. A brief description of the surface rocks is provided in Table 2.

Table 2. Surface Rocks Found In Williams Run Watershed

Time Period	Group	Description
Mississippian	Pocono	Sandstone, conglomerate, some shale Lowest lying
Pennsylvanian	Pottsville	Sandstone, small amount of shale Second lowest formation
Pennsylvanian	Allegheny	Coal, shale, some clay & sandstone, and limestone in southern part of the county Highest lying (closest to surface)

Source: Churchill, Norman J., Donald P Hipes, and Franklin S. Ackerman. 1975. *Soil Survey of Venango County, Pennsylvania.* United States Department of Agriculture Soil Conservation Service, Washington, D.C. 86 pp.

Soils

The following soil information was reported by Churchill, 1975.

The majority of Williams Run Watershed lies within the Hanover-Alvira association, however, a small portion of the headwaters lies within the Canfield-Ravenna association. The Hanover Series is characterized by deep, nearly level to very steep, moderately well drained and well drained soils on uplands. In winter and spring, the water table is at an average depth of 18-36 inches, which creates the limitation of a seasonal high water table. The Alvira Series is characterized by deep, nearly level to sloping, somewhat poorly drained soils on uplands. In winter and spring, the water table is at an average depth of 6-18 inches, which creates the limitation of a seasonal high water table. The native vegetation of both the Hanover and the Alvira Series is mostly mixed oaks, maple, ash, and black cherry.

The Canfield Series is characterized by deep, gently sloping to moderately steep, moderately well drained soils on uplands. In winter and spring, the water table is at an average depth of 18-36 inches, which creates the limitation of a seasonal high water table. The Ravenna Series is characterized by deep, nearly level to sloping, somewhat poorly drained soils on uplands. In winter and spring, the water table is at an average depth of 6-18 inches, which creates the limitation of a seasonal high water table. The native vegetation of both the Canfield and the Ravenna Series is mostly mixed oaks, maple, ash, and black cherry.

Twenty soil types were mapped within the Williams Run Watershed and are listed in Table 3 along with approximate acreage and limitations.

Table 3. Soil Types Found Within Williams Run Watershed

Soil Symbol	Soil Name	Approx. Acreage	Limitations
AlA	Alvira silt loam	114.01	Restricted permeability Seasonal high water table
AlB	Alvira silt loam	1118.18	Restricted permeability Seasonal high water table Erosion hazard
ArB	Alvira and Ravenna very stony silt loams	131.64	Stoniness Slow permeability Seasonal high water table
At	Atkins silt loam	55.84	Flood hazard Seasonal high water table
Bt	Brinkerton and Frenchtown very stony silt loams	35.80	Stoniness Slow permeability Seasonal high water table
CdB	Canfield gravelly silt loam	18.99	Erosion hazard Restricted permeability Seasonal high water table
FeA	Frenchtown silt loam	270.27	Restricted permeability Seasonal high water table
FeB	Frenchtown silt loam	31.59	Restricted permeability High water table
HaA	Hanover silt loam	27.17	Restricted permeability Seasonal high water table
HaB	Hanover silt loam	344.86	Erosion hazard Restricted permeability Seasonal high water table
HaC	Hanover silt loam	92.59	Erosion hazard Restricted permeability Seasonal high water table
HdB	Hanover very stony silt loam	216.49	Stoniness Restricted permeability Seasonal high water table
HdD	Hanover very stony silt loam	1101.64	Stoniness Restricted permeability Slope Seasonal high water table
HdE	Hanover very stony silt loam	10.77	Stoniness Steep slopes
HlB	Hazleton very stony loam	2.94	Stoniness
HnF	Hazleton and Gilpin very stony soils	117.20	Stoniness Steep slopes
Ph	Philo silt loam	72.59	Flooding Seasonal high water table
Po	Pope loam	17.83	Flooding hazard
RaA	Ravenna silt loam	33.29	Restricted permeability Seasonal high water table
Sm	Strip Mines	429.94	
W	Water	8.05	

Blue shaded rows indicate major components of Hydric Soils

Source: Churchill, Norman J., Donald P Hipes, and Franklin S. Ackerman. 1975. *Soil Survey of Venango County, Pennsylvania.* United States Department of Agriculture Soil Conservation Service, Washington, D.C. 86 pp.

Wetlands

Wetlands are defined by three criteria: the presence of hydric soils, a dominance of hydrophytic vegetation (plants with adaptations for surviving in seasonally wet growing conditions), and wetland hydrology. Wetlands are important for groundwater recharge, flood prevention, and wildlife habitat. Williams Run Watershed has 8.11 acres of wetlands (Table 4) identified on the National Wetlands Inventory (NWI) maps produced by the U.S. Fish and Wildlife Service. Although these identified wetlands are accurately depicted on the maps, the NWI maps are created by interpretation of satellite imagery and therefore are not a complete inventory of all wetlands. Since hydric soil must be present for a wetland, it can be assumed that the potential for at least an additional 349 acres of wetlands exist within the watershed.

In addition, there are man-made wetlands near Woods Corners that were created to treat abandoned mine drainage. The wetlands on the east side of Hells Kitchen Road have been drained while the wetland on the west side of Hells Kitchen Road is still in existence.

Table 4. Wetland Acreage and Description Based on National Wetlands Inventory Codes

National Wetlands Inventory Code	Acres Within Williams Run Watershed	Description
PUBZ	6.41	Palustrine, Unconsolidated bottom, Intermittently exposed/permanent
PFO1/SS1Y	0.30	Palustrine, Forested, Broad-leaved deciduous/Scrub-scrub, Broad-leaved deciduous, Saturated/semipermanent/seasonal
PSS1Y	1.40	Palustrine, Scrub-scrub, Broad-leaved deciduous, Saturated/semipermanent/seasonal

Biology

Vegetation

Williams Run Watershed lies in a temperate forest region (Molles, Jr. 1999) where one can find various tree species such as maples, oaks, cherries, and eastern hemlocks. In addition to the canopy level, various types of shrubs and herbaceous vegetation can be found (see Photo 1).

The mined lands generally contain pioneer species, such as bigtooth aspen (*Populus grandidentata*) and red pine (*Pinus resinosa*)

Photo 1. Fiddleheads, Indian pipes, and violets are just a few examples of the various herbaceous vegetation that can be found in Williams Run Watershed.

Wildlife
Numerous species of small mammals, songbirds, fish, waterfowl, and game birds, such as ruffed grouse (*Bonasa umbellus*) reside in the watershed. In addition, larger mammals such as fisher (Martes pennanti), mink (*Mustela vison*), porcupine (*Erethizon dorsatum*), coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*) (see Photo 2), and black bear (*Euarctos americanus*) can be found within the watershed boundaries.

A recent sighting of 13 timber rattlesnakes (*Crotalus horridus*) in the summer of 2007 by the Pennsylvania Game Commission is an exciting and noteworthy find due to the current decline in their population. These rattlesnakes are listed as a candidate species in Pennsylvania, meaning that they may reach the threatened or endangered status.

Photo 2. White-tailed deer fawn seeking refuge near the confluence of Williams Run & South Sandy Creek.

Species of Special Concern

Results from DCNR's Pennsylvania Natural Diversity Index (PNDI) indicated no species of special concern within the Williams Run Watershed. However, results from PFBC and DCNR have shown that species of special concern are found within the South Sandy Creek Watershed (see Table 5 below).

Table 5. Species of Special Concern Found Within South Sandy Creek Watershed

Common Name	Scientific Name	Status
Eastern Massasauga	*Sistrurus catenatus catenatus*	PA Endangered
Spotted darter	*Etheostoma maculatum*	PA Threatened
Ohio lamprey	*Ichthyomyzon bdelloim*	PA Candidate
Longhead darter	*Percina Macrocephela*	PA Threatened
Small Wood Flower	Helianthus microcephalus	PA Tentatively Undetermined

Land Use

With 1,615 acres of Williams Run Watershed located in SGL #39, the majority (76.8%) of the watershed is forested, open land used for wildlife habitat and recreation (see Map 2). Agriculture is present in the watershed and accounts for 12.6% of the land use. Abandoned mine lands accounts for 11.6% and are largely found at Woods Corners and along Allen Road.

The major industries for Venango County are manufacturing with 3,865 paid employees and health care/social assistance with 3,215 paid employees. (Please note that mining, utilities, and construction data is not published by counties.)

Climate

Located in a humid, continental type climate, Venango County has an average summer temperature of 68°F and an average winter temperature of 26°F. The average precipitation for the area is 42 inches annually.

Demographics & Population Centers

By using the 2000 United States Census Data, the following statistics have been noted in Table 6.

Table 6. Demographics

Location	2000 Population	Square Miles	Population Density Per Square Mile
Pennsylvania	12,281,054	44,816.61	274.0
Venango County	57,656	675	85.3
Irwin Township	1309	30.2	43.4
Mineral Township	533	22.5	23.7
Victory Township	408	19.9	20.5

Currently, there are no population centers in existence within Williams Run Watershed. The small village of Pearl is located near the intersection of Slatertown Road and Old Route 8.

Existing & Potential Uses of Watershed

With 40% of the land being classified as public lands, recreational activities are nearly endless. SGL #39 provides excellent hunting and fishing opportunities, along with hiking, horseback riding, cross-country skiing, bird watching, and other wildlife observing.

However, it is the potential that this watershed has that keeps SSCWA and its partners pushing forward. In September 2005, a fisheries survey of Williams Run Watershed by the Pennsylvania Fish and Boat Commission (PFBC), found wild brook trout *(Salvelinus fontinalis)* in a tributary to Williams Run. By restoring Williams Run Watershed, the wild brook trout will be able to expand their range throughout the watershed and ultimately form one large, genetically diverse population within the South Sandy Creek Watershed instead of several isolated populations scattered throughout (see Map 3).

In addition, other wildlife species, the community, and area visitors would benefit from a cleaner watershed.

Unique and/or Outstanding Features

- Remoteness – As stated earlier, SGL #39 provide 1,615 acres of remote wilderness open to the public.
- Sound Land Management – Those same 1,615 acres are under the management of the Pennsylvania Game Commission so they are being managed & protected as wildlife habitat.
- Impact – In addition to improving the Williams Run Watershed with remediation efforts, a significant improvement will also be made in the South Sandy Creek Watershed (SSCW) because Williams Run is a major polluter of SSCW.
- Native Wild Brook Trout –Tributary #51365 (locally known as the East Branch) to Williams Run is listed on the PFBC's Pennsylvania Stream Sections that Support Native Reproduction of Trout (revised 2007). The data collected in 2005 show native brook trout is the species that placed the tributary on the list.

Data & Recommendations

Water Sampling

Six points were sampled monthly in Williams Run Watershed over the course of the CHP grant. The points were already established by Jon Smoyer of BAMR and were part of his routine sampling for the area (see Map 4). The assessor (Jennifer Hedglin) partnered with Smoyer to adopt the sites for quarterly sampling and then to share all data collected by both parties. The samples collected by Hedglin were analyzed at Analytical Testing Services, Inc. of Franklin, PA.

Additional data was included on both the 6 sites sampled by Hedglin and on other sites in the watershed to try to get a complete picture.

The results from the water quality sampling confirm Williams Run Watershed is not achieving its designated use as a coldwater fishery. Low alkalinity and high metals are the main threats, which stem from pollution from abandoned mine drainage.

However, the headwaters of Williams Run (WRHW) are meeting the requirements for a coldwater fishery, so the degradation of this watershed begins below the headwaters.

A summary table is included on the next page of the averages of each sampling point. A complete data table for each sampling point is included in Appendix 1. Table 8 includes the location and description of each sampling point.

> Recommendations: Continue following a water sampling schedule to collect data and keep a water quality database up-to-date. It may be beneficial to include Tributary #51365 (East Branch) in a routine sampling schedule to detect any decline in the water quality.
>
> Conducting a visual assessment of both the stream and riparian zone would be beneficial to develop a greater understanding of what is affecting the watershed.

Table 7. Summary Table of Water Quality Data for Williams Run Watershed

Location	**# of Samples**	**Source of Data**	**Flow** (gpm) or **SWL** (inches)	**pH** (Lab)	**Cond.** (Lab)	**Alk** (Lab)	**Acidity**	**Iron**	**Mn**	**Al**	**SO4**	**TSS**	**TDS**	**Hardness**
					uohms/cm	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
WRHW	9	BAMR	x	6.9	0.00	44.56	-6.13	0.97	0.34	0.55	27.14	8.60	x	x
WRR5	13	CHP, BAMR	x	4.2	445.75	8.15	106.02	15.29	6.94	7.40	565.54	5.13	294.25	421.43
WRL7	16	CHP, BAMR	77.72	4.4	104.23	5.24	46.18	1.64	1.78	1.93	86.19	4.23	52.77	51.23
WR2	16	CHP, BAMR	83.93	4.0	241.33	3.65	48.71	2.70	3.25	1.85	217.48	4.54	159.10	152.07
WRR4	7	BAMR	x	3.8	x	0.54	54.46	1.537	3.24	3.80	168.31	3.1	x	x
WRL6	1	BAMR	x	5.9	x	7.80	9.80	0.111	0.09	0.20	20.00	2.0	x	x
WRR3	7	BAMR	x	3.3	x	0	133.03	6.94	8.12	10.71	597.50	4.29	x	x
WRR2	1	BAMR	x	5.0	x	6.80	12.20	0.05	0.24	0.45	20.00	12.00	x	x
WRR1	1	BAMR	x	4.0	x	1.00	49.80	2.07	2.21	3.23	152.80	8.00	x	x
WRL5	1	BAMR	x	6.6	x	11.40	24.20	0.16	0.06	0.20	20.00	4.00	x	x
WRL4	1	BAMR	x	6.7	x	23	25.8	2.33	0.11	0.2	20	14	x	x
WRL3	1	BAMR	x	5.8	x	7.80	8.80	0.06	0.03	0.20	20.00	6.00	x	x
WRL2	1	BAMR	x	6.4	x	9.00	6.40	0.06	0.01	0.20	20.00	6.00	x	x
WRL1	1	BAMR	x	5.9	x	7.60	7.60	0.02	0.06	0.20	20.00	4.00	x	x
WR1	19	CHP, BAMR, TAG	x	5.4	290.48	8.44	39.41	0.38	1.00	0.90	113.36	3.41	56.50	x
AARS	10	BAMR	x	7.4	x	117.36	-82.38	0.51	0.32	0.83	57.29	5.3	x	x
ARS	19	CHP, BAMR	x	3.1	796.76	65.41	769.98	139.28	4.37	36.63	864.71	17.25	422.45	259.95
Woods	12	CHP, BAMR	x	3.3	603.5	9.83	287.19	11.85	12.70	29.53	607.47	x	398.00	388.7

Water Quality Criteria for a Coldwater Fishery:

pH = 6.0 to 9.0
Alkalinity = minimum of 20 mg/l, except where natural conditions are less
Iron = 1.5 mg/l as 30-day average
Manganese = maximum of 1.0 mg/l
Sulfate = maximum of 250 mg/l
Total Dissolved Solids (TDS) = 500 mg/l as monthly average; maximum of 750 mg/l

Sources of Data:

CHP = Coldwater Heritage Partnership (grant to fund sample analysis)
BAMR = Bureau of Abandoned Mine Reclamation
TAG = Technical Assistance Grant from PA DEP

Table 8. Location & Description of Water Sampling Points

Location	Type	Latitude	Longitude	Description
WRHW	stream	41-15-02	079-58-14	Headwaters of Williams Run at Hells Kitchen Road
WRR5	discharge	41-15-15	079-57-53	**W**illiams **R**un **5**th tributary on **R**ight Discharge from Gadsby Pond
WRL7	stream	41-15-35	079-57-33	**W**illiams **R**un **7**th tributary on **L**eft
WR2	stream	41-15-37	079-57-36	**W**illiams **R**un
WRR4	stream	41-15-41	079-57-37	**W**illiams **R**un **4**th tributary on **R**ight
WRL6	stream	41-15-45	079-57-36	**W**illiams **R**un **6**th tributary on **L**eft
WRR3	discharge	41-15-54	079-57-41	**W**illiams **R**un **3**rd tributary on **R**ight
WRR2	stream	41-16-15	079-57-31	**W**illiams **R**un **2**nd tributary on **R**ight
WRR1	stream	41-16-32	079-56-50	**W**illiams **R**un **1**st tributary on **R**ight
WRL5	stream	41-16-32	079-56-52	**W**illiams **R**un **5**th tributary on **L**eft
WRL4	discharge	41-16-34	079-56-46	**W**illiams **R**un **4**th tributary on **L**eft
WRL3	stream	41-16-59	079-56-49	**W**illiams **R**un **3**rd tributary on **L**eft
WRL2	stream	41-17-12	079-56-41	**W**illiams **R**un **2**nd tributary on **L**eft
WRL1	stream	41-17-17	079-56-41	**W**illiams **R**un **1**st tributary on **L**eft
WR1	stream	41-17-45	079-57-04	**W**illiams **R**un
AARS	stream	41-14-56	079-58-11	**A**bove **A**llen **R**oad **S**ite
ARS	stream	41-14-56	079-59-04	**A**llen **R**oad **S**ite
Woods	discharge	41-15-55	079-58-10	Discharge to Chuck Woods' Upper Pond

Table 9. Summary Table of Major Impacts to Water Quality within Williams Run Watershed

Site	Major Impacts Affecting Water Quality	Cause	Recommendation
WRR5	Low pH & Alkalinity High iron, manganese, sulfate	Abandoned Mine Drainage (AMD)	Also known as the Gadsby pasture site. This is the discharge with the highest iron and second highest acidity loading in the Williams Run watershed with 22 pounds per day (PPD) and 137 ppd respectively. The source of AMD is not fully known. It is most likely pyretic spoil or buried coal refuse upgradient of the seep area. Exploratory drilling could help determine the source of the AMD as well as the source of the groundwater recharge generating the AMD. Land reclamation to remove of abate the source of the problem is recommended. The chemistry, flow variations and site constraints do not easily accomodate passive treatment of this discharge. The pond located upslope of the seep area, from which there is no visible discharge is suspected of being a constant source of recharge to the problem.
WRL7	Low pH & Alkalinity High iron, manganese	AMD	This discharge is the lowest ranked source of AMD pollution to Williams Run. The mild AMD chemistry originates in the abandoned surface mine pits on SGL. No. 39 and property owned by John Clark. Mr. Clark has already stated to BAMR his desire not to have the pit reclaimed. Water remediation in the pit without reclamation may be possible, but may also interfere with future reclamation of the physical hazard of the highwall and pit. Given that this discharge is the smallest in terms of AMD loading to the watershed, it is recommended that it should be the last to be addressed unless Mr. Clark consents to land reclamation at which time the highwall and AMD can be addressed in a single mine reclamation project.
WR2	Low pH & Alkalinity High iron, manganese	AMD	This is Williams Run at its midpoint. It is located downstream of ARS, WRR5 and WRL7. Reclamation or treatment of the AMD problems upstream should be addressed to restore this point in the stream.
WR1	Low pH & Alkalinity	AMD	This is Williams Run at the confluence with South Sandy Creek. As such it is located downstream of all AMD problems. Reclamation or treatment of the AMD problems upstream should be addressed to restore this stream.

ARS	Low pH High iron, manganese, sulfate	AMD	Known as the Allen Road Site.This is the 3rd highest source of AMD loading to the watershed. It is located in the very headwaters. The source of the AMD is coal refuse and acidic spoil on abandoned mine lands parallel to Allen Road. Testing of the coal refuse shows it to be of little to no fuel value in terms of BTU and is highly pyretic. Removal of the acid forming materials would be the best reclamation option. However, removal may be cost prohibitive. Another possible reclamation option is to blend the acid forming materials with an alkaline product in order to both neutralize and encapsulate them. And prevent contact with air and water. This may still be a very costly venture, The contour of the site would have to be adjusted to accommodate the large volume of material needed to offset the volume of acid forming materials. These seeps are low in flow and as such give the site a moderate rank in terms of loading. The site does exhibit the worst AMD chemistry in the watershed. Passive treatment of this chemistry is not technically feasible for any sustainable period of time. Active chemical treatment of the seeps would result in sludge that must be handled. Land reclamation is clearly the best option to remedy this site.
Woods	Low pH & Alkalinity High iron, manganese, sulfate	AMD	This site is the source of the highest acidity loading (142ppd) and aluminum loading (15.ppd) in the Willaims Run watershed. The South Sandy Watershed Association currently has plans to convert the abandoned surface mine pond owned by Charles Woods into a passive treatment system. The group should move forward with the design and construction of the system. Long term operation and maintenance of the system should be considered prior to construction.

Macro-invertebrate Sampling
The Venango Chapter of the PaSEC partnered with SSCWA and agreed to do macro-invertebrate sampling at two of the sampling points. By using the PA DEP Citizens' Volunteer Monitoring Protocol, they concluded that WR1 (near mouth of Williams Run) and WR2 (~3.4 river miles upstream) are classified as "poor" water quality due to the lack of sensitive species being present. Their completed data sheets are included in Appendix 2.

> Recommendations: Continue monitoring macro-invertebrate populations in Williams Run Watershed.

Fish Sampling
PFBC sampled the main branch of Williams Run at several locations using electro-fishing gear (see Photo 3). One point (river mile 1.62) was sampled in 1998 and again in 2005 to determine any changes (see Table 9). While there was a change, it was for the worse with 2 species of fish found in 1998 and then 0 in 2005.

Photo 3. PFBC & SSCWA sampling Unknown Tributary to Williams Run

However, the water quality of Tributary #51365 (East Branch) to Williams Run was stable due to the presence of wild brook trout in 1998 and in 2005 (see Photo 4 & Table 10), demonstrating that this watershed has the potential to house a healthy population of wild brook trout. By taking a look at the whole South Sandy watershed (see Map 3), one can see the various isolated populations of wild brook trout that could eventually become one large population.

> Recommendations: Continue monitoring the brook trout populations in the Williams Run & South Sandy Creek Watersheds.

Photo 4. Wild brook trout sampled from Tributary #51365 (East Branch) to Williams Run.

Abandoned Mine Drainage (AMD) & Abandoned Mine Lands (AML)

The combination of these two issues is the primary threat to Williams Run Watershed. With 1,956 acres of AML in Venango County, nearly one quarter (~463 acres) of those are within the Williams Run Watershed. Various portions of the streams in this watershed are considered "dead" due to the impact that AMD has had on the streams (see Photo 5), consequently, Williams Run and 4 of its tributaries are listed as a Category 5: Impaired Streams Requiring TMDLs (PA DEP 2006). In addition, dangerous highwalls can be found in the watershed as well.

At the time of this assessment, several projects are getting started to help make the community safer by eliminating dangerous highwalls and alleviating some of the stress on the aquatic ecosystems. The projects include filling & sloping the highwalls along Hells Kitchen Road and directing the flow of AMD to an inclined limestone bed for treatment.

> Recommendations: Continue working on remediation projects & educating the public about the significance of these projects to continue building local support.

Photo 5. Confluence of Unknown Tributary & Williams Run. Note the aluminum (silver or whitish color) in Williams Run.

Table 10. Fish Sampling Data on Williams Run

		February 23, 1982	June 23, 1998	June 28, 2004	Sept. 12, 2005
		Site 05	rm 1.62	rm 0.03	rm 1.62
Rhinichthys atratulus	Blacknose Dace	NO FISH COLLECTED	✓	NO FISH COLLECTED	NO FISH COLLECTED
Salvelinus fontinalis	Brook Trout				
Salvelinus fontinalis	Brook Trout - hatchery				
Salmo trutta	Brown Trout				
Campostoma anomalum	Central Stoneroller				
Luxilus cornutus	Common Shiner				
Semotilus atromaculatus	Creek Chub		✓		
Etheostoma flabellare	Fantail Darter				
Etheostoma blennioides	Greensided Darter				
Etheostoma nigrum	Johnny Darter				
Rhinichthys cataractae	Longnose Dace				
Cottus bairdi	Mottled Sculpin				
Hypentelium nigricans	Northern Hog Sucker				
Lepomis gibbosus	Pumpkinseed				
Clinostomus elongatus	Redside Dace				
Catostomus commersoni	White Sucker				
	Total # of species	0	2	0	0

Table 11. Fish Sampling Data on Tributary #51365 (East Branch) to Williams Run
At Latitude 41° 16’ 32” Longitude 079° 56’ 53”

		June 23, 1998	Sept. 12, 2005
		rm 0.00	rm 0.00
Rhinichthys atratulus	Blacknose Dace	✓	✓
Salvelinus fontinalis	Brook Trout	✓	✓
Salvelinus fontinalis	Brook Trout - hatchery		
Salmo trutta	Brown Trout		
Campostoma anomalum	Central Stoneroller		
Luxilus cornutus	Common Shiner		
Semotilus atromaculatus	Creek Chub	✓	✓
Etheostoma flabellare	Fantail Darter		
Etheostoma blennioides	Greensided Darter		
Lepomis cyanellus	Green Sunfish		✓
Etheostoma nigrum	Johnny Darter		
Rhinichthys cataractae	Longnose Dace		
Cottus bairdi	Mottled Sculpin	✓	✓
Hypentelium nigricans	Northern Hog Sucker		
Lepomis gibbosus	Pumpkinseed		
Clinostomus elongatus	Redside Dace		
Catostomus commersoni	White Sucker		✓
	Total # of species	4	6

Riparian Vegetation

The upper portions of Williams Run lack riparian vegetation in various spots. One example would be the stretch of stream that flows across a cow pasture along Hells Kitchen Road.

With the lower portions of Williams Run lying in SGLs, there is adequate riparian vegetation in existence.

> Recommendations: Check into various grants (Partners for Fish and Wildlife Program, National Fish and Wildlife Foundation General Matching Grants, etc.) to help fund streambank fencing projects to keep livestock out of streams and to also plant native species. Educate the community on the importance of riparian vegetation and overall water quality.

Illegal Dumps

During surveys of the watershed, illegal dumps were not located within Williams Run Watershed. After consulting several other agencies that frequently work in the area, no illegal dumps were identified.

One issue that was identified was littering. On several occasions, a bag of trash was left along side the road.

> Recommendations: To prevent illegal dumps from becoming a problem, set up neighborhood patrols, educate the community, and host another trash day where the community can get rid of large items responsibly.

Invasive Species

The presence of invasive species does not seem to be a primary threat currently in the watershed. It was not the purpose of this assessment to do a complete vegetative survey, however, Knotweed (*Polygonum* sp.) was located along Alan road.

> Recommendations: While removal of the presently occurring invasive species may not be feasible, preventing them from moving onto another site is highly recommended. When the vegetation is disturbed on any remediation project, plant native species whenever possible. Also, educate the community on the importance of landscaping with native species.

Public Participation

The first public meeting was held on April 6, 2006 to announce the grant & also to get any public input on the project. The public meetings were advertised in local newspapers. The SSCWA Board reviewed the plan on September 6, 2007 and the second public meeting was held on October 4, 2007 at the Mineral Township building.

Conclusion
Williams Run Watershed provides a unique wilderness experience and has the potential to increase wildlife habitat and recreational activities for its visitors. Protecting and improving this watershed will also result in improved wildlife habitat in the South Sandy Creek Watershed.

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tree_id=4001&-redoLog=true&-geo_id=04000US42&-format=ST-2|ST-2S&-_lang=en

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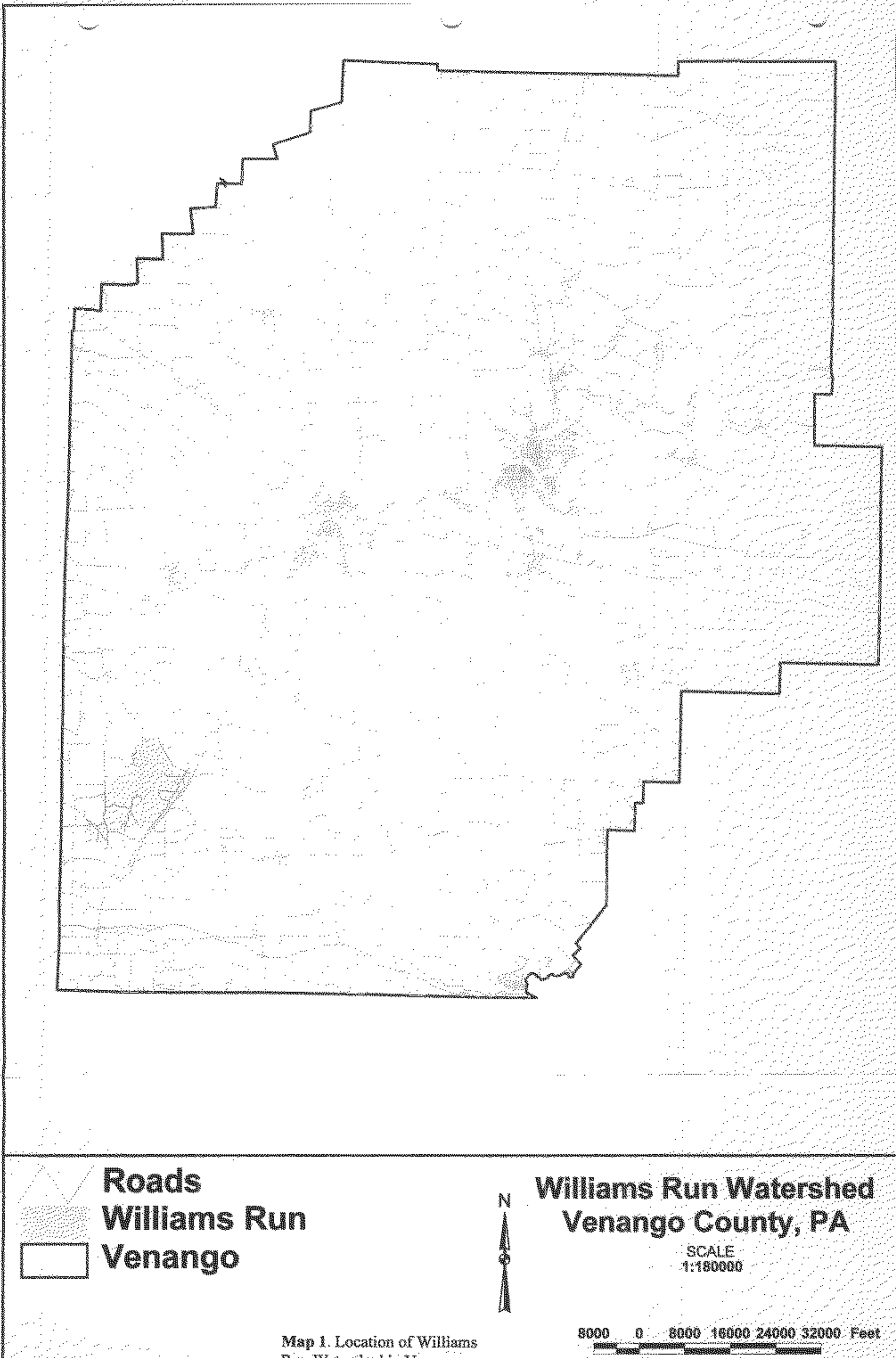
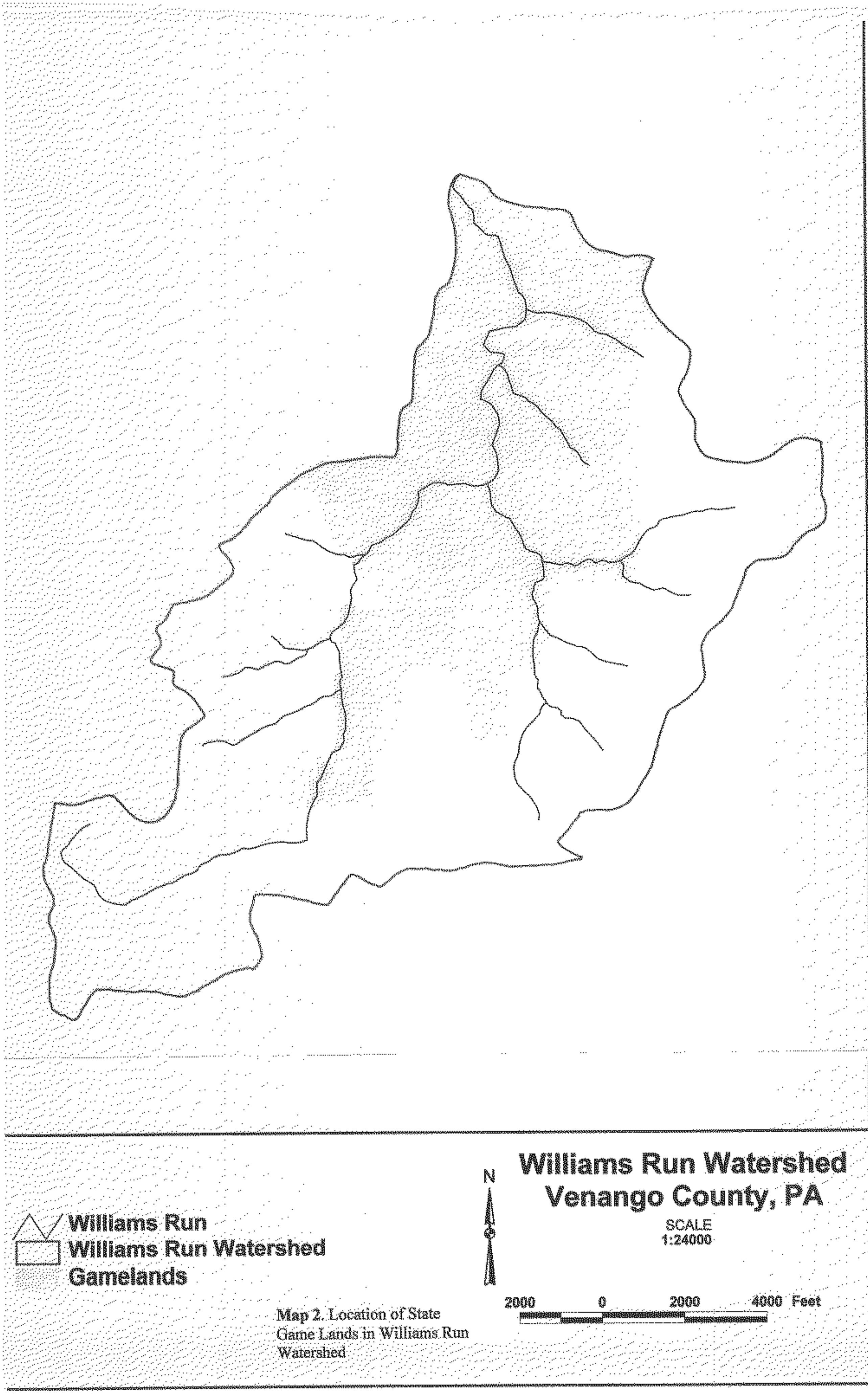
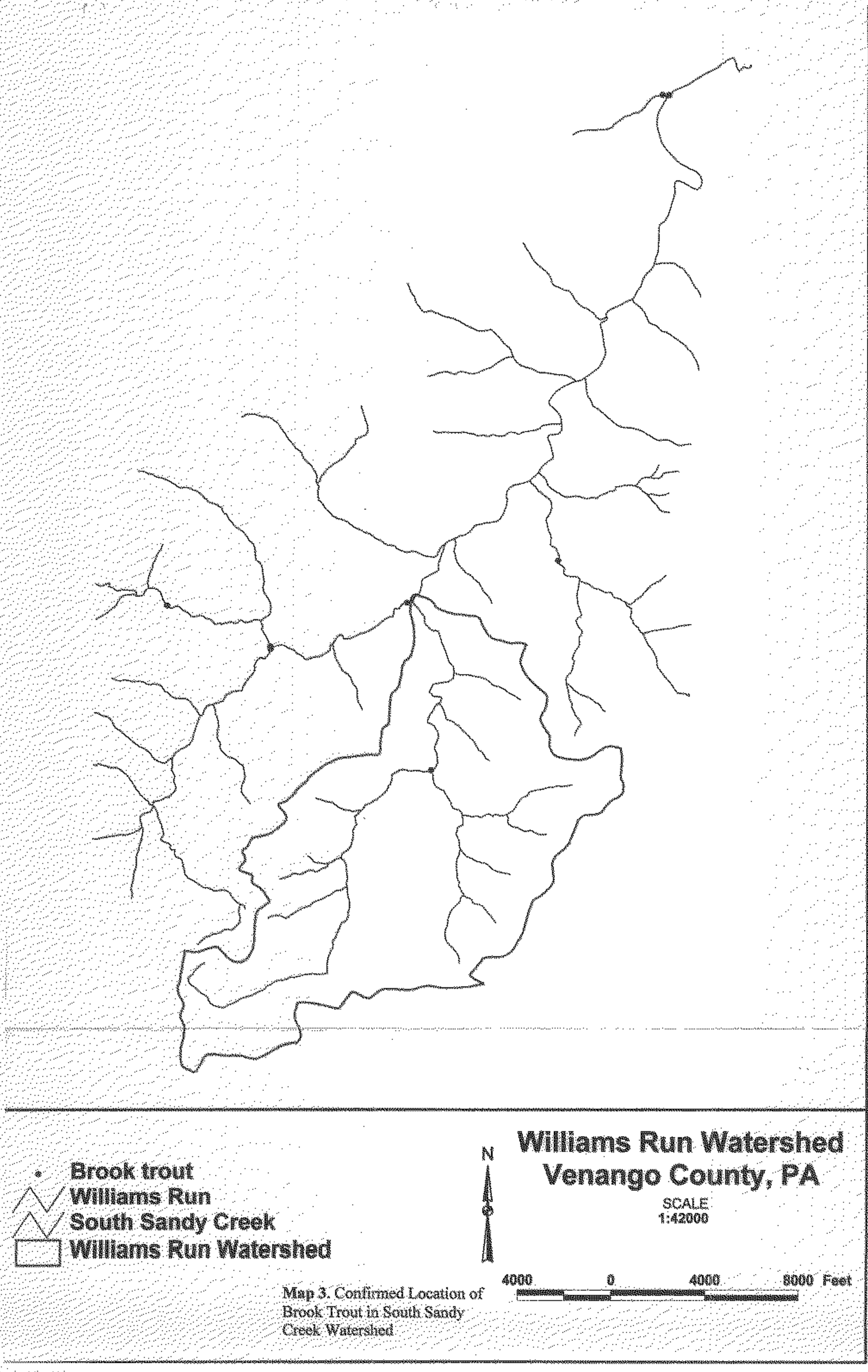
MAPS



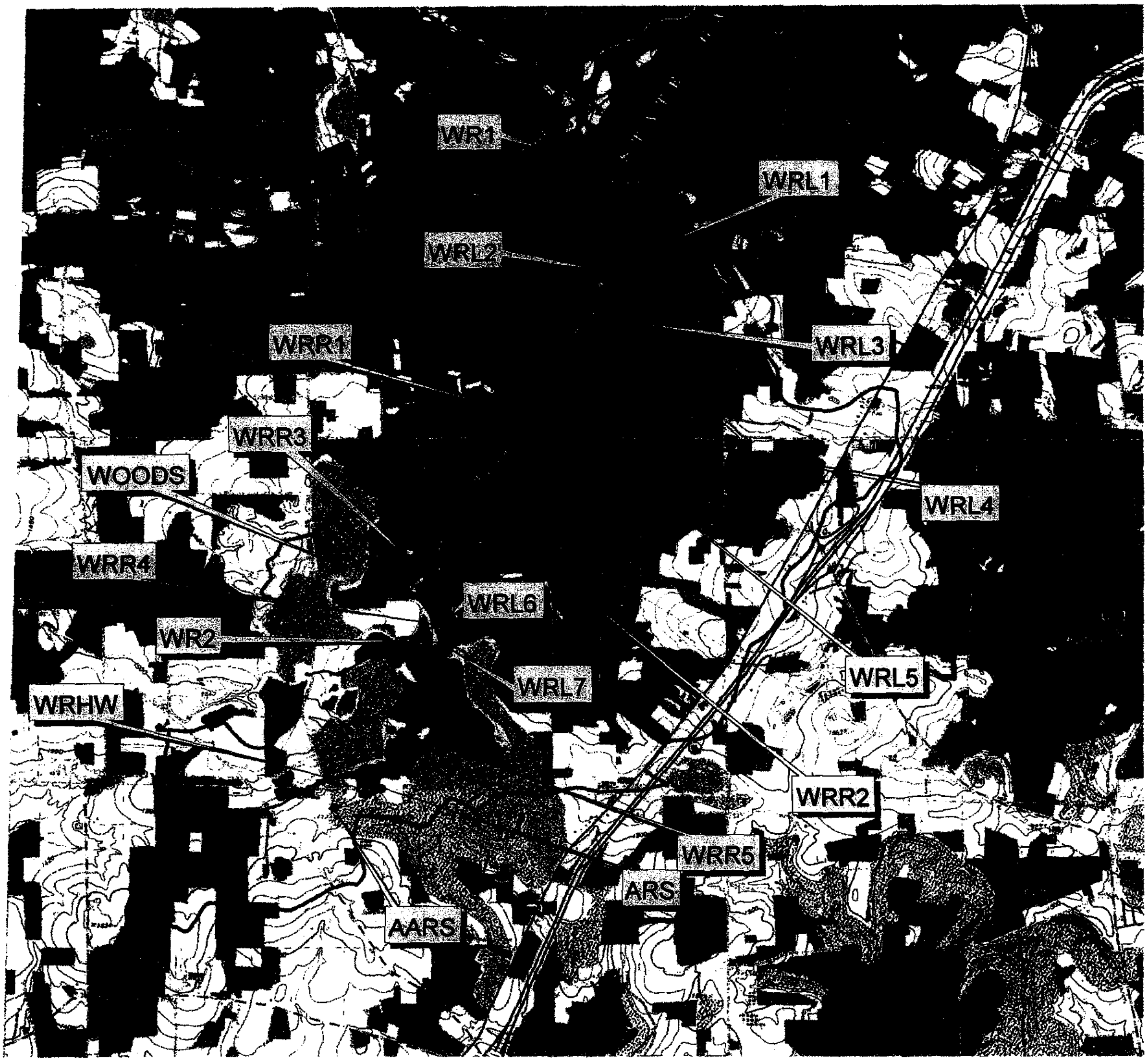
Map 1. Location of Williams Run Watershed in Venango County

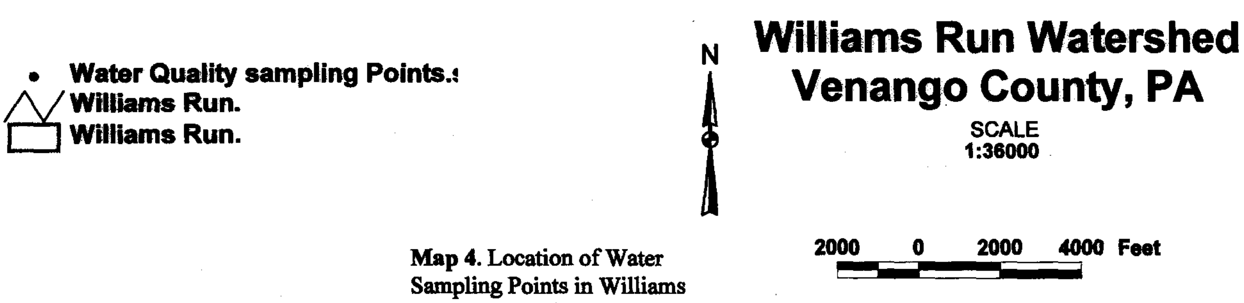


Map 2. Location of State Game Lands in Williams Run Watershed



Map 3. Confirmed Location of Brook Trout in South Sandy Creek Watershed





Map 4. Location of Water Sampling Points in Williams Run Watershed

Appendix 1

Water Sampling Data

Williams Run Watershed
Williams Run Headwaters - along Hells Kitchen Road

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	5/18/04	WRHW			7			33.20	35.20	1.520	0.38	0.699	21.00	32.0		
BAMR	7/7/04	WRHW			7			40.80	9.80		0.05		37.40			
BAMR	6/15/05	WRHW			6.9			62.00	-13.60	2.070	0.91	0.77		12.0		

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Tributary to Williams Run - on Gadsby's property

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	8/19/05	WRR5			4.5			16.40	50.00	9.50	6.90	2.36	823.80	12.0		
BAMR	12/22/05	WRR5			4.8			11.40	100.00	20.50	7.74	7.19	722.10			
BAMR	3/20/06	WRR5			4.4			7.80	88.00	16.40	6.71	7.39	587.20			
BAMR	4/20/06	WRR5			4.6			9.60	84.40	15.10	6.60	6.41	646.30	6.0		
CHP	5/25/06	WRR5			3.2	202		28.00	121.00	2.59	4.61	6.61	100.00		133.0	47
BAMR	6/15/06	WRR5			4.0			2.80	105.40	17.90	6.12	9.40	633.00			
BAMR	7/26/06	WRR5			4.0			1.60	108.60	17.80	5.82	7.82	630.90	4.0		
CHP	8/17/06	WRR5			4.5	589		2.00	63.50	3.40	3.45	2.27	110.00		389.0	671.1
BAMR	9/15/06	WRR5			3.7			0.00	89.80	15.50	5.54	6.86	556.50	4.0		
BAMR	10/16/06	WRR5			4.4			9.40	113.00	20.60	6.57	9.61	647.20			
CHP	11/18/06	WRR5			4.1	435		5.00	207.00	19.60	10.15	9.76	550.00		287.0	339.7
BAMR	12/12/06	WRR5			4.4			8.00	118.00	20.10	6.73	11.00	605.00	6.0		
CHP	2/26/07	WRR5			4.5	557		4.00	129.50	19.77	13.29	9.56	740.00		368.0	627.9

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Tributary to Williams Run - on SGL #39

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab) uohms/cm	Temp. °C	Alk (Lab) (mg/L)	Acidity (mg/L)	Iron (mg/L)	Mn (mg/L)	Al (mg/L)	SO4 (mg/L)	TSS (mg/L)	TDS (ppm)	Hardness (mg/L)
BAMR	3/31/04	WRL7			4.5			6.40	58.60	0.675	1.55	3.16	77.00	6.0		
BAMR	8/19/05	WRL7			4.0			2.40	45.20	3.800	2.75	2.98	120.20	4.0		
BAMR	9/12/05	WRL7			4.0			2.60	77.40	1.890	2.50	2.73	112.60	10.0		
BAMR	11/9/05	WRL7	21.70		4.1			3.40	70.20	0.460	2.17	1.97	107.00			
BAMR	12/22/05	WRL7	27.50		4.4			6.20	64.80	0.895	2.10	2.35	90.70			
BAMR	1/24/05	WRL7	103.00		4.7			6.60	47.00	0.736	1.02	1.25	59.50			
BAMR	3/20/06	WRL7	110.00		4.7			6.80	31.40	0.823	0.95	1.33	71.70			
BAMR	4/20/06	WRL7	29.00		4.6			7.40	59.00	1.550	1.66	1.80	93.60	8.0		
CHP	5/25/06	WRL7			4.35	98.8		2.00	45.50	0.640	1.45	1.55	70.00		15.3	61.1
BAMR	6/15/06	WRL7	15.00		4.3			4.80	21.20	2.330	1.89	2.26	85.70			
BAMR	7/26/06	WRL7	84.00		4.4			5.60	13.80	1.600	1.00	0.73	66.70			
CHP	8/17/06	WRL7			4.48	133		2.00	63.50	3.400	3.45	2.27	110.00		89.6	92.6
BAMR	9/15/06	WRL7	243.00		4.7			7.60	16.60	1.560	1.27		90.70			
BAMR	10/16/06	WRL7	72.00		4.6			8.40	19.20	2.210	1.50	2.43	79.20			
CHP	11/18/06	WRL7			4.22	80.9		3.00	66.00	1.330	1.75	1.59	70.00		53.4	0
BAMR	12/12/06	WRL7	72.00		4.9			8.60	39.40	2.310	1.45	2.02	74.50			

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Williams Run - on SGL #39

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	6/15/05	WR2	83.93		3.6			0.00	49.80	2.840	3.97	2.27	286.40			
BAMR	7/20/05	WR2			3.6			0.00	56.00	2.290	3.60	0.89	280.20			
BAMR	8/19/05	WR2			3.6			0.00	47.80	3.060	5.28	1.21	272.60	4.0		
BAMR	9/12/05	WR2			3.7			0.00	70.00	2.230	4.34	1.13	297.30	14.0		
BAMR	12/22/05	WR2			4.5			7.00	50.40	7.280	3.62	1.73	222.70			
BAMR	1/24/06	WR2			4.6			6.20	46.00	2.870	1.36	1.30	119.80	6.0		
BAMR	3/20/06	WR2			4.3			5.20	36.60	3.930	2.22	2.09	171.40	4.0		
BAMR	4/20/06	WR2			4.0			1.40	38.00	2.120	3.02	1.61	234.00	6.0		
CHP	5/25/06	WR2			3.9	229		5.00	70.50	1.450	3.38	2.31	175.00		151.0	174.60
BAMR	6/5/06	WR2			3.7			0.00	44.40	1.700	3.94	3.68	337.20			
BAMR	7/26/06	WR2			4.1			3.00	21.60	1.390	2.08	1.09	169.20			
CHP	8/17/06	WR2			3.5	358		13.00	77.50	0.720	6.11	2.36	315.00		236.0	277.70
BAMR	9/15/06	WR2			4.4			6.80	20.40	2.510	1.28	1.48	61.30			
BAMR	10/16/06	WR2			4.0			2.20	33.80	2.930	3.14	2.61	239.20			
CHP	11/16/06	WR2			4.6	137		1.00	70.00	2.090	2.15	1.24	130.00		90.3	3.90
BAMR	12/12/06	WR2			4.6			7.60	46.60	3.750	2.58	2.63	168.40	4.0		

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRR4			4			1.40	52.20	1.070	1.94	2.99	84.10	4.0		
BAMR	7/7/04	WRR4			3.5			0.00	69.60	2.420	4.97	5.52	313.90	[illegible]		
BAMR	12/22/05	WRR4			3.8			0.00	49.20	1.280	3.06	2.96	151.70	[illegible]		
BAMR	4/20/06	WRR4			3.8			0.00	70.00	0.781	3.16	3.58	150.70	[illegible]		
BAMR	6/15/06	WRR4			3.6			0.00	56.20	0.979	4.27	5.44	258.70	[illegible]		
BAMR	10/16/06	WRR4			3.7			0.00	46.20	2.450	3.01	3.29	140.20	[illegible]		
BAMR	12/12/06	WRR4			4.0			2.40	37.80	1.780	2.30	2.81	78.90	[illegible]		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRL6			5.9			7.80	9.80	0.111	0.09					

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab) uohms/cm	Temp. °C	Alk (Lab) (mg/L)	Acidity (mg/L)	Iron (mg/L)	Mn (mg/L)	Al (mg/L)	SO4 (mg/L)	TSS (mg/L)	TDS (ppm)	Hardness (mg/L)
BAMR	3/24/04	WRR3			3.4			0.00	141.20	9.930	7.33	12.30	543.70	4.0		
BAMR	7/7/04	WRR3			3.1			0.00	164.60	5.180	9.75	12.80	782.10			
BAMR	12/22/05	WRR3			3.8			0.00	73.40	4.430	7.38	6.28	543.40			
BAMR	4/20/06	WRR3			3.3			0.00	126.00	5.450	8.36	10.00	538.00	10.0		
BAMR	6/15/06	WRR3			3.1			0.00	161.40	6.150	8.45	12.40	727.70			
BAMR	10/16/06	WRR3			3.2			0.00	143.20	8.890	8.06	11.00	542.00	3.0		
BAMR	12/12/06	WRR3			3.4			0.00	121.40	8.530	7.51	10.20	505.60	4.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab) uohms/cm	Temp. °C	Alk (Lab) (mg/L)	Acidity (mg/L)	Iron (mg/L)	Mn (mg/L)	Al (mg/L)	SO4 (mg/L)	TSS (mg/L)	TDS (ppm)	Hardness (mg/L)
BAMR	3/24/04	WRR2			5			6.80	12.20	0.046	0.24	0.45		12.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRR1			4.0			1.00	49.80	2.070	2.21	3.23	152.80	8.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRL5			6.6			11.40	24.20	0.162	0.06			4.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRL4			6.7			23.00	25.80	2.330	0.11			14.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab) uohms/cm	Temp. °C	Alk (Lab) (mg/L)	Acidity (mg/L)	Iron (mg/L)	Mn (mg/L)	Al (mg/L)	SO4 (mg/L)	TSS (mg/L)	TDS (ppm)	Hardness (mg/L)
BAMR	3/24/04	WRL3			5.8			7.80	8.80	0.064	0.03			6.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRL2			6.4			9.00	6.40	0.056				6.0		

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Williams Run Watershed
Tributary to Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/24/04	WRL1			6.4			9.00	6.40	0.056				6.0		

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Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
WR 1 - Near mouth of Williams Run

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
TAG	10/22/01	WR01		7	6.6	354		14	0	0.2	0.1	0.1	220	1		
TAG	11/10/01	WR01		7.5	7.1	514		15	0	0.2	0.2	0	242	3		
TAG	12/15/01	WR01		6.6	6.2	362		8	0	0.3	0.7	0.3	160	1		
?	1/19/02	WR01	6"	5.4	6.86	332	-0.2	12.97	N.D.	0.62	0.45	0.4	152.3	4		
BAMR	3/24/04	WR1			4.7			6.80	47.00	0.727	1.05	1.55	80.60	[illegible]		
BAMR	5/18/04	WR1			4.1			3.80	80.60	1.050	2.57	2.78	170.30	6.0		
BAMR	7/7/04	WR1			4.8			10.60	43.80	[illegible]	1.84	1.54	139.60	[illegible]		
BAMR	6/15/05	WR1	230.50		4.8			7.60	33.80	[illegible]	1.49	0.98	114.70	[illegible]		
BAMR	12/22/05	WR1			5.7			8.40	49.40	[illegible]	0.80	[illegible]	100.00	[illegible]		
BAMR	1/24/06	WR1			5.2			7.20	44.00	0.332	0.62	0.65	58.50	6.0		
BAMR	3/20/06	WR1			4.9			7.40	27.20	0.430	0.95	1.00	65.60	[illegible]		
BAMR	4/20/06	WR1			5.0			7.40	28.00	[illegible]	1.00	0.76	79.90	8.0		
CHP	5/25/06	WR1			5.9	95.2		8.00	59.00	0.190	0.71	0.29	52.00			
BAMR	6/15/06	WR1			4.7			7.00	13.60	[illegible]	1.46	1.74	149.00	[illegible]		
BAMR	7/26/06	WR1			5.2			7.60	6.40	[illegible]	0.83	[illegible]	64.10	[illegible]		
BAMR	9/15/06	WR1			5.8			10.60	7.00	0.409	0.56	[illegible]	44.70	[illegible]		
BAMR	10/16/06	WR1			4.9			9.40	13.20	[illegible]	1.38	1.41	103.70	[illegible]		
CHP	11/18/06	WR1			4.5	85.7		1.00	83.50	0.220	0.96	0.59	60.00		56.5	0
BAMR	12/12/06	WR1			4.7			7.60	54.60	0.488	1.35	1.62	96.80	[illegible]		

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CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Discharge to Williams Run - along Alan Road

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	5/18/04	AARS			7.4			128.2	-94.8	0.797	0.37	0.44	70.6	14.0		
BAMR	7/7/04	AARS			7.6			101.6	-61.4	[illegible]	[illegible]	[illegible]	31.2	[illegible]		
BAMR	6/15/05	AARS		2.00	7.5			154.60	-101.20	0.635	0.88	[illegible]	40.10	[illegible]		
BAMR	7/20/05	AARS		2.00	7.7			149.00	-113.60	[illegible]	0.62	[illegible]	60.00	[illegible]		
BAMR	12/22/05	AARS		5.00	7.0			72.60	-26.80	0.471	0.37	2.09	84.80	6.0		
BAMR	1/24/06	AARS		5.00	7.3			83.20	-37.40	0.651	0.15	1.07	59.50	6.0		
BAMR	3/20/06	AARS			6.8			86.60	-61.00	0.454	0.21	1.74	86.40	8.0		
BAMR	4/20/06	AARS			7.7			131.00	-90.80	[illegible]	0.09	[illegible]	65.70	4.0		
BAMR	6/15/06	AARS			7.2			131.60	-120.20	0.871	0.30	[illegible]	48.30	[illegible]		
BAMR	9/15/06	AARS			7.6			135.20	-116.60	[illegible]	0.15	[illegible]	26.30	[illegible]		

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Discharge to Williams Run - along Alan Road

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	3/31/04	ARS			3.6			0.00	186.4	77.600	1.13	11.0	289.5	50.0		
BAMR	5/18/04	ARS			3.0			0.00	172.6	14.100	3.72	11.0	193.1	12.0		
BAMR	7/7/04	ARS			2.5			0.00	632.2	61.200	4.92	39.6	840.2			
BAMR	6/15/05	ARS	5.00		2.6			0.00	645.00	63.900	6.85	34.30	1024.60	4.0		
BAMR	7/20/05	ARS			2.6			0.00	499.20	49.400	5.76	30.00	719.70			
BAMR	11/9/05	ARS			2.9			0.00	352.00	67.100	1.99	14.70	494.30			
BAMR	12/22/05	ARS			2.9			0.00	579.20	156.000	4.13	31.20	734.00			
BAMR	1/24/06	ARS			3.0			0.00	470.00	142.000	1.45	20.70	583.10			
BAMR	3/20/06	ARS			2.6			0.00	1310.00	300.000	4.33	53.20	1.36			
BAMR	4/20/06	ARS			2.7			0.00	972.80	214.000	5.41	44.90	1090.30			
CHP	5/25/06	ARS			2.4	1.49		436.00	1853.00	205.200	6.72	46.88	2050.00		9.8	
BAMR	6/15/06	ARS			2.4			0.00	2425.80	300.000	8.83	106.00	1677.40			
BAMR	7/26/06	ARS			2.7			0.00	872.00	188.000	4.22	35.10	1152.10			
CHP	8/17/06	ARS			2.4	1.55		775.00	2526.00	502.300	15.71	165.02	3875.00		1030.0	
BAMR	9/15/06	ARS			3.5			0.00	92.00	38.800	0.93	5.58	218.00			
BAMR	10/16/06	ARS			2.9			0.00	560.20	146.000	3.87	29.00	789.30			
CHP	11/18/06	ARS			3.8	2479		9.00	262.00	51.850	1.10	8.02	300.00		184.0	
BAMR	12/12/06	ARS			4.2			5.80	158.20	56.400	1.40	9.82	257.60			
CHP	2/26/07	ARS			6.0	705		17.00	61.00	12.460	0.62	0.00	140.00		466.0	

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Williams Run Watershed
Discharge to Williams Run - Woods' Ponds

Source	Date	Station	Flow (gpm) or SWL (inches)	pH (Field)	pH (Lab)	Cond. (Lab)	Temp.	Alk (Lab)	Acidity	Iron	Mn	Al	SO4	TSS	TDS	Hardness
						uohms/cm	°C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(mg/L)
BAMR	1/24/06	Woods			3.4			0.00	235.40	9.870	10.00	28.70	618.30			
BAMR	3/20/06	Woods			3.3			0.00	226.40	8.520	10.00	28.30	565.00			
BAMR	4/20/06	Woods			3.3			0.00	243.80	6.940	10.10	27.90	604.30			
CHP	5/25/06	Woods			3.5	625		17.00	398.00	21.110	26.63	35.59	625.00		412.0	
BAMR	6/15/06	Woods			3.3			0.00	246.00	10.100	9.17	30.40	295.50			
BAMR	7/26/06	Woods			3.4			0.00	279.40	14.000	9.82	29.90	656.60			
CHP	8/17/06	Woods			3.4	632		22.00	431.00	31.070	20.14	35.12	960.00		416.0	
BAMR	9/15/06	Woods			3.3			0.00	268.60	14.400	10.50	29.40	631.00			
BAMR	10/16/06	Woods			3.3			0.00	231.60	10.400	9.83	28.10	586.30			
CHP	11/18/06	Woods			3.0	591		55.00	398.00	2.280	12.88	26.09	550.00		390.0	
BAMR	12/12/06	Woods			3.2			0.00	215.60	5.470	9.14	24.80	487.60			
CHP	2/26/07	Woods			3.4	566		24.00	272.50	7.980	14.20	30.04	710.00		374.0	

BAMR = Bureau of Abandoned Mine Reclamation
CHP = Coldwater Heritage Partnership Grant
TAG = Technical Assistance Grant from DEP

Values in shaded cells indicate amounts less than that of the lowest detectable limit.

Appendix 2

Macro-Invertebrate Data Sheets

Biosurvey Data Sheet (page 2)　　　Macro-invertebrate Survey　　　Rocky bottom stream

Site name: Williams Run - Near mouth of stream　　　Date: _______5/15/06_________

Location: ***41° 17' 45.3" 79° 57' 3.2"***

Monitor ID#s: __iep1275 , efk6435, jak6435, lb2832

Weather in last 24 hrs.　Showers　　Weather today: ___Rain_______________

Identify the macro-invertebrates (to order) in your sample using the identification card. We are only concerned with organisms that appear on the tally sheet. Record the number of organisms below and then assign them letter codes based on their abundance as listed below.

R(rare) = 1-9 organisms　　C(common) = 10-99 organisms　　D(dominant) = 100 plus organisms

---

Group I – Sensative

__0___ ( ) Gilled snails
__0___ ( ) Hellgrammites
__0___ ( ) Mayfly nymph
__0___ ( ) Non net-spinning caddisfly larva (case builders)
_0____ ( ) Riffle beetle adults
_6___ (R) Stonefly nymph
_0____ ( ) Water Penny larva

Group II – Somewhat sensitive

__0___ ( ) Alderfly larvae
__3__ (R) Beetle larvae
__0___ ( ) Clam
__0___ ( ) Cranefly larvae
__0___ ( ) Crayfish
__0___ ( ) Damselfly nymph
__0___ ( ) Dragonfly nymph
__0___ ( ) Fishfly larvae
__0___ ( ) Net-spinning caddisfly larvae (non case builders)
__0___ ( ) Scuds
__0___ ( ) Sowbugs

Group III – Tolerant

__0___ ( ) Aquatic worms
__0___ ( ) Blackfly larvae
__0___ ( ) Leeches
__5__ (R) Midge larvae
__0__ ( ) Snails (other)

Continue on to page 3

Biosurvey: Data Sheet (Page 3)

Site ID: Williams Run – Near mouth of stream __Date: ____5/15/06___________

41° 17' 45.3"   79° 57' 3.2"

Water Quality Rating

To calculate the index value, add the number of letters found in the three groups on the previous page and multiply by the indicated weighing factor.

Group I . Sensitive

# of R's, C's, and D's

___1___ (# of R's) x 5.0 = ___5.0_

___0___(# of C's) x 5.6 = _______

___0___(# of D's) x 5.3 = _______

Sum of the Index Value for Group I= _5.0__

Group II . Somewhat Sensitive

# of R's, C's, and D's

____1___ (# of R's) x 3.2 = __3.2__

____0___(# of C's) x 3.4 = _______

____0___(# of D's) x 3.0 = _______

Sum of the Index Value for Group II= __3.2_____

Group III. Tolerant

# of R's, C's, and D's

____1___ (# of R's) x 1.2 = __1.2__

____0___(# of C's) x 1.1 = _______

____0___(# of D's) x 1.0 = _______

Sum of the Index Value for Group III= __1.2___

To calculate the water quality score for the stream site, add together the index values for each group. The sum of these *values* equals the water quality score.

Water Quality Score = ____9.4______

Compare this score to the following number ranges to determine the quality of your stream site.

____Good > 40   ____Fair 20-40   _X_ Poor < 20

Note: The tolerance groupings (Group I, II, III) and the water quality rating categories were developed for streams in the Mid-Atlantic states.

Comments: Stream contained few attachment sites for macro-invertebrates. Sand and gravel were abundant

Biosurvey Data Sheet (page 2)   Macro-invertebrate Survey   Rocky bottom stream

Site name: Williams Run - off of Game Land Road   Date: _______5/15/06___________

Location: ***41° 15' 37.5"*** ***79° 57' 36.1"***

Monitor ID#s: __iep1275 , efk6435, jak6435, lb2832

Weather in last 24 hrs.   Showers   Weather today: Rain

Identify the macro-invertebrates (to order) in your sample using the identification card. We are only concerned with organisms that appear on the tally sheet. Record the number of organisms below and then assign them letter codes based on their abundance as listed below.

R(rare) = 1-9 organisms   C(common) = 10-99 organisms   D(dominant) = 100 plus organisms

---

Group I – Sensative

__0___ ( ) Gilled snails
__0___ ( ) Hellgrammites
__0___ ( ) Mayfly nymph
__0___ ( ) Non net-spinning caddisfly larva (case builders)
_0____ ( ) Riffle beetle adults
_2___ (R) Stonefly nymph
_0____ ( ) Water Penny larvae

Group II – Somewhat sensitive

__0___ ( ) Alderfly larvae
__0__ ( ) Beetle larvae
__0___ ( ) Clam
__0___ ( ) Cranefly larvae
__0___ ( ) Crayfish
__1___ (R) Damselfly nymph
__0___ ( ) Dragonfly nymph
__0___ ( ) Fishfly larvae
__0___ ( ) Net-spinning caddisfly larvae (non case builders)
__0___ ( ) Scuds
__0___ ( ) Sowbugs

Group III – Tolerant

__0___ ( ) Aquatic worms
__0___ ( ) Blackfly larvae
__0___ ( ) Leeches
__1__ (R) Midge larvae
__0__ ( ) Snails (other)

Continue on to page 3

Biosurvey: Data Sheet (Page 3)
Site ID: Williams Run – ~~Near mouth of stream~~ __Date: ____5/15/06___________
Location: ***41° 15' 37.5" 79° 57' 36.1"***
Water Quality Rating

To calculate the index value, add the number of letters found in the three groups on the previous page and multiply by the indicated weighing factor.

Group I . Sensitive

# of R's, C's, and D's

___1____ (# of R's) x 5.0 = ___5.0_

___0___(# of C's) x 5.6 = _______

___0____(# of D's) x 5.3 = _______

Sum of the Index Value for Group I= _5.0___

Group II . Somewhat Sensitive

# of R's, C's, and D's

____1___ (# of R's) x 3.2 = __3.2__

____0___(# of C's) x 3.4 = _______

____0___(# of D's) x 3.0 = _______

Sum of the Index Value for Group II= __3.2_____

Group III. Tolerant

# of R's, C's, and D's

____1___ (# of R's) x 1.2 = __1.2__

____0___(# of C's) x 1.1 = _______

____0___(# of D's) x 1.0 = _______

Sum of the Index Value for Group III= __1.2___

To calculate the water quality score for the stream site, add together the index values for each group.
The sum of these *values* equals the water quality score.

Water Quality Score = ___9.4_____

Compare this score to the following number ranges to determine the quality of your stream site.

___Good > 40 **___Fair 20-40** **_X_ Poor < 20**

Note: The tolerance groupings (Group I, II, III) and the water quality rating categories were developed for streams in the Mid-Atlantic states.

Comments: There was abundant flow from an upstream impoundment due to heavy rain in previous days which may explain the presence of the Damselfly nymph. Stream bottom showed abundant deposits of Iron Oxide.

Appendix B – Macro Study Raw Data

Macroinvertebrate Sample Summary

Assessment ID:	56798
Station ID:	20070510-0915-dersmith (Latitude: 41.3004, Longitude: -79.9502)
Method:	6-Dframe Composite, 200 subsample
Location:	Beaver Pond 01 Polk Quad. 16G Venango Co.; Mineral Twn. Rt. 965 to Slatertown Rd.; walk up the DCNR Rd. to small stream crossing; sample upstream

Metrics:

Total # Organisms: 240	Hilsenhoff: 3.80	%EPT: 76	FCPRSH: 11
Taxa Richness: 19	Beck3: 12	Beck4: 16	Modified %EPT: 73
Modified Caddis: 2	EPT: 13	%Mayflies: 32	%Dominant: 36
Caddisfly Taxa: 4	Mayfly Taxa: 6	Modified EPT: 10	Modified %Mayflies: 31
%Intol-Limestone: 52	%Tol-Limestone: 0	%Intol-Freestone: 76	%Tol-Freestone: 24
Shannon Diversity: 2.03			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400100	Acentrella	5	4
1020400300	Baetis	1	6
1020401300	Plauditus	43	4
1020500100	Isonychia	1	3
1020600700	Stenonema(old genus)	19	3
1020800300	Ephemerella	7	1
1040400100	Amphinemura	86	3
1040500200	Leuctra	2	0
1040900300	Haploperla	1	0
1060200400	Nigronia	1	2
1080100100	Chimarra	3	4
1080100200	Dolophilodes	7	0
1080400600	Cheumatopsyche	2	6
1080400700	Hydropsyche	5	5
1101301000	Stenelmis	1	5
1121200500	Hemerodromia	1	6
1121900400	Tipula	1	4
1122100500	Simulium	23	6
1122200000	Chironomidae	31	6

Habitat:

1 Instream Cover:	12	2 Epifaunal Substrate:	16		
3 Embeddedness:	11	4 Velocity/Depth Regimes:	15		
5 Channel Alterations:	20	6 Sediment Deposition:	11		
7 Frequency of Riffles:	16	8 Channel Flow Status:	15		
9 Condition of Banks:	14	10 Bank Vegetation:	20	áááá Total	
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20	áááá	190

Impairment:

Insufficient?	N	Impaired?	Y	áááá Biology Impaired?	áá Y
Habitat Impaired?	N	Rock picks influenced?	N	áááá Impact Localized?	áá N
Designated Use needs reevaluation?	N				

Comments:

Land Use:	Stream flows out of State Game Lands; low gradient tribe that are around abandon mines
Impairment:	IBI-61.5 This station is most likely impaired due to AMD influences. (high numbers of Amphinemuras are a good indicator of this)

Macroinvertebrate Sample Summary

Assessment ID:	56788
Station ID:	20070511-1045-dersmith (Latitude: 41.3115, Longitude: -79.9625)
Method:	6-Dframe Composite, 200 subsample
Location:	Beaver Pond 02 Venango Co. Mineral Twn. Polk Quad. 16G Slatertown Road. to where the small UNT meets the Road; sample upstream

Metrics:

Total # Organisms: 240	Hilsenhoff: 4.19	%EPT: 59	FCPRSH: 12
Taxa Richness: 25	Beck3: 20	Beck4: 22	Modified %EPT: 47
Modified Caddis: 3	EPT: 14	%Mayflies: 20	%Dominant: 29
Caddisfly Taxa: 4	Mayfly Taxa: 4	Modified EPT: 12	Modified %Mayflies: 8
%Intol-Limestone: 46	%Tol-Limestone: 3	%Intol-Freestone: 58	%Tol-Freestone: 42
Shannon Diversity: 2.20			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020100100	Ameletus	2	0
1020400300	Baetis	29	6
1020800300	Ephemerella	13	1
1020800400	Eurylophella	3	4
1030200000	Gomphidae	1	4
1040300300	Oemopteryx	1	3
1040400100	Amphinemura	70	3
1040500200	Leuctra	2	0
1040801200	Isoperla	4	2
1040900200	Alloperla	1	0
1040900300	Haploperla	11	0
1080200100	Lype	1	2
1080300500	Polycentropus	1	6
1080400300	Diplectrona	3	0
1081100100	Neophylax	1	3
1101000400	Ectopria	2	5
1101300600	Optioservus	7	4
1101300800	Oulimnius	15	5
1121200100	Chelifera	2	6
1121400000	Tabanidae	1	6
1121900400	Tipula	1	4
1121901500	Hexatoma	1	2
1122200000	Chironomidae	61	6
9020100000	Sphaeriidae	1	8
11000000000	Oligochaeta	6	10

Habitat:

1 Instream Cover:	13	2 Epifaunal Substrate:	18		
3 Embeddedness:	12	4 Velocity/Depth Regimes:	17		
5 Channel Alterations:	19	6 Sediment Deposition:	12		
7 Frequency of Riffles:	19	8 Channel Flow Status:	10		
9 Condition of Banks:	18	10 Bank Vegetation:	20	Total	
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	17		195

Impairment:

Insufficient?	N	Impaired?	N	Biology Impaired?	N
Habitat Impaired?	N	Rock picks influenced?	N	Impact Localized?	N
Designated Use needs reevaluation?	N				

Comments:

Land Use:	Primary use of land is state game lands
Impairment:	IBI-65.5 This stream has alot of taxa that indicate AMD influences (amphinemura in high numbers for one)

Macroinvertebrate Sample Summary

Assessment ID:	56790
Station ID:	20070511-1000-dersmith (Latitude: 41.3112, Longitude: -79.9686)
Method:	6-Dframe Composite, 200 subsample
Location:	Beaver Pond 03 Venango Co. Mineral Twn. 16G Slatertown Road pull off; take the right split on the four wheeler path

Metrics:

Total # Organisms: 206	Hilsenhoff: 2.71	%EPT: 79	FCPRSH: 15
Taxa Richness: 22	Beck3: 20	Beck4: 21	Modified %EPT: 62
Modified Caddis: 3	EPT: 12	%Mayflies: 35	%Dominant: 24
Caddisfly Taxa: 4	Mayfly Taxa: 3	Modified EPT: 10	Modified %Mayflies: 19
%Intol-Limestone: 62	%Tol-Limestone: 1	%Intol-Freestone: 74	%Tol-Freestone: 26
Shannon Diversity: 2.32			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400300	Baetis	34	6
1020800300	Ephemerella	32	1
1021200500	Paraleptophlebia	7	1
1030200000	Gomphidae	1	4
1040400100	Amphinemura	18	3
1040500200	Leuctra	2	0
1040700400	Acroneuria	1	0
1040801200	Isoperla	5	2
1040900300	Haploperla	50	0
1080100100	Chimarra	1	4
1080300500	Polycentropus	1	6
1080400300	Diplectrona	9	0
1080910100	Lepidostoma	2	1
1101300600	Optioservus	2	4
1101300800	Oulimnius	21	5
1120201500	Probezzia	2	6
1121200100	Chelifera	1	6
1121901100	Dicranota	1	3
1121901500	Hexatoma	1	2
1122200000	Chironomidae	12	6
9020100000	Sphaeriidae	1	8
11000000000	Oligochaeta	2	10

Habitat:

1 Instream Cover:	10	2 Epifaunal Substrate:	10		
3 Embeddedness:	10	4 Velocity/Depth Regimes:	14		
5 Channel Alterations:	20	6 Sediment Deposition:	10		
7 Frequency of Riffles:	20	8 Channel Flow Status:	10		
9 Condition of Banks:	12	10 Bank Vegetation:	20	Total	
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20		176

Impairment:

Insufficient?	N	Impaired?	N	Biology Impaired?	N
Habitat Impaired?	N	Rock picks influenced?	N	Impact Localized?	N
Designated Use needs reevaluation?	N				

Comments:

Land Use:	Primary use of land is state game lands
Impairment:	IBI-69.2

Macroinvertebrate Sample Summary

Assessment ID:		56777	
Station ID:	20070516-1100-dersmith (Latitude: 41.3081, Longitude: -79.9324)		
Method:	6-Dframe Composite, 200 subsample		
Location:	Lyons Run LR 01 16G Venango Co.; Victoria Twn. In state game lands #39		

Metrics:

Total # Organisms: 240	Hilsenhoff: 3.09	%EPT: 69	FCPRSH: 12
Taxa Richness: 27	Beck3: 26	Beck4: 27	Modified %EPT: 59
Modified Caddis: 1	EPT: 17	%Mayflies: 48	%Dominant: 16
Caddisfly Taxa: 3	Mayfly Taxa: 9	Modified EPT: 14	Modified %Mayflies: 43
%Intol-Limestone: 51	%Tol-Limestone: 1	%Intol-Freestone: 81	%Tol-Freestone: 19
Shannon Diversity: 2.81			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400100	Acentrella	15	4
1020400300	Baetis	13	6
1020600100	Epeorus	19	0
1020600700	Stenonema(old genus)	1	3
1020600800	Cinygmula	5	1
1020800200	Drunella	10	1
1020800300	Ephemerella	10	1
1020800500	Serratella	38	2
1021200000	Leptophlebiidae	5	4
1030200000	Gomphidae	1	4
1040100100	Pteronarcys	3	0
1040400100	Amphinemura	9	3
1040500200	Leuctra	11	0
1040700400	Acroneuria	2	0
1040900300	Haploperla	5	0
1080300500	Polycentropus	2	6
1080400300	Diplectrona	8	0
1080400700	Hydropsyche	9	5
1101300600	Optioservus	9	4
1101300800	Oulimnius	32	5
1101300900	Promoresia	1	2
1120200700	Ceratopogon	1	6
1121900700	Antocha	1	3
1122100500	Simulium	3	6
1122200000	Chironomidae	25	6
11000000000	Oligochaeta	1	10
15000000000	Hydracarina	1	7

Habitat:

1 Instream Cover:	17	2 Epifaunal Substrate:	19		
3 Embeddedness:	12	4 Velocity/Depth Regimes:	19		
5 Channel Alterations:	20	6 Sediment Deposition:	12		
7 Frequency of Riffles:	17	8 Channel Flow Status:	15		
9 Condition of Banks:	14	10 Bank Vegetation:	20	áááá	Total
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20	áááá	205

Impairment:

Insufficient?	Y	Impaired?	N/A	áááá	Biology Impaired?	áá N/A
Habitat Impaired?	N/A	Rock picks influenced?	N	áááá	Impact Localized?	áá N
Designated Use needs reevaluation?	N					

Comments:

Land Use:	State Game Lands
Impairment:	IBI- 81.0 Lots of sand in the stream bead

SWP	GIS Key	Stream Name	County	Topo Quad	Latitude	Longitude	IBI Score		
16G	20070509-1100-DMS	South Sandy Creek 02	Venango	Polk	41.326878	-79.923185	83.7	41°19'36.762"N	79°55'23.466"W
16G	20070510-0915-DMS	UNT South Sandy Creek (Beaver Pond 01)	Venango	Polk	41.300503	-79.950289	61.5	41°18'1.809"N	79°57'1.04"W
16G	20070510-1000-DMS	South Sandy Creek 03	Venango	Polk	41.298219	-79.948609	70.2	41°17'53.59"N	79°56'54.994"W
16G	20070510-1030-DMS	Williams Run	Venango	Polk	41.29556	-79.950901	54.4	41°17'44.016"N	79°57'3.243"W
16G	20070510-1215-DMS	South Sandy Creek 01	Venango	Polk	41.357022	-79.908113	80.8	41°21'25.28"N	79°54'29.205"W
16G	20070511-1000-DMS	UNT South Sandy Creek (Beaver Pond 03)	Venango	Polk	41.311294	-79.968721	69.2	41°18'40.657"N	79°58'7.394"W
16G	20070511-1045-DMS	UNT South Sandy Creek (Beaver Pond 02)	Venango	Polk	41.311335	-79.962535	65.5	41°18'41.807"N	79°57'45.125"W
16G	20070511-1145-DMS	South Sandy Creek 04	Venango	Polk	41.290973	-79.974148	79.3	41°17'27.502"N	79°58'26.934"W
16G	20070511-1230-DMS	Unt South Sandy Creek	Venango	Polk	41.288111	-79.974284	72.6	41°17'17.201"N	79°58'27.421"W
16G	20070514-1000-DMS	UNT South Sandy Creek	Venango	Polk	41.264847	-79.987176	16.7	41°15'53.45"N	79°59'13.834"W
16G	20070516-1100-DMS	Lyons Run	Venango	Polk	41.308117	-79.932403	81	41°18'29.22"N	79°55'56.652"W

Macroinvertebrate Sample Summary

Assessment ID:	56793
Station ID:	20070509-1100-dersmith (Latitude: 41.3268, Longitude: -79.9231)
Method:	6-Dframe Composite, 200 subsample
Location:	Probablistics Site # 030 South Sandy Creek 02 Venango Co. Polk Quad South Sandy Creek at Probabilistic section 030

Metrics:

Total # Organisms: 198	Hilsenhoff: 3.80	%EPT: 71	FCPRSH: 16
Taxa Richness: 29	Beck3: 31	Beck4: 30	Modified %EPT: 34
Modified Caddis: 4	EPT: 18	%Mayflies: 12	%Dominant: 32
Caddisfly Taxa: 6	Mayfly Taxa: 6	Modified EPT: 15	Modified %Mayflies: 8
%Intol-Limestone: 37	%Tol-Limestone: 3	%Intol-Freestone: 90	%Tol-Freestone: 10
Shannon Diversity: 2.58			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400300	Baetis	7	6
1020600100	Epeorus	5	0
1020800200	Drunella	1	1
1020800300	Ephemerella	8	1
1020800400	Eurylophella	1	4
1021200000	Leptophlebiidae	1	4
1030200000	Gomphidae	2	4
1040100100	Pteronarcys	3	0
1040400100	Amphinemura	22	3
1040500200	Leuctra	11	0
1040700300	Paragnetina	3	1
1040700400	Acroneuria	5	0
1040900200	Alloperla	1	0
1060200400	Nigronia	2	2
1080100100	Chimarra	1	4
1080400200	Parapsyche	1	0
1080400300	Diplectrona	3	0
1080400600	Cheumatopsyche	2	6
1080400700	Hydropsyche	64	5
1080910100	Lepidostoma	2	1
1101300600	Optioservus	5	4
1101300800	Oulimnius	21	5
1101300900	Promoresia	7	2
1101301000	Stenelmis	7	5
1101400100	Anchytarsus	2	5
1120200900	Culicoides	1	10
1121200500	Hemerodromia	1	6
1122200000	Chironomidae	4	6
11000000000	Oligochaeta	5	10

Habitat:

1 Instream Cover:	14	2 Epifaunal Substrate:	15		
3 Embeddedness:	12	4 Velocity/Depth Regimes:	16		
5 Channel Alterations:	20	6 Sediment Deposition:	12		
7 Frequency of Riffles:	13	8 Channel Flow Status:	12		
9 Condition of Banks:	10	10 Bank Vegetation:	20	Total	
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20		184

Impairment:

Insufficient?	N	Impaired?	N	Biology Impaired?	N
Habitat Impaired?	N	Rock picks influenced?	N	Impact Localized?	N
Designated Use needs reevaluation?	N				

Comments:

Land Use: mostly forested with sgl #39

Impairment:

Macroinvertebrate Sample Summary

Assessment ID: 56796
Station ID: 20070510-1000-dersmith (Latitude: 41.2982, Longitude: -79.9485)
Method: 6-Dframe Composite, 200 subsample
Location: South Sandy 03 Polk Quad 16G Venango Co. Mineral Twn. Sample location is just downstream of Williams Run; Rt. 965 to Slatertown rd.; sample upstream of bridge

Metrics:

Total # Organisms: 186	Hilsenhoff: 3.75	%EPT: 77	FCPRSH: 12
Taxa Richness: 27	Beck3: 15	Beck4: 20	Modified %EPT: 28
Modified Caddis: 2	EPT: 13	%Mayflies: 8	%Dominant: 48
Caddisfly Taxa: 3	Mayfly Taxa: 7	Modified EPT: 11	Modified %Mayflies: 7
%Intol-Limestone: 32	%Tol-Limestone: 1	%Intol-Freestone: 91	%Tol-Freestone: 9
Shannon Diversity: 2.16			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400100	Acentrella	2	4
1020400300	Baetis	1	6
1020401300	Plauditus	1	4
1020500100	Isonychia	2	3
1020800300	Ephemerella	5	1
1020800400	Eurylophella	2	4
1021100100	Baetisca	1	4
1040400100	Amphinemura	8	3
1040500200	Leuctra	15	0
1040700400	Acroneuria	2	0
1060200400	Nigronia	4	2
1080200200	Psychomyia	1	2
1080400300	Diplectrona	14	0
1080400700	Hydropsyche	89	5
1101300600	Optioservus	10	4
1101300800	Oulimnius	3	5
1101300900	Promoresia	5	2
1101301000	Stenelmis	1	5
1120200700	Ceratopogon	1	6
1120200900	Culicoides	1	10
1121200500	Hemerodromia	1	6
1121410000	Ephydridae	1	6
1121900400	Tipula	1	4
1122100400	Prosimulium	4	2
1122200000	Chironomidae	8	6
13040100000	Cambaridae	2	6
15000000000	Hydracarina	1	7

Habitat:

1 Instream Cover:	18	2 Epifaunal Substrate:	17		
3 Embeddedness:	10	4 Velocity/Depth Regimes:	16		
5 Channel Alterations:	18	6 Sediment Deposition:	9		
7 Frequency of Riffles:	11	8 Channel Flow Status:	12		
9 Condition of Banks:	9	10 Bank Vegetation:	19	áááá	Total
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	19	áááá	178

Impairment:

Insufficient?	N	Impaired?	N	áááá Biology Impaired?	áá N
Habitat Impaired?	N	Rock picks influenced?	N	áááá Impact Localized?	áá N
Designated Use needs reevaluation?	N				

Comments:
Land Use: Primary use of land is State Game Lands; with AMD areas
Impairment: IBI-70.2

Macroinvertebrate Sample Summary

Assessment ID:	56787
Station ID:	20070511-1145-dersmith (Latitude: 41.2909, Longitude: -79.9741)
Method:	6-Dframe Composite, 200 subsample
Location:	South Sandy Creek 04 Venango Co., Mineral Twn. Polk Quad 16G Hells Kitchen Road to Gadsby Rd.; sample South Sandy Creek upstream

Metrics:

Total # Organisms: 240	Hilsenhoff: 2.39	%EPT: 80	FCPRSH: 13
Taxa Richness: 26	Beck3: 20	Beck4: 26	Modified %EPT: 74
Modified Caddis: 4	EPT: 19	%Mayflies: 55	%Dominant: 40
Caddisfly Taxa: 6	Mayfly Taxa: 8	Modified EPT: 16	Modified %Mayflies: 54
%Intol-Limestone: 66	%Tol-Limestone: 0	%Intol-Freestone: 88	%Tol-Freestone: 12
Shannon Diversity: 2.31			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400100	Acentrella	9	4
1020400200	Acerpenna	1	6
1020401300	Plauditus	9	4
1020600700	Stenonema(old genus)	12	3
1020800200	Drunella	1	1
1020800300	Ephemerella	96	1
1020800400	Eurylophella	2	4
1021200000	Leptophlebiidae	1	4
1040400100	Amphinemura	6	3
1040500200	Leuctra	24	0
1040700200	Neoperla	1	3
1040801200	Isoperla	1	2
1040900300	Haploperla	1	0
1060200400	Nigronia	2	2
1080100100	Chimarra	1	4
1080100300	Wormaldia	12	0
1080400300	Diplectrona	1	0
1080400600	Cheumatopsyche	5	6
1080400700	Hydropsyche	9	5
1080500100	Rhyacophila	1	1
1101300600	Optioservus	3	4
1101300800	Oulimnius	13	5
1101301000	Stenelmis	5	5
1121900700	Antocha	1	3
1122100500	Simulium	4	6
1122200000	Chironomidae	19	6

Habitat:

1 Instream Cover:	18	2 Epifaunal Substrate:	16		
3 Embeddedness:	16	4 Velocity/Depth Regimes:	17		
5 Channel Alterations:	17	6 Sediment Deposition:	15		
7 Frequency of Riffles:	16	8 Channel Flow Status:	16		
9 Condition of Banks:	15	10 Bank Vegetation:	16	áááá	Total
11 Grazing or Disruptive:	17	12 Riparian Vegetation:	18	áááá	197

Impairment:

Insufficient?	N	Impaired?	N	áááá Biology Impaired?	áá N
Habitat Impaired?	N	Rock picks influenced?	N	áááá Impact Localized?	áá N
Designated Use needs reevaluation?	N				

Comments:

Land Use:	Primary use of land is State Game Lands
Impairment:	IBI-79.3

Macroinvertebrate Sample Summary

Assessment ID:	56791
Station ID:	20070510-1215-dersmith (Latitude: 41.3570, Longitude: -79.9081)
Method:	6-Dframe Composite, 200 subsample
Location:	Sandy Mouth 01 Venango Co. French Creek Twn. Polk Quad. 16G Mouth of South Sandy into Sandy Creek

Metrics:

Total # Organisms: 206	Hilsenhoff: 4.48	%EPT: 41	FCPRSH: 14
Taxa Richness: 31	Beck3: 26	Beck4: 28	Modified %EPT: 32
Modified Caddis: 3	EPT: 19	%Mayflies: 17	%Dominant: 27
Caddisfly Taxa: 6	Mayfly Taxa: 8	Modified EPT: 15	Modified %Mayflies: 17
%Intol-Limestone: 22	%Tol-Limestone: 9	%Intol-Freestone: 78	%Tol-Freestone: 22
Shannon Diversity: 2.77			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400100	Acentrella	17	4
1020400300	Baetis	2	6
1020600100	Epeorus	3	0
1020600700	Stenonema(old genus)	4	3
1020800200	Drunella	1	1
1020800300	Ephemerella	3	1
1020800400	Eurylophella	4	4
1021200000	Leptophlebiidae	2	4
1030200000	Gomphidae	2	4
1040400100	Amphinemura	7	3
1040700400	Acroneuria	8	0
1040700500	Attaneuria	1	3
1040900200	Alloperla	1	0
1040900300	Haploperla	6	0
1060200400	Nigronia	1	2
1080100300	Wormaldia	5	0
1080400300	Diplectrona	1	0
1080400600	Cheumatopsyche	2	6
1080400700	Hydropsyche	11	5
1080500100	Rhyacophila	3	1
1080700400	Hydroptila	4	6
1101300600	Optioservus	16	4
1101300800	Oulimnius	55	5
1101300900	Promoresia	2	2
1101301000	Stenelmis	7	5
1121200500	Hemerodromia	4	6
1122100500	Simulium	1	6
1122200000	Chironomidae	14	6
11000000000	Oligochaeta	17	10
13040100000	Cambaridae	1	6
15000000000	Hydracarina	1	7

Habitat:

1 Instream Cover:	17	2 Epifaunal Substrate:	15	
3 Embeddedness:	13	4 Velocity/Depth Regimes:	12	
5 Channel Alterations:	19	6 Sediment Deposition:	13	
7 Frequency of Riffles:	11	8 Channel Flow Status:	14	
9 Condition of Banks:	9	10 Bank Vegetation:	20	Total
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20	183

Impairment:

Insufficient?	N	Impaired?	N	Biology Impaired? N
Habitat Impaired?	N	Rock picks influenced?	N	Impact Localized? N
Designated Use needs reevaluation?	N			

Comments:

Land Use:	Primary use of land is state game lands
Impairment:	IBI-80.8

Macroinvertebrate Sample Summary

Assessment ID:	58013
Station ID:	20070511-1230-dersmith (Latitude: 41.2880, Longitude: -79.9742)
Method:	6-Dframe Composite, 200 subsample
Location:	UNT South Sandy 01 Venango Co., Mineral TWN. 16G Hellskitchen Rd. to the 1st bridge over South Sandy; Sample at the mouth of the stream

Metrics:

Total # Organisms: 208	Hilsenhoff: 3.85	%EPT: 46	FCPRSH: 11
Taxa Richness: 27	Beck3: 19	Beck4: 25	Modified %EPT: 38
Modified Caddis: 3	EPT: 18	%Mayflies: 16	%Dominant: 32
Caddisfly Taxa: 6	Mayfly Taxa: 7	Modified EPT: 15	Modified %Mayflies: 16
%Intol-Limestone: 32	%Tol-Limestone: 0	%Intol-Freestone: 66	%Tol-Freestone: 34
Shannon Diversity: 2.47			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020400100	Acentrella	6	4
1020401300	Plauditus	4	4
1020600600	Stenacron	1	4
1020600700	Stenonema(old genus)	3	3
1020800300	Ephemerella	11	1
1020800400	Eurylophella	1	4
1021200000	Leptophlebiidae	8	4
1030200700	Lanthus	3	5
1040400100	Amphinemura	3	3
1040500200	Leuctra	12	0
1040700400	Acroneuria	1	0
1040900200	Alloperla	2	0
1040900300	Haploperla	22	0
1080300500	Polycentropus	1	6
1080400300	Diplectrona	4	0
1080400700	Hydropsyche	13	5
1080700400	Hydroptila	1	6
1080910100	Lepidostoma	1	1
1081100100	Neophylax	1	3
1101300600	Optioservus	7	4
1101300800	Oulimnius	26	5
1101301000	Stenelmis	1	5
1121200100	Chelifera	1	6
1121900400	Tipula	1	4
1121900700	Antocha	7	3
1122200000	Chironomidae	66	6
13040100100	Cambarus	1	6

Habitat:

1 Instream Cover:	15	2 Epifaunal Substrate:	16		
3 Embeddedness:	11	4 Velocity/Depth Regimes:	16		
5 Channel Alterations:	18	6 Sediment Deposition:	11		
7 Frequency of Riffles:	13	8 Channel Flow Status:	15		
9 Condition of Banks:	9	10 Bank Vegetation:	19	áááá	Total
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20	áááá	183

Impairment:

Insufficient?	N	Impaired?	N	áááá	Biology Impaired?	áá N
Habitat Impaired?	N	Rock picks influenced?	N	áááá	Impact Localized?	áá N
Designated Use needs reevaluation?	N					

Comments:

Land Use:	Primary use of land is state game lands
Impairment:	IBI-72.6 Rocks are stained oragne; cond. is low and pH is in the 6.5 range

Macroinvertebrate Sample Summary

Assessment ID:	56778
Station ID:	20070514-1000-dersmith (Latitude: 41.2647, Longitude: -79.9871)
Method:	6-Dframe Composite, 200 subsample
Location:	UNT South Sandy 02 Polk Quad. 16G Venango Co.; Irwin Twn. Hellskitchen Rd. to ? Rd. to where Unt. crosses the Road. Sample downstream

Metrics:

Total # Organisms: 240	Hilsenhoff: 6.03	%EPT: 1	FCPRSH: 4
Taxa Richness: 7	Beck3: 3	Beck4: 4	Modified %EPT: 1
Modified Caddis: 0	EPT: 3	%Mayflies: 0	%Dominant: 95
Caddisfly Taxa: 0	Mayfly Taxa: 1	Modified EPT: 3	Modified %Mayflies: 0
%Intol-Limestone: 1	%Tol-Limestone: 2	%Intol-Freestone: 2	%Tol-Freestone: 98
Shannon Diversity: 0.26			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020800300	Ephemerella	1	1
1040400100	Amphinemura	1	3
1040400200	Ostrocerca	1	2
1060100100	Sialis	2	6
1100300000	Dytiscidae	1	5
1122200000	Chironomidae	229	6
11000000000	Oligochaeta	5	10

Habitat:

1 Instream Cover:	10	2 Epifaunal Substrate:	11	
3 Embeddedness:	10	4 Velocity/Depth Regimes:	13	
5 Channel Alterations:	17	6 Sediment Deposition:	9	
7 Frequency of Riffles:	10	8 Channel Flow Status:	7	
9 Condition of Banks:	4	10 Bank Vegetation:	20	Total
11 Grazing or Disruptive:	20	12 Riparian Vegetation:	20	151

Impairment:

Insufficient?	N	Impaired?	Y	Biology Impaired?	Y
Habitat Impaired?	N	Rock picks influenced?	N	Impact Localized?	N
Designated Use needs reevaluation?	N				

Comments:

Land Use:	The primary use of land is old strip mines
Impairment:	-Stream is colored bright Orange -Banks are scoured out; lots of bank failure areas

Appendix C – Williams Run Macros

Biosurvey Data Sheet (page 2) Macro-invertebrate Survey Rocky bottom stream

Site name: Williams Run - Near mouth of stream Date: _______5/15/06___________

Location: ***41º 17' 45.3"*** ***79º 57' 3.2"***

Monitor ID#s: __iep1275 , efk6435, jak6435, lb2832

Weather in last 24 hrs. Showers Weather today: ___Rain______________

Identify the macro-invertebrates (to order) in your sample using the identification card. We are only concerned with organisms that appear on the tally sheet. Record the number of organisms below and then assign them letter codes based on their abundance as listed below.

R(rare) = 1-9 organisms C(common) = 10-99 organisms D(dominant) = 100 plus organisms

---

Group I – Sensative

__0___ ( ) Gilled snails

__0___ ( ) Hellgrammites

__0___ ( ) Mayfly nymph

__0___ ( ) Non net-spinning caddisfly larva (case builders)

_0____ ( ) Riffle beetle adults

_6___ (R) Stonefly nymph

_0____ ( ) Water Penny larva

Group II – Somewhat sensitive

__0___ ( ) Alderfly larvae

__3__ (R) Beetle larvae

__0___ ( ) Clam

__0___ ( ) Cranefly larvae

__0___ ( ) Crayfish

__0___ ( ) Damselfly nymph

__0___ ( ) Dragonfly nymph

__0___ ( ) Fishfly larvae

__0___ ( ) Net-spinning caddisfly larvae (non case builders)

__0___ ( ) Scuds

__0___ ( ) Sowbugs

Group III – Tolerant

__0___ ( ) Aquatic worms

__0___ ( ) Blackfly larvae

__0___ ( ) Leeches

__5__ (R) Midge larvae

__0__ ( ) Snails (other)

Continue on to page 3

Biosurvey: Data Sheet (Page 3)

Site ID: Williams Run – Near mouth of stream __Date: ____5/15/06____________

41º 17’ 45.3”   79º 57’ 3.2”

Water Quality Rating

To calculate the index value, add the number of letters found in the three groups on the previous page and multiply by the indicated weighing factor.

Group I . Sensitive

# of R's, C's, and D's

___1____ (# of R's) x 5.0 = ___5.0_

___0____(# of C's) x 5.6 = _______

___0____(# of D's) x 5.3 = _______

Sum of the Index Value for Group I= _5.0___

Group II . Somewhat Sensitive

# of R's, C's, and D's

____1___ (# of R's) x 3.2 = __3.2__

____0___(# of C's) x 3.4 = _______

____0___(# of D's) x 3.0 = _______

Sum of the Index Value for Group II= __3.2_____

Group III. Tolerant

# of R's, C's, and D's

____1___ (# of R's) x 1.2 = __1.2__

____0___(# of C's) x 1.1 = _______

____0___(# of D's) x 1.0 = _______

Sum of the Index Value for Group III= __1.2___

To calculate the water quality score for the stream site, add together the index values for each group.

The sum of these *values* equals the water quality score.

Water Quality Score = ___9.4______

Compare this score to the following number ranges to determine the quality of your stream site.

____Good > 40   ____Fair 20-40   __X__ Poor < 20

Note: The tolerance groupings (Group I, II, III) and the water quality rating categories were developed for streams in the Mid-Atlantic states.

Comments: Stream contained few attachment sites for macro-invertebrates. Sand and gravel were abundant

Biosurvey Data Sheet (page 2) Macro-invertebrate Survey Rocky bottom stream

Site name: Williams Run - off of Game Land Road Date: _______5/15/06___________

Location: 41º 15' 37.5" 79º 57' 36.1"

Monitor ID#s: __iep1275 , efk6435, jak6435, lb2832

Weather in last 24 hrs. Showers Weather today: Rain

Identify the macro-invertebrates (to order) in your sample using the identification card. We are only concerned with organisms that appear on the tally sheet. Record the number of organisms below and then assign them letter codes based on their abundance as listed below.

R(rare) = 1-9 organisms C(common) = 10-99 organisms D(dominant) = 100 plus organisms

---

Group I – Sensative

__0___ ( ) Gilled snails
__0___ ( ) Hellgrammites
__0___ ( ) Mayfly nymph
__0___ ( ) Non net-spinning caddisfly larva (case builders)
_0____ ( ) Riffle beetle adults
_2___ (R) Stonefly nymph
_0____ ( ) Water Penny larvae

Group II – Somewhat sensitive

__0___ ( ) Alderfly larvae
__0__ (.) Beetle larvae
__0___ ( ) Clam
__0___ ( ) Cranefly larvae
__0___ ( ) Crayfish
__1___ (R) Damselfly nymph
__0___ ( ) Dragonfly nymph
__0___ ( ) Fishfly larvae
__0___ ( ) Net-spinning caddisfly larvae (non case builders)
__0___ ( ) Scuds
__0___ ( ) Sowbugs

Group III – Tolerant

__0___ ( ) Aquatic worms
__0___ ( ) Blackfly larvae
__0___ ( ) Leeches
__1__ (R) Midge larvae
__0__ ( ) Snails (other)

Continue on to page 3

Biosurvey: Data Sheet (Page 3)

Site ID: Williams Run – Near mouth of stream __Date: ____5/15/06____________

Location: ***41º 15' 37.5"*** ***79º 57' 36.1"***

Water Quality Rating

To calculate the index value, add the number of letters found in the three groups on the previous page and multiply by the indicated weighing factor.

Group I . Sensitive

# of R's, C's, and D's

___1____ (# of R's) x 5.0 = ___5.0_

___0____(# of C's) x 5.6 = _______

___0____(# of D's) x 5.3 = _______

Sum of the Index Value for Group I= _5.0___

Group II . Somewhat Sensitive

# of R's, C's, and D's

____1___ (# of R's) x 3.2 = __3.2__

____0___(# of C's) x 3.4 = _______

____0___(# of D's) x 3.0 = _______

Sum of the Index Value for Group II= __3.2_____

Group III. Tolerant

# of R's, C's, and D's

____1___ (# of R's) x 1.2 = __1.2__

____0___(# of C's) x 1.1 = _______

____0___(# of D's) x 1.0 = _______

Sum of the Index Value for Group III= __1.2___

To calculate the water quality score for the stream site, add together the index values for each group.

The sum of these *values* equals the water quality score.

Water Quality Score = ____9.4______

Compare this score to the following number ranges to determine the quality of your stream site.

____Good > 40 **____Fair 20-40** **__X__ Poor < 20**

Note: The tolerance groupings (Group I, II, III) and the water quality rating categories were developed for streams in the Mid-Atlantic states.

Comments: There was abundant flow from an upstream impoundment due to heavy rain in previous days which may explain the presence of the Damselfly nymph. Stream bottom showed abundant deposits of Iron Oxide.

Appendix D – PAF&BC Electroshock

Lance,

Attached are some tables of data from past surveys of South Sandy Creek, Williams Run and an unnamed tributary to Williams Run. We have done several sites in different years 2005, 2004 and 1998.

Williams Run is badly polluted by acid mine drainage and we found no fish in it in 2005 after finding few in 1998. I include the data on the unnamed tributary to Williams Run because it is not affected by the AMD and it has a very good wild brook trout population which demonstrates the potential of Williams Run if the pollution effects were eliminated.

I also include a draft report of Bear Run a small tributary about 0.62 mile upstream of the mouth of South Sandy Creek. It too is unaffected by AMD and had a Class A wild brook trout population.

South Sandy Creek has some fish and wild trout presently but would do much better if pollution influences were eliminated throughout the drainage area, especially Williams Run. There are two files for South Sandy Creek, one covers 2005 and 2004 data and the other 1998.

I strongly recommend projects that will eliminate AMD influences in Williams Run and the rest of the South Sandy Creek drainage and would rate it my number 1 priority for that county.

Any questions give me a call and I hope this helps you out.

Al

Allen Woomer
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Pennsylvania Fish and Boat Commission
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Tionesta, PA 16353
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Table 1. South Sandy Creek site locations in 1998.

Site RM 7.55	**GADSBY RD BRIDGE**
Site RM 7.4	**150M DNST SR3011 BRIDGE**
Site RM 5.9	**100M UPST T-330 BRIDGE**
Site RM 4.4	**FIRST TRIB DNST LYONS RN**
Site RM 3.66	**100M DNST TRIB 1.7KM DNST LYONS RN**

Table 2. Chemical-thermal analyses of South Sandy Creek, 1998.

	Section				
	02			01	
Riv. Mile	3.66	4.40	5.90	7.40	7.58
Date	06/22	06/22	06/22	06/23	06/23
Air Temp	25	24	25	27	26
Water Temp	19.7	18.5	21.0	19.5	19.5
pH	7.1	7.0	7.1	7.0	7.1
Spec Cond	190	198	198	128	138
Tot Alk	19	21	18	32	42
Tot Hard	62	72	61	53	67

Table 3. Fish species occurrence in South Sandy Creek, Section 01, 1998

	Section #:	01	01
	River mile:	7.40	7.58
	Date:	06/23	06/23
Common Name	Scientific Name		
Redside dace	Clinostomus elongatus	x	x
Blacknose dace	Rhinichthys atratulus	x	x
Longnose dace	Rhinichthys cataractae	x	x
Creek chub	Semotilus atromaculatus	x	x
White sucker	Catostomus commersoni	x	x
Northern hog sucker	Hypentelium nigricans	x	x
Mottled sculpin	Cottus bairdi	x	x
Johnny darter	Etheostoma nigrum	x	x
Fantail darter	Etheostoma flabellare	x	x

Table 4. Fish species occurrence in South Sandy Creek, Section 02, 1998

Common Name	Scientific Name	Section #: 02 River mile: 5.90 Date: 06/22	02 4.40 06/22	02 3.66 06/22
Lamprey unid	Lamprey			x
Brown trout	Salmo trutta	x		x
Brook trout	Salvelinus fontinalis	x	x	x
Brown trout - hatchery	Salmo trutta			x
Central stoneroller	Campostoma anomalum	x	x	
Blacknose dace	Rhinichthys atratulus	x	x	x
Longnose dace	Rhinichthys cataractae	x	x	x
Creek chub	Semotilus atromaculatus	x	x	x
White sucker	Catostomus commersoni	x	x	x
Northern hog sucker	Hypentelium nigricans			x
Greenside darter	Etheostoma blennioides		x	x
Rainbow darter	Etheostoma caeruleum			x
Johnny darter	Etheostoma nigrum	x	x	x
Mottled sculpin	Cottus bairdi	x	x	x
Redside dace	Clinostomus elongatus	x	x	
Common shiner	Luxilus cornutus		x	
Fantail darter	Etheostoma flabellare	x		
Species Total		11	11	13

Table 5. Length/frequency distribution and abundance statistics for brook trout from SANDY CK S (0216G). Site located at River Mile 5.9 with a site Lat/Lon of 411753/795657. Site currently located within section 2. Survey Date: 06/22/98. Collection gear Electrobackpack.

Length Group (mm)	Catch	Total Catch/Total Effort CPUE	Mean CPUE	Standard Error
100	1	1.88	n/a	n/a
125	3	5.63	n/a	n/a
150	1	1.88	n/a	n/a
225	1	1.88	n/a	n/a
Total	6	11.27		
Total Effort	= 0.53			

Table 6. Length/frequency distribution and abundance statistics for brown trout from SANDY CK S (0216G). Site located at River Mile 5.9 with a site Lat/Lon of 411753/795657. Site currently located within section 2. Survey Date: 06/22/98. Collection gear Electrobackpack.

Length Group (mm)	Catch	Total Catch/Total Effort CPUE	Mean CPUE	Standard Error
250	1	1.88	n/a	n/a
300	1	1.88	n/a	n/a
325	1	1.88	n/a	n/a
Total	3	5.64		
Total Effort	= 0.53			

Table 7. Length/frequency distribution and abundance statistics for brook trout from SANDY CK S (0216G). Site located at River Mile 4.4 with a site Lat/Lon of 411838/795557. Site currently located within section 2. Survey Date: 06/22/98. Collection gear Electrobackpack.

Length Group (mm)	Catch	Total Catch/Total Effort CPUE	Mean CPUE	Standard Error
125	2	4.14	n/a	n/a
Total	2	4.14		
Total Effort	= 0.48			

Table 8. Length/frequency distribution and abundance statistics for brook trout from SANDY CK S (0216G). Site located at River Mile 3.66 with a site Lat/Lon of 411916/795536. Site currently located within section 2. Survey Date: 06/22/98. Collection gear Electrobackpack.

Length Group (mm)	Catch	Total Catch/Total Effort CPUE	Mean CPUE	Standard Error
100	5	7.69	n/a	n/a
125	6	9.23	n/a	n/a
150	4	6.15	n/a	n/a
175	1	1.54	n/a	n/a
225	2	3.08	n/a	n/a
Total	18	27.69		
Total Effort	= 0.65			

Table 9. Length/frequency distribution and abundance statistics for brown trout from SANDY CK S (0216G). Site located at River Mile 3.66 with a site Lat/Lon of 411916/795536. Site currently located within section 2. Survey Date: 06/22/98. Collection gear Electrobackpack.

Length Group (mm)	Catch	Total Catch/Total Effort CPUE	Mean CPUE	Standard Error
425	1	1.54	n/a	n/a
Total	1	1.54		
Total Effort	= 0.65			

Table 1. Chemical-thermal analyses of South Sandy Creek (216G) over all survey years.

River Mile	SiteLatLon	Section	Site Date	Air Temp	Water Temp	pH	Sp Conductance	Total Alkalinity	Total Hardness
10.46	411824800053	1	7/20/2005	32	22	7.5	196	50	
8.53	411738795920	1	7/20/2005	30	22.4	7.3	189	52	69
7.6	411724795824	1	2/23/1982	10	2	6.9	161	16	52
7.58	411725795826	1	6/23/1998	26	19.5	7.1	138	42	67
7.49	411721795822	1	6/28/2004		14.3	7.1	148	36	54
7.4	411722795816	1	6/23/1998	27	19.5	7	128	32	53
6.2	411742795708	1	2/23/1982	10	2	6.7	147	10	40
6.01	411743795706	1	6/28/2004	20	15	7.1	120	28	48
5.9	411753795657	2	6/22/1998	25	21	7.1	198	18	61
5.9	411753795657	2	7/11/1983	26	17.5	6.2	189	6	12
5.8	411754795655	2	2/23/1982	8	2	5.8	210	2	60
5.61	411801795650	2	6/28/2004		14.7	6.6	198	14	
4.4	411838795557	2	6/22/1998	24	18.5	7	198	21	72
4.4	411838795557	2	7/11/1983	27	17.5	6.6	150	6	62
3.66	411916795536	2	6/22/1998	25	19.7	7.1	190	19	62
2.8	411938795525	2	7/11/1983	22	13	6.7	130	6	50
0.57	412116795450	2	7/20/2005	30	21.1	7.1	207	19	75
0.2	412132795419	2	2/23/1982	13	4	6.6	190	2	60

Table 2. Site species collection matrix from South Sandy Creek (216G). Data collected within 2005 survey year.

Common Name	Scientific Name	0.57	8.53	10.46
Blacknose Dace	Rhinichthys atratulus	X	X	X
Bluntnose Minnow	Pimephales notatus	X		
Brook Trout	Salvelinus fontinalis	X	X	
Brown Trout	Salmo trutta	X		X
Brown Trout - Hatchery	Salmo trutta	X		
Central Stoneroller	Campostoma anomalum	X		
Common Shiner	Luxilus cornutus		X	
Creek Chub	Semotilus atromaculatus	X	X	X
Fantail Darter	Etheostoma flabellare	X	X	
Green Sunfish	Lepomis cyanellus	X	X	X
Greenside Darter	Etheostoma blennioides	X		
Johnny Darter	Etheostoma nigrum		X	X
Longnose Dace	Rhinichthys cataractae	X		
Mottled Sculpin	Cottus bairdii	X	X	X
Northern Hog Sucker	Hypentelium nigricans	X		
Pumpkinseed	Lepomis gibbosus		X	
Rainbow Darter	Etheostoma caeruleum	X		
Redside Dace	Clinostomus elongatus		X	X
Rosyface Shiner	Notropis rubellus	X		
Silver Shiner	Notropis photogenis	X		
Smallmouth Bass	Micropterus dolomieu	X		
Striped Shiner	Luxilus chrysocephalus			X
Tonguetied Minnow	Exoglossum laurae	X		
White Sucker	Catostomus commersonii	X	X	X

Table 3. Length/frequency distribution and catch biomass statistics for brown trout from South Sandy Creek (216G). Site located at River Mile 10.46 with a site Lat/Lon of 411824/800053. Site currently located within section 1. Survey Date: 07/20/05. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
100	2	14.31	StateMeanWt	0.54	38	13	0.0532	152
375	1	579.91	StateMeanWt	10.9	19	7	0.0532	152
Totals	3			11.44	57	20		

Table 4. Length/frequency distribution and catch biomass statistics for brook trout from South Sandy Creek (216G). Site located at River Mile 8.53 with a site Lat/Lon of 411738/795920. Site currently located within section 1. Survey Date: 07/20/05. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
100	1	13.68	StateMeanWt	0.22	16	6	0.0616	162
125	3	24.32	StateMeanWt	1.18	49	19	0.0616	162
Totals	4			1.4	65	25		

Table 5. Length/frequency distribution and catch biomass statistics for brook trout from South Sandy Creek (216G). Site located at River Mile 0.57 with a site Lat/Lon of 412116/795450. Site currently located within section 2. Survey Date: 07/20/05. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
50	1	2.4	StateMeanWt	0.02	8	7	0.1233	145
150	1	41.05	StateMeanWt	0.33	8	7	0.1233	145
Totals	2			0.35	16	14		

Table 6. Length/frequency distribution and catch biomass statistics for brown trout from South Sandy Creek (216G). Site located at River Mile 0.57 with a site Lat/Lon of 412116/795450. Site currently located within section 2. Survey Date: 07/20/05. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
75	1	6.33	StateMeanWt	0.05	8	7	0.1233	145
175	2	66.97	StateMeanWt	1.09	16	14	0.1233	145
Totals	3			1.14	24	21		

Table 7. Length/frequency distribution and catch biomass statistics for brown trout - hatchery from South Sandy Creek (216G). Site located at River Mile 0.57 with a site Lat/Lon of 412116/795450. Site currently located within section 2. Survey Date: 07/20/05. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
275	1	240.48	StateMeanWt	1.95	8	7	0.1233	145
Totals	1			1.95	8	7		

Table 8. Length/frequency distribution and catch biomass statistics for smallmouth bass from South Sandy Creek (216G). Site located at River Mile 0.57 with a site Lat/Lon of 412116/795450. Site currently located within section 2. Survey Date: 07/20/05. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
25	1	1.44	StateMeanWt	0.01	8	7	0.1233	145
50	12	3.01	StateMeanWt	0.29	97	83	0.1233	145
Totals	13			0.3	105	90		

Table 9. Site species collection matrix from South Sandy Creek (216G). Data collected within 2004 survey year.

Common Name	Scientific Name	5.61	6.01	7.49
Blacknose Dace	Rhinichthys atratulus	X	X	X
Brook Trout	Salvelinus fontinalis			X
Central Stoneroller	Campostoma anomalum		X	X
Common Shiner	Luxilus cornutus		X	X
Creek Chub	Semotilus atromaculatus	X	X	X
Fantail Darter	Etheostoma flabellare			X
Greenside Darter	Etheostoma blennioides		X	
Johnny Darter	Etheostoma nigrum		X	
Longnose Dace	Rhinichthys cataractae	X	X	X
Mottled Sculpin	Cottus bairdii	X	X	X
Northern Hog Sucker	Hypentelium nigricans			X
Redside Dace	Clinostomus elongatus	X	X	X
White Sucker	Catostomus commersonii	X	X	X

Table 10. Length/frequency distribution and catch biomass statistics for brook trout from South Sandy Creek (216G). Site located at River Mile 7.49 with a site Lat/Lon of 411721/795822 DMS o. Site currently located within section 1. Survey Date: 6/28/2004. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
125	1	24.3	StateMeanWt	0.35	14	6	0.0696	174
Totals	1			0.35	14	6		

Table 1. Time series site chemistries from Unt To Williams Run at site rivermile 0 with Site Latitude 411632 Longitude 795653 DMS or 41.275555 -79.948059 DD. This site is currently located within Section Number 1 within sub-subbasin 16G.

Chemical Test	Test Units	Values 6/23/1998	Values 9/12/2005
Air Temperature	C	25	22
pH Field Colorimetric	SU	6.8	6.7
Specific Conductance	UMHOS	103	162
Total Alkalinity Field Mixed Indicator	MG/L	10	16
Total Hardness Field EDTA	MG/L	34	
Water Temperature	C	18	14.4

Table 2. Fish collected from Unt To Williams Run at site rivermile 0 with Site Latitude 411632 Longitude 795653 DMS using Electrobackpack gear. Site established 9/12/2005 by Fisheries Management Area 2. This site is currently located within Section Number 1, 16G

Comname	*Sciname*	06/23/1998	09/12/2005
Blacknose Dace	*Rhinichthys atratulus*	X	X
Brook Trout	*Salvelinus fontinalis*	X	X
Creek Chub	*Semotilus atromaculatus*	X	X
Green Sunfish	*Lepomis cyanellus*		X
Mottled Sculpin	*Cottus bairdii*	X	X
White Sucker	*Catostomus commersonii*		X

Table 3. Length/frequency distribution and catch biomass statistics for brook trout from Unt To Williams Run (216G). Site located at River Mile 0 with a site Lat/Lon of 411632/795653 DMS o. Survey Date: 9/12/2005. Collection gear Electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
75	31	5.92	StateMeanWt	1.57	265	103	0.1170	300
100	35	13.68	StateMeanWt	4.09	299	117	0.1170	300
125	2	24.3	StateMeanWt	0.42	17	7	0.1170	300
150	12	41	StateMeanWt	4.21	103	40	0.1170	300
175	6	63.9	StateMeanWt	3.28	51	20	0.1170	300
200	4	92.37	StateMeanWt	3.16	34	13	0.1170	300
225	1	131.03	StateMeanWt	1.12	9	3	0.1170	300
Totals	91			17.85	778	303		

Table 4. Estimated Abundance and Biomass of brook trout from Unt To Williams Run (216G), using a Petersen estimator. Site located at River Mile 0 with a site Lat/Lon of 411632/795653 DMS. Survey Date: 6/23/1998. Collection gear Electrobackpack.

Size Group	Population Estimate	Low 95% CI	High 95% CI	Estimated Number/Ha	Estimated Kg/Ha	Estimated Number/Km
25	3			25	0.03	10
50	59	41	87	496	1.19	193
75	4			34	0.2	13
100	12	7	23	101	1.38	39
125	27	16	49	227	5.51	89
150	7	3	16	59	2.41	23
175	4			34	2.15	13
200	3			25	2.33	10
225	2			17	2.2	7
Totals:	121			1018	17.4	397

Table 1. Chemical-thermal analyses of Williams Run (216G) over all survey years.

River Mile	SiteLatLon	Section	Site Date	Air Temp	Water Temp	pH	Sp Conductance	Total Alkalinity	Total Hardness
1.89	411631795653	1	6/24/1998	20	18.8	5.7	700	1	
1.62	411634795649	1	9/12/2005	22	15	5.4			
1.62	411641795652	1	6/23/1998	25	18	6.6	352	8	
0.1	411740795708	1	2/23/1982	10	2	4.1	380		240
0.03	411742795702	1	6/28/2004		14	4.6	320	0	

Table 2. Fish collected from Williams Run (216G) at site rivermile 1.62 with Site Latitude 411641 Longitude 795652 DMS using Electrobackpack gear. Site established 6/23/1998 by Fisheries Management Area 2. Site located 100 m downstream unnamed tributary.

Comname	*Sciname*
Blacknose Dace	*Rhinichthys atratulus*
Creek Chub	*Semotilus atromaculatus*

This site was sampled again on 9/12/05 and no fish were sampled in 100m of electrofishing.

A second site was sampled in 2005 at river mile 0.03 (50 m upstream of the mouth. No fish were sampled at this site in 115 m of electrofishing.

PA FISH AND BOAT COMMISSION
COMMENTS AND RECOMMENDATIONS
August 11, 2008

WATER: Bear Run (216G) Venango County

EXAMINED: July 20, 2005

BY: Allen Woomer and Tim Wilson

Bureau Director Action:_______________________________ Date:_________________

Division Chief Action:________________________________ Date:_________________

WW Unit Leader Action:________________________________ Date:_________________

CW Unit Leader Action:________________________________ Date:_________________

AREA COMMENTS:

An initial inventory of Bear Run was performed to characterize and document the wild brook trout fishery. An excellent Class A abundance of brook trout was sampled in this small 1st order stream with biomass estimated at 55.11 kg/ha. Bear Run is part of the South Sandy Creek drainage basin which is classified Cold Water Fishery in Chapter 93 Water Quality Standards.

AREA RECOMMENDATIONS:

1. Manage this stream as a Class A wild brook trout fishery under statewide regulations with no stocking.

2. Provide a copy of this report to PA DEP for reclassification of Bear Run to High Quality Cold Water Fishery.

This work made possible by funding from the Sport Fish Restoration Act Project F-57-R Fisheries Management.

PENNSYLVANIA FISH AND BOAT COMMISSION
BUREAU OF FISHERIES
DIVISION OF FISHERIES MANAGEMENT

Bear Run (216G)
Management Report
Section 01

Prepared by
Allen Woomer and Tim Wilson

Fisheries Management Database Name: Bear Rn
Lat/Lon: 412115/795451

Date Sampled: July 20, 2005 Date Prepared: August 2007

Introduction

Bear Run (216G) is a very small first order headwaters stream located in Venango County and tributary to South Sandy Creek, entering at River Mile 0.62 and found on the Polk 7.5 minute USGS quadrangle. It has a total length of 1.40 km, a drainage area of 1.37 km^2 and has a stream gradient of 73.1 m/km. Around 47% of the stream is located on State Game Lands No. 39 and the remaining 53 % is on private lands open to fishing.

The purpose of this survey was to initially inventory Bear Run for management purposes and to characterize and document the wild brook trout (*Salvelinus fontinalis*) population. In addition, the South Sandy Creek Watershed Association was interested in showing the capacity of streams in the South Sandy Creek drainage unaffected by pollution or habitat degradation to produce quality wild trout fisheries. Their group is attempting to gain funds to perform remediation of streams in a watershed badly polluted by acid mine drainage.

Methods

This survey was conducted using standard Pennsylvania Fish and Boat Commission (PFBC), Fisheries Management procedures (Marcinko et al. 1986). A single site was sampled on July 20, 2005 at River Mile 0.01 located 10 m upstream from the mouth (Figure 1). A Coffelt model BP-1C backpack set at 200 VAC was used to electrofish the site. Biomass and abundance estimates were based on the actual number of trout obtained in a single electrofishing pass.

Fisheries Assessment

Water chemistry results (Table 1) indicate Bear Run is slightly acidic under low flow conditions and has a low level of alkalinity and hardness typical of small headwaters stream in this part of Pennsylvania.

Six fish species were identified in the 130 m backpack electrofishing site (Table 2). Wild brook trout ranged in size from the 25-49 to 175-199 mm size groups and biomass was estimated at 55.11 kg/ha (Table 3). This Class A estimate was product of two strong year classes produced in 2004 and 2005 and the very small size of the stream. Mean width was measured at 1.01 m at the site. Abundance of legal size (≥175 mm) brook trout was estimated at 15/km. This was quite a good density for such a small stream.

Management Recommendations

Bear Run (216G) should be managed as a single section encompassing headwaters to the mouth. It is recommended that Bear Run be added to the list of Class A trout streams and managed under statewide regulations with no stocking. Bear Run was added to the list of streams supporting natural reproduction of trout in 2006. Bear Run is part of the South Sandy Creek drainage basin which is classified Cold Water Fishery in Chapter 93 Water Quality Standards. Given the Class A brook trout population identified on Bear Run, this stream should be reclassified High Quality Cold Water Fishery.

Literature Cited

Marcinko, M., R. Lorson and R. Hoopes. 1986. Procedures for Stream and River Inventory Information Input. Pennsylvania Fish and Boat Commission, 450 Robinson Lane, Bellefonte, PA.

Table 1. Chemistries collected from Bear Run (216G) at Site rivermile 0.01 with Site Lat/Lon 412116/795452 on July 20, 2005.

Air Temperature (°C): 30
General Chemistries Sample Time Of Day: 1215
Alkalinity Test: Total Alkalinity Field Mixed Indicator
Hardness Test: Total Hardness Field EDTA
pH Test: pH Field Colorimetric

Sample Depth (m)	Water Temp (°C)	Dissolved Oxygen (ml/g)	Alkalinity (mg/l)	Hardness (mg/l)	Specific Conductance (umhos/cm@25°C)	pH (SU)
0	18.3		6	15	46	6.5

No Additional Chemistries Collected

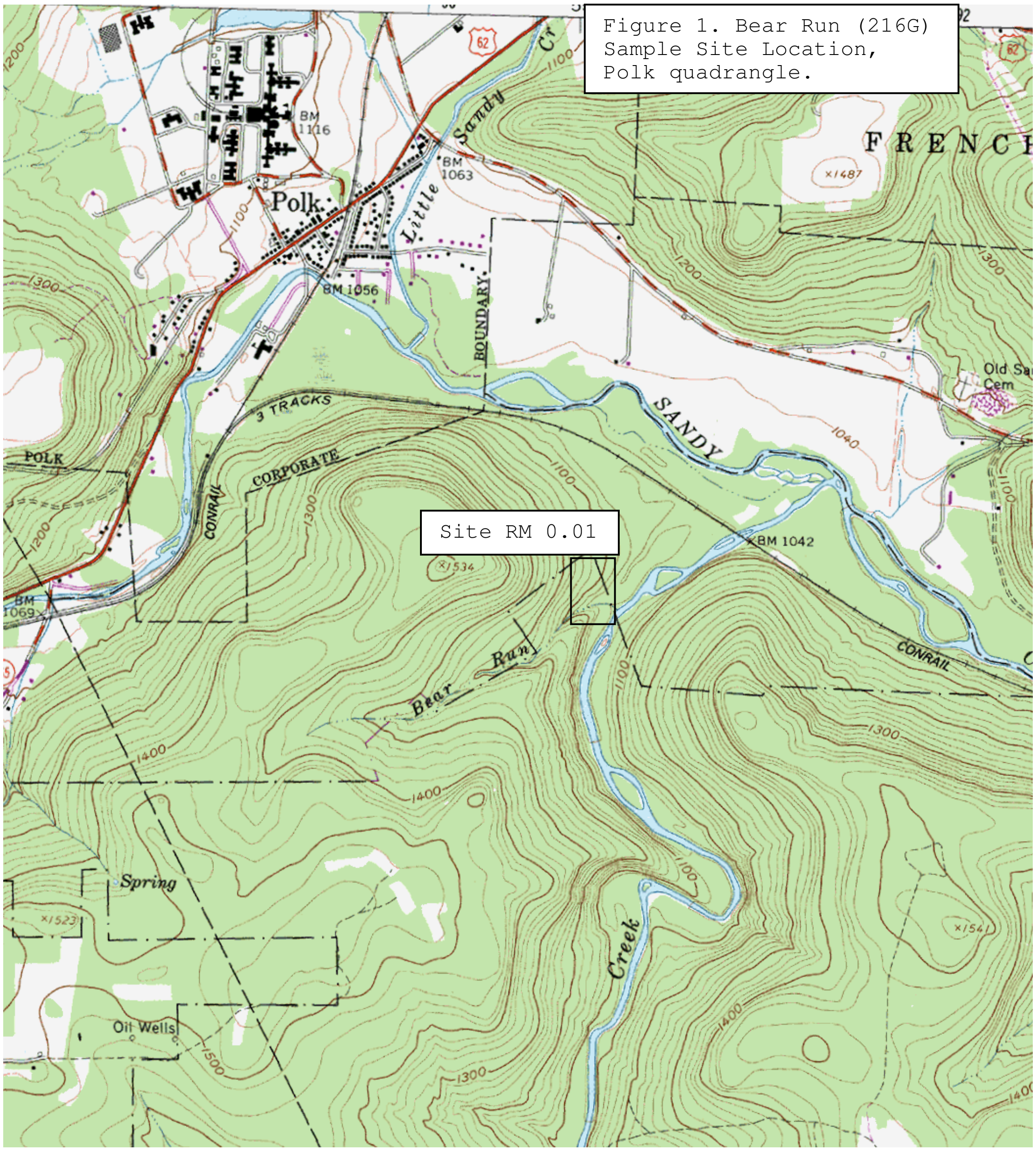
Table 2. Fish collected from Bear Run (216G) at Site rivermile 0.01 with Site Lat/Lon 412116/795452 using electrobackpack gear on July 2, 2005.

Common name	*Scientific name*
Blacknose Dace	*Rhinichthys atratulus*
Brook Trout	*Salvelinus fontinalis*
Creek Chub	*Semotilus atromaculatus*
Fantail Darter	*Etheostoma flabellare*
Longnose Dace	*Rhinichthys cataractae*
Mottled Sculpin	*Cottus bairdi*

Table 3. Length/frequency distribution and catch biomass statistics for brook trout from Bear Run (216G). Site located at River Mile 0.01 with a site Lat/Lon of 412116/795452. Survey Date: July 20, 2005. Collection gear electrobackpack.

Size Group	Catch	Mean Wt(g)	Wt Source	Kg/ Ha	Num/ Ha	Num/ Km	Site Area Ha	Site Length
25	7	1.04	StateMeanWt	0.55	534	54	0.0131	130
50	58	2.4	StateMeanWt	10.64	4427	446	0.0131	130
75	3	5.91	StateMeanWt	1.35	229	23	0.0131	130
100	10	13.68	StateMeanWt	10.44	763	77	0.0131	130
125	7	24.31	StateMeanWt	12.99	534	54	0.0131	130
150	3	41.01	StateMeanWt	9.39	229	23	0.0131	130
175	2	63.88	StateMeanWt	9.75	153	15	0.0131	130
Totals	90			55.11	6869	692		

Figure 1. Bear Run (216G) Sample Site Location, Polk quadrangle.



Appendix E – Mercer County Field Data

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL

Date: 04/10/07

Type of Discharge: ____

Description of site: ~~RIGHT~~ EASTERN UPPER TRIB TO MAIN STEM

Location:

Latitude: ____ Decimal Degrees: 41 31 200 80 02 125

Longitude: ____

pH: 7.2

Conductivity: 82

Temperature: Air 44 Water 42

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL / SHAWN HEDGLIN

Date: 04/10/07

Type of Discharge: ______

Description of site: LOWEST [illegible] ON KEBSIK PROPERTY AT CONFL. W/ MAIN STEM

Location:

Latitude: 41.30997 Decimal Degrees: ______

Longitude: 80.01837

pH: [illegible]

Conductivity: 57

Temperature: Air [illegible] Water 37

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL
Date: 4/10/07
Type of Discharge: STREAM

Description of site: STREAM BELOW ROAD CULVERT ON McCOMB RD.

Location:
Latitude: ______ Decimal Degrees: 41.303.70 80.05231
Longitude: ______

pH: 6.7

Conductivity: 260

Temperature: Air 35° Water 35°

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL

Date: 04/10/07

Type of Discharge: MAIN STREAM

Description of site: MAIN BRANCH ABOVE LOWEST TRIB ON KOBSIK PROPERTY

Location:

Latitude: ______ Decimal Degrees: 41.31 001 80.01822

Longitude: ______

pH: 7.1

Conductivity: 149

Temperature: Air 39 Water 39

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL

Date: 04/10/07

Type of Discharge: __________

Description of site: MAIN STEM BELOW LOWEST TRIB ON KOBSIK PROPERTY

Location:

Latitude: __________ Decimal Degrees: 41.30990 80.01838

Longitude: __________

pH: 6.9

Conductivity: 143

Temperature: Air 39 Water 40

#2 LEFT SIDE

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL
Date: 04/10/07
Type of Discharge: ______

Description of site: WESTERN UPPER TRIB TO MAIN STEM
WOODED, WETLAND

Location:
Latitude: ______ Decimal Degrees: 41 31 196 80 02 119
Longitude: ______

pH: 7.2

Conductivity: 200

Temperature: Air 42 Water 39

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL

Date: 04/10/07

Type of Discharge:

Description of site: ~~WESTERN TRIB TO~~ MAIN STEM BELOW E+W TRIB CONFL

WOODED, WETLAND AREA

Location:

Latitude: ______ Decimal Degrees: 41 31 200 80 02 118

Longitude: ______

pH: 7.1

Conductivity: 92

Temperature: Air 42 Water 42

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL / LARRY WHEELER
Date: 05-03-07
Type of Discharge: ____________

Description of site: AT BRIDGE ON GADSBY ROAD

Location:
Latitude: ____________ Decimal Degrees: N 41.27898 W 079.99548
Longitude: ____________

pH: 7.1

Conductivity: 65

Temperature: Air 61 Water ____________

South Sandy Creek
Field Assessment Form

Name or Assessor: JILL SHANKEL / LARRY WHEELER
Date: 05/03/07
Type of Discharge: MAIN STEM
Description of site: AT RTE 965 - BEFORE ROAD CROSSING (JUST UPSTREAM OF POND OUTFALL) (KEEHER PROPERTY)

Location:
Latitude: ______ Decimal Degrees: 31.308 14 080.017 76
Longitude: ______

pH: 7.2

Conductivity: 138

Temperature: Air 60 Water ______

Appendix F – Water Sample Raw Data

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Ag Site **Name** Williams Run Agricultural Site **LATITUDE** 41.25051 **LONGITUDE** -79.97073

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/18/2004		7			33.2	35.2	1.52	0.38	0.699	21	32	BAMR
7/7/2004		7			40.8	9.8	< 0.15	0.05	< 0.25	37.4	< 3	BAMR
6/15/2005		6.9			62	-13.6	2.07	0.91	0.77	< 20	12	BAMR
8/19/2005		7.7			103.4	-84	1.22	0.53	< 0.25	38.3	12	BAMR
12/22/2005		7			36.4	17.2	0.541	0.24	< 0.25	24.8	< 3	BAMR
3/20/2006		6.5			23.6	3.8	0.728	0.15	< 0.25	33.8	< 3	BAMR
4/20/2006		7			34	14.6	0.62	0.18	< 0.25	< 20	6	BAMR
6/15/2006		6.6			39.8	-27	1.24	0.46	< 0.25	29	< 3	BAMR
9/15/2006		6.8			27.8	-11.2	0.442	0.13	< 0.25	< 20	< 3	BAMR
5/29/2007		7.7	180.4		48.4	-4	0.907	0.425	0.238	< 20	4	South Sandy
6/26/2007		7.9	214			-39.6	1.04	0.464	0.278	31.8	< 2	South Sandy
7/30/2007		8	247			-12.2	1.162	0.434	0.328	38.4	8	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Tipple **Name** Tipple Site **LATITUDE** 41.26036 **LONGITUDE** -79.97842

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/29/2007		5.1	99.1		8.4	43.2	1.42	0.619	< 0.1	29.8	16	South Sandy
6/26/2007		3.4	337		0	58	2.71	1.06	3.28	96.7	< 2	South Sandy
7/30/2007		3.4	282		0	47.4	3.03	0.723	2.41	75.3	< 2	South Sandy
8/28/2007	17.5	3.6	189.9		0	41.6	1.92	0.92	2.04	55.1	< 2	South Sandy
9/27/2007		3.7	247									South Sandy
10/30/2007	5	3.4	299		0	89.6	1.25	0.819	2.52	63	10	South Sandy
11/13/2007	25.77	3.1	656		0	177	42.8	0.647	4.85	165.6	76	South Sandy
12/19/2007	140.86	2.8	924		0	399.8	74.1	0.96	11.5	250.9	< 2	South Sandy
1/29/2008	59.85	3.7	223		0	32.4	2.399	1.012	2.066	52.9	< 2	South Sandy
2/25/2008	24.6	3.8	369		0	-111	16	1.218	4.399	91.9	2	South Sandy
3/24/2008	139.16	3.1	520		0	140	30	1.199	6.495	136.7	18	South Sandy
4/28/2008	814.11	3.8	162.3		0	23.6	3.465	1.566	1.184	42.8	52	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Woods Rd **Name** Woods Road Site **LATITUDE** 41.26414 **LONGITUDE** -79.98589

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum		Sulfate	TSS		Source
5/29/2007		3.3	758		0	78.4	14.4	3.17	<	0.1	280.6		14	South Sandy
6/26/2007	7	3.3	797		0	86.6	19.6	3.19	<	0.1	293.4	<	2	South Sandy
7/30/2007	6	3.2	789		0	82.4	17.8	3.11	<	0.1	312.1	<	2	South Sandy
8/28/2007	6.5	3.3	776		0	84.2	26.2	2.99	<	0.1	286.8	<	2	South Sandy
9/24/2007	7.5	3.3	752		0	78.8	20.3	3.18	<	0.1	933.5		6	South Sandy
10/30/2007	7	3.2	788		0	74.4	6.36	3.04	<	0.1	316.2	<	2	South Sandy
11/13/2007	7	3.2	756		0	66.6	6.2	2.82	<	0.1	230.3		6	South Sandy
12/19/2007	11	3.5	601		0	51	15.3	2.532	<	0.1	211.7		4	South Sandy
1/29/2008	14	3.4	630		0	-145	290	2.529	<	0.1	229.4		460	South Sandy
2/25/2008	13.5	3.4	682		0	-137	34.1	3.106	<	0.1	248.5		30	South Sandy
3/24/2008	13.5	3.5	589		0	58.8	18.1	2.458	<	0.1	253.6		6	South Sandy
4/28/2008	24	3.5	382		0	35.8	6.999	1.449	<	0.1	126.2	<	5	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Woods Rd In stream **Name** Woods Road Site In - Stream **LATITUDE** 41.26436 **LONGITUDE** -79.9861

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/29/2007		3.6	344		0	45.8	2.99	1.71	1.42	101.5	14	South Sandy
6/26/2007	282	3.3	486		0	61.2	4.73	1.78	1.75	141.4	< 2	South Sandy
7/30/2007	297	3.2	578		0	95.4	7.47	2.06	4.69	172	< 2	South Sandy
8/28/2007	287.91	3.5	347		0	41.6	5.72	1.39	0.767	97.9	< 2	South Sandy
9/24/2007	223.88	3.3	468									South Sandy
10/30/2007	366.48	3.2	402									South Sandy
11/13/2007	774.09	3.6	338		0	59.6	7.42	1.42	2.42	75.9	6	South Sandy
12/26/2007	1451.91	3.5	238									South Sandy
1/29/2008	1630.11	4.1	216									South Sandy
2/25/2008	1057.06	3.9	263		0	37.8	4.556	1.343	2.718	81.2	2	South Sandy
3/24/2008	1203.35	3.3	237									South Sandy
4/28/2008	8468.75	4.1	135.4		3	23.6	2.42	0.866	1.406	45.4	22	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

SGL1 **Name** State Game Lands #1 **LATITUDE** 41.29054 **LONGITUDE** -79.96355

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/29/2007		7.2	67.1		28.4	26.8	7.2	0.7	0.257	< 20	76	South Sandy
6/27/2007	21	7.3	309		115.2	-85.6	10.405	0.724	< 0.1	31	20	South Sandy
7/30/2007	20	7.2	325		115.2	-26	15.3	0.822	< 0.1	41.9	30	South Sandy
8/28/2007	18.5	7.2	316		104.2	-7.4	11.2	0.762	< 0.1	38.6	24	South Sandy
9/25/2007	19	7	342		118.8	-40.6	12	0.892	< 0.1	35.9	< 2	South Sandy
10/30/2007	18	7.2	334		115.4	-35.4	13	0.859	< 0.1	58.4	18	South Sandy
11/14/2007	22	7	256		86	-57.6	7.03	0.637	< 0.1	46.9	10	South Sandy
12/19/2007	58	6.9	136.4		40	-27.2	4.862	0.296	< 0.1	23.2	2	South Sandy
1/31/2008	54	7	151.9		44.4	-32	7.399	0.399	< 0.1	37.4	10	South Sandy
2/26/2008	56	7.1	174.7		56.6	-39.4	8.374	0.386	< 0.1	34.1	10	South Sandy
3/24/2008	85	7	118.1		31	-19.4	4.289	0.263	< 0.1	25.3	14	South Sandy
4/28/2008	300	6.8	55.9		16.8	1.8	2.02	0.141	0.408	81.9	10	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

SGL4 **Name** State Game Lands #4 **LATITUDE** 41.29147 **LONGITUDE** -79.9816

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/29/2007		7.2	67.1		28.4	25.8	7.2	0.7	0.257	< 20	76	South Sandy
6/27/2007		7.1	63.7		22.2	-5.2	21.8	1.209	1.232	< 20	170	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Williams Run In Stream **Name** Williams Run In-Stream **LATITUDE** 41.26538 **LONGITUDE** -79.96131

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
6/27/2007	529.14	3.4	872		0	77.8	1.75	5.791	5.239	391.4	4	South Sandy
7/30/2007	809.8	3.4	759		0	63.4	1.43	4.8	4.22	326.5	< 2	South Sandy
8/28/2007	1150.13	3.5	583		0	46.6	1.43	3.68	2.62	242.8	< 2	South Sandy
9/24/2007	958.18	2.9	1060									South Sandy
10/30/2007	1187.53	3.4	904									South Sandy
11/13/2007	2918.83	3.8	660		0	48	2.06	3.84	3.14	302.5	6	South Sandy
12/26/2007	2396.59	3.3	602									South Sandy
1/29/2008	2168.24	3.5	979									South Sandy
2/25/2008	1949.92	3.8	613		0	60.4	3.928	4.542	5.688	243.8	2	South Sandy
3/26/2008	6325.42	2.8	868									South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

STB in stream **Name** Slatertown Bridge In-Stream **LATITUDE** 41.29838 **LONGITUDE** -79.94842

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		6.4			11.8	44.6	0.447	0.46	0.63	46.6	2	BAMR
5/18/2004		6.4			15.6	53.2	0.94	0.91	0.91	71.5	18	BAMR
7/7/2004		6.9			28	16	< 0.15	0.71	< 0.25	64.3	< 3	BAMR
8/17/2006		7			22	7	0.19	0.58	0.07	66		SSWA
5/29/2007		7.1	209		23	18.8	0.267	0.781	0.75	71.5	18	South Sandy
6/27/2007		7.4	221		31	-13.2	0.316	0.722	0.446	66.6	< 2	South Sandy
7/30/2007	4605.84	7.4	239		34.4	5.6	0.285	0.697	0.373	64.4	< 2	South Sandy
8/28/2007	5959.92	7.5	188.1		28.8	10.8	0.396	0.485	0.209	49.4	< 2	South Sandy
9/25/2007	4815.62	7.1	205									South Sandy
10/31/2007	5541.76	7.1	205									South Sandy
11/14/2007	14108.66	7.2	183.2		24	4.2	0.326	0.466	< 0.1	53.7	6	South Sandy
12/26/2007	23580.34	7.8	97									South Sandy
1/30/2008												South Sandy
2/26/2008	21279.44	6.5	164.8		13.4	3.6	0.324	0.589	0.753	56.6	< 2	South Sandy
3/25/2008	29431.22	6.4	149									South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR1 **Name** Beaver Pond Run #1 **LATITUDE** 41.30021 **LONGITUDE** -79.94846

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/29/2007		7.4	253		109	-83.2	17.2	0.89	0.331	< 20	96	South Sandy
6/27/2007	1	7.7	268		111.4	-83.6	13.3	1.041	0.91	< 20	280	South Sandy
7/31/2007	1	7.4	272		110.4	-16	11.3	0.611	0.788	< 20	416	South Sandy
8/28/2007	1	7.6	264		107.4	-15	2.94	0.738	< 0.1	< 20	66	South Sandy
9/25/2007	1	6.9	278									South Sandy
10/31/2007	1	7.1	237									South Sandy
11/14/2007	10.58	7.2	239		52.6	-26.8	1.56	0.382	< 0.1	49.8	16	South Sandy
12/26/2007	12.97	7.7	157									South Sandy
1/30/2008	40.06	7.4	83									South Sandy
2/26/2008	1.29	7.2	180		66.6	-46.6	2.966	0.464	< 0.1	< 15	54	South Sandy
3/25/2008	24.63	6.2	139									South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR2 **Name** Beaver Pond Run #2 **LATITUDE** 41.30141 **LONGITUDE** -79.95289

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/29/2007		6.6	83.5		35.8	21.6	13.3	0.816	1.11	20.3	58	South Sandy
6/27/2007		6.6	73.1		29.8	-10.8	20.635	0.796	1.614	20.5	72	South Sandy
7/31/2007		6.6	82.7		33.6	10.8	8.42	0.73	< 0.1	< 20	12	South Sandy
8/28/2007	2.6	6.9	76.3		32	9	18.6	0.743	0.688	< 20	90	South Sandy
9/25/2007	0.74	6.9	83									South Sandy
10/31/2007	0.8	7.1	76									South Sandy
11/14/2007	1.2	6.7	72.5		28.4	-4.8	5.48	0.603	0.321	< 20	12	South Sandy
12/26/2007	11.15	7.5	41									South Sandy
1/30/2008	0.25	6.9	76									South Sandy
2/26/2008	10.79	6.7	59		22.2	-3.4	11.1	0.515	1.543	17.9	50	South Sandy
3/25/2008		6.3	48									South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR3 **Name** Beaver Pond Run #3 **LATITUDE** 41.30408 **LONGITUDE** -79.96149

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/31/2007		6.8	210		98.4	-75	15.7	1.73	< 0.1	< 20	< 2	South Sandy
6/28/2007		6.8	208		92.8	-73	12.9	1.763	< 0.1	< 20	18	South Sandy
7/31/2007	1	6.9	210		88.6	20.2	15.4	1.67	< 0.1	< 20	16	South Sandy
8/29/2007	1	7.3	224		92	24.2	14.1	1.8	< 0.1	< 20	16	South Sandy
9/25/2007		6.8	208									South Sandy
10/31/2007		6.6	240									South Sandy
11/15/2007	1	7	238		100	-81	12.9	2	< 0.1	20.9	10	South Sandy
12/20/2007	11.63	7.8	295									South Sandy
1/30/2008	34.08	6.2	273									South Sandy
2/27/2008	19.3	7.2	220		97.6	-72.8	12.8	1.58	< 0.1	< 15	12	South Sandy
3/26/2008	21.72	6.2	286									South Sandy
4/30/2008	2.02	6.9	210		100	-76	14.1	1.59	< 0.1	< 15	14	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR3A **Name** Beaver Pond Run #3A **LATITUDE** 41.3081 **LONGITUDE** -79.96602

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/31/2007		7.2	204		51	-28.6	1.12	0.749	< 0.1	41.6	2	South Sandy
6/28/2007		7.2	288		71.4	-49.2	13.7	1.934	0.742	58.6	36	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR4 **Name** Beaver Pond Run #4 **LATITUDE** 41.3095 **LONGITUDE** -79.96637

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum		Sulfate	TSS		Source
5/30/2007		7	595		127	-23.2	13.7	1.387	<	0.1	186.1		58	South Sandy
6/28/2007	38.05	6.9	601		124.4	-105	13.7	1.403	<	0.1	185		18	South Sandy
7/31/2007	11.91	6.9	610		127	-48.6	8.69	1.35	<	0.1	212.9	<	2	South Sandy
8/29/2007	13.27	7.1	612		119.8	-50.6	9.83	1.49	<	0.1	214		18	South Sandy
9/25/2007	34.6	7	562		124.2	-45.2	9.295	3.397	<	0.1	200.5	<	2	South Sandy
10/31/2007	25.88	7.1	616		121.4	-42	6.79	1.294	<	0.1	201.3		16	South Sandy
11/14/2007	48.65	7.1	604		122.6	-90	5.77	1.21	<	0.1	190		34	South Sandy
12/20/2007	48.65	7.2	572		115	-97.4	5.682	1.113	<	0.1	174.4		18	South Sandy
1/31/2008	15.79	7.2	590		120.2	-107	5.902	1.151	<	0.1	202.5		8	South Sandy
2/27/2008	16.85	7.3	579		112.4	-89	6.72	1.14	<	0.1	176.5		10	South Sandy
3/25/2008	18.81	7.1	550		111.2	-90.2	9.44	1.16	<	0.1	196.9		20	South Sandy
4/29/2008	21.61	7	556		112.2	-87.2	6.309	1.173	<	0.1	176.7	<	5	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR5 **Name** Beaver Pond Run #5 **LATITUDE** 41.31087 **LONGITUDE** -79.96799

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/30/2007		6.8	539		136.8	-18.6	14.3	3.491	< 0.1	154.1	22	South Sandy
6/28/2007	0.85	7	544		126.2	-102	7.01	3.343	< 0.1	163.6	< 2	South Sandy
7/31/2007	1.72	7	557		125.8	-54.2	5.93	3.2	< 0.1	189	< 2	South Sandy
8/29/2007	2.3	7.4	556		121.2	-44.8	6.2	3.63	< 0.1	196.5	10	South Sandy
9/25/2007	2.99	6.8	467		125.6	-45	2.655	2.478	< 0.1	144.7	< 2	South Sandy
10/31/2007	6.85	7	557		118.8	-29	3.709	2.985	< 0.1	174.3	< 2	South Sandy
11/14/2007	12.73	7.2	547		118.2	-81.8	3.25	2.68	< 0.1	166.3	18	South Sandy
12/20/2007	16.51	7.2	474		114	-95.6	2.502	2.271	< 0.1	141.5	14	South Sandy
1/31/2008	4.68	7.2	484		112.4	-96.8	8.034	2.897	0.594	149.8	22	South Sandy
2/27/2008	20.88	7.3	486		108.6	-88	4.31	2.54	< 0.1	137.5	2	South Sandy
3/25/2008	3.78	7	441		105.4	-85.4	3.79	2.45	< 0.1	132.6	6	South Sandy
4/29/2008	5.71	7.2	437		102.4	-78.4	3.401	2.657	< 0.1	134.8	< 5	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

BPR in stream **Name** Beaver Pond Run In - Stream **LATITUDE** 41.30296 **LONGITUDE** -79.95901

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
6/28/2007	1021.11	7.4	522		71.8	-53	1.33	1.532	< 0.1	185.6	< 2	South Sandy
7/31/2007	374.3	7.7	526		78	-46.4	1.46	0.651	< 0.1	224	< 2	South Sandy
8/29/2007	589.74	7.6	397		63.4	-28.6	0.833	0.444	< 0.1	148.8	4	South Sandy
9/25/2007	169.43	6.9	539									South Sandy
10/17/2007	423.12	6.5	406									South Sandy
11/15/2007	372.92	7.4	334		42.6	-26	0.851	0.464	< 0.1	119.1	< 2	South Sandy
12/20/2007	1145.99	7.8	218									South Sandy
1/30/2008	3315.46	6.4	147									South Sandy
2/27/2008	2139.61	7.2	355		32.4	-18.4	0.318	0.393	< 0.1	144.7	< 2	South Sandy
3/26/2008	2409.44	6.7	296									South Sandy
4/30/2008	2858.14	7.2	251		27.6	-16	0.985	0.334	< 0.1	88.7	< 5	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Reagleman1 **Name** Reagleman #1 **LATITUDE** 41.31291 **LONGITUDE** -79.96368

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/30/2007		7.2	1794		158.8	-87.8	2.078	4.657	< 0.1	994	14	South Sandy
6/27/2007	10	7.3	1771		173.8	-134	3.246	5.353	< 0.1	973.2	14	South Sandy
7/30/2007	5	7.4	1711		194	-152	1.63	4.68	< 0.1	975.9	10	South Sandy
8/29/2007	6	7.4	1705		209.2	-105	3.23	5.74	< 0.1	924.7	8	South Sandy
9/24/2007	3	7	1706		210.4	-98.4	1.39	4.57	< 0.1	313.3	36	South Sandy
10/30/2007	2	7.4	1658		209.2	-129	4.162	4.734	< 0.1	820.8	8	South Sandy
11/14/2007	3	7.4	1615		196.2	-154	4.8	5.91	0.403	869	20	South Sandy
12/20/2007	12.5	7.5	1762		197	-187	10.3	10.3	0.756	978.8	34	South Sandy
1/31/2008	13.5	7.6	1770		171.8	-157	1.649	3.535	< 0.1	908.7	10	South Sandy
2/26/2008	26	7.4	1722		134	-113	4.306	3.424	1.12	1018	8	South Sandy
3/25/2008	38	7	1844		82.2	-58	2.393	4.507	0.863	1073	14	South Sandy
4/29/2008	21		1824		130.4	-105	4.73	5.04	0.499	1057.6	18	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Reagleman2 **Name** Reagleman #2 **LATITUDE** 41.31218 **LONGITUDE** -79.96456

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/30/2007		7.3	1212		58.6	-17.2	3.549	3.335	0.553	652.9	6	South Sandy
6/27/2007	4.5	7.4	1228		56.6	-31.8	0.248	1.696	< 0.1	695.6	< 2	South Sandy
7/30/2007	3.5	7.5	1223		61	-38.4	0.954	2.29	< 0.1	704.8	4	South Sandy
8/29/2007	2	7.6	1174		62.2	-28.2	0.535	2.36	< 0.1	650.6	14	South Sandy
9/24/2007	2	6	1156									South Sandy
10/30/2007	1	6.6	1105									South Sandy
11/14/2007	2	7.4	1134		65.6	-38.6	0.334	1.32	< 0.1	604.2	18	South Sandy
12/20/2007	5	8	994									South Sandy
1/31/2008	8.5	6.7	1112									South Sandy
2/26/2008	14	7.3	1118		58.6	-39.6	0.667	1.778	< 0.1	593.1	8	South Sandy
3/25/2008	30	6.9	1188		42.2	-16.8	0.345	3.19	< 0.1	695.9	< 2	South Sandy
4/29/2008	8	7.1	1156		46.2	-27.6	6.67	6.55	1.02	563.7	32	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Mamula1 **Name** Mamula #1 **LATITUDE** 41.31959 **LONGITUDE** -79.95929

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/31/2007		6.8	481		121.4	-92.2	7.04	2.3	< 0.1	145.9	< 2	South Sandy
6/27/2007	11.06	6.8	487		123	-87.2	2.849	2.522	< 0.1	143.6	< 2	South Sandy
7/31/2007	6.85	6.7	491		129.2	-35.6	2.88	2.63	< 0.1	149.8	< 2	South Sandy
8/29/2007	8.12	7.1	454		116.2	-36.2	6.52	2.53	< 0.1	132.7	16	South Sandy
9/25/2007	5.71	6.9	617		128	-56.8	9.187	1.421	< 0.1	215.9	< 2	South Sandy
10/31/2007	11.06	6.9	478		123	-31.6	6.04	2.39	0.205	125.1	18	South Sandy
11/15/2007	23.3	6.8	400		98	-78.8	7.95	1.96	< 0.1	116.7	2	South Sandy
12/20/2007	23.3	6.7	400		96.6	-79.8	2.968	1.729	< 0.1	105.3	14	South Sandy
1/31/2008	28.62	6.7	407		99	-84.2	4.359	1.717	< 0.1	109.7	< 2	South Sandy
2/27/2008	25.88	6.9	480		111.6	-92	5.16	1.98	< 0.1	127.3	< 2	South Sandy
3/25/2008	48.65	6.8	488		115.8	-93.4	2.88	1.36	< 0.1	154.5	8	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Mamula2 **Name** Mamula#2 **LATITUDE** 41.31751 **LONGITUDE** -79.95973

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/31/2007		6.1	546		83	0.8	25	6.69	< 0.1	214.6	58	South Sandy
6/27/2007	2.3	6.5	519		83.6	-19.2	22	6.439	< 0.1	188.5	< 2	South Sandy
7/31/2007	0.54	6.2	494		91.8	23.2	72.6	6.08	< 0.1	193.5	14	South Sandy
8/29/2007	2.3	6.3	541		80.6	-20	24	6.43	< 0.1	199.3	< 2	South Sandy
9/25/2007		6.1	562									South Sandy
10/31/2007		6.1	548									South Sandy
11/15/2007	1	6.4	497		102.2	-59.6	16.6	5.76	< 0.1	163.7	4	South Sandy
12/20/2007	23.3	6.2	590		92.6	-41.6	29.1	6.477	< 0.1	235.1	26	South Sandy
1/31/2008	14.55	6.2	619		98.8	-29.6	25	0.07066	< 0.1	223.3	< 2	South Sandy
2/27/2008	28.62	6.3	619		77.2	-15.6	29.3	7.58	< 0.1	216.5	2	South Sandy
3/25/2008	31.53	6.2	707		80	7.4	30.9	8.94	< 0.1	73.1	4	South Sandy
4/30/2008	18.62	6.1	613		85.8	-14.6	28.2	7.405	< 0.1	312.8	< 5	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

Fleming **Name** Fleming Site **LATITUDE** 41.26222 **LONGITUDE** -79.97124

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
6/26/2007		4.6	1483		10.2	109	10.1	17.3	13.9	819.5	230	South Sandy
7/30/2007	14.55	6.3	1602		22.4	40.4	7.71	16	3.81	934.5	66	South Sandy
8/28/2007	0.54	4.6	1320		8	93.6	2.82	13	11.4	705	6	South Sandy
9/24/2007	0.85	4.8	1410		10.2	110.8	1.22	16.8	12.5	802.5	8	South Sandy
10/30/2007	1.24	6.9	1919		51	16.4	1.18	12.8	4.66	1082.2	6	South Sandy
11/13/2007	8.12	8	2390		171.2	-51.2	1.54	1.83	1.12	924.7	16	South Sandy
12/19/2007	9.52	5.7	1559		21	21	6.791	6.421	8.159	676	30	South Sandy
1/29/2008	5.71	4.9	1205		11.8	83.6	20.5	12.8	11	632	22	South Sandy
3/24/2008	9.52	4.7	883		0	52	2.851	7.059	8.875	414.2	22	South Sandy
4/28/2008	12.73	7	1547		67.4	-35	1.547	2.853	2.121	616.7	14	South Sandy

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

AARS **Name** Above Allen Road Site **LATITUDE** 41.2484 **LONGITUDE** -79.97004

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
5/18/2004		7.4			128.2	-94.8	0.797	0.37	0.44	70.6	14	BAMR
7/7/2004		7.6			101.6	-61.4	< 0.15	< 0.025	< 0.25	31.2	< 3	BAMR
6/15/2005	2	7.5			154.6	-101	0.635	0.88	< 0.25	40.1	< 3	BAMR
7/20/2005	2	7.7			149	-114	< 0.15	0.62	< 0.25	60	< 3	BAMR
12/22/2005	5	7			72.6	-26.8	0.471	0.37	2.09	84.8	6	BAMR
1/24/2006	5	7.3			83.2	-37.4	0.651	0.15	1.07	59.5	6	BAMR
3/20/2006		6.8			86.6	-61	0.454	0.21	1.74	86.4	8	BAMR
4/20/2006		7.7			131	-90.8	< 0.15	0.09	< 0.25	65.7	4	BAMR
6/15/2006		7.2			131.6	-120	0.871	0.3	< 0.25	48.3	< 3	BAMR
9/15/2006		7.6			135.2	-117	0.3	0.15	< 0.25	26.3	< 3	BAMR
3/23/2007		7.7			95.2	-81	0.361	< 0.025	< 0.25	20.4	< 3	BAMR
6/7/2007		7.4			85.2	-56	< 0.15	0.405	< 0.25	30.2	< 3	BAMR
10/5/2007	5	7.6			148.4	-133	< 0.15	0.649	< 0.25	96.4	< 3	BAMR
11/1/2007	105.42											SSWA
12/1/2007	82.19											SSWA

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WOODS **Name** Woods **LATITUDE** 41.26528 **LONGITUDE** -79.96944

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
1/24/2006		3.4			0	235.4	9.87	10	28.7	618.3	< 3	BAMR
3/20/2006	43	3.3			0	226.4	8.52	10	28.3	565	< 3	BAMR
4/20/2006	28	3.3			0	243.8	6.94	10.1	27.9	604.3	4	BAMR
5/25/2006		3.5			17	398	21.11	26.63	35.59	625		SSWA
6/15/2006	33	3.3			0	246	10.1	9.17	30.4	295.5	< 3	BAMR
7/26/2006	22	3.4			0	279.4	14	9.82	29.9	656.6	4	BAMR
8/17/2006					22	431	31.07	20.14	35.12	960		SSWA
9/15/2006		3.3			0	268.6	14.4	10.5	29.4	631	< 3	BAMR
10/16/2006		3.3			0	231.6	10.4	9.83	28.1	586.3	< 3	BAMR
11/18/2006		3			55	398	2.28	12.88	26.09	550		SSWA
12/12/2006		3.2			0	215.6	5.47	9.14	24.8	487.6	< 3	BAMR
2/26/2007		3.4			24	272.5	7.98	14.2	30.04	710		SSWA
3/23/2007		3.4			0	208.4	3.83	9.43	22.7	533.6	< 3	BAMR
4/5/2007		3.4			0	208	3.14	8.34	23.1	529.2	< 3	BAMR
6/7/2007		3.3			0	198.2	3.4	7.42	20.9	514.1	< 3	BAMR
10/5/2007		3.4			0	197.6	8.02	9.33	23.6	540.7	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WOODS2 **Name** Woods 2 **LATITUDE** 41.26445 **LONGITUDE** -79.96889

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
7/26/2006	22	3.2			0	235.6	9.87	7.93	25.3	539	< 3	BAMR
9/15/2006	46	3.2			0	226.6	6.42	8.45	22.8	540.6	< 3	BAMR
10/16/2006	37	3.2			0	223.4	6.54	8.85	25	514.6	< 3	BAMR
12/12/2006	37	3.3			0	218.8	6.33	8.46	24.6	487.1	< 3	BAMR
3/23/2007	160	3.3			0	194	4.34	8.06	21.1	440.4	< 3	BAMR
4/5/2007	81	3.3			0	201	5.77	7.98	22.7	493.8	< 3	BAMR
6/7/2007	17	3.2			0	195.6	3.67	7.79	21.3	479.8	< 3	BAMR
10/5/2007	12	3.2			0	190.8	4.55	8.72	19.2	510.7	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL6 **Name** Williams Run Left #6 **LATITUDE** 41.2623 **LONGITUDE** -79.96

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		5.9			7.8	9.8	0.111	0.09	< 0.1	< 20	< 2	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRR2 **Name** Williams Run Right #2 **LATITUDE** 41.27071 **LONGITUDE** -79.95876

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		5			6.8	12.2	0.046	0.24	0.45	< 20	12	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRR3 **Name** Williams Run Right #3 **LATITUDE** 41.26509 **LONGITUDE** -79.96162

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		3.4			0	141.2	9.93	7.33	12.3	543.7	4	BAMR
7/7/2004		3.1			0	164.6	5.18	9.75	12.8	782.1	< 3	BAMR
12/22/2005		3.8			0	73.4	4.43	7.38	6.28	543.4	< 3	BAMR
4/20/2006		3.3			0	126	5.45	8.36	10	538	10	BAMR
6/15/2006		3.1			0	161.4	6.15	8.45	12.4	727.7	< 3	BAMR
10/16/2006		3.2			0	143.2	8.89	8.06	11	542	3	BAMR
12/12/2006		3.4			0	121.4	8.53	7.51	10.2	505.6	4	BAMR
4/5/2007		3.4			0	118.6	5.82	6.85	10.2	573.4	< 3	BAMR
6/7/2007		3.2			0	126.2	5.88	7.87	10.3	576.6	< 3	BAMR
10/5/2007		3.1			0	144.8	3.94	9.29	10.9	541.3	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRR4 **Name** Williams Run Right #4 **LATITUDE** 41.2617 **LONGITUDE** -79.96074

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		4			1.4	52.2	1.07	1.94	2.99	84.1	4	BAMR
7/7/2004		3.5			0	69.6	2.42	4.97	5.52	313.9	< 3	BAMR
12/22/2005		3.8			0	49.2	1.28	3.06	2.96	151.7	< 3	BAMR
4/20/2006		3.8			0	70	0.781	3.16	3.58	150.7	< 3	BAMR
6/15/2006		3.6			0	56.2	0.979	4.27	5.44	258.7	< 3	BAMR
10/16/2006		3.7			0	46.2	2.45	3.01	3.29	140.2	< 3	BAMR
12/12/2006		4			2.4	37.8	1.78	2.3	2.81	78.9	< 3	BAMR
4/5/2007		4			1.4	52.4	0.985	1.9	2.62	93.7	< 3	BAMR
6/7/2007		3.4			0	61	1.8	4.55	5.2	230.8	< 3	BAMR
10/5/2007		3.6			0	85.8	0.977	5.25	3.79	218.4	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRR5 **Name** Williams Run Right #5 **LATITUDE** 41.25403 **LONGITUDE** -79.96468

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
8/19/2005		4.5			16.4	50	9.5	6.9	2.36	823.8	12	BAMR
12/22/2005		4.8			11.4	100	20.5	7.74	7.19	722.1		BAMR
3/20/2006		4.4			7.8	88	16.4	6.71	7.39	587.2	< 3	BAMR
4/20/2006		4.6			9.6	84.4	15.1	6.6	6.41	646.3	6	BAMR
5/25/2006		3.2			28	121	2.59	4.61	6.61	100		SSWA
6/15/2006		4			2.8	105.4	17.9	6.12	9.4	633	< 3	BAMR
7/26/2006		4			1.6	108.6	17.8	5.82	7.82	630.9	4	BAMR
8/17/2006		4.5			2	63.5	3.4	3.45	2.27	110		SSWA
9/15/2006		3.7			0	89.8	15.5	5.54	6.86	556.5	4	BAMR
10/16/2006		4.4			9.4	113	20.6	6.57	9.61	647.2	< 3	BAMR
11/18/2006		4.1			5	207	19.6	10.15	9.76	550		SSWA
12/12/2006		4.4			8	118	20.1	6.73	11	605	6	BAMR
2/26/2007		4.5			4	129.5	19.77	13.29	9.56	740		SSWA
3/23/2007		3.9			0.4	85	9.69	6.46	8.54	483.7	< 3	BAMR
4/5/2007		3.9			0	131.2	15.1	6.81	12.8	670.3	< 3	BAMR
6/7/2007		3.9			0	97	13.4	6.49	9.42	727.8	< 3	BAMR
10/5/2007	8.27	3.8			0	80.6	17.8	7.52	4.74	836	12	BAMR
11/1/2007	11.26											SSWA
12/1/2007	88.81											SSWA
1/1/2008	38.59											SSWA
3/1/2008	227.49											SSWA
4/1/2008	46.38											SSWA

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

ARS **Name** Allen Road Site **LATITUDE** 41.24919 **LONGITUDE** -79.96782

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/31/2004		3.6			0	186.4	77.6	1.13	11	289.5	50	BAMR
5/18/2004		3			0	172.6	14.1	3.72	11	193.1	12	BAMR
7/7/2004		2.5			0	632.2	61.2	4.92	39.6	840.2	< 3	BAMR
6/15/2005	5	2.6			0	645	63.9	6.85	34.3	1024.6	4	BAMR
7/20/2005	5	2.6			0	499.2	49.4	5.76	30	719.7	< 3	BAMR
11/9/2005	15	2.9			0	352	67.1	1.99	14.7	494.3	< 3	BAMR
12/22/2005	10	2.9			0	579.2	156	4.13	31.2	734	8	BAMR
1/24/2006	10	3			0	470	142	1.45	20.7	583.1	4	BAMR
3/20/2006		2.6			0	1310	300	4.33	53.2	1.36	8	BAMR
4/20/2006		2.7			0	972.8	214	5.41	44.9	1090.3	4	BAMR
5/25/2006		2.4			436	1853	205.2	6.72	46.88	2050		SSWA
6/15/2006		2.4			0	2426	300	8.83	106	1677.4	< 3	BAMR
7/26/2006	10	2.7			0	872	188	4.22	35.1	1152.1	< 3	BAMR
8/17/2006		2.4			775	2526	502.3	15.71	165.02	3875		SSWA
9/15/2006		3.5			0	92	38.8	0.93	5.58	218	50	BAMR
10/16/2006		2.9			0	560.2	146	3.87	29	789.3	4	BAMR
11/18/2006		3.8			9	262	51.85	1.1	8.02	300		SSWA
12/12/2006		4.2			5.8	158.2	56.4	1.4	9.82	257.6	22	BAMR
2/26/2007		6			17	61	12.46	0.62	0	140		SSWA
3/23/2007		6.9			48.6	-28.4	10.4	0.19	1.53	58.2	32	BAMR
4/5/2007		3.2			0	225.8	71.5	1.58	11.2	270.3	42	BAMR
6/7/2007		2.9			0	99.6	36.5	2.62	11.9	352.8	18	BAMR
10/5/2007		2.6			0	100.2	53.3	10.6	65.3	1067.1	6	BAMR
3/1/2008	60.93											SSWA
4/1/2008	37.01											SSWA

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

SS2 **Name** South Sandy #2 **LATITUDE** 41.29583 **LONGITUDE** -79.95139

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		6.8			18.4	26.2	0.278	0.11	< 0.1	22.9	10	BAMR
5/18/2004		7.4			27.2	33.6	1.09	0.18	0.35	21.9	14	BAMR
7/7/2004		7.7			45.6	-0.4	0.428	0.06	< 0.25	36.7	< 3	BAMR
6/15/2005	1524.01	7			46.6	-4	0.41	0.05	< 0.25	< 20	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

SS3 **Name** South Sandy #3 **LATITUDE** 41.28972 **LONGITUDE** -79.97334

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/31/2004		7.3			22.6	15.8	0.298	0.05	< 0.1	25.4	8	BAMR
5/18/2004		7.5			33	27.2	1.16	0.14	0.3	< 20	16	BAMR
6/15/2005	866.81	7.3			54	-7.8	0.983	0.17	< 0.25	< 20	16	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

SS4 **Name** South Sandy #4 **LATITUDE** 41.28962 **LONGITUDE** -79.97254

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/31/2004		7.1			19.2	25	0.413	0.13	< 0.1	26.3	10	BAMR
5/18/2004		7.2			25.4	37	0.959	0.19	0.27	24.2	4	BAMR
6/15/2005	1567.52	7.1			47.2	-2.8	0.765	0.21	< 0.25	< 20	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

UNNAMED **Name** Unnamed **LATITUDE** 41.28922 **LONGITUDE** -79.97323

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/31/2004		6.9			15	34.2	9.23	0.22	0.23	31.2	4	BAMR
5/18/2004		7.4			21	44.2	0.872	0.22	0.33	25.5	6	BAMR
6/15/2005	402.84	6.8			33.8	6.2	< 0.15	0.27	< 0.25	58.4	< 3	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WR1 **Name** Williams Run #1 **LATITUDE** 41.29569 **LONGITUDE** -79.95086

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		4.7			6.8	47	0.727	1.05	1.55	80.6	< 2	BAMR
5/18/2004		4.1			3.8	80.6	1.05	2.57	2.76	170.3	6	BAMR
7/7/2004		4.8			10.6	43.8	< 0.15	1.84	1.54	139.6	< 3	BAMR
6/15/2005	230.5	4.8			7.6	33.8	< 0.15	1.49	0.98	114.7	< 3	BAMR
12/22/2005		5.7			8.4	49.4	< 0.15	0.8	< 0.25	100	< 3	BAMR
1/24/2006		5.2			7.2	44	0.332	0.62	0.65	58.5	6	BAMR
3/20/2006		4.9			7.4	27.2	0.43	0.95	1	65.6	< 3	BAMR
4/20/2006		5			7.4	28	< 0.15	1	0.76	79.9	8	BAMR
5/25/2006		5.9			8	59	0.19	0.71	0.29	52		SSWA
6/15/2006		4.7			7	13.6	< 0.15	1.46	1.74	149	< 3	BAMR
7/26/2006		5.2			7.6	6.4	< 0.15	0.83	< 0.25	64.1	< 3	BAMR
9/15/2006		5.8			10.6	7	0.409	0.56	< 0.25	44.7	< 3	BAMR
10/16/2006		4.9			9.4	13.2	< 0.15	1.38	1.41	103.7	< 3	BAMR
11/18/2006		4.5	85.7		1	83.5	0.22	0.96	0.59	60		SSWA
12/12/2006		4.7			7.6	54.6	0.488	1.35	1.62	96.8	< 3	BAMR
3/23/2007		5			6.8	11.8	0.601	0.78	0.93	56.3	< 3	BAMR
4/5/2007		4.5			6.2	67.8	0.442	1.29	1.94	107.5	< 3	BAMR
5/29/2007		4.5	336		7.4	43.6	0.157	1.83	2.01	150.7	16	South Sandy
6/7/2007		4.6			6.2	12.8	< 0.15	1.7	1.85	134.2	< 3	BAMR
10/5/2007		5.4			7.2	21.2	< 0.15	1.11	< 0.25	105.3	< 3	BAMR
1/1/2008	2823.17											SSWA
2/26/2008	6682.72											South Sandy
3/25/2008	11909.17	4	279									South Sandy
4/1/2008	8643.92											SSWA

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL1 **Name** Williams Run Left #1 **LATITUDE** 41.28723 **LONGITUDE** -79.94436

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		5.9			7.6	7.6	< 0.01	0.06	< 0.1	< 20	4	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL2 **Name** Williams Run Left #2 **LATITUDE** 41.28694 **LONGITUDE** -79.94433

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		6.4			9	6.4	0.056	< 0.005	< 0.1	< 20	6	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL3 **Name** Williams Run Left #3 **LATITUDE** 41.28311 **LONGITUDE** -79.94643

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		5.8			7.8	8.8	0.064	0.03	< 0.1	< 20	6	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL4 **Name** Williams Run Left #4 **LATITUDE** 41.27611 **LONGITUDE** -79.94611

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		6.7			23	25.8	2.33	0.11	< 0.1	< 20	14	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL5 **Name** Williams Run Left #5 **LATITUDE** 41.27532 **LONGITUDE** -79.94764

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		6.6			11.4	24.2	0.162	0.06	< 0.1	< 20	4	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRL7 **Name** Williams Run Left #7 **LATITUDE** 41.25973 **LONGITUDE** -79.95944

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/31/2004		4.5			6.4	58.6	0.675	1.55	3.16	77	6	BAMR
1/24/2005	103	4.7			6.6	47	0.736	1.02	1.25	59.5	< 3	BAMR
8/19/2005		4			2.4	45.2	3.8	2.75	2.98	120.2	4	BAMR
9/12/2005		4			2.6	77.4	1.89	2.5	2.73	112.6	10	BAMR
11/9/2005	21.7	4.1			3.4	70.2	0.46	2.17	1.97	107	< 3	BAMR
12/22/2005	27.5	4.4			6.2	64.8	0.895	2.1	2.35	90.7	< 3	BAMR
3/20/2006	110	4.7			6.8	31.4	0.823	0.95	1.33	71.7	< 3	BAMR
4/20/2006	29	4.6			7.4	59	1.55	1.66	1.8	93.6	8	BAMR
5/25/2006		4.4			2	45.5	0.64	1.45	1.55	70		SSWA
6/15/2006	15	4.3			4.8	21.2	2.33	1.89	2.26	85.7	< 3	BAMR
7/26/2006	84	4.4			5.6	13.8	1.6	1	0.73	66.7	< 3	BAMR
8/17/2006		4.5			2	63.5	3.4	3.45	2.27	110		SSWA
9/15/2006	243	4.7			7.6	16.6	1.56	1.27	< 0.25	90.7	< 3	BAMR
10/16/2006	72	4.6			8.4	19.2	2.21	1.5	2.43	79.2	< 3	BAMR
11/18/2006		4.2			3	66	1.33	1.75	1.59	70		SSWA
12/12/2006	72	4.9			8.6	39.4	2.31	1.45	2.02	74.5	< 3	BAMR
3/23/2007		4.6			6.2	20.6	7.03	7.21	7.35	56.1	< 3	BAMR
4/5/2007		4.8			7.2	48	1.16	1.08	1.91	63.4	< 3	BAMR
6/7/2007	33	4.2			3.8	59.6	2.96	1.87	2.6	86	< 3	BAMR
9/1/2007	7.09											SSWA
10/5/2007	13	4.4			5	56.2	3.58	2.96	2.54	106	< 3	BAMR
11/1/2007	16.51											SSWA
12/1/2007	121.95											SSWA
1/1/2008	48.65											SSWA
2/1/2008	128.75											SSWA
3/1/2008	247.91											SSWA
4/1/2008	91.21											SSWA

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WRR1 **Name** Williams Run Right #1 **LATITUDE** 41.27547 **LONGITUDE** -79.94814

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
3/24/2004		4			1	49.8	2.07	2.21	3.23	152.8	8	BAMR

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

WR2 **Name** Williams Run #2 **LATITUDE** 41.26028 **LONGITUDE** -79.96

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
6/15/2005	83.93	3.6			0	49.8	2.84	3.97	2.27	286.4	< 3	BAMR
7/20/2005	101.4	3.6			0	56	2.29	3.6	0.89	280.2	< 3	BAMR
8/19/2005		3.6			0	47.8	3.06	5.28	1.21	272.6	4	BAMR
9/12/2005		3.7			0	70	2.23	4.34	1.13	297.3	14	BAMR
12/22/2005		4.5			7	50.4	7.28	3.62	1.73	222.7	< 3	BAMR
1/24/2006		4.6			6.2	46	2.87	1.36	1.3	119.8	6	BAMR
3/20/2006		4.3			5.2	36.6	3.93	2.22	2.09	171.4	4	BAMR
4/20/2006		4			1.4	38	2.12	3.02	1.61	234	6	BAMR
5/25/2006		3.9			5	70.5	1.45	3.38	2.31	175		SSWA
6/5/2006		3.7			0	44.4	1.7	3.94	3.68	337.2	< 3	BAMR
7/26/2006		4.1			3	21.6	1.39	2.08	1.09	169.2	< 3	BAMR
8/17/2006		3.5			13	77.5	0.72	6.11	2.36	315		SSWA
9/15/2006		4.4			6.8	20.4	2.51	1.28	1.48	61.3	< 3	BAMR
10/16/2006		4			2.2	33.8	2.93	3.14	2.61	239.2	< 3	BAMR
11/18/2006		4.6			1	70	2.09	2.15	1.24	130		SSWA
12/12/2006		4.6			7.6	46.6	3.75	2.58	2.63	168.4	4	BAMR
3/23/2007		4.7			6.6	20.6	1.45	1.41	1.58	84.1	< 3	BAMR
4/5/2007		4			2.2	55.4	3.03	2.68	4.21	186.5	< 3	BAMR
6/7/2007		3.6			0	147	2.41	4.25	4.26	284.3	< 3	BAMR
6/27/2007	529.14	3.4	872		0	77.8	1.75	5.79	5.24	391.4	4	SSWA
7/30/2007	809.8	3.4	759		0	63.4	1.43	4.8	4.22	326.5	< 2	SSWA
8/28/2007	1150.13	3.5	583		0	46.6	1.43	3.68	2.62	242.8	< 2	SSWA
9/24/2007	958.18	2.9	1060									SSWA
10/5/2007		3.6			0	51	3.01	4.81	1.48	254.2	8	BAMR
10/30/2007	1187.53	3.4	904									SSWA
11/13/2007	2918.83	3.8	660		0	48	20.6	3.84	3.14	302.5	6	SSWA
12/26/2007	2396.59	3.3	602									SSWA

SOUTH SANDY CREEK WATERSHED RESTORATION PLAN DATABASE

FLEMING WELL **Name** Fleming Well **LATITUDE** 41.26083 **LONGITUDE** -79.97166

Date	Flow (gpm)	pH	Sp. Cond.	Temp	Alkalinity	Acidity	Iron	Manganese	Aluminum	Sulfate	TSS	Source
12/3/2004		5.3			16.8	989	757	43.2	0.99	2382.2		BAMR
12/3/2005		5.3			16.8	1398	759	44	1.1	2.48		BAMR