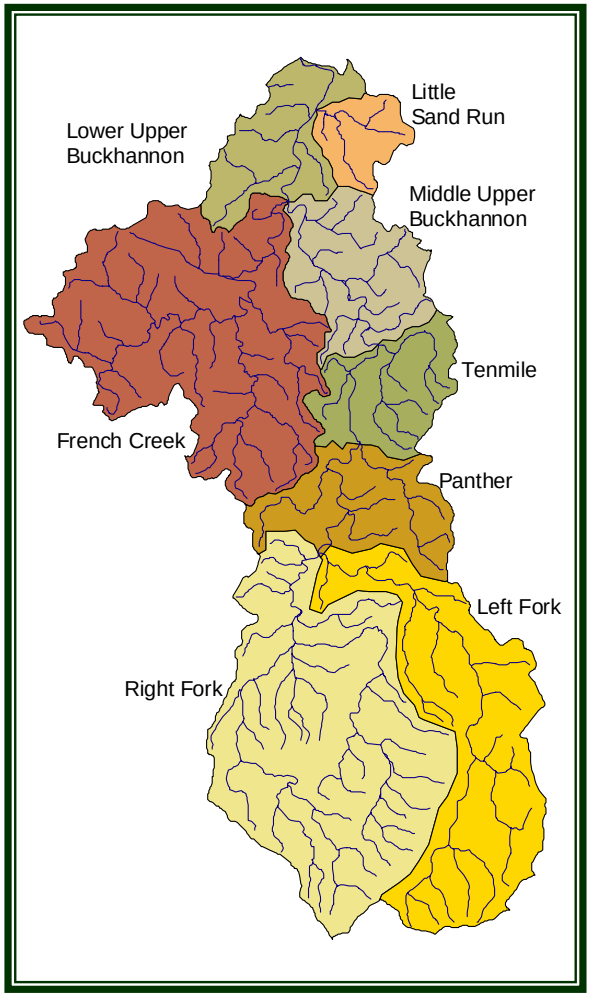
WATERSHED-BASED PLAN FOR THE IMPLEMENTATION OF THE UPPER BUCKHANNON TMDL



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through a grant awarded by
WV Division of Environmental Protection
(Agreement DWWM No. 1112)

Revised by:
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through a grant awarded by
WV Division of Environmental Protection
(Agreement)
WV Project # 127

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Introduction

The Upper Buckhannon River Watershed consists of approximately 127,623 acres located in north-central West Virginia. It is a sub-watershed of the Tygart Valley River Watershed and includes most of Upshur County and parts of Barbour, Lewis, Webster, Harrison and Randolph counties (Figure 1). There are 329 stream miles in the watershed.

The four dominant water quality problems within the watershed are metals, pH/acidity, sediment, and fecal bacteria. The main sources of these contaminants are coal mining, acid precipitation, agriculture, road construction and use, logging, and wastewater.

This plan elucidates the sources of contamination and describes the steps that will need to be taken to achieve load reductions in metals, pH/acidity, sediment, and fecal bacteria due to non-point sources of these pollutants.

A. CAUSES AND SOURCES OF NON-POINT SOURCE POLLUTION

A.1 Geographical Extent

The Upper Buckhannon River rises near Parting Springs, four miles southeast of Pickens in Randolph County at an elevation of 3,450 feet. It flows northward through Upshur County to Buckhannon where it joins with Fink Run at an elevation of 1,390 feet. This stream is rough and turbulent from its source to Hampton, a few miles upstream from Buckhannon. From Hampton to the mouth of Fink Run the stream is placid and smooth; approaching a base level condition because of a 6-foot dam located about 0.5 miles before Fink Run. This impoundment serves as the water supply for the City of Buckhannon and a large portion of Upshur County.

The Upper Buckhannon River watershed is rural with a total population of approximately 12,225. Buckhannon, located at the lower end of the Upper Buckhannon River is the only major population center in the watershed with a population of approximately 6,000. Hampton, Adrian, Alton and Pickens are small towns located upstream from Buckhannon (Figure 1).

Only 2,412 acres or 2% of the Upper Buckhannon River watershed is urban commercial or industrial (Table1). This illustrates the low population density of the watershed. The primary land use is deciduous and mixed forests (74%), with pasture land coming in second (21%). More details can be found in Table 1. Although mining causes a large portion of the water quality problems in the watershed, it only makes up 1% of the land use.

For the purposes of this report the Upper Buckhannon Watershed was divided into eight subwatersheds: Lower Upper Buckhannon, Little Sand Run, Middle Upper Buckhannon, Tenmile, Panther, French Creek, Right Fork, and Left Fork (Figure 2, Table 2).

West Virginia water quality standards are based on the federal Clean Water Act and state Water Pollution Control Act and related criteria and standards (Title 40 CSR, Series 2). Numeric and narrative water quality criteria are applied to -streams based on their designated use. Designated uses for the streams in the Upper Buckhannon River watershed include: maintenance and

propagation of warm water and cold water aquatic life (Categories B1 and B2 respectively) and water contact recreation (category C). Only the Buckhannon River (above Beans Mill), The Right Fork Buckhannon River, and Left Fork of the Right Fork are trout waters (B2).

Table 1. Land use in the Upper Buckhannon River Watershed (excluding French Creek).

LAND USE	**ACRES**	**PERCENT**
Forested		
Private	93,614	
Public	1,100	
Total	*94,714*	74%
Agricultural	26,686	21%
Urban, Commercial, Industry	2,412	2%
Water Surface and Wetlands	678	1%
Roads	767	1%
Mining	1,000	1%
Other Non-Agricultural	1,366	1%
TOTAL	**127,623**	

Table 2. Subwatershed names, areas, and stream miles for the Upper Buckhannon River Watershed based on 2003 GIS DRG maps (see Figure 2).

Subwatershed Name	**Area**	**Stream Miles**
	(acres)	*(mi)*
Little Sand	7,888	8.0
Lower	3,727	17.8
Middle	10,047	29.7
French	31,264	80.1
Tenmile	7,817	20.6
Panther	9,542	24.5
Right Fork	34,512	90.6
Left Fork	22,826	50.6
Total	**127,623**	**321.9**

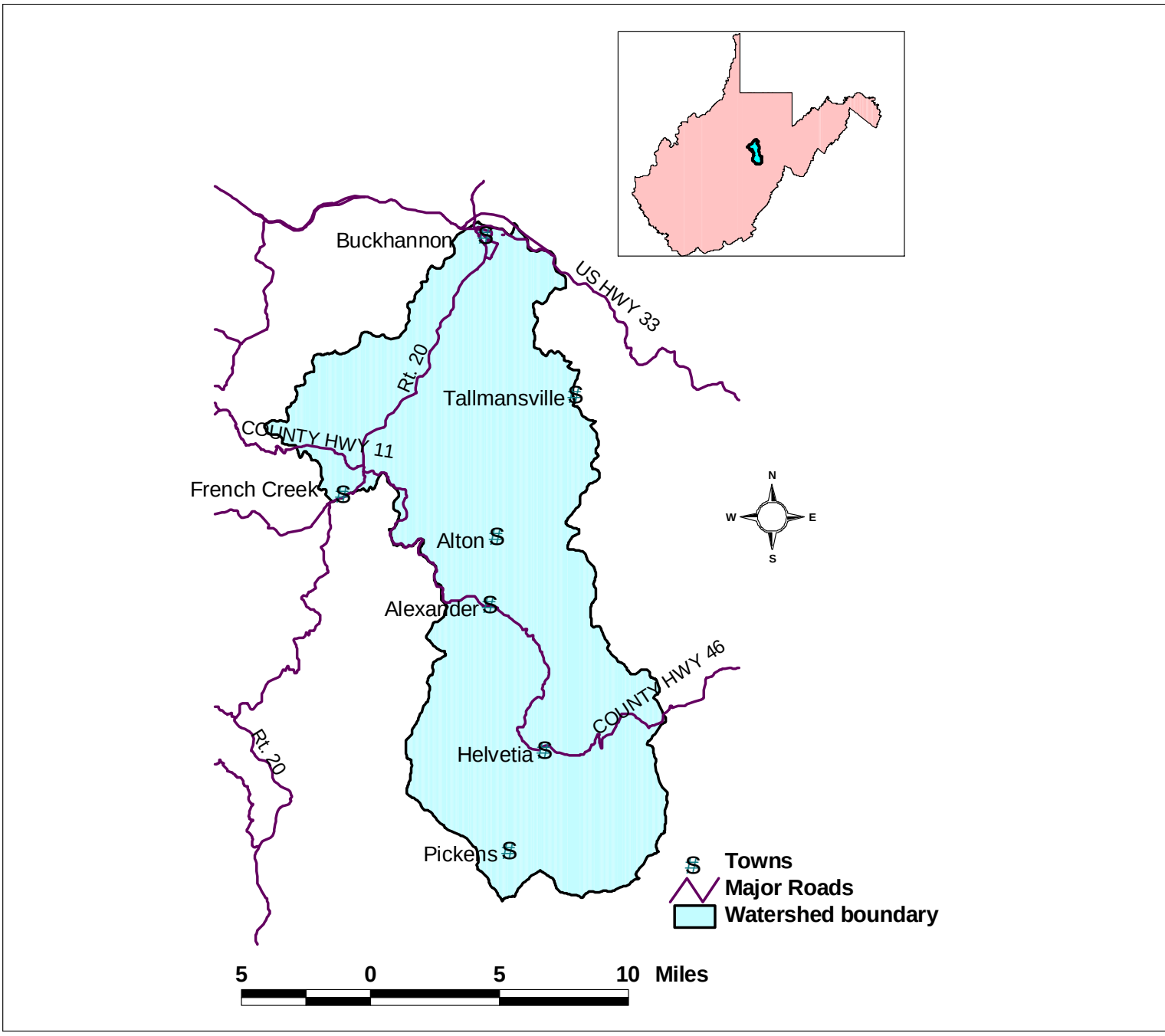


Figure 1. Map of the Upper Buckhannon watershed showing major roads and towns. The inset shows the watershed's location within West Virginia.

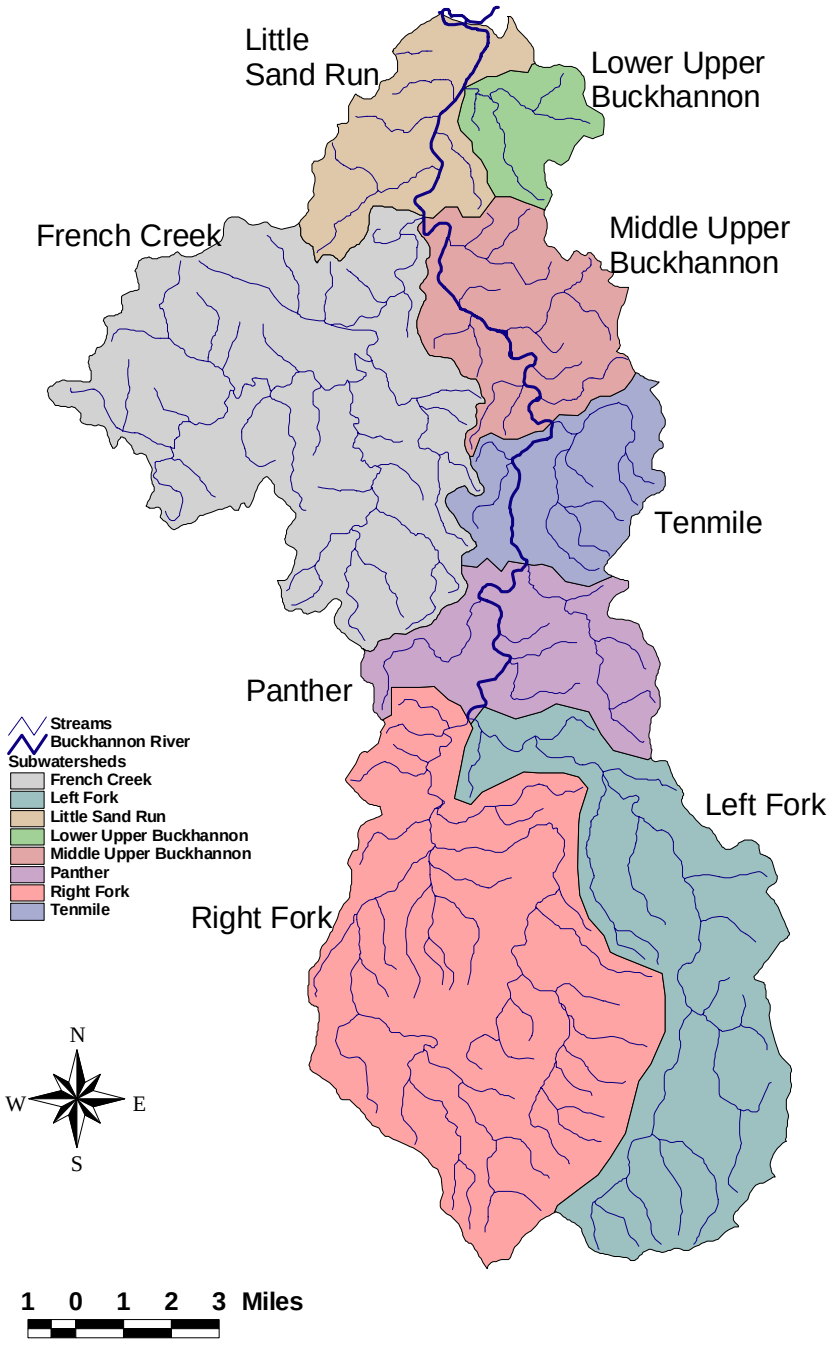


Figure 2. Map of the eight subwatersheds of the Upper Buckhannon watershed.

A.2. Measurable Water Quality Goals for the Upper Buckhannon

Metals: Achieve load reductions in iron in accordance with the UB TMDL in order to achieve 100% compliance with state water quality criteria. The WV Fe criterion is 1.5 mg/L for the protection of warmwater (B-1) and 0.5 mg/L for trout waters (B-2). The 1998 TMDL also addressed and proposed load reductions for both aluminum and managanese. However since then the state aluminum criterion has been changed from total concentration to dissolved concentration. In addition EPA (2005) approved a revision to the aluminum chronic criterion for B1 waters from 87 µg/L to 750 µg/L. Similarly, in 2005 the manganese standard was revised to only apply within five miles upstream of a public water supply intake. The nearest public water intake is on the Buckhannon River more than five miles from the nearest potential restoration effort. Because of the change in Al and MN criteria, the TMDL for aluminum and manganese is no longer applicable until it is revised.

pH/Acidity: Reduce loads and/or mitigate surface water to achieve 100% compliance with state water quality criteria (6-9 pH units) in all streams in the watershed.

Sediment: There is no state water quality criterion for sediment and there is little information available on sediment loads in the watershed so a water quality goal cannot be established. However, sediment sources can be identified and in many cases quantities can be estimated. Our goal is for 100% of stream miles in the watershed to achieve a Habitat Score of 180 or greater using the Rapid Habitat Assessment Index.

Fecal Bacteria: Reduce loads and/or mitigate surface water to achieve 100% compliance with category C water quality criteria for fecal coliform in all streams in the watershed. The state water quality standard for fecal coliform for recreational waters is 200 CFU per 100 mL as a monthly geometric mean based on not fewer than 5 samples per month or 400 CFU per100 mL in more than ten percent of all samples taken during the month.

Biological Integrity: Most of the pollutants listed above have a negative impact on the biota of streams. To ensure that the biological integrity of streams is being preserved and maintained, biological assessments of streams should be conducted. These biological assessments of fish and benthic macroinvertebrate diversity and abundance answer the ultimate question, “Is overall water quality good enough to support a viable stream community?” Furthermore, bioassessments complement point-in-time chemical sampling because they are time-integrated measures of water quality. The goal here is a rating of 68% or better on the WV Stream Condition Index (WVSCI) for all streams in the watershed.

A.3. Causes and Sources of Non-Point Source Pollution

The WV DEP completes a water quality sweep of every watershed in the state as part of the Watershed Assessment Program on a 5 year cycle. Streams that do not meet water quality standards are placed on the Section 303d list and are scheduled for TMDL development. The Upper Buckhannon was sampled in 1997 and again in 2002. The first sampling event led to the development of the 1998/2001 TMDL (Table 3). The subsequent sampling by the WVDEP resulted in 10 additional tributaries being listed on the 2006 Section 303d list (Table 3).

Table 3. Tributaries in the UB watershed with a TMDL or appear on the 2006 Section 303d list

TMDL		
Stream Name	**Criteria**	**TMDL Date**
Tenmile Creek	Iron	1998
Panther Fork	pH	2001
Swamp Run	Iron, pH	2001
Herods Run	pH	2001
Left Fork/Buckhannon River	Iron	1998
Section 303d list		
Little Sand Run	Fecal Coliform	2020
Left Fork/Little Sand Run	Fecal Coliform	2020
Ratcliff Run	Fecal Coliform	2020
Cutright Run	pH	2015
Sawmill Run	CNA-Biological	2015
Right Fork/Tenmile	pH	2015
Marsh Fork	pH	2015
Smooth Rock Lick	pH	2015
Bearcamp Run	pH	2015
Beech Run	pH	2015

A.3.a. Acid Mine Drainage and pH/Acidity

Acid mine drainage (AMD) is the primary source of metals and a major source of acidity in the Upper Buckhannon watershed. AMD can be caused by abandoned mine lands, bond forfeiture sites, and/or active permitted coal mines. Figure 3 shows streams impaired by AMD. The TMDL developed in 1998 by EPA for the Upper Buckhannon watershed was revised with regards to the aluminum criterion in 2001. At the time of TMDL development, the loads of aluminum, iron, and manganese from tributaries were such that the main stem of the river from Alexander to Hampton violated state water quality standards for these three metals. The TMDL established target loads for each metal, which, if achieved, would maintain the metal concentrations at acceptable levels. However, as discussed above only the iron criterion is currently applicable and addressed in this plan.

The WV Office of Abandoned Mine Lands and Reclamation (AML&R) is responsible for reclaiming abandoned mine sites with health and safety problems. Reclamation includes

regarding, vegetation, proper disposal and burial of waste rock and slag, which helps prevent AMD formation. They also install active and passive treatment systems to reduce acid loads in tributaries. AML&R maintains a prioritized list of abandoned sites that require reclamtion. According to the 2002 Watershed Restoration Action Strategy for the Upper Buckhannon River, there are thirty AMLs in the watershed (Figure 4). 75% of these problem areas are located within the Left Fork subwatershed. Of those thirty AMLs in the watershed only 2 have been reclaimed (Table 4). The majority of the AMLs in Table 4 do not present health or safety concerns.

A recent inventory completed by WV DEP revealed one additional AML within the watershed (Table 4). In a previous version of this plan, AML WV Problem Area Description (PAD) 3173 was described as a potential project. It is the site of an abandoned strip mine over a very acidic coal seam. Based on water chemistry data from streams below the site (Herods Run and Smooth Rock Lick Run), water quality problems were thought to exist. However, AMD discharges from the area have not been documented. The proposed project entailed backfilling several sections of highwall. This PAD is a land reclamation project and does not specifically address any water quality issues. Therefore it is no longer included in the expected load reductions section of this plan.

Table 4. AML Problem Areas within the Upper Buckhannon Watershed

Pad#	Pad Name	Planning Unit Name	Receiving Streams(s)	Status
2089	Turkeybone Strip	Blue Rock Knob	Left Fork Buckhannon River	U
2090	Phillips Camp Run Strip	Blue Rock Knob	Beech Run and Phillips Camp Run of Left Fork Buckhannon River	
2091	Hicks Ridge Gob Area	Blue Rock Knob	Left Fork Buckhannon River	U
2092	Beech Run Refuse Area	Blue Rock Knob	Beech Run of Left Fork Buckhannon River	U
2094	Blue Rock Knob Strip	Blue Rock Knob	U.T. #1 of Beech Run of Left Fork Buckhannon River	U
2238	Vera Hornbeck	French Creek	Grassy Run of Buckhannon River	U
2274	Left Fork Strip	Buckhannon	Left Fork Buckhannon River	U
2275	Tennerton School Refuse	Buckhannon	Buckhannon River	R
2441	Lane Highwall	French Creek	Buckhannon River	U
2422	Left Fork Strip #2	Buckhannon	Left Fork Buckhannon River	U
3093	Blue Rock Strip	Blue Rock Knob	Lower Dry Run of Left Fork Buckhannon River	U
3254	Turner Highwall	French Creek	U.T.s #1 & 2 of Trubie Run	U
3739	Hicks Ridge #1	Helvetia	Left Fork Right Fork Buckhannon River	U
3740	Hicks Ridge #2	Helvetia	U.T. of Left Fork Right Fork Buckhannon River	U
3741	Turkeybone Strip #2	Helvetia	Anderson Camp Run of Left Fork Right Fork Buckhannon River	
3804	Beech Lick Run #2	Blue Rock Knob	Beech Run and Lick Run of Beech Run	U
3805	Beech Run Highwall	Blue Rock Knob	Beech Run of Left Fork buckhannon River	U
3806	Blue Rock Knob Strip #2	Blue Rock Knob	Lick Run of Beech Run of Left Fork Buckhannon River	U
3832	Beech Lick Run #1	Blue Rock Knob	Lick Run of Beech Run of Left Fork Buckhannon River	U
3833	Beech Mountain #1	Blue Rock Knob	Left Fork Buckhannon River	U
3834	Beech Mountain #2	Blue Rock Knob	Beech Run of Left Fork Buckhannon River	U
3835	Hicks Ridge #3	Blue Rock Knob	Left Fork Buckhannon River	U
3836	Palace Ridge Highwall	Blue Rock Knob	Left Fork Buckhannon River	U
3837	Star #1 Highwall	Blue Rock Knob	Left Fork Buckhannon River and Dry Run of Left Fork Buckhannon River	U
3944	Metzner Highwall	Helvetia	Satlick Run of Left Fork Right Fork Buckhannon River	U
3945	Pickens Prep Plant Site	Helvetia	Right Fork Buckhannon River	R
3946	Star Highwall	Blue Rock Knob	Lower Dry Run and Dry Run of Left Fork Buckhannon River	U
3946	Star Highwall #2	Blue Rock Knob	Lower Dry Run and Dry Run of Left Fork Buckhannon River	U
4017	Pringle Drainage	French Creek	Grassy Run of Buckhannon River	U
3173	Alton Highwall	Blue Rock Knob	Left Fork of Buckhannon River and Buckhannon River	U

U = Unreclaimed R = Reclaimed

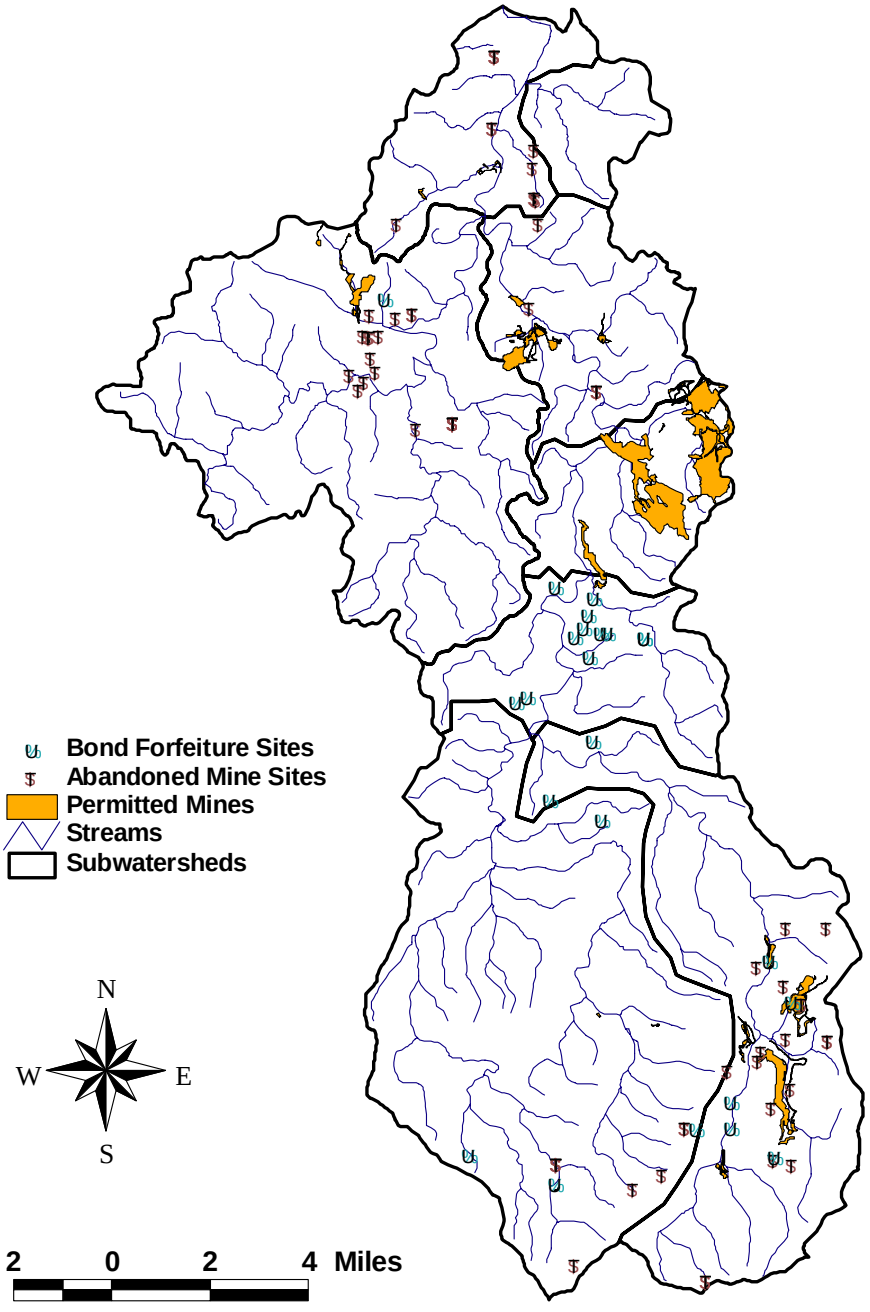


Figure 4. Map of Upper Buckhannon watershed showing bond forfeiture sites, abandoned mine sites (AML), and permitted mine sites.

WV DEP listed six streams for pH impairment from the Upper Buckhannon watershed on its 2006 303(d) List of Impaired Streams (Table 3). The impairment could be caused by AMD, acid precipitation or both. For example, the Right Fork of Tenmile subwatershed contains an inactive strip mine so some of the pH violations are probably due to AMD. In contrast, there is no mining in the Bear Camp Run watershed; therefore, the most likely cause is acid precipitation. Not included on this 303(d) list were streams for which TMDLs have been developed.

Central WV receives some of the most acidic precipitation in the nation with a mean annual rain pH of about 4.6 (National Atmospheric Deposition Program, http://nadp.sws.uiuc.edu). This equates to about 0.45 lbs H^+ ion per acre each year (as measured at the closest NADP monitoring site located in Parsons, WV). Some of this acidity is absorbed or neutralized by vegetation and soils before it enters streams.

Streams that are impaired by acid precipitation are characterized by low pH, low conductivity, low alkalinity and low metal concentrations. In contrast, AMD-impacted streams exhibit either low or high pH, high conductivity, sometimes-high alkalinity, and elevated metal concentrations. Streams that *appear* to be impaired by acid precipitation were designated as such based on water chemistry data collected between 1997 and 2002 by the Stream Restoration Group (WV DEP) and WV Wesleyan College. These streams are presented in Table 5 and shown in Figure 5.

About 400 miles of trout streams in West Virginia are impaired as a result of acid precipitation or acid mine drainage. The West Virginia Division of Natural Resources (DNR) uses hunting and fishing license revenue to fund treatment of waters impacted by acid precipitation through the West Virginia Wildlife Endowment Fund (WEF). Agency policy prohibits the use of this revenue to treat acid mine drainage. The early phase of this program treated 23 streams and 3 lakes with limestone sand. However, additional streams would significantly benefit from limestone treatment. In 2001 the DNR received a grant from WV DEP to expand this program and treat additional streams that are impaired by acid precipitation. DEP actively partners with DNR to identify candidate streams for this program. Several streams in the Buckhannon watershed have either received treatment through this program or are slated to receive treatment. As of January 2006 Marsh Fork, Right Fork, and Left Fork have been treated with limestone sand (Table 6). Right Fork of Tenmile Creek and Bearcamp Run are to be added to the limestone sand treatment program. Treatment may begin as early as fall 2006 (personal communication with Lou Schmidt, WV DEP).

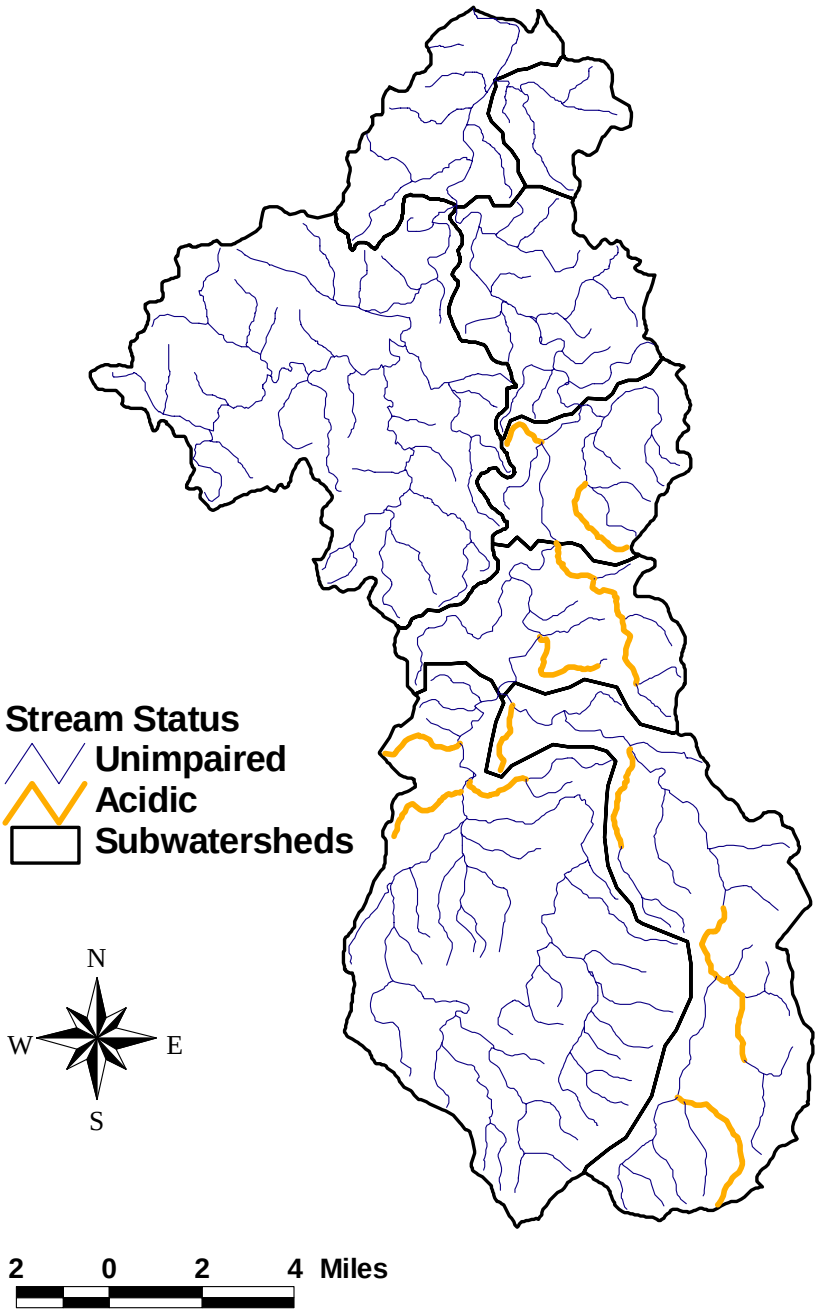


Figure 5. Map of streams impaired by acid precipitation in the Upper Buckhannon watershed.

Table 5. Measured water quality parameters for select streams in the Upper Buckhannon Watershed divided by subwatershed. Samples were collected by West Virginia Wesleyan College's Environmental Laboratory or the WV Stream Restoration Group between 1997 and 2002. Only those samples with pH less than 5.75 are listed. This list represents the potential sources of acid loads in the Upper Buckhannon watershed. Asterisks denote streams that are listed on the state's 303(d) list.

Site		Collected			Field	Field	Total	Total	Stream
Description	shed	Yr.	Mon	Day	Cond.	pH	Acidity	Fe	Miles
					(uS/cm)		*(mg/l carb)*	*(mg/l)*	*(mi)*
Left Fork Subwatershed									
Beech Run of Left Fork Buckhannon River upstream of Bear Run *	Beech	2002	5	1	18	**4.65**	3	0	2.2
Bear Camp Run of Left Fork Buckhannon River at mouth *	LLF	1997	7	29	20	**4.6**	57	0	2.3
BR at Star Bridge									
Unnamed Tributary 1 of Left Fork Buckhannon River at mouth	LLF	2002	4	30	19	**5.68**	1	0	1.6
Unnamed Tributary 11 of Left Fork Buckhannon River at mouth	LLF	2002	5	1	16	**5.55**	2	0	0.3
Unnamed Tributary 12 of Left Fork Buckhannon River at mouth	LLF	2002	5	1	12	**5.66**	2	0	0.2
Phillips Camp Run of Left Fork Buckhannon River near mouth	ULF	2002	5	1	18	**5.08**	2	0.136	3.3
Right Fork Subwatershed									
Alec Run of Right Fork Buckhannon River at mouth	LRF	2002	4	30	20	**4.79**	1.16	0	1.9
Bens Run of Right Fork Buckhannon River at mouth	LRF	2002	5	2	16	**5.59**	6	0.173	2.1
Millsite Run of Right Fork Buckhannon River near headwaters	LRF	2002	5	2	25	**5.69**	2.42	0.264	1.5
Unnamed Tributary 10 of Right Fork Buckhannon River at mouth	LRF	2002	5	1	18	**5.19**	4	0	0.2
Panther Subwatershed									
Herods Run of Buckhannon River at mouth	Panther	2002	4	30	55	**4.56**	7.78	0	2.3
Panther Creek at Stockert site near headwaters	Panther	2002	5	1	16	**4.94**	4.66	0	1.6
Panther Creek of Buckhannon River at mouth	Panther	2002	5	1	37	**5.07**	1.64	0	2.7
Tenmile Subwatershed									
Right Fork Tenmile Creek near headwaters*	Tenmile	2002	4	30	25	**4.05**	2.5	0	4.5
Unnamed Tributary 14 of Buckhannon River near mouth (above Tenmile)	Tenmile	2002	5	1	15	**5.22**	1.58	0	1.2
Total Miles									**29.7**

Table 6. Acid Precipitation Streams Treated with Limestone Sand by WVDNR			
	Right Fork	**Left Fork**	**Marsh Fork**
Miles Treated	10	6.2	4.5
Tons of Sand	40	80	80
Truck Loads	2	3	3
Fisheries management	Native Brook Trout 7 mi, Stocked Trout 3 mi	Native Brook Trout	Native Brook Trout

A.3.b. Sediment

Sediment from Agriculture

The Upper Buckhannon River watershed consists of approximately 127,600 acres. About one-sixth, approximately 26,686 acres (Table 1), is under agricultural production. Most of the 112 farms present in this watershed are involved in hay and beef production with an average of 35 head of cattle per herd. One-sixth of the farms located within the watershed have management plans (NRCS and WV Conservation Agency, personal communication). Visual inspection of several farms shows the potential for erosion and sediment influx to streams due allowance of livestock to access the streams.

Sediment from Forestry

The Upper Buckhannon River watershed is about 75% forested and most of the forested land is privately owned. Mixed deciduous forests are common in this watershed. In 2003, there were 49 logging operations registered with the WV Division of Forestry (DOF) (Jim Hayes, personal communication) that covered a total of 3,748 acres. This includes 5 operations in which a total of 124 acres were clearcut. The WV DOF estimates that about 8% of the logged area, or 300 acres, was disturbed (i.e., converted to roads and landings). All registered logging operations are required to use best management practices (BMPs) and are periodically inspected by the DOF.

Sediment from Oil and Gas Roads

There are approximately 1,337 oil and gas wells within the Upper Buckhannon River watershed (WRAS, 1999). The status of these wells is described in Table 7 and their locations are plotted in Figure 6. The Division of Oil and Gas estimates that 205 miles of oil and gas roads exist in the watershed and 128 miles of these are critically eroding. Thus, there is tremendous erosion potential due to widespread illicit land abuse by recreational off road vehicles along pipelines and access roads.

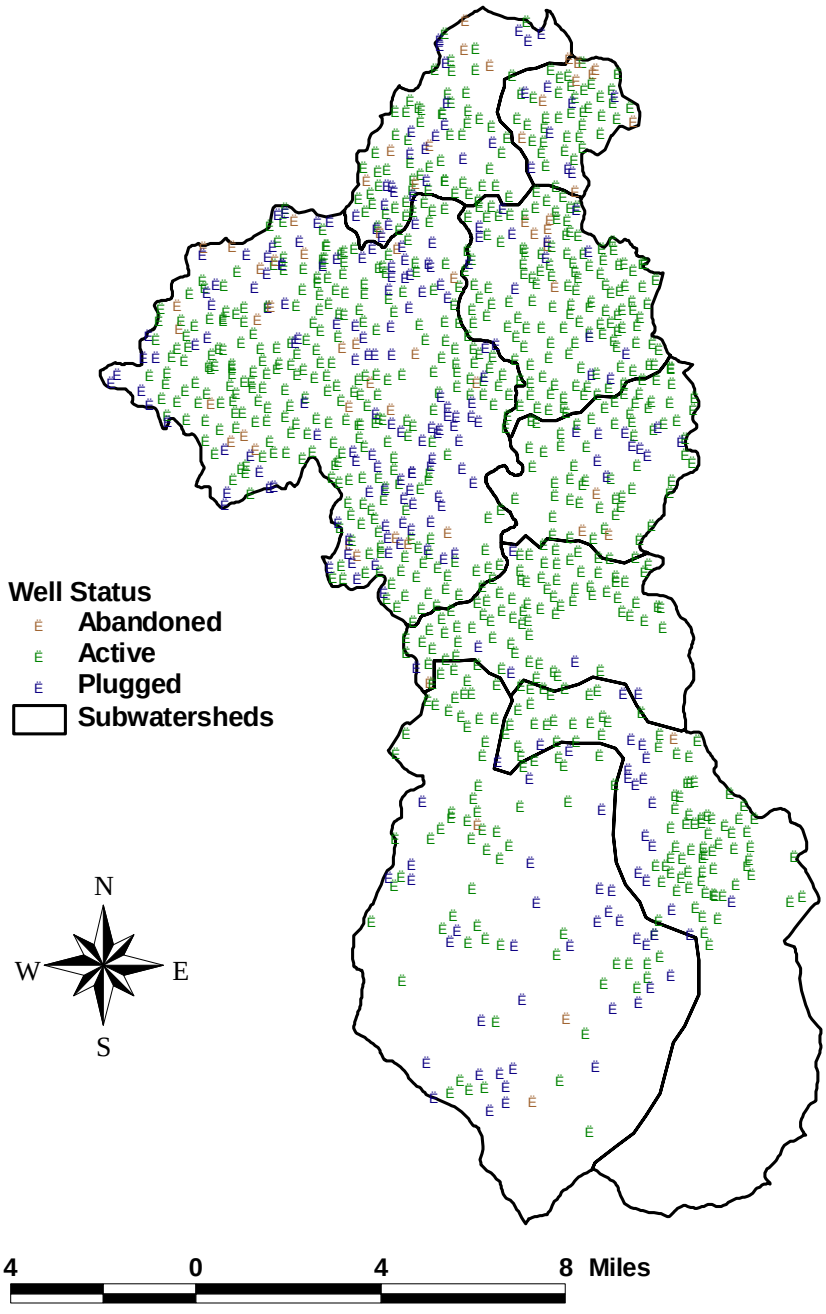


Figure 6. Map of gas well locations in the Upper Buckhannon River Watershed according to WV DEP GIS shape files (WV DEP 2004).

Table 7. Status of oil and gas wells within the Upper Buckhannon River watershed in 1999.	
STATUS	**# OF WELLS**
Unknown	119
Abandoned	59
Active	809
Future Use	39
Never Drilled	74
Plugged	237
Total	**1,337**

A.3.c. Habitat Quality

In 1997 WVDEP conducted an ecological assessment of the Tygart Valley River Watershed, which includes the Buckhannon River Watershed. One of the parameters they examined was habitat quality in the stream channel and riparian zone. The Rapid Habitat Assessment (RHA) Score is a combination of scores that measure: in-stream cover, substrate size, embeddedness, velocity/depth regime, channel alteration, sediment deposition, riffle frequency, channel flow status, bank condition, bank vegetative protection, grazing, and riparian vegetation zone width. Twenty-six stream sections were assessed. The average score was 166.5 (on a scale of 12 to 240), which is considered sub-optimal. The highest score was 195 (optimal) and the lowest was 123 (sub-optimal). Six streams fell in the sub-optimal range (120 to 180). Thus, stream habitat overall is not adequate to sustain healthy biological communities (Table 8).

Table 8. List of streams with WVSCI scores < 61 (impaired) or with Habitat Scores less than 120 (poor to marginal). Source: WVDEP (2003).			
Stream Name	**Subwatershed**	**WVSCI**	**RHA Score**
Mudlick Run	French Creek	**41.8**	123
Bull Run	French Creek	**56.4**	143
Sawmill Run	Middle U.B.	**52.3**	162
Laurel Run	French Creek	**56.3**	154
Tenmile Creek	Tenmile	**49.5**	147
Panther Fork	Panther	**59.5**	137

During that same 1997 assessment the WVDEP evaluated biological integrity of using the WV Stream Condition Index (SCI) based on benthic macroinvertebrate counts. The SCI is a combination of six different metrics that assess the diversity and abundance of macroinvertebrate populations. The scale ranges from 0 to 100 with categories of Impaired (0 to 61), Gray Zone (61 to 68), and Good (68 to 100). Twenty-three stream sections were assessed and they had an average score of 69.0 (on a scale of 0 to 100), which is just above the "gray zone" in the Good category. The highest score was 82.3 (Good) and the lowest was 41.8 (Impaired). The six impaired streams (with scores below 61) are listed in Table 8.

In summary, although the habitat in the six streams studied was not poor or marginal, the biological diversity was impaired which suggests chemical (such as acidity or AMD) and possibly sediment factors are responsible for the low diversity.

A.3.d. Fecal Bacteria

Fecal coliform contamination has been a concern in the Buckhannon River watershed for several years. In 1998 a student and professor at West Virginia Wesleyan College conducted a watershed-wide survey of over 30 locations along the mainstem of the river and many of its tributaries (Long and Simmons, 1998). The most severely contaminated tributaries were located in and around the city of Buckhannon (Middle Upper Buckhannon, Tenmile, and Little Sand Run subwatersheds). These included Hickory Flat Run, Tenmile Creek, Stony Run, Ratcliff Run, Little Sand Run, Cutright Run, and the Buckhannon River mainstem from Sago to the public water intake.

Since 2001 the Buckhannon Sewer Department has been monitoring fecal coliform levels in the river mainstem in and around Buckhannon and has found that higher flows lead to dramatic increases in coliform concentrations which often exceed 1,000 CFU per 100 mL (Simmons, 2003). In 2002 the Stream Restoration Group from the WV DEP sampled a large number of sites for coliform. Table 9 shows the results of three separate sampling series conducted between 1998 and 2004. A total of 39.1 miles of stream showed violations of the state criteria for fecal coliform on at least one of the sampling dates. The majority of these streams were in the Lower and Little Sand Run subwatersheds (Figure 8).

In 2003 the BRWA was awarded a Stream Partners Grant to pursue additional coliform testing. The main goal of this sampling was to perform an intensive sampling of a few tributaries to determine whether or not the streams should be categorized as “Impaired” according to state water quality criteria. The geometric mean of coliform concentrations from this sampling series is shown in Table 9. West Virginia’s water quality regulations state that if the mean coliform concentration (the geometric mean of no less than 5 samples taken during a one-month period) is greater than 200 CFU per 100 mL, then the water body should be considered “Impaired” for recreation and drinking water uses. All six sampling sites would be considered impaired according to state water quality criteria during April 2004.

Since 2004 all of Stony Run has received sewage service, and Little Sand Run has received partial sewage service. Hickory Flats run is scheduled to receive sewer lines in 2007. Cutright Run continues to have bacterial contamination, though it is most likely related to agriculture.

The WV Rivers Coalition has a proposal under consideration by WVDEP, to identify a need for decentralized sewage treatment in areas identified as contributing to the degradation of the watershed by the Upshur County Health Department.

Table 9. Fecal coliform concentrations (CFU per 100 mL) in the Upper Buckhannon watershed on three different sampling dates. The 1998-99 values represent either single samples or the means of 2 to 4 samples. The May 2002 values are single samples. In the April 2004 column the values represent the mean of five collections within that month. Blanks indicate that no sample was collected on that date.

			Date Sampled		
Description	**Subshed**	**Stream Miles**	**1998-99**	**May 2002**	**April 2004**
Ratcliff Run at mouth	LUB	1.8	4,864	440	1,036
Hickory Flat Run at mouth	LUB	2.1	28,000	1,700	628
Buckhannon River at Water Intake	LUB	3.3	677		220
Little Sand Run at mouth	Little Sand	1.0	4,102	636	811
Little Sand Run upstream of Left Fork Little Sand Run	Little Sand	3.5		400	
Left Fork Little Sand Run at mouth	Little Sand	3.6		360	1,049
Lick Run of Cutright Run	MUB	1.6		3,400	
Stony Run	MUB	2.1	1,840		
Cutright Run downstream (at highway)	MUB	1.7	850	3,000	422
Cutright Run near headwaters	MUB	1.7		545	
Laurel Run near mouth	MUB	2.4	370	330	
Grassy Run near mouth	MUB	1.0		310	
Grassy Run near headwaters	MUB	1.1	420	4,700	
Sharps Run of Little Laurel Run	MUB	1.0		250	
Buckhannon River at Hampton	MUB	2.6		210	
BR at Sago	MUB	0.9	842		
French Creek near mouth	French Ck.	2.0	1,077	1,455	
BR at Alton	Panther	1.0	176		
Tenmile at Mouth	Tenmile	1.1	2,850		
Alec Run at mouth	Right Fork	1.0		1,000	
Right Fork BR at Selbyville	Right Fork	0.6		400	
Right Fork BR at Silica	Right Fork	2.0		360	
Total Miles		**39.1**			

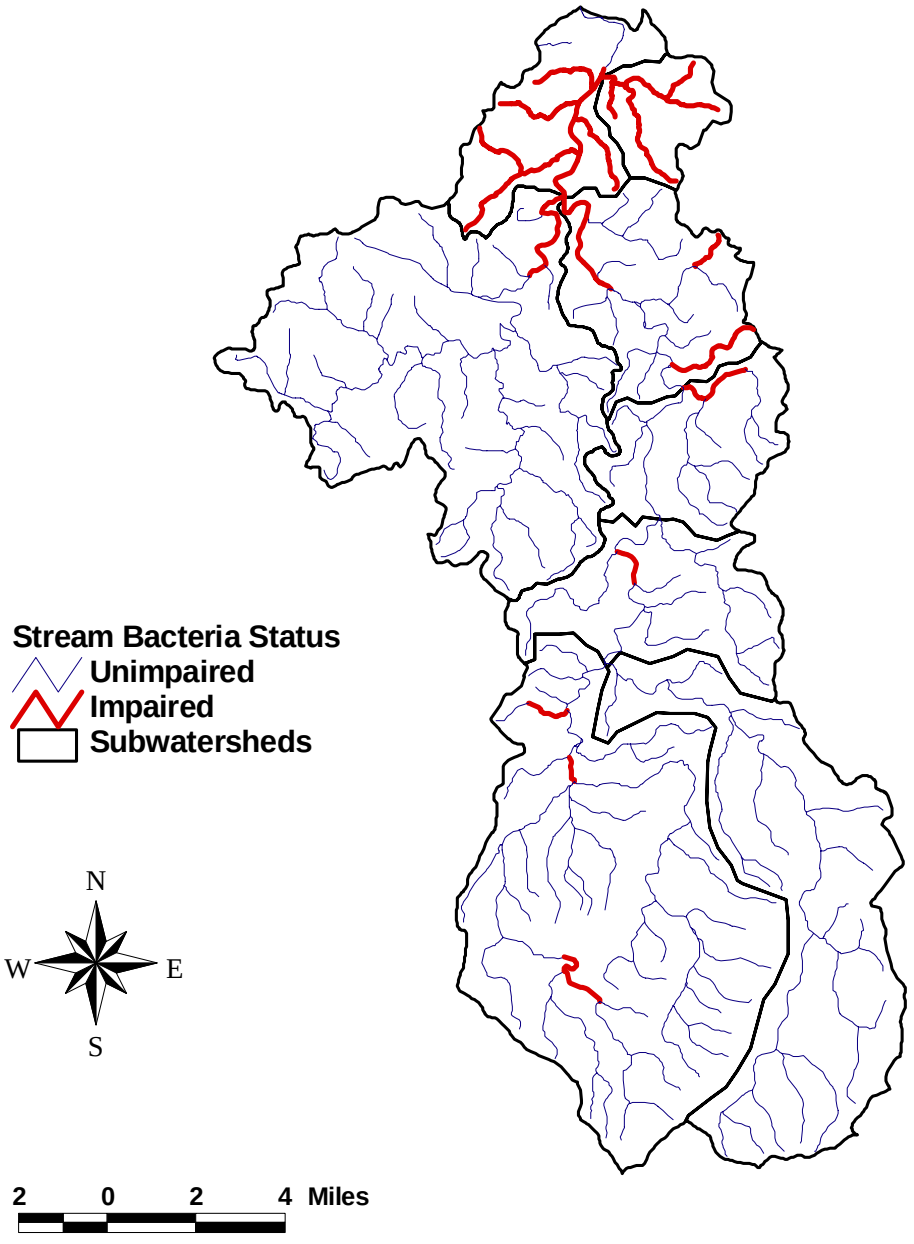


Figure 7. Map of bacteria-impaired streams in the Upper Buckhannon watershed.

B. EXPECTED LOAD REDUCTIONS

B.1 Acid Mine Drainage

Panther Subwatershed

Panther Fork

There is very little surface mining in the Panther watershed (Figure 9). Therefore the low pH of the water is likely caused by acid precipitation. While Panther Fork is not being considered by the WV DNR for treatment, this watershed is a good candidate for treatment with limestone sand by the WV DNR's Limestone Restoration project.

Herods Run

Table 10 lists water chemistry data provided by the Special Reclamation Office of the WV DEP. Table 11 lists water chemistry data collected by WRI in late 2005 and early 2006 (Figure 9). The Special Reclamation Office data show, except for the headwaters of Herods Run, that the streams are quite acidic. Furthermore, at some sites the average iron concentration exceeds the B-2 iron criterion of 0.50 mg/L and the maximum iron concentrations at all sites exceed both the B-1 and B-2 iron criteria.

Table 10. Stream pH, total iron, and total aluminum at several locations along Swamp Run and two sites along Herod's Run in the Panther Subwatershed. Samples were collected monthly from 1999-2002.

	Swamp Run Sites				Herods Run Sites	
	23	**82**	**80**	**81**	**8**	**24**
pH						
Ave.	4.93	4.41	3.15	4.64	7.13	4.61
Min.	3.8	4.2	2.9	3.4	5.2	3.8
Max.	6.8	4.6	4.5	6.6	8.2	7.3
Total Iron (mg/ L)						
Ave.	0.4	0.2	6.93	0.64	0.73	0.27
Min.	0.08	bd	2.31	0.07	0.16	bd
Max.	1.82	3.03	10.9	3.22	2.43	3.12

Table 11. Stream pH, total iron, and total aluminum at several locations along Swamp Run and two sites along Herod's Run in the Panther Subwatershed. Samples were collected by WRI in late 2005 and early 2006.

	Swamp Run Sites			Herods Run Sites		
	Swamp Mouth	Swamp #1	Right Fork Swamp	Head of Herods	Herods Downstream	Mouth of Herods
date	11/9/2005	11/9/2005	11/9/2005	3/22/2006	3/22/2006	11/9/2005
pH	5.79	3.56	4.05	4.1	4.67	4.72
acidity	54.35	254.11	110.05	105.76	55.6	63.16
alkalinity	15.01	0	0	0	3.04	2.87
Mg	7.07	28.71	9.44	13.99	1.53	1.43
Ca	23.7	32.89	10.05	13.1	2.34	3.22
Fe	<.1	2.86	0.15	0.43	0.1	<.1
Al	<.1	11.15	4.05	6.1	1.39	0.44
Mn	1.48	8.32	3.18	4.06	0.48	0.48
SO4	74.1	335	85.2	104	13.1	17.1
Cond	228	817	262	318	65.8	61.5

Herods Run

Project 1:

The proposed project site is located at the Head of Herods sampling location and would consist of upgrading a current sediment pond to a limestone leach bed/open limestone channel. With such low concentrations of iron, a passive system would not require a large footprint.

Project 2:

There is an additional site further down in the Herods Run watershed that may require treatment. This site, located just outside the Alton Special Reclamation Site has initial pH measurements indicate moderate water quality. Proposed treatment for this location could consist of a Limestone Leach bed / Open Limestone Channel system. A steel slag leach bed in the tributary adjacent to the impacted tributary could be used to add additional alkalinity to system.

Refer to table 14 for sub-watershed loadings and anticipated reductions for this sub-watershed.

Swamp Run

Recent data collected by WVWRI show that all of the sample locations within the watershed are net acidic. The iron concentration in Swamp Run #1 exceeds both the B-2 and the B-1 criteria. These data indicate that more treatment is necessary in this watershed. Special Reclamation Office has been treating Swamp Run with limestone sand to reduce the metals and increase the pH. Additional treatment of Swamp run at Swamp Run #1 would further improve the water quality.

Project 3:

One site on Swamp Run was selected for Passive Treatment. This site, designated as Right Fork Swamp Run on Figure 9, consists of a seep area that flows down through a wooded area and into Swamp Run. Proposed treatment for this project consists of collecting the seep and directing it into a series of limestone leach beds and retention structures to neutralize the acidity and precipitate metals.

Refer to table 14 for sub-watershed loadings and anticipated reductions for this sub-watershed.

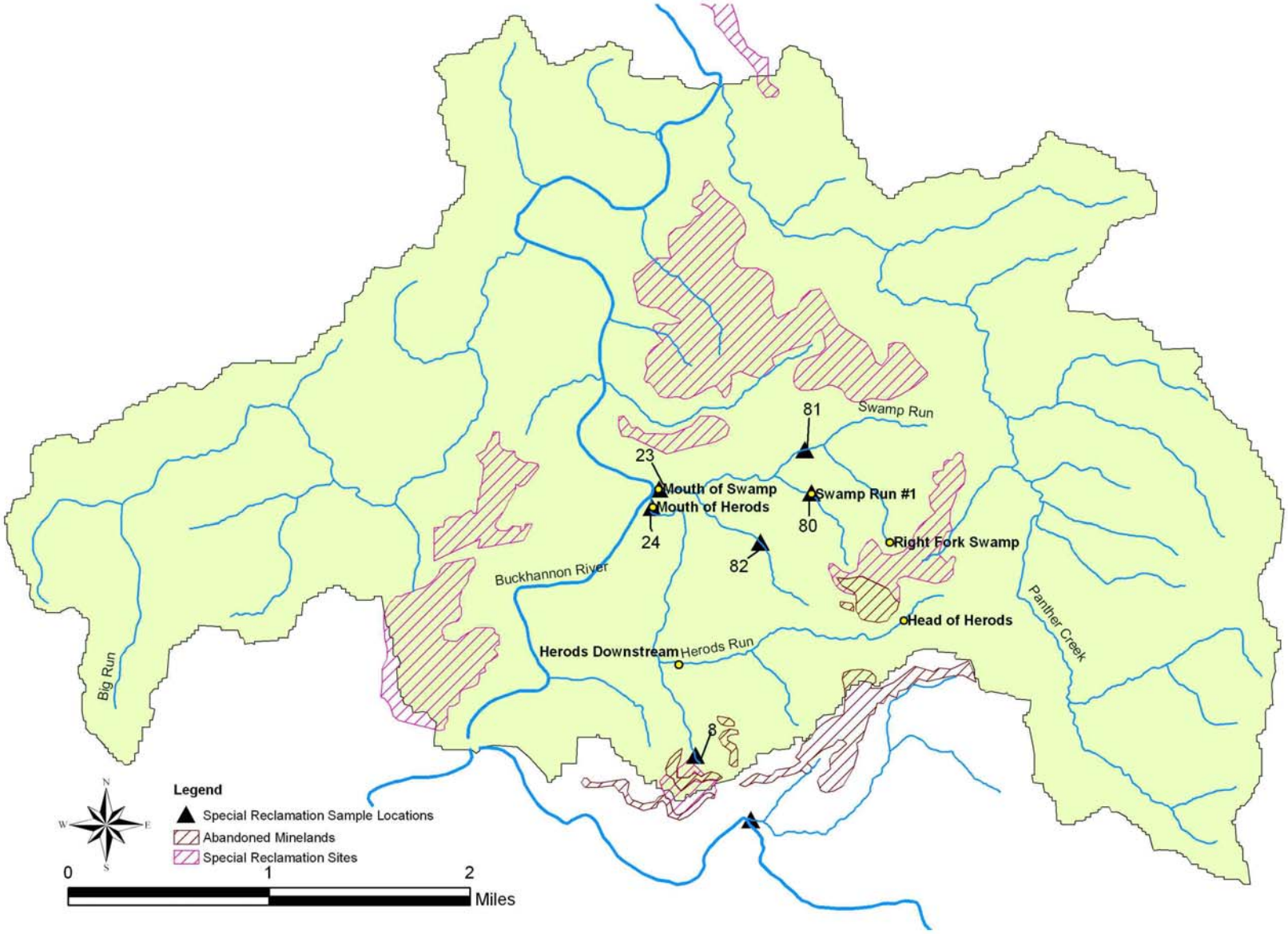


Figure 8. Map of Pather subwatershed showing WRI sample locations, abandoned mine lands, and special reclamation sites (bond forfeitures). The sample site numbers correspond to those in Table 10.

Tenmile Subwatershed

Tenmile subwatershed is 5,132 acres in size and contains 16.8 miles of streams. Tenmile Creek splits into the Right and Left Forks about one mile above the creek mouth (Figure 10). A large portion of the watershed is covered by the inactive Island Creek mine and processing plant. Several treatment ponds and two limestone dosers are used to treat the AMD before it is discharged. The Left Fork of Tenmile; however, still violates water quality standards on a regular basis and is typically orange in color. In April 2004 a macroinvertebrate collection by The Highlands Institute from the Left Fork resulted in one organism (a midge larva).

In June 2004 a detailed survey of Tenmile watershed was conducted by the Highlands Institute with the help of the Office of Surface Mining and the Buckhannon River Watershed Association. Two acid seeps were identified in the Left Fork of Ten mile watershed that was not being treated (Figure 9). The seeps contribute approximately 693 lbs. of iron to the Left Fork of Tenmile creek annually. This corresponds to 24% of the Ten mile Creek loading and very close to the targeted reductions estimated for Tenmile Creek (Table 12). These seeps are being addressed in ongoing permit boundary discussions between the coal operator and the Office of Mining and Reclamation. If it is determined that coal operator is responsible, the seeps fall under the jurisdiction of the Office of Special Reclamation. Otherwise project 4 is necessary to bring the Left Fork of Ten mile Creek up to water quality standards.

Table 12. Metal loads contributed to the Left Fork of Ten mile Creek by two AMD seeps compared to the total load at the mouth of Tenmile Creek. See Figure 5 for location of seeps.

Source	**Iron Load**
	(lbs yr^{-1})
Seep A	529
Seep B	164
Seep Total	**693**
Tenmile Creek Total	2,915

Project 4: Additional sampling needs to be done on Tenmile Creek in order to develop reclamation projects. Engineers from the National Mine Land Reclamation Center in Morgantown, WV will be invited to develop plans for a treatment system based on the quantity of AMD, its concentration, and the geology of the area. Funding for the project will be sought through the 319 program and through a Watershed Cooperative Agreement with the federal Office of Surface Mining. Pre- and post-monitoring will be an integral part of this project. This project will lead to reductions in metal concentrations. The annual loads from untreated AMD seeps in Tenmile Creek are listed in Table 12.

Project 5: The Right Fork of Tenmile Creek is a candidate for the limestone sand program implemented by WV DNR. This project will not require any 319 money.

Refer to table 14 for sub-watershed loadings and anticipated reductions for this sub-watershed.

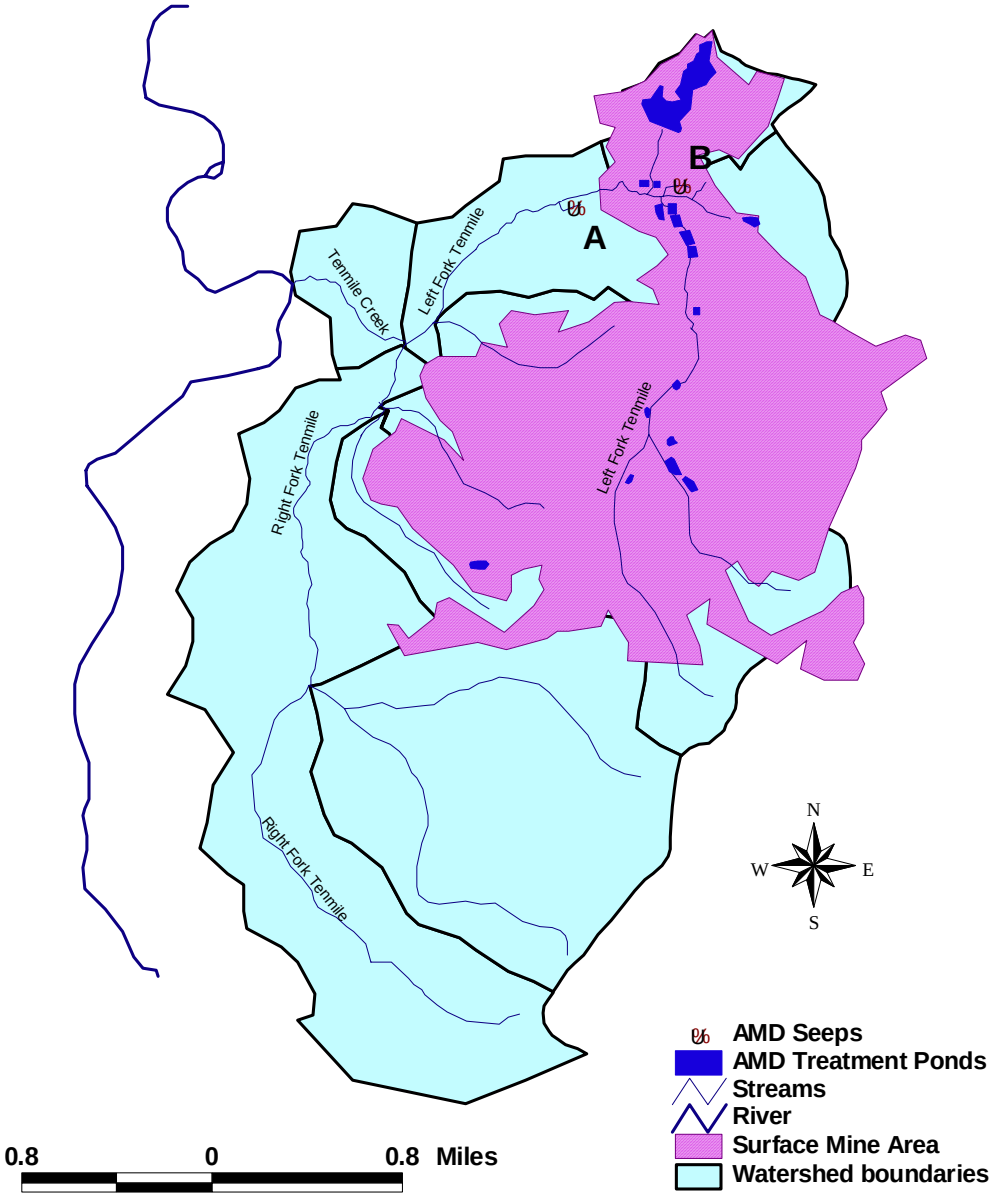


Figure 9. Detailed map of Ten mile subwatershed showing streams, surface mine coverage, acid mine drainage (AMD) treatment ponds, and AMD seeps.

Right Fork and Left Fork Buchannan

Project 6: The WV Division of Natural Resources limestone application project is addressing acidity generated in the Right Fork and Left Fork of the Buckhannon River. Limestone is being added each year to six streams at a dose that is calculated to neutralize all of the acidity exported from each stream (i.e., to bring the pH to 7.0). Therefore, we expect a complete acid load reduction for those streams. A very rough calculation of load reduction can be made from an estimate of total annual discharge (22.7 million cubic meters per year for the Right Fork and 15.0 million cubic meters per year for the Left Fork) and mean total acidity (2.1 mg/L for the Right Fork and 1.4 mg/L for the Left Fork (average of 3 samples collected from 1996 to 2003). Assuming a 95% reduction in total acidity would lead to a reduction in annual acid load of 99,869 lbs/yr in the Right Fork and 43,871 lbs yr^{-1} in the Left Fork.

Project 7: The WV Division of Natural Resources is adding limestone sand to acid-impacted streams in the Upper Buckhannon River Watershed. Limestone will be added each year to about 12 streams at a dose that is calculated to neutralize all of the acidity exported from each stream (i.e., to bring the pH to 7.0). The Left Fork, Right Fork and Marsh Run are being currently being treated through this program. Other sampling locations have not yet been finalized but will likely include Bear Camp Run, Phillips Camp Run, Beech Run, Alec Run, Bens Run, and Millsite Run. The alkalinity added by this project will not only restore the pH of the targeted streams but will also improve the buffering capacity of the river mainstem for several miles downstream. No 319 funding is required for this project. However, efforts are directed through the Upper Buckhannon Watershed Framework.

Smooth Rock Lick

Smooth Rock Lick is a 675-acre watershed containing 2.75 miles of stream. The northwestern portion of the watershed is a large reclaimed surface mine. Currently there is no active treatment for the discharges in this area.

Table 13 shows water chemistry data collected by WRI in 2006 and the Special Reclamation Office. SRL#1, #2, and #3 are acidic seeps with elevated iron concentrations that impact the headwaters of Smooth Rock Lick. Upstream of these seeps, the water chemistry is in compliance with the state water quality criteria. Special Reclamation site 91 is the same location as WRI site Mouth. All of the seeps impacting Smooth Rock Lick have iron concentrations above the B-2 criterion and SRL #2, and #3 have iron concentrations well above the B-1 criterion. SRL #1 flows into Trib (Figure 11), SRL #2 flows into Smooth Rock Lick, and SRL #3 flows into Left Trib.

Table 13. Water chemistry data collected by WRI in early 2006 and the Special Reclamation Office.

Sample ID	US Confluence	DS Confluence	Left Trib	SRL #1	SRL #2	SRL #3	Trib	Mouth	Special Rec 91
date	AVG	AVG	AVG	AVG	AVG	AVG	3/9/2006	3/9/2006	
pH	5.57	5.425	4.655	3.85	4.29	4.88	4.92	5.34	4.01
acidity	52.1	57.63	62.28	71.82	67.4	76.3	48.37	42.29	
alkalinity	5.95	6.165	0.865	0	1.685	6.4	2.58	3	
Mg	0.795	0.875	1.635	2.05	0.95	2.74	1.41	1.11	
Ca	1.44	1.695	2.955	2.69	3.345	3.96	2.66	2.16	
Fe	0.24	0.1	0.155	1.435	2.475	9.27	<0.1	<0.1	*0.4
Al	0.27	0.25	1.915	2.155	1.51	0.2	0.7	0.56	*0.53
Mn	0.18	0.14	0.69	0.48	0.47	1.14	0.58	0.18	
SO4	6.185	7.515	16.94	31	22.95	30.2	12.2	9.81	
Cond	21.3	30.35	75.45	178.4	109.1	101	57.7	38	

*Data measured as Total not dissolved

Project 8: Water chemistry data at Smooth Rock Lick #3 showed an average pH of 4.88, an iron loading of 3,080pounds/year. This can be addressed by installing an 800-foot open limestone channel (OLC) and a retention pond at the base of the OLC. In order to improve the performance of the OLC and the retention pond, the OLC would be a mixture of limestone and limestone sand, and the retention pond will contain baffling to increase retention time. With an efficiency rate of 80% the load reduction from this treatment system will be 2,464 pounds/year of iron. In addition, although the stream is not listed for aluminum impairment this treatment system will remove an estimated 288 pounds/year of aluminum.

Project 9: Acid mine drainage coming from Smooth Rock Lick #1 and #2 (Figure 11) impair the lower tributary of Smooth Rock Lick. Although not adequate to fully treat the water, some treatment does exist at the top of the tributary. At Smooth Rock Lick #1 there is an existing pond. The pond needs to be enlarged, with a dam at the western end and a larger culvert installed. At the outfall of the culvert, an open limestone channel should be installed which will convey the mine drainage northeast in an attempt to utilize the upper portion of the watershed for treatment.

Smooth Rock Lick #2 is a seep that starts at the highwall and collects additional mine drainage as it flows downstream. A limestone channel should be built as far upstream as possible. A retention structure should be built to collect the drainage from the two sources for further precipitation of metals. The combination of these treatments should have an 80% efficiency rate reducing both acidity, and iron.

Loadings from these two project sites contribute approximately 400 pounds/year of iron. After construction, we anticipate an 80% reduction or 320 pounds per year of iron entering Smooth Rock Lick.

Figure 10. Seep at Smooth Rock Lick #2

Refer to table 14 for sub-watershed loadings and anticipated reductions for this sub-watershed.

Table 14. Acid Loadings with anticipated reductions for sub-watersheds that are going to receive 319 funding

	Loading Pounds/Year	Anticipated Reduction Pounds/Year	% Reduction
Herods Run	53,000	42,400	80
Swamp Run	84,000	67,193	80
Tenmile Creek	2,915	2,332	80
Smooth Rock Lick	3,480	2,784	80

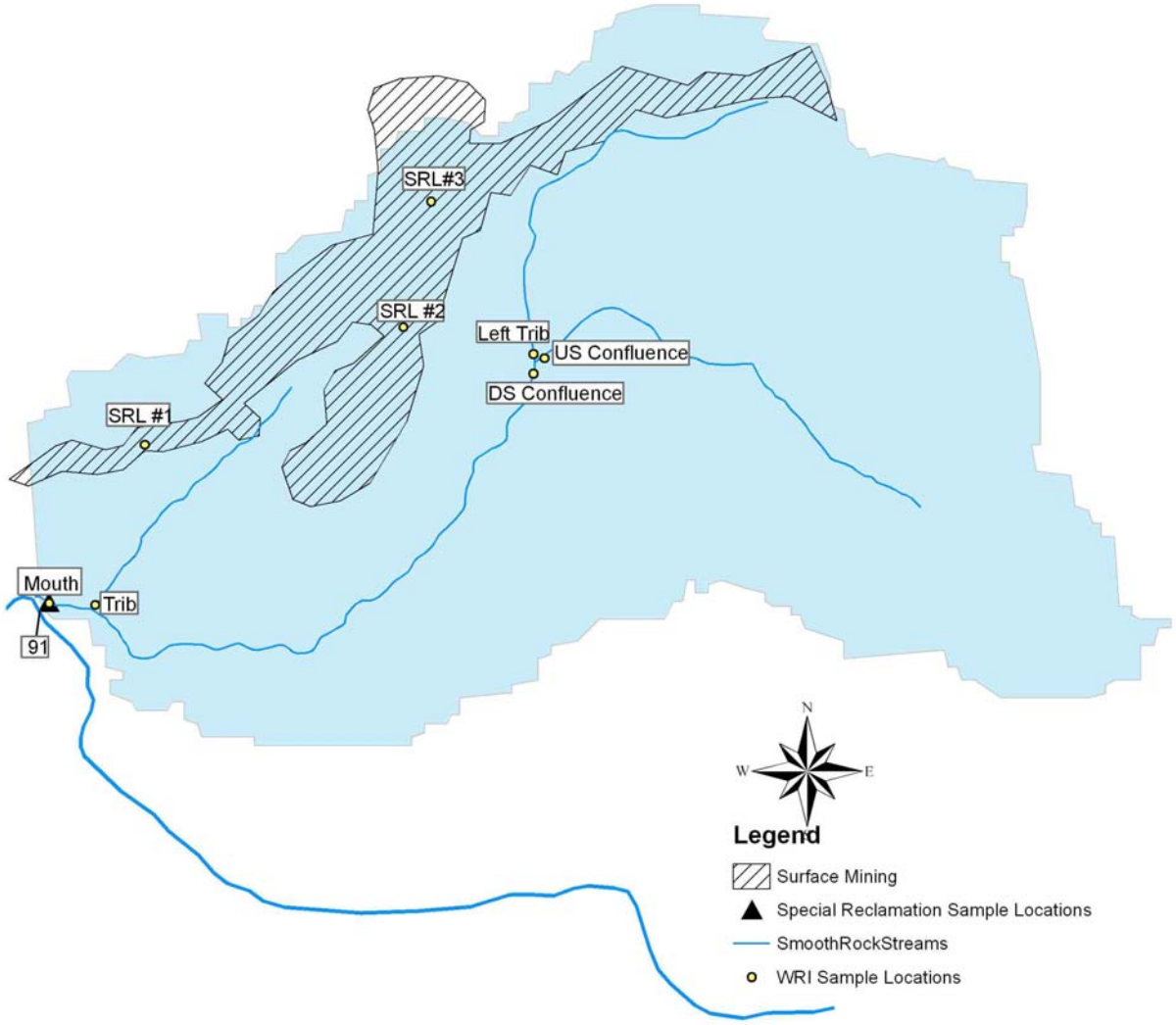


Figure 11. Detailed Map of Smooth Rock Lick subwatershed showing abandoned surface mines, special reclamation sample locations, and WRI sample locations.

B.2 Implementation of Agriculture Best Management Practices

Project 10: Sediment and fecal bacteria reduction within an agricultural operation can best be achieved by the implementation of Best Management Practices or BMPs. These BMPs are designed and established to help reduce the delivery of agricultural nonpoint source pollution to state waters. A second benefit to the implementation of BMPs is that they can make a farmer's agricultural operation run more efficiently saving time and money. A few BMPs that reduce sediment and bacterial inputs to streams include: rotational grazing, streambank fencing, alternative water sources, stream crossings, buffer strips, filter strips, riparian area development, winter feeding areas, and roof run off management. These BMPs work to reduce water flow over bare ground, reduce the amount of bare ground, and encourage vegetative growth. WVCA estimates approximately 48 miles of streams and riparian zones in the Upper Buckhannon watershed will be improved by this project. So far the WVCA has facilitated the implementation of

- 1,002 acres under nutrient management plans
- 3,334 tons of manure being managed
- 2,400 feet of fence installed
- 10 acres of critical area treatment (bare ground covered)
- 10 alternative water supplies
- 4 heave use protection areas established
- 4 animal waste storage facilities.

The WV Conservation Agency and the Natural Resources Conservation Service currently promote BMPs through the Environmental Quality Incentives Program (EQIP) and Conservation Reserve Enhancement Programs (CREP). The WVCA and NRCS will also seek 319 funds to expand their ability to offer incentive programs and to offer a greater diversity of programs to landowners.

Load Reductions
371.8 tons nitrogen
477.1 tons phosphorus
1457.5 tons sediment

B.3 Reclamation of Oil and Gas roads

Success Story

In order to address the sedimentation problems associated with oil and gas operations, several state agencies partnered with Columbia Gas and Coastal Lumber to restore some of the worst areas. A 20" high-pressure gas line right of way and the access roads to it were being used by locals as an off-road driving track. Known locally as the "Mud Bog" it became the Craddock Pipeline Project. The Project was implemented with many partners including the WV Conservation Agency (WVCA), WV Department of Environmental Protection (WVDEP), BRWA, WV Division of Natural Resources (WVDNR), Columbia Gas, and Coastal Lumber. A total of 68 tons of sediment was eroding from these sites per year. The restoration work reduced

erosion to 4.5 tons/yr or a 93.4% reduction. The total 319 cost of the pipeline restoration project was $19,998.00. The match for this project, totaling $28,885.08, came from Columbia Gas which was concerned that this unauthorized activity could damage the gas line and cause personal injury.

Figure 12. Craddock Pipeline Project from "Mud bog" to restored area.

Project 11: Through the use of Clean Water Act Section 319 Incremental Project funds 1,000 feet of pipeline and 4,000 feet of abandoned roads will be restored in a project called Palace valley Oil and Gas Rod and Pipeline Restoration Project. This will be achieved through reshaping, installing breakers, diversions, broad-based dips, out sloping and other Best Management Practices to control the velocity and discharge of water causing erosion and sediment deposition in streams**.** Firm load reductions won't be available until project implementation.

Figure 13. Reclamation of ATV impaired pipeline and abandoned gas well roads on the Left Fork of the Buckhannon.

C. NONPOINT SOURCE MANAGEMENT MEAUSURES (as modified from the Watershed Based Plan for the Lower Cheat River Watershed)

C.1 Acid mine drainage

Passive AMD Treatment

- **Oxic (Open) limestone channels (30%).** OLCs have the advantage that continually moving water erodes iron armoring on limestone, and water flow removes precipitates from OLC so that they don't interfere with acid neutralization. In practice, the efficacy of OLCs may suffer when they are too short or do not have sufficient gradient. Recent research suggests that the acid neutralization that takes place in OLCs is actually greater than can be accounted from limestone dissolution.
- **Limestones leach beds (50%).** Limestone leach beds are most effective when water has a pH of 3 or less, and when water retention times are short (~90 minutes). The low pH promotes rapid limestone dissolution, and the short retention time prevents armoring.
- **Steel Slag (50%).**

C.2 Biological impairment

Once a stream is placed on the 303(d) list for biological impairment, a stressor identification process is completed to determine the cause(s) of impairment prior to TMDL development. The WVDEP uses a modified version of the USEPA's *Stressor Identification: Technical Guidance Document* for their stressor identification process (WVDEP, 2004c, p.22). Data collected prior to TMDL development is used to establish a link between the impairment and the possible source(s) of pollution. The following list of candidate causes has been developed by the WVDEP to help guide the stressor identification process:

- metal contamination (including metals contributed through soil erosion) causes toxicity;
- acidity (low pH) causes toxicity;
- high sulfates and increased ionic strength cause toxicity;
- altered hydrology, nutrient enrichment, and increased biochemical oxygen demand reduces dissolved oxygen;
- algal growth causes food supply shift;
- high levels of ammonia causes toxicity (including toxicity increases due to algal growth); and
- chemical spills causes toxicity (WVDEP, 2004c, pp. 22-23).

The streams on the 303(d) list for biological impairment for the UB watershed are scheduled to have a TMDL developed not later than 2020. Prior to their TMDL development, WVDEP will most likely complete a stressor identification process similar to the one completed for the Upper Kanawha TMDL (WVDEP, 2004c). The pollution sources already discussed in this document are most likely the causes of biological impairment for these streams. When the

source(s) are addressed, the approaches to nonpoint source management should be consistent with this document.

C.3 Fecal coliform

Depending on what a future investigation may find regarding possible nonpoint sources of fecal coliform bacteria in the Upper Buckhannon watershed, a number of control measures may be effective. These control measures may include:

- septic system installation and maintenance or upgrades,
- fencing livestock out of streams,
- connecting homes to centralized or managed decentralized wastewater treatment systems, and/or
- urban storm water treatment and control measures.

C.4 Sediment

Depending on what a future investigation may find regarding nonpoint sources of sediment in the Upper Buckhannon watershed, a number of control measures may be effective. For agriculture, the following control measures have proven to be effective in controlling nonpoint source pollution:

- establishment of buffer strips and or filter strips between streams and crop or pasture land,
- fencing livestock from streams,
- planting cover crops, and/or
- stabilizing eroding stream banks using appropriate techniques.

For forestry, installing and maintaining best management practices to prevent erosion will be effective in controlling nonpoint source pollution. Besides agriculture and forestry, other sediment sources dirt and gravel roads, development, construction, and illegal off road vehicle use. Control measures will be tailored to the particular sources found to be causing sedimentation.

D. TECHNICAL AND FINANCIAL ASSISTANACE NEEDED

D.1 Technical Assistance

West Virginia Department of Environmental Protection

The Division of Water and Waste Management will provide technical assistance in the implementation of the watershed based plan through two programs; the Watershed Assessment Program and the Nonpoint Source Program (NPS). The water quality section of the Division of Water and Waste Management conducts monitoring in the Upper Buckhannon on a five year cycle through its Watershed Assessment Program. The next sampling is to be completed in 2007. The program provides information on the severity of existing or potential pollution sources,

evaluates the potential for cleanup, and supports stakeholders in the implementation of management and control measures. The NPS Program is funded primarily by the Clean Water Act Section 319 Grants in order to:

- Education of the public and land users on non-point source issues
- Support citizen based watershed organizations
- Support enforcement of non-point source water quality laws
- Restoration of impaired watersheds

Another technical assistance program within the WVDEP is the WV Save our Streams program. This is a volunteer monitoring program that trains West Virginia citizens of all ages, how to monitor, and become watchdogs over their local wadeable streams and rivers. This program has proven to be an invaluable asset in educating members of watershed groups as well as the general public.

West Virginia University

The primary organization housed within West Virginia University that provides technical assistance for watershed groups is the National Mine Land Reclamation Center (NMLRC). This organization can provide conceptual site designs for reclamation of AMD, as well as oversee the installation of the project site, and monitor the pre and post construction water quality. The NMLRC also provides support to DEP in developing watershed plans and training for watershed organizations. NMLRC can draw upon the expertise of the numerous university colleges at WVU to address other types of nonpoint source pollutants.

West Virginia Conservation Agency

The West Virginia Conservation Agency will provide technical assistance in the proper installation and maintenance of best management practices (BMPs), as well as offer support for education and outreach efforts.

D.2 Funding Sources

Section 319 funds

Clean Water Act Section 319 funds may be provided by USEPA to WVDEP to be used for reclamation of nonpoint source AMD sources. This Watershed Based Plan is being developed so that these funds in fiscal year 2007 and beyond can be allocated to the Upper Buckhannon watershed. WVDEP's Division of Water Resources sets priorities and administers the state Section 319 program.

Watershed Cooperative Agreement Program

Grants specifically for AMD remediation projects on AMLs are available through OSM's Watershed Cooperative Agreement Program (WCAP). The WCAP is part of the Appalachian

Clean Streams Initiative. Grants of up to $100,000 area warded to not-for-profit organizations that have developed cooperative agreements with other entities to reclaim AML sites.

The Abandoned Mine Land Trust Fund

D.3 Funding Requirements

Table 15. Estimated costs associated with expected load reductions for projects requiring 319 funding

Project	Watershed	Cost Description	Estimated Cost
1	Herods	Passive Treatment System	$150,000
2	Herods	Passive Treatment System	$130,000
3	Swamp Run	Passive Treatment System	$175,000
4	Tenmile Creek	Passive Treatment System	$175,000
7	Smooth Rock Lick	Passive Treatment System	$150,000
8	Smooth Rock Lick	Passive Treatment System	$150,000
9	Upper Buckhannon	Agriculture BMP's	$408,331
10	Upper Buckhannon	Reclamation of Oil & Gas Roads	$41,000

E. INFORMATION AND EDUCATION COMPONENT

E.1. Acid Mine Drainage

"Education" is featured prominently in the mission statements of both the Buckhannon River Watershed Association and the Highlands Institute for Environmental Research and Education at WVWC. These two organizations have a history of outreach and education in the local community and make use of a variety of media. The BRWA will keep local citizens informed through its newsletter, pubic forums, and educational displays at regional fairs and festivals. BRWA may also organize volunteer citizen monitoring of some of the AMD projects proposed herein. The Upper Buckhannon Framework team will convene meetings with state, county, and local agencies and facilitate communication among all participants.

E.2. Agriculture

Educating the agricultural community can bring about change. Through educational activities, workshops, and technical assistance landowners will be offered education concerning sediment, water quality, best management practices, as well as their surrounding environment. Technical assistance will be given to landowners who have questions or concerns about their agricultural operation. The Natural Resource Conservation Service and WV Conservation Agency will also promote their cost share programs from which both farmers and the environment can benefit. News releases and brochures will be used as methods to inform the public of upcoming events, and programs that are available to them.

E.3. Forestry

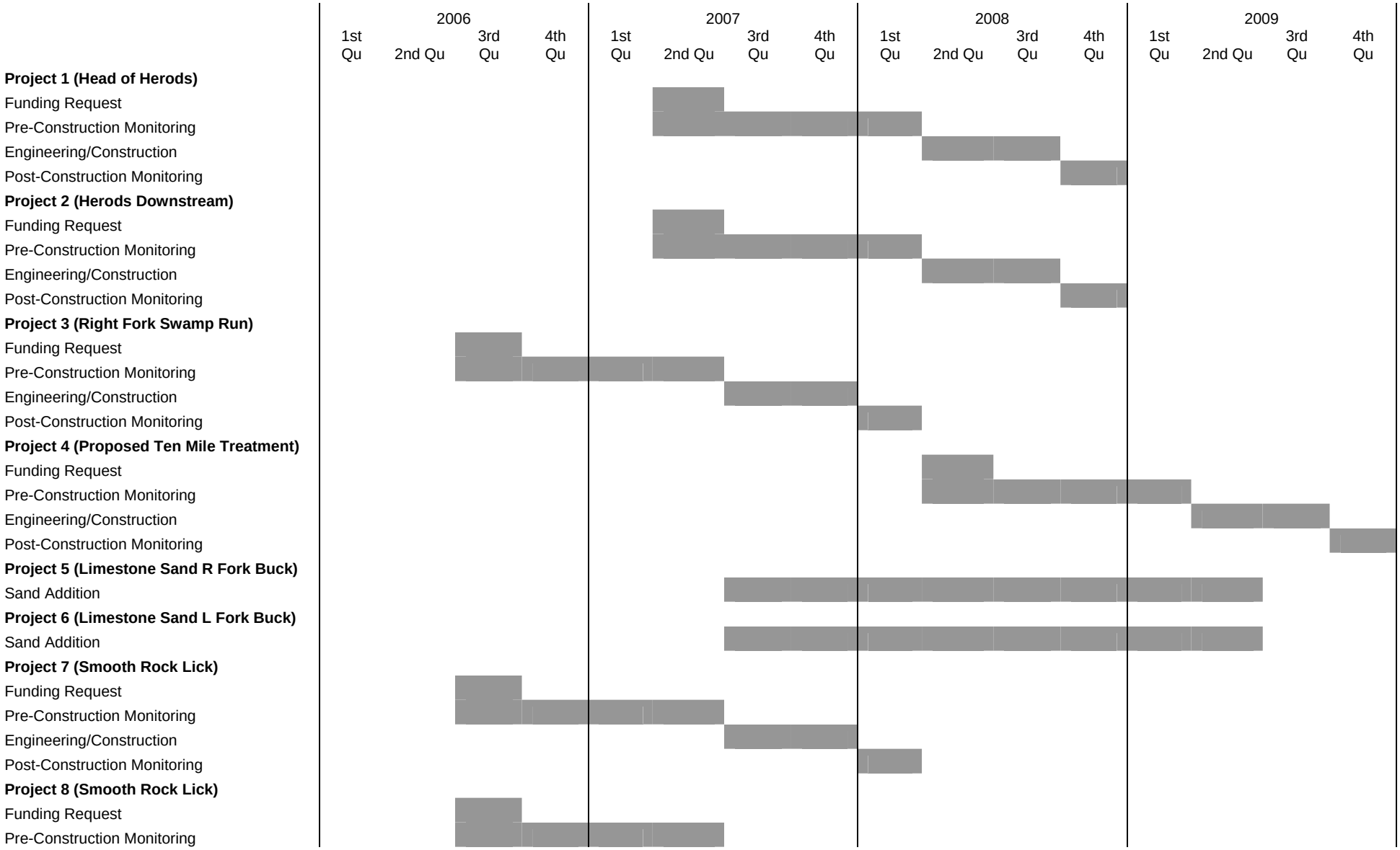
The West Virginia Division of Forestry holds several workshops each year for their staff and for loggers within the state. Workshops are held to certify loggers and timber operators. These workshops are designed to educate loggers and operators about our environment and Best Management Practices to use while harvesting timber. Landowners who use a properly licensed

timber operator and a certified logger know the workers will use BMPs that reduce both soil erosion and water pollution.

E.4. Oil and Gas

Educating the public about the risks of using of oil and gas roads and pipelines as ATV roads is critical. Educational workshops, news articles, or demonstration projects to deter riders from these areas are key to their improvement. Similarly roads used by logging operations that are not brought back to oil and gas specifications also pose a problem. An education program used to teach loggers will be implemented in connection with the WV Division of Forestry concerning the use of oil and gas roads as logging roads, and how to bring them back to DEP standards.

F. SCHEDULE OF IMPLEMENTATION




Engineering/Construction
Post-Construction Monitoring
Project 9 Agriculture BMPs)
Project 10 (Oil and Gas Reclamation)
Project 11 (Coordination and Education)

G. SCHEDULE OF INTERIM MILESTONES

The criteria listed in section H will be evaluated every two years according to the monitoring plan described in section I in a biennial report. These reports will evaluate the progress made by each of the projects.

The first major milestone will be reached in the middle of 2007 when all assessment and site identification (Projects 1 and 2) is to be completed and the first progress report is written. The second milestone will be the second progress report in 2009 at which time projects 1, 2, 3, 7, 9, 10 and 11 will be complete (except perhaps for some post-monitoring). The success at achieving the targeted load reductions will be evaluated at that point.

The final milestone will occur after 5 years in 2011. At that time the Watershed Implementation Plan Committee will reconvene to revise the Watershed Implementation Plan. Our objective is to have achieved 25% of our main goals (see section A.1.) within 5 years. That is, achieve load reductions in metals of 25% of our target, improve RHA Index scores by 25%, improve 25% of the impaired stream riparian zones, etc. The two previous progress reports will provide much of the information needed to evaluate progress to date.

H. CRITERA TO BE USED

H.1. Metals

Concentrations and loads of iron will be used as the criteria. . WV state water quality standards for total iron are 0.5 and 1.5 mg/L^{-1} for B-1 and B-2 waters, respectively. The load limits for iron is established in the 1998 TMDL report.

H.2. pH/Acidity

The criterion that will used for pH and acidity is pH which, according to state regulations, must be between 6.0 and 9.0.

H.3. Sediment

Because it is difficult to measure sediment loads directly, we will make use of several indirect measures of sediment. The Rapid Habitat Assessment Index will be used extensively to quantify stream channel and riparian zone quality. RHAI scores of > 180 are desirable. In addition, we will keep record of number of stream miles improved by agriculture BMP implementation and miles of gas well road and pipelines restored.

H.4. Fecal Bacteria

Fecal coliform concentrations will be used as the criterion for fecal bacteria assessment. The state water quality standard for fecal coliform for C waters is 200 CFU per 100 mL as a monthly geometric mean based on not less than 5 samples per month or 400 CFU per100 mL in more than

ten percent of all samples taken during the month. Because coliform bacteria are so closely linked to sediment, the Rapid Habitat Assessment Index will also be used as an indirect indicator of bacterial inputs.

H.5. Bioassessment

Bioassessment of benthic macroinvertebrates will be used to supplement the criteria listed above because periodic chemical sampling of specific pollutants may not provide a complete and accurate description of water quality. The WV Stream Condition Index will be used as the criterion for assessment. Values greater than 68% (Good category) are desirable.

I. MONITORING COMPONENT

Monitoring is an essential component of a watershed-based implementation plan because it allows stakeholders to see what progress is being made and when goals are achieved. Monitoring will be a key component of each of the projects described in section C above. In general at least one year of chemical monitoring will be conducted before and after each project within the project's subwatershed (see section F). Habitat assessment and bioassessment will be conducted once before and one year after the completion of each project. Chemical sampling will be the responsibility of the organization that is conducting the reclamation. Habitat and bioassessment may be done by the reclaiming organization or by WV Save Our Streams or The Highlands Institute.

In addition to localized, project-related monitoring, watershed-wide surveys of water quality will take place at least every two years and will include all of the criteria listed in section H. The Watershed Assessment Program (WAP group) is doing a watershed assessment in 2007 and members of the BRWA will assist them in their selection of sampling locations. Other monitoring efforts include using a BRWA member who also works with the SOS program to assist in the benthic sampling for the watershed. Also, members of the rivers coalition have offered to advise and give recommendations to the BRWA on fecal and wastewater monitoring. In regards to sampling streams listed for acid deposition, DNR and possibly the NPS program will do some pH monitoring simultaneously with other water quality monitoring efforts. All monitoring efforts will be covered by the quality assurance project plan (QAPP). The Upper Buckhannon Framework team will serve as the data repository and will generate a biennial report on water quality in the watershed.

J. REFERENCES

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