Sunday Creek Watershed Group

A Comprehensive Watershed Management Plan for the Sunday Creek Watershed

Third Edition
2010

A Collaboration of
the Partners of the Sunday Creek Watershed Group and the Residents of the Sunday Creek Watershed

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Table of Contents

Section I: Watershed Overview

Chapter I. Introduction

Watershed Description.....11

History of the Sunday Creek Valley

In the Beginning 12
Boom and Bust Cycles of the Towns.....13
Brief Histories of Four Towns within the Watershed.....13-15
Social and Cultural Resources 15

Demographics and Economic Infrastructure.....16

Age and Sex Ratios 16
Economic Characteristics.....16
Occupations and Industry.....17
Housing and Infrastructure.....17
Poverty, Unemployment, and Education Statistics.....18
People Living and Working in the Watershed.....19
Economic Benefits of Restoration.....19

Chapter II. Watershed Plan Development

Project Background.....21
Organizational Structure of Watershed Group.....22-23
Collaboration at Work.....24-25
Purpose of the Management Plan 26
Development of the Management Plan 26-28
Historic Watershed Community Survey Results 29-31
Endorsement and Adoption of Plan.....32-33

Chapter III. Watershed Inventory

Geology.....34
Topography.....35
Soils.....35-36
Septic Tank Absorption Fields.....37
Highly Erodible Soils.....37
Land Use 38-39
Agriculture 39-40
Local Community Parks.....40
Federal and State Owned Land.....41
Sunday Creek and Trimble Wildlife Areas.....42
Trimble Township Community Forest.....43
Biological Features
Federally Listed Threatened, Rare, or Endangered Species.....43
State Listed Rare Animals, Plants, and Plant Communities.....44-47
Flora and Fauna.....48
Water Resources
Climate and Precipitation.....49
Surface Water- Wetlands and Streams.....49-50
Flow.....52-53
100 yr. Floodplain.....53
Sinuosity 54
Permitted Discharges.....56
Entrenchment and Floodplain Connectivity.....56
Lakes and Reservoirs.....57
Groundwater (SWAP and DRASTIC maps). 57-61

Table of Contents (Continued)

Section II. Watershed Action Plans for 14 digit HUC Subwatersheds

Introduction

Hydrological Unit Codes (HUCs).....63

Chapter I: Water Quality Standards and Impairments

Historic Aquatic Use Designations for Sunday Creek.....64-65

Ohio Water Quality Standards: Designated Aquatic Life Uses.....66-67

Ohio Water Quality Standards: Non-Aquatic Life Uses.....68

Aquatic Habitat.....69

Overview of Current and Historical Water Quality Inventory

Interpretation of Biological Sampling 70-72

Macroinvertebrate Sampling.....73

Sunday Creek AMDAT Plan.....73-76

Sunday Creek TMDL Study 76-78

Summer AmeriCorps* VISTA Data- 2001.....78

Water Quality Targets and Standards.....78-80

Water Quality Impairments.....81

Issue: Acid Mine Drainage.....82-87

Issue: Improperly Treated Wastewater.....88-90

Issue: Illegal Trash Dumping and Urban Run-off.....91-93

Issue: Erosion and Sedimentation.....94-97

Issue: Flooding.....98-99

Chapter II: East Branch Sunday Creek

Subwatershed Description.....100

Water Quality Inventory 101

Subwatershed Impairments.....101

Restoration and Protection Goals.....101-102

Implementation of Plan.....103

Chapter III: West Branch Sunday Creek

Subwatershed Description.....104

Water Quality Inventory 105

Subwatershed Impairments.....105

Restoration and Protection Goals.....106-113

Implementation of Plan.....114

Chapter IV: Upper Sunday Creek

Subwatershed Description.....115

Water Quality Inventory 116

Subwatershed Impairments.....116

Restoration and Protection Goals.....117-119

Implementation of Plan.....120

Chapter V: Lower Sunday Creek

Subwatershed Description.....121

Water Quality Inventory 122

Subwatershed Impairments.....122

Restoration and Protection Goals.....123-126

Implementation of Plan.....127

Section III. Glossary and References

Glossary.....129-132

Sited References.....133-136

Table of Contents (Continued)

List of Figures:

Figure 1: Sunday Creek Watershed Group Organizational Structure.....23
Figure 2: Sunday Creek Management Plan Ranked Concerns from Surveys.....30
Figure 3: IBI Scores from TMDL Study 71
Figure 4: QHEI Scores Along the Mainstem of Sunday Creek.....72
Figure 5: Sunday Creek Mainstem Long-Term Monitoring-Net Acidity 74
Figure 6: Sunday Creek Mainstem Long-Term Monitoring-pH 75
Figure 7: Sunday Creek Mainstem Long-Term Monitoring-Total Iron 75
Figure 8: Sunday Creek Mainstem Long-Term Monitoring-Total Aluminum 76
Figure 9: Fecal Coliform Data Collected at TMDL sites (Only the highest range data points are shown in this figure, > 1000 counts/100 ml).....89

Table of Contents (Continued)

List of Tables:

Table 1: Population Profile for the Sunday Creek Watershed 1900-2000 16
Table 2: Median Household Income Profile for Sunday Creek Watershed 2000 16
Table 3: Major Two Occupations and Industries by Percent in the year 2000, for all Three Counties in the Sunday Creek Watershed 17
Table 4: Summary of the Percent of Rural versus Urban Areas in the Watershed Correlating with the Lack of Plumbing and Telephone Service Per County 18
Table 5: Population and Housing for 5 Villages in the Watershed 18
Table 6: Comparison of the Percentage of People below Poverty and Unemployed in all of Ohio versus Athens, Morgan, and Perry Counties 18
Table 7: Educational Attainment for People 25 years old and over in Athens, Morgan, and Perry Counties 19
Table 8: A Summary of the Potential Economic Benefits of Improved Water Quality in the Hocking River Basin 20
Table 9: Historic and Current Stakeholders Involved in the Development of the Sunday Creek Watershed Group and Management Plan 27-28
Table 10: Survey Results for Sunday Creek Watershed Management Plan 29
Table 11: Urban Land Use And Sewage Statistics by Subwatershed 37
Table 12: Sunday Creek Watershed Land Use Distribution by Major Land Use Category 39
Table 13: 2008 Agricultural Statistics per County in Sunday Creek Watershed 40
Table 14: Stream Statistics of Sunday Creek 51
Table 15: Peak Stream Flows USGS 03159246 Sunday Creek below Millfield, OH 52
Table 16: Annual Mean Flows (cfs) USGS 03159246 Sunday Creek below Millfield, OH 52
Table 17: Monthly Mean Discharge, Cubic Feet Per Second, 2002-2008 53
Table 18: Physical Attributes of Streams 55
Table 19: Subwatersheds by 14 Digit Hydrological Unit Codes (HUC) 63
Table 20: Biological Impacts Due to Pollutants 72
Table 21: MAIS Sampling Results from 2000-2009 in Sunday Creek Watershed 73
Table 22: Ohio EPA Standards, Benchmarks Established by Outside Resources, SCWG Targets 79
Table 23: Benchmark Levels for Sediment Data 80
Table 24: Historic and Current Impairment Causes and Sources 81
Table 25: East Branch Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category 100
Table 26: Timeline and Activity Sheet to Address East Branch Impairments 103
Table 27: West Branch Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category 104
Table 28: Water Quality Impact of Restored Tributary to Pine Run 110
Table 29: Timeline and Activity Sheet to Address West Branch Impairments 114
Table 30: Upper Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category 115
Table 31: Water Quality Comparison Downstream of Corning Gob Reclamation 2007 119
Table 32: Timeline and Activity Sheet to Address Upper Sunday Creek Impairments 120
Table 33: Lower Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category 121
Table 34: Timeline and Activity Sheet to Address Lower Sunday Creek Impairments 127

Table of Contents (Continued)

List of Appendices:

Appendix One: Sunday Creek Watershed Maps

List of Maps:

Map 1: Sunday Creek Drainage Basin
Map 2: Land Use / Land Cover
Map 3: Abandoned Underground and Surface Mines
Map 4: Acid Mine Drainage Sources and Subsidences
Map 5: Sunday Creek 14-digit HUC Subwatersheds
Map 6: Isaac Walton Scores of Summer AmeriCorps* VISTA Sites
Map 7: IBI scores of Ohio EPA Total Maximum Daily Loads (TMDL) Sites
Map 8: Comparison of HEL to PHEL per 14-digit Subwatershed
Map 9: U.S. Forest Service Lands
Map 10: Active and Inactive Railroads
Map 11: Quality of Land Cover 100 Foot Buffer from Stream
Map 12: 100 and 500 Year Floodplain

Acronym Reference List

AFRRI-Appalachian Flood Risk Reduction Initiative

AMD-Acid Mine Drainage

AMDAT-Acid Mine Drainage Abatement and Treatment

AWS-Agricultural Water Supply

BMPs-Best Management Practices

BOD-Biological Oxygen Demand

CCC-Civilian Conservation Corps

COD-Chemical Oxygen Demand

CSO-Combined Sewer Overflow

CWH-Coldwater Habitat

DBH-Diameter Breast Height

DO-Dissolved Oxygen

EB-East Branch

EPT-Ephemeroptera (mayfly), Plecoptera (stonefly), Tricoptera (caddisfly)

EWH-Exceptional Warmwater Habitat

FEMA-Federal Emergency Management Agency

FWPCA- Federal Water Pollution Control Administration

GIS-Geographical Information Systems

HVCRC-Hocking Valley Community Residential Center

IBI-Index of Biological Integrity

ICI-Invertebrate Community Index

ILGARD-Institute for Local Government Admin. & Rural Dev.

IWS-Industrial Water Supply

LRW-Limited Resource Water

LTM-Long-term Monitoring

MS-Master's of Science

MWH-Modified Warmwater Habitat

NLTTB-Nothing Less Than The Best

NPDES-National Pollutant Discharge Elimination System

NPS-Non-point Source Pollution

NRCS-Natural Resources Conservation Services

NTU-National Turbidity Unit

OAC-Ohio Administrative Code

ODNR-Ohio Department of Natural Resources
- **AML**-Abandoned Mine Land
- **MRM**-Mineral Resources Mgt.

ODOD- Ohio Department of Development

OEPA-Ohio Environmental Protection Agency
- **OEEF**- Ohio Environmental Education Fund
- **SEP**-Supp. Environ. Projects
- **SWAP**- Source Water Assessment and Protection Program

OES-Order of the Eastern Star

ORV-Off Road Vehicle

OSM-Office of Surface Mining
-**ACSI**-Appalachian Clean Streams Initiative

OSU-Ohio State University

OU-Ohio University

PCR-Primary Contact Recreation

POTW-Publicly Owned Treatment Works

PWS-Public Water Supply

QHEI-Qualitative Habitat Evaluation Index

RC&D-Resource Conservation & Development

RM-River Mile

RT&E-Rare, Threatened & Endangered

SC-Sunday Creek

SCR-Secondary Contact Recreation

SCWG-Sunday Creek Watershed Group

SEPTA-South-Eastern Probation Treatment Alternative

SPiCYAM-Southern Perry County Youth Arts and Media Center

SSH-Seasonal Salmoid Habitat

STORET-Storage and Retrieval

SWCD-Soil and Water Conservation District

TAC-Technical Advisory Committee

TDS-Total Dissolved Solids

TMDL-Total Maximum Daily Load

TOC-Total Organic Carbon

TSS-Total Suspended Solids

USDA-United States Department of Agriculture

USFWS-United States Fish and Wildlife Service

VISTA-Volunteers in Service to America

WB-West Branch

WET-Whole Effluent Toxicity

WLA-Waste Load Allocation

WNF-Wayne National Forest

WPCLF-Water Pollution Control Loan Fund

WQPSDs-Water Quality Permit Support Documents

WQS-Water Quality Standards

WTP-Water Treatment Plant

WWH-Warmwater Habitat

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Section I: Watershed Overview

Chapter I: Introduction

Watershed Description

The Sunday Creek Watershed consists of 88,772 acres (139 square miles), lying in Athens (38.8%), Perry (42.84%), Morgan (18.35%), and Hocking (0.01%) Counties (Map 1- Sunday Creek drainage basin). The watershed is located in the Shawnee-Mississippian and Marietta Plateaus of the Allegheny Plateau region. Sunday Creek is 27.2 miles long with an average slope of 11.5 feet per mile. There are 6 main tributaries of Sunday Creek. The longest of them are the East Branch at 15.5 miles, and the West Branch at 14.0 miles. There are a total of 14 tributaries in the watershed.

Sunday Creek begins around Tatman's Gap, Sulfur Springs Road, and the northeastern end of the Santoy area at approximately 39°40′28″North Latitude and 82°05′37″ West Longitude. It flows through Hemlock, Oakfield, Corning, Burr Oak Reservoir, Glouster, Jacksonville, and Trimble all the way to Chauncey where it joins the Hocking River near the old Athens County Home at 39°23'32" North Latitude and 82°07'24" West Longitude. The Sunday Creek Watershed is located within parts of Homer, Deerfield and Union Townships in Morgan County; within parts of Dover and Trimble Townships in Athens County; and within Coal, Saltlick, Bearfield, Pleasant and Monroe Townships in Perry County.

Districts:

The following districts serve the people of the watershed:

- Athens, Perry and Morgan Soil and Water Conservation Districts
- Buckeye Hills Hocking Valley Regional Development District
- Army Corps of Engineers, Huntington District
- Ohio Environmental Protection Agency, Southeastern District Office
- Public Sewage Districts: Trimble Township Sewage District (Jacksonville, Trimble and Glouster), Chauncey Water and Sewer, Village of Corning Sewer District.
- Public Water Districts: Sunday Creek Valley Water, Glouster Water and Electric, Chauncey Sewer and Water, Corning Water District.
- School Districts: Trimble Local Schools, Southern Local (Perry County) Schools, Athens City Schools
- Southeast Ohio Joint Solid Waste Management District

History of the Sunday Creek Valley

In the Beginning

The first inhabitants in the Sunday Creek Watershed were the Adena prehistoric tribe, famous for their burial mounds. In the 1740's, Native American tribes such as the Shawnee lived in the area. Many lived on the plains west of Sunday Creek. After the Treaty of Greenville in 1795, it was 'unlawful' for Native Americans to live in most of Ohio. The Indian tribes left behind footpaths that were used for generations to travel to and from various hunting grounds. The Belpre Trail in southern Perry County is one of the trails that was later used by early pioneers to navigate their way to new settlements (Winnenburg, 2000).

The Sunday Creek Watershed was originally part of the Northwest Territory, a region Great Britain deeded to the U.S. in the Treaty of Paris in 1783. The purchase of the Sunday Creek region was in 1784 when Virginia seceded all rights and claims to 964,285 acres of forestland. Four Revolutionary War heroes, Generals Rufus Putman, Dr. Manassah Cutler, Samuel Parson, and Benjamin Tupper, who formed the Ohio Company, bought one and a half million acres in southeast Ohio. Their purchase of land began the development and settlement of the Sunday Creek Watershed. The Northwest Ordinance mandated a system of townships as local government. This system is still in place with no major revisions. The city of Athens, then known as Middletown, was settled in 1796 (Bloom, 1966). Athens County was established 1805, two years after Ohio became a state. The county was formed in part because of Ohio University being established in 1804. Perry County was established in 1818, and Morgan County was organized in 1819.

According to James G. Blower, who wrote the history of Trimble Township, the first settlers to explore the Sunday Creek area were Solomon Tuttle, his son Cyrus, and William Morrow. They left Middletown in 1802 and walked north for several days. They moved through the Forks (Glouster), and parts of the Burr Oak area, but settled near what is now Bishopville. As the story goes, they named Sunday and Monday Creek after the days of the week that they were discovered on.

Boom and Bust Cycles of the Towns

Many of the towns within the watershed have histories that interconnect. They experienced 'boom years' followed by 'bust years'. Early settlers like the Tuttles and

Morrows were originally attracted to the area because of wildlife, timber, and agriculture. The areas surrounding the creek expanded into booming towns with the knowledge that the available resources included coal, brick/clay, salt, and oil. Coal, which acquired the nickname 'black diamond', was the resource that had the strongest influence on the futures of many of the towns. Underground coal mining was at its peak and the Hocking Valley region lived the boom years, surviving a depression and several recessions between 1870 and 1900 (Tribe, 1986). Culture and entertainment thrived with theaters, bars, large circuses coming to towns, horse sales, local baseball teams, and church events.

In the Epilogue to his book on Urban Development in the Hocking Coal Region, Ivan Tribe writes that after World War I the market for coal dropped, leaving the towns' economies suffering. Technological advances after World War II led to an increase in surface mining as opposed to underground mining, but it did little to revive the towns. Forty years ago, the final sharp decline in mining occurred after an increase in health, safety, and air quality regulations. Most of the towns weren't able to come back from the 'bust' years because of their remote geographic locations, which did little to encourage diversification of industry. Towns, which once produced a large influx of immigrants looking for employment and a place to raise a family, were abandoned.

***Brief Histories of Four Towns within the Sunday Creek Watershed*:**

Corning & Rendville (Northern part of the Sunday Creek Watershed):

According to the local history organization, Little Cities of Black Diamonds, Joseph Rodgers established Corning in 1879 after settling the town site in preparation of the Ohio Central Railway extending the rail down from the north. In 1880 there were only 271 residents, but by 1890 the population was over 1,500. Along with the rail line, coalmines, a stone quarry, and a brick plant surrounded the town, providing employment. Corning became the major business town within the entire Hocking Valley, due to the store and offices of the Ohio Central Coal Company residing there. By the turn of the century, the railroad employed more people than coal mining. Oil was

discovered in the late 1800's and is still a source of employment for Corning, giving the town some economic buoyancy after coal and the railroad left the area in the 1950s (Little Cities of Black Diamonds web site).

The railroad extension instigated a second town just north of Corning, Rendville (map 10). W.P Rend from Chicago leased the land from the Ohio Central Coal Company, then set up mines and the town with the help of Captain Thomas J. Smith. The town started small like Corning, with 249 people for the 1879 census (Tribe, 1986). Soon the town grew with a great variety of ethnic nationalities. Corning and Rendville became more and more ethnically diverse in the 1880s and 1890s as immigrants came to America. The original Scotch-Irish and Welsh miners lived alongside German, Italian, Hungarian and other eastern Europeans (Little Cities of Black Diamonds web site).

In 1880, African Americans were brought in for cheaper wages to work at Mine No. 3. During this time, tensions were already running high due to a new wage policy known as 'the sliding scale'. The National Guard had to be called in to ensure that a large outbreak of racial violence did not occur (Nelson, 1998). Although Rendville survived times of racial tension, it was not as successful as Corning in surviving the drop in coal prices. The town is now 'a mere shell' of the boomtown it once was.

Chauncey & Millfield (Southern part of the Sunday Creek Watershed):

Chauncey was established in 1839 halfway between Nelsonville and Athens. The town was named for Philadelphian Elihu Chauncey who was one of the main investors in the salt works surrounding the area. By 1840 there were 118 people in the town. Salt was mined by pumping brine from the earth, boiling off the liquid, and removing impurities to allow the salt to crystallize. Although there were high hopes for Chauncey by the town's founders, the salt industry could not compete with the expanding coal industry. At the turn of the century, the local market slackened and other areas began competing in the salt market. Coal mining developed in Chauncey slowly. Eventually several

mines were opened and the long period of economic stagnation ended, making it one of the larger mining towns in the Hocking Valley.

The pronunciation of the town's name, 'chancy,' as in risky, is said to have been a deliberate decision. It was so that outsiders, such as scab laborers for the local coalmines or federal prohibition agents, would reveal themselves when they'd mispronounce 'Chauncey' as it's spelled.

The town of Millfield, north of Chauncey, was originally called Millville. This was probably because, in 1802, the first saw mill in Dover Township was established there. People from Athens, Dover Township and Ames Township used the mill before other mills were built. In the 1860s another mill was built that was run by steam and in 1882 the railroad began servicing the area (Beatty & Stone, 1984). The Pendergrass Lumber Company had their headquarters in Millfield and had five sawmills cut timber from Morristown to Oregon Ridge. Millfield remained a relatively small village of farms and few people with trades until 1909, when coalmines were opened near Millfield. C.S. Poston and his family built four mines close to Millfield: #7 (Scratchback), #6, 'L.D.' and Freeport. By the 1920s, there were 1,520 people living in Millfield (Earich, 1967). The No. 6 mine in Millfield was closed on November 5th 1930 after the largest mining disaster in Ohio's history. An explosion of methane gas, sparked by a trolley wire and rail, killed 82 men and was said to have wrecked the health of the few that survived. Ironically, many of the people killed in the explosion included Sunday Creek Coal Company officials and visiting dignitaries. They had entered the mine to inspect newly installed safety devices (Beatty & Stone, 1984).

Social and Cultural Resources

Today, the towns and villages within the Sunday Creek Watershed work to revitalize their communities. Several festivals and community events are held throughout the year to commemorate their history and bring people in the communities together.

Local community organizations such as the Little Cities of Black Diamonds group, Rural Action, and the 'Glouster Ladies' have become important resources in preserving the stories of the past in order to continue to share them with future generations. In 1999, Rural Action, the Ohio Arts Council, and people from the community of Glouster sponsored the creation of a mural that represents the history of the town. The mural depicts 35 well-known historical icons of the village combined with scenes of coal mining and railroads, a local magician, and the two main industries of the town. The town of Corning also has a mural that depicts the main street of Corning with a color

guard marching in front and the railroad and coal mining entrance in the background. This mural was painted by John Miller, a high school art teacher from Southern Local Schools. The project was funded through a grant from the Ohio Arts Council.

Demographics and Economic Infrastructure

The population of the Sunday Creek Watershed, in 2000, was approximately 12,650 according to the 2000 U.S. Census Data. Since the early 1900s, the Sunday Creek Watershed has experienced a dramatic drop in population due to the coal mines and factories shutting down. The boom-bust industry took its toll on the small towns in the Sunday Creek Watershed, along with many other towns in the Ohio Appalachian region. The populations in these areas are generally poorer, less educated, and have higher unemployment rates than the state of Ohio as a whole, which includes many larger urban counties.

Table 1. Population Profile for the Sunday Creek Watershed 1900-2000

Place	1900	1920	1940	1960	1980	2000
Glouster Village	2,155	3,140	2,847	2,255	2,211	1,972
Chauncey Village	----	1,178	1,234	996	1,050	1,067
Corning Village	1,401	1,628	1,433	1,065	789	593
Jacksonville Village	1,047	1,046	812	580	651	544
Trimble Village	625	806	686	481	579	466
Hemlock Village	581	497	353	227	197	142
Rendville Village	790	515	387	197	68	46

Source: U.S. Census Bureau 2000

Age and Sex Ratios

Information from the 2000 Census shows that for every 100 females there are approximately 90 males in the villages of Rendville, Glouster, Corning, and Chauncey. The average age in these villages ranges from 32 to 38. The age category with the least number of people is the 18 to 24 age bracket, suggesting that the young adults are leaving the area.

Table 2. Median Household Income Profile for Sunday Creek Watershed 2000

Place	Median Income
Ohio	$40, 956
Athens	$27, 322
Morgan	$28, 868
Perry County	$34, 383

Source: U.S. Census Bureau 2000

Economic Characteristics

For the year 2000, the U.S. Census Bureau shows the median household income for all of Ohio to be $40,956. Table 2 illustrates the

median household income for Athens, Morgan and Perry Counties. Each county within the watershed has a lower median household income compared to the overall Ohio median income.

Occupations and Industry

Perry and Morgan Counties have more closely related industries. The presence of Ohio University in Athens County causes a shift in occupations and industries to more professional, sales, and service orientated jobs (table 3).

Table 3. Major Two Occupations and Industries by Percent in the year 2000, for all Three Counties in the Sunday Creek Watershed

County	Occupations	Industries
Athens	34.6% - Management, professional 24.0% - Sales and Office	39.5% - Education, health, and social services 10.8% - Arts, entertainment, recreation, accommodation, food service
Morgan	23.9% - Production, transportation, and materials moving 23.8% - Management, professional related	20.3% - Education, health social services 19.5% - Manufacturing
Perry	29% - Production, transportation, and materials moving 21.3% - Sales and Office	26.1% - Manufacturing 18.4% - Education, health, and social services

Source: U.S. Census Bureau 2000

Housing and Infrastructure

The majority of Athens, Perry and Morgan Counties are composed of rural areas. This has an effect on the infrastructure within the watershed. For all of Ohio, only 0.4% of the housing units lack complete plumbing and 2.2% do not have telephone service. Table 4 summarizes the percent of each county that is rural combined with the percentage of housing units that do not have complete plumbing or telephone service. Morgan County, with no urban areas within the watershed, has the highest percentage of housing units without proper plumbing or phone service. However, all the percentages are higher than the Ohio averages.

Table 4. Summary of the Percent of Rural versus Urban Areas in the Watershed Correlating with the Lack of Plumbing and Telephone Service Per County

County	% Rural	% Urban	% Farm of Rural area	% Houses Without Complete Plumbing	% Houses Without Telephone Service
Athens	52	48	1.6	1.2	4
Morgan	100	0	5.5	2.5	6.2
Perry	76	24	3.8	0.7	3.9

Source: U.S. Census Bureau 2000

Table 5 shows the population and housing units for 5 villages in the watershed for 2000. These data show that there are approximately 2 people per household.

Table 5. Population and Housing for 5 villages in the Watershed

Place	Population	Housing Units
Glouster	1,972	906
Chauncey	1,067	483
Corning	593	269
Jacksonville	544	246
Trimble	466	195
Hemlock	142	58
Rendville	46	30

Source: U.S. Census Bureau 2000

Poverty, Unemployment and Education Statistics

According to 2000 census data for poverty in Ohio, Athens County reported 27.4% of residents listed as living below the federally established poverty level, Morgan County reported 18.4%, and Perry County had 11.8%. These statistics are high compared to the 10.6% poverty rate for the entire state of Ohio (table 6). The percent of people 16 years old and older that are unemployed in all of Ohio for 2000 is reported as 3.2%. Table 6 illustrates the unemployment rate for each county within the Sunday Creek Watershed. Athens County has the highest unemployment rate with 6.3%, followed by Morgan County 4.7%, and then Perry County 3.6%.

Table 6. Comparison of the Percentage of People Below Poverty and Unemployed in all of Ohio versus Athens, Morgan, and Perry Counties

Place	% Below Poverty	% Unemployment
Ohio	10.6	3.2
Athens	27.4	6.32
Morgan	18.4	4.7
Perry	11.8	3.6

Source: U.S. Census Bureau 2000

The educational attainment in the counties of the Sunday Creek Watershed is lower than the rest of the counties in Ohio. According to 2000 census data, the number of residents 25 years and older attaining a high school degree in Athens County - 34.2%, Morgan County - 50.5%, and Perry County - 51.1% (table 7). Although Athens County has a lower percentage of people with a high school degree, a higher percentage of those with high school degrees continue on to complete a bachelor's degree.

Table 7. Educational Attainment for people 25 years old and over in Athens, Morgan, and Perry Counties

County	% High school or above	% Bachelors or above
Athens	34.2	23.4
Morgan	50.5	7.4
Perry	51.1	5.8
Ohio	83	21

Source: U.S. Census Bureau 2000

People Living and Working Within the Watershed

Morgan County residents commute the farthest to work, with an average 36.2 minute commute, compared to 21.7 minutes for Athens County residents. Perry County commuters drive on average 33.5 minutes to get to work. The fact that over 70% of the employed people in Morgan and Perry Counties commute by car for over 30 minutes suggests that these areas are in need of a more sustainable local economy.

Economic Benefits to Restoration

Stating an economic value to the benefits of environmental restoration is a challenge. Stream restoration obviously has measurable benefit to aquatic life and stream habitat, but what economic benefit can stream restoration have in a small town or village? Faculty from Ohio State University conducted a study to develop a method to value environmental resources (Sommer, 2001). They looked at the economic value of potential water quality improvements, from boaters and fishers in the Hocking River Valley.

Although the Hocking River Valley in southeast Ohio is a popular destination for boaters and fishers, there are concerns that water quality problems from acid mine drainage and other point and non-point source run-off may limit potential recreational use and subsequent spending on consumer items such as bait, tackle, food, beverages, etc. This study estimated the economic value of recreation for two water users in the region: boaters and fishers. The study also estimated the economic benefit to the region of improving water quality. A mail survey was given and survey results were used to

estimate travel cost models that predict the relationship between the additional number of trips, expenditures, and other important variables.

The results are shown in table 8. It shows clearly that water quality improvements would have a significant effect on the amount of money spent on the local economy by boaters and fishers.

Table 8. A Summary of the Potential Economic Benefits of Improved Water Quality in the Hocking River Basin

HOCKING RIVER VALLEY		
Currently	Fishers	Boaters
Amount of one day trips	5.5	4.5
Money spent on local economy per year	$3.2 million	$1.0 million
Hypothetical change of 50% improvement in the water quality		
Additional one day trips per year	2.3	1.4
Increase of money spent on local economy per year	$3.3 million	$0.5 million
Total money spent on local economy per year	$6.5 million	$1.5 million
Hypothetical change of 200% improvement in the water quality		
Additional one day trips per year	4.7	2.5
Increase of money spent on local economy per year	$9.2 million	$1.2 million
Total money spent on local economy per year	$12.4 million	$2.2 million

Chapter II: Watershed Plan Development

Project Background

The Sunday Creek Watershed Group emerged from local residents' concerns for the health of Sunday Creek. The new group met monthly at the Trimble High School to discuss the mission and purpose of the watershed group. Members of the group took the initiative to learn from other watershed groups that had already formed in the area. A Rural Action AmeriCorps VISTA started working with the local watershed group to collect water quality data and write a grant to the Ohio EPA. These initial efforts led to the Ohio EPA granting the Sunday Creek Watershed Group funding to complete a comprehensive watershed management plan. The following is an article written by Jim Hart, chairman of the Sunday Creek Watershed Group, from the Sunday Creek Newsletter, Winter 2001:

'Asked to look back and write an article about how our Sunday Creek Watershed Group began, I find that the simplest response is this: It must have been the right time! In the fall of 1999, as owner of land on Dotson Creek in southern Perry County, I was attempting to put together a list of folks to invite to an organizational meeting to get a sense of local concerns about Sunday Creek. I learned that a Trimble Township Trustee and former Athens County Commissioner were organizing the same type of meeting. After a couple of phone calls, we agreed it made much better sense to have one big meeting than two little ones, so our first meeting was held at the Trimble High School Library. We had over twenty folks attend that initial get-together.

To ensure involvement from all regions of the watershed, we invited people from all the communities throughout Athens, Perry and Morgan Counties. Since then, new faces have joined the group, mostly by word of mouth. We try to keep the business part of the meetings short, and attempt to have interesting speakers or presentations to educate ourselves about watershed-related issues.

As to why, our group of interested citizens is defining that as we go along. Over the past 24 months, we have discussed what we would like to accomplish, we have established a mission statement for the group, elected some officers, developed some committees, and obtained funding for projects that will help us meet our short term goals. Boring? Not at all! We now have folks working on developing educational programs for both students and adults, painting the different fish species found in Sunday Creek on the watershed office ceiling panels, and establishing long-term monitoring stations in the creek with Miller High School students and volunteers. We are actively collecting and compiling water quality, fish, sediment, stream habitat, macro-invertebrate data, maps, and historical data.

So, why is there a Sunday Creek Watershed Group? There are residents who live in that watershed who care about the future water quality of our region, and there is much work to be done. We now know that it took decades to cause some of the problems we face; we expect it to take decades to fix them. SCWG hopes to be here for the long haul. Perhaps most importantly, we should all remember that the land that is called our watershed will always mean more to those who live here than anyone else, whether they are educators, regulators or project funders. To paraphrase rather loosely an old adage of Aldo Leopold, "Only the local landowners and residents can practice sound water quality management cheaply and wisely." '

Organizational Structure

During the Sunday Creek Watershed Group inception, much time was devoted to developing the group's purpose. The group identified problems to address, wrote a mission statement, and set-up its organizational structure. From the beginning, the group has represented a diversified cross-section of local residents, including Township Trustees, Mayors, Farm Bureau members, a Certified Tree Farmer, students at local colleges, several retirees (one a former employee of Ohio Division of Wildlife), rural landowners, village dwellers, and several residents who also happened to have expertise in forestry, coal, oil, and gas extraction. The group elected a chairperson, vice chairperson, secretary, and had one staff person, an AmeriCorps VISTA assigned through Rural Action, Inc. These four people organized and facilitated meetings and recorded minutes. At that time many meeting sessions were devoted to establishing all the concerns and problems citizens have with Sunday Creek. The concerns were identified and committee groups were formed to address each issue. Four committees were formed: illegal dumping and sewage waste, erosion and sedimentation, acid mine drainage and related mining issues, and education and outreach. Members divided themselves into the committee groups of interest. These committee groups were responsible for establishing project goals, timelines, resources, and activities.

Mission of the Sunday Creek Watershed Group (SCWG)

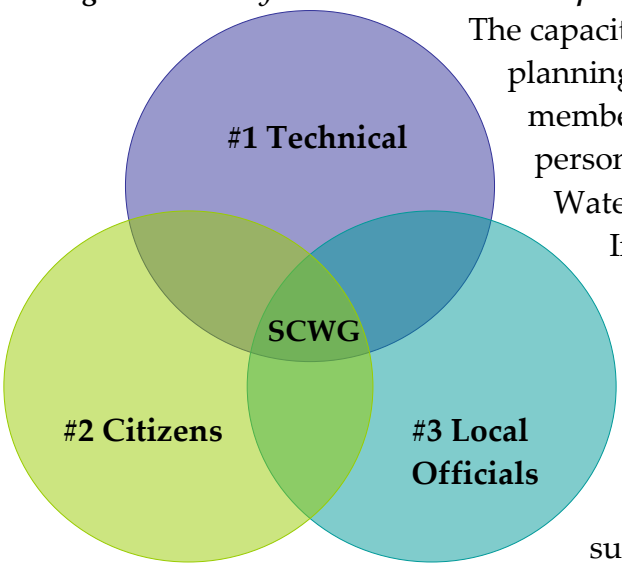
As adopted by the Sunday Creek Watershed Group in 2000,
"The Sunday Creek Watershed Group is committed to restoring and preserving water quality through community interaction, conservation, and education; in pursuit of a healthy ecosystem capable of supporting bio-diversity and recreation."

In addition to the citizen-based committee groups, a technical advisory committee (TAC) was formed. The TAC group consists of state and local government officials, professors, an Ohio State University (OSU) Extension watershed agent, an Ohio Environmental Protection Agency (Ohio EPA) area assistance team leader, Institute for Local Government Administration and Rural Development (ILGARD) project coordinators, and geographical information systems (GIS) personnel. This group meets quarterly and discusses how to get

the projects completed that are discussed monthly at the citizen's meetings. This is where the Sunday Creek Watershed Group acts as a liaison between the local citizens and government agencies. Figure 1 shows the Sunday Creek Watershed Group role placed in the middle of three intersecting circles:

- Circle one represents state and federal government agencies
- Circle two represents local citizens (school groups, clubs, volunteers…etc.)
- Circle three represents local officials (trustees, mayors, commissioners…etc.)

Figure 1. Sunday Creek Watershed Group Organizational Structure-



The capacity for the group to carry out long-term planning relies on the coordinator, AmeriCorps members, citizen volunteers, partnering agency personnel, and Rural Action. Sunday Creek Watershed Group is a part of Rural Action, Inc., a membership-based sustainable development organization working for healthy communities in Appalachian Ohio. Rural Action provides the 501 C(3) status for Sunday Creek. Rural Action works with various program areas including three watershed groups, sustainable agriculture and forestry programs, and hosts an energy committee. Rural Action also provides the AmeriCorps members that work within the Sunday Creek Office.

The role of the Sunday Creek Watershed Group is to educate, motivate, organize and focus the goals of the different groups represented by these three intersecting circles (citizens, local officials, and state and federal technical agencies), to acquire needed resources, and ultimately take action. Long-term planning is possible as long as a core group of people remain focused and motivated, otherwise many good ideas would be wasted. Local communities want clean water and they need the assistance of the watershed group to direct them. In order for a watershed group to be effective and begin to take action, this core group of motivators and organizers is essential.

Collaboration at Work

The following past and current water quality efforts have been implemented throughout the watershed. These efforts have been instrumental in supplementing the Sunday Creek Watershed Group by increasing acceptance and awareness of the partnership.

- **The Sunday Creek Acid Mine Drainage Abatement and Treatment plan (AMDAT)** completed in May of 2003 was the culmination of the efforts of many volunteers, staff, state and federal agency personnel, and private contractors. The goal of the Sunday Creek AMDAT Plan is to create a blueprint for systematically restoring acid mine drainage impacted segments of Sunday Creek and its tributaries to meet their potential "aquatic life designated use" as established by the Ohio EPA. The purpose for the AMDAT Plan is to identify all of the existing sources of acid mine drainage (AMD) in the Sunday Creek Watershed, and to prioritize for treatment or prevention of those sources based on their relative effects on the aquatic health of the watershed. Priority vs. non-priority restoration will be based on restoring AMD parameter concentrations to targets that have been determined not to have adverse effects on stream biology in the Sunday Creek Watershed. The rationale behind the plan is to improve surface water quality that has been adversely affected by coal mining practices that occurred before the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. To accomplish this goal, a thorough watershed investigation, including field and laboratory data, was conducted from September of 2000 to June of 2002. The data from this investigation, along with data from the Ohio EPA Total Maximum Daily Load (TMDL) study in the summer of 2001 and historical sources of data, were used to prioritize potential sites for abatement and treatment of AMD in the watershed. Prioritization and treatment selection will be discussed thoroughly in the methods and project areas sections of this plan.

- In 2005 the Ohio EPA completed a **Total Maximum Daily Load (TMDL) study** on the Sunday Creek Watershed. Chemical, physical and biological sampling was conducted in the summer of 2001 to assess and characterize all potential sources of water quality impairment in the Sunday Creek Watershed. Our partnership worked closely with Ohio EPA's TMDL coordinator, Keith Orr. SCWG maintained close contact with OEPA to insure TMDL process completion. TMDL results, combined with public input,

provided this project with an understanding of the problems and potential solutions we face in the watershed.

- SCWG, in cooperation with ODNR Division of Mineral Resources Management, has been awarded three **319 Water Quality Grants** from the Ohio EPA. These grants were awarded in 2002, 2004 and 2008 and totaled $2,154,156 in federal, state and local funding.

- The **Athens County Recycling and Litter Prevention Program** provided $5,000 to the SCWG in 2004 to target the villages (Chauncey, Jacksonville, Trimble, Glouster) and schools (Trimble Elementary, Middle, and High Schools, and Chauncey Elementary) with the goal of improving recycling efforts in the school buildings, helping to initiate expanded household recycling in the villages.

- The Office of Surface Mining has provided two **Appalachian Clean Streams Initiative grants** to the SCWG totaling $319,668. These grants were matched by ODNR Division of Mineral Resource Management to close two stream captures and convey clean water to the stream.

- The **Huntington District of the Army Corps of Engineers** conducted a Reconnaissance Study in Sunday Creek Watershed. The purpose of the reconnaissance study was to take a basin- wide look at the Sunday Creek Watershed and determine where flood prone areas and water quality problems occur. The Army Corps determined what can be done to control and prevent flooding and improve the water quality in those areas.

Programs we can refer people to their local SWCD offices to participate in:

- The **USDA's Environmental Quality Incentive Program (EQIP)** provides educational, technical, and financial assistance for the implementation of conservation practices throughout the watershed. Conservation practices available through EQIP are related to the management of manure storage/utilization systems and grazing lands.

- **USDA's Conservation Reserve Program (CRP)** is a federal program designed to take actively eroding land out of production. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers.

- **Livestock Environmental Assurance Program (LEAP)** meetings educate producers on the need and benefits of sound environmental practices on their farm (SWCD, Ohio Livestock Coalition). There is interest in the watershed to learn more about how to get the highest yield or most benefit out of the land while sustaining the land for future generations. This program will raise the level of awareness and improve the water quality throughout the watershed.

Purpose of the Management Plan

This plan serves as the blueprint for improving the overall health of the watershed. It includes water quality and natural resources inventory, causes and sources of impairments, priority goals, objectives, actions, measurable indicators, timelines, and a list of resources to help meet these goals. This plan answers these questions:

1) What are the causes of impairment?
2) Where are the sources of impairment?
3) What actions need to be taken in order to restore the water quality in Sunday Creek to meet Warmwater Habitat for aquatic life uses?
4) Most importantly, it is a guide we can use to work together to meet these goals.

Development of the Management Plan

Stakeholders involved in the development of the Sunday Creek Watershed Group and management plan are listed below in table 9. Stakeholders include watershed group members, technical agency personnel, local residents, and local officials.

Table 9. Historic and Current Stakeholders Involved in the Development of the Sunday Creek Watershed Group and Management Plan

Stakeholder Group	What are their interests in the watershed group?	These individuals and groups are represented in the watershed group.	How do they participate in the planning process?
SCWG members	Interested in overall sustainability of watershed, landuses, education and financial status.	Approximately 10-20 core members	Gathering input from local citizens, developing solutions, financial status.
Village Councils	Addresses issues within their villages where they have the authority to implement	Corning, Glouster	Gathering input from local citizens, knowledge of available resources, and developing solutions
Ohio University	Research opportunities, technical assistance and collaborate on grants/research	Kelly Johnson, Guy Riefler	Editors, reviewers and advisors on technical issues. Partner on Macroinvertebrate sampling and Truetown Discharge
Township Trustees	Townships could benefit from improvements to watershed	Trimble, Monroe, and Dover	Assist in gathering local concerns, knowledge of possible solutions and raise local awareness about watershed issues (i.e. litter clean-ups, signage)
Soil and Water Conservation District / NRCS	Their best management practices (BMP) and incentive programs could be used in part of the action strategies.	Perry County, Athens County, Morgan County	Technical expertise, help form solutions, and information on potential programs to offer to landowners. In addition, assist with outreach and education on environmental issues.
ODNR – Div. Natural Areas and Preserves	Protecting threatened and endangered plants and species	Staff	Knowledge of plants within the counties of our watershed for the Natural Resources section and editor
ODNR – Div. Wildlife	Protecting streams from soil loss	Staff	Technical assistance on stream morphology and restoration practices
ODNR- Div. MRM	Restoring streams damaged by acid mine drainage (AMD)	Staff	Developing solutions to AMD related problems, engineering designs, funding, and expertise in land reclamation
ODNR- Div. Soil and Water Resources	Restoring streams damaged by erosion	Staff	Developing solutions to issues and concerns, engineering designs, technical assistance, and experience in conservation practices
County Health Departments	Action plan will include on-site wastewater treatment projects	Athens and Perry County	Resources and data, develop solutions and technical assistance
Athens County Planner	Land use planning, flooding, drainage and floodplain issues.	Bob Eichenberg	Assisted with Floodplain/Flooding awareness training in Chauncey and Trimble.

Stakeholder Group	What are their interests in the watershed group?	These individuals and groups are represented in the watershed group.	How do they participate in the planning process?
ILGARD	They are experts and enjoy sharing their knowledge about GIS, Watershed Issues and Technical Support	Scott Miller, Matt Trainer, Jen Bowman	Expertise in mapping, planning, writing and editing, as well as assisting in developing solutions and indicators.
North Country Trail Association	Hiking Trails within watershed	Andrew Bashaw	Assist with Watershed Leadership Trainings and Day Camps
Appalachia Ohio Alliance	Easements and Land Preservation	Steve Goodwin, Brian Blair and Board of Directors	Assist with Trimble Township Community Forest, Trimble High Land Lab.
Southern Perry School District	Education and Outreach	School Board, Science and Vo-Ag Teachers	Education and Outreach Programs and Tree Plantings
Rural Action	Overall sustainability of watershed group	Mike Steinmaus, Michelle Decker, Linda Thornton, Sunday Creek AmeriCorps and other Staff.	Financial Management, Operations Support, Management, VISTA
Hocking College	GIS and GPS Support	Mike Hass, BJ Harper, Geoff Simon ant other Students	Riparian buffer project, organized GIS database, GPS water monitoring points, Georeferenced Truetown mine layer
Sunday Creek Associates	Historical and Cultural and Education and Outreach	Sandra Landris, John Winnenberg and Board of Directors	Assist with Education and Outreach Tours and Provide Historical/Cultural Perspective
Little Cities of Black Diamonds	Historical and Cultural and Education and Outreach	Cheryl Blosser, Sandra Landris, John Winnenberg Board of Directors and Volunteers,	Assist with Education and Outreach Tours and Partnering with them for OEEF Grant: Utilizing the Little Cities Microregion as a Class Room.
OSU Extension (Athens County)	Assist with Agriculture and Riparian Buffer Issues	Rory Lewandowski	Riparian Buffer Tour, 3 Day Equine Stewardship Training, Conservation Connection Tour
Wayne National Forest	15% landowner, action plan can restore/ protect WNF land	Pam Stachler, Gary Willison, Jarel Bartig, DeVela Clark	Technical assistance, resources, and developing solutions
Little Cities of the Forest Collaborative	Education and Outreach, community projects	Sunday Creek Watershed Group, Monday Creek Restoration Project, Sunday Creek Associates, North Country Trail Association, US Forest Service	Assist with Education and Outreach projects and partnering with them for OEEF grant.

Historic Watershed Community Survey Results

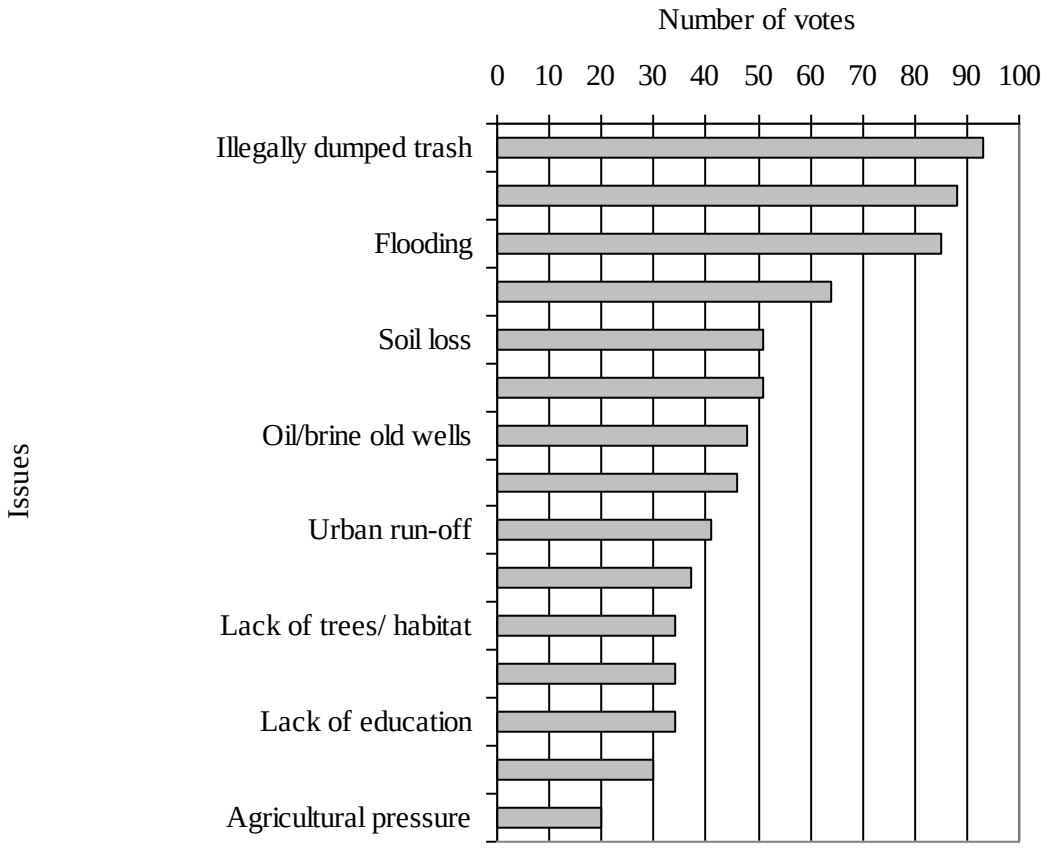
In order to gather additional input from the local community about watershed problems, public meetings were held and surveys were distributed door-to-door. 117 surveys were received from February 2001 through August 2001, listing concerns and issues community members felt were important. Table 10 shows the tallied survey results.

Table 10. Survey Results for Sunday Creek Watershed Management Plan

Topic listed in survey	Question	Total votes for issues citizens considered important	% of total votes
Watershed Resident	Yes	89	76
	No	28	24
Land Use	Agriculture	7	6
	Residential	90	77
	Commercial	4	3
	Recreation	20	17
Recreation Use	Fishing	45	38
	Canoeing	11	9
	Swimming	22	19
	Hiking	37	32
	Hunting	28	24
	Camping	27	23
If water quality improved, would you use for recreation?	Yes	96	82
	No	11	9
Personal opinion of current water quality	Excellent	1	1
	Good	7	6
	Fair	33	28
	Poor	47	40
	Bad	27	23
Problems in watershed that are a concern to you	Illegally dumped trash and litter	93	79
	Acid mine drainage (AMD)	88	75
	Flooding	85	73
	Log jams	64	55
	Soil loss	51	44
	Poor wastewater treatment	51	44
	Oil/Brine old wells	48	41
	Property damage from sinkholes	46	39
	Urban run-off	41	35
	Lack of recreation opportunity	37	32
	Lack of trees/habitat	34	29
	Lack of good drinking water access	34	29
	Lack of education	34	29
	Sedimentation from timbering	30	26
	Agricultural pressure	20	17

Figure 2 shows the total number of votes each watershed issue received, listed from highest to lowest number of votes.

Figure 2. Sunday Creek Management Plan Ranked Concerns from Surveys



Results were tallied and discussed with members of the Sunday Creek Watershed Group. The listed survey concerns were prioritized based on their impacts to water quality and grouped into categories of similar issues. The committee groups worked on developing goals, objectives, and designed activities to address the problems created from illegally dumped trash and litter, acid mine drainage and sinkholes, improperly treated wastewater, sedimentation, and lack of education.

Committees developed specific activities towards addressing these issues. The main activities included the following:

Illegally dumped trash and litter

- remove trash from the creek and stream bank
- educate neighbors to report illegal dumpers
- work with local officials to provide more rural garbage collection.

Acid mine drainage

- close subsidence holes that supply surface water into the abandoned coal mines
- install treatment systems at major acid mine drainage discharges
- cap gob piles to preclude the erosion of coal fine sediment draining into the creek.

Improperly treated wastewater

- work with landowners to upgrade failing septic tank systems
- educate landowners about the proper maintenance of septic systems
- work with local health departments to decrease the amount of improperly treated wastewater from entering the creek.

Sedimentation and lack of habitat

- plant trees on barren hillsides, eroded stream banks, and in the riparian corridor areas.

Lack of education

- teach in local schools
- participate in village council meetings
- set-up informational displays at fairs, festivals and conferences
- conduct workshops, trainings, and demonstrations
- organize public meetings with informational speakers.

Endorsement and Adoption of Plan

Historically, Sunday Creek Watershed Group completed the following steps prior to the endorsement of the first Watershed Action Plan in 2003. To facilitate the adoption and endorsement of our Watershed Management Plan, the SCWG employed various techniques. These techniques ranged from public meetings to presenting the plan to local politicians. Once the plan was written and approved, there were two public meetings for the general public, local health departments, and local realtors. The purpose of those meetings was to gain endorsements by the key stakeholders and inform the general public that the plan was completed.

To gain the necessary adoptions and endorsements SCWG visited various groups, organizations, politicians, etc. These meetings involved presenting the plan, (PowerPoint when necessary) and providing time for questions and comments. The plan was presented to the following groups, organizations, politicians, etc.:

- Perry, Athens and Morgan County Commissioners
- Perry, Athens and Morgan Counties Annual Trustee Meetings
- Mayors and City Councils (Glouster, Trimble, Jacksonville and Corning) within the watershed
- Perry, Athens and Morgan County Health Departments
- Senators, Congress Persons and Representatives within the watershed
- Kiwanis Clubs
- Rotary Clubs
- 4-H Council
- Emergency Management Agencies within the watershed
- Farm Bureaus and Soil and Water Districts within the watershed
- OSU Extension Advisory Committees within the watershed

A copy of the revised plan will be available at the Perry, Athens and Morgan County Libraries and at Soil and Water Conservation District Offices. Interested parties will have the opportunity to obtain the updated management plan on-line at the Sunday Creek Watershed Group website (www.sundaycreek.org) and/or the Ohio Watershed Network website (www.ohiowatersheds.osu.edu). Various media outlets will be utilized to disseminate the Sunday Creek Watershed Management Plan. They include: Sunday Creek Watershed Group Newsletter (*Splash*), Rural Action's Annual Report and *Rural Rambler, Perry County Tribune, Athens Messenger,* and *The Athens News*.

Watershed tours, field days and other watershed events will facilitate long-term pubic understanding and encourage continued participation in the plan. Progress of the plan's implementation will be tracked using an excel chart that will be on file at the Sunday Creek Watershed Office. Tracking of project completion will be available online at www.sundaycreek.org and also in the SWIMS reporting system developed by ODNR-Division of Soil and Water Resources.

Chapter III: Watershed Inventory

Geology

According to ODNR -Division of Geological Survey's physiographic regions of Ohio, the Sunday Creek Watershed lies within the Pennsylvanian geologic system. This system is between 320-286 million years old. Within this system, 3 distinct rock units make up the strata of the watershed. They include the Monongahela Group, the Conemaugh Group, and the Allegheny and Pottsville Group.

The Monongahela group's lithology or rock composition consists of layers of shale, siltstone, limestone, sandstone, and coal. The thickness of this group is usually 350 plus feet. Diagnostic features of the Monongahela group are its economic coal beds, and laterally extensive non-marine limestone layers. The color of this rock is typically shades of gray, green, and infrequently red.

The Conemaugh Group is characterized by layers of shale, siltstone, sandstone, mudstone, with lesser amounts of limestone and coal. This rock unit ranges from 350-490 feet, and is typically gray, green, red, brown or black. Features of the Conemaugh group include multi-colored mudstones and thin to thick marine shale with limestone in the lower 2/3 of the unit. Rapid vertical and horizontal changes of rock types are also noted within this group. Coal beds are rare within this group.

The Allegheny and Pottsville Group consist of shale, siltstone, sandstone, and conglomerate, with subordinate amounts of limestone, clay, flint and coal. The predominant colors are shades of gray and black. The thickness of this group is between 450 to 620 feet. Features include economic beds of coal and clay. In the lower quarter of the unit, local development of thick quartzose sandstone and conglomerate has occurred. Also characteristic of this group are the rapid horizontal and vertical changes of rock types (Swinford et al., 1999).

Topography

The Sunday Creek Watershed lies in the un-glaciated, Appalachian foothills of Southeastern Ohio. It originates in the southern portion of Perry County, and drains into the Hocking River in Athens County. Sunday Creek's topography is composed of narrow, strongly sloping and moderately steep ridgetops; steep and very steep side slopes and varying sized valley bottoms along the mainstem of West Branch and Sunday Creek. The watershed is located in the Shawnee-Mississippian and Marietta Plateaus of the Allegheny Plateau region. Sunday Creek is 27.2 miles long with an average gradient of 11.5 feet per mile. The following USGS Quadrangle Topographic maps make up the Sunday Creek Watershed: New Lexington, Deavertown, Rokeby Lock, New Straitsville, Corning, Ringgold, Nelsonville, and Jacksonville.

Soils

Soil associations have distinctive patterns of soils, relief and drainage in common. Each soil association has a unique natural landscape. Typically, an association consists of one or more major soils, from which the name is derived, and some minor soil types (USDA, 1985).

The Athens County portion of the Sunday Creek Watershed consists of three soil associations. The Westmoreland-Guernsey-Dekalb Association is predominant in the county. These soils are located on hillsides with side slopes that are occasionally broken by narrow benches. Slopes range from 25 to 70 percent. Streams are small with relatively narrow valleys. The soils are characterized as deep, predominantly steep, and well drained. Most areas of this association are in woodlands. Major limitations for most land uses are the steep slopes, erosion hazard, slow permeability, and high shrink-swell potential in the Guernsey soil series (USDA, 1985).

The Chagrin Orville-Otwell Association, (formally known as the Chagrin-Nolin Association), is also found in the Sunday Creek Watershed. This association consists of soils on floodplains along major streams that are subject to rare or frequent flooding. Slopes range from 0 to 3 percent. These are deep, nearly level, well drained soils formed in alluvium. Chagrin soils have moderate permeability with slow runoff. Most areas of this association are used for

agricultural purposes. They are suited for crops such as corn, soybeans, and hay, or for use as pasture. The flooding hazard is the major limitation for most uses (USDA, 1985).

Athens County has minor portions of Westmoreland-Guernsey soils while it is the major association found in both Perry and Morgan counties. These soils are found on uplands, are well drained, and were formed in residuum and colluvium from sandstone, siltstone, shale, mudstone and limestone. Athens County's association is called the Westmoreland-Guernsey-Upshur Association. This association consists of high hills and ridges. Slopes are predominantly 15 to 40 percent but range from 8 to 70 percent. Most of these soils were once cleared and farmed, but most have reverted to brush and woodland. Strong sloping areas are suited to cropping and pasture. Steep soils in this association are unsuited to most of these uses. Ridgetops provide the best sites for building. Slope and erosion hazard are the major concerns for management in this association (USDA, 1985).

Perry County has only one major soil association within the Sunday Creek Watershed. The Westmoreland-Guernsey-Zanesville Association is located on convex, narrow ridge tops typically ranging from 200 to 400 feet wide and on dissected side slopes. Slopes range from 3 to 70 percent, with maximum relief at 150 to 250 feet in most areas. Most of this association is woodland, or is idle land that is reverting to woodland. The gentle sloping soils in this association are generally suited and used as cropland and pasture. Steeper soils are poorly suited for these uses. Steep slopes and the hazard of erosion are the main concerns for management in this association (USDA, 1988).

The Westmoreland-Guernsey Association is the only major soils association found in the Morgan County portion of the Sunday Creek Watershed. These soils are located on hillsides and benches, that are dissected by deep drains and very narrow flood plains. Slopes range from 12 to 70 percent. Most soils in this association are located in woodlands. These soils are poorly suited for urban uses. The major management concerns are steep slopes and hazard of erosion (USDA, 1998).

Septic Tank Absorption Fields

Septic tank absorption fields are an increasing concern in the Sunday Creek Watershed. Malfunctioning septic tanks have had an adverse affect on the water

quality in some parts of the watershed. The placement of septic tank absorption fields is critical for the system to function properly. Landowners and developers must research the site for proper soil type and flooding rates, and also contact their local health department prior to installing a septic system. To obtain proper soil information, contact your local Soil and Water Conservation District to obtain the *NRCS Soil Survey* for your county.

The Sanitary Facilities Table in the *NRCS Soil Survey* of Athens, Perry and Morgan Counties shows the degree and kind of soil limitations that affect septic tank absorption fields. These tables indicate that 88% of all soil series named as part of the STATSGO soil associations in the Sunday Creek Watershed have severe limitations that affect septic tank absorption fields. A soil has severe limitations "if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required (NRCS Soil Survey)".

Table 11: Urban Land Use And Sewage Statistics by Subwatershed

Subwatershed	Urban%	Impervious %	Total # Homes	Population	# Homes with Public Sewage	# Home Sewage Treatment Systems	Number of Failing Systems	% of Total Systems Failing+
Upper *	1.8	1.26	752	1,671	288	464	162	35
Lower +	3.2	2.24	2,916	6,480	1,458	1458	510	35
West Branch	0.62	0.45	1,811	4,024	428	1383	484	35
East Branch	0.12	.084	214	475	0	214	75	35
Totals	**n/a**	**n/a**	**5,693**	**12,650**	**2,174**	**3,519**	**1,231**	**n/a**

***Data reflects completion of the Corning Waste Water Treatment Plant in 2010.**
+ Estimate from Athens County Home Sewage Treatment System Plan

Highly Erodible Soils

Highly erodible soils are a concern for the Sunday Creek Watershed because sediment/siltation is a known water quality impairment. Using slope and individual soil types, soils are classified by the NRCS into one of three categories: Highly Erodible Land (HEL), Potential Highly Erodible Land (PHEL), and Non Highly Erodible Land (NHEL). Utilizing these classifications the Sunday Creek

Watershed was assessed to determine the amount of Highly Erodible Land by 14-digit subwatershed (map 8). Sunday Creek Watershed is divided into four 14-digit subwatersheds and more information on each subwatershed is provided in section two of this plan.

Land Use

The Sunday Creek Watershed is located in the Appalachian foothills. It is mostly rural with many small villages throughout it and the majority of the land is privately owned. Public lands within the watershed are the Trimble Wildlife Area, Burr Oak State Park, Sunday Creek Wildlife Area, and Wayne National Forest. Due to the steep terrain, agricultural land is limited. There are pasture lands and crop production in the lower stretches of the Sunday Creek Valley and some of the flood plains of smaller tributaries. The primary land use historically has been mineral and resource extraction. This included underground and surface coal mining as well as natural gas and oil wells throughout the watershed. There has also been logging on private and public lands over the years. (map 3).

Much of the Sunday Creek Watershed lies within the coalfields of southeast Ohio (map 3). Historically, sub-surface and surface mining has occurred in many townships in the watershed, making up approximately 39% of the watershed area. Today, there is the only one mine operation in the watershed that is located north of Glouster.

Major land uses within the Sunday Creek Watershed include a mix of deciduous forest, evergreen forest, mixed forest, pasture/hay, and row crops. The three forest classes account for 83% of the total land in Sunday Creek Watershed. Conversely, residential, commercial and industrial land use categories account for only 1.1% of the total area. Further, a very small portion of the watershed is considered barren, 40.12 acres, 60% in the West Branch Subwatershed, 10% in the East Branch Subwatershed, 10% in the Upper Sunday Creek Subwatershed, and 20% in the Lower Sunday Creek Subwatershed. Land use data for the area are available from the Multi-Resolution Land Characterization (MRLC) database for Ohio and are shown in table 12 and map 2. Refer to section two of the plan to see the breakdown of land use per subwatershed.

ODNR officials state that perceived land use challenges for the future would include current and future mining (underground and surface). Also, there may be more potential for sewage problems with the extension of water lines without the option of hooking up to a wastewater treatment plant in the lower portions of the watershed. This would be categorized as 'rural/ residential' and again may be a future land use challenge in the Sunday Creek Watershed.

Table 12. Sunday Creek Watershed Land Use Distribution by Major Land Use Category

Land Use	Area (acres)	%
Deciduous Forest	70,649	79.42
Pasture/Hay	8,493	9.55
Row Crops	3,572	4.02
Evergreen Forest	2,936	3.30
Open Water	886	1.00
Low Intensity Residential	715	0.80
Mixed Forest	641	0.72
Urban Recreational Grasses	231	0.26
Transitional	202	0.23
High Intensity Residential	141	0.16
Commercial/Industrial/Transportation	127	0.14
Emergent Herbaceous Wetlands	91	0.10
Woody Wetlands	36	0.04
Quarries	17	0.02

Source: MLRC 2000

The characteristic forest type of the area is mixed mesophytic, which consist of a diverse composition of trees. The woody vegetation includes such species as beech (*Fagus grandifolia*); silver and red maple (*Acer spp*.); white, red and chestnut oak (*Quercus spp*.); and tulip poplar (*Liriodendron tulipifera*).

Agriculture

Agriculture statistics for the Sunday Creek Watershed are divided by county; information found on the USDA, National Agriculture Statistics Service website. The most recent data is from 2008, showing Perry County having 99,000 acres in farmland with 640 farms, Morgan County having 104,000 acres in farmland with

520 farms, and Athens County having 79,000 acres in farmland with 570 farms. Only part of these statistics will apply for the watershed since only portions of these counties reside in the watershed. Refer to table 13 for further information on crop type and livestock inventory for these counties.

Table 13: 2008 Agricultural Statistics per County in Sunday Creek Watershed

County: 2008 Data	Crop Planted: Wheat	Crop Planted: Corn for Grain	Crop Planted: Soybeans	Crop Planted: Hay	Livestock: Cattle	Livestock: Hogs	Livestock: Sheep
Perry	2,800 acres	18,000 acres	13,800 acres		10,100 head	5,700 head	
Athens		2,400 acres	1,900 acres	16,900 acres	8,500 head 1,100 head (Milk)		1,000 head
Morgan		3,500 acres	1, 100 acres	18,000 acres	14,000 head 1,100 head (Milk)	4,000 head	

Source: USDA, National Agriculture Statistics Service Website

Local Community Parks

Within the Sunday Creek Watershed there are several local community parks, most of which have a stream side view of Sunday Creek. John Altier Park, that has two separate parcels, both next to the main stem of Sunday Creek, is located in the town of Corning. The town of Glouster has a community park that resides on the west side of State Route 13 between the highway and Sunday Creek on the south side of town. Trimble Village Park is located off of State Route 13. Jacksonville Memorial Park resides in the village of Jacksonville off of High Street. The village of Chauncey was ceded old strip mine land from the U.S. Forest Service to make the Chauncey-Dover Township Park (127 acres).

Federally Owned Land

Wayne National Forest

The U.S. Forest Service maintains approximately 15% of the land area within the Sunday Creek Watershed (map 9). It is Ohio's only national forest. Acquisition of this land was made possible by the passage of the Weeks Act of 1911. Land included in Wayne National Forest began being purchased in 1935 and by 1942 more than 77,000 acres were acquired. In 1951, with the purchase of more than 97,000 acres, it became an official national forest. Much of this forest had been intensely logged, mined and grazed before its acquisition. The passage of the Multiple-Use Sustained Yield Act has resulted in reclamation of many national forest lands since the 1960's. Wayne National Forest is now managed according to this Act, which includes provisions that require forests to be maintained to sustain timber and other vegetation, clean water supplies, recreation, minerals, fish and wildlife, and other commodities (USDA, web site).

State Owned Land

Burr Oak State Park

Burr Oak State Park is located within the Sunday Creek Watershed. Burr Oak Lake was created in 1950 by the construction of the Tom Jenkins Dam across the East Branch of Sunday Creek. It was dedicated as a state park two years later. The park itself encompasses 2,592 acres of land, while the lake is 664 acres. Recreation opportunities in and around the park include camping, boating, swimming, picnicking, fishing and hunting (ODNR Div. of Parks and Recreation, 2000).

In 1960, a water treatment plant was constructed at the base of the Tom Jenkins Dam. The water treatment plant (WTP) now serves 15 villages, water districts, and water associations in Athens, Hocking, Perry, and Morgan Counties. The WTP has a peak capacity of 2 million gallons a day, with the average daily output of approximately 1.3 million gallons per day. Four hundred thirty square miles are serviced by the WTP, with about 14,500 customers. The 1.3 million gallons of water taken from Sunday Creek per day represents a loss of 2 cubic feet per second from the East Branch of Sunday Creek. Water is treated with one or more of the following chemicals, depending on conditions: chlorine,

potassium permangate, carbon, chloride, caustic soda, fluoride, and megaflock coagulant (Burgess and Niple, 1998).

Sunday Creek Wildlife Area

Sunday Creek Coal Company, one of the largest owners of land and minerals in southeastern Ohio, entered into a cooperative agreement with the Ohio Department of Natural Resources, Division of Wildlife in 1966. Together they created the Sunday Creek Wildlife Area. Developed with a long-range sustained yield timber management plan, the area consists of 10,000 acres. Much of the timber will be cut on a short-term rotation for the production of pulpwood. Better growing sites within the area will be managed for larger trees.

Many recreation opportunities lie within the area. Largemouth bass and bluegill have been stocked in area ponds. Gray squirrel, ruffed grouse, deer, wild turkey, raccoon and gray fox are the principal game and fur species in the area, where a variety of songbirds can also be found (ODNR, 1998). Today ODNR-Division of Wildlife owns approximately 4,600 acres of land in this area. A map of the area can be obtained from the ODNR-Division of Wildlife, Publication 46.

Trimble Wildlife Area

Prior to state ownership of this area, the land was deep-mined by Sunday Creek Coal Company and Ohio Colliers Company. Producing approximately 1,000 tons of coal per day, the mine was the primary source of employment for local people from about 1900 to 1941. The State of Ohio purchased the area in 1944 and managed it as a game refuge. Trimble Wildlife Area is 2,098 acres and lies one mile west of Glouster. About 92% of the area is forested, with rough terrain that consists of deep narrow valleys and narrow ridgetops. Streams in the area are typically dry during the summer months, and three ponds, a quarter acre each, provide limited fishing. The Ohio Buckeye Trail also passes through the area, which provides hiking opportunities.

The most abundant game species located in the area is the gray squirrel. White-tailed deer, ruffed grouse, and wild turkey are the other principal game species. A variety of songbirds thrive in the area (ODNR, 1996). A map of the area can be obtained from the ODNR-Division of Wildlife, Publication 38.

Trimble Township Community Forest

Appalachian Ohio Alliance (AOA) acquired a 1,200-acre tract of hardwood forest in Northern Athens County from the Sunday Creek Coal Company. The property known as "Taylor Ridge" is officially named the Trimble Township Community Forest in recognition of Trimble Township and its residents. This large parcel of habitat will help to connect the Wayne National Forest with the Trimble Wildlife area. AOA has established a local citizens' land management committee for the Community Forest that meets monthly at the Sunday Creek Watershed office, in Glouster. This land is managed with the assistance of ODNR's Division of Wildlife as a Wildlife Area. The preserve is open to the public for hiking and hunting.

Biological Features

Federally Listed Threatened, Rare, or Endangered Species

Ohio currently has twenty-five species of fish and wildlife and five species of plants listed as federally threatened or endangered (updated November 2009). The U.S. Fish and Wildlife Service (USFWS) has reported four of the twenty-five endangered animal species may reside within the watershed. They include:

- Fanshell mussel (*Cyrrogenia stegaria*)
- Pink mucket mussel (*Lampsilis orbiculata*)
- American burying beetle (*Nicrophorus americanus*)
- Indiana bat (*Myotis sodalis*)

The USFWS has also reported three of the five federally listed threatened and endangered plant species possibly residing within the watershed. They include:

- Northern monkshood (*Aconitum noveboracense*)
- Running buffalo clover (*Trifolium stoloniferum*)
- Virginia spiraea (*Spiraea virginiana*)

Species become endangered primarily due to loss or degradation of habitat. The most critical causes of habitat loss pertinent to the Sunday Creek Watershed come from loss of formerly vast forest areas and degradation of natural waters. Land clearing for agriculture and extensive cutting of the forest for charcoal in the iron industry were major early causes of forest removal. Though recovery of Ohio's forestlands has been significant since the 1940's, species such as timber

wolves and mountain lions have been permanently removed from the area. However, sightings of black bear are becoming more numerous. Degradation of natural waters, caused by acid mine drainage, poor agricultural management practices and sewage discharges, has caused the listing of many aquatic species in this region (ODNR, Division of Wildlife, 1997).

State Listed Rare Animals, Plants, and Plant Communities

In 1974, Ohio adopted its first endangered species list that included 71 species. By 1996, 108 species were listed. In January of 2009, the list was updated to 125 endangered, 55 threatened, 99 concern, 42 special interest, 32 extirpated, and 9 extinct. Species are divided into categories pending the severity of the threat to that species. (Ohio Department of Natural Resources Website)

Endangered Species Categories:

Endangered - A native species or subspecies threatened with extirpation from the state. The danger may result from one or more causes, such as habitat loss, pollution, predation, interspecific competition, or disease.

Threatened - A species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered.

Concern- A species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern, but for which information is insufficient to permit an adequate status evaluation. This category may contain species designated as a furbearer or game species, but whose statewide population is dependent on the quality and/or quantity of habitat and is not adversely impacted by regulated harvest.

Special Interest - A species or subspecies, which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern but for which information is insufficient to permit an adequate status evaluation.

Extirpated – A species or subspecies that occurred in Ohio at the time of European settlement and that has since disappeared from the state.

Extinct- A species or subspecies that occurred in Ohio at the time of European settlement and that has since disappeared from its entire range.

Information provided by the Ohio Division of Natural Areas and Preserves shows that several species found within the boundaries of the Sunday Creek Watershed qualify for state designation under one of these categories.

According to the Ohio Natural Heritage Database, updated June of 2008, there are 25 rare plant species found in Athens County, six rare plants species found in Perry County, and two found in Morgan County.

Also, Ohio's top ten invasive plant species are: Japanese Honeysuckle, Japanese Knotweed, Autumn Olive, Buckthorns, Purple Loosestrife, Common Reed, Reed Canary Grass, Garlic Mustard, Multifora Rose, and Bush Honeysuckle. These species could pose a threat in our natural areas by crowding out our Ohio native plants. They are invading woodlands and displacing native plant species and they can impact our wetlands by creating monocultures. Native plant diversity is vital for many animals and insects for food and cover.

In addition to the ODNR Division of Natural Areas and Preserves list, many rare plant communities in the Ohio Element Occurrence Record can be found in this region. Historically, within the watershed, six such communities exist.

State Listed Endangered Plant Species Within the Main Watershed Counties of Athens, Morgan and Perry:

Athens County:
Arabis hirsuta var. adpressipilis- Southern Hairy Rock Cress (P)
Asplenium bradleyi- Bradley's Spleenwort (T)
Aureolaria pedicularia var. pedicularia- Woodland Fern-leaved False Foxglove (E)
Cardamine dissecta Narrow-leaved Toothwort (P)
Chrysogonum virginianum Golden-knees (T)
Cirsium carolinianum Carolina Thistle (T)
Corallorhiza wisteriana Spring Coral-root (P)
Corydalis sempervirens Rock-harlequin (P)
Croton glandulosus Northern Croton (E)
Cystopteris tennesseensis Tennessee Bladder Fern (P)
Eryngium yuccifolium Rattlesnake-master (P)
Gentiana alba Yellowish Gentian (T)
Lechea minor Thyme-leaved Pinweed (T)
Lechea tenuifolia Narrow-leaved Pinweed (P)
Liatris cylindracea Slender Blazing-star (T)
Luzula bulbosa Southern Woodrush (T)
Malaxis unifolia Green Adder's-mouth (P)
Panicum verrucosum Warty Panic Grass (T)
Penstemon pallidus Downy White Beard-tongue (T)
Rhexia virginica Virginia Meadow-beauty (P)
Spiranthes ovalis Lesser Ladies'-tresses (P)
Viola lanceolata Lance-leaved Violet (P)
Woodwardia areolata Netted Chain Fern (P)

Morgan County:
Cardamine dissecta Narrow-leaved Toothwort (P)
Chrysogonum virginianum Golden-knees (T)

Perry County:
Cardamine dissecta- Narrow-leaved Toothwort (P)
Castanea dentata- American Chestnut (P)
Cynoglossum virginianum var. boreale- Northern Wild Comfrey (X)
Juncus diffusissimus- Diffuse Rush (T)
Malaxis unifolia- Green Adder's-mouth (P)
Panicum laxiflorum- Pale Green Panic Grass (P)

P=Potentially Threatened, T=Threatened, E=Endangered, X=Presumed Extirpated PFT=Federally Threatened, FE=Federally Endangered

Source: Ohio Natural Heritage Database

Rare Plant Communities in Watershed:

1. **Mixed Emergent Marsh** - Found in Section 18 of Dover Township in Athens County, this marsh is described as a true cemetery marsh. Lines of trees separate open wet areas. Mostly surrounded by old fields, and County Road 93, the marsh is cut off from Sunday Creek. Species found within the marsh include Smartweeds (*Polygonum hydropiperoides & P. sagittatum*), Rush (*Juncus effuses*), and Yellow pond-lily (*Nuphar luteum*). It is also found in Section 35 of Monroe Township in Perry County. This section is dominated mostly by cattails, sensitive fern, and local bands of black willow (*Salix nigra*). It has a greater number of species with fewer disturbances than most sites along Sunday Creek.
2. **Buttonbush Shrub Swamp** – Located in Section 7 of Trimble Township, this swamp is a dense Buttonbush thicket with a few small grassy openings scattered throughout.
3. **Maple Ash Oak Swamp** – Surrounding a Buttonbush shrub swamp, seasonal water stands approximately 10 inches deep. Pin Oak dominates the swamp with 61% density, but all with less than 45-centimeter diameter breast height (DBH). American elm and silver maple are also present.
4. **Mixed mesophytic Forest** – Found in 5 different sections, this plant community is the most abundant in the watershed. Section 30 located in Union Township, Morgan County is dominated by 30% sugar maple and tuliptree with 10% being yellow buckeyes and slippery elms, plus basswood and many mesic herbs including Synandra (*Synandra hispidula*). Section 32 located in Monroe Township in Perry County is dominated by second hand growth tuliptrees (35-45cm DBH), beech, white ash and sugar maple (most 35-45cm DBH). This section is completely wooded with a well-developed herb layer. There are two parts in Section 22 that have a mixed mesophytic forest section. Located one-mile south of the junction of State Routes 13 and 155 in Monroe Township of Perry County, the north half of the southwest quarter of Section 22 is dominated mostly by white oak, cherry and beech. The ridge tops are covered with mixed oaks and hickories. Also in the southwest quarter of Section 22, 1.25 miles south of the junction of State Routes 13 and 155, is a rich woodland ravine with large beech, oaks and one very large *M. acuminata.* Located north of State Route 155 and west of State Route 309 in Section 17 of Monroe Township in Perry County is second in growth woods, where most trees are 40cm DBH with red and black oaks as large as 70cm DBH. Also there are some mountain laurel and blueberry shrubs on sandstone outcroppings. Located in Monroe Township, Perry County Sections 32 and 29, directly southwest of the junction of Township Road 283 and Scenic Road (County Road 31), is a young mixed mesophytic forest dominated by beech (15-60cm DBH) and white oak (20-60cm DBH) with good species diversity in all layers.
5. **Oak-Maple Forest** – This section of plant community is located northeast of Tom Jenkins Dam on Burr Oak Reservoir in Section 6 of Trimble Township in Athens County. The east portion is more diverse and the west section is more upland with a slope that becomes very steep along the small stream terrace. The upper slope is early successional growth. It is a nice mix of young upland woods and small stream terrace with no invasive exotic species.
6. **Beech-Sugar Maple Forest-** Located in Monroe Township of Perry County, in Sections 31 and 32, there are two ravines on either side of the section line. The approximate age of the hardwood forest is 60 years old and is dominated by beech (*Fagus grandifolia*). There is high species diversity in the saplings with a rich herbaceous cover.

Flora and Fauna

As discussed earlier, the forest type characteristic of the Sunday Creek Watershed is mixed mesophytic. This forest type consists of a diverse composition of trees. Much of the watersheds' forests are mature, second or third-growth hardwoods dominated by native tree species including beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), tulip tree (*Liriodendron tulipifera*), and oaks (*Quercus spp*.). Undisturbed areas of the forest typically have an herb layer dominated by tree seedlings and native forbs including Virginia creeper (*Parthenocissus quinquefolia*), baneberry (*Actaea spp*.), rue anemone (*Amemonella thalictroides*), and black cohosh (*Cimcifuga racemosa*).

This forest type provides excellent habitat for mammals such as whitetail deer, bobcat, opossum, raccoon, grey and fox squirrels, and chipmunk. These species can all be found in abundance in the Sunday Creek Watershed. Migratory songbirds also utilize the habitat during the spring and fall seasons. Other bird species that are permanent inhabitants of this area include the northern cardinal, common flicker, hairy woodpecker, and the blue jay. Other species such as the eastern phoebe, flycatchers, nuthatch, chickadee, and various warblers also utilize the forested area because of its extensive food sources and nesting habitat.

Water Resources

Climate and Precipitation

The Hocking River Basin, of which the Sunday Creek Watershed is a part, is classified as having a continental climate. Large annual, daily, and day-to-day ranges of temperature mark this area with at average yearly temperature of about 55 degrees Fahrenheit. Summers are moderately warm and humid with occasional days when the temperature exceeds 90 degrees. Winters are seasonably cold and cloudy. There are very few days of subzero temperatures. The mean annual precipitation in the area is 40.7 inches, which is more than 2 inches above the mean for the state as a whole. Since the watershed is unglaciated, creating a rougher terrain, it probably adds to the above average rainfall of the area due to uplift and turbulence produced as air masses traverse the hilly countryside (Ohio EPA, 1979).

Surface Water

Wetlands

According to the Multi-Resolution Land Characterization (MRLC) database, wetlands make up 0.14% (127 acres) of the watershed. Of the total percent of wetlands in the watershed, woody wetlands make up 0.04% (36 acres) while emergent herbaceous wetlands make up 0.10% (91 acres). Wetland acreage data shows the location of woody wetlands and emergent herbaceous wetlands throughout the watershed, information shown in land use table 12 and map 2.

Most wetlands in the watershed are not affected by acid mine drainage. However, some wetlands are notably affected by AMD which negatively changes their water quality, but in most cases these wetlands passively treat the AMD. One in particular is WB-36, more commonly referred to as 'Drakes Wetland,' which runs south along St. Rt. 155 in the village of Drakes in the West Branch Subwatershed. This wetland acts as a filter for the AMD. Plans have been made in the AMDAT to construct a project that would increase residence time for neutralization and metal precipitation. Another wetland that is contaminated by AMD is located along Pine Run on Sulphur Springs Road; treatment is currently being discussed for this subwatershed.

Streams

The Gazetteer of Ohio Streams states that the Sunday Creek Watershed has 16 named streams totaling 108.4 stream miles. There are 6 main tributaries of Sunday Creek. The stream pattern of Sunday Creek is branching, with steep gradients in the many minor laterals as they descend to the main and tributary flood plains. About 15 % of the main channel of Sunday Creek has been channelized due to the construction of State Route 13 and the railroad. Therefore, approximately 16.3 miles of stream have been channelized or modified within the watershed. Table 14, Stream Statistics of Sunday Creek, shows drainage area, flow, length, elevation and gradient of the main branches within the watershed.

Table 14: Stream Statistics of Sunday Creek

Stream Name	Flows Into	Avg. Flow (cfs)*	Length (miles)	Elev. (source)	Elev. (mouth)	Avg. Fall (ft./mile)	Drains (sq.miles)
Sunday Creek	Hocking River	140.4	27.2	960	648	11.5	139
Bailey Run	Sunday Creek	7.9	3.8	850	650	52.6	7.8
North Branch Bailey Run	Bailey Run	2.4	3.4	885	655	67.7	2.4
Greens Run	Sunday Creek	5.4	3	860	665	65	5.3
Taylor Run	Greens Run	2.7	3.2	885	675	65.6	2.7
Congress Run	Sunday Creek	3.2	3.3	830	670	48.5	3.2
West Branch	Sunday Creek	42.9	14	1000	675	23.2	42.5
Mud Fork	West Branch	7.4	4.8	838	675	34	7.3
Johnson Run	West Branch	4.2	3.5	830	698	27.5	4.2
Indian Run	West Branch	3.4	3.5	833	702	37.4	3.4
Pine Run	West Branch	4.4	6.6	1000	730	45	4.4
East Branch	Sunday Creek	33.4	15.5	1025	690	21.6	33.1
Bloody Run	East Branch	2.6	1	755	715	40	2.6
Cedar Run	East Branch	3.1	2.7	812	730	30.4	3.1
Congo Run	West Branch	7.9	6.3	970	764	32.7	7.8
Dotson Creek	Sunday Creek	7.9	6.6	980	710	41	7.8

*Calculated using a USGS best-fit equation for estimating selected streamflow statistics in Ohio (G.F. Koltun and M.T. Whitehead, U.S. Geological Survey).

Flow

There is currently one USGS gauge (03159246) station in the Sunday Creek Watershed located just below Millfield in Athens County. The gauge calculates the flow in cubic feet per second (cfs) on the mainstem of Sunday Creek for a drainage area of 126 square miles.

Table 15: Peak Stream Flows USGS 03159246 Sunday Creek below Millfield, OH.

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
2003	Feb. 23, 2003	9.10	1,880
2004	Sep. 18, 2004	24.48	4,440
2005	Jan. 06, 2005	22.93	3,690
2006	Mar. 13, 2006	18.76	1,970
2007	Oct. 28, 2006	18.78	1,980

Source: USGS

Specifically the Millfield gauge at Latitude 39°25'47", Longitude 82°06'04" is located at 665.23 feet above sea level. A second gauge was in operation near Glouster between 1952 and1981. Flow data below from the Millfield gauge looks at peak stream flows, annual mean flows and monthly mean flows from 2003 to2008. Refer to Section Two, Chapter One, for flow information of the long-term sites monitored in the Sunday Creek Watershed bi-annually.

Table 16: Annual Mean Flows (cfs) USGS 03159246 Sunday Creek below Millfield, OH.

Water Year	Discharge, cfs
2003	126.2
2004	259.7
2005	218.8
2006	102.7
2007	152.9
2008	189.9

Source: USGS

Table 17: Monthly Mean Discharge, cubic feet per second, 2002-2008

YEAR	Monthly mean in cfs (Calculation Period: 2002-10-01 -> 2008-09-30)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002										18.5	42.4	125.2
2003	127.3	239.4	238.5	111.8	236.3	157.5	39.5	80.0	106.2	65.3	133.0	165.9
2004	339.3	315.8	211.1	397.9	562.2	230.1	43.9	38.1	628.3	74.8	204.6	338.6
2005	834.6	213.6	347.2	427.1	99.4	27.2	16.5	19.3	15.4	24.5	91.6	63.5
2006	252.9	106.9	230.6	255.0	51.1	34.9	56.7	13.0	53.4	369.5	135.1	96.1
2007	388.6	242.6	332.6	203.1	31.9	10.2	9.08	8.60	8.15	13.4	39.8	206.6
2008	150.5	399.3	800.3	181.9	273.3	129.4	66.1	12.4	5.63			
Mean of monthly Discharge	349	253	360	263	209	98	39	29	136	94	108	166

Source: USGS

100 Year Floodplain

Flood prone areas in the Sunday Creek Watershed are shown on map 12. Some human activities can contribute to, or even exacerbate, the degree of flooding and subsequent flood damage. Loss of streamside vegetation, an increase of impervious surfaces (for example; roads and parking lots), and the channeling of water are just a few of the things that contribute to flooding. Each year, floods damage homes, businesses, farmland, water treatment facilities, and roadways.

During the flood of March 1997, 18 southeastern Ohio counties (including Athens and Perry) were declared federal disaster areas. According to USGS the preliminary cost of the flood damage was estimated to be $180 million for the region. Following a flood in 1998, the village of Corning was declared a federal disaster area. Fifty-eight structures were damaged in the flood. As a result, the village currently has a budget of 1.3 million dollars to work on Hazard Mitigation Projects. In addition, the villages of Corning and Trimble have begun the mitigation planning process as part of the Appalachian Flood Risk Reduction Initiative (AFRRI) project co-sponsored by ODNR, FEMA, and Ohio Department of Development (ODOD).

Sinuosity

The majority of Sunday Creek Watershed has not been subjected to hydromodification, which has allowed the watershed as a whole to maintain a natural channel with appropriate sinuosity. Hydromodification is known as the alteration of the natural flow of water through a landscape, and often takes the form of channel modification or channelization. However, hydromodification has occurred in small segments along the mainstem of Sunday Creek to make way for State Route 13 and the railroad. These transportation projects are located within the floodplain adjacent to Sunday Creek from its confluence with the Hocking River near Chauncey to the headwaters north of West Rendville. Channel sinuosity is the ratio of stream channel length to valley distance. Table 18, Physical Attributes of Streams, lists all sites by subwatershed, which have been subjected to hydromodification, therefore affecting sinuosity. Concerning the main channels of Sunday Creek, measurements taken from aerial photos using Arc View GIS indicate average sinuosity ratios of 1.3-1.4. Tributaries throughout the watershed have an average sinuosity ratio of 1.1. These sinuosity ratios are consistent to other streams of similar size and land use in the Western Allegheny Plateau Ecoregion. (Bob Mulligan, ODNR-DSWC)

Table 18: Physical Attributes of Streams

Subwatershed	Upper Sunday Creek 05030204-070-010	East Branch 05030204-070-020	West Branch 05030204-070-030	Lower Sunday Creek 05030204-070-040
Entrenchment Floodplain Connectivity	Segments along SR-13 and Railroad	Good Connectivity	Pine Run, West Branch Headwaters, West Branch	RM 0.0-1.75 in Chauncey, Segments along SR-13 and Railroad
Eroding Locations	Corning Gob Pile Reclaimed at RM 8.3	Livestock Access at RM 8.3	Gob Piles: Pine Run-07 at RM 0.7, WBHW-99 at RM 14.6 (to be reclaimed spring 2010)	Downstream of Truetown Discharge at RM 6.4
Riparian Buffer (100') **26% of the stream has poor landuse/ landcover** **74% of the stream has good landuse/ landcover** **(Refer to Map 11)**	Poor QHEI Scores: Sunday Creek (RM 26.6, 26, 24) Dotson Creek (RM 0.3)	Poor QHEI Scores: East Branch (RM 12.6,11.2, 9.9) San Toy (RM 0.7)	Poor QHEI Scores: West Branch (RM 0.1, 10.3) Pine Run (RM 2.4) Congo Run (RM 0.1, 1) Mud Fork (RM 3.1, 0.2)	Poor QHEI Scores: Sunday Creek (RM 14.6, 10.2, 7.3, 4.2) Congress Run (RM 2.2) Little Green's Run (RM 2.1, 0.7) Green's Run (RM1.7) Carr Bailey (RM 0.7) Big Bailey (RM 0.3) Middle and West Bailey (RM 0.5)
Livestock Access	None	East Branch at RM 8.3	At West Branch (RM 10.73) confluence with Congo Run	Sunday Creek at RM 5.3 near confluence with Jackson Run, Sunday Creek at RM 7.8
Dams	None	Tom Jenkins Dam-Burr Oak	None	None
Permanent Protection Name and Acres	USFS- 3,570	USFS- 5, 884 Burr Oak- 3, 270	USFS- 1, 461 Trimble Twp. Community Forest-1,200 Trimble Wildlife Area- 2,100 Sunday Creek Wildlife Area-4,600	USFS-5,626
Channelization and Hydromodification	Segments along SR-13 and Railroad	Upstream and Downstream of Burr Oak on East Branch	None	Segments along SR-13 and Railroad
Riparian Levees	None	None	None	None

Permitted Discharges

There are only two minor permitted dischargers in the watershed: Buckingham No. 2 mine (three outfalls) and the Trimble Township Wastewater Treatment Plant (one outfall). The permit for these facilities requires a pH range between 6.5 to 9 and a wasteload allocation would only be required if the pH dropped below 6.5. Information is from the 2005 TMDL report for the Sunday Creek Watershed.

Entrenchment and Floodplain Connectivity

Entrenchment is a condition in which a stream begins to down-cut and contain water flow within the channel with little or no out-of-channel flooding. A stream must have adequate access to its floodplain in order for it to effectively transport and remove sediment loads from the aquatic system. When a stream floods and has access to its floodplain, it is able to deposit sediment into the floodplain. This effectively reduces the amount of sediment found in the normal stream channel. Entrenched streams typically do not have access to a sufficient floodplain to facilitate this process.

Watersheds that have been subjected to increased urbanization and development commonly result in entrenched streams. The large amount of impervious surfaces such as parking lots and roofs increase the peak storm water runoff within a watershed. Entrenchment is often an early indicator of a stream's response to this intense water discharge. The Sunday Creek Watershed has not experienced large-scale urban or industrial development, or suburban sprawl. As a result, severe entrenchment does not appear to be a significant problem at the current time.

However, Sunday Creek has experienced coal mining within 40% of is land area thus leaving several watersheds with entrenchment issues including but not limited to Pine Run, West Branch Headwaters and West Branch of Sunday Creek. These entrenched areas are problematic but not the limiting factor when discussing water quality impairments.

In general, landowners that own land or reside near floodplain areas comment frequently that Sunday Creek is able to flow freely out of its banks when large precipitation events occur. In general, floodplains are subjected to flood events on average 3 to 4 times per year. There are however, a few locations where the filling of the floodplain has occurred, preventing the stream from accessing the

floodplain. Refer to table 18 for the location by subwatershed where the stream does not have access to the floodplain.

Lakes and Reservoirs

Sunday Creek Watershed has one major lake/ reservoir in its boundaries, a well-known regional recreational destination called Burr Oak Lake. This lake, residing in the East Branch Subwatershed, was created in 1950 by the construction of the Tom Jenkins Dam in Morgan County. Surrounding areas were dedicated as a state park in 1952. The lake is divided between two townships, with 1.5 miles of the lake residing in Homer Township to the south and about 4 miles of the lake resting in Union Township to the north—both in Morgan County.

After the ODNR purchased the land, the U.S. Army Corps of Engineers constructed the dam. Burr Oak Lake consists of 687 acres of water, and 17.8 miles of shoreline. Burr Oak Lake was built as a multiple-use reservoir for flood control, water supply, and recreation. This lake maintains good water quality and is monitored often due to it being used for recreation and a water supply source. Today many people enjoy this area for boating and fishing; the lake is known for good populations of largemouth bass, bluegill, channel catfish, white crappie, and saugeye, all of which indicate good water quality. This information and more is available on the ODNR Division of Wildlife website.

Groundwater

According to the groundwater resources map from ODNR-Division of Water, the Perry County portion of the Sunday Creek Watershed lies within an area where well yields seldom exceed 3 gallons of water per minute. Well depths vary from 100 to 400 feet, and are usually developed in sandstone, shale, mudstone and limestone sequences of the upper Allegheny and Conemaugh Groups. The two main aquifer types in the Perry County portion of the watershed are sandstone and shale (Spahr, 1996). Groundwater resources are limited for the watershed due to low-yielding aquifers. Therefore, surface water is the primary drinking water supply.

The portion of the watershed located in Athens County has well yields of less than 2 gallons per minute. Alternating layers of shale and thin sandstone yield less than 1 gallon per minute at depths of less than 125 feet. Deeper drilling is

not recommended, and dry wells are common. Cisterns, spring horizons, and properly constructed dug wells may supplement a meager water supply. Aquifers in this area are interbedded sandstone and shale (Schmidt, 1985).

SWAP

The Source Water Assessment and Protection Plan (SWAP) for Ohio started after the Safe Drinking Water Act Amendments of 1996 were passed at the national level. According to the OEPA this program is intended to identify drinking water protection areas and provide information for the best methods of avoiding contamination to these public water sources. The ultimate goal of the program is to provide long-term availability of safe and abundant drinking water for citizens of Ohio. These reports only look at public drinking water sources and do not evaluate residential wells or cisterns. OEPA's definition for a public water system is " a facility that provides drinking water to 15 or more service connections or that regularly serves at least 25 people a day for at least 60 days a year, whether from an underground well or spring, or from an above ground stream, lake, or reservoir. The Sunday Creek Watershed does have many residents that have their own drinking water sources (i.e. wells or cisterns), however this section will address those who are part of the public drinking water systems.

The section of Morgan County that lies within the Sunday Creek Watershed does not have a public water system. However, when looking at the entire county's source water area protection plan, most of the county's water supply is from ground water and is labeled to be at high susceptibility to contamination.

The two counties that have public water systems in the Sunday Creek Watershed are Perry and Athens Counties. All sections of Perry County that lie in the watershed purchase surface water from Burr Oak Regional Water District. This includes the Villages of Corning and Hemlock. Most of the public water systems in Athens County that lie in the watershed also purchase surface water from Burr Oak Regional Water District (Villages of Glouster, Jacksonville, and Trimble) except the Village of Chauncey. The Village of Chauncey get their water from a groundwater source.

A closer look at the Drinking Water Source Assessment Report by OEPA for Burr Oak Regional Water District was compiled in August of 2002. The source for this water system is surface water taken from the East Branch of Sunday Creek, and

the system's design capacity is about 2.0 million gallons per day. The average daily production however is only about 1.4 millions gallons. The report concluded that the current threats to the surface water source are: individual home wastewater treatment systems, permitted discharges, oil and gas wells and agricultural activities.

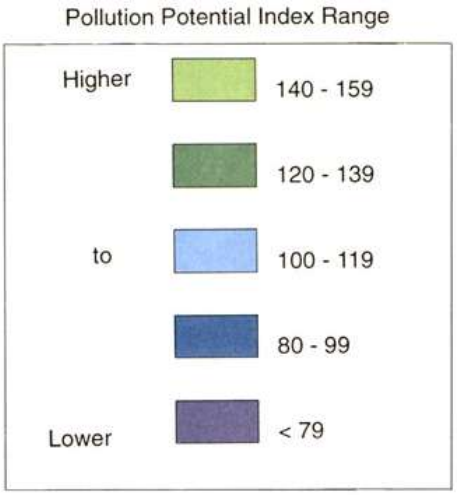
Protection strategies that OEPA outlined in their 2002 report include: 1) proper maintenance and operation of all home sewage and wastewater treatment plants, 2) reducing nutrient and soil runoff from agricultural areas, 3) eliminating hydrocarbon and brine discharges from the hundreds of oil and gas wells and transmission systems and 4) coordinating with local emergency response agencies. OEPA does advise caution in these inventories stating that they locate potential contaminant sources and not actual sources of contamination. These surface water sources all have a high susceptibility to contamination.

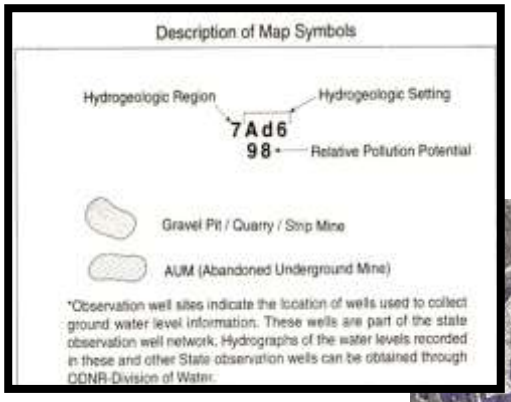
The SWAP report by OEPA for the Village of Chauncey was completed in March of 2003. The Village of Chauncey is a community public water system that operates two wells that pump about 234,000 gallons of water a day from a sand and gravel aquifer within the Hocking River buried valley aquifer. This aquifer is 6-18 feet below the ground surface. The wellfield is located near Sunday Creek's confluence with the Hocking River. This system serves about 1,230 people in Chauncey.

The inventory completed by the OEPA to find potential sources of contamination in 2002 found seventeen potential sources that were identified within the protection area. This shows only the sources that could be a threat to the drinking water source not those that actually are. The susceptibility for contamination is high due to the lack of a protective layer of clay overlying the aquifer, the shallow depth of the aquifer, and the presence of significant potential contaminant sources in the protection area.

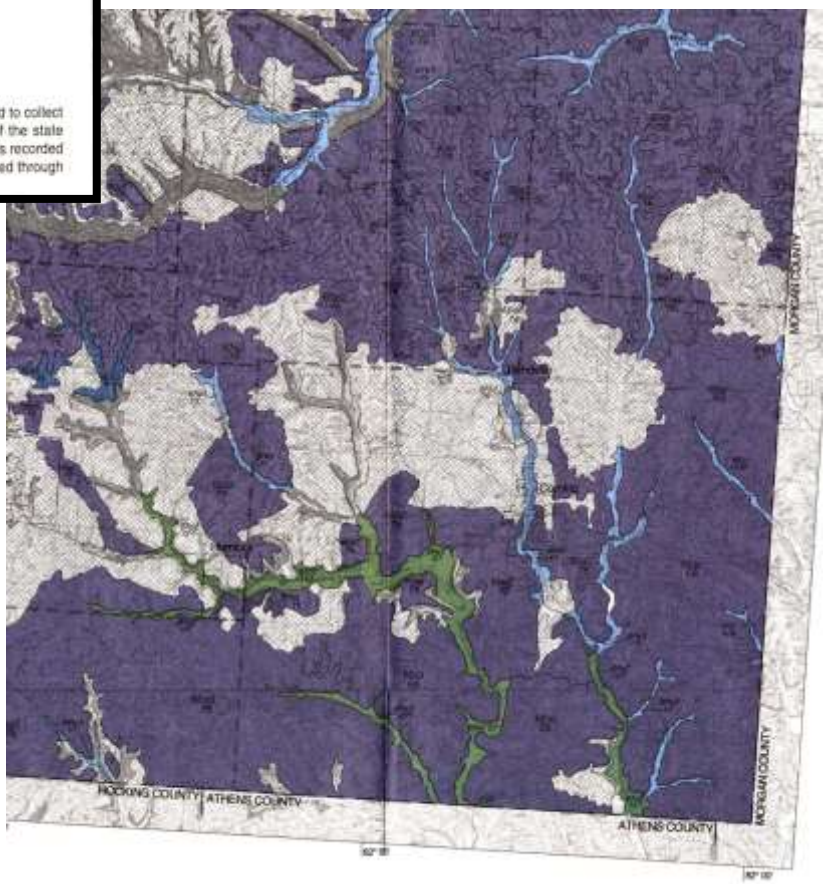
Ground Water Pollution Potential Reports (DRASTIC Maps):

The ODNR Division of Water Resources is currently putting together maps and reports for each county to show their sensitivity of groundwater. These reports have been completed for both Perry and Morgan counties, but Athens County is not available. Perry County had their ground water pollution potential report completed in 1997. The DRASTIC system is to evaluate an area's vulnerability to contamination and the map is shown with a pollution potential index. The higher the number in the index that greater the area is susceptible to contamination.

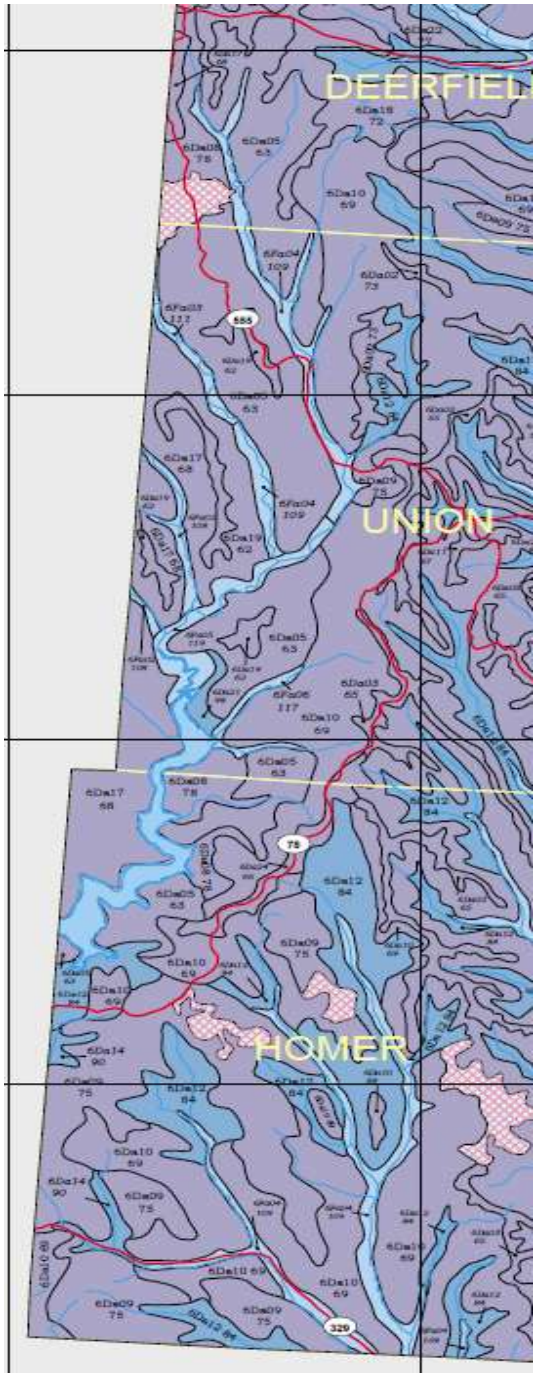




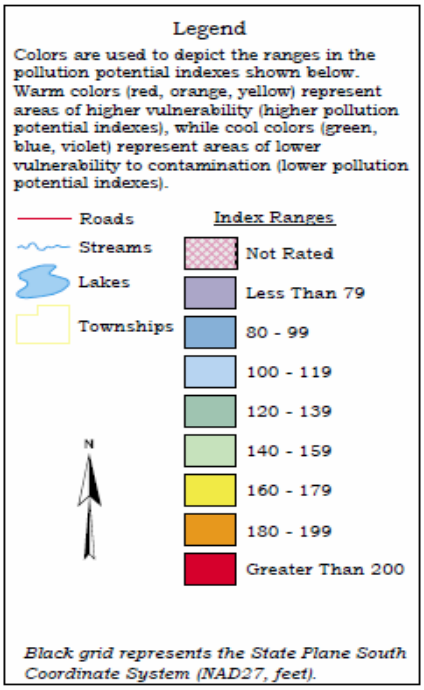
Therefore, these numeric values make comparing different areas possible. A major portion of Perry County in the Sunday Creek Watershed has lower vulnerability to contamination with a score of below 79 (represented by the color purple). There were however some areas following the upper portions of Sunday Creek (south of Corning and following the West Branch) that were in the highest category of vulnerability to



contamination (140-159), represented by a light green color. Although the pollution potential of strip and abandoned underground mined areas were not evaluated, they were delineated as stated in the completed report. Only the most prominent mined areas are shown on the map. There is much uncertainty of evaluating the pollution potential on groundwater in mined areas. See section of map below that represents the portion of Perry County in the Sunday Creek Watershed.



Morgan County's report was completed in 2001. As seen in map to the left, most of Morgan County in the Sunday Creek Watershed is in the less than 79 index rating(the lowest pollution potential). However, some areas following the East Branch of Sunday Creek are shown to be a little higher (represented by a light blue color, in the 100-119 range). There are no abandoned deep mined areas shown in this portion of the watershed. Refer to the legend on the right for a description of map colors.



Section II: Watershed Action Plans for 14 digit HUC Subwatersheds

Introduction

Hydrological Unit Codes (HUCs)

For management purposes, watersheds are broken down into smaller areas called Hydrological Unit Codes (HUCs). The Sunday Creek Watershed is represented by four 14-digit HUCs. For a description and size of the four 14-digit HUCs refer to table 19: Subwatersheds by 14 Digit Hydrological Unit Codes (HUC) and map 5: Subwatersheds.

In this section of the plan, each 14 digit HUC subwatershed will be evaluated. Information for this section is based on the previous Watershed Action Plan, Sunday Creek's AMDAT, TMDL, and other more recent reports. The inventory and description will describe previous work that the Sunday Creek Watershed Group and partners accomplished within the last ten years along with information about that particular subwatershed. Each subwatershed will have an 'action plan' where the impairments are listed and the restoration and protection goals are assigned for future progress. The implementation portion is a realistic look at prioritizing these goals for future projects towards which the group can work. Activities developed in this plan are focused on reaching the collective goal of obtaining clean water.

Table 19: Subwatersheds by 14 Digit Hydrological Unit Codes (HUC)

14 Digit HUC's	Description	Acres	Square Miles
05030204-070-010	Upper Sunday Creek	15,434.2	24.1
05030204-070-020	East Branch Sunday Creek	21,188	33.1
05030204-070-030	West Branch Sunday Creek	27,189.5	42.5
05030204-070-040	Lower Sunday Creek	24,960.6	39.0
	TOTALS	**88,772**	**138.7**

Chapter I: Water Quality Standards and Impairments

Historic Aquatic Use Designations for Sunday Creek

In order to be in compliance with the Clean Water Act, the state of Ohio is required to establish water quality standards for all surface waters in the state. Water quality standards represent a level of water quality that will support the goal of "fishable/swimmable" waters. The goals of the Clean Water Act are to protect, maintain and improve the quality of the nation's surface waters. As a result of the Clean Water Act, a stream has a designation associated with its aquatic life use. The categories of aquatic life use include Exceptional Warmwater Habitat, Warmwater Habitat, Modified Warm-water Habitat, Limited Resource Water, and Limited Warmwater Habitat. Some streams that do not meet their aquatic life use but have the potential to meet this category are considered non-attaining. Others are considered permanently impacted, so may have limited present use, but no hope for higher use. Those waterways are listed as attaining a limited use. These designations describe the existing or potential uses of water bodies (Ohio EPA, 2001).

Historic aquatic life use designations for Sunday Creek Watershed were established from a limited number of data samples. Available information from the Ohio EPA 305(b) report and the Ohio EPA Non-point Source Assessment Hydrologic Unit Water Quality report contained the first attainment classifications.

According to the Ohio Nonpoint Source Assessment Hydrologic Unit Water Quality report in 1997, 14 sections of Sunday Creek were identified as follows:

1) The mainstem of the Sunday Creek is thirteen miles long and flows into the Hocking River. This stream has been designated as "Limited Resource Water", which means that the stream has been irretrievably damaged to the extent that no appreciable aquatic life can be supported. The sources of known or suspected impact are non-point sources such as surface coal mining, urban runoff, subsurface coal mining, oil and gas production, and lack of on-site wastewater treatment systems. The known cause of impairment is the low pH of the stream, caused by acid mine drainage.
2) The West Branch of Sunday Creek is fourteen miles long and intersects the mainstem in Glouster. It has been assessed as an attaining use stream.

Known or suspected causes of impairment are storm sewers, surface and subsurface coal mining, and on-site wastewater treatment. This tributary has been designated as a Limited Warmwater Habitat.

3) Big Bailey Run, located in the southwestern portion of the watershed, is approximately four miles long and is impaired by non-point source pollution. Surface and subsurface coal mining are the main detrimental factors contributing to this stream. It has not yet been designated in an aquatic use category.
4) Greens Run is impacted by non-point source pollution as well. The same agents that impair many of the streams in the watershed impact this three mile tributary. The aquatic life designation for this stream is Warmwater Habitat, as it is capable of supporting some forms of life at this time.
5) Mud Fork is five miles in length and is a tributary to the mainstem of Sunday Creek. Sources of known or suspected impact include surface coal mining, subsurface coal mining and on-site wastewater treatment. The aquatic life designation is Warmwater Habitat.
6) Pine Run is seven miles long and is a tributary to the headwaters of West Branch of Sunday Creek. Sources of known or suspected impact include coal mining, surface coal mining, and subsurface coal mining. The aquatic life designation is Warmwater Habitat.
7) Surface coal mining has impacted Johnson Run, which is a four- mile long tributary of the Sunday Creek and is listed as Warmwater Habitat.
8) The East Branch Sunday Creek is the only stream in the entire watershed that received the designation of Exceptional Warmwater Habitat. This tributary is sixteen miles long, and is the main source of drinking water for much of the watershed. The main sources of impairment are crop production and use of the stream and riparian zone for pasturelands and agricultural uses. These uses cause erosion of the stream banks and sedimentation to build up in the streambeds.
9) Indian Run (4 miles long), Congress Run (3miles long), Little Greens Run (3 miles long), Bloody Run (1mile long), Cedar Run (3 miles long), and Dotson Creek (7miles long) are all listed as Warmwater Habitat but have no information listed for stream assessment status

In summary, the Ohio Non-point Source Assessment report shows surface water resources vary from Exceptional Warmwater Habitat for aquatic life to Limited Resource Water, with most streams somewhere between these endpoints. In nearly all cases, the lower use category is the result of mining.

Ohio Water Quality Standards: Designated Aquatic Life Uses

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the narrative goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in rivers and streams, the aquatic life use criteria frequently control the resulting protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting aquatic life generally results in water quality suitable for all uses.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such, the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that, varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

Five Aquatic Life Uses Currently Defined in the Ohio WQS :

1. ***Warmwater Habitat (WWH)*** – this designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; this use represents the principal restoration target for the majority of water resource management efforts in Ohio. Biological criteria are stratified across five ecoregions for the WWH use designation.

2. ***Exceptional Warmwater Habitat (EWH)*** - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.* Biological criteria for EWH apply uniformly across the state.

3. ***Coldwater Habitat (CWH)*** - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall. No specific biological criteria have been developed for the CWH use although the WWH biocriteria are viewed as attainable for CWH designated streams.

4. ***Modified Warmwater Habitat (MWH)*** - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned and permitted by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat. Biological criteria for MWH were derived from a separate set of habitat modified reference sites and are stratified across five ecoregions and three major modification types: channelization, run-of-river impoundments, and extensive sedimentation due to non-acidic mine drainage.

5. ***Limited Resource Water (LRW)*** - this use applies to small streams (usually <3 $mi.^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways. No formal biological criteria have been established for the LRW use designation.

Ohio Water Quality Standards: Non-Aquatic Life Uses

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. Criterion for designating the PCR use is simply having a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.*, fecal coliform bacteria, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Water supply uses include Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). Public Water Supplies are simply defined as segments within 500 yards of a potable water supply or food processing industry intake. The Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) use designations generally apply to all waters unless it can be clearly shown that they are not applicable. An example of this would be an urban area where livestock watering or pasturing does not take place, thus the AWS use would not apply. Chemical criteria are specified in the Ohio WQS for each use and attainment status is based primarily on chemical-specific indicators. Human health concerns are additionally addressed with fish tissue data, but any consumption advisories are issued by the Ohio Environmental Protection Agency and are detailed in other documents (Ohio EPA, Boucher 2002).

According to the Ohio EPA 305(b) (1978-1997) report for rivers and streams, two sections of Sunday Creek were identified. Section OH26_8 Sunday Creek (West Branch Sunday Creek to Hocking River) aquatic life use is designated as "limited resource water". Section OH26_ 19.1 tributary to Sunday Creek river mile 25.45, aquatic life use is designated as "none". Sources of impairment are surface and subsurface mining. Causes of impairment are listed as high pH, habitat alterations, siltation, and flow alterations.

Aquatic Habitat

The Ohio EPA the aquatic uses of Ohio's waterways. Several structural indices are used to assess the health of the biological community and measure habitat quality. The indices used by the Ohio EPA are the Index of Biological Integrity (IBI), the Invertebrate Community Index (ICI) and the Qualitative Habitat Evaluation Index (QHEI). These biological indicators are features of the aquatic ecosystem that demonstrate the health and vitality of that ecosystem.

The Index of Biological Integrity (IBI) is a measure of fish species diversity and species populations. This index gives a score which indicates how much a stream habitat is affected by pollutants, and the types of fish present. Depending on the pollution tolerance of the species, the IBI indicates which species are likely to be found in the stream. The highest score attainable is 60, and higher scores indicate healthier streams (Ohio EPA, 2001). Scores ranging from 44-49 are considered Warmwater Habitat in the Western Alleghany Plateau (WAP) region of Ohio.

The Invertebrate Community Index (ICI) is based on measurements of macro-invertebrate communities living in a stream. Macro-invertebrate studies are important to assess because many insect taxa are known to be either pollution tolerant or intolerant. The presence of certain species indicates the general water quality of an area. This index gives helpful clues about the amount of pollution stressing the stream environment. Scores ranging from 36-45 are considered Warmwater Habitat in the WAP region of Ohio (Ohio EPA, 2001).

The Qualitative Habitat Evaluation Index (QHEI) is a qualitative evaluation of stream habitat. Physical features that affect fish and invertebrate communities are evaluated. Some of the features evaluated include; type of substrate, amount and type of in-stream cover, channel width, sinuosity, and erosion. QHEI scores of 60 or above are considered conducive to the establishment of warm water fauna.

Overview of Current and Historical Water Quality Inventory

Interpretation of Biological Sampling

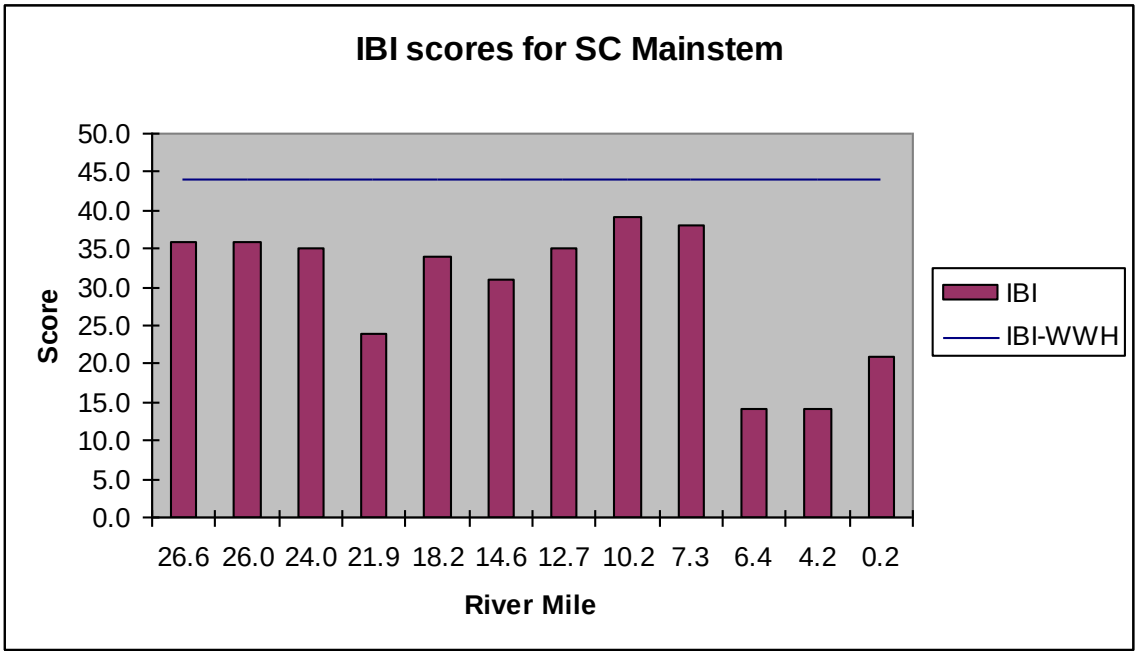
Biological monitoring of both fish and macroinvertebrates took place throughout the Sunday Creek Watershed in 2000 and 2001 and results were published in Sunday Creek's Total Maximum Daily Load (TMDL) report. Ohio EPA and Sunday Creek Watershed Volunteers conducted the biological survey.

The Index of Biological Integrity (IBI), scores for Sunday Creek ranged from 12 to 50, indicating low species diversity in the watershed due to pollution. The average scores for the mainstem, West Branch, and East Branch (29.8, 33.6 and 37 respectively) categorize the creek as having Modified Warmwater Habitat for the IBI parameter. The highest IBI score, 50, was measured at Congress Run (river mile 2.2). Both Pine Run (river mile 0.1) and a tributary of Dotson Creek (river mile 0.1) received the lowest score of 12. Pine Run is severely impacted from acid mine drainage and Dotson Creek received a low score simply because the creek was dry.

During sampling in July 2000 and during the TMDL study in the summer of 2001, a total of 43 species of fish were found in Sunday Creek. Samples collected from the mainstem had some of the highest species diversity; while Pine Run had the lowest species diversity. The number of fish found ranged from 2,194 at East Branch to 2 at Pine Run. Some of the more unusual species found were the Orangethroated Darter and the Stonecat Madtom. The Stonecat Madtom, found upstream of the Truetown acid mine drainage discharge in July 2000, is highly intolerant to pollution. A species list is shown in appendix two: Ohio EPA TMDL Fish Data, grouped by number and type of species found.

IBI scores for Sunday Creek ranged from 12 to 50. The highest IBI score (50) at a site occurred in Congress Run. The mouth of Pine Run received the lowest score (12) and is heavily impacted by AMD. Thirty-eight sites within the watershed scored within the MWH (25-43) range, nine scored within the LRW (12-24) range, twenty within the WWH range (44-49), and one within the EWH (> or = 50) range.

Figure 3: IBI Scores from TMDL Study



The Invertebrate Community Index (ICI) data for the Sunday Creek Watershed is listed in appendix two. As part of the TMDL, the Ohio EPA has provided further interpretation of this information.

The Izaak Walton League's Save Our Streams program was used to analyze the macro-invertebrate data collected in the Summer of 2001. Map 6, Izaak Walton Score shows the four categories used in the Izaak Walton League system (excellent, good, fair, and poor). Only one site received an excellent score; a site at the mouth of Big Bailey upstream of the acid mine drainage seep found near the St. Rt. 13 bridge north of Chauncey. The majority of the sites received a fair or poor classification.

The highest Qualitative Habitat Evaluation Index (QHEI) score (82.5) occurred on the West Branch of Sunday Creek (river mile 13.3). The lowest score was 28 on the East Branch (river mile 12.6) (See map 11). Figure 4 shows QHEI scores, for the mainstem of Sunday Creek, from the TMDL study.

Figure 4: QHEI Scores Along the Mainstem of Sunday Creek

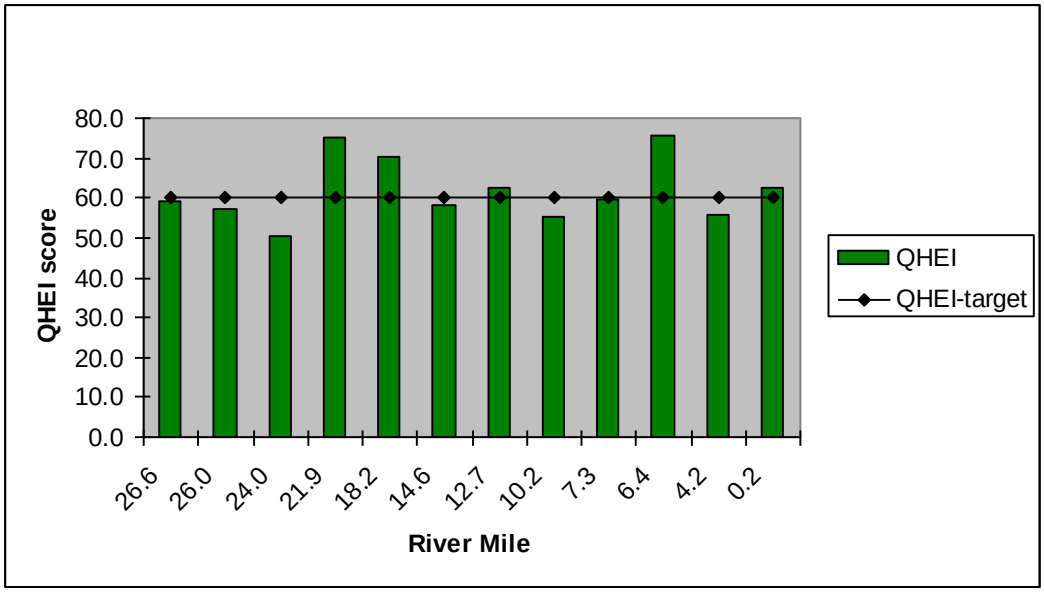


Table 20 shows IBI, ICI, and QHEI standards for headwaters/ wadeable streams and the percentage of the 68 sites that meet the aquatic life uses designation for IBI, the percentage of the 68 sites that meet Warmwater Habitat for QHEI data, and the percentage of 14 sites (long-term monitoring sites plus one site at the spillway from Burr Oak Dam on the East Branch of Sunday Creek) that meet aquatic life designation for ICI data.

Table 20: Biological Impacts Due to Pollutants

Parameter	Exceptional	Warmwater	Modified	Limited Resource	Measured score locations
IBI standard	>49	49-44	44-24	<24	
IBI - Fish	2%	29%	59%	10%	Map 7: IBI scores
ICI standard	>45	45-36	35-30	<30	
ICI- Bugs	7%	43%	0%	50%	
QHEI target		60			
QHEI - Habitat	NA	56%	NA	NA	Map 11: QHEI scores

Macroinvertebrate Sampling

Additional macroinvertebrate monitoring took place in 2002, 2003, and 2005-2009 at 14 sites, using the Macroinvertebrate Aggregated Index for Streams (MAIS) technique as part of the Non-Point Source project conducted by ILGARD at Ohio University. Four categories are assigned based on the MAIS scores: 0-7= very poor, 8-11= poor, 12-15=good, and 16-18= very good. Table 21 shows MAIS data from 2000-2009. Continued fish and macroinvertebrate sampling takes place annually and is included in Sunday Creek's annual sample plan on file at the Sunday Creek Office.

Table 21: MAIS Sampling Results from 2000-2009 in Sunday Creek Watershed

SITE	RM	2000-1	2002	2003	2005	2006	2007	2008	2009
SC RM 25.6	25.6				15	14			
SC 077								13	13
SC 079	24				12	10	10	14	12
SC 080	23.3				5	3	2	7	0
SC 076	21.9	2	1	2	11	5	5	9	2
SC 075	18.2	5	9	8	10	8	10	5	7
SC 073	7.3	10	11	11	11	10	10	10	12
SC 071	0.2	4	2	3	8	7	3	6	11
WBHW 50	?					11	10	11	8
WBHW 003	13.35				5	6	4	8	6
WB 004	13.3				1	2	2	5	5
WB 051	11.4				8	4	2	7	9
WB 003	10.3				8	4	3	4	8
WB 002	6.2				7	10	8	10	10
RH05								11	15

Sunday Creek AMDAT Plan

SCWG, with the help of interns and volunteers, gathered field data and compiled all information needed to complete this watershed management plan and the Acid Mine Drainage Abatement and Treatment (AMDAT) plan (completed in 2002). The AMDAT plan is solely dedicated to tracking sources of acid mine drainage, developing restoration activities, and estimating the cost of restoration. Field data collection occurred in two phases. Phase I field data collection consisted of measuring basic field parameters (pH, conductivity, acidity, alkalinity, nitrate, and temperature) and a physical land use site description

including gob piles, AMD seep discharges, subsidence features, trash dumps, septic discharges, erosion along banks, and presence of livestock (map 4). Phase II data collection consisted of collecting water flow measurements and water quality samples to be analyzed at a certified Ohio EPA laboratory. This information is used to generate acid, metals, and flow budgets to prioritize potential acid mine drainage project sites.

Thirteen long-term monitoring sites are established along the mainstem of Sunday Creek, West Branch, and the mouth of the Bailey's Subwatershed (map 4). These sites were monitored monthly for 1 year and sites were monitored quarterly for AMD water quality parameters and ammonia, nitrate, and phosphate annually. Currently, the long term sites are monitored twice a year, usually in high and low flow conditions. Refer to figures 5-8 for results from the last ten years of the mainstem long-term sampling sites in the Sunday Creek Watershed. Other short term sites are monitored monthly depending on the current sample plan that includes pre and post construction sampling. A yearly sample plan is created with the input of the SCWG staff and the technical advisory committee (TAC). The sample plan is on file at the Sunday Creek Office. All data, current and historic can be accessed online at www.watersheddata.com.

Figure 5: Sunday Creek Mainstem Long-Term Monitoring-Net Acidity

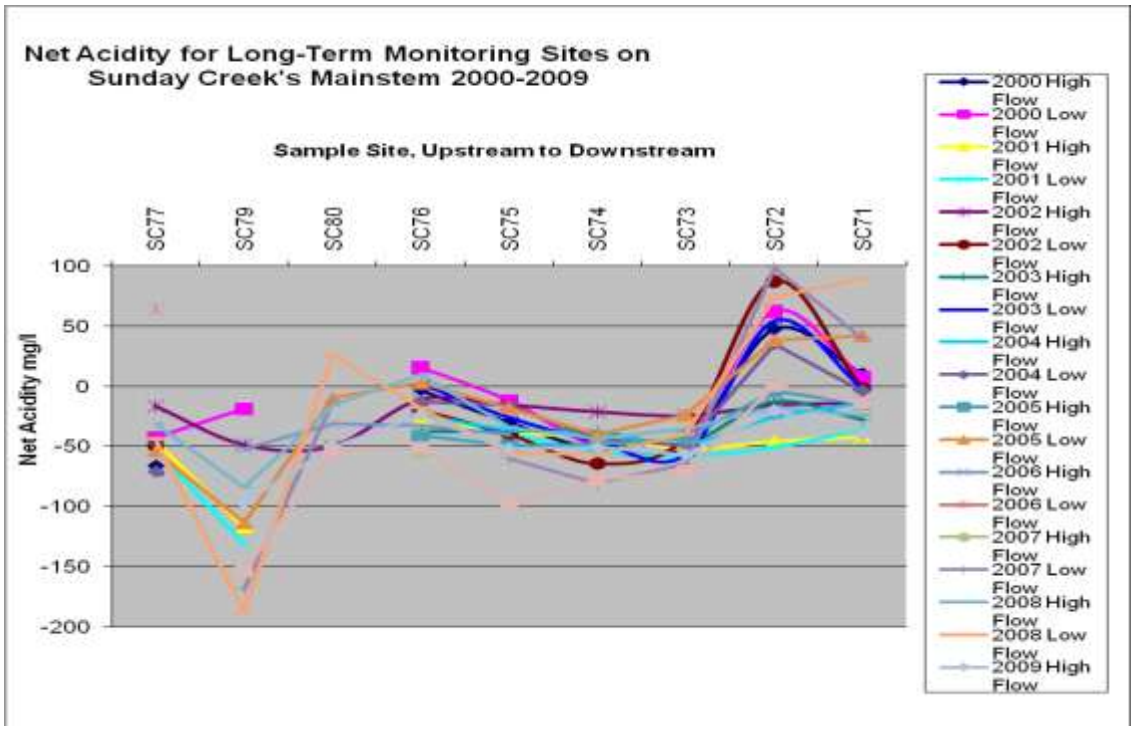


Figure 6: Sunday Creek Mainstem Long-Term Monitoring-pH

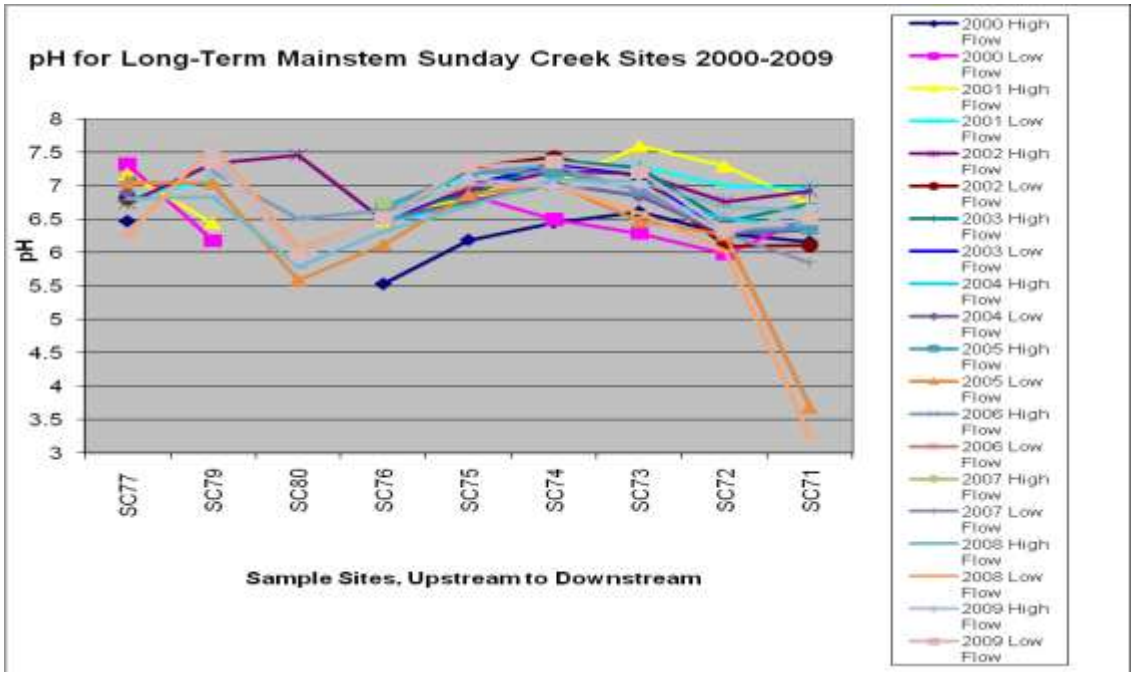


Figure 7: Sunday Creek Mainstem Long-Term Monitoring-Total Iron

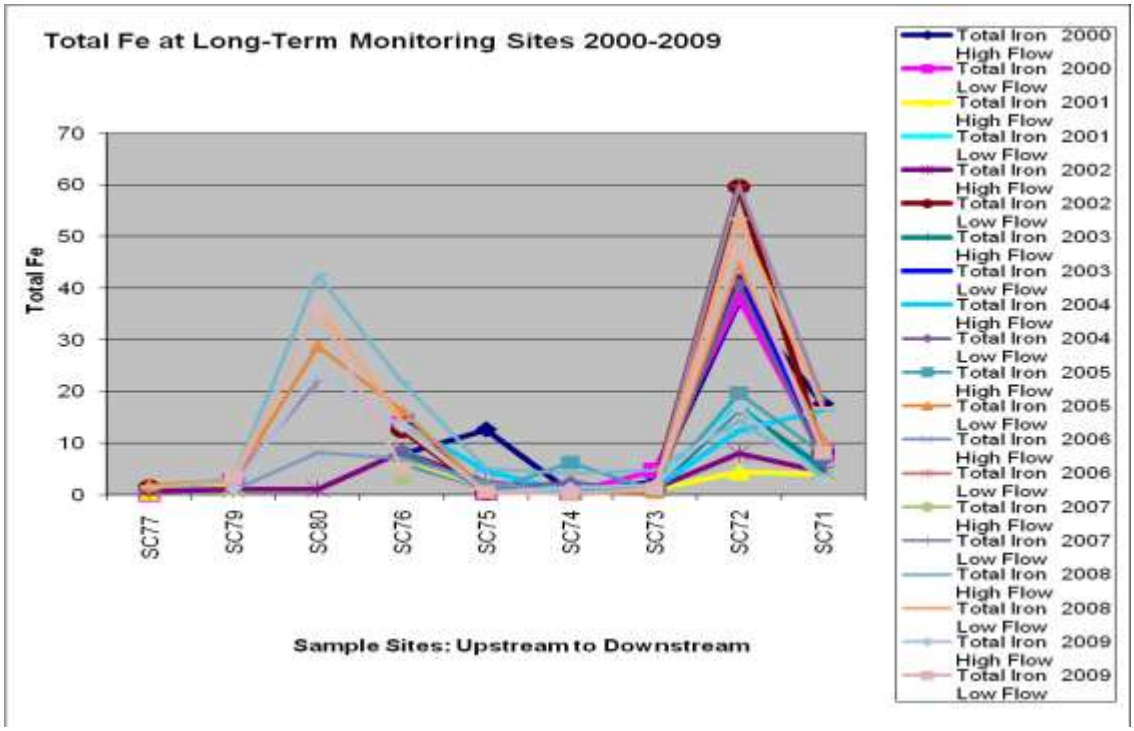
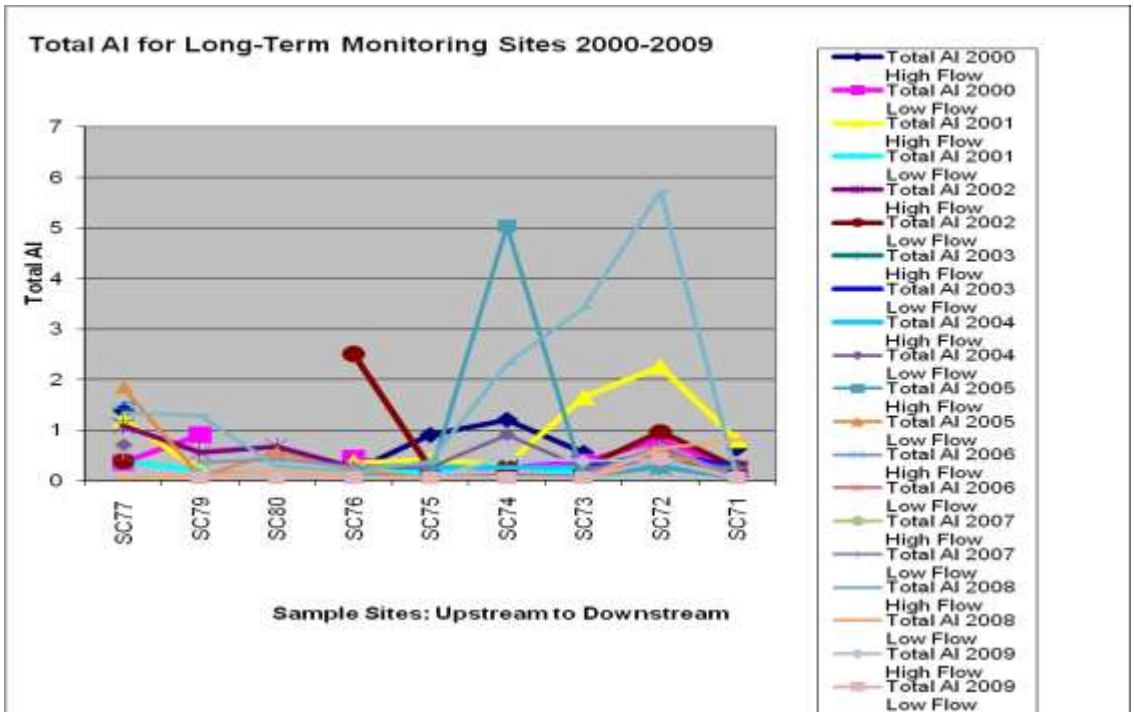


Figure 8: Sunday Creek Mainstem Long-Term Monitoring-Total Aluminum

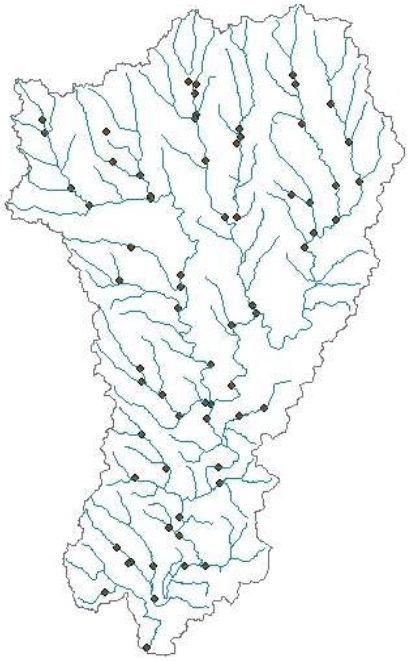


Sunday Creek TMDL Study

SCWG collaborated with the Ohio EPA on the Total Maximum Daily Loads (TMDL) project (summer 2001-2003) by collecting discharge measurements throughout the watershed. Ohio EPA collected ambient biology, stream habitat quality, water column chemistry, bacteriological data, and sediment chemistry. Ohio EPA also conducted water sampling at 68 sites for the Sunday Creek Watershed TMDL from July, 2002 - September, 2002 (map 7). Water column data included conductivity, alkalinity, sulfate, total iron (Fe), total manganese (Mn), total aluminum (Al), hardness, total dissolved solids (TDS), total suspended solids (TSS), ammonia, nitrate+nitrite, total phosphate, arsenic (As), cadmium (Cd), calcium (Ca), chromium (Cr), copper (Cu), lead (Pb), magnesium (Mg), mercury (Hg), nickel (Ni), potassium (K), selenium, sodium (Na), zinc (Zn), biological oxygen demand (BOD), total organic carbon (TOC), chemical oxygen demand (COD), chloride, total phosphorus, barium, strontium. Sediment samples were analyzed for the following metals: Al, As, Cd, Cr, Cu, Pb, Fe, Mn, Ni, Zn, and Hg. Other data collected includes: macro-invertebrates (resulting in

an ICI score), fish (resulting in an IBI score), habitat (resulting in a QHEI score), fecal coliform, and discharge.

Ohio Environmental Protection Agency (Ohio EPA) Total Maximum Daily Loads (TMDL) Monitoring Stations within the Sunday Creek Watershed 2001



The objectives of the TMDL process include the following:

1) To estimate pollutant loads from various sources within the basin
2) Define or characterize allowable loads to support the various beneficial uses
3) To allocate (or manage) pollutant loads among different sources through appropriate controls (e.g. NPDES permitting, storm water management, 319 proposals, NPS controls or other abatement strategies).

Components of the TMDL process supported by the Sunday Creek survey were primarily:

1) The identification of impaired waters
2) Verification (and re-designating if necessary) of beneficial use designations
3) Gathering ambient information that will factor into the waste load allocation
4) Ascribing causes and sources of beneficial use impairment.

These data are necessary precursors to the development of effective pollution control or abatement strategies (Boucher, 2002).

This study found that 26.1 miles (27.2%) of stream miles in the watershed could fully support existing and recommended aquatic life uses. Partial attainment was found in 30.3 miles (30.8%) and non-attainment was found in the remainder of the watershed, 41.38 miles (42%). The report concludes that the leading cause for aquatic life use impairments were associated mine drainage (AMD, sedimentation, and hydraulic disruption) which accounted for 67.2% of the impaired miles. Other impairments ranged from agriculture (livestock- 2%), natural features or phenomenons (10.6%), failing septic systems (6.7%), and impacts related to impoundment (Burr Oak Reservoir- 13.5%). TMDLs were developed for bacteria, pH, and habitat (sediment).

Summer AmeriCorps* VISTA data- 2001

As part of a Summer AmeriCorps* VISTA program, SCWG recruited and trained five individuals to collect water quality data. Parameters measured were pH, conductivity, temperature, acidity, alkalinity, nitrate, ammonia, turbidity, dissolved oxygen, macro-invertebrates, qualitative habitat evaluation index (QHEI), flow measurement, and a pebble count at 53 sites throughout the watershed. The watershed was divided into 22 sub-watersheds sections to group project areas. The sites targeted the mouths of major tributaries throughout the watershed on the mainstem, including upstream, downstream, and within small villages and towns (map 6). Data was collected once per site from July 18, 2001 – August 8, 2001.

Water Quality Targets and Standards

Water quality activities mentioned above provide information needed to interpret water quality impairments and possible solutions. To analyze data, available water quality standards were used and target values were set for parameters that did not have a standard. Targets were set using data from sites where IBI scores met Warmwater Habitat (WWH). Table 22 shows the following standards and targets used to determine impairments.

The Voinovich School of Leadership and Public Affairs at Ohio University annually publishes a document titled *Nonpoint Source (NPS) Monitoring Project for Acid Mine Drainage.* This document is an evaluation of water quality, biology, and acid mine drainage reclamation in four watersheds: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. It provides accurate records from recent data on Sunday Creek's current attainment levels and is another way to show the

public and agency personnel if load reductions (as outlined in each sub-watershed plan) are being achieved and if progress is being made toward meeting the watershed targets as listed below.

Table 22: Ohio EPA Standards, Benchmarks Established by Outside Resources, SCWG Targets

Parameter	Ohio EPA standard	Benchmark	Watershed Group target
Fecal coliform	2000 #/100ml‡		
PH	6.5-7.5*		
Dissolved oxygen	4.0 mg/l*		
IBI		44-50§	
ICI		36-46§	
QHEI		60§	
Conductivity			571 uS/cm £
Alkalinity		20 mg/l☼	
Total dissolved solids	1500 mg/l*		280 mg/l £
Ammonia	2.2 mg/l*		
Iron			1.0 mg/l £
Manganese			0.5 mg/l £
Aluminum			0.3 mg/l £
Sulfate			80 mg/l £
Net alkalinity			90 mg/l £

‡ Ohio EPA water quality standard from primary contact

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone, in stream aquatic life use

☼ Benchmark set by the Raccoon Creek Watershed Ohio EPA TMDL study

£ Target set by the Sunday Creek Watershed based on current water quality data sites that meet WWH limits for IBI scores

§ Ohio EPA benchmarks set for individual parameters to meet Warmwater Habitat aquatic life use designation

Source: TMDL Study

Ohio EPA, as part of the TMDL study, collected sediment data at eleven sites throughout the Sunday Creek Watershed. There are currently no Ohio EPA standards for sediments, however two sources have set benchmarks for certain sediment parameters. The state of New York has established low and severe effect levels. The following is a compilation of those standards, as well as Ohio EPA thresholds for iron and aluminum. Table 23 shows sediment benchmarks from two different sources.

Table 23: Benchmark Levels for Sediment Data

Parameter	Lowest effect level (ppm)	Severe effect level (ppm)
Arsenic	6.0	33.0
Cadmium	0.6	9.0
Chromium	26.0	110.0
Copper	16.0	110.0
Iron (%)	2.0	4.0
Lead	31.0	110.0
Manganese	460.0	1100.0
Mercury	0.2	1.3
Nickel	16.0	50.0
Zinc	120.0	270.0
TOC %	1.0	10.0
Total Phosphate	600.0	2000.0
Iron	29,000.0 mg/kg #	57,000.0 mg/kg #
Aluminum	33,000.0 mg/kg #	100,000.0 mg/kg #

#- Based on Ohio EPA STORET Database compiled by F.R. Smith (OU Masters Thesis 1993).

Source: *NYDEC, 1999*

Water Quality Impairments

There are a number of sites in the watershed that are impacted by pollutants which are discussed in the following subwatershed sections. Impairments of water quality within the watershed are summarized in table 24.

Table 24: Historic and Current Impairment Causes and Sources

Causes	Sources	Adverse impacts
pH (acidity)	Mine drainage	Acidic water will adversely affect biological processes. Extreme low pH will kill fish or inhibit the growth of intolerant species of fish. Acidic conditions also cause the release of toxic metals into the water column that were adsorbed to the sediments.
Toxic substances suspended and dissolved (heavy metals)	Mine drainage	Heavy metals such as arsenic, lead, nickel, chromium, manganese, zinc, copper, and iron enter surface water from acid mine drainage sources. These metals settle out into and become attached to the sediment causing toxic sediments to accumulate downstream of acid mine drainage discharge points. Principal concern in surface water is entry into the food chain, bioaccumulation, toxic effects on aquatic organisms, other wildlife and microorganisms, and degradation of water supplies.
Pathogens (Fecal coliform)	Human/ animal excreta, waste-water treatment plant	The principal concern in both surface and ground waters is the potential degradation of public water supply sources. Pathogens reaching a lake or other surface water body may limit primary contact recreation, such as swimming.
Litter and other debris	Illegal dumping of solid waste, Litter	Litter in a creek can clog fish spawning areas; stress aquatic organisms; reduce water clarity; impair recreational uses of the water body, such as swimming, fishing, and boating.
Turbidity, erosion, and total dissolved solids	Lack of riparian corridor, agricultural	Habitat for fish eggs and macroinvertebrates is destroyed. Sediments can choke filter feeders, and clog the gills of fish, thus reducing their ability to feed and decreasing their resistance to disease.

The watershed impairment issues outlined below are discussed in the following chapters per subwatershed, which include: acid mine drainage, improperly treated wastewater, illegal trash dumping, urban run-off, soil loss, sedimentation, riparian habitat, and water quality impacts from flooding.

Issue: Acid Mine Drainage

Gob pile in headwaters of West Branch of Sunday Creek

AMD source in Pine Run tributary to West Branch

Problem Statement

The Sunday Creek Watershed has excessive levels of acidity and metals such as iron, aluminum, manganese, acidity, and low pH from historic coal mining practices.

Description of AMD

Acid Mine Drainage (AMD) is polluted water flowing from, or caused by, deep mining, surface mining, or left over coal refuse piles (commonly referred to as gob piles). This drainage is usually orange in color and may be acidic or alkaline with high levels of dissolved metals. Contaminated AMD can lower water quality and impair aquatic life as noted in Section II -Water Quality Inventory. It is most often characterized by one or more of the following five components:

- Low pH
- High acidity
- High metal concentrations
- Excessive suspended solids
- Excessive siltation

Chemical Production of AMD

Pyrite, an iron sulfide mineral, is frequently found in coal mine refuse piles and underground coal mines. When water and air come in contact with acidic material such as pyrite, there is a chemical reaction. It produces iron hydroxide

and sulfuric acid, which contaminates surface and sub-surface waters. This contamination is known as acid mine drainage (AMD).

> pyrite (in coal) + oxygen + water = iron hydroxide + sulfuric acid + aluminum + manganese + sulfate = Acid Mine Drainage

Where Does AMD Come From?

- Surface mining – past unregulated strip mining
- Deep mining –series of underground tunnels
- Bore holes – a hole drilled to relieve water pressure in deep mines
- Refuse piles – unused waste coal left in piles

Acid mine drainage (AMD) often occurs down-dip within the underground coal mines. AMD forms in the void space where the coal was mined long ago. In the abandoned coal mines, there are coal pillars supporting the roof of the mine and waste coal that was left behind. This coal contains pyrite that creates sulfuric acid once exposed to air and water. Air enters the mine due to the void space left during mining and through fractures in the overburden. Water also enters the mine through fractures and subsidence features. Subsidence features form when the 'rooms' of a coal mine collapse leaving moderate to large depressions in the earth. Rainwater and surface stream water funnels down through these holes and collects in the mines with air and water for the AMD reaction to occur. Then, the AMD drains down-dip through the mine until it reaches an old portal, or an opening to the mine, and then drains into streams. In some cases, the portals to the mines were closed off and the mine water collects until the water pressure forces water up to the surface where the overlying rock is weak or very thin. This mine water then drains to a nearby stream.

Effects of AMD

Sulfuric acid in streams is a problem because it can corrode metal pipes and structures, break down concrete, and kill or stunt the growth of plants and other aquatic life-forms. Acid waters can also break down compounds containing iron, sulfur, manganese, and aluminum found in nearby rock or earthen waste piles. Often, rock found near coal seams contains trace amounts of these elements. These metals can be dissolved from the rocks through exposure to acid water and be washed into streams as sediment. Called flocculates, these sediments eventually precipitate out and constitute a large proportion of downstream

sedimentation. Many metals can be toxic to fish and other aquatic life when found in high concentrations. "Iron toxicity is in the range of 50 mg/l. The major iron problems occur from the precipitation of iron; the deposition of iron hydroxide on the gills of aquatic animals can inhibit respiration and heavy precipitation can smother fish eggs." (Ohio EPA, 1979)

Indicators

- Little or no evidence of aquatic life -fish, macro-invertebrates, amphibians
- High levels of metals found in the sediments in the creek
- High concentrations of sulfate, iron, aluminum, manganese, acidity
- Low: pH, dissolved oxygen
- Stream bottom coating and/or stream discoloration
    - Orange: evidence of iron
    - White/Gray: evidence of aluminum
    - Black: evidence of manganese

The impacts of past coal mining can be documented from the presence of AMD. When AMD enters a stream, it usually contains high levels of sulfates, iron, aluminum, manganese, acidity, and an orange and/or white flocculent created by the precipitating metals that coat the banks and bottom of the stream.
Field studies by SCWG show that many subsidence features exist within the northwestern (West Branch Subwatershed) section of the watershed where the coal seam is shallow, and are contributing to AMD discharges. Closing these subsidence features and diverting the stream provides several important benefits. First, closing subsidence holes prevents clean source water from entering the mine and becoming acidified. Second, once the hole is closed no long-term maintenance is needed and the risk to human health and safety is greatly reduced. Third, the diverted stream adds neutralizing capacity against the AMD in the receiving stream. Finally, closing subsidence features eliminates oxygen from entering into the abandoned mine complexes, one of the elemental constituents, along with water, needed to produce acid mine drainage.

Sediment

Sediment toxicity and problems associated with sedimentation from AMD sources also show correlations with poor biological health. Sedimentation is especially pervasive in areas where abandoned gob (coal spoil piles) exist. These piles are usually unvegetated and during rainfall events produce large amounts

of sedimentation in streambeds. AMD seeps and discharges also create sedimentation problems when metals in the water column begin to precipitate out of solution. This creates a thin flocculent layer in the streambed, which interferes with macro-invertebrate habitat and fish reproduction. The second way that sediments can affect aquatic biology is through their toxic nature. High levels of heavy metals in sediments have been documented as being toxic to aquatic organisms (Ohio EPA, 1979). Sediment samples were collected by the Ohio EPA during the TMDL study in 2001 at eleven stations in Sunday Creek. Results document pollution from sediments as another cause of impaired aquatic life in Sunday Creek.

Sediment concentration levels do not necessarily correspond with water column concentration levels. Metal precipitation is based on pH levels, and sites with better water chemistry may in fact have higher concentrations of contaminated sediments. This phenomenon depends on the pH level where a metal precipitates as a solid. In general, iron starts to precipitate at a pH value of 3.5, aluminum at 4.5, and manganese at 10.

Solutions

Reducing or eliminating acid mine drainage is costly and difficult. Controlling mine drainage can happen by either treating water after it leaves a mine (treatment- active or passive) or preventing the acid from being produced (source control).

Active treatment – acidic discharges are neutralized by the addition of alkaline chemicals like lime and ammonia to neutralize acidity and facilitate the precipitation of metals.

Passive treatment systems – naturally occurring chemical and biological reactions are established in a controlled environment. Construction of passive systems requires less maintenance than active systems. These systems increase the oxidation of metals and facilitate the production of clean water. AMD passes through one or several of the following passive treatment systems:

- Wetlands – including marshes, swamps, or bogs
- Open limestone channels – ditches lined with limestone sand/rock
- Diversion wells – a holding tank filled with crushed lime
- Anoxic limestone drains – beds of buried limestone that react with mine water before oxidation

- Vertical flow reactor – AMD is diverted vertically through compost and limestone
- Steel slag leach bed- Yields several hundred times more alkalinity per equal weight as limestone, can be combined with AMD source to treat downstream.

Source control – prevents the formation of acid and contaminated water, thus preventing the need for costly treatment systems. Types of source control treatment are as follows:

- Closing subsidence holes – Coal mine subsidence holes and fractures are filled in to eliminate surface water from entering into the underground mine complex where AMD is generated.
- Gob pile capping- coal refuse piles are covered with a layer of clay or some other impermeable substance. This reduces the amount of precipitation able to infiltrate through the coal waste piles, thus preventing AMD formation.
- Re-mining – In situations where previous mining was completed using inefficient technologies, a modern surface mining operation may be viable. Under these conditions, careful planning, engineering, and post-mining reclamation may reduce or eliminate mine drainage, thus providing both an environmental and economic benefit to the area.

In addition, sedimentation from run-off from poorly reclaimed or un-reclaimed mine lands chokes waterways and reduces water quality. Listed below are best management practices used to reduce sedimentation problems caused by current mining activities:

- Construction of water diversions and sediment ponds
- Construction of road across slope of the land.
- Removing and storing topsoil in a protected area.
- Back filling and grading with stored soil.
- Grading to gentle slopes.
- Re-vegetation of bare soils.

Contaminated sediments from surface mines and precipitates from mine drainage cause impairment. Solutions to remediate contaminated sediments coating the bottom of the stream from past mining practices need to be researched further. Remediation of sediment contamination is not easy, and

once sediments are contaminated in a stream there are not many options for removing them without causing ecological harm. Instead, remediation is focused on eliminating the sediments at the source by capturing sediments in wetland cells from AMD seeps or by capping and sealing gob piles. Through time, sediments will be buried or carried downstream and diluted so the integrity of the stream can recover. The potential of accumulation in fish and macroinvertebrates is an area needing research.

The effects of coal mining in the Sunday Creek Watershed are widespread and devastating. There are numerous acid mine drainage seeps, stream captures through subsidence holes, and gob piles. Sunday Creek Watershed Group's Acid Mine Drainage Treatment and Abatement (AMDAT) Plan explains in detail water quality from each source, site locations, design considerations, suggested treatment alternatives, load reductions, costs, and monitoring plan for each priority project site (Sunday Creek Watershed Group, 2003). Information related to site specific remediation action plans are outlined in Sunday Creek's AMDAT Plan.

Indicators

1) Calculate number of gallons of water prevented from entering deep mines and load reductions from AMD sources.
2) Improvement of AMD water quality parameters measured at long-term monitoring sites (increase pH and alkalinity, decrease iron, acidity, and coal fines in sediment).

Resources

ODNR- AML -Funds
Ohio EPA 319- Funds
OSM-ACSI –Funds
ODNR-MRM- Engineering designs
Ohio University- Research and monitoring
Muskingum College- Research and monitoring
Hocking College-Research and monitoring
Landowners-Monitoring
Local schools-Monitoring
Funding opportunities- ILGARD's web site (www.ilgard@ohiou.edu/publications/index/html)

Issue: Improperly Treated Wastewater

Septic discharge into Sunday Creek

Cows accessing the West Branch of Sunday Creek

Problem Statement

Fecal coliform levels are above Ohio EPA's primary contact standard in parts of Sunday Creek and its tributaries.

Effects of Improperly Treated Wastewater

Many human health risks can be attributed to improper sewage disposal. Raw sewage contains various pathogens that are easily transmitted through open waterways. This is a particular concern to areas that are known to flood frequently, such as the streams of the Sunday Creek Watershed. Individuals coming into contact with contaminated water can contract illnesses such as typhoid, tuberculosis, dysentery, cholera, tetanus, hepatitis, and several types of gastroenteritis among others. Several types of internal parasites are also present in sewage, along with a handful of fungal diseases.

Streams contaminated by sewage also suffer a great number of ecological risks. Sewage contains high levels of nutrients that encourage the growth of bacteria and algae. While certain species of algae might thrive under these conditions, a rapid 'bloom' of algae colonies can reduce the amount of oxygen in the stream, causing all animal life in that section of the stream to die. This effect is commonly referred to as a 'fish kill' and is often associated with sewage system failures and other contamination events.

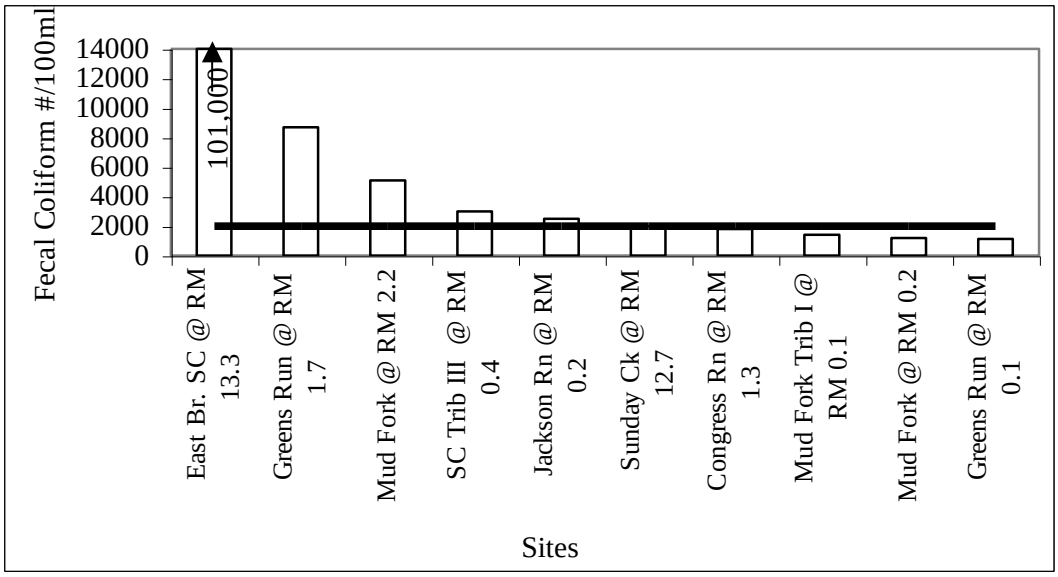
Indicator

The amount of fecal coliform is an indicator of poorly treated wastewater and livestock run-off. Improperly treated wastewater discharge will look whitish-gray and have a foul odor.

Current Impacts from Improperly Treated Sewage

According to the Ohio Non-point Source Assessment Hydrologic Unit Water Quality Report, all 27 miles of the mainstem of Sunday Creek is known or suspected to be impacted by home septic treatment systems . Fecal coliform data collected by Ohio EPA in the summer of 2001 as part of the TMDL showed values above the 2000 counts/100ml, the upper limit for primary contact water, in upper East Branch, Glouster, Millfield, Green's Run, and Mud Fork (map 7 and figure 9). Other villages and tributaries located near acid mine drainage discharges may have septic run-off but do not indicate a high fecal coliform count. This is because the presence of low pH and high acidity masks the septic run-off problem. As acid mine drainage restoration projects are completed, more fecal coliform sampling will be needed to reveal the presence of untreated sewage.

Figure 9: Fecal Coliform Data Collected at TMDL Sites (Only the highest range data points are shown in this figure, > 1000 counts/100 ml)



Source: TMDL Study

Field surveys along the mainstem of Sunday Creek show six septic discharges from private homes. There are also a few septic discharges in Green's Run and Mud Fork. Five sites throughout the Sunday Creek Watershed show activity of livestock having access to the creek. Field data collected by the Sunday Creek Watershed Group and the Summer 2001 VISTA data collection shows high levels of ammonia at the following sites: Millfield , State Route 13 crossing with Sunday Creek near Red Town, Upper East Branch, Dotson Creek , and Upstream Rendville (map 6). The ammonia standard for WWH at a temperature of 20 Celsius and pH 6.5-7.5 is 2.2 mg/l. 90% of the Summer VISTA sites meet this standard.

Solutions

1) In rural areas, septic systems need to be maintained and upgraded to meet water quality standards. There needs to be continued collaboration with county health departments in Athens, Morgan, and Perry Counties on this topic.
2) Sources of funding need to be researched to help individuals pay for these septic system upgrades within the watershed.

Indicators for Reducing Wastewater Impairments

1) Monitor levels of fecal coliform and ammonia at five target areas once a year.
2) Monitor levels of ammonia, phosphate, and nitrate at long-term monitoring sites once a year.
3) Analyze trends in reduction of these causes of impairment.

Resources

County Health Departments -Resources
Local village officials- Resources
Soil and Water Conservation Districts- Resources/ cost share
Ohio EPA 319 implementation grants- Funds
Ohio EPA WPCLF- Loans
Buckeye Hills RC&D-Resources
Local community- Monitoring, participation

Issue: Illegal Trash Dumping and Urban Run-Off

Illegal trash dump on Johnson Creek tributary to West Branch

Clean-up in the Baileys

Problem Statement

Illegal trash dumping in the Sunday Creek Watershed.

Description

Illegal trash dumping in the Sunday Creek Watershed remains a widespread problem. This is a region long dominated by mineral extractive industries with much land owned by absentee landowners. People raised in the area sense that nothing matters about the environment; trash has been dumped everywhere, abandoned mine spoils dot the landscape and sulfur water runs in the streams.

Effects

Harmful impacts to the watershed and water quality from illegally dumped trash include: debris jams which increase the impacts of flooding, surface water contamination from dump site runoff containing chemicals, and significant health risks. Some health risks include: injury due to sharp objects, increase in rodents, the potential spread of diseases (West Nile Virus, encephalitis and Dengue Fever) from mosquito breeding in scrap tires. Perhaps the most

important component of the illegal trash dumping problem is the continued lack of respect for the environment and how that can affect future economic development in the area.

Economic impacts caused by illegal trash dumping include: decreased property values because communities become unattractive, and increased cost because of government clean-up expenditures leading to higher local, state, and federal taxes (EPA 905-B-97-001 March 1998).

Current Sources of Illegal Trash Dumping

Sources of illegally dumped trash in the Sunday Creek Watershed include: landowners disposing of household trash, auto repair shops and individuals disposing of large quantities of tires and used auto parts, individuals disposing of roadside litter, construction companies and individuals disposing of demolition debris, urban run-off, and renters littering the area they live in due to lack of care or pride for the land. Location of illegal trash dumpsites were identified in the watershed in 2001-2002 by Athens and Perry County litter prevention and recycling programs, Athens Health Department, and the SCWG. Much work has been done to help clean-up many of these dumpsites, but continued efforts still need to be made within the watershed.

Critical areas where illegal trash dumping occurs include: rural public lands - Wayne National Forest; rural Sunday Creek Coal Company land; steep ravines leading to the creek; rural county and township roads, especially where there are pull-offs; and bridges over the creek.

Solutions

Sunday Creek Watershed Group has organized many litter clean-ups throughout the watershed in the last ten years. Litter clean-ups will continue until the goal of removing 125 tons of trash from the Sunday Creek Watershed is reached. Another solution to illegal trash dumping in the rural areas is to work with local officials to have mandatory trash hauling services and to expand rural trash hauling route services. Sunday Creek Watershed Group has also joined the 'Adopt-A-Highway' program in 2009 to clean the roadsides of a two- mile segment of St. Rt. 155 west of Corning.

Indicators

1) Monitor the rate of trash accumulation at five previously cleaned dumpsites.
2) Measure the number of participants in ultimate recycling programs per year.

Resources

Ohio EPA SEP-Funds
Local recycling and litter prevention groups –Resources such as trash bags, gloves, dump trucks, and some disposal costs.
319 Ohio EPA education programs –Funds
Ohio EPA –OEEF grants
VISTA volunteers- Monitoring, resources, community organizing, volunteers
College interns- Resources, volunteers
County Health Departments- Resources, monitoring
Wayne National Forest- Resources such as hauling (trucks and drivers), trash bags
Township Trustees- Hauling (trucks and drivers), heavy equipment use, volunteers, and some disposal costs
County crews –Hauling (trucks and drivers)
Local village officials- Community organizing, volunteers
Clubs and youth groups- Monitoring, volunteers
Funding opportunities- ILGARD's web site (www.ilgard@ohiou.edu/publications/index/html)

Issue: Erosion and Sedimentation

Bank erosion at park in Corning

Willow planting along Indian Run

Problem Statement

Erosion which causes increased turbidity and substrate embeddedness creates poor habitat for aquatic life in parts of Sunday Creek Watershed.

Description

Erosion is the removal and loss of soil by ice, gravity, wind, or most often, water. In this process, soil from one area is carried away and later deposited downhill or downstream. This deposition of soil leads to sedimentation. Many human land uses contribute to erosion and sedimentation either directly or indirectly by increasing the exposure of bare soil to water. Destroying riparian areas, or buffers, can result in increased erosion, siltation, downstream flooding, increased pollution, species and diversity loss, and damage to aquatic wildlife.

Effects of Sedimentation

Sedimentation is the accumulation of soil particles in a streambed. Over time, sediment can build up in the stream, filling the channel. This stream 'choking' can eventually lead to alterations in normal stream flow that can exacerbate flooding. Sedimentation also degrades the habitat of aquatic plants and animals, such as clogging fish gills, and cutting off light to underwater vegetation.

Indicators

Sedimentation is indicated by low dissolved oxygen and increased turbidity. Embeddedness is indicated by the percent distribution of substrate size particles. A pebble count is conducted to measure the size distribution of particles found on the streambed.

Current Impacts and Sources of Sediment in the Watershed

- Poorly maintained and/or illegal off-road vehicle (ORV) trails
- Deposition of mineral flocculates from abandoned underground mines.
- Lack of vegetation along stream banks due to cattle, farming, clearing of trees, and/or abandoned mining operations (gob piles, strip mine high walls, etc…)
- The clearing and grading of riparian corridor land for construction, mining, flood reduction initiatives, or logging.

Of the 27 miles of the mainstem of Sunday Creek surveyed in June 2002, only 800 feet of the stream banks were found eroded because of lack of vegetation and/or the presence of livestock. The survey indicated several sites along the mainstem lack trees or grass to stabilize soils on the bank. Three sites showed evidence of livestock having access to the stream causing bank erosion. Substrate scores and riparian zone scores measured during a QHEI survey during the Summer VISTA data collection of 2001 showed low values at numerous sites.

Low substrate scores, less than five out of a maximum score of 20, were found at the following sites: Jackson Run (6), Millfield (5,9), along State Route 13 crossing with Sunday Creek near Red Town (10), Glouster (20, 24, 27), San Toy (36), East Branch headwaters (39), Corning (41, 42), and West Branch (51, 52) (map 6).

Riparian zone scores less than 3.0 (out of a maximum score of 10) were found at sites: Millfield (8), Upper Green's Run (12), Glouster (23), Oakdale (28), Johnson Run (29), Upper East Branch (39), and Corning (41, 42) (map 6). The dissolved oxygen standard for Warmwater Habitat (WWH) is 4.0 mg/l, and 93% of these sites meet this standard.

Pebble counts were conducted at all Summer AmeriCorps* VISTA sites in 2001. Most of the substrate measured falls in the sand-size particle category. Many of the sites show even distribution across the fine gravel to small cobble size particles. QHEI data measured during the TMDL study , data collected summer 2001, indicates half of the 68 sites contained moderate to heavy silt while the other half had normal to silt-free sites. Most of the heavy silt sites are located near mined areas. Therefore, the source of siltation is principally limited to flocculates produced in the acid mine discharge.

Map 11 shows the quality of land cover along mainstem of Sunday Creek, West Branch and East Branch of Sunday Creek. 74 % of these sections of creek provide a good land use/land cover type and 26% are of a poor land use/land cover type. Good land use/land cover consists of wooded, shrub, agriculture/urban non-impervious (i.e. parks), and non-forested wetlands. Poor land use/land cover consists of barren (quarries, gravel pits, surface mines) and urban (open impervious surfaces).

Solutions

Land covered by vegetation is better protected from erosion than bare soils. The roots of plants and trees hold the stream bank in place, stabilizing the land and absorbing the water and materials that flow across them. Riparian areas, or streamside forests, are essential components of the aquatic ecosystem. They act as corridors for wildlife dispersal, habitat for aquatic life, prevent sediment from runoff and are sinks for the removal and storage of excess nutrients.

Best management practices, commonly referred to as BMP's, are techniques developed to prevent soil erosion and stream sedimentation. BMP's have been determined and are encouraged for various natural resource industries, including farming and construction.

BMP's for agricultural sites:

- Rotating crops with different growing seasons and nutrient needs in the same field to enrich soil, and keep it covered year round.
- Using no-till planting
- Fencing livestock out of waterways, which reduces streamside erosion.
- Adding mulch to small gardens
- Encouraging the maintenance of a streamside riparian corridor.

BMP's for construction sites:

- Working with existing topography to minimize grading of surface.
- Grading to gentle slopes to minimize high velocity surface runoff.
- Integrating surface and storm water drainage systems.
- Retaining existing vegetation as much as possible.
- Seeding temporary vegetation on bare areas.
- Strategically placing sedimentation fencing, hay bales, or sediment ponds to slow runoff.

BMP's for mining sites:

- Construction of water diversions and sediment ponds
- Construction of roads across the slope of the land.
- Removing and storing topsoil in a protected area.
- Back filling and grading with stored soil.
- Grading to gentle slopes.
- Re-vegetation of bare soils.

Indicators

1) Measure the number of feet of stream bank stabilized.
2) Monitor the change in QHEI/pebble count scores at long-term sediment sampling sites
3) Measure the number of trees planted in the riparian corridor and barren hillsides
4) Measure the number of local livestock farmers who participate in cattle fencing or cost-share alternative programs.

Resources

Soil and Water Conservation Districts-Resources such as education, tools, and program funding/cost share
Natural Resource and Conservation Service-Resources such as education, tools, and program funding/cost share
Wayne National Forest-Resources, participation and tools
Ohio EPA 319 grant- Funding
Trimble Wildlife Area-Participation
Burr Oak State Park-Participation
Sunday Creek Wildlife Area-Participation
Volunteers-Field work
Landowners-Field work and participation
Ohio University-Research and field work
Hocking College- Research and field work

Issue: Flooding

High flow in Rodger's Hollow, left channel being captured by a subsidence feature

Wetland in the Baileys

Problem Statement

Damaging effects to properties and Sunday Creek from flooding.

Description

Flooding is an overflow of water into areas that are normally dry. Floods are natural occurrences that serve several valuable ecological functions. There are several types of flooding in Ohio:

- General river flooding occurs after heavy rain falls during an extended period. It usually occurs slowly enough so people and property can be moved to safety.
- Urban and small stream flooding occurs when heavy rain falls in a short time. Storm sewers and small streams cannot handle the excessive runoff. This excess water often floods underpasses and basements, and can back-up sewers.
- Flash flooding is always life threatening because it occurs very quickly. It occurs most frequently in hilly or mountainous areas, but can occur anywhere when very heavy rain falls in a very short time. Rainfall of two to four inches in a couple hours can cause a flash flood.

A flood can also seriously damage communities that are unprepared for its devastating impacts. After the destructive flooding in the Mississippi River

Basin in the summer of 1992, Federal and State agencies will no longer fully underwrite flood cleanup costs. The policy of Federal and State governments, therefore, is to move people away from potentially damaging flood prone areas.

Some human activities can contribute to, or even exacerbate, the degree of flooding and subsequent flood damage. Loss of streamside vegetation, an increase of impervious surfaces (for example; roads and parking lots), and the channeling of water are just a few of the things that contribute to flooding. Each year, floods damage homes, businesses, farmland, water treatment facilities, and roadways. Flood prone areas in the Sunday Creek Watershed are shown in map 12 .

Resources

ODNR – Division of Water, Floodplain Management- Resources, funds
FEMA-Funds, resources
AFRRI-Funds, resources
Local officials- Participation
Local landowners- Participation
Funding opportunities- ILGARD's web site (www.ilgard@ohiou.edu/publications/index/html)

Chapter II: East Branch Sunday Creek

Subwatershed Description

East Branch Sunday Creek comprises the northeast section of the Sunday Creek watershed, constituting the entire drainage from the confluence of East Branch with mainstem Sunday Creek from St. Rt. 13 north of Glouster to the headwaters within the subwatershed. The mainstem of East Branch is impounded by the Tom Jenkins Dam to form Burr Oak Reservoir. The eastern section of Sunday Creek is located mostly in Morgan County, but has a small portion in both Athens and Perry Counties. East Branch Sunday Creek has a drainage area of 32.59 square miles, with the main stem of East Branch being 15.5 miles long. Major tributaries to the subwatershed include San Toy Creek, Cedar Run, Eel's Run, and Bloody Run. The topography of this subwatershed is predominately steep with narrow ravines. There are no incorporated areas within the subwatershed.

The predominant land use is forest in the East Branch Subwatershed (map 2). Refer to table 25 for a breakdown of land use by acre and percentage.

Table 25: East Branch Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category

Land Use	Area (acres)	%
Open Water	686	3.24
Low Intensity Residential	12	0.06
High Intensity Residential	1	0.005
Commercial/Industrial/Transportation	13	0.06
Quarries	1	0.005
Transitional	0	0.00
Deciduous Forest	16,836	79.50
Evergreen Forest	1,020	4.82
Mixed Forest	202	0.95
Pasture/Hay	1,736	8.20
Row Crops	631	2.98
Urban Recreational Grasses	0	0.00
Woody Wetlands	8	0.04
Emergent Herbaceous Wetlands	31	0.15

Water Quality Inventory

During the TMDL study a total of 12 stations were monitored in the East Branch Subwatershed to evaluate the mainstem of the East Branch and tributaries making the complete assessment of 19.6 linear stream miles. Full attainment of the existing and recommended aquatic life uses was indicated for 7.6 miles (38.8%). The remaining miles were found to be impaired, including 8.2 miles (41.8%) in partial attainment and 3.8 miles (19.4%) in non-attainment. Eels Run, Cedar Run, and the vast majority of San Toy Creek were found to fully support the WWH aquatic life use.

Subwatershed Impairments

According to the TMDL completed in 2005 impairments listed for East Branch proper included the reservoir (flow and bottom release) lower 0.1 miles, livestock access (upstream of reservoir), intermittent flow (uppermost site), and modest AMD (up from reservoir). Eels Run, Bloody Run, and Cedar Run had no listed impairments. San Toy Creek had one impairment of naturally low gradient swamp/ beaver- affected stream. TMDLs focusing on sediment were made for San Toy Creek and East Branch proper. Further, cattle access and intermittence were the primary problems upstream of the reservoir and the primary problem downstream of the reservoir was the regular anoxic, hypolimnetic releases from the reservoir.

Restoration and Protection Goals

Goals were laid out in the original action plan to reduce the bacteria concentrations and sedimentation and erosion in the watershed. These are areas which need to be focused on in the East Branch Subwatershed. Objectives and actions are outlined below pertaining to each goal.

Goal 1: Reduce high levels of fecal coliform and nutrients to below 2000 counts/100ml for fecal coliform and 2.2 mg/l for ammonia being contributed from livestock accessing the stream at an upper mainstem site of the East Branch.

Objective 1*:* To limit livestock access to the Sunday Creek by fencing 14,200 linear feet of stream bank and provide alternate watering systems at a cost of $31,880.

Actions:

1) Provide information to landowners about Soil and Water Conservation Districts cattle fencing programs.
2) Organize one speaker at a public meeting to discuss the benefits of cattle fencing.

Goal 2: Decrease erosion and sedimentation in East Branch Subwatershed through education and the following activities to meet a turbidity target value of five NTU in Sunday Creek.

Objective 1: To inventory the East Branch Subwatershed for sources of erosion.

Actions:

1) Inventory the East Branch of Sunday Creek for eroded stream banks and write an action plan to revegetate.
2) Inventory tributaries to the East Branch , for eroded stream banks and write an action plan to revegetate.
3) Monitor 8 long-term sediment sampling sites (East Branch Subwatershed) by conducting a QHEI/pebble count measurement to determine the change in quantity and quality of substrate material in creek bed every five years.

Objective 2: To revegetate about 2.5 miles of eroded stream bank to reduce soil loss along the mainstem of East Branch (See Map 11).

Actions:

1) Work with ODNR Division of Wildlife, Morgan County Soil and Water Conservation District, and local schools or volunteers to plant trees in the riparian corridor 5-30 feet from bank along the high impact areas along Sunday Creek.
2) Plant vegetation such as willow trees on eroded stream banks in headwater streams.

Objective 3: To decrease soil loss from farming practices through education.

Actions:

1) Distribute alternative best management practices on farming.
2) Work with Morgan Soil and Water Conservation District to establish cattle fencing projects and alternative cattle/livestock watering projects in the East Branch Subwatershed.
3) Feature a speaker on alternative farming practices once a year at monthly public Sunday Creek meeting.

Implementation of Plan

Table 26: Timeline and Activity Sheet to Address East Branch Impairments

Activity	2010	2011	2012	2013	2014-2020
Monitor levels of fecal coliform and ammonia		Sample		Sample	Sample
Monitor pebble counts Sediment samples			1 event		1 event
Provide information about SWCD cattle fencing program to land owners who have livestock			1 site visit		
Cattle fencing program				1 farm	
Tree planting			500 trees	500 trees	500 + trees
Distribute facts sheets		10 sheets	10 sheets	10 sheets	10 sheets
Speaker presentations	1	1	1	1	1

Chapter III: West Branch Sunday Creek

Subwatershed Description

West Branch Sunday Creek comprises the northwest section of the Sunday Creek Watershed, constituting the entire drainage from the confluence of West Branch with mainstem Sunday Creek in Glouster to the headwaters within the subwatershed. The western section of Sunday Creek is located in Athens and Perry Counties. West Branch Sunday Creek has a drainage area of 42.5 square miles, with the main stem of West Branch being 14 miles long. Major tributaries to the subwatershed include Congo Run, Pine Run, West Branch Headwaters, Indian Run, Johnson Run and Mud Fork. Incorporated areas include Hemlock, Glouster and a small portion of Shawnee, with several small villages existing within the subwatershed as well.

The predominant land use is forest in the West Branch Subwatershed (map 2). Refer to table 27 for a breakdown of land use by acre and percentage.

Table 27: West Branch Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category

Land Use	Area (acres)	%
Open Water	71	0.26
Low Intensity Residential	118	0.43
High Intensity Residential	16	0.06
Commercial/Industrial/Transportation	26	0.10
Quarries	9	0.03
Transitional	79	0.29
Deciduous Forest	22,880	84.17
Evergreen Forest	633	2.33
Mixed Forest	114	0.42
Pasture/Hay	2,122	7.81
Row Crops	1068	3.93
Urban Recreational Grasses	9	0.03
Woody Wetlands	13	0.05
Emergent Herbaceous Wetlands	25	0.09

Water Quality Inventory

During the TMDL study there were 26 sampling stations allocated to evaluate the mainstem of West Branch and eleven direct and indirect tributaries, totally 30.4 stream miles that were assessed. By far the leading cause of aquatic life impairment was mine drainage which accounted for over 85% of all the impaired waters. The study found that due to several large mine seeps the upper portion of the mainstem and its tributaries were heavily impacted by AMD. Other tributaries and parts of the mainstem are affected by other mine seeps and flow over and through reclaimed and unreclaimed minelands and mine spoil.

The only subwatershed of the West Branch that appears to be unaffected by AMD is Mud Fork, which was found to support aquatic communities and labeled WWH. There has been much effort over the last ten years to combat the effects of AMD in this portion of the watershed. Four reclamation projects (stream captures) have been completed and a currently funded project will be the first AMD treatment project in the watershed. More information and water quality information obtained from pre- and post- construction monitoring is outlined in the restoration and protection goals section of this plan.

Subwatershed Impairment

As stated in the water quality inventory, this subwatershed has been severely impacted by past mining. The effects of acid mine drainage pollution are severe in the West Branch Subwatershed. The Sunday Creek AMDAT report discusses in detail projects that need to take place to remediate the high levels of metals and acidity in this part of the watershed.

Other impairments that were listed in the TMDL study were high levels of bacteria in the Mud Fork tributary of the West Branch subwatershed, and several smaller unnamed tributaries that had sedimentation problems (not meeting the QHEI target score). Goals to clean-up several illegal trash dumps in the West Branch Subwatershed indentified in the original action plan are included here.

Restoration and Protection Goals

Listed below are goals to combat identified impairments for the West Branch Subwatershed including: acid mine drainage, illegal dumps, sedimentation, and bacteria.

Goal 1: Enable 80% of Sunday Creek to attain Warmwater Habitat aquatic life use designation

Objective 1: To reduce 77 million gallons of surface water per year from entering abandoned deep mines by closing eight subsidence holes by year 2015 as identified in the Acid Mine Drainage Abatement and Treatment Plan at a cost of approximately $300,000. Project sites that are located within the West Branch Subwatershed: Congo, mainstem of West Branch, and headwaters of West Branch. Currently four subsidence projects have been completed in this subwatershed with two projects currently being funded for completion in the next two years.

Actions:

1) Write grants to obtain funds to close subsidence holes.
2) Draw designs and start construction projects to close subsidence holes.
3) Monitor high-risk areas for future subsidence features, yearly.
4) Monitor the effectiveness of completed subsidence closure projects, bi-yearly during high and low flow conditions.

Objective 2: Implement six treatment systems (after subsidence closures are complete) in the West Branch at an estimated cost of over $831,000. Sites that are located within the West Branch Subwatershed are: Pine Run, mainstem of West Branch, and West Branch Headwaters. Currently one AMD treatment system is funded for West Branch Headwaters to be constructed in 2011.

Actions:

1) Write grants to obtain funding for treatment systems.
2) Build partnerships and support research to promote acid mine drainage remediation projects.

3) Collaborate and leverage funds for remediation projects with partners.
4) Construct acid mine drainage treatment systems to lessen the effect of acid mine drainage in Sunday Creek (refer to Sunday Creek's AMDAT Plan for complete list of project, remediation strategy, cost, and load reductions).
5) Monitor the effectiveness of completed reclamation projects, yearly.

Goal 2: Improve communities' appreciation of clean streams by decreasing illegal trash dumping in creeks and the riparian corridor and reduce litter on roadsides by promoting solid waste reduction and recycling programs.

Objective 1: Clean up the existing illegal trash and litter progressively over the next three years. Several sites have been identified in the lower portions of the West Branch Subwatershed that still need to be cleaned up. SCWG has held many trash pick-ups in the West Branch over the last ten years.

Actions:

1) Write grants and request funding for trash disposal from Ohio Environmental Protection Agency – Supplemental Environmental Programs grant.
2) Work with local solid waste districts, Recycling & Litter Prevention programs, county health departments, Wayne National Forest, and local communities to identify dumpsites to clean up.
3) Mark a map with all existing dumpsites, maintain records, and monitor cleaned up sites.
4) Organize volunteers to conduct clean ups and township trustees to help haul trash to certified licensed landfills.
5) Organize four clean-ups a year for SCWG's highway segment (St. Rt. 155) for ODOT's 'Adopt-A-Highway' Program.

Goal 3: Decrease erosion and sedimentation in Sunday Creek Watershed through activities to meet a turbidity target value of five NTU in Sunday Creek.

Objective 1: To inventory the West Branch of Sunday Creek for sources of erosion.

Actions:

1) Inventory the West Branch for eroded stream banks and write an action plan to revegetate.
2) Inventory the tributaries to the West Branch for eroded stream banks and write an action plan to revegetate.

Objective 2: To revegetate approximately two miles of eroded stream bank to reduce soil loss along the mainstem of the West Branch (See Map 11).

Actions:

1) Work with ODNR Division of Wildlife, local Soil and Water Conservation Districts, local schools, and landowners to plant trees in the riparian corridor 5-30 feet from bank along the high impact areas of the West Branch.
2) Plant vegetation such as willow trees on eroded stream banks in headwater streams.

Objective 3: To research the sources of erosion both present and historic.

Actions:

1) Monitor 14 long-term sediment sampling sites by conducting a QHEI/pebble count measurement to determine changes in quantity and quality of substrate material in the creek bed every five years.
2) Conduct research about the historic substrate composition of the West Branch streambed.

Objective 4: To decrease soil loss from farming practices through education.

Actions:

1) Distribute alternative best management practices on farming.
2) Work with Perry and Athens County Soil and Water Conservation Districts to establish cattle fencing projects and alternative cattle/livestock watering projects.

Goal 4: Reduce high levels of fecal coliform contributed from improperly treated wastewater at all sample sites in Sunday Creek to below the primary contact level, 2000 counts/100ml.

Objective 1: Decrease approximately 60,000 – 100,000 gal/day of improperly treated septic water from entering Sunday Creek Mainstem. Sites where fecal coliform and ammonia levels have been detected: Mud Fork in the West Branch Subwatershed.

Actions:

1) Conduct inventory of West Branch for falling septic systems.

2) Implement an on-site septic system plan to follow a four phase approach:
    - Phase I - upgrade failing septic systems within 200 feet of West Branch where high fecal coliform levels were detected.
    - Phase II - monitor West Branch for fecal coliform levels above 2000#/100ml at low flow conditions after phase I upgrades are complete and write a strategy plan for any new areas detected.
    - Phase III - upgrade failing systems that are within 500 feet of the West Branch and in any areas detected as a result of phase II monitoring.
    - Phase IV - monitor Sunday Creek for fecal coliform levels above 2000#/100 ml after phase III upgrades are complete and design any additional upgrades that are necessary.
3) Work with Perry and Athens County Health Departments to conduct pre- and post- inspections.
4) Collect and monitor fecal coliform and ammonia samples before and after septic upgrade project.

Completed work

Four AMD projects have been completed to date in the West Branch Subwatershed and two projects are funded for 2010. Current load reductions for the West Branch expressed in terms of fresh water returning to the stream due to subsidence closures is 769,557,000 gallons per year, according to the 2009 NPS Report published by Ohio University's Voinovich School. This report also states that the expected additional alkaline loading from these closures returning clean water to the streams is 986 lbs/day. Projects are listed below in order of completion:

Congo Subsidence/Stream Capture Project

This project was completed in 2004 and funded by an OSM Appalachian Clean Stream Initiative Grant totaling $90,426. The project reclaimed a 72-acre tributary in the Congo sub-watershed located west of Perry County Road 68, Monroe

Township. Treatment filled the stream capture and re-channeled the stream to promote positive drainage to Congo Run, eliminating its capture into a deep mine complex. By eliminating this surface water from entering the deep mine, an estimated 8,000 cubic feet daily or 3 million cubic feet per year will be returned to Congo Run and will reduce the production of acid mine drainage (AMD) in the mine complex.

Pine Run Stream Capture and Subsidence Closing

Pine Run Stream Capture and Subsidence Closing was completed in April of 2007. The total cost for this project was $129,171, with $58,831 of that coming from 319 federal funds and $70,340 from ODNR state matching funds. This project closed one stream capture, two subsidence holes and created a natural channel for positive drainage. All of the water flowing in the stream during normal conditions enters into the stream capture. The feature is estimated to capture 50 million gallons of water per year, has a pH of 6.5, conductivity of 180 u/S, and was net alkaline by 40 mg/l.

Maximum buffering capacity will result when precipitation events are conveyed to Pine Run. Preliminary data at the downstream site suggests that flow (cfs), pH and alkalinity loadings (lb/day) have increased downstream of the restored tributary's confluence with Pine Run. These results match the expected downstream water quality outcomes of the stream capture project due to the influx of clean, net-alkaline water now being conveyed into Pine Run. The post construction flow, pH and loading data have been interpreted and are summarized in the table below.

Table 28: Water Quality Impact of Restored Tributary to Pine Run

	CFS	Gallons per Minute	Alkalinity Loading (lb/day)	pH
Upstream	1.13	508.48	69.40	6.30
Downstream	1.19	532.70	92.90	6.42

Rodger's Hollow Stream Capture Project

The Rodger's Hollow Stream Capture Project, completed in December of 2007 and funded by an OEPA 319 Implementation Grant, is working as designed. The total cost for this project was $428,218; $310,998 was supplied through the 319 federal grant program. After the multiple stream captures were closed and the stream channel was rerouted away from a high wall, the data proves the project's effectiveness. Clean, net alkaline water stays on the surface and is conveyed downstream rather than entering into the underground mine and becoming acid mine drainage.

Pictured Above: Primary Stream Capture- Pre-Construction

Additionally, there is an acid reduction component where the captured surface water previously discharged from the underground mine as acid mine drainage. This project is adding alkalinity and reducing acidity to the downstream subwatershed.

- Rodger's Hollow Alkaline Addition: 651-lb/day of alkalinity is now conveyed downstream as a natural, cost- effective treatment system.
- Rodger's Hollow Acid Reduction: 18.6-lb/day reduction in acidity at the known acid mine drainage discharge point.

Pictured Above: Stream Channel- Post-Construction

Congo Run (CR-11/Little Hocking) Stream Capture Project

In December 2009, the Congo Run-11/Little Hocking Stream Capture Project was completed. This stream capture project is part of the Congo Run Subwatershed and is the fourth stream capture project to be completed within the Sunday Creek Watershed. The drainage area that was being captured by the subsidence feature was approximately 256 acres, which captured an estimated 94 million gallons of surface water annually. The surface water that was entering the subsidence was net alkaline and it was estimated that 219 lb/day of alkalinity was being lost through this stream capture, thus reducing Congo Run's buffering capacity while increasing the amount of AMD being produced underground. The project consisted of sealing one primary stream capture and two secondary stream captures. Three rock channels were created that now carry the net-alkaline surface water to an impoundment that flows into Congo Run. Post- construction monitoring will begin in 2010. An OSM Clean Streams Initiative Grant was awarded to help fund this project. The final cost for the project was $197,286. Of that amount, ODNR-DMRM contributed a total of $133, 513 towards the completion of this project.

Pictured Above: Primary Stream Capture-Pre-Construction

Pictured Below: Rock Channel-Post-Construction

Pictured Below: Primary Stream Capture-Post-Construction

West Branch Headwaters Construction Project

Pictured Below: One of the Four Stream Captures

Work will begin on the West Branch Headwaters Project in the spring of 2010. This project is being funded through an OEPA 319 Grant and an OSM Clean Streams Initiative Grant. This project will include two phases; Phase I will begin construction this spring and Phase II is on track for construction winter/spring of 2010-2011. Phase I of this project involves installation of four monitoring wells (installed summer of 2009), sealing of four stream captures and reclaiming a 1.28 acre gob pile (WBHW 99). Collectively, these four subsidence features capture an estimated 25-million gallons of net-alkaline surface water annually that would otherwise provide buffering capacity to the stream. Phase II will include the construction of Sunday Creek's first AMD treatment system to help treat four AMD discharges in the area (WBHW 16, WBHW 17, WBHW 06 and WBHW 19). A few months of post-construction monitoring of Phase I will be done this summer/fall to evaluate any changes to flow/ water quality before Phase II construction begins.

Pictured Below: AMD Discharge

Pictured Below:

1.28 acres Gob Pile to be reclaimed

These sites are adjacent to the West Branch Headwaters main stem, which is located in the northwestern part of the Sunday Creek watershed at Section 23 of Saltlick Township, Perry County. The main goal of the West Branch Headwaters Sunday Creek Restoration Project is to reduce acidity and metal loadings. This would equate to annual acid and metal reductions of 10,731 (lb/year) and 59,787 (lb/year) respectively. ODNR-DMRM will contribute $280,080 to the $505,478 total project cost.

Implementation of Plan

Table 29: Timeline and Activity Sheet to Address West Branch Impairments

Project Complete	2001-2009	2010	2011	2012	2013	2014-2020
Pine Run Subwatershed	**2007**- Pine Run Closure Project			1 Treatment System		
Congo Run Subwatershed	**2004**- Congo Run Closure Project **2007-** Rodger's Hollow Closure Project **2009-**Little Hocking Closure Project					
West Br. Headwaters		4 Subsidence Closures, 1 Gob Pile Reclaimed	1 Treatment System			
West Branch Mainstem		1 Subsidence Closure WB-43				4 Treatment Systems
Provide information about SWCD cattle fencing program				1 Site Visit		
Inventory Septic System Upgrades				Phase I	Phase II	Phase III and IV
Monitor levels of fecal coliform and ammonia			Sample		Sample	
Trash clean-ups	**2002**- 4 trash clean-up events, over 12 tons of trash removed **2005**- 1 trash clean-up **2009**-1 trash clean-up	2 trash clean-up events	2 trash clean-up events	2 trash clean-up events	2 trash clean-up events	2 trash clean-up events
Tree planting	**2001**- 1,000 trees **2002**-1,000 trees **2003**-2,000 trees **2008**-8,500 trees		1,000 trees		2,000 trees	
Monitor pebble counts Sediment samples	**2001** Pebble count baseline data-			1 event		1 event

Chapter IV: Upper Sunday Creek

Subwatershed Description

Upper Sunday Creek comprises the central and northernmost section of the Sunday Creek watershed, constituting the entire drainage above the confluence of West Branch with mainstem Sunday Creek in Glouster to the headwaters of Sunday Creek. The upper section of Sunday Creek is almost entirely contained within Perry County, with very small portions in Athens County to the south and Morgan County to the southeast. Upper Sunday Creek constitutes the entire drainage from above the confluence of the East Branch into Sunday Creek (north of Glouster) to the headwaters of Sunday Creek (north of Rendville). Major tributaries to the subwatershed include Eighteen Run, Dotson Creek, and Long Run. Incorporated areas include Rendville, Corning and Glouster. There are several unincorporated communities within this section of the watershed as well.

The predominant land use is forest in the Upper Sunday Creek Subwatershed (map 2). Refer to table 30 for a breakdown of land use by acre and percentage.

Table 30: Upper Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category

Land Use	Area (acres)	%
Open Water	59	0.38
Low Intensity Residential	148	0.96
High Intensity Residential	33	0.21
Commercial/Industrial/Transportation	15	0.10
Quarries	3	0.02
Transitional	20	0.13
Deciduous Forest	12,207	79.11
Evergreen Forest	586	3.80
Mixed Forest	95	0.62
Pasture/Hay	1,266	8.20
Row Crops	960	6.22
Urban Recreational Grasses	28	0.18
Woody Wetlands	2	0.01
Emergent Herbaceous Wetlands	9	0.06

Water Quality Inventory

During the TMDL study full attainment was found for Unnamed Tributary I in the Upper Sunday Creek Subwatershed and nearly all of Dotson Creek. The other tributaries: Unnamed Tributary II, Eighteen Run, and Long Run were found to be impaired, either partial or non-attainment. Eighteen Run was found to be impacted by mine drainage and Long Run and Unnamed Tributary I seemed to be naturally limited by intermittent or interstitial flow. About 7.8 miles of the Upper Sunday Creek Subwatershed were evaluated: 70% found to support an aquatic community fully consistent with recommended and existing aquatic life uses, the remaining 30% had impairments with 26% partially meeting the recommended aquatic life uses and 4% fell into the non-attainment category.

Subwatershed Impairments

As stated in the water quality inventory, this subwatershed has been slightly impacted by past mining, especially in the Eighteen Run Subwatershed. In Dotson Creek, sediment was found to be the main impairment from oil and gas extraction in a lower site, upstream impoundments, and beaver influence in a lower site.

The two major impairments to this subwatershed are sedimentation and acid mine drainage. There are more details laid out in the Sunday Creek Watershed AMDAT about which priority projects need to take place. In particular, the Corning Discharge (located in John Altier Park in the village of Corning directly on the mainstem of Sunday Creek) is one of the largest contributors of AMD to the mainstem of Sunday Creek and potentially damages aquatic health for approximately 5 miles downstream (Sunday Creek AMDAT). This discharge has the largest flow rate of any discharge in the watershed at 3.59 cfs (1608 gpm). Steps are currently being taken by the Sunday Creek TAC to remediate this problem, although no construction design has been made.

Restoration and Protection Goals

Goal 1: Enable 80% of Sunday Creek to attain Warmwater Habitat aquatic life use designation by reducing the effects from acid mine drainage.

Objective 1: To restrict 88,464,400 gallons of surface water per year from entering abandoned deep mines by closing two subsidence holes by year 2011 as identified in the Acid Mine Drainage Abatement and Treatment Plan at a cost of approximately $81,400. This project site is referred to as West Rendville Stream Capture Project.

Actions:

1) Work with ODNR staff and obtain funds to close these subsidence features.
2) Work with ODNR to develop designs and start construction projects to close subsidence holes.
3) Monitor the effectiveness of the completed subsidence closure project, bi-yearly during high and low flow conditions.

Objective 2: Implement one treatment system (after subsidence closures are complete) in the Upper Sunday Creek Subwatershed at an estimated cost of over $526,000. This site is the Corning Park Discharge.

Actions:

1) Write grants to obtain funding for a treatment system.
2) Build partnerships and support research to promote an acid mine drainage remediation project.
3) Collaborate with partners to leverage funds for a remediation project.
4) Construct an acid mine drainage treatment system to lessen the effect of acid mine drainage in Sunday Creek (refer to Sunday Creek's AMDAT Plan for complete list of project, remediation strategy, cost, and load reductions).
5) Monitor the effectiveness of completed reclamation project, yearly.

Goal 2: Decrease erosion and sedimentation in Sunday Creek Watershed through education and activities to meet a turbidity target value of five NTU in Sunday Creek.

***Objective 1**:* To inventory the entire Sunday Creek Watershed for sources of erosion

Actions:

1) Inventory the Upper Sunday Creek Subwatershed, including tributaries, for eroded stream banks and write an action plan to revegetate.

Objective 2: To revegetate over 2 miles of eroded stream bank to reduce soil loss along the mainstem of Sunday Creek in the Upper Subwatershed (See Map 11).

Actions:

1) Work with ODNR Division of Wildlife, local Soil and Water Conservation Districts, and local schools to plant trees in the riparian corridor 5-30 feet from bank along the high impact areas along Sunday Creek.
2) Plant vegetation such as willow trees on eroded stream banks in headwater streams.

Objective 3: To research the sources of erosion both present and historic.

Actions:

1) Monitor 11 long-term sediment sampling sites by conducting a QHEI/pebble count measurement to determine the change in quantity and quality of substrate material in creek bed every five years.
2) Conduct research about the historic substrate composition of the Sunday Creek streambed.

Completed Projects

One reclamation project has been completed in the Upper Sunday Creek and one is being funded for 2010. Current load reductions for the Upper Sunday Creek Subwatershed below the Corning Gob Floodplain is a 100% decrease in net acidity concentrations with the project discharge now being net alkaline, according to the 2009 NPS Report published by Ohio University's Voinovich School. Completed and funded projects are listed below. There has been work in the past with the village of Corning to maintain and operate a wastewater facility since none had existed for residents of this town. Construction of the Corning plant is completed and it will be online in 2010.

Corning Gob Pile Reclamation Project

The Corning Gob Pile project was completed in December of 2007. The total cost of this project was 135,069 with $130,069 coming from the federal 319-grant program. Post- construction water quality data indicated favorable downstream and discharge results. For example, at the project's downstream sampling site, the alkalinity load (lb/day) has increased by approximately 300 lb/day when compared to pre- construction data. The high flows increased the loadings, while the net alkalinity (mg/L) concentrations remained about the same. The net acidity (mg/L) concentrations at the discharge decreased by about 40 (mg/L) after the project was completed. If this level is maintained the downstream water quality improvement will continue.

The post- construction flow, pH and loading data have been interpreted and are summarized in the table below.

Table 31: Water Quality Comparison Downstream of Corning Gob Reclamation 2007

CG03	CFS	Gallons per Minute	Alkalinity Loading (lb/day)	pH
Pre Construction	0.43	193.5	94.7	6.7
Post Construction	2.3	1,016.2	406.7	6.6

West Rendville Stream Capture Project

ODNR-Division of Mineral Resources Management is funding this project, beginning with the survey in 2008. This 240-acre (0.38 sq. miles) capture site is associated with underground mine Py-137, which is suspected to be one of many complexes connected to the Corning discharge. This site consists of two subsidence holes, one on each branch of a small-unnamed tributary to Sunday Creek. These two subsidence holes capture an estimated 88,464,400 gallons of fresh surface water per year. Closing these subsidence holes is a high priority in Sunday Creek because of their suspected connectedness to the Corning discharge. Due to the close proximity and linked affects of the two sites, remediation of both holes is suggested at the same time.

Implementation of Plan

Table 32: Timeline and activity sheet to address Upper Sunday Creek impairments

Project Complete	2001-2009	2010	2011	2012	2013	2014-2020
18 Run discharge			Data Analysis			
Corning Discharge	**2007**: Corning gob pile reclaimed				Corning Discharge	
West Rendville Subsidence			WR-01 and 02 Closure project			
Tree planting	**2003**-20 trees **2009**-400 trees			500 trees		500 + trees
Monitor pebble counts Sediment samples	**2001:** Pebble count baseline data			1 event		1 event

Chapter V: Lower Sunday Creek

Subwatershed Description

Lower Sunday Creek comprises the southernmost section of the Sunday Creek Watershed, constituting the entire drainage from the confluence of West Branch with mainstem Sunday Creek in Glouster to Sunday Creek's confluence with the Hocking River near Chauncey. The lower section of Sunday Creek is almost entirely contained within Athens County, with very small portions in Perry County to the north and Morgan County to the east. Major tributaries to the subwatershed include Congress Run, Greens Run, Big Bailey Run and Jackson Run. Incorporated areas include Glouster, Trimble, Jacksonville and Chauncey. Several villages of unincorporated communities exist within this section of the watershed as well.

The predominant land use is forest in the Lower Sunday Creek Subwatershed (map 2). Refer to table 33 for a breakdown of land use by acre and percentage.

Table 33: Lower Sunday Creek Subwatershed Land Use Distribution by Major Land Use Category

Land Use	Area (acres)	%
Open Water	71	0.28
Low Intensity Residential	438	1.76
High Intensity Residential	92	0.37
Commercial/Industrial/Transportation	73	0.29
Quarries	4	0.02
Transitional	102	0.41
Deciduous Forest	18,727	75.06
Evergreen Forest	696	2.79
Mixed Forest	230	0.92
Pasture/Hay	3,370	13.51
Row Crops	912	3.66
Urban Recreational Grasses	194	0.78
Woody Wetlands	13	0.05
Emergent Herbaceous Wetlands	26	0.10

Water Quality Inventory

During the 2001 TMDL study, fifteen stream miles were assessed in the Lower Sunday Creek Subwatershed, which included: Big Bailey Run mainstem, Middle Bailey Run, Carr Bailey (North Branch), and West Bailey Run, Congress Run, Unnamed Tributary III, Greens Run, Little Greens Run, Unnamed Tributary IV, and Jackson Run. Full attainment for aquatic life uses was indicated for Congress Run, an unnamed tributary, and .7 miles of Little Greens Run. The Middle Fork Big Bailey and the middle segment of Bailey Run were found to support WWH communities. As with other areas in the watershed, Lower Sunday Creek had various impairments that are explained in the following section.

Subwatershed Impairments

In the Big Bailey Run Subwatershed of Lower Sunday Creek, acid mine drainage and landscape modifications associated with unreclamined minelands were the leading causes for aquatic life use impairments found in the TMDL study. Big Bailey Run was largely impacted from mine drainage from one of the largest seeps in the entire watershed that joins the stream 0.4 mile from its confluence with the mainstem of Sunday Creek. Other impairments to this subwatershed were limited to the upper 0.7 mile of Big Bailey Run and the lower mile of both Carr Bailey Run and West Bailey Run. Impairments in these stream segments were found to be from intermittent or interstitial flow.

In the other sections of the Lower Sunday Creek Subwatershed there was only one area that was affected by mine drainage, Unnamed Tributary IV. This tributary is influenced by the largest single source of AMD within the entire watershed, referred to as the Truetown Seep. All other remaining waterbodies not meeting WWH were impacted by failing septic systems (low dissolved oxygen levels, elevated ammonia-N concentrations, and high levels of fecal coliform bacteria) or were naturally limited by intermittent flow. Illegal dumps have also been identified in the Lower Sunday Creek Subwatershed, mainly along the mainstem of Sunday Creek, Big Bailey, and Carr Bailey Subwatersheds.

Restoration and Protection Goals

Goal 1: Reduce high levels of fecal coliform contributed from improperly treated wastewater at all sample sites in Sunday Creek to below the primary contact level, 2000 counts/100ml.

Objective 1: Decrease approximately 60,000 – 100,000 gal/day of improperly treated septic water from entering Sunday Creek mainstem. Sites where fecal coliform and ammonia levels have been detected: Green's Run and Jackson Run in the Lower Sunday Creek Watershed.

Actions:

1) Conduct inventory of Lower Sunday Creek for failing septic systems.
2) Implementation of an on-site septic system plan will follow a four phase approach:
    - Phase I - upgrade failing septic systems within 200 feet of Lower Sunday Creek where high fecal coliform levels were detected.
    - Phase II - monitor Lower Sunday Creek for fecal coliform levels above 2000#/100ml at low flow conditions after phase I upgrades are complete and write a strategy plan for any new areas detected.
    - Phase III - upgrade failing systems that are within 500 feet of Lower Sunday Creek and in any areas detected as a result of phase II monitoring.
    - Phase IV - monitor Lower Sunday Creek for fecal coliform levels above 2000#/100 ml after phase III upgrades are complete and design any additional upgrades that are necessary.
3) Work with Athens County Health Department to conduct pre- and post-construction inspections.
4) Collect and monitor fecal coliform and ammonia samples before and after septic upgrade project.

Goal 2: Enable 80% of Sunday Creek to not be inhibited from attaining Warmwater Habitat aquatic life use designation because of the effects from acid mine drainage.

Objective 1: Implement 3 treatment systems at an estimated cost of $1,056,000. Sites are located within the sub-watersheds: Baileys and lower Sunday Creek (Truetown discharge).

Actions:

1) Write grants to obtain funding for treatment systems.
2) Build partnerships and support research to promote acid mine drainage remediation projects.
3) Collaborate and leverage funds for remediation projects with partners.
4) Construct acid mine drainage treatment systems to lessen the effect of acid mine drainage in Sunday Creek (refer to Sunday Creek's AMDAT Plan for complete list of project, remediation strategy, cost, and load reductions).
5) Monitor the effectiveness of completed reclamation projects, yearly.

Goal 3: Improve communities' appreciation of clean streams by removing illegal trash dumps in creeks and the riparian corridor and reducing litter on roadsides by promoting solid waste reduction and recycling programs.

Objective 1: Clean up the existing illegal trash and litter progressively over the next five years.

Actions:

1) Write grants and request funding for trash disposal from Ohio Environmental Protection Agency – Supplemental Environmental Programs grant.
2) Work with local solid waste districts, Recycling & Litter Prevention programs, county health departments, Wayne National Forest, and local communities to identify dumpsites to clean up.
3) Mark a map with all existing dumpsites, maintain records, and monitor cleaned up sites.
4) Organize volunteers to conduct clean ups and township trustees to help haul trash to certified licensed landfills.

Goal 4: Decrease erosion and sedimentation in Lower Sunday Creek Subwatershed through activities to meet a turbidity target value of five NTU in Sunday Creek.

Objective 1: To revegetate an estimated 3 miles of eroded stream bank to reduce soil loss along the mainstem of Sunday Creek (See Map 11).

Actions:

1) Work with ODNR Division of Wildlife, local Soil and Water Conservation Districts, and local schools to plant trees in the riparian corridor 5-30 feet from bank along the high impact areas along Sunday Creek.

Objective 2*:* To inventory the Lower Sunday Creek Subwatershed for sources of erosion

Actions:

1) Inventory the Lower Sunday Creek Subwatershed and tributaries for eroded stream banks and write an action plan to revegetate.

Objective 3: To research the sources of erosion both present and historic.

Actions:

1) Monitor 25 long-term sediment sampling sites by conducting a QHEI/pebble count measurement to determine the change in quantity and quality of substrate material in creek bed every five years.
2) Conduct research about the historic substrate composition of the Lower Sunday Creek streambed.

Completed Projects

Work in the Lower Sunday Creek Subwatershed has focused primarily on home septic system upgrades, clean-up of illegal trash dumps, and several tree plantings.

Through an OEPA 319 Implementation Grant, the SCWG repaired or replaced 17 Home Sewage Treatment Systems (HSTS) throughout the watershed. The goal of the program was to remedy water quality problems in Sunday Creek Watershed neighborhoods where fecal coliform levels far exceeded Ohio's limit. Program participation was a success.

The cost-share program was a voluntary program in which homeowners were eligible to receive reimbursement for up to 75 percent of the total cost to upgrade

an on-lot, non-discharging septic system on their property. Program participants needed to complete the program by March 31, 2006 for reimbursement. The program focused on reimbursing residents near Oakdale, Hollister, Congress Run, Greens Run, Millfield, and Redtown who upgraded their old septic systems to systems that would not discharge to or pollute Sunday Creek.

The comparatively small number of systems and their spatial distance didn't quantitatively improve the water quality of the downstream segments. However, there still remains a documented need for centralized sewer systems or repair/replacement HSTS. For example, in Athens County it is estimated that there are nearly 28,000 Athens County residents (11,000 households) utilizing HSTS every day.

The Sunday Creek Watershed Group received funding through the Ohio EPA Supplemental Environmental Projects (SEP) grant to conduct trash clean-ups along steam banks and public lands. Eight clean-ups were completed. Projects were conducted along Big Bailey Road (Lower Sunday Creek Subwatershed), Johnson Run (West Branch Subwatershed), Sunday Creek, and throughout the watershed, leading to the removal of 63 tons of trash, tires and scrap metal. In addition, nine hundred tires and four tons of scrap metal were recycled. Volunteer help came from local residents; youth from Hocking Valley Correctional Resident Center (HVCRC); adults from the South East Probation Treatment Alternatives (SEPTA); the Civilian Conservation Corps (CCC); Wayne National Forest; Athens and Perry County crews; and Trimble, Monroe, and Dover Township Trustees. Clean-ups continue to be organized to help remove illegal dumps throughout the watershed.

Implementation of Plan

Table 34: Timeline and Activity Sheet to Address Lower Sunday Creek Impairments

Project Complete	2001-2009	2010	2011	2012	2013	2014-2020
Truetown Discharge						1 treatment system
Bailey Discharge						1 treatment system
Inventory septic system upgrades				Phase I	Phase II	Phase III and Phase IV
Monitor levels of fecal coliform and ammonia			Sample		Sample	
Trash clean-ups	**2001**- 1 trash clean-up **2002**- 6 trash clean-ups (over 5 tons of trash removed) **2003**-3 trash clean-ups **2004**-1 trash clean-up **2005**- 1 trash clean-up **2006**-1 trash clean-up **2007**- 1 trash clean-up **2008**-1 trash clean-up	1 trash clean-up event	2 trash clean-up events	2 trash clean-up events	2 trash clean-up events	2 trash clean-up events
Tree planting	**2005**- 150 trees **2009**-500 trees	500 trees		500 trees		500 + trees
Monitor pebble counts Sediment samples	**2001-**Pebble count baseline data			1 event		1 event

Sunday Creek Watershed Group

Section III:

Glossary and References

Glossary

acidic-A condition where the concentration of positively charged hydrogen ions is high; identified as having a pH less than 7.0.

attaining-Meeting the applicable aquatic life use designation.

best management practices-management practices (such as nutrient management) or structural practices (such as terraces) designed to reduce the quantities of pollutants, such as sediment, nitrogen, phosphorous, and animal wastes washed by rain and/or snow melt from land into nearby receiving waters, such as lakes, creeks, streams, rivers, estuaries and ground- water.

biodiversity-The variety of flora and fauna in a particular niche or ecotome. Generally, greater variety indicates a healthier environment.

fecal coliform-Bacteria that are common in the intestines and feces of both warm- and cold-blooded animals and are an indicator of possible sewage contamination.

flocculates-Metal precipitates which build up in streams as sediment. impairment-Any type of impact that degrades the health or water quality of the creek or waterbody.

limited resource water-The stream has been irretrievably damaged to the extent that no appreciable aquatic life can be supported.

macroinvertebrate-An environmental indicator of stream health, macro-invertebrates are crustaceans, insects (without a backbone) and worms, which assemble in semi-permanent populations. Numerous taxa of macro-invertebrates exist that are either pollutant-tolerant or pollutant-sensitive; thus they are a good indicator of water quality.

National Pollutant Discharge Elimination System-Established by the Clean Water Act of 1972, the program imposes effluent limitations and monitoring requirements on point source dischargers, which may include municipal, private and industrial sources. The NPDES permits may contain compliance schedules

to ensure construction of facilities needed to achieve the required effluent limitations.

non-attaining-Not meeting applicable aquatic life use designation.

nonpoint source pollution-Water pollution that results from a variety of human land use practices, such as agriculture, surface mines, forestry, construction sites, and urban yards and roadways. As a result, nonpoint source pollution is controllable by implementing land management practices that protect water quality and economic, social and political interests. These practices are often referred to as best management practices.

nutrient runoff-Phosphorous and nitrate bind to soils and are thereby transported with eroding soils. Synthetic fertilizers or manures applied to undeveloped cropland can wash off into streams and rivers, particularly when applied just prior to a large rain event.

overburden-Material of any nature, consolidated or unconsolidated, that lies on top of a deposit of useful materials, ores or coal, especially those deposits that are mined from the surface by open cuts.

pebble count- Method used to determine dominant substrate type in a creek bed.

point source pollution-Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fixture, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged.

publicly owned treatment works-Public water suppliers or wastewater treatment facilities.

sedimentation- The action or process of forming or depositing sediment. This affects water temperature, reduces aesthetic value, and causes degradation of aquatic habitat. Sources include eroding river banks and areas of disturbed soil caused by various human activities and animals.

siltation-The filling up of a water body with water-borne sediment.

sinuosity-The degree to which a stream channel has a meandering or straight pattern.

stream flow-The volume of water in a stream or riverbed varies according to the amount of rain or snowfall; it is usually greatest in the spring and lowest in the fall. Release of water from impoundments may also influence stream flow. The volume of flow affects the water body's carrying capacity. Thus, at low flows a stream would be more impacted by discharge and runoff than at high flow.

strata-Parallel layers of sedimentary rock.

subsidence holes-Surface of the land that sinks due to the settling of waste piles or other areas at mine sites.

substrate-Particles and organic matter on the stream bottom. Substrate size ranges from the finest sediments such as silt, clay, and mud, to increasingly larger particles: sand, gravel, cobble, boulders and solid bedrock.

substrate embeddedness-The extent to which substrate particles are surrounded or covered by fine sediment. When substrate embeddedness is high, spawning habitat is lost and macroinvertebrate populations are threatened.

sub-watershed-The watersheds of tributaries, which empty into larger streams or rivers.

surface water-water bodies which are visible at the surface of the earth (as opposed to underground aquifers).

topography-slope of the land expressed as percent slope. The amount of slope in an area affects the likelihood that a contaminant will run off from an area or be ponded and ultimately infiltrate into the subsurface. Topography also affects soil development and often can be used to help determine the direction and gradient of ground water flow under water table conditions.

total maximum daily loads-Consists of wasteload allocations and load allocations. Wasteload allocations determine the amount of pollutants that can be discharged from point sources without violating water quality standards. Load allocations consider nonpoint sources of pollution. Historically, TMDLs have focused on reducing loads of pollutants from point sources.

turbidity-Describes how the particles suspended in the water affect its clarity. It is a measure of how these particles scatter light as it passes through the water. It is an important indicator of suspended sediment and its effects on rivers.

water column-The width and depth of the water in the stream.

water quality standards-The rules set forth in Chapter 3745-1 of the Ohio Administrative Code establish stream use designations and water quality criteria (scientifically derived ambient concentrations developed by the state) that are protective of the surface waters of the state.

water resource-Includes the physical, chemical and biological features of water and its stream channel, riparian corridor and environs.

watershed-An area of land surrounding and 'shedding' water into a stream, a river, a lake, or wetland.

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Appendix One: Watershed Maps