319 WATERSHED IMPLEMENTATION PLAN:

BUFFALO CREEK WATERSHED
UNION COUNTY, PA

NOVEMBER 2008

PREPARED BY THE UNION COUNTY CONSERVATION DISTRICT
WITH ASSISTANCE FROM THE BUFFALO CREEK WATERSHED ALLIANCE

UNION COUNTY CONSERVATION DISTRICT

BCWA Buffalo Creek Watershed Alliance

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CHAPTER 1

WATERSHED OVERVIEW

OVERVIEW

The Buffalo Creek Watershed is located in central Pennsylvania and covers a land area of 134 square miles or 85,760 acres[1]. The watershed is in the heart of Buffalo Valley and is one of the most important watersheds and the largest in land area within Union County (See Figure 1.1). Buffalo Creek and its headwater tributaries originate in the western forested mountains of Union County and eastern Centre County. The main stem flows 28 miles from its origin to the mouth at Lewisburg where it empties into the West Branch of the Susquehanna River. The watershed has a regular dendritic drainage pattern. The meander ratio of Buffalo Creek is 1.18 with a relief ratio of 63.8 and a channel slope of 46.8 feet per mile.[2] Average annual precipitation is 42 inches with an average daily temperature of 51 degrees.[3]

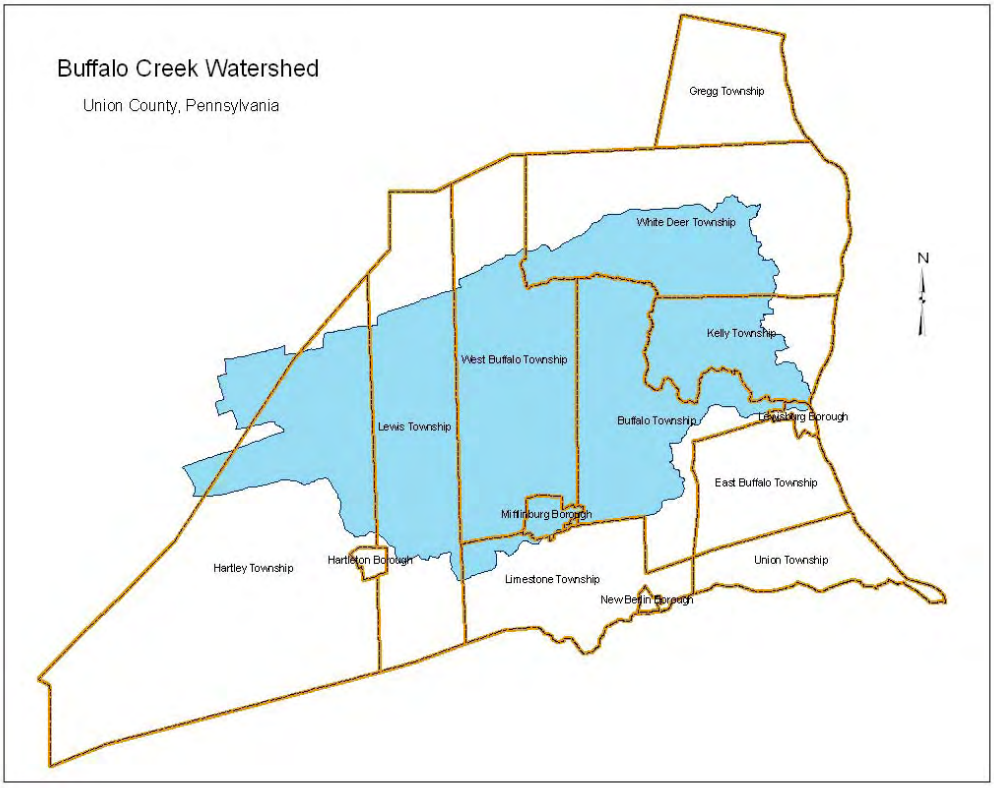

Figure 1.1 Map of the Buffalo Creek watershed located in Union County, Pennsylvania.

The Buffalo Creek watershed covers portions of 9 townships and two boroughs in parts of two counties. In addition to the two larger boroughs of Lewisburg and Mifflinburg, the watershed includes villages and locales such as Pleasant Grove, Forest Hill, Vicksburg, Cowan, Mazeppa, Buffalo Crossroads, Kelly Crossroads and Kelly Point. In total, the watershed is home to nearly 15,000 people.[4]

LAND RESOURCES

As stated above the Buffalo Creek watershed is 134 square miles in area. Topography throughout the watershed is varied. The headwater areas in the western and northern regions of the watershed are more rugged and mountainous with steeper ridges while the central and eastern portion is a more level to small-scale rolling hill topography.

GEOLOGY

Geology in the Buffalo Creek Watershed and all of Union County is within the Ridge and Valley Physiographic Province and is characterized by folded, faulted and fractured sedimentary rocks. The Buffalo Valley lies between topographic highs to the northwest and southeast. Over time less resistant, younger bedrock has weathered away exposing more resistant older bedrock. These older rocks are typically sandstones and conglomerates of the Tuscarora, Juniata, and Bald Eagle Formations. The valley floor occurs in younger carbonate rocks of the undifferentiated Keyser and Tonoloway Formations. The Keyser and Tonoloway Formations include nodular limestone, and, argillaceous (shaley) limestone and dolomite. In addition the undifferentiated Onondaga and Old Port Formations consist of cherty limestone, calcareous shale and calcareous sandstone. The Union County Water Supply and Wellhead Protection Plans identify these limestone formations as having a greater capacity to yield groundwater. Buffalo Creek flows mostly on weaker, easily-eroded rocks in the major valley or in the synclines between anticlinal ridges while some of the headwaters show evidence of being superimposed on resistant rock. To this day Buffalo Creek and its tributaries are responding to a geologic framework imposed millions of years ago by deposition of sediments, deformation of rocks, and subsequent differential erosion of weak and strong rocks to form valleys and uplands.[5]

Often people overlook the importance or influence geology has on a stream network. In the Buffalo Creek watershed the underlying geology has been found to have a dramatic impact on water quality. For example in the headwaters of Buffalo Creek the stream is chronically acidified in the upper five to seven miles due to acid deposition (acid precipitation) while just over the mountains to the north the North Branch of Buffalo Creek and Spruce Run are not. The reason the other two are not similarly affected is believed to be a result of the geology. The North Branch and Spruce Run originate in rock that contains carbonate minerals (i.e. limestone and dolomite) which provide natural buffering capacity, while the main stem headwaters are in a Tuscarora sandstone formation which cannot neutralize the acid precipitation. Refer to Figure 1.2 for map of the watershed surface geology and Appendix A for geologic descriptions.[6]

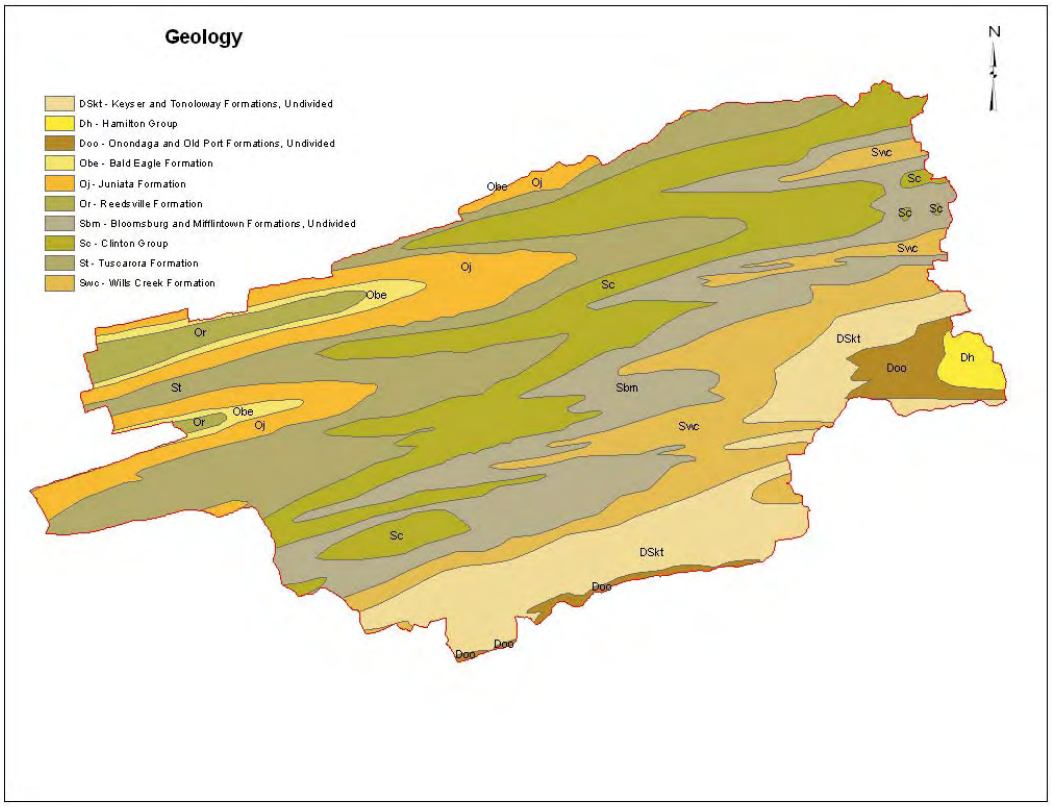

Figure 2.1 Surface geology of the Buffalo Creek watershed.

SOILS

Soils throughout the watershed are varied and can be classified into specific soil associations or generalized categories such as hydrologic soil groups which provide a basic description of how certain soil associations will affect water runoff. Individual soil associations that are commonly found in the watershed and make up a significant portion of the overall soil cover include the following: LaidigBuchanan-Meckesville, Dekalb-Ungers-Hazelton, Weikert-Berks-Hartleton, Edom, Hagerstown-Elliber-Washington, Holly-Basher-Monongahela, Allenwood-Alvira-Shelmadine, and Klinesville-CalvinMeckesville.[7]

The hydrologic soil groups are in four main sub-groups lettered “A” through “D” based on infiltration rate and depth. Refer to Figure 1.3 for the watershed hydrologic soil grouping map. Hydrologic Soil Group (HSG) “A” soils are the most permeable and have the lowest runoff potential while HSG “D” soils have low permeability and have a high runoff potential. Often these are floodplain and wetland soils. The majority of the soils in the watershed fall into the HSG “B” and “C” categories with HSG “B” soils found mainly in the western upper portion of the watershed and “C” soils in the eastern reaches.[8]

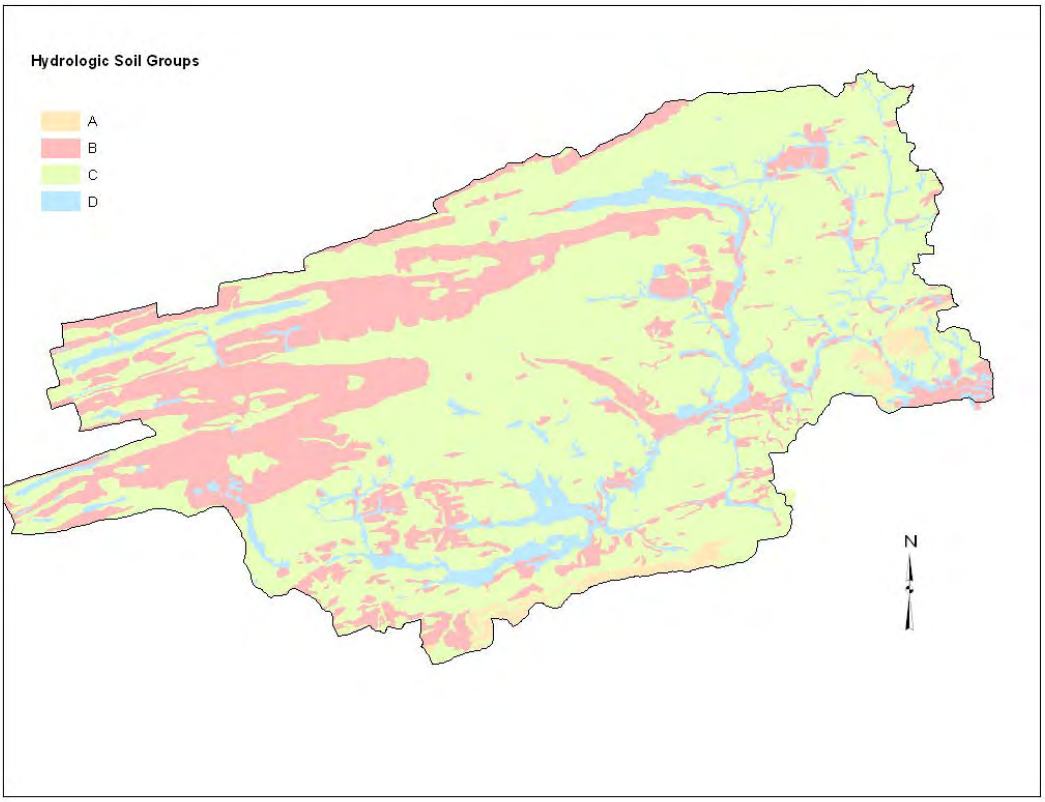

Figure 1.3 Hydrologic soil groups in the Buffalo Creek watershed.

FLOODPLAINS & WETLANDS

Floodplains are low-lying areas adjacent to watercourses that are either inundated or likely to be inundated by flood waters and serve to store excess water during high flow events. Typically the floodplain is expressed in terms of the 100-year floodplain, which is the area of land adjacent to a stream that would be flooded by a storm on the magnitude of having a statistical probability of occurring once every 100 years or a one percent chance in any year. In many cases floodplains are delineated on maps and in Flood Insurance Studies prepared by the United States Department of Housing and Urban Development or the Federal Emergency Management Agency. For those streams that do not have floodplains identified by such sources the regulatory floodway and floodplain in Pennsylvania is 50 feet landward from the top of the stream bank as per the regulations contained in Title 25, Chapter 105 of the Pennsylvania Code. Within the Buffalo Creek Watershed there are 3,945 acres of floodplains that are mapped by the Federal

government. In addition there are 1,672 acres of additional floodplains in the watershed based on the 50 foot rule. Refer to Figure 1.4 for a map of floodplains in the watershed.

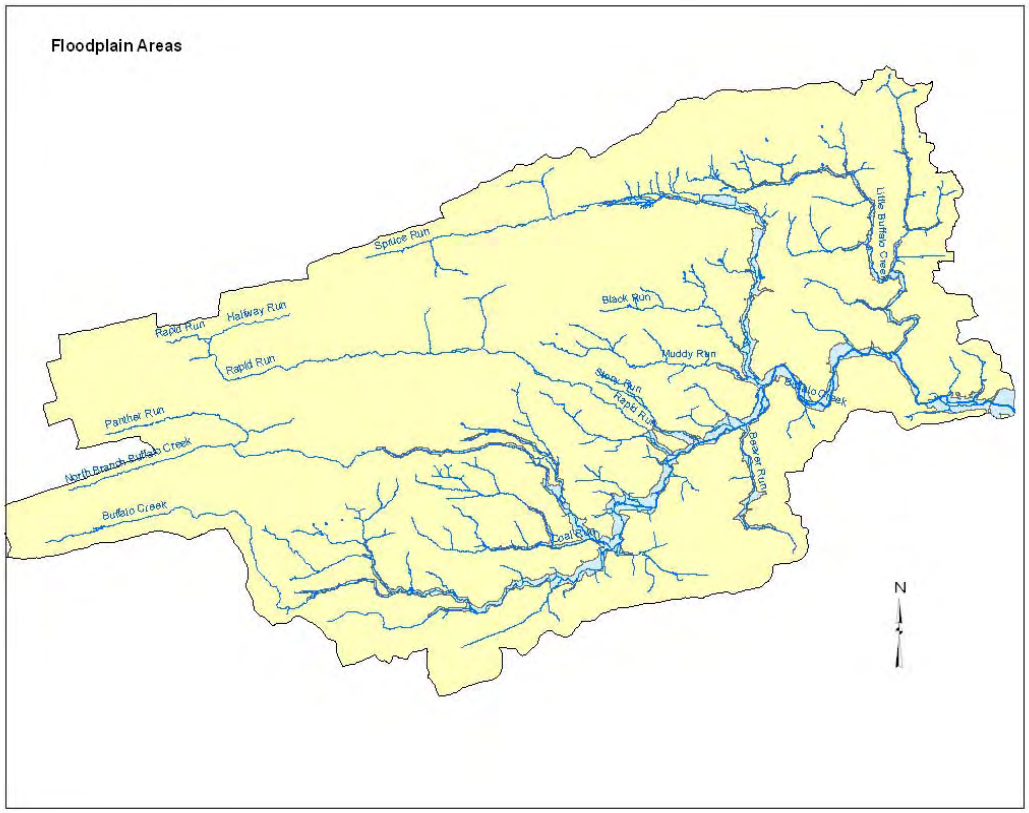

Figure 1.4 Floodplain areas throughout the Buffalo Creek watershed.

Wetlands are defined as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation adapted for life in saturated soil conditions and includes terms such as swamps, marshes, bogs, fens, and similar areas. Wetlands perform many important functions within watershed ecosystems such as filtering sediments and pollutants, groundwater recharge, floodwater storage and wildlife habitat. In the Buffalo Creek Watershed there are 800 acres of wetlands mapped on the National Wetland Inventory (NWI) which was prepared and is maintained by the United States Department of Interior, Fish and Wildlife Service. However these maps are very general in nature and should be used with extreme caution. They cannot be relied upon to determine if a site does or does not contain wetlands. Professionals experienced in wetland regulation and permitting believe the NWI maps miss 50% or more of all actual wetlands.[9] If this is the case there would actually be at least

1,600 acres of wetlands in the Buffalo Creek Watershed. Due to the unreliability and frequent misuse of the NWI data a wetlands map was not included in this watershed plan.

WATER RESOURCES

The watershed has over 268 stream surface miles that range in quality from pristine reaches to those with lesser attributes. Major tributaries to Buffalo Creek include: North Branch of Buffalo Creek, Rapid Run, Spruce Run, Beaver Run, and Little Buffalo Creek. Waters in the Commonwealth of Pennsylvania have been assigned water quality designations which are contained in Title 25, Chapter 93- Water Quality Standards of the Pennsylvania Code. Buffalo Creek and its tributaries are listed in Table 1.1 along with the applicable use classification assigned by the PA DEP. Water quality standards can be found in Tables 1.2 and 1.3.

Table 1.1 Buffalo Creek watershed tributaries and their designated uses.

Name	Segment	Designated Use[1]
Buffalo Creek	Source to SR 3005 bridge	HQ-CWF
Buffalo Creek	SR 3005 bridge to Rapid Run	CWF
Buffalo Creek	Rapid Run to mouth	TSF
Unnamed tributaries to Buffalo Creek	Basins, SR 3005 bridge to Rapid Run	CWF
North Branch Buffalo Creek	Source to Mifflinburg Reservoir	EV
North Branch Buffalo Creek	Mifflinburg Reservoir to mouth	HQ-CWF
Rapid Run	Basin	HQ-CWF
Unnamed tributaries to Buffalo Creek	Basins, Rapid Run to mouth	CWF
Stony Run	Basin	HQ-CWF
Beaver Run	Basin	CWF
Spruce Run*	Basin	HQ-CWF[11]
Little Buffalo Creek	Basin	CWF

[1]HQ-CWF = High Quality Cold Water Fishery, * Headwaters to Bald Eagle State Forest Boundary is in CWF – Cold Watery Fishery and is in the process of being upgraded to EV. TSF – Trout Stocking EV- Exceptional Value

High Quality-Cold Water Fisheries are streams or watersheds that have excellent water quality and environmental or other features that require special water quality protection. They also maintain and/or

propagate fish species, including the Salmonidae family, and additional flora and fauna which are indigenous to a cold water habitat. A Cold Water Fishery is similar except it lacks the higher-level water quality protection provisions under state law. An Exceptional Value stream or watershed constitutes an outstanding national, state, regional or local resource such as waters of national, state, or county parks, forests, or waters which are a source of unfiltered potable water supply…or of substantial recreational or ecological significance. Only one area of the watershed has attained this designation, North Branch of Buffalo Creek, although a case could perhaps be made for the upper reaches of Spruce Run from its source to the Spruce Run Reservoir. Both the North Branch of Buffalo Creek and Spruce Run are public drinking water supplies. Trout Stocked Fisheries are waters that maintain stocked trout from February 15th to July 31st and also support the maintenance and propagation of fish species and other flora and fauna that are indigenous to a warm water habitat.

Table 1.2 Water quality standards and their critical use.

Parameter	**Criteria**	**Critical Use***
Alkalinity	Minimum 20 mg/L as $CaCO_3$ (except where natural conditions are less)	CWF, WWF, TSF, MF
DO_1	Minimum daily average 6.0 mg/L	CWF
DO_3	Minimum daily average 6.0 mg/L (Feb 15 - July 13), 5.0 mg/L (rest of year)	TSF
DO_4	Minimum daily average 7.0 mg/L	HQ-CWF
Iron	30-day average 1.5 mg/L as total recoverable	CWF, WWF, TSF, MF
Osmotic Pressure	Maximum 50 milliosmoles/kg	CWF, WWF, TSF, MF
pH	From 6.0 to 9.0 inclusive	CWF, WWF, TSF, MF
Chlorine	Four-day average 0.011 mg/L as total residual	CWF, WWF, TSF, MF

*EV streams based on existing quality

Table 1.3 Temperature standards by critical use.

	Temperature (F)		
Critical Use Period	**CWF**	**WWF**	**TSF**
January 1-31	38	40	40
February 1-29	38	40	40
March 1-31	42	46	46
April 1-15	48	52	52
April 16-30	52	58	58
May 1-15	54	64	64
May 16-31	58	72	68
June 1-15	60	80	70
June 16-30	64	84	72
July 1-31	66	87	74
August 1-15	66	87	80
August 16-30	66	87	87
September 1-15	64	84	84
September 16-30	60	78	78
October 1-15	54	72	72
October 16-31	50	66	66
November 1-15	46	58	58
November 16-31	42	50	50
December 1-31	40	42	42

Besides Chapter 93 the PA DEP maintains a statewide list of impaired waters as is required by the Federal Clean Water Act. This list was previously referred to as the 303.d list but is now commonly called the Integrated Streams list. There are a number of stream reaches in the Buffalo Creek Watershed that are on this list. The location of these and their sources of stream impairment will be identified later in this report and on the map in Appendix A.

Often overlooked but equally important to surface water is the groundwater in the watershed. The watershed is underlain by a complex underground flow regime that provides well owners with potable water and serves as the main source of water for stream base flow during the dryer months of the year. In the Buffalo Creek Watershed groundwater quality and quantity is linked to the underlying geology. Limestone aquifers typically produce larger yields of water but can be susceptible to pollution due to the fractured nature of the formations. Sinkholes and other cracks and voids can develop over and within limestone that can eventually become direct conduits for pollutants to enter the groundwater supply. Once it is contaminated groundwater is extremely difficult to clean, and treatment measures are often cost prohibitive. Even small amounts of

substances around the home like motor oil, gasoline, and pesticides can ruin millions of gallons of water.

Biological resources of the watershed include all the plant and animal species that dwell in the woods, waters, and open areas of the drainage basin including but not limited to aquatic and terrestrial insects, fish, vegetation, mammals, reptiles, trees, shrubs, grasses, and other vegetation. The watershed forests are primarily deciduous hardwoods of oak, cherry, maple, hickory and beech with coniferous stands of hemlock and pine interspersed.

Common fish in the colder flowing stream segments are brook and brown trout while the warmer water reaches hold suckers, smallmouth bass and those species tolerant of warmer conditions. Half of all Pennsylvania Fish and Boat Commission approved trout waters in Union County are in the Buffalo Creek Watershed and include: Buffalo Creek from the T-366 Bridge on Aikey Road in Hartley Township downstream to the confluence with Rapid Run at Cowan, Halfway Lake at Raymond B. Winter State Park, North Branch of Buffalo Creek, Rapid Run and Spruce Run. In addition two of the four Class A Wild Trout Waters in Union County are in the watershed and include the North Branch of Buffalo Creek (brook trout) above the Mifflinburg Reservoir intake and Rapid Run (brown trout) from the Walbash Road Bridge on T-383 upstream to Buffalo Path.

A summary and description of available in-stream biological data will be presented in the next chapter of this plan. The watershed is also home to a variety of wildlife such as whitetail deer, black bear, wild turkey, songbirds, raptors, waterfowl, rodents such as mice, squirrel, muskrat and chipmunk, red and gray fox, raccoon, opossum, skunk, reptiles and amphibians too numerous to mention. Probably unbeknownst to the average homeowner is the fact the watershed also contains a number of species of special concern, such as rare, threatened, or endangered plants and animals, that were identified in the Union County Natural Areas Inventory of 1993 and the 2000 update.

LAND USE

Land use can significantly influence water quality. Generally areas undeveloped with little human presence have better water quality while streams in and around agricultural and developed areas generally show some signs of degradation. Erosion from cultivated fields and streambanks where livestock is not excluded, manure runoff, and over-application of fertilizer and pesticides can be problems associated with land that is farmed. Land that is used for residential and commercial purposes often contribute excessive amounts of stormwater runoff, pollutants that wash off parking lots, thermal inputs, and increased nutrient loads associated with over application of lawn and garden chemicals, malfunctioning on-lot septic systems and effluent from sewage treatment plants.

The predominant land uses in the watershed are forest at approximately 60 percent, a significant portion of which is within the Bald Eagle State Forest District, and agriculture at 34 percent. The remaining six percent is developed in the form of residential, commercial, industrial and institutional uses. The majority of the forested area lies in the western and northern extremities of the watershed while the central and eastern portion is largely farmland with development mainly concentrated in the Lewisburg and Mifflinburg regions. Figure 1.5 shows the distribution of land uses throughout the watershed.

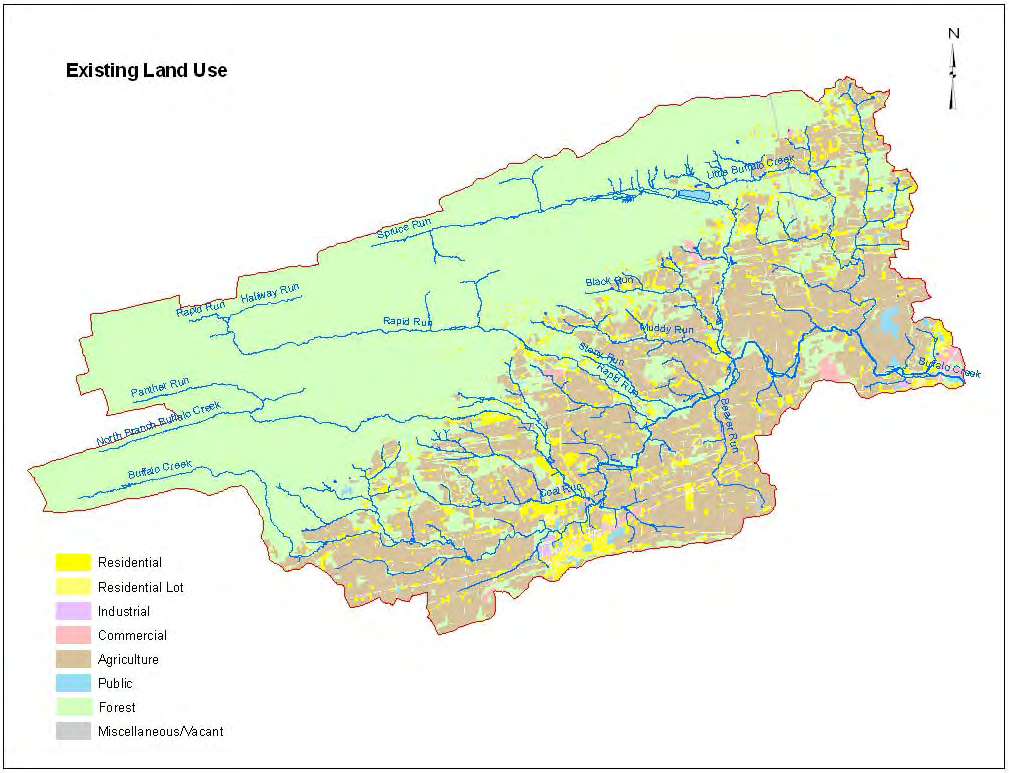

Figure 1.5 Existing land use in the Buffalo Creek watershed.

Expected future development will primarily occur where it is most easily attained under existing land use regulations, such as zoning ordinances, and where it will be readily served by necessary infrastructure like roads, water, and sewer. By examining the municipal zoning districts and associated infrastructure service areas, it appears the majority of future development will occur in and around Mifflinburg and Lewisburg Boroughs, particularly the PA Route 45 corridor. However, growth is also expected in and around the villages of Vicksburg and Pleasant Grove and northwest of Mazeppa in the Black Run area.

Currently about 38% of the watershed is zoned Agricultural Preservation and 36% Woodland/Public Land. Agricultural and Woodland zoning, although intended to be conservation type zoning districts, do not preclude development of those areas. Generally non-agricultural development is permitted to a limited scale. Today's changing nature of agricultural production can bring significant development to the watershed even in the agricultural areas. Newly constructed barns intended to house large animal production operations are often 20,000

to 40,000 square feet per structure. One of these facilities can contribute as much impervious surface as a small residential development of five to seven homes, and nearly 8% is zoned low density residential, while approximately 4% is zoned medium to high density residential, typical of suburban and urban development patterns. If one were to guide growth within a watershed with the goal of maintaining a healthy ecosystem the best approach might be to locate the most intense growth near the mouth or stream outlet thereby confining the negative impacts of human impact to a smaller area. However in this watershed much of the rural residential zoned land is in the middle of the watershed. In much of these areas zoning promotes what is typically referred to as suburban sprawl where there are homes on larger lots of at least one-acre in size with wider than necessary streets. Commercial zoned areas barely account for 1% of the entire watershed land area. It should be noted that there are two areas in the watershed that are not zoned that equal about 5% of the watershed in Haines, Miles and Limestone Townships. The land in Haines and Miles Townships are in the Bald Eagle State Forest but the 1,108 acres in Limestone Township is in private ownership. Refer to Figure 1.6 for watershed zoning districts. Figure 1.7 shows the protected lands in the watershed in the form of state forest, state parks, state gamelands, preserved farms, conservation easements and federal reservation which accounts for 33,000 acres or 33% of the land area.

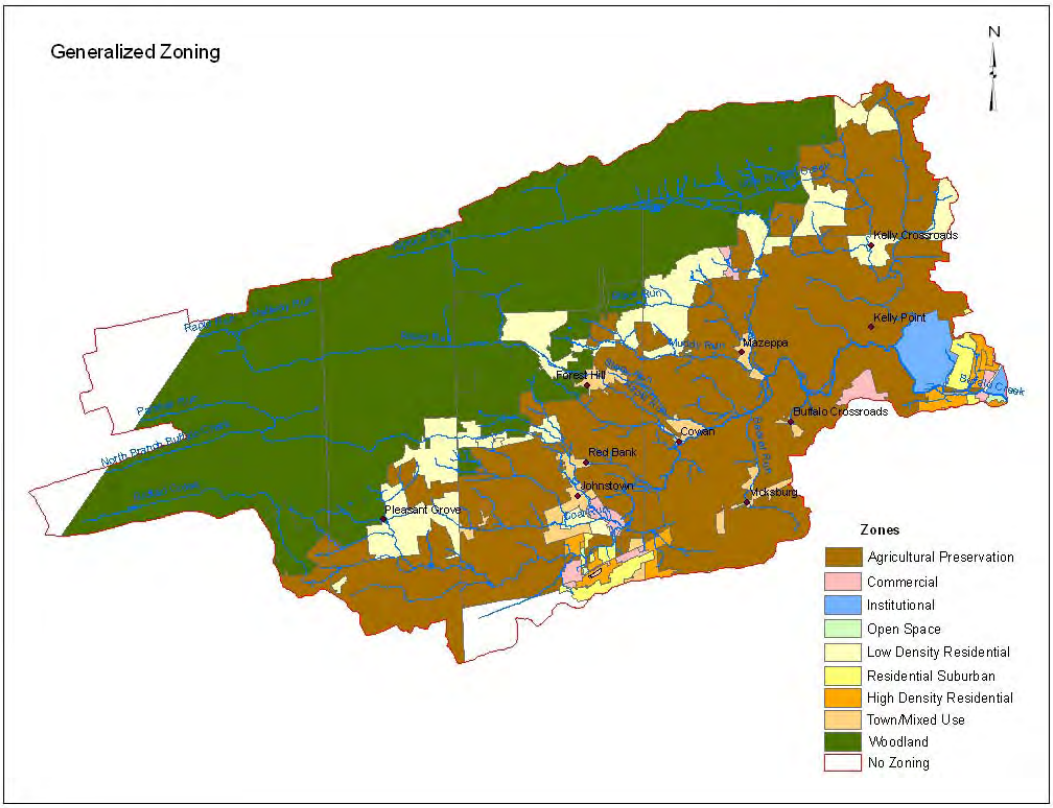

Figure 1.6 Zoning districts within the Buffalo Creek watershed.

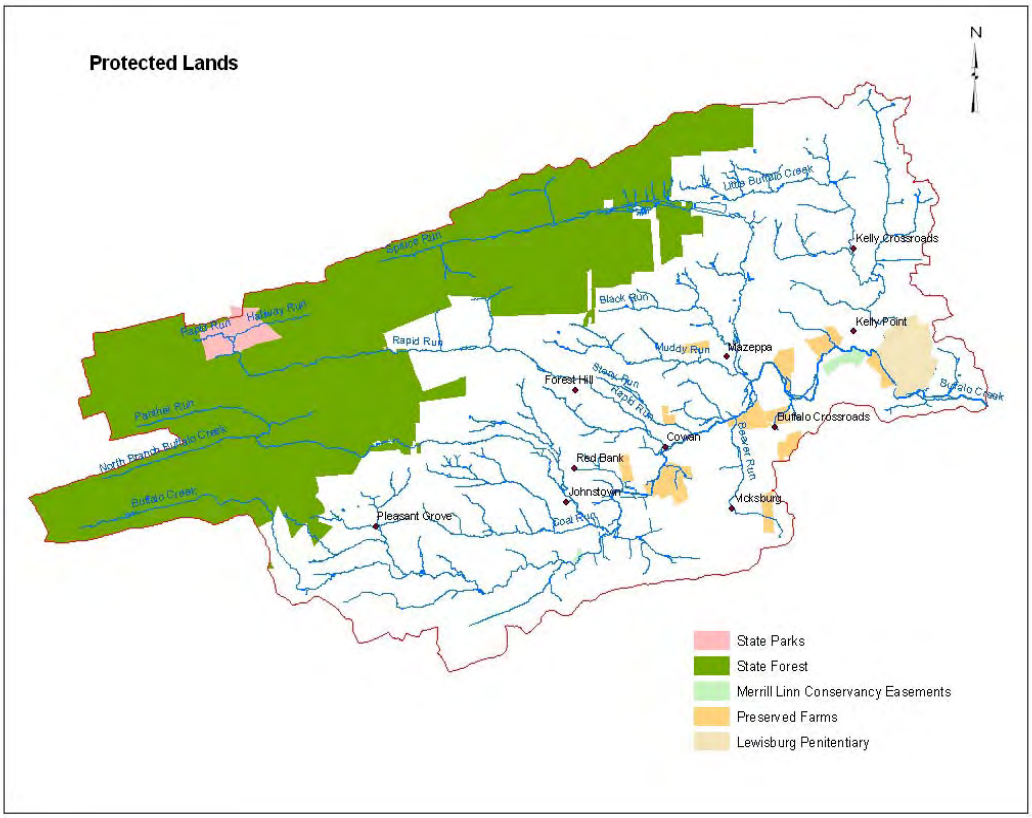

Figure 1.7 Protected lands within the Buffalo Creek watershed.

Within the watershed there are two water supply reservoirs, one operated by Mifflinburg Borough on the North Branch of Buffalo Creek and the other is operated by the Pennsylvania American Water Company on Spruce Run. At one time Pennsylvania American had land holdings along Rapid Run as a potential future water supply; however, the company recently sold a number of these holdings. The Borough of Mifflinburg provides a public water system to its residents and to a limited number of homes in the surrounding townships of Buffalo, Limestone and West Buffalo. Pennsylvania American supplies water to the eastern fringe of the watershed in Lewisburg Borough and portions of Kelly Township. There are two sewage treatment plants with effluent discharges into Buffalo Creek; these are the Mifflinburg Borough and the Buffalo Township Sewage Treatment Plants. The Mifflinburg plant had a 10-year Average Monthly Daily Flow of 0.74 million gallons per day (MGD) from 1995 to 2004 and is currently rated for an Average Daily Flow of 1.40 MGD.[12] The plant uses gaseous chlorine for primary disinfection. Presently Mifflinburg is looking to invest several million dollars to bring

the plant into compliance with the latest Chesapeake Bay nutrient removal requirements. The Buffalo Township operation is permitted for 0.05 MGD and is operating at approximately 50% capacity.[13]

Transportation infrastructure in the watershed is limited to roadways as the area is too rural to support public transit. The major roadways are PA Routes 45 and 192 that bisect the middle of the watershed and provide an east-west connection from Lewisburg to the greater State College region. US Route 15 passes through a small portion of the watershed near the mouth of Buffalo Creek.

The Mifflinburg Area School District has several schools in the watershed including the elementary, intermediate, middle, and high schools in the Borough of Mifflinburg and the Buffalo Crossroads Elementary School in Buffalo Township. The BCWA has utilized a number of these facilities for public meetings in the past. In addition Buffalo Township, Mifflinburg Borough, and West Buffalo Township have their buildings and maintenance operations in the watershed. Union County Government also owns a building adjacent to the Mifflinburg Borough office which BCWA has frequently used.

ENDNOTES

[1] Union County Geographic Information System. Lewisburg, PA, 2005.

[2] Commonwealth of Pennsylvania, Department of Environmental Resources, Gazetteer of Streams. 1978.

[3] DeBarry, Paul. Buffalo Creek Act 167 Stormwater Management Plan. Stroudsburg, PA. 1998.

[4] Union County Planning Department estimates based on United States Census Bureau, 2000 Decennial Census. 2005, Lewisburg, PA.

[5] Nickelsen, Richard. Unpublished *Geology of the Buffalo Creek Watershed.* Lewisburg, PA, 2002.

[6] Wardrop, Richard and Ewart, Dr. James. Union County Wellhead and Aquifer Protection Plan. State College, PA.

[7] United States Department of Agriculture. Soil Survey of Union County, PA. March 1985.

[8] DeBarry, Paul. Buffalo Creek Act 167 Stormwater Management Plan. Stroudsburg, PA. 1998.

[9] Personal communiqué with staff of Union County Conservation District and Mid-Penn Engineering, Corp. Lewisburg, PA. 2005.

[10] Commonwealth of Pennsylvania, Title 25, Chapter 93: Water Quality.

[11] Exceptional Value designation proposed and pending for headwaters to the eastern boundary of Bald Eagle State Forest as per Commonwealth of Pennsylvania, Department of Environmental Protection, July 19, 2006. Available online at http://www.depweb.state.pa.us/watersupply/lib/watersupply/Co60.pdf.

[12] Herbert, Rowland, & Grubic. Borough of Mifflinburg Act 537 Plan Update. State College, PA. 2005.

[13] Personal communiqué with Larry Berger of Buffalo Township Sewer Authority.

CHAPTER 2

WATERSHED CONDITION

As the title would suggest this chapter presents a summary of existing watershed conditions based on relevant and available data and reports. This information has been synthesized to identify critical issues within the watershed that are presently causing, or could in the future result in stream impairment or degradation of the ecosystem.

EXISTING REPORTS AND STUDIES

There are a number of existing reports and studies that provide data and information about the Buffalo Creek Watershed. Some of these are published, while others are simply raw data sheets that have not been compiled, analyzed, and thoroughly reported. The following is a list of documents known to be available entirely about, or having a heavy concentration on, conditions in the Buffalo Creek Watershed.

1985 *Buffalo Creek Watershed, Union County Pennsylvania Watershed Plan* – prepared by the Union County Conservation District and the USDA Soil Conservation Service

1998 *Buffalo Creek Act 167 Stormwater Management Plan* – prepared by RKR Hess Associates for Union County

1998 *Union County Water Supply and Wellhead and Aquifer Protection Plan* – prepared by Gannet Fleming, Inc. and Nittany GeoScience, Inc. for Union County.

1998 *Biological and Hydraulic & Hydrological Investigations of Buffalo Creek Watershed, PA* – prepared by Versar, Inc. for the United States Army Corps of Engineers and Union County

2004 *A Physical, Chemical, and Biological Assessment of Buffalo Creek* – prepared by the Lycoming College Clean Water Institute on behalf of BCWA.

2005 *Technical Report Summary: Hydrogeomorphic Studies of Buffalo Creek (2003-2005)* – prepared by Dr. Craig Kochel, Bucknell University on behalf of BCWA.

2005 *A Physical, Chemical, and Biological Assessment on Buffalo Creek Tributaries* – prepared by the Lycoming College Clean Water Institute on behalf of BCWA.

2007 *Buffalo Creek Watershed Alliance Watershed Management Plan* – prepared by BCWA with assistance for the Union County Conservation District, Union County Planning Commission, and PA Department of Environmental Protection. *(This plan serves as the primary source for Chapters 1, 2, and 3 of this WIP.)*

SUBWATERSHEDS

The Buffalo Creek Watershed is made of smaller subwatershed areas. The watershed has eleven main subwatersheds, including the main stem of Buffalo Creek, that range in size from one to 40 square miles in land area. Figure 2.1 shows and Table 2.1 lists each subwatershed and the contributing drainage acreage to the total watershed. As can be seen from Table 2.1 the main stem of Buffalo Creek is the largest contributor to the entire system with Little Buffalo, Rapid Run and Spruce Run all nearly equal in size. Figure 2.1 shows the subwatershed boundaries, land use, and impaired waters.

Table 2.1 Subwatersheds of the Buffalo Creek watershed

Subwatershed	Square Miles	Acreage	% Contribution	Forested	Agriculture	Existing Imperv.	Future Imperv.
North Branch	14	8,720	10%	87%	9%	2%	10%
Spruce Run	18	11,434	13%	88%	9%	2%	7%
Black Run	5	3,009	3%	71%	22%	3%	31%
Muddy Run	5	2,928	3%	57%	35%	3%	26%
Stony Run	1	925	1%	61%	32%	3%	30%
Little Buffalo	19	12,147	14%	54%	37%	3%	26%
Panther Run	3	2,024	2%	100%	0%	0%	0%
Beaver Run	5	3,051	3%	6%	83%	7%	41%
Coal Run	5	3,405	3%	40%	50%	3%	24%
Rapid Run	19	11,926	14%	88%	7%	2%	7%
Buffalo (Main)	40	25,517	30%	38%	51%	8%	28%

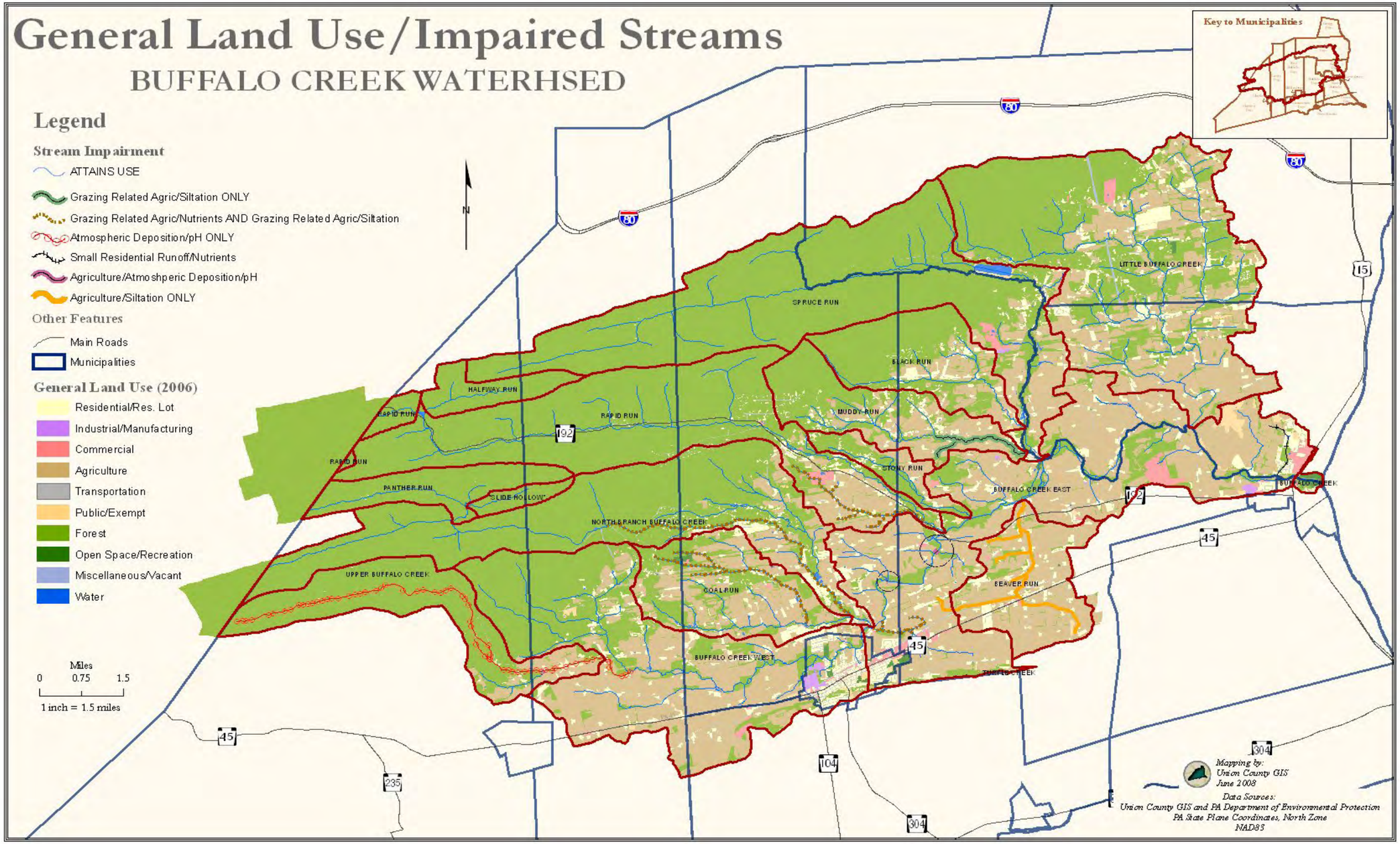

Figure 2.1 Land use, subwatersheds, and impaired streams of the Buffalo Creek Watershed.

From Table 2.1 it is easy to see the distribution of forested and agricultural land in the sub-watersheds, which should correlate to expected levels of impairment from sources such as nutrients, livestock access, etc. But the profound effects of urbanization and suburbanization on the hydrology, morphology, and water quality are also important. Research has quantified the relationship between development and the health of watersheds; the Center for Watershed Protection has suggested that once impervious coverage in a watershed reaches 25% or greater the stream will be impaired to a point it can no longer attain its original water quality designation.[4] Table 2.2 also shows the existing and future impervious coverage under existing zoning requirements. Seven of the eleven subwatersheds will be near or above that 25% threshold in the future.

BIOLOGICAL CONDITIONS

Benthic macroinvertebrates are extremely useful indicators of water quality conditions and respond to a variety of physical and chemical changes in streams. As a result, they have been used to determine the health of streams throughout Pennsylvania, including Buffalo Creek. BCWA reviewed benthic macroinvertebrate data from surveys conducted in 1993, 1995, 1998, and 2000 by PA DEP and 2004 (main stem) and 2005 (tributaries) by Lycoming College Clean Water Institute (CWI) to describe the biological condition of sites throughout the Buffalo Creek watershed. Based on our evaluation of data from these six surveys, several observations can be made related to reach-specific conditions along the main stem and tributaries along with patterns over time. In general, the main stem and many tributaries (e.g., North Branch, Rapid Run, Stony Run, and unnamed tributary in Pleasant Grove) support healthy benthic macroinvertebrate populations. Benthic macroinvertebrate assemblages in much of the main stem and healthy tributaries contain greater than 15 families, many of which are pollution-sensitive Ephemeroptera, Plecoptera, and Trichoptera (EPT) families. However, invertebrate assemblages from several sites indicate impairment from acid deposition in the headwater sites, agriculture and development along the main stem in the valley and on tributaries, and inadequate or improper sewage treatment in the Mifflinburg area.

The more pervasive factors causing biological impairment of streams in Buffalo Creek are agriculture and development. In the main stem, sites surrounded by and downstream of agriculture were characterized by lower abundance of pollution-sensitive invertebrates (lower EPT) and higher abundance of tolerant Hilsenhoff Biotic Index (HBI) invertebrates than less impaired tributaries of similar size (e.g., Rapid Run, Little Buffalo Creek, Spruce Run). As you move down the main stem, diversity and abundance of pollution-sensitive taxa decreases (lower EPT, higher HBI), which indicates the cumulative effects of agriculture and development in the watershed. Although not "technically" impaired, these observations suggest that Buffalo Creek is not achieving its biological potential and could be particularly vulnerable to further degradation from agriculture and development. Agriculture and development appear to affect Buffalo Creek primarily through high sediment loading (as evidenced by several tributaries with impaired habitat), but the stream also shows moderate eutrophication from nutrient loading.

DEP has identified and listed many impaired tributaries in Buffalo Creek as a result of agricultural activity in the sub-watersheds and riparian zones. However, some tributaries like Beaver Run, which is equally degraded but did not receive an impaired designation, should be reconsidered by DEP. In Beaver Run chemical and biological indicators point toward a more pronounced problem than was recognized by the PA DEP during its assessment. Beaver Run registers high nitrogen levels and lacks macroinvertabrate diversity as pollution tolerant species are most prevalent. In September of 2006 BCWA petitioned the PA DEP Northcentral Regional Office to reconsider data for Beaver Run that was summarized by Bucknell University professor Matthew McTammany, Ph.D. in hopes the tributary would be reclassified as an impaired stream to accurately reflect the observed state of the drainage basin[6]. This would make work to correct agricultural impacts along Beaver Run eligible for Section 319 funding. Beaver Run was reevaluated by DEP, and was officially listed as impaired in the 2008 Integrated Streams List (see Table 2.2).

Biological data also indicate some positive patterns related to riparian management and wetland restoration efforts in two major tributaries. Little Buffalo Creek is less impaired biologically than

was expected given the amount of agriculture and the local fervor about livestock activities in the watershed. Several forested riparian zones have been established on previously agricultural land as part of USDA's Conservation Reserve Enhancement Program (CREP). In addition, some landowners have re-created wetlands along Little Buffalo Creek to improve habitat for waterfowl. The cumulative effect of these activities enables the Little Buffalo Creek watershed to support agriculture while maintaining healthy biological communities in streams.

The effects of the Mifflinburg Sewage Treatment Plant (STP) on water quality and benthic macroinvertebrates in Buffalo Creek were assessed in some detail by the PA DEP in 1993 and 1995. During these surveys, macroinvertebrates immediately at and downstream of the Mifflinburg STP were less diverse and were comprised of fewer pollution-sensitive and more pollution-tolerant groups than at sites upstream of the plant. These negative effects appeared to remain highly localized and did not affect benthic macroinvertebrates for more than a mile downstream. According to DEP, the Mifflinburg STP has fixed the problems in its treatment system that caused these impairments in the mid-1990s. As a result, surveys in 1998, 2000, and 2004 do not indicate any effect of the STP effluent on Buffalo Creek at sites near the STP or further downstream. This finding enables us to have cautious optimism that Mifflinburg STP effluent effects have been improved and no longer have a major influence on macroinvertebrates in Buffalo Creek.

SUBWATERSHED IMPAIRMENT

The various reports and data point to several impairment problems, such as widespread erosion and sedimentation (silt loading), elevated nutrients, and atmospheric deposition. There is a total of 37.5 miles in the watershed included on the state and federal impaired waters list that require the development and implementation of Total Maximum Daily Loads (TMDL's). A TMDL is the total allowable pollutant load a water body can receive while still maintaining water quality standards for its designated use. This allowable load includes all contributing point and non-point sources. A TMDL report includes these allowable loads as well as sections on pollutant source

analyses, margins of safety, seasonal variations, critical conditions, public participation, implementation, and monitoring. Table 2.2 lists the stream segments, miles of impairment, cause of impairment, and date by which a TMDL will be developed by the Pennsylvania Department of Environmental Protection. These impaired waters are also shown on Figure 2.1 and on the watershed map found in Appendix A. Thus far the only TMDL that has been developed by the PA DEP is for the headwaters area that is impacted by atmospheric deposition.

Table 2.2 Impaired streams in the Buffalo Creek watershed.

Map No.	Stream	NHD Code	Assess. ID	Miles Impacted	Cause	TMDL Date
1	Buffalo Creek	02050206000290	981	9.3	Atmospheric deposition/pH	2005
2	Tributaries to Coal Run	02050206000650	1025	5.1	Grazing related agric/nutrients and siltation	2015
3	North Branch of Buffalo Creek	02050206000410	1286	5.9	Grazing related agric/nutrients and siltation	2015
4	Tributaries to Rapid Run	02050206000638	1286	4.1	Grazing related agric/nutrients and siltation	2015
5A	Buffalo Creek	02050206000281	8141	0.02	Agric/unknown, Atmospheric deposition/pH	2008
5B	Buffalo Creek	02050206000281	8141	0.09	Agric/unknown, Atmospheric depositions/pH	2008
6	Tributaries to Buffalo Creek	02050206000668	1159	1.3	Grazing related agric/nutrients and siltation	2015
7	Beaver Run and tributaries *(2008 list)*	02050206000670	14157	7.8	Agriculture/siltation	2021
8	Muddy Run and tributary	02050206000623	932	2.6	Grazing related agric siltation	2015
9	Tributary to Buffalo Creek	02050206000610	1179	1.3	Small residential runoff/nutrients	2015

*Map number corresponds to the map in Figure 3.1

The list in Table 2.2 represents the primary impairments in the Buffalo Creek watershed. Visual assessments and other reports suggest other issues associated with agriculture may exist in the watershed, however not to the degree of those streams listed in Table 2.2. Currently listed impaired streams are our highest priority for remediation. In the event new streams become listed in the future, these too would then become priorities.

Table 2.3 lists pollutant types found in the Buffalo Creek watershed, sources of those pollutants, their causes, and the sub-watersheds that have potential to be impacted by the particular

pollutant. These are based on the irregularly collected and non-systematic data available and are somewhat general for that reason. However a sustained monitoring program should improve the BCWA's ability to identify trends in water quality and put the group in a position where, with continued and ongoing research by partners such as Bucknell University, it will be able to make more informed decisions and will be able to identify pollutants and their sources with more accuracy.

Table 2.3 Common pollutants in the Buffalo Creek watershed.

Pollutant	Source	Cause	Subwatersheds Impacted*
Nutrients	Livestock in streams, failing on-lot septic systems, agricultural and residential fertilizer, manure runoff, community sewage treatment plants.	Unrestricted livestock access, improper installation and maintenance of on-lost sewage systems, improper application of fertilizer and manure, lack of barnyard runoff controls.	NB, SpR, BlR, BvR, CR, MR, StR, LB, RR, MB
Sediment	Livestock in streams, crop fields, stream banks/legacy sediment, dirt and gravel roads, construction sites, and developed areas.	Lack of crop field and pasture BMPs, excessive storm flows, inadequate stormwater controls, and elimination of riparian buffers.	NB, SpR, BlR, BvR, CR, MR, StR, LB, RR, MB
E. Coli	Livestock, failing septic, manure runoff, community sewage treatment plants.	Unrestricted livestock access, improper installation and maintenance of on-lot sewage systems, over application of manure.	MR, StR, LB, BvR, CR, RR, MB
Oil, grease, & metals	Parking lots, roads, stormwater conveyances, sewage treatment plants, homeowners.	Improper disposal of materials, lack of BMPs for stormwater control, lack of buffers to filter out materials.	MB
Thermal/Heat	Natural radiant heat from sun.	Removal of buffers and streamside canopy trees that shade the water, impervious surfaces.	BvR, CR, MR, StR, LB, RR, MB

*North Branch (NB), Spruce Run (SpR), Black Run (BlR), Coal Run (CR), Muddy Run (MR), Stony Run (StR), Little Buffalo (LB), Rapid Run (RR), and Mainstem Buffalo Creek (MB).

ENDNOTES

[1] McDiffett, Wayne, Ph.D. personal communiqué at BCWA March 26, 2006 planning retreat.

[2] Buffalo Township has not adopted the minimum ordinance standards of the Buffalo Creek Stormwater Management Plan as required by Act 167 of 1978.

[3] Hartley, Lewis, Limestone, and West Buffalo Townships are under the county Subdivision and Land Development Ordinance and the stormwater provisions contained therein.

[4] Caraco, Claytor, et al. Rapid Watershed Planning Handbook – A Comprehensinve Guide for Managing Urbanizing Watersheds. Center for Watershed Protection, Endicott, MD. 1999.

[5] Kochel, Craig, Ph.D. Technical Report Summary: Hydrogeomorphic Studies of Buffalo Creek (2003-2005). Lewisburg, PA.

[6] McTammany, Matthew, Ph.D. personal communiqué, unpublished reports and data summary provided to the Buffalo Creek Watershed Alliance. Lewisburg, PA. October 2006.

CHAPTER 3

WATERSHED RESTORATION

AGRICULTURAL STREAM ASSESSMENTS

Due to the prevalence of farming and agriculturally impaired streams in the Buffalo Creek watershed a series of farm visits were conducted along many of the impaired streams in order to better understand the BMP needs along those reaches. An Agricultural/Environmental Specialist was hired by the Union County Conservation District in June of 2007 as part of a 319 grant cosponsored by the Conservation District and BCWA. This position was specifically created to assess streams impaired by agriculture, conduct windshield surveys, utilize GIS resources, make preliminary BMP recommendations, conduct watershed modeling with DEP, and write this implementation plan. Being in the field helps to better determine the status of agricultural BMP use. Simply reviewing conservation plans would show the watershed to be worse than it actually is. We recognize that not having a conservation plan does not necessarily mean a total lack of BMPs. By having someone in the field to see firsthand some of the issues facing our impaired streams we feel we will be a step ahead when the time comes for working with landowners to identify and implement needed BMPs.

RECOMMENDED BMPS

One of the primary reasons for conducting farm visits, windshield surveys, GIS research, etc. was to generate a list of recommended BMPs for farms located along agriculturally impaired stream sections. Table 3.1 (pages 34-47) shows past (before 2000), present (2000 – 2008), and future BMP recommendations for individual farms. Also included are the BMP units (Acres, Feet, or Number) and their NRCS practice codes. This table is not for every farm in each subwatershed, but rather those having potential to directly impact an agriculturally impaired stream section; as these subsheds are our higher priorities. Figure 3.1 shows the location of these farms in reference to the impaired streams. Each numbered dot represents one tax parcel. Note many tax parcels fall under the same farm number. We recognize that, although not eligible for 319 funding at this time, all subwatersheds could benefit from an increase in agricultural BMPs.

Table 3.1 Individual farm BMPs

Farm #	Water-shed	Past BMPs before July, 2000	Unit Ac, Ft, No	Present BMPs July, 2000 to present	Unit Ac, Ft, No	Future BMPs	Unit Ac, Ft, No
1	Buffalo Trib	Conservation Crop Rotation (Ac.) (328)	84	Stripcropping, Field (Ac.) (586)	20	Barnyard Runoff Control (No.) (357)	1
		Conservation Plan (Ac.) (003)	69	Cover Crop (Ac.) (340)	30	Waste Management System (No.) (312)	1
		Residue Mgmt, Mulch Till (Ac.) (329B)	84			Residue Mgmt, No-Till (Ac.) (329A)	84
		Roof Runoff Structure (No.) (558)	2			Fence (Ft.) (382)	1800
		Grassed Waterway (Ac.) (412)	0.3			Stream Crossing (No.) (578)	2
		Grassed Waterway (Ac.) (412)	0.55			Animal Trails and Walkways (Ft.) (575)	350
		Fence (Ft.) (382) (*streambank one side)*	730			Riparian Forest Buffer (Ac.) (391) in Ft. length	1800
2	Buffalo Trib	Conservation Plan (Ac.) (003)	190	Use Exclusion (Ac.) (472)	0.3	Fence (Ft.) (382)	3060
		Roof Runoff Structure (No.) (558)	3	Riparian Forest Buffer (Ac.) (391) in Ft. length	600	Streambank & Shoreline Protection (Ft.) (580)	245
		Pond (No.) (378)	2	Riparian Forest Buffer (Ac.) (391) in Ft. length	800	Stream Crossing (No.) (578)	2
		Waste Storage Facility (No.) (313)	2	Riparian Forest Buffer (Ac.) (391) in Ft. length	2600	Riparian Forest Buffer (Ac.) (391) in Ft. length	3060
		Grassed Waterway (Ac.) (412)	1.5	Riparian Forest Buffer (Ac.) (391) in Ft. length	880	Stream (equipment) Crossing (No.) (578)	1
		Conservation Crop Rotation (Ac.) (328)	55	Residue Mgmt, No-Till (Ac.) (329A)	7.2	Cover Crop (Ac.) (340)	88
		Contour Farming (Ac.) (330)	78			Barnyard Runoff Control (No.) (357)	1
		Cover Crop (Ac.) (340)	31			Waste Management System (No.) (312)	1
		Residue Mgmt, No-Till (Ac.) (329A)	130			Cover Crop (Ac.) (340)	7.2
		Roof Runoff Structure (No.) (558)	2				

2		Fence (Ft.) (382) (*streambank one side*)	420				
3	Buffalo Trib	Prescribed Grazing (Ac.) (528A)	6			Roof Runoff Structure (No.) (558)	1
		Trough or Tank (No.) (614)	3			Riparian Forest Buffer (Ac.) (391) in Ft. length	835
		Channel Bank Vegetation (Ac.) (322)	0.3				
		Riparian Herbaceous Cover (Ac.) (390) in Ft. length (*one side)*	340				
		Fence (Ft.) (382) *(streambank one side)*	540				
4	Buffalo Trib			Channel Bank Vegetation (Ac.) (322)	0.2	Residue Mgmt, No-Till (Ac.) (329A)	6.3
				Conservation Cover (Ac.) (327)	1.6	Riparian Forest Buffer (Ac.) (391) in Ft. length	590
5	Buffalo Trib	Conservation Plan (Ac.) (003)	12			Residue Mgmt, No-Till (Ac.) (329A)	8
		Roof Runoff Structure (No.) (558)	2				
		Grassed Waterway (Ac.) (412)	0.2				
6	Buffalo Trib	Conservation Plan (Ac.) (003)	136.5			Waste Management System (No.) (312)	1
		Roof Runoff Structure (No.) (558)	3			Barnyard Runoff Control (No.) (357)	1
		Residue Mgmt, No-Till (Ac.) (329A)	123.6			Fence (Ft.) (382)	1520
		Grassed Waterway (Ac.) (412)	1.3			Stream Crossing (No.) (578)	3

6		Pond (No.) (378)	1			Riparian Forest Buffer (Ac.) (391) in Ft. length	1520
		Cover Crop (Ac.) (340)	16			Cover Crop (Ac.) (340)	54.75
		Conservation Crop Rotation (Ac.) (328)	123.6				
		Barnyard Runoff Control (No.) (357)	1				
		Heavy Use Protection (Ac.) (561)	1.5				
		Riparian Herbaceous Cover (Ac.) (390) in Ft. length	2000				
7	Buffalo Trib	Conservation Crop Rotation (Ac.) (328)	45			Prescribed Grazing (Ac.) (528A)	7.7
		Conservation Plan (Ac.) (003)	80			Fence (Ft.) (382)	3400
		Residue Mgmt, Mulch Till (Ac.) (329B)	45			Cover Crop (Ac.) (340)	11.25
8	Buffalo Trib	Conservation Plan (Ac.) (003)	125	Prescribed Grazing (Ac.) (528A)	10	Fence (Ft.) (382)	1380
		Conservation Crop Rotation (Ac.) (328)	79	Roof Runoff Structure (No.) (558)	2	Stream Crossing (No.) (578)	2
		Stripcropping, Contour (Ac.) (585)	50	Conservation Cover (Ac.) (327)	2.5	Riparian Forest Buffer (Ac.) (391) in Ft. length	690
		Contour Farming (Ac.) (330)	37.5	Residue Mgmt, No-Till (Ac.) (329A)	79	Cover Crop (Ac.) (340)	50
		Channel Bank Vegetation (Ac.) (322)	0.4	Cover Crop (Ac.) (340)	15.5		
		Pond (No.) (378)	2				
		Riparian Forest Buffer (Ac.) (391) in Ft. length	1500				
9	Buffalo Trib			Riparian Herbaceous Cover (Ac.) (390) in Ft. length	2000	Riparian Forest Buffer (Ac.) (391) in Ft. length	2000

10	Buffalo Trib						
11	Buffalo Trib						
12	Rapid	Conservation Plan (Ac.) (003) Roof Runoff Structure (No.) (558) Pond (No.) (378) Riparian Forest Buffer (Ac.) (391) in Ft. length	42 2 1 1426	Residue Mgmt, No-Till (Ac.) (329A)	16.8	Stream Crossing (No.) (578)	2
13	Rapid	Conservation Plan (Ac.) (003) Conservation Cover (Ac.) (327) Pond (No.) (378) Riparian Forest Buffer (Ac.) (391) in Ft. length	102 17.1 3 3000	Conservation Cover (Ac.) (327)	7		
14	Rapid			Conservation Plan (Ac.) (003) Nutrient Mangement (Ac.) (590) Cover Crop (Ac.) (340) Residue Mgmt, No-Till (Ac.) (329A) Diversion (Ft.) (362) Contour Farming (Ac.) (330) Contour Buffer Strips (Ac.) (332) Stripcropping, Contour (Ac.) (585)	82.5 73.8 11.85 65 600 6 1.8 25	Stream (equipment) Crossing (No.) (578) Waste Storage (stacking) Facility (No.) (313)	1 1

14				Waste Storage Facility (No.) (313)	1		
				Heavy Use Protection (Ac.) (561)	0.1		
				Barnyard Runoff Control (No.) (357)	1		
				Waste Management System (No.) (312)	1		
				Roof Runoff Structure (No.) (558)	2		
				Conservation Crop Rotation (Ac.) (328)	65		
				Riparian Herbaceous Cover (Ac.) (390) in Ft. length	3000		
				Riparian Herbaceous Cover (Ac.) (390) in Ft. length	1860		
				Fence (Ft.) (382) (*streambank)*	1455		
15	Rapid	Conservation Plan (Ac.) (003)	63	Residue Mgmt, No-Till (Ac.) (329A)	40	Fence (Ft.) (382)	2200
				Cover Crop (Ac.) (340)	6	Stream Crossing (No.) (578)	1
						Riparian Forest Buffer (Ac.) (391) in Ft. length	2200
16	Rapid	Conservation Plan (Ac.) (003)	56			Fence (Ft.) (382)	2600
		Prescribed Grazing (Ac.) (528A)	64			Stream Crossing (No.) (578)	1
		Roof Runoff Structure (No.) (558)	3			Riparian Forest Buffer (Ac.) (391) in Ft. length	1600
		Pasture and Hayland Planting (Ac.) (512)	54.7			Pasture and Hayland Planting (Ac.) (512)	0.25
17	Rapid	Riparian Forest Buffer (Ac.) (391) in Ft. length	4620	Residue Mgmt, No-Till (Ac.) (329A)		Fence (Ft.) (382)	1200

17				Roof Runoff Structure (No.) (558)		Riparian Forest Buffer (Ac.) (391) in Ft. length	1200
				Cover Crop (Ac.) (340)		Stream Crossing (No.) (578)	1
						Conservation Plan (Ac.) (003)	105
18	Rapid	Baryard Runoff Control (No.) (357) (*ROOF*)	1	Residue Mgmt, No-Till (Ac.) (329A)	35	Conservation Plan (Ac.) (003)	95
				Contour Farming (Ac.) (330)	8	Fence (Ft.) (382)	2300
				Pasture and Hayland Planting (Ac.) (512)	29	Riparian Forest Buffer (Ac.) (391) in Ft. length	2300
				Prescribed Grazing (Ac.) (528A)	43	Riparian Forest Buffer (Ac.) (391) in Ft. length	2500
						Stream Crossing (No.) (578)	1
						Cover Crop (Ac.) (340)	7.8
						Heavy Use Area Protection (Ac.) (561)	0.1
						Waste Storage (stacking) Facility (No.) (313)	1
						Stream Crossing (No.) (578) (equipment)	1
						Access Road (Field Lane fix) (Ft.) (561)	390
19	Rapid					Conservation Plan (Ac.) (003)	51
20	Rapid	Conservation Plan (Ac.) (003)	33	Nutrient Management (Ac.) (590)	9.2	Riparian Forest Buffer (Ac.) (391) in Ft. length	1400
21	Rapid					Conservation Plan (Ac.) (003)	64
22	Rapid			Conservation Plan (Ac.) (003)	36		
23	Rapid	Conservation Plan (Ac.) (003)	64				

24	Coal	Conservation Plan (Ac.) (003)	250				
		Riparian Forest Buffer (Ac.) (391) in Ft. length					
24	Coal	Conservation Plan (Ac.) (003)	11			Channel Stabilization (Ft.) (584)	100
		Pond (No.) (378)	5				
		Conservation Cover (Ac.) (327)	11				
		Riparian Forest Buffer (Ac.) (391) in Ft. length	3300				
25	Coal	Conservation Plan (Ac.) (003)	100	Residue Mgmt, No-Till (Ac.) (329A)	13.6	Cover Crop (Ac.) (340)	13.6
		Pond (No.) (378)	1	Contour Farming (Ac.) (330)	9.6		
		Riparian Forest Buffer (Ac.) (391) in Ft. length	3700				
		Riparian Forest Buffer (Ac.) (391) in Ft. length	4550				
		Riparian Forest Buffer (Ac.) (391) in Ft. length	4400				
26	Coal	Conservation Plan (Ac.) (003)	60			Riparian Forest Buffer (Ac.) (391) in Ft. length	4000
		Pasture and Hayland Planting (Ac.) (512)	35				
27	Coal	Conservation Plan (Ac.) (003)	60				
		Riparian Forest Buffer (Ac.) (391) in Ft. length	5200				
		Riparian Forest Buffer (Ac.) (391) in Ft. length	1400				
		Residue Mgmt, No-Till (Ac.) (329A)	32				
28	Coal	Residue Mgmt, No-Till (Ac.) (329A)	16	Fence (Ft.) (382)	1700	Conservation Plan (Ac.) (003)	

28		Stripcropping, Field (Ac.) (586) 16	Riparian Herbaceous Cover (Ac.) (390) in Ft. length 1700	Fence (Ft.) (382)	600
				Riparian Herbaceous Cover (Ac.) (390) in Ft. length	600
29	Coal	Riparian Forest Buffer (Ac.) (391) in Ft. length		Conservation Plan (Ac.) (003)	
30	Coal	Stripcropping, Field (Ac.) (586) 60		Conservation Plan (Ac.) (003)	77
		Waste Storage Facility (No.) (313) 1		Residue Mgmt, No-Till (Ac.) (329A)	60
				Prescribed Grazing (Ac.) (528A)	5.25
				Fence (Ft.) (382)	2000
				Riparian Forest Buffer (Ac.) (391) in Ft. length	2000
				Stream Crossing (No.) (578)	1
				Barnyard Runoff Control (No.) (357)	1
31	Coal	Riparian Forest Buffer (Ac.) (391) in Ft. length 400		Conservation Plan (Ac.) (003)	24
				Stream Crossing (No.) (578)	1
				Barnyard Runoff Control (No.) (357)	1
				Fence (Ft.) (382)	200
				Riparian Herbaceous Cover (Ac.) (390) in Ft. length	200
32	Coal	Conservation Plan (Ac.) (003) 105		Residue Mgmt, No-Till (Ac.) (329A)	62
		Stripcropping, Field (Ac.) (586) 62		Prescribed Grazing (Ac.) (528A)	27
		Riparian Forest Buffer (Ac.) (391) in Ft. length 4120		Stream Crossing (No.) (578)	1