WATERSHED BASED PLAN FOR THE LOWER CHEAT RIVER WATERSHED

From river mile 43 at Rowlesburg, WV to the West Virginia / Pennsylvania border, including all tributaries

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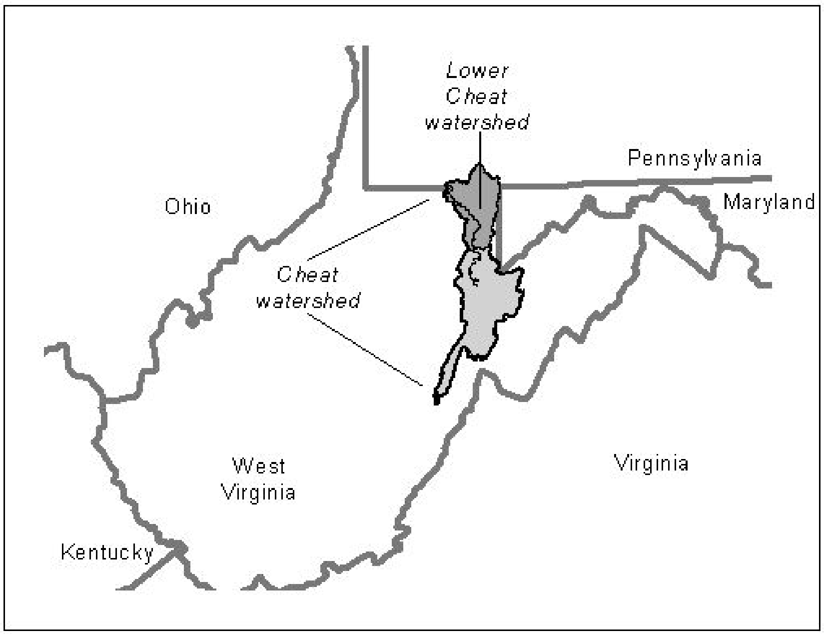
ABBREVIATIONS

Al	aluminum
AMD	acid mine drainage
AML	abandoned mine land
BFS	bond forfeiture site
co.	county
dis.	dissolved
Fe	iron
FOC	Friends of the Cheat
gpm	gallons per minute
L	liter
mg/L	milligrams per liter
Mn	manganese
MRB	manganese removal bed
NMLRC	National Mine Land Reclamation Center
NR	not reported
NTU	nephelometric turbidity unit
OAMLR	Office of Abandoned Mine Lands and Reclamation
OLC	oxic (or open) limestone channel
OSM	Office of Surface Mining, Reclamation, and Enforcement
PA	problem area
PAD	problem area description
PCEDA	Preston County Economic Development Authority
RAPS	reducing and alkalinity producing system
SRG	Stream Restoration Group
TMDL	total maximum daily load
tot.	total
ug/L	micrograms per liter
UNT	unnamed tributary
USACE	United States Army Corps of Engineers
USGS	United States Geologic Survey
WCAP	Watershed Cooperative Agreement Program
WVDEP	West Virginia Department of Environmental Protection
Zn	zinc

1. INTRODUCTION

The Cheat River, which drains the largest uncontrolled watershed in the eastern United States, flows north through north-central West Virginia before draining into the Monongahela River just north of the West Virginia/Pennsylvania border (Figure 1). This Watershed Based Plan covers the lower Cheat watershed: the Cheat mainstem and its impaired tributaries from Rowlesburg, West Virginia at approximately river mile 43 to where it crosses the state line near Point Marion, Pennsylvania.

Figure 1: The lower Cheat watershed in West Virginia



Many streams in the watershed are impaired by acid mine drainage pollutants, and biological impairments of unknown causes. Bacteria and sediment problems have also been documented.[1]

This Watershed Based Plan has been written to allow incremental Section 319 funds in fiscal year 2005 and beyond to be spent in the lower Cheat watershed to clean up nonpoint sources that contribute to these pollution problems.

After summarizing the range of impairments documented in the watershed, this plan focuses on acid mine drainage (AMD)—by far its most significant water quality problem—and documents the dozens of nonpoint sources of AMD. Where data allow, costs of remediating each site are calculated. This plan also addresses technical and financial assistance needs, proposes an implementation schedule with milestones and measurable goals, and documents an outreach and education program that will help make this plan a reality.

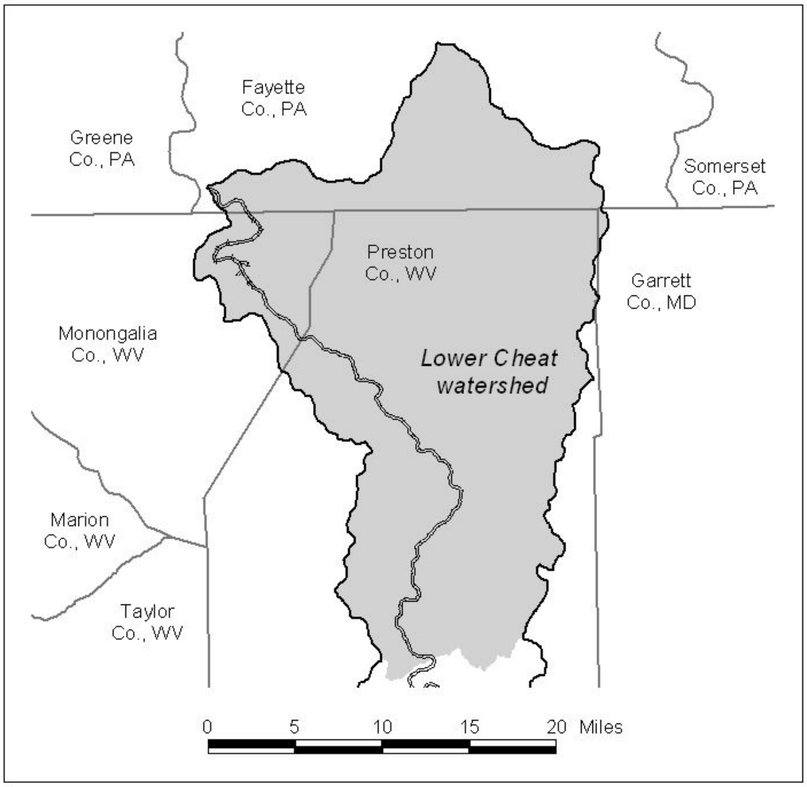
The following background information on the lower Cheat watershed is quoted from a recent report on the Cheat watershed (Hansen et al., 2004). The quoted text covers the entire Cheat watershed, but provides sufficient background information for the area covered by this Watershed Based Plan.

[1] Although WVDEP considers Cheat Lake to be impaired by mercury, this pollutant is not considered in this Watershed Based Plan because it is believed that nonpoint sources do not contribute to this impairment.

1.1 General information

"The Cheat River … is one of the larger tributaries to the Monongahela River, which, with the Allegheny River, forms the Ohio River in Pittsburgh, Pennsylvania. [As shown in Figure 2, its] watershed—1,426 square miles—is located almost entirely in West Virginia, although 7% lies in Pennsylvania and a small fraction is in Maryland.

Figure 2: States and counties in the vicinity of the lower Cheat watershed



"… [T]wo major branches meet in Parsons to form the Cheat River: Shavers Fork flows north-northwest from Pocahontas County, and the…Black Fork gathers several smaller tributaries (Blackwater River, Dry Fork, Laurel Fork, Glady Fork, and Red Creek) from Tucker and Randolph Counties. The mainstem of the Cheat River flows north 84 miles from Parsons to its confluence with the Monongahela River at Point Marion, Pennsylvania, just north of the border with West Virginia. The river is dammed a short distance upstream from its mouth to form Cheat Lake, also known as Lake Lynn. Upstream from Cheat Lake, the Cheat is advertised as the largest uncontrolled watershed in the eastern United States by whitewater guide companies (Canaan Valley Outfitters, 2003).

"Both Shavers Fork and the five major tributaries that form the Black Fork rise in sparsely settled mountainous terrain, much of which is part of the Monongahela National Forest. Four of the five federally designated wilderness areas in the forest lie within the Cheat watershed.

"The sparsely populated and very rural Cheat watershed has no major population centers. Incorporated towns in the watershed include Kingwood, the Preston county seat (population

2,944); Parsons, the Tucker County seat (population 1,463); as well as Terra Alta (1,456), Rowlesburg (613), parts of Tunnelton (336), Albright (247), and Bruceton Mills (74) (U.S. Census Bureau, 2003)…

"About 16% of the total population of 45,970 lives in Pennsylvania. The overall population density is just over 32 persons per square mile based on the 2000 Census. Overall, using block level information from the 2000 Census, 25% of the population lives on less than 5% of the land, which lies within most of the towns in the watershed. The density then decreases quickly: 50% of the population lives on 25% of the watershed area. A significant portion of the watershed is very sparsely populated. In total, 99% of all inhabitants are found on 70% of the land area. This implies a population density of about one person per square mile in the least densely populated 30% of the watershed. By any measure, the Cheat watershed is an extremely rural landscape with a significant portion of the population scattered in individual homes or small communities…" (Hansen et al., 2004, p. 4).

1.2 Land use/Land cover

"… [T]he Cheat watershed is primarily forested. Together, forested, pasture/grassland, and shrubland make up 95% of the total land area in the watershed. Mined land, the source of acid mine drainage, accounts for just over 1% of the total (USGS, 1992). While this is an underestimate as reclaimed sites may now be classified as forested or pasture/grassland, it suggests the relatively small percentage of land area that is contributing to AMD-related water quality problems" (Hansen et al., 2004, p. 6).

Table 1: Land cover summary for the Cheat watershed

Land cover	Area (mi^2)	Percent of watershed
Forested	1,135.1	80.0%
Pasture/grassland	184.8	13.0%
Shrubland	25.9	1.8%
Wetland	22.4	1.6%
Surface water	18.4	1.3%
Mined	15.2	1.1%
Urban developed	10.2	0.7%
Row crop agriculture	4.0	0.3%
Barren	3.4	0.2%
Total	1,419.4	100.0%

Source: Hansen et al., 2004, p. 7. Data from U.S. Geological Survey, 1992.

1.3 Aquatic resources

"Although less diverse than the fish fauna of southern Appalachian watersheds, more than 30 species are known to inhabit streams of the Cheat watershed. The cleanest, highest-elevation tributaries have self-sustaining populations of the region's only native trout species: brook trout (*Salvelinus fontinalis*). Many other streams contain stocked rainbow and brown trout. Larger and lower-elevation streams support various eurythermal and warm-water fish species, including creek chubs, stonerollers, numerous minnows (*Notropis spp.*), blacknose and longnose dace, white suckers, hognose suckers, fantail and greenside darters, bluegills, redbreast sunfish, and smallmouth bass" (Hansen et al., 2004, pp. 7-8).

1.4 Economy

"Coal mining in Preston County, which contains most of the AMD problems in the watershed, started at the beginning of the twentieth century. The first reports of mining activity from Preston County to the Division of Mines were from the Tunnelton area. A mining boom followed the spread of railroads along the Cheat River. During this period, coal mining and related services employed a large portion of the population in the coal-mining regions.

"Coal production peaked once during World War II and remained strong in the 1950s and 1960s. Since then, the thin, sloped seams of Preston County have competed poorly with thicker, flatter seams further south in the state, as well as those in the western United States. As [the West Virginia Department of Environmental Protection (WVDEP)] stopped most permitting of acid-producing coal seams with long-term treatment liabilities in the 1990s, it became more difficult to obtain permits to mine the Upper Freeport seam in Preston County. Also, as a result of the Clean Air Act, West Virginia mining has generally shifted from the Cheat watershed and other nearby areas, where high-sulfur and relatively low-energy coal are typically found, to West Virginia's southern coalfields.

"Allegheny Power operates a coal-fired power plant in Albright, on the Cheat River. Other large employers in Preston County include the Preston County Board of Education, hospitals (Preston Memorial Hospital and Hopemont State Hospital), a coal mining company (Coastal Coal West Virginia), small manufacturers (Hollinee, a maker of fiberglass air filters, and Matthews International, a maker of gravestones and caskets), and wood products companies (Allegheny Wood Products and Coastal Lumber Company). There are no employers with more than 250 employees, and only eight with 100 or more employees (PCEDA, 2003). A thriving white-water rafting tourism industry brings tourists to the region.

"Preston County has developed into a bedroom community for surrounding areas. The 2003 County Data Profiles developed by the Bureau of Business Research at West Virginia University provide a summary of Preston County economic conditions (Bureau of Business Research, 2003). Less than 55% of employed residents of Preston County actually work in Preston County. Nearly 27% work in nearby Monongalia County, West Virginia while the remaining 19% primarily work in a number of surrounding counties in Maryland, Pennsylvania, and West Virginia. Conversely, fewer than 19% of workers in Preston County commute in. While the local economy is not strong, unemployment is relatively low. In 2001, the 4.6% unemployment rate in Preston County was lower than that for the state (4.9%) or the nation (4.7%). Income levels, however, paint a somewhat different picture. The 2001 per capita personal income of Preston County residents was $17,998, only 78% of the state average of $22,862 and 59% of the national average, $30,413." (Hansen et al., 2004, pp. 8-9)

2. MEASURABLE WATER QUALITY GOALS

All stream segments in the lower Cheat watershed should, at a minimum, be fishable and swimmable, and should be clean enough to contain healthy communities of indigenous aquatic species. The federal Clean Water Act, state Water Pollution Control Act, and federal and state regulations have determined a set of interlinked water quality goals. Designated uses for the streams in the lower Cheat watershed include public water supply (Category A), maintenance and propagation of aquatic life (warm water fishery streams) (Category B1), maintenance and propagation of aquatic life (trout waters) (Category B2), and water contact recreation (Category C). The numeric and narrative water quality standards shown in Table 2 are relevant for the nonpoint source pollution problems addressed by this Watershed Based Plan.

Table 2: Selected West Virginia water quality standards

		Aquatic life		Human health	
Parameter	**Section**	**Category B1 (Warm water fishery streams)**	**Category B2 (Trout waters)**	**Category A (Public water supply)**	**Category C (Water contact recreation)**
Aluminum (dissolved)	8.1	Not to exceed 87 µg/L (chronic) or 750 µg/L (acute)		None	None
Biological impairment	3.2.i	[N]o significant adverse impact to the…biological [component] of aquatic ecosystems shall be allowed.			
Fecal coliform	8.13	None	None	Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN or MF) shall not exceed 200/100 ml as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 ml in more than ten percent of all samples taken during the month.	
Iron (total)	8.15	Not to exceed 1.5 mg/L (chronic)	Not to exceed 0.5 mg/L (chronic)	Not to exceed 1.5 mg/L	None
Manganese (total)	8.17	None	None	Not to exceed 1.0 mg/L	None
pH	8.23	No values below 6.0 nor above 9.0. Higher values due to photosynthetic activity may be tolerated.			
Turbidity	8.32	No point or non-point source to West Virginia's waters shall contribute a net load of suspended matter such that the turbidity exceeds 10 NTUs over background turbidity when the background is 50 NTU or less, or have more than a 10% increase in turbidity (plus 10 NTU minimum) when the background turbidity is more than 50 NTUs.			
Zinc (dissolved)	8.33	Not to exceed chronic and acute concentrations that vary with hardness		None	None

Source: 46 Code of State Rules Series 1. Sections refer to this rule. At the time that this plan is being written, EPA is considering whether or not to approve a modification to the state manganese criterion that would make it apply only upstream from known drinking water sources. When the TMDL was developed for the Cheat River watershed, an acute total aluminum criterion of 750 µg/L was in effect. Since then, the aluminum criterion was changed to dissolved aluminum, and a chronic criterion was added. At the time that this plan is being written, the West Virginia Environmental Quality Board is moving forward with suspending the chronic dissolved aluminum criterion of 87 µg/L. If formally approved by this board, EPA would still need to decide whether or not to approve this modification before it can take effect. The chronic dissolved zinc equation is: $Zn = e^{(0.8473[\ln(hardness)]+0.7614)} \times 0.986$. The acute dissolved zinc equation is: $Zn = e^{(0.8473[\ln(hardness)]+0.8604)} \times 0.978$. See Sections 8.32 and 8.32.1 for special circumstances for the turbidity standard. NTU = nephelometric turbidity unit.

3. SOURCES OF NON-POINT SOURCE POLLUTION THAT MUST BE CONTROLLED

Streams that do not meet water quality standards are placed on a statewide list of impaired streams called the 303(d) list. Improving water quality so that these streams are once again clean and can be removed from this list is the primary goal of this plan. Segments of the lower Cheat watershed covered by this plan are on the 2004 303(d) list for AMD-related pollutants (pH, dissolved aluminum, iron, manganese, dissolved zinc), and/or biological impairment (WVDEP, 2004a).

This plan also considers two other types of pollution—fecal coliform and sediment—because other data sources have identified these pollution problems in the lower Cheat watershed.

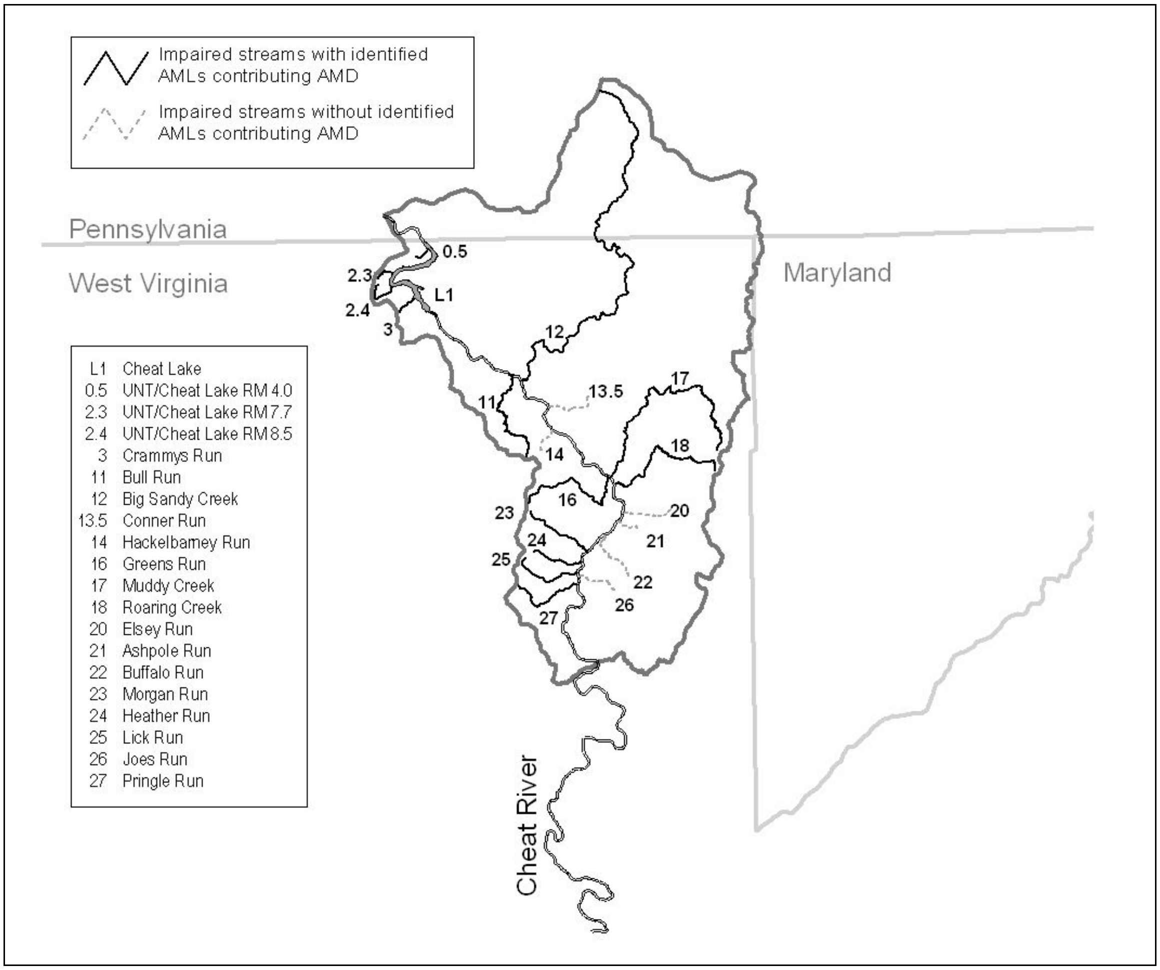
3.1 Acid mine drainage

The most important nonpoint source pollution in the lower Cheat watershed is acid mine drainage from abandoned mine lands (AMLs). WVDEP's most recent 303(d) list (WVDEP, 2004a) and their earlier assessment of the Cheat watershed (WVDEP, 1999) list specific segments of the lower Cheat watershed as impaired by high concentrations of iron, aluminum, manganese, and/or zinc and by low pH from AMD. Figure 3 shows which streams are impaired by AMD. These impairments are further explained in Table 3. These AMD impairments may be caused in whole or in part by AMLs, bond forfeiture sites (BFSs), and/or active permitted coal mines. The ten AMD-impaired streams with known AML discharges of AMD are drawn as solid lines in Figure 3. Impaired streams with no known AML discharges of AMD are drawn as dashed lines.

Inventories of AMLs and BFSs that discharge AMD are shown in Tables 4 and 5. Although Figure 3 and Table 3 show 17 tributaries and the Cheat River itself as being impaired by AMD, only ten of these tributaries are known to have AMD discharging from nonpoint source AMLs. Therefore, this Watershed Based Plan focuses on these 10 tributaries.

A total of 239 AMLs are known to exist in the lower Cheat watershed. Of these, the 66 sites thought to discharge AMD are listed in Table 4. The others likely do not discharge AMD; therefore, they are only listed in Appendix A. The methods used to identify sites in Table 4 and Appendix A are not foolproof. If new information indicates that an AML that was left out of Table 4 does, in fact, discharge AMD, the Watershed Based Plan will be updated as appropriate.

Figure 3: Stream segments impaired by acid mine drainage



Note: Numbers refer to stream codes. For example, the stream code for Bull Run is MC-11.

Table 3: Stream segments impaired by acid mine drainage

Stream code	Stream name	Impaired miles	Al (dis)	Al (tot)	Fe	Mn	pH	Zn
Cheat River								
MC	Cheat River	69.4	x	X	x		x	x
Cheat Lake								
MC-0.5	UNT/Cheat Lake RM 4.0	0		x	x	x	x	
MC-2.3	UNT/Cheat Lake RM 7.7	0		x	x	x	x	
MC-2.4	UNT/Cheat Lake RM 8.5	0		x	x	x	x	
Crammys Run								
MC-3	Crammys Run	1.4		x	x	x		
Bull Run								
MC-11	Bull Run	6.2		x	x	x	x	
MC-11-0.1A	UNT#1/Bull Run RM 1.6	1.44		x			x	
MC-11-A	Middle Run	1.7		x	x	x	x	
MC-11-B	Mountain Run	2.4		x	x	x	x	
MC-11-B-1	Lick Run	1.5		x	x	x	x	
MC-11-C	UNT#2/Bull Run RM 2.1	1.4		x*	x	x	x	
MC-11-D	Left Fork Bull Run	NR		x*	x*	x*		
MC-11-E	Right Fork Bull Run	1.8		x	x	x	x	
Big Sandy Creek								
MC-12	Big Sandy Creek	19	x	x	x	x	x	
MC-12-0.2A	UNT/ Big Sandy Creek RM 2.9	0		x	x	x	x	
MC-12-0.5A	Sovern Run	4.7		x	x	x	x	
MC-12-A	Laurel Run	NR			x*			
MC-12-A	Laurel Run Above Patterson Run	NR		x*				
MC-12-A-1	Little Laurel Run	NR			x*			
MC-12-B	Little Sandy Creek	14		x	x	x	x	
MC-12-B-0.5	Webster Run	3		x	x	x	x	
MC-12-B-0.5-A	UNT/Webster Run	NR		x*		x*	x*	
MC-12-B-1	Beaver Creek	7.4		x	x	x	x	
MC-12-B-1-A	Glade Run	2.8		x	x	x	x	
MC-12-B-1-B	UNT#1 of Beaver Creek	NR		x*	x*	x*	x*	
MC-12-B-1-C	UNT/Beaver Creek RM 1.68	0		x	x	x	X	
MC-12-B-2	Barnes Run	NR			x*			
MC-12-B-3	Hog Run	4.6		x	x	x	X	
MC-12-B-4.5	Piney Run	NR			x*	x*		
MC-12-B-5	Cherry Run	3		x	x	x	X	
MC-12-B-5-C	Headwaters of UNT #3/Cherry Run	NR					x*	
MC-12-B-6	Mill Run	NR					x*	
MC-12-C	Hazel Run	5.6		x	x	x	X	
Conner Run								
MC-13.5	Conner Run	2.9		x	x	x	X	
Hackelbarney Run								
MC-14	Hackelbarney Run	NR		x*	x*			
	(continued on next page)							

Table 3: Stream segments impaired by acid mine drainage (continued)

Stream code	Stream name	Impaired miles	Al (dis)	Al (tot)	Fe	Mn	pH	Zn
Greens Run								
MC-16	Greens Run	8.2		x	x	x	x	
MC-16-A	SF Greens Run	4.3		x	x	x	x	
MC-16-A-1	UNT/SF Greens Run RM 0.6	2.4		x	x	x	x	
Muddy Creek								
MC-17	Muddy Creek	15.6	x	x	x	x	x	
MC-17-0.6A	UNT #2/Muddy Creek	NR			x*			
MC-17-A	Martin Creek	2.6		x	x	x	x	
MC-17-A-0.5	Fickey Run	2.8		x	x	x	x	
MC-17-A-1	Glade Run	3.6		x	x	x	x	
MC-17-A-1-A	UNT/Glade Run RM 1.06	1		x	x	x	x	
MC-17-A-1-B	UNT/Glade Run RM 1.36	1.2		x	x	x	x	
MC-17-B	Jump Rock Run	NR		x*			x*	
MC-17-C	Sugar Camp Run						x*	
Roaring Creek								
MC-18	Roaring Creek	9.2		x	x		x	
MC-18-A	Lick Run above Little Lick Run	NR		x*			x*	
Elsey Run								
MC-20	Elsey Run	NR			x*			
Ashpole Run								
MC-21	Ashpole Run	NR		x*	x*			
Buffalo Run								
MC-22	Buffalo Run Above UNT #2	NR				x*	x*	
Morgan Run								
MC-23	Morgan Run	4.6		x	x	x	x	
MC-23-0.2A	UNT/Morgan Run RM 1.1	2.29		x	x	x	x	
MC-23-A	Church Creek	4		x	x	x	x	
MC-23-A-1	UNT/Church Creek RM 1.2	--		x	x	x	x	
Heather Run								
MC-24	Heather Run	3.4		x	x	x	x	
MC-24-A	UNT/Heather Run RM 1.5	1		x	x	x	x	
Lick Run								
MC-25	Lick Run	4		x	x	x	x	
Joes Run								
MC-26	Joes Run	2.8		x	x	x	x*	
Pringle Run								
MC-27	Pringle Run	4.7		x	x	x	x	
MC-27-A	Left Fork/Pringle Run	4		x	x	x	x	
MC-27-B	Right Fork/Pringle Run	3		x	x	x	x	

Source: All impairments from 2004 303(d) list, Supplement Table B and Supplement Table E (WVDEP, 2004a) except those marked with an asterisk (*), which are from WVDEP (1999). Impaired miles are from WVDEP (2004a and 1998), and are only provided for segments included in the 2004 303(d) list and the supplemental tables (WVDEP, 2004a). Impaired miles for segments listed in WVDEP (1999) are shown as NR because this document does not report impaired miles. Impaired miles are shown as "--" for streams where impaired segments have been combined into one listing and miles of impairment are currently unknown. Impaired miles are listed as zero following WVDEP (1998).

Table 4: Abandoned mine lands that discharge acid mine drainage

Stream code	Problem area no.	Problem area name	Tributary
Cheat Lake			
MC-(L1)	219	Pt. Marion Maintenance	Cheat Lake
MC-(L1)	1128	St. Clair Portals	UNT/Cheat Lake
MC-(L1)	2977	Skidmore Site (Canyon Mine) Maint.	UNT/Cheat Lake
MC-(L1)	3912	Davidson Highwall	UNT/Cheat Lake
MC-(L1)	3940	Lake Lynn Complex	Cheat Lake
MC-(L1)	4409	Washington Road Drainage	UNT/Cheat Lake
Bull Run			
MC-11	1755	Rosati Mine Drg./Herring Complex	UNT/Bull Run
MC-11	1756	Bull Run PA #37	UNT/Bull Run
MC-11	1765	Bull Run #35	Bull Run
MC-11	4912	Masontown Refuse & Portal	Bull Run
MC-11	2821	Masontown #4	Bull Run
MC-11-A	1764	Bull Run #27	Middle Run/Bull Run
Big Sandy Creek			
MC-12-0.5A	5112	Sovern Run Mine Drainage	Sovern Run
MC-12-0.5A	5785	Sovern Run Site #62	Sovern Run
MC-12-0.5A	5947	Sovern Run (Clark)[2]	Sovern Run
MC-12-0.5A	5977	Sovern Run (Titchnell)[2]	Sovern Run
MC-12-B	4915	Livengood Water Supply	Little Sandy Creek
MC-12-B	5157	Webster Run Portal & AMD	Little Sandy Creek
MC-12-B-1	5784	Beaver Creek/Auman Road	Beaver Creek/Little Sandy Creek
MC-12-B-1	5821	McCarty Highwall	Beaver Creek/Little Sandy Creek
MC-12-B-1-A	5150	Livengood Highwall & AMD	Glade Run/Beaver Ck/Little Sandy Ck
MC-12-B-5	854	Cherry Run #3	Cherry Run/Little Sandy Creek
Greens Run			
MC-16	1048	Greens Run Refuse and AMD	Greens Run
MC-16	1815	Middle Fork Greens Run	Greens Run
MC-16	5899	North Fork of Greens Run[2]	Greens Run
MC-16-A	1064	Kingwood (Pace) Portals	SF Greens Run
MC-16-A-1	1814	South Fork Greens Run #2	UNT/South Fork Greens Run
Muddy Creek			
MC-17	1046	Muddy Creek Tipple I[1]	Muddy Creek
MC-17	3067	Lawson Highwall #35	UNT/Muddy Creek
MC-17	5948	Muddy Creek (Upper)[2]	Muddy Creek
MC-17-0.7A	1758	Crab Orchard Portals[1]	Crab Orchard Creek
MC-17-A	1759	Martin Creek Seepage[1]	Martin Creek
MC-17-A	4542	Martin Creek Refuse	Martin Creek
MC-17-A-0.5	1453	Valley Point #9	Fickey Run/Martin Creek
MC-17-A-0.5	1760	Fickey Run Portals & Refuse	Fickey Run/Martin Creek
MC-17-A-1	340	Glade Run (AMD) II	Glade Run/Martin
MC-17-A-1	3033	Valley Point #5[1]	Glade Run/Martin Creek
MC-17-A-1	4027	Conners Highwall[1]	Glade Run/Martin Creek
MC-17-A-1	5056	Valley Point Portals & Drainage	Glade Run/Martin Creek
MC-17-A-1	1455	Valley Point #11	UNT/Glade Run/Martin Creek
Roaring Creek			
MC-18	1039	Roaring Creek #2	Roaring Creek

(continued on next page)

Table 4: Abandoned mine lands that discharge acid mine drainage (continued)

Stream code	Problem area no.	Problem area name	Tributary
Morgan Run			
MC-23	1770	Morgan Run PA #2	Morgan Run
MC-23	307	Snider Portal	Morgan Run
MC-23-A	397	Irona Refuse Pile[1]	Church Creek
MC-23-A	1056	Church Creek/Manown Highwall[3]	Church Creek/Morgan Run
Heather Run			
MC-24	1057	Heather Run Area I	Heather Run
MC-24	1058	Heather Run Area #2	Heather Run
MC-24	3488	Borgman Highwall	Heather Run
Lick Run			
MC-25	1548	Howesville Site	UNT/Lick Run
MC-25	1820	Lick Run Portal #4	Lick Run
MC-25	1822	Lick Run #2	Lick Run
MC-25	2745	Philip Thorn Highwall & Portals	Lick Run
Pringle Run			
MC-27	541/544	Burke Coal & Coke, R & R[1]	Pringle Run
MC-27	1052	Tunnelton Gob[1]	Pringle Run
MC-27	1059	Camp Ground Refuse and Portal	UNT/Pringle Run
MC-27	1063	Blazer Portals	UNT/Pringle Run
MC-27	1546	Jessop Strip #4	UNT/Pringle Run
MC-27	1698	Jessop Strip #2	UNT/Pringle Run
MC-27	1817	Pringle Run PA #2	Pringle Run
MC-27	1829	Blaser Refuse	UNT/Pringle Run
MC-27	2412	Jessop Highwall #10	UNT/Pringle Run
MC-27	3056	Jessop Portals #1	UNT/Pringle Run
MC-27	3058	Jessop Portals #2	UNT/Pringle Run
MC-27	4609	Tunnelton Portal[1]	UNT/Pringle Run
MC-27	4992	Tunnelton Mine Drainage[1]	Pringle Run
MC-27	5875	Pringle Run Pace AMD[2]	Pringle Run

Source: Hansen, et al. 2004 except [1] WVDEP, various dates, [2] Pitzer, 2004a. [3] Church Creek (1056) was combined with Manown Highwall (2671) for reclamation purposes (Zambelli, 2004b). Stream codes are for the smallest tributary that the site is known to discharge to, and for which a stream code is known. FOC is currently monitoring water quality at an AML in the Morgan Run subwatershed, but it is not clear whether this is one of the AMLs listed in Table 4, another known AML, or an un-inventoried site.

The lower Cheat watershed is also impaired by BFSs that discharge AMD, as shown in Table 5. These sites often contribute a significant amount of AMD, and in some cases may account for most or all of the pollution in a subwatershed. However, BFSs are considered to be point sources and are not eligible for Section 319 funding. These sites are therefore not covered in detail in this plan.

Table 6 summarizes whether AMLs, BFSs, or both discharge AMD to each impaired stream segment. Only ten of the 18 subwatersheds that are impaired by AMD are known to receive AMD from nonpoint source AMLs. These ten subwatersheds are highlighted in Table 6 and are the focus of the Watershed Based Plan. However, AMLs are located in most other AMD-impaired subwatersheds, and Table 6 notes that future monitoring is likely to find that AMLs do, indeed, discharge AMD in these subwatersheds.

Table 5: Bond forfeiture sites that discharge acid mine drainage

Stream code	Mining permit	Const. date	Company	Receiving stream
Cheat River				
MC	S-1024-88		Bolingreen Mining	Beech Run
MC	124-79	9/05	Daugherty Coal	UNT/Cheat River
MC	246-74		Daugherty Coal	UNT/Cheat River
MC	65-77	9/05	Daugherty Coal	UNT/Cheat River
MC	S-73-83		Daugherty Coal	UNT/Cheat River
MC	34-81	12/05	Farkas Coal	UNT Cheat River
MC	S-112-80	3/05	Inter-State Lumber	Cheat River
MC	S-71-79		Weter	UNT/Cheat River
MC-15-0.5A, MC	S-1026-87	6/05	F & M Coal	Hogback & UNT/Cheat River
Cheat Lake				
MC-(L1)	S-1010-87		Alan Blosser	Cheat Lake
MC-(L1)	S-1041-89	12/04	Edward E. Thompson	Cheat Lake
Coles Run				
MC-2.5	S-55-84	12/05	Lakeview Coal	UNT/Coles Run
Maple Run				
MC-6.5 & MC-5	S-64-83	3/05	Valley Mining	Buzzard Run and Maple Run
Bull Run				
MC-11	17-81	9/05	Daugherty Coal	Bull Run
MC-13.7, MC-11	192-77	9/05	Daugherty Coal	Gum Run & Bull Run
MC-13.7, MC-11	S-1009-86		Daugherty Coal	Gum Run & Bull Run
Big Sandy Creek				
MC-12	S-1004-88	6/08	Freeport Mining	UNT Big Sandy Creek
MC-12	S-1005-95	6/05	Freeport Mining	UNT Big Sandy Creek
MC-12	237-76	12/04	Rockville Mining	Conner Run and Sovern Run/Big Sandy
MC-12-0.5A	S-1035-86	12/04	Rockville Mining	Sovern Run
MC-12-B-1-A	S-1030-86		Jones Coal	Glade Run/Big Sandy Ck.
MC-17-A-0.5, MC-12-B-5	60-79	12/04	Zinn Coal	Fickey/Martin and Cherry Run/Little Sandy
MC-12-B-6	S-60-84		Hidden Valley Coal	UNT/Mill Run/Little Sandy Ck.
Conner Run				
MC-17-A-1, MC-13.5	S-65-82		Rockville Mining	Glade/Martin and Conner Run
Gum Rum				
MC-13.7, MC-11	192-77	9/05	Daugherty Coal	Gum Run & Bull Run
MC-13.7, MC-11	S-1009-86		Daugherty Coal	Gum Run & Bull Run
Hogback Run				
MC-15-0.5A, MC	S-1026-87	6/05	F & M Coal	Hogback & UNT/Cheat River
Greens Run				
MC-16	40-81		Hallelujah Mining	Greens Run

(continued on next page)

Table 5: Bond forfeiture sites that discharge acid mine drainage (continued)

Stream code	Mining permit	Const. date	Company	Receiving stream
Muddy Creek				
MC-17	EM-113	9/07	T & T Fuels, Inc.	Muddy Creek
MC-17	U-125-83		T & T Fuels, Inc.	Muddy Creek
MC-17	4-76		Williford Excavating	UNT/Muddy Creek
MC-17-A-0.5	S-91-85	3/08	Rockville Mining	Fickey Run/Martin Creek
MC-17-A-0.5	UO-519		Viking Coal	UNT/Fickey Run/Martin Creek
MC-17-A-0.5, MC-12-B-5	60-79	12/04	Zinn Coal	Fickey/Martin & Cherry Run/Little Sandy
MC-17-A-1	S-27-83	3/05	Crane Coal, Inc.	Glade Run/Martin Creek
MC-17-A-1	UO-204		Lobo Capitol, Inc.	Glade Run/Martin Creek
MC-17-A-1	65-78		Rockville Mining	UNT/Glade Run/Martin Creek
MC-17-A-1, MC-13.5	S-65-82		Rockville Mining	Glade/Martin and Conner Run
Roaring Creek				
MC-18	S-176-77		Inter-State Lumber	Roaring Creek
Ashpole Run				
MC-21	46-79	6/05	F & M Coal	Ashpole Run
Morgan Run				
MC-23	S-37-81		Bjorkman Mining	Morgan Run
MC-23	S-1063-86		J. E. B., Inc.	UNT/Morgan Run
MC-23-A	S-61-82	12/04	J. E. B., Inc.	Church Creek
MC-23-A	S-62-84	6/06	J. E. B., Inc.	Church Creek
MC-23-A	S-26-85		Wocap Energy Res.	UNT/Church Creek
Heather Run				
MC-24	EM-32		Borgman Coal	Heather Run
Pringle Run				
MC-27	P-177-85	12/07	T & J Coal	UNT/Pringle Run

Source: All except projected construction dates from Hansen et al. (2004) and Sheehan (2003). Projected construction dates from WVDEP (2004g). If dates are not shown, then the project has been contracted or completed. Stream codes are for the smallest tributary that the site is known to discharge to, and for which a stream code is known.

Table 6: Known and likely sources of acid mine drainage by subwatershed

Stream code	Subwatershed	AML	BFS
MC	Cheat River	Likely	Yes
MC-(L1)	**Cheat Lake**	Yes	Yes
MC-3	Crammys Run	Likely	
MC-11	**Bull Run**	Yes	Yes
MC-12	**Big Sandy Creek**	Yes	Yes
MC-13.5	Conner Run	Likely	Yes
MC-14	Hackelbarney Run		
MC-16	**Greens Run**	Yes	Yes
MC-17	**Muddy Creek**	Yes	Yes
MC-18	**Roaring Creek**	Yes	Yes
MC-20	Elsey Run	Likely	
MC-21	Ashpole Run		Yes
MC-22	Buffalo Run	Likely	
MC-23	**Morgan Run**	Yes	Yes
MC-24	**Heather Run**	Yes	Yes
MC-25	**Lick Run**	Yes	
MC-26	Joes Run	Likely	
MC-27	**Pringle Run**	Yes	Yes

Source: Tables 3 through 5. Subwatersheds are highlighted if AMLs are known to discharge AMD. AMLs are listed as "Likely" if the subwatershed is impaired by AMD as listed in Table 3 and contains AMLs within its boundaries, but it is not know at this time if these AMLs produce AMD. Further assessment of each AML will be necessary to determine whether or not AMD is actually being discharged.

3.2 Biological impairment

As shown in Table 7, the 2004 303(d) list includes seven streams in the lower Cheat River watershed with biological impairments. WVDEP intends to complete TMDLs for these streams in 2014 (WVDEP, 2004a).

Big Sandy Creek and Muddy Creek are also listed as impaired by AMD; therefore, these biological impairments may be due to AMD pollutants. Coles, Kelly, Whites, and Scott Runs, however, are not listed for AMD. Biological impairments may therefore be caused by other pollutants.

Table 7: Stream segments with biological impairments

Stream code	Stream name
Coles Run	
MC-2.5	Coles Run
Kelly Run	
MC-2.7	Kelly Run
Whites Run	
MC-4	Whites Run
Scott Run	
MC-7	Scott Run
Big Sandy Creek	
MC-12-A-2	Patterson Run
MC-12-B-0.5-A	UNT/Webster Run RM 1.3
Muddy Creek	
MC-17-0.7A	Crab Orchard Creek

Source: WVDEP, 2004a.

Streams are listed for biological impairment based on a survey of their benthic macroinvertebrate communities. A West Virginia Stream Condition Index score is generated from this survey. Streams with a score of 60.6 or less are considered biologically impaired and placed on the list. Entire stream lengths are typically considered impaired, and the cause of impairment is listed as unknown until more data are collected prior to the total maximum daily load (TMDL) development process (WVDEP, 2004a, p.22).

3.3 Fecal coliform

WVDEP (2004a and 1999) has found that fecal coliform bacteria impair many West Virginia waters. But currently, the 303(d) list does not contain any segments of the lower Cheat watershed for fecal impairment (WVDEP, 2004a). WVDEP states that:

> "[m]any West Virginia waters contain elevated levels of fecal coliform bacteria. Contributors to the problem include leaking or overflowing sewage collection systems, illegal homeowner sewage discharges by straight pipes or failing septic systems, and runoff from urban or residential areas and agricultural lands. Other West Virginia waters besides those identified on the list may be impaired for fecal coliform bacteria, but those waters are not listed because there is insufficient or no data demonstrating impairment. The WVDEP's watershed assessment and TMDL development methodologies will subject suspect streams to intensified bacteria monitoring in the future and additional listings will be forthcoming. This targeting effort has increased the number of fecal coliform listings from 29 on the 2002 Section 303(d) list to 185 on the current list. The

combined length of waters identified as impaired for fecal coliform is approximately 1,490 miles." (WVDEP, 2004a, p. 27)

Currently only limited fecal coliform data exist for the lower Cheat watershed. As shown in Table 8, WVDEP (1999) lists several lower Cheat watershed streams as violating standards based on single water samples collected in 1996. The samples were compared against the 400 units/100 mL standard because one sample is not enough to be compared with the 200 units/100 mL standard. WVDEP considers water exceeding the 400 units/100 mL standard to be potentially unsafe (WVDEP, 1999, p. 81).

More recent data collected in 2001 by WVDEP provide a different picture (WVDEP, 2004b). As in 1996, only one sample was collected at each site and the data were compared to the 400 units/100 mL standard. As shown in Table 9, no sites sampled in 2001 showed violations of the fecal coliform standard. Sites sampled in 2001 included the same sites from 1996 as well as sites on streams that showed violations in 1996, but at different locations.

The variability in the fecal coliform levels from the two sampling periods is most likely attributed to rain. United States Geologic Survey (USGS) historical gage records indicate that the 1996 data were collected during the peak of a high discharge flow event, while the 2001 data were collected during lower discharge levels occurring during both peak flow events and non peak flow periods (USGS, 2004). The variability of fecal coliform levels on the account of weather is typical of the behavior of nonpoint source pollution. A study of the watershed to locate nonpoint sources of fecal coliform bacteria is recommended.

Table 8: Stream segments with high 1996 fecal coliform levels

Stream code	Site name	Mile point	Fecal coliform (units/100 mL)
Cheat River			
MC-00	Cheat River @ Albright	28.8	20,000
Coles Run			
MC-2.5-A	Birch Hollow	NA	3,000
Bull Run			
MC-11-D	Left Fork Bull Run @ Headwaters	10	1,100
Big Sandy Creek			
MC-12-.7A	Parker Run of Big Sandy Creek	NA	850
MC-12-A	Laurel Run/Big Sandy Creek Near Mouth	2.5	1,200
MC-12-A-1	Little Laurel Run	NA	1,500
MC-12-B-1	Beaver Creek Near Mouth	1	680
MC-12-B-1-B	UNT #1/Beaver Creek	NA	1,300
MC-12-B	Little Sandy Creek Below Hog Run	6	540
MC-12-B-4	Elk Run Near Mouth	2	500
MC-12-B-4	Elk Run Above UNT	3	17,000
MC-12-B-4.5	Piney Run @ Mouth	NA	14,000
MC-12-B	Little Sandy Above Cherry Run	12	450
MC-12-C	Hazel Run Near Mouth	1	30,000
MC-12-C	Hazel Run @ Headwaters	4	60,000
MC-12-D	Glade Run West of Bruceton Mills	NA	2,200
MC-12	Big Sandy Creek @ Bruceton Mills	10	1,700
Gibson Run			
MC-13	Gibson Run	1	900
Hacklebarney Run			
MC-14	Hacklebarney Run Near Headwaters	2	60,000
Laurel Run			
MC-15	Laurel Run Above Hogback Run	1	1,300
Muddy Creek			
MC-17-.6A	UNT #2/Muddy Creek	NA	430
MC-17-.7	Crab Orchard Creek @ Mouth	NA	4,200
MC-17-A-.5	Fickey Run Near Headwaters	3	4,500
MC-17	Muddy Creek Above Martin Creek	3.2	5,000
MC-17-A.1	UNT of Muddy Creek @ Mouth	NA	1,500
MC-17	Muddy Creek @ Brandonville Turnpike	6.8	850
MC-17-B	Jump Rock Run @ Mouth	NA	1,000
MC-17	Muddy Creek Above Sugar Camp Run	10.2	450
MC-17	Muddy Creek Near Headwaters	14.4	2,400
Roaring Creek			
MC-18	Roaring Creek @ Mouth	0	450
MC-18-.1A	UNT #1 of Roaring Creek @ Mouth	NA	3,000
MC-18-A-1	Little Lick Run		530

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Table 8: Stream segments with high 1996 fecal coliform levels (continued)

Stream code	Site name	Mile point	Fecal coliform (units/100 mL)
Daugherty Run			
MC-19	Daugherty Run		3,200
MC-19-A	Dority Run @ Mouth		860
Elsey Run			
MC-20	Elsey Run	0	9,000
Buffalo Run			
MC-22-B	UNT #2 of Buffalo Run		2,300
Joes Run			
MC-26	Joes Run Near Mouth	0	4,000
MC-26	Joes Run Above UNT#1	1.5	1,100
Saltlick Creek			
MC-32-E	Bucklick Run of Saltlick Creek	NA	450

Source: WVDEP, 1999. Table 19. Samples collected June and July of 1996.

Table 9: Stream segments with low 2001 fecal coliform levels

Stream code	Stream name	Mile point	Fecal coliform (colonies/100ml)
Bull Run			
MC-11-D	Left Fork/Bull Run	0.3	28
Big Sandy			
MC-12-A	Laurel Run	5.3	2
MC-12-A-1	Little Laurel Run	2.2	4
MC-12-B-1	Beaver Creek	0.8	36
MC-12-B-4	Elk Run/Little Sandy Creek	0.6	2
MC-12-B-4	Elk Run/Little Sandy Creek	1.4	15
MC-12-C	Hazel Run	1	290
Muddy Creek			
MC-17	Muddy Creek	0	2
MC-17	Muddy Creek	3.36	2
MC-17	Muddy Creek	6.8	2
MC-17	Muddy Creek	10.2	54
MC-17-A-0.5	Fickey Run	3	2
MC-17-A-0.5	Fickey Run	0	2
MC-17-A-1	Glade Run	1	2
MC-17-B	Jump Rock Run	0	2
Roaring Creek			
MC-18	Roaring Creek	2.6	23
MC-18-A	Lick Run/Roaring Creek	0.2	6
Heather Run			
MC-24	Heather Run	NA	2
Lick Run			
MC-25	Lick Run	NA	2
Saltlick Creek			
MC-32-E	Bucklick Run	2.6	110

Source: WVDEP, 2004b. Samples collected May and June 2001. Stream Code listed as ANCode in WVDEP, 2004b.

3.4 Sediment

Sediment sources and loads currently entering the lower Cheat watershed are not fully understood at this time, and the 2004 303(d) list does not list any stream segments for sediment impairment. But as shown in Table 10, WVDEP has documented habitat impairments due to sediment deposition in many lower Cheat watershed streams (WVDEP, 1999, pp. 267-270).

Sources for sediment likely include, but are not limited to, construction and urban runoff, logging, dirt roads, mismanaged agricultural lands, and stream bank erosion. It is suggested that a study be completed to identify sediment sources so sediment impairment can be properly addressed.

Table 10: Stream segments with habitat impairment due to sediment deposition

Stream code	Site name	Sediment deposition score	Sediment deposition category
Coles Run			
MC-2.5	Coles Run	10	Marginal
Big Run			
MC-10	Big Run Near Pisgah	7	Marginal
Bull Run			
MC-11-0.1A	UNT/Bull Run RM 1.6@ Mouth	3	Poor
MC-11-D	Left Fork Bull Run @ Mouth	7	Marginal
MC-11-D	Left Fork Bull Run @ Headwaters	9	Marginal
MC-11-E	Right Fork Bull Run @ Mouth	2	Poor
Big Sandy Creek			
MC-12	Big Sandy Creek @ Bruceton Mills Falls	10	Marginal
MC-12	Big Sandy Creek Above Little Sandy Creek	6	Marginal
MC-12-0.5A	Sovern Run @ Hudson	10	Marginal
MC-12-0.5A	Sovern Run @ Headwaters	10	Marginal
MC-12-B	Little Sandy Creek Below Hog Run	6	Marginal
MC-12-B	Little Sandy Creek Below Cherry Run	10	Marginal
MC-12-B	Little Sandy Creek Above Cherry Run	8	Marginal
MC-12-B-0.5-A	UNT/Webster Run RM 1.3	0	Poor
MC-12-B-1	Beaver Creek Near Headwaters	10	Marginal
MC-12-B-3	Hog Run @ Mouth	8	Marginal
MC-12-B-3	Hog Run @ Headwaters	8	Marginal
MC-12-B-4	Elk Run Near Mouth	10	Marginal
MC-12-B-4.5	Piney Run @ Mouth	1	Poor
MC-12-B-5-C	UNT #3/Cherry Run Near Headwaters	10	Marginal
MC-12-C	Hazel Run Near Mouth	1	Poor
MC-12-C	Hazel Run at Headwaters	2	Poor
MC-12-E	Glade Run North of Brandonville	10	Marginal
MC-12-F	Little Sandy Creek @ Mouth	8	Marginal
Gibson Run			
MC-13	Gibson Run	2	Poor
Conner Run			
MC-13.5	Conner Run Near Headwaters	1	Poor
Hackelbarney Run			
MC-14	Hackelbarney Run Near Headwaters	3	Poor
Laurel Run			
MC-15-A	Long Hollow	5	Poor
Greens Run			
MC-16	Greens Run	5	Poor
MC-16-A-1	UNT/ SF Greens Run RM 0.6	5	Poor
MC-16-A	SF Greens Run @ Mouth	5	Poor
MC-16-A	SF Greens Run Above Middle Fork	5	Poor
MC-16-A	SF Greens Run Near Headwaters	1	Poor

(continued on next page)

Table 10: Stream segments with habitat impairment due to sediment deposition (continued)

Stream code	Site name	Sediment deposition score	Sediment deposition category
Muddy Creek			
MC-17-A-0.5	Fickey Run near Headwaters	2	Poor
MC-17-A	Martin Creek @ Headwaters	3	Poor
MC-17-A-1	Glade Run Near Headwaters	2	Poor
MC-17-A-1-A	UNT/Glade Run RM 1.06 Near Mouth	2	Poor
MC-17-A-1-B	UNT/Glade Run RM 1.36 Near Mouth	2	Poor
MC-17-B	Jump Rock Run @ Mouth	10	Marginal
Roaring Creek			
MC-18-A	Lick Run Above Little Lick Run	2	Poor
Daugherty Run			
MC-19	Daugherty Run	5	Poor
Ashpole Run			
MC-21	Ashpole Run	10	Marginal
Buffalo Run			
MC-22	Buffalo Run Below UNT #1	8	Marginal
MC-22	Buffalo Run Above UNT #2	8	Marginal
MC-22-B	UNT #2/Buffalo Run	9	Marginal
Morgan Run			
MC-23	Morgan Run Above Church Creek	3	Poor
MC-23	Morgan Run Below Church Creek	10	Marginal
MC-23-A-0.1-B	Right Fork UNT/Church Creek	6	Marginal
Heather Run			
MC-24	Heather Run Above UNT/#2	3	Poor
Joes Run			
MC-26	Joes Run Near Mouth	10	Marginal
MC-26	Joes Run Above UNT#1	10	Marginal
Pringle Run			
MC-27	Pringle Run Below Forks	8	Marginal
MC-27-B	Right Fork of Pringle Run @ Mouth	3	Poor

Source: WVDEP, 1999, Table 31. Rapid Habitat Assessment sediment deposition scores and categories are based on Klemm and Lazorchak, 1994.

4. NONPOINT SOURCE MANAGEMENT MEASURES

4.1 Acid mine drainage

The following list describes in depth the various measures that may be used to control AMD, with references. Numbers in parentheses following the name of the method indicate the potential load reductions when the method is used correctly and in the proper situation.

4.1.1 Land reclamation

- **Removing acid-forming material (95%).** This method has the potential to eliminate the acid load completely if all of the acid-forming material can be removed. In the context of the Cheat watershed, this method is unlikely to eliminate the loads to the watershed or the subwatersheds, because acid-forming materials do not seem to be gathered in small areas, and because where such materials are on the surface, there are other sources of AMD nearby. Furthermore, the cost of removing the materials is much greater than the cost of covering them with an impervious layer and revegetating the cap.
- **Isolating acid-forming material from flowpaths (50%).** See the next two items. It is difficult to estimate the efficacy of these measures exactly. On the one hand, some AMD is often visible seeping from the edges reclaimed areas. On the other hand, a measurement of AMD loads frequently shows such seeps are small compared to loads from nearby mine openings.
- **Sealing from above.** Infiltration of water into acid-forming material can be slowed by covering the material with low-permeability material, such as clay, and covering that layer with a vegetated layer to stabilize it. Effective reclamation and revegetation can eliminate a large proportion of the AMD from a given site.
- **Isolating from below.** Interactions between water and acid-forming materials can be further minimized by separating the waste material from impermeable bedrock below with conductive materials. Water may then flow beneath the spoil and be conducted away from it rapidly, so the water table does not rise into the spoil.
- **Surface water management.** Rock-lined ditches or grouted channels can be used to convey surface water off site before it can percolate into acid-forming material. Limestone is often used in such channels to neutralize acidity, as with oxic limestone channels (OLCs), discussed below.

4.1.2 Passive AMD treatment

- **Reducing and Alkalinity Producing Systems (25 g acidity/m^2).** In these systems, also known as “successive alkalinity producing systems” and “vertical flow ponds,” water encounters two or more treatment cells in series. First, water passes through organic material to deplete dissolved oxygen. Several helpful reactions take place in the anoxic environment. First, bacteria reduce sulfate in an alkalinity producing reaction. Second, ferric iron which comes into contact with pyrite should reoxidize the sulfur and turn to ferrous iron. In a second cell, the anoxic solution comes into contact with limestone. H+ acidity is neutralized through contact with the limestone. Additional alkalinity dissolves into the water as well. Iron does not armor the limestone because it is the ferrous form. Water then runs through an aeration and settling pond, in which ferrous iron oxidizes and then precipitates out of solution as ferric hydroxide. The acidity released in this process is neutralized by the alkalinity that has accumulated in the solution.
- **Manganese removal beds (to 2 mg/L).** Manganese may be removed from AMD either by active treatment (Section 4.1.3) or by manganese removal beds (MRBs). In MRBs, water is passed over a wide limestone bed, and dissolved manganese oxidizes and precipitates from solution.

- **Oxic (or Open) limestone channels (30%).** Research to estimate the efficacy of OLCs is active. OLCs have the advantage that continually moving water may erode any armoring from limestone, and that water flow should remove precipitates from OLC so that they don't interfere with acid neutralization. In practice, the efficacy of OLCs may suffer because they are too short, most limestone may be placed so as to react with water only at high flows, and fluctuating water levels enhance armoring. Recent research suggests that the acid neutralization that takes place in OLCs is actually greater than can be accounted for by limestone dissolution
- **Limestone leach beds (50%).** Limestone leachbeds 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, but the short retention time prevents armoring.
- **Steel slag leach beds (addition of alkalinity).** Steel slag leachbeds are not exposed to AMD. Rather, circumneutral feed water passes through these leachbeds, and that water is then mixed with AMD to reduce its acidity drastically.
- **Compost wetlands (wide range).** Constructed wetlands can serve multiple functions in AMD treatment. Wide areas of exposure to the atmosphere allow metals in solution to oxidize. Slower waters allow precipitates to fall out of suspension. Anaerobic zones in sediments allow for sulfate reduction, which consumes acidity. Inclusion of limestone in the substrate provides an additional alkalinity source and helps maintain conditions that support sulfate reduction.
- **Grouting (50%).** Setting up grout walls or curtains in deep mines has a great deal of potential to solve AMD problems. Ideally, such barriers may serve to keep water from entering mines and interacting with acid-forming materials. They must be constructed carefully so as not to build water pressures near a weak point and to avoid "blowouts". Also, fractures in bedrock always allow some water into mines, even if flows are eliminated. A grouting project at Winding Ridge, near Friendsville, MD, decreased acidity by 50% (MPPRP, 2000).

4.1.3 Active AMD treatment

- **Treating (100+%).** A variety of treatment methods exist for AMD. One of a number of alkaline chemicals can be mixed with the polluted water. The mixture may then be aerated and is finally passed through ponds allowing metal hydroxides to settle out as sludge.

4.2 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 causes reduced 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 lower Cheat watershed are scheduled to have a TMDL developed not later than 2014. 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. Source(s) not addressed in this document should be managed in such a way to ensure that water quality standards are met.

4.3 Fecal coliform

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

- septic system installation and maintenance,
- fencing livestock out of streams,
- hooking people up to centralized or managed decentralized wastewater treatment systems, and/or
- storm water treatment and control measures.

4.4 Sediment

Depending on what a future investigation may find regarding possible nonpoint sources of sediment in the lower Cheat watershed, a number of control measures may be effective. For agriculture, the following control measures may be effective in controlling nonpoint source pollution:

- planting buffer strips between streams and crop or pasture land,
- fencing off livestock from streams,
- planting cover crops, and/or
- repairing eroding stream banks using natural stream channel design.

For forestry, installing and maintaining best management practices to prevent erosion may be effective in controlling nonpoint source pollution. Besides agriculture and forestry, other sediment sources may include dirt roads, eroding stream banks, or other nonpoint sources. Control measures will be tailored to the particular sources found to be causing sedimentation.

5. LOAD REDUCTIONS AND COSTS

The TMDL for the Cheat watershed set goals for pollutant reductions from nonpoint and point source activities that, if enacted, should improve water quality so that the stream segments are removed from the 303(d) list and meet standards (USEPA, 2001). While the TMDL calls for wasteload allocations for specific point sources, load allocations for nonpoint sources are not tied to specific AMLs. Instead, the load allocations are provided catchment-by-catchment.[2] If all wasteload and load allocations for aluminum, iron, manganese, and zinc are met, the TMDL asserts that the water quality criteria for pH will also be met (USEPA, 2001).

Table 11 compares the TMDL's nonpoint source load reduction goals with the load reductions expected if this Watershed Based Plan is implemented. However, this comparison should be considered a rough estimate. If enough flow and chemistry data were available for each AML, detailed site-specific load reductions could be calculated. However, detailed site data are only available for a few sites. Therefore, assumptions are made to predict iron, aluminum, and manganese loads found at each site. These assumptions are explained in Appendix B. The treatment measures proposed for each site are sized with the goal of reducing these loads by 90%.

Treatment systems for each site are chosen based on the assumption that Section 319 funds will continue to be limited to funding capital costs. Treatment options are therefore limited to land reclamation and passive systems that do not require ongoing operations and maintenance. Load reductions and costs are based on what can reasonably be achieved by land reclamation or installing appropriate passive treatment systems.

AMD may be generated within accumulations of mine spoil or refuse on the surface, or in similar acid forming materials located in underground mines. If site descriptions suggest that materials on the surface are responsible for the AMD, then the remediation cost was determined according to the acres of land requiring reclamation. In some cases, spoil piles may be large and adequately vegetated, and passive water treatment may be more cost effective.

When AMD flows out of underground mines, a passive treatment system can be chosen and sized based on water chemistry and flow data. The appropriate passive water treatment system for the sources that have been studied in the lower Cheat and nearby watersheds is a reducing and alkalinity producing system (RAPS), according to Watzlaf et al. (2004). Net acidity in the water rules out treatment with only aerobic wetlands. Concentrations greater than 1 mg/L of dissolved oxygen, aluminum or iron in the ferric state rule out use of anoxic limestone drains. It is assumed that deep-mine AMD sources that have not been carefully examined will also produce water requiring RAPSs. RAPSs were sized according to the acidity load from the AMD source. Detailed sizing and cost assumptions are included in Appendix C. Because RAPSs are not designed to treat manganese, MRBs are also included in the cost estimates. MRBs are sized to achieve a 24-hour retention time, which has proven effective for manganese removal. Detailed sizing and cost assumptions for MRBs are also included in Appendix C.

The Office of Surface Mining, Reclamation and Enforcement's (OSM's) AMDTreat computer program is used to calculate costs for both RAPSs and MRBs. The cost calculations for each AML are detailed in Appendix C. The following sections describe each AML known to discharge AMD, and where possible projects the cost to install RAPSs and MRBs at each site.

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[2] In the TMDL, zinc is an exception. A single wasteload allocation and a single load allocation are calculated for the entire Cheat watershed.

Table 11: Watershed Based Plan load reductions and TMDL targets for abandoned mine lands (lb/year)

			Load estimates from this plan		
Stream code	Subwatershed	Metal	Current load	Reduced load	TMDL target
MC-(L1)	Cheat Lake	Al	87,300	8,730	NR
		Fe	206,100	20,610	NR
		Mn	7,600	760	NR
MC-11	Bull Run	Al	36,700	3,670	12,665
		Fe	77,000	7,700	22,002
		Mn	9,800	980	17,973
MC-12	Big Sandy Creek	Al	30,100	3,010	72,305
		Fe	65,700	6,570	173,191
		Mn	6,300	630	66,075
MC-16	Greens Run	Al	302,900	30,290	3,966
		Fe	737,800	73,780	9,634
		Mn	11,200	1,120	5,318
MC-17	Muddy Creek	Al	40,200	4,020	7,147
		Fe	94,500	9,450	7,990
		Mn	3,900	390	9,825
MC-18	Roaring Creek	Al	N/A	N/A	6,767
		Fe	N/A	N/A	6,623
		Mn	N/A	N/A	5,585
MC-23	Morgan Run	Al	144,000	14,400	4,319
		Fe	330,600	33,060	10,541
		Mn	19,000	1,900	6,303
MC-24	Heather Run	Al	35,200	3,520	1,591
		Fe	83,200	8,320	2,822
		Mn	3,100	310	2,084
MC-25	Lick Run	Al	359,200	35,920	4,243
		Fe	866,100	86,610	8,840
		Mn	19,300	1,930	6,471
MC-27	Pringle Run	Al	40,500	4,050	6,441
		Fe	87,200	8,720	13,594
		Mn	9,300	930	8,721

Note: N/A = Not applicable. NR = Not reported. The TMDL does not provide target loads for the Cheat Lake subwatershed. The TMDL also does not provide a target load for iron for the entire Muddy Creek watershed, so the target of 7,990 in this table is actually for Martin Creek, Muddy Creek's largest tributary. Loads are not estimated in this plan for the Roaring Creek subwatershed because Roaring Creek #2 (1039) is the only AML considered and there is not enough information for this site to estimate loads. Detailed load calculations are shown in Appendix B.

Recall that BFSs—the other major AMD sources in the lower Cheat watershed—are not eligible for 319 funding and are being addressed by WVDEP through the Special Reclamation Fund. For this plan it is assumed that WVDEP will follow through with their commitment to treat all BFSs to meet their previous discharge limits.

Together, fully treating AMLs and BFSs should result in waters once again meeting standards in most subwatersheds because the load reductions required by the TMDL will be achieved. The Cheat River mainstem will also be improved and meet standards. As shown in Table 12, a total of 231.8 stream miles will be improved.

The cost to fully remediate the nonpoint source AMLs in the lower Cheat watershed will be high. This plan estimates a cost of more than $20 million, as shown in Table 12.[3] Costs are only estimated for the ten AMD-impaired subwatersheds listed above in Table 6, which are known to receive AMD from nonpoint source AMLs.

The following sections also document how much money has already been spent to reclaim each site by the WVDEP Office of Abandoned Mine Lands and Reclamation (OAMLR) and other agencies and organizations. These reclamation projects may or may not have focused on water quality. Even if they focused on water quality, these projects likely did not result in the scale of load reductions required by this Watershed Based Plan. AMD still flows from many of these sites. The estimated future cost for water remediation calculated in this plan for each site is based on water quality costs only, and is therefore not directly comparable to the past reclamation cost.

The costs calculated in this chapter should be considered very rough estimates. These costs are useful for comparing among sites, but should not be used as estimates of the actual expected costs of remediation projects. Data are typically extremely sparse on AMD discharging from AMLs. More frequent data collection would be required to refine these costs. For some AMLs, data do not exist and costs simply cannot be estimated at this time. In many cases, intelligent use of existing landscape features may be used to increase the efficiency and reduce the cost of water treatment measures. Ongoing research in AMD treatment may also lead to more cost-effective treatment methods.

Table 12: Summary of costs and stream miles improved

		Impaired miles			Estimated future cost for
Stream code	Subwatershed	Mainstem	Tributaries	Total	water remediation
MC-(L1)	Cheat Lake	N/A	N/A	N/A	>$2,980,000
MC-11	Bull Run	6.2	10.2	16.4	>$2,300,000
MC-12	Big Sandy Creek	19	45.1	64.1	>$1,920,000
MC-16	Greens Run	8.2	6.7	14.9	>$2,210,000
MC-17	Muddy Creek	15.6	11.2	26.8	$3,200,000
MC-18	Roaring Creek	9.2	NR	9.2	No estimate possible
MC-23	Morgan Run	4.6	6.3	10.9	>$2,540,000
MC-24	Heather Run	3.4	1	4.4	>$1,150,000
MC-25	Lick Run	4	0	4	>$2,950,000
MC-27	Pringle Run	4.7	7	5.4	>$2,250,000
	Subwatershed total	**74.9**	**87.5**	**162.4**	>$21,590,000
MC	Cheat River	69.4		69.4	
	Total incl. Cheat River	**144.3**	**87.5**	**231.8**	>$21,590,000

Source: Impaired miles from Table 3. N/A = Not applicable. NR = Not reported. Actual impaired miles are likely greater than those listed because of unknown impaired miles form WVDEP (1999). Cost to remediate AMLs are the total costs calculated in this Watershed Based Plan, as detailed in the following subsections. No AMLs are known to discharge AMD directly to the Cheat River, other than those that discharge in the Cheat Lake subwatershed.

[3] This cost estimate should be considered a lower bound because it does not include sites for which flow and/or water quality information are insufficient to make cost estimates, and sites on which projects are expected by be built by 2005. In addition, any cost estimates that exceed $1 million are estimated as “>$1 million.” This may significantly underestimate the cost of some sites.

5.1 Cheat Lake (MC-(L1))

Figure 4: Abandoned mine lands in the Cheat Lake subwatershed

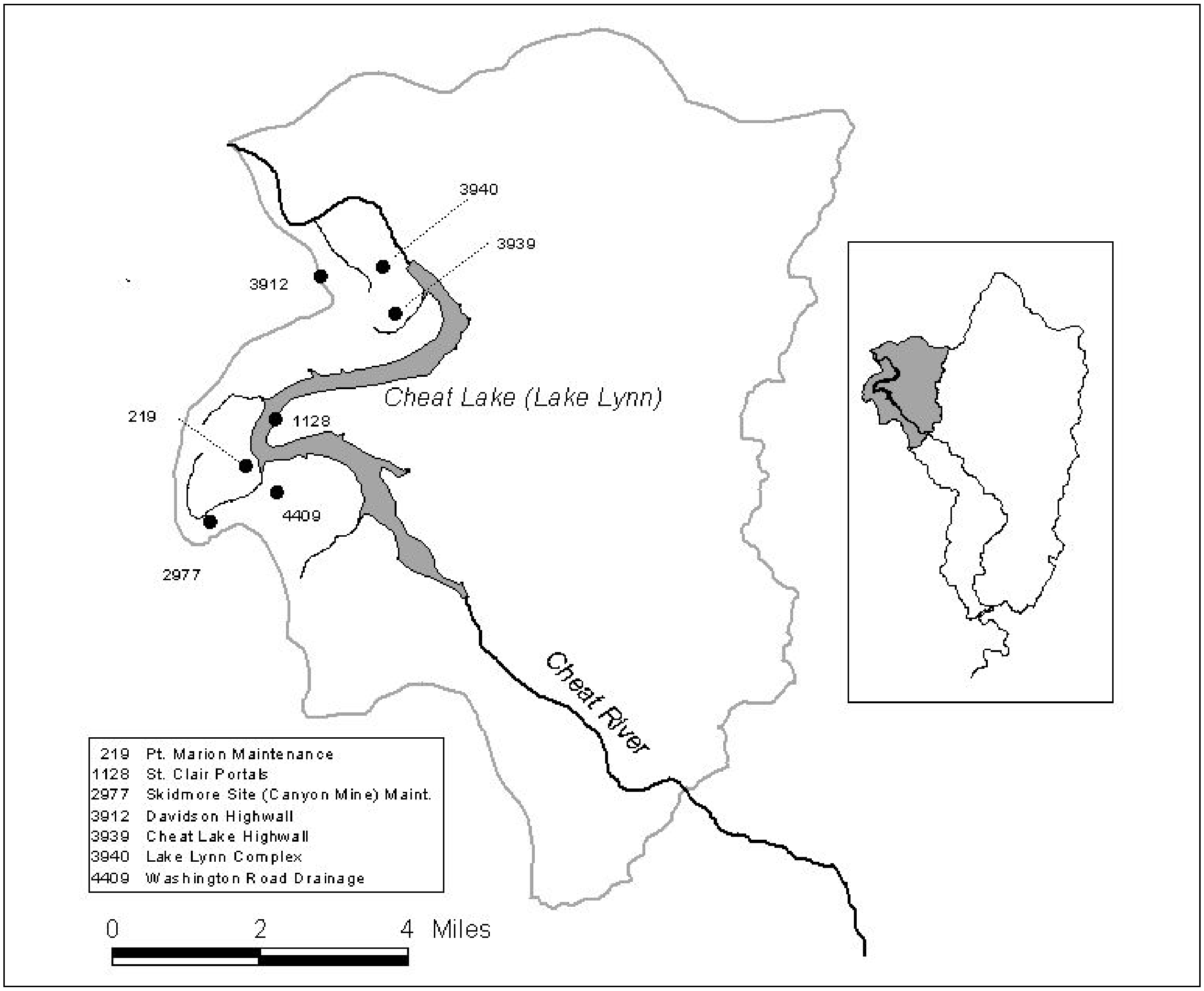

Table 13: Costs and descriptions of abandoned mine lands in the Cheat Lake subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Pt. Marion Maintenance (219)	$234,929 by OAMLR	According to the General Environmental Assessment, the site consists of six portals that discharge about 20 gpm. Field water tests showed pH 3.6 and iron > 10 mg/L. DNR sealed the portals and installed drainage channels and a catch basin in 1983. The system has since failed. According to a 1994 AML Complaint Investigation Report, highly saturated land at the site of a landslide had pH of 4.5 and iron of 4.5 mg/L. This was below the drainage ditch apparently constructed in 1983. In 2000, reclamation was done to install three wet seals and a diversion channel. According to a 9/7/00 WVDEP memo, the project has since failed because the ditch was blocked by vegetation and seepage developed below the ditch.	$190,000
St. Clair Portals (1128)	$0	According to the PAD, the site includes coal refuse, AMD with impounded water, and twelve collapsed portals along the highwall bench. Two areas had impounded water. Water flowing from the impoundments was estimated to have a total flow of 300 gpm. Field water tests showed pH of 3.1 and iron > 10 mg/L. The extremely steep refuse impoundment was about 35 to 40 feet high and about 200 feet long. Refuse is also scattered along the creek.	>$1,000,000
Skidmore Site (Canyon Mine) Maint. (2977)	$49,196 by OAMLR	The OSM-51 indicates that this site resulted from a failed AML Emergency Project completed in December 1990. The site developed three seeps due to the iron clogged underdain system. Flow and water quality information were not provided. Site was reclaimed in 2000 by OAMLR. Water quality treatment systems were not installed.	No estimate possible
Davidson Highwall (3912)	$310,997 by OAMLR	According to the PAD, the site has at least five portals. Two of the portals are open and three have collapsed. AMD flows from three portals with a total flow estimated at 90 gpm. Field water tests showed pH of 2.3 and iron of 8 mg/L. This site drains to an unnamed tributary that enters the Cheat downstream of Cheat Lake and downstream of the state line. It is included because it is located in the lower Cheat River watershed in West Virginia.	>$1,000,000
Lake Lynn Complex (3940)	$0	According to the AML Inventory Update Form, this site consists of at least five open portals. Approximately 25 gpm of AMD drains from the site.	$790,000
Washington Road Drainage (4409)	$0	The PAD reports that AMD from this site seeps from an abandoned deep mine and eventually flows onto Washington Road. No flow or water quality information is given.	No estimate possible
		Total, Cheat Lake subwatershed	**>$2,980,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.2 Bull Run (MC-11)

Figure 5: Abandoned mine lands in the Bull Run subwatershed

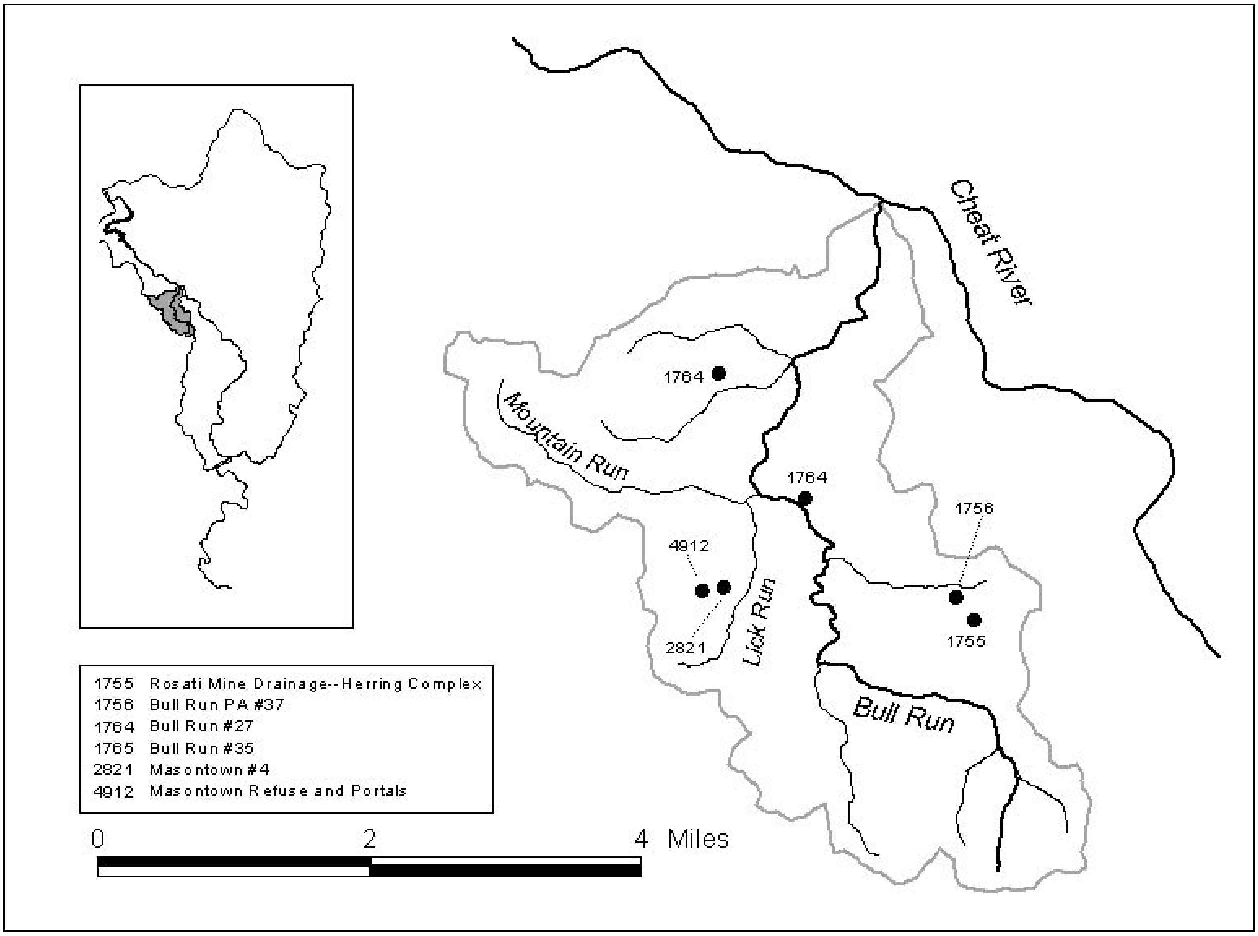

Table 14: Costs and descriptions of abandoned mine lands in the Bull Run subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Rosati Mine Drainage-Herring Complex (1755)	$147,945 by OAMLR	The OSM-51 indicates that this site contained two open and two collapsed portals with AMD discharging at 20 gpm, a highwall and two acres of refuse. The project summary indicates in 1994 five wet seals, underdrains, two treatment ponds containing peat, hay and stone, and rip rap channels were installed.	$490,000
Bull Run PA #37 (1756)	$0	According to the AML Inventory Update Form this site contains two mine portals, one sealed and one open. The open portal is discharging AMD at 100 gpm.	$350,000
Bull Run #27 (1764)	$1,065,751 by OAMLR	The OSM-51 indicates that this AML consisted of four sites. Site #1 contained 1/4 acre of refuse and two mine portals. One portal was discharging water at 5gpm and a small seep also existed about 50 feet from the portal. Site #2 contained three mine portals and twelve acres of coal refuse. All three portals were discharging AMD at a rate of 83 gpm. Site #3 contained 1-2 collapsed portals with AMD. Site #4 contained a small refuse pile and a collapsed mine portal with AMD. According to the project summary this site was reclaimed in 2002. The PAD indicates that in total 17 portals, 35 acres of dangerous piles and embankments, and four impoundments were reclaimed.	>$1,000,000
Bull Run #35 (1765)	$433,865 by OAMLR	The OSM-51 indicates that this site contained at least four portals with AMD and three refuse piles covering five acres. According to the project summary this site was reclaimed in 2000. Reclamation consisted of wet sealing the portals, installing a SAPS and reclaiming the refuse piles.	$50,000
Masontown #4 (2821)	$322,883 by OAMLR	According to the OSM-51 this AML consisted of four sites. Site #1 contained six acres of refuse, a highwall, and one collapsed portal with AMD. Site #2 contained one collapsed portal with AMD. Site #3 contained 7 acres of refuse and a collapsed portal with AMD. Site #4 contained 8 acres of refuse, one collapsed portal with AMD and three open portals with water impounded inside the portals. According to the project summary this site was reclaimed in 1999. Reclamation consisted of reclaiming refuse piles, and installing mine seals and ditches and constructing access ramps for dumping limestone fines.	$310,000
Masontown Refuse and Portals (4912)	$0	The PAD indicates that this site contains three acres of coal refuse and a collapsed portal discharging AMD.	$100,000
		Total, Bull Run subwatershed	**>$2,300,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.3 Big Sandy Creek (MC-12)

Figure 6: Abandoned mine lands in the Big Sandy Creek subwatershed

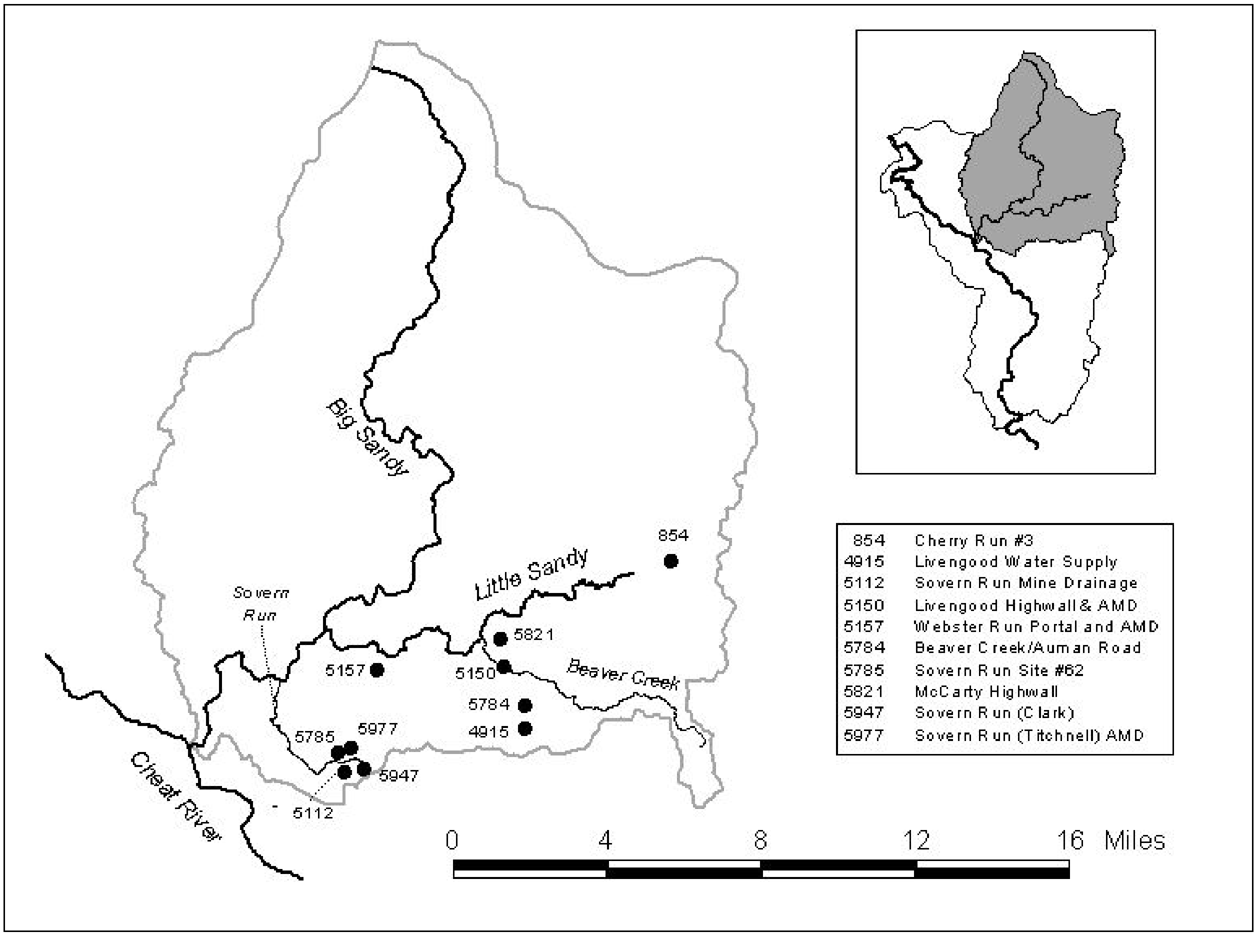

Table 15: Costs and descriptions of abandoned mine lands in the Big Sandy Creek subwatershed

Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
Cherry Run #3 (854)	$271,465 by OAMLR	The OSM-51 states that this site contained ten acres of spoil material, AMD discharging at 15 gpm, a 1/2 acre impoundment and a highwall. According to the project summary the reclamation that took place in 1996 involved backfilling the highwall and installing an anoxic limestone drain and a wetland.	$130,000
Livengood Water Supply (4915)	$0	The PAD indicates that the water quality of a spring and well have been impaired by AMD seeping from a surface mine at this site.	No estimate possible
Sovern Run Mine Drainage (5112)	$446,174 by OAMLR & FOC	The OSM-51 states hat this AML consists of two sites. Site #1 contained at least two collapsed portals, a highwall, and AMD. Site #2 contained a one acre refuse pile, two collapsed portals, and one open mine portal with AMD. According to the project summary this site was reclaimed in 2001. Limestone fines are the only water quality treatment mentioned in the information from OAMLR.	>$1,000,000
Livengood Highwall & AMD (5150)	$113,453 by OAMLR	The PAD indicates that this AML consists of four sites. Site #1 contained a highwall, Site #2 contained AMD seeping from spoil material and a highwall, Site #3 contained 7 AMD seeps, and Site #4 consisted of two impoundments, AMD seeps and spoil. The project summary indicates that this site was reclaimed in 2001. Project summary does not indicate if water quality treatment structures were installed.	$370,000
Webster Run Portal and AMD (5157)	$0	The PAD states this site contains a collapsed portal discharging AMD and two AMD seeps. This site has blowout potential. Site visit in 2002, revealed no flow from the 2 seeps, but AMD was seeping into a highwall ditch below and from the portal.	$420,000
Beaver Creek/ Auman Road (5784)	Unknown cost by OAMLR	According to FOC, this site contains a pit lake that receives flow from the base of a reclaimed highwall. OAMLR completed reclamation work on this site recently, but AMD is still discharged. A $94,500 project has been designed for a limestone check dam across the downstream end of the lake. An OLC will then be built down to the receiving stream. This project has been delayed because of landowner concerns. FOC is working to address those concerns and/or to develop alternative treatment.	No estimate possible
Sovern Run Site #62 (5785)	Unknown cost in late 1990s $28,636 by FOC in 2003	According to FOC, this site contains a collapsed portal with AMD. In the late 1990s, FOC injected limestone into the open portal and built a small impoundment in front of portal to prevent air from entering the mine. The impoundment included steel slag. A steep OLC drains the impoundment. In 2003, FOC added an additional 140 tons of limestone to the OLC.	No estimate possible
McCarty Highwall (5821)	$108,792 by FOC in 1999 $6,000 by FOC in 2004	According to FOC, this site contains collapsed portals at the base of a highwall. In 1999, FOC routed AMD through an impoundment with a limestone/steel slag check dam. From the impoundment, the water flowed through an OLC to second impoundment with the same kind of check dam. Over time, the steel slag hardened. In fall 2004, the slag was replenished.	No estimate possible
Sovern Run (Clark) (5947)	$80,000 from FOC in 2001 Unknown cost from OAMLR in 2001	According to FOC, this site includes previously constructed wet seals but no treatment, through a 2001 partnership between FOC and OAMLR. Reclamation at that time also included regrading a highwall and burying alkaline materials at base of the highwall across the street. Now, conceptual designs have been completed, funding has been secured, and contractors have been hired to install a new project to further address water quality. The $192,500 budget includes OLCs and treatment with steel slag to boost alkalinity on fresh water. Until post-construction data are available, remaining costs are unknown.	No estimate possible
Sovern Run (Titchnell) AMD (5977)	$0	The PAD notes three sources of AMD at this site: flow from a collapsed borehole, flow from a pond, and a large seep 50 feet from the borehole. According to FOC, a new project with a $191,700 budget will be used for a limestone leach bed, OLC, and adjacent freshwater treatment with steel slag to boost alkalinity. Conceptual designs have been completed, funding has been secured, and contractors have been hired to install this project. Until post-construction data are available, remaining costs are unknown.	No estimate possible
		Total, Big Sandy Creek subwatershed	**>$1,920,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.4 Greens Run (MC-16)

Figure 7: Abandoned mine lands in the Greens Run subwatershed

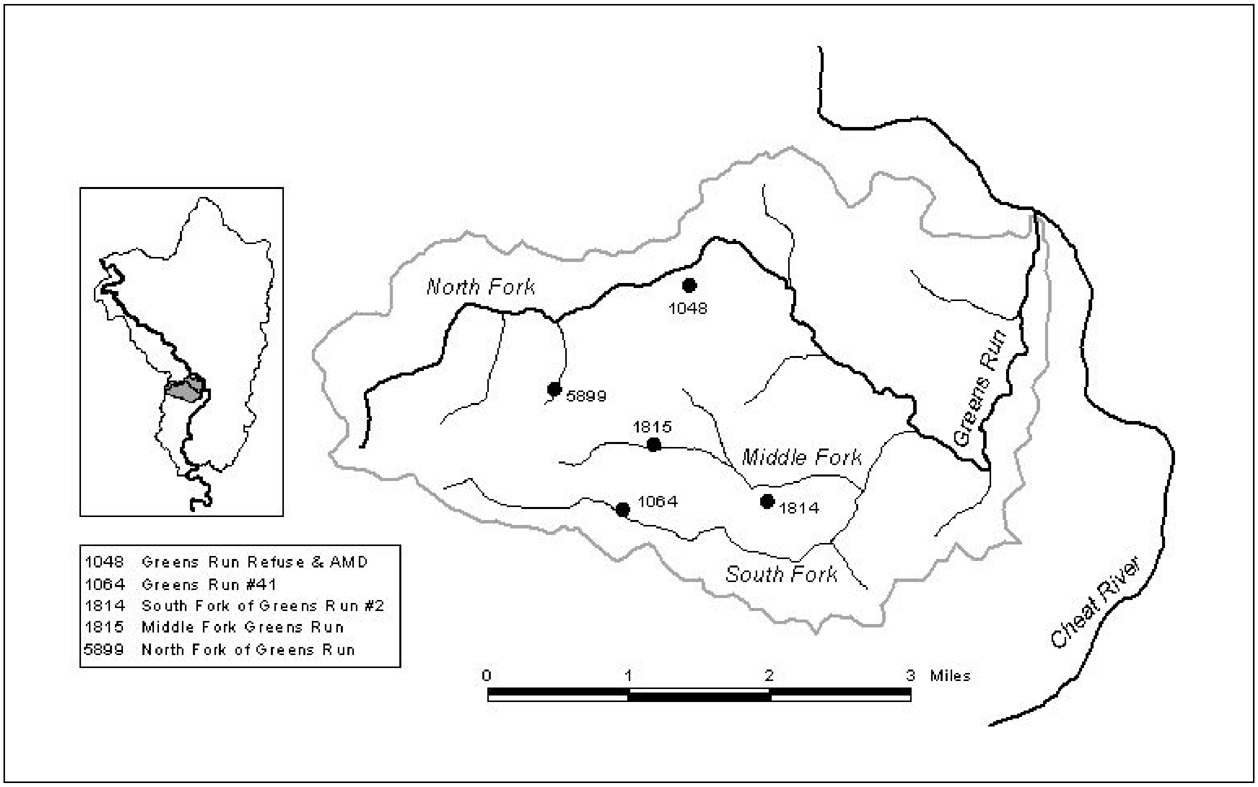

Table 16: Costs and descriptions of abandoned mine lands in the Greens Run subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Greens Run Refuse & AMD (1048)	$113,886 by OAMLR	The General Environmental Assessment states that this site contained one partially collapsed portal, 10 acres of refuse piles, a highwall and AMD. Site was reclaimed in 2003 with no indication that water quality was addressed.	$90,000
Greens Run #41 (1064)	$0	The AML Inventory Update Form indicates that this site contains two mine portals and AMD.	>$1,000,000
South Fork of Greens Run #2 (W1814)	$0	The AML Inventory Update Form indicates that this site contains AMD and 10 acres of spoil.	$120,000
Middle Fork Greens Run (1815)	$0	The PAD indicates that this AML contains a portal draining AMD into Greens Run.	>$1,000,000
North Fork of Greens Run (5899)	$43,646 by FOC	According to FOC, AMD flows from a portal from an old deep mine. FOC completed a reclamation project on this site in 2003. Treatment consists of a limestone leach bed and an OLC. FOC is considering maintenance or enhancement of this project to repair damage to the leach bed. Until post-construction data are available, remaining costs are unknown.	No estimate possible
		Total, Greens Run subwatershed	$2,210,000

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.5 Muddy Creek (MC-17)

Figure 8: Abandoned mine lands in the Muddy Creek subwatershed

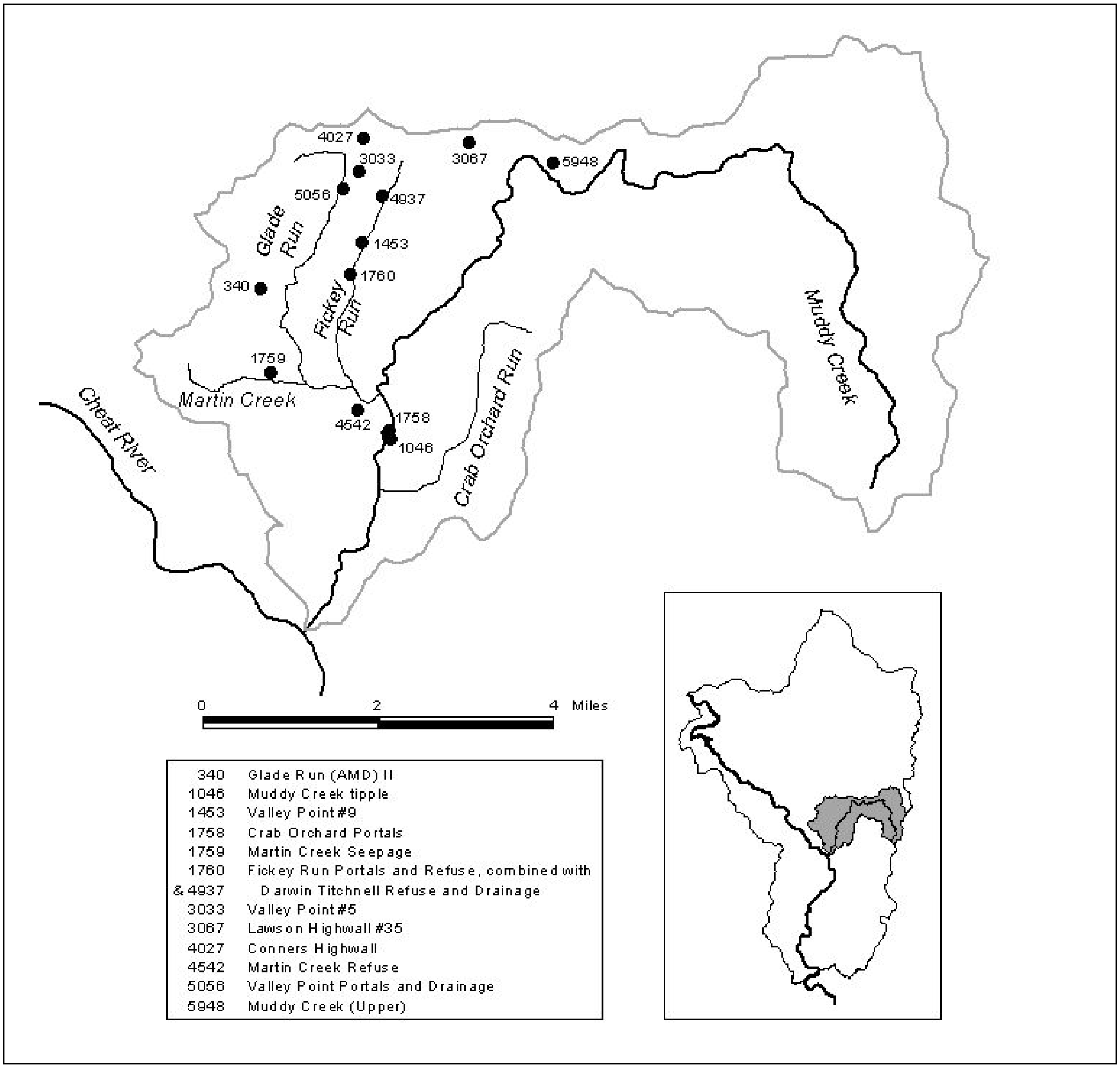

Table 17: Costs and descriptions of abandoned mine lands in the Muddy Creek subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Glade Run (AMD) II (340)	$255,422 by OAMLR	The OSM-51 states that this site was reclaimed in 1985, but the project completely failed. The failed reclamation was due to seepage from an abandoned deep mine and runoff from a surface mine. Site was again reclaimed in 1992 according to the project summary. Reclamation involved the installation of underdrains and site revegetation.	$560,000
Muddy Creek Tipple (1046)	$698,821 by OAMLR	According to the Environmental Assessment this site consists of six separate sites that contained a total of 13 portals, 30 acres of refuse, a highwall and AMD. Site was reclaimed in 1990 according to the project summary. The project information sheet indicates that reclamation involved the installation of eight wet seals, revegetating 51.5 acres, and installing rip rap channels-the only water quality treatment systems on site.	No estimate possible
Valley Point #9 (1453)	$0	The AML Inventory Update Form indicates that this site contains a highwall and 9.5 acres of mine spoil and coal refuse.	No estimate possible
Valley Point #11 (1455)	$0	The AML Inventory Update Form describes a dangerous highwall but no AMD. This site is included because FOC is collecting data, indicating that AMD may, indeed, be discharged. Data are not available to estimate future costs.	No estimate possible
Crab Orchard Portals (1758)	$0	According to the AML Inventory Update Form a blow out occurred at this site 1978 creating land slides. This site contains two portals, and AMD drains from this site into Muddy Creek.	No estimate possible
Martin Creek Seepage (1759)	$0	The AML inventory Update Form indicates that this site contains ten acres of refuse and AMD seeps.	$160,000
Fickey Run Portals & Refuse (1760) combined with Darwin Titchnell Refuse and Drainage (4937)	$382,394 by OAMLR	The OSM-51 indicates that this AML consists of three sites. Site #1 contained a 1/2 acre refuse pile and one collapsed mine portal with AMD. Site #2 contained two acres of refuse. Site #3 contained three collapsed mine portals, a small pond, three acres of refuse and AMD. The project summary indicates that this project was reclaimed in 2002. It also indicates that site #3 contained five draining mine portals and the only water quality treatment on site included OLCs and check dams. The Titchnell PAD indicates that this site contains a highwall, a 1/8 acre pond, one or more collapsed portals with AMD, an a 1/8 acre refuse pile.	$970,000
Valley Point #5 (3033)	$0	The AML Inventory Update Form indicates that this site contains a highwall and two open portals discharging AMD.	No estimate possible
Lawson Highwall #35 (3067)	$0	According to the AML Inventory Update Form this site contains a highwall, two portals, one collapsed with AMD.	$590,000
Conners Highwall (4027)	$388,081 by OAMLR	The Environmental Assessment indicates that this site contained a highwall, four open portals and AMD. According to the project information sheet reclamation in 1991 involved sealing the mine portals and regrading and revegetating spoil material	No estimate possible
Martin Creek Refuse (4542)	$459,874 by OAMLR	The Environmental Assessment indicates this AML consists of two sites. Site #1contained four acres of refuse, an old mine bench, three collapsed portals. Site #2 contained three acres of refuse, one collapsed portal with AMD and an old mine bench. The project summary indicates that this site was reclaimed in 1996. SRG data indicate the water quality treatment exist at this site	$710,000
Valley Point Portals and Drainage (5056)	$52,300 by OAMLR	According to the OSM-51 this site contains three collapsed mine portals with flowing AMD and a 1/2 acre pond. The project summary states that the site was reclaimed in 2002. Reclamation involved dewatering and sealing the mine portals. There is not indication of water quality treatment at this site.	$210,000
Muddy Creek (Upper) (5948)	$0	Conceptual designs have been completed, funding has been secured, and contractors have been hired to install this project. According to FOC, a $241,700 budget has been approved. Treatment will include leach beds at each of four seeps or discharges from collapsed portals, followed by extensive OLCs. Until post-construction data are available, remaining costs are unknown.	No estimate possible
		Total, Muddy Creek subwatershed	**$3,200,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.6 Roaring Creek (MC-18)

Figure 9: Abandoned mine lands in the Roaring Creek subwatershed

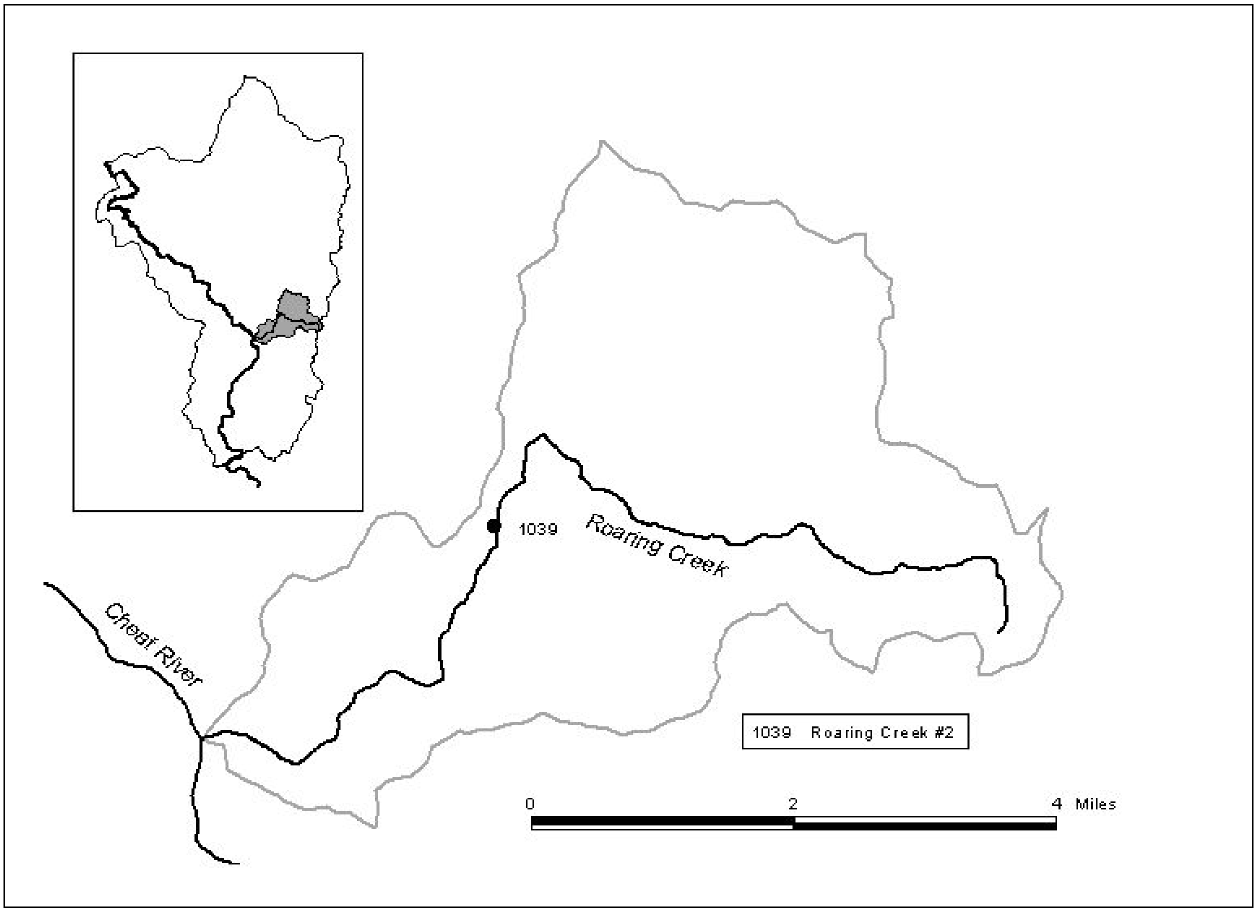

Table 18: Costs and descriptions of abandoned mine lands in the Roaring Creek subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Roaring Creek #2 (1039)	$0	According to the AML Inventory Update Form, this site includes a boggy area of about 12 acres below an active mine. Seepage appears to be coming from an old portal below the active area. No flow or water quality information is given.	No estimate possible
		Total, Roaring Creek subwatershed	No estimate possible

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.7 Morgan Run (MC-23)

Figure 10: Abandoned mine lands in the Morgan Run subwatershed

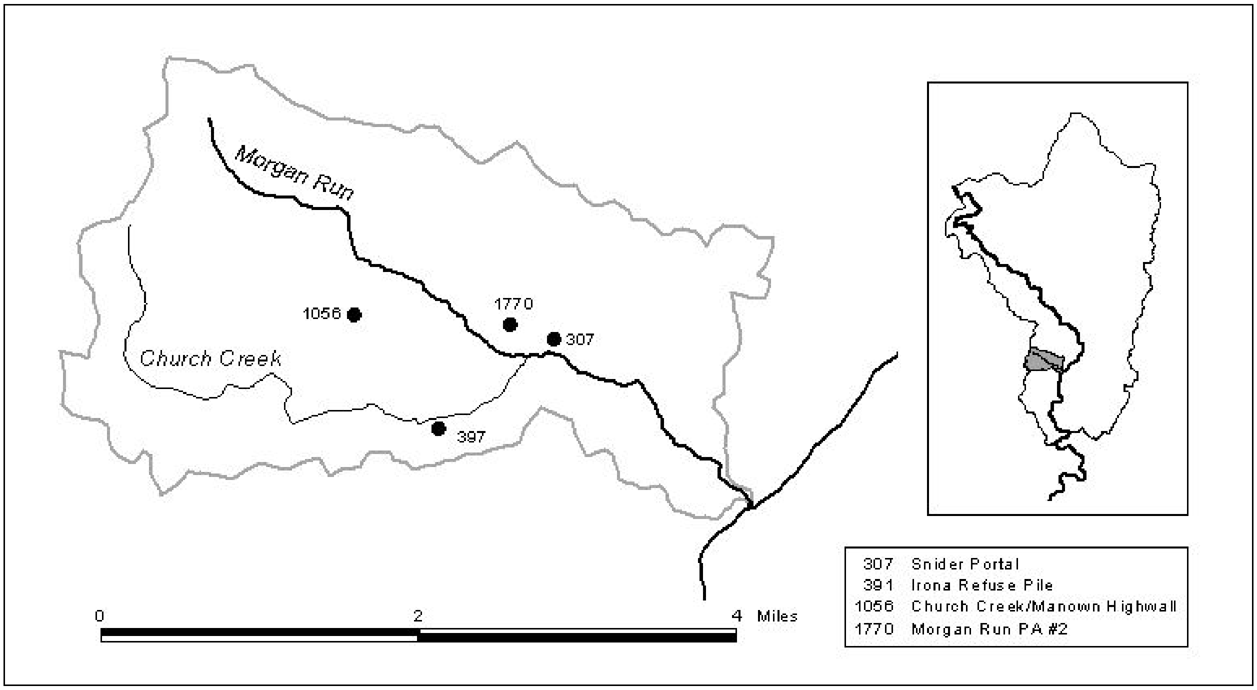

Table 19: Costs and descriptions of abandoned mine lands in the Morgan Run subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Snider Portal (307)	$11,700 by OAMLR	According to an AML Inventory Update Form, this site consists of one open portal.	$90,000
Irona Refuse Pile (397)	$1,134,452 by OAMLR	According to the OSM-51, the site includes about 61 acres of a burning gob pile (in 1988), which is also eroding into Church Creek. Two free flowing portals drain into Church Creek with pH 4.0 and iron > 10 mg/L.	>$1,000,000
Church Creek/Manown Highwall (1056)	$0	According to the PAD, this problem area includes three sites: Site 1 includes 1,000 linear feet of highwall that is 25 feet high. The bench area is slightly vegetated with a small impoundment. Field water samples showed a pH of 4.1 and iron at 5 mg/L. Site 2 includes 1,200 linear feet of highwall that is 40 feet high. Site 3 includes 2,000 linear feet of highwall that is 35 feet high, at least three collapsed portals, two small impoundments trapped between the spoil and highwall, remains of a coal loadout, eight old mine cars, four abandoned vehicles, and numerous AMD seeps. In total, Site 3 was estimated to discharge 300 gpm to Church Creek, with pH of 2.9 and iron greater than 10 mg/L. [AMD remediation costs are based on Site 3 only.]	>$1,000,000
Morgan Run PA #2 (1770)	$0	According to the PAD, this site contains three portals, two of which are backfilled and one of which is partially open, measuring two by six feet. AMD is seeping from lowest backfilled portal into Morgan Run (WVDEP, 1981). Water quality data from WVDEP (1981) suggests another AMD source other than the single seep in this PA contributes to pollution at Morgan Run just above confluence with Church.	$450,000
		Total, Morgan Run subwatershed	**>$2,540,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.8 Heather Run (MC-24)

Figure 11: Abandoned mine lands in the Heather Run subwatershed

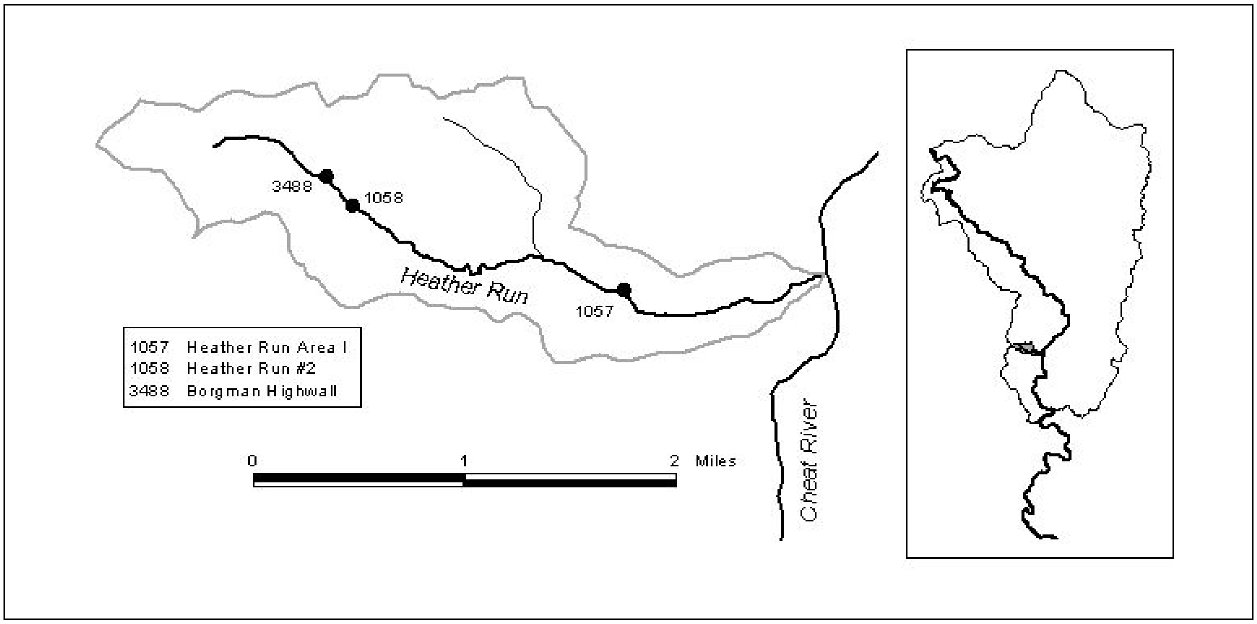

Table 20: Costs and descriptions of abandoned mine lands in the Heather Run subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Heather Run Area I (1057)	$0	The AML Inventory Form indicates that this site contains one acres of gob and three open portals. A site visit in 2002 found four additional portals, two air intakes and an AMD seep.	$10,000
Heather Run #2 (1058)	$0	The PAD indicates that this site contains 13 portals, 4 acres coal refuse piles, a highwall and acid mine drainage.	>$1,000,000
Borgman Highwall (3488)	$0	The AML Inventory Update Form lists only a highwall in the original description. A site visit in 2002 found 5 portals, with no flows reported, and an unknown amount of coal refuse. The PAD indicates AMD is a problem at this site.	$140,000
		Total, Heather Run subwatershed	>$1,150,000

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.9 Lick Run (MC-25)

Figure 12: Abandoned mine lands in the Lick Run subwatershed

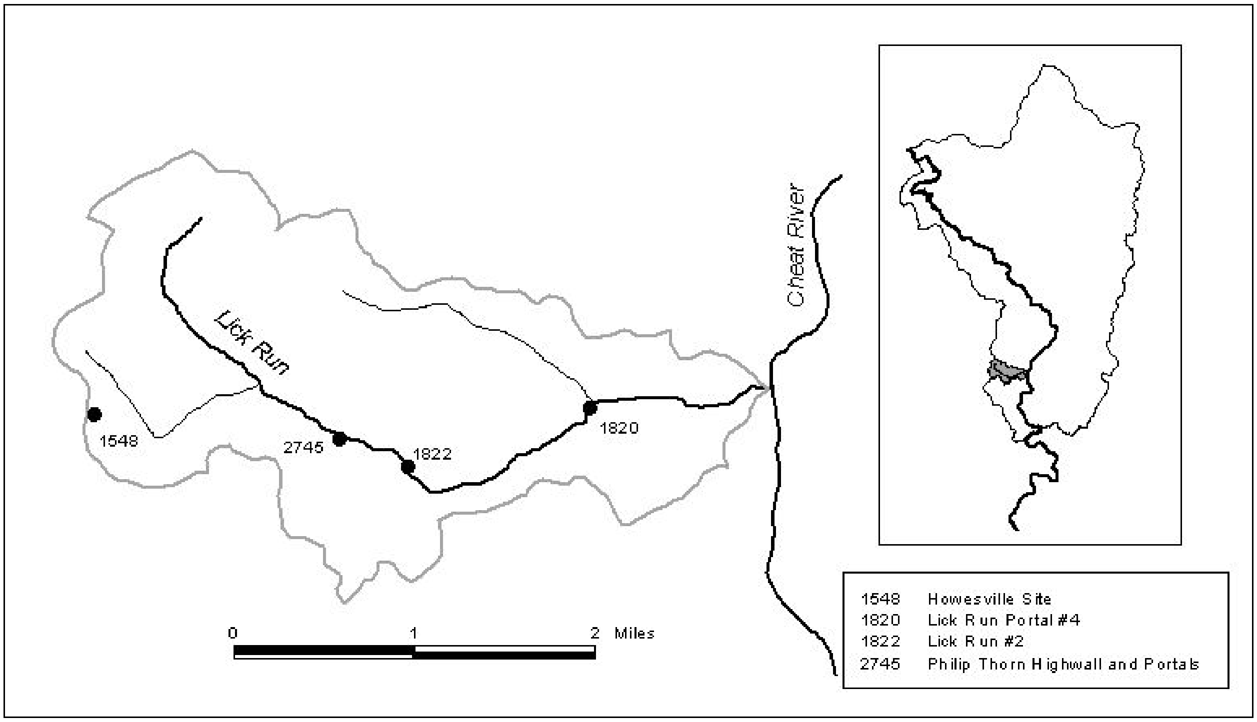

Table 21: Costs and descriptions of abandoned mine lands in the Lick Run subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Howesville Site (1548)	$0	The AML Inventory Update Form indicates that this site contains 16 mine portals, a highwall and AMD.	$360,000
Lick Run Portal #4 (1820)	$0	According to the OSM-51 this site consists of at least four collapsed deep mine portals, one open mine portal, about three acres of refuse, and AMD. USACE, in partnership with River of Promise, plans to install a remediation system here, but it is unclear when this project will begin. For this reason, a cost is included in this plan.	>$1,000,000
Lick Run #2 (1822)	$172,237 by OAMLR	According to the Environmental Assessment this site contained at least 8 mine portals, two with AMD and two acres of coal refuse. Project summary indicates that in 1999 twelve wet seals were installed.	>$1,000,000
Philip Thorn Highwall and Portals (2745)	$523,091 by OAMLR	OSM-51 indicates that this site contains three open and seven collapsed portals, a highwall, two acres of coal refuse and AMD. Five of the portals are discharging AMD. Site has been reclaimed.	$590,000
		Total, Lick Run subwatershed	**>$2,950,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

5.10 <u>Pringle Run (MC-27)</u>

Figure 13: Abandoned mine lands in the Pringle Run subwatershed

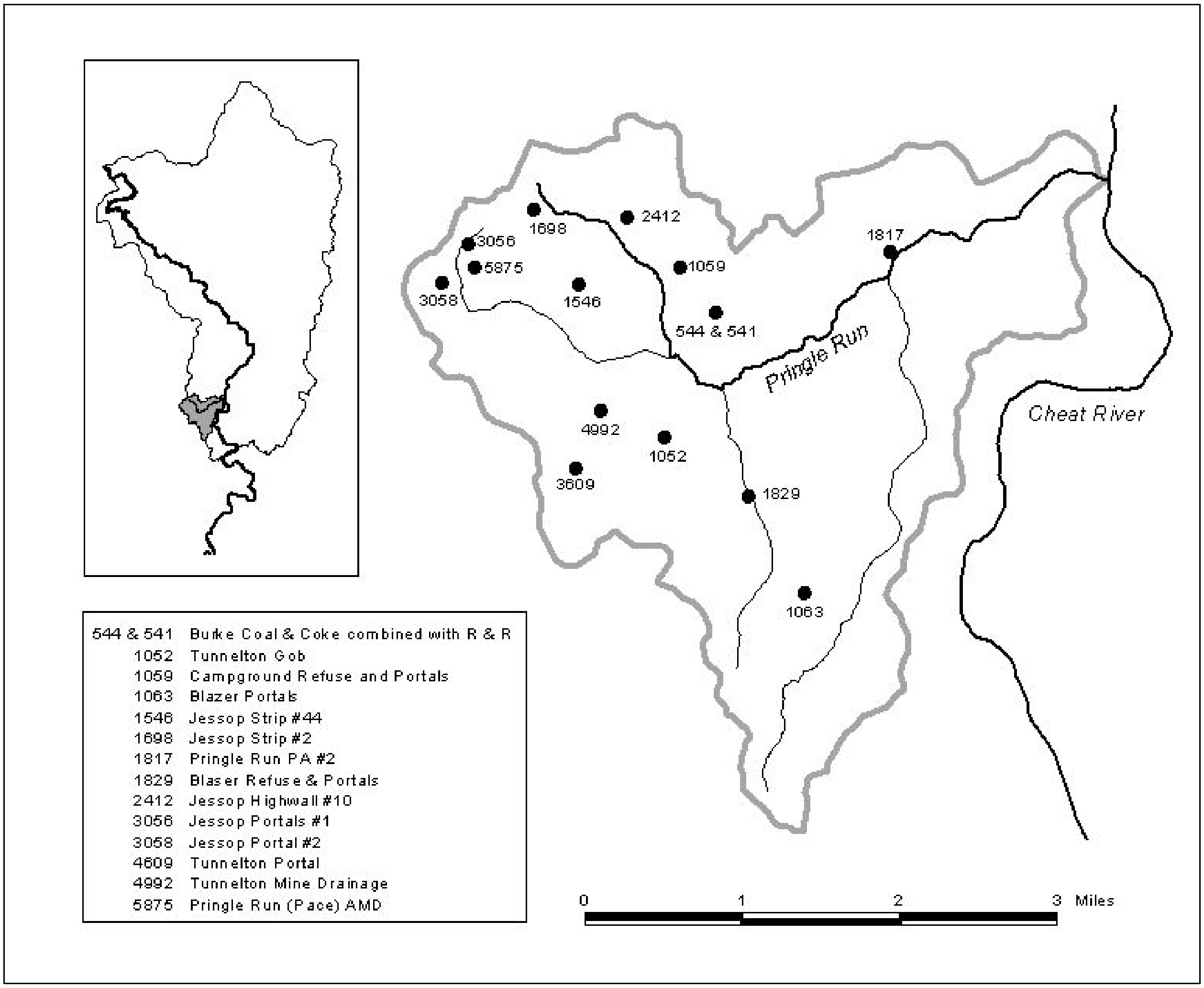

Table 22: Costs and descriptions of abandoned mine lands in the Pringle Run subwatershed

Site name (Problem area no.)	Past recla-mation cost	Site and cost description	Estimated future cost for water remediation
Burke Coal & Coke (544) combined with R & R (541)	$410,271 by OAMLR	These two sites were reclaimed together (WVDEP, 2004b). OAMLR data indicate that Burke Coal & Coke originally contained 11.5 acres of refuse, a highwall, open pits and two portals, one partially open. OAMLR information does not mention the presence of AMD at this site. No data sources indicate that AMD is flowing from R & R, so remaining costs are unknown.	No estimate possible
Tunnelton Gob (1052)	$252,667 by OAMLR	According to the OSM-51, the site originally contained around thirty acres of refuse that showed signs of past burning and an open portal discharging AMD. The project summary states that in 1992 the site was regarded, topsoil was placed on the spoil, and a wet seal and drainage ditches were installed. The only pollution load estimates at this site are for a portal which received a wet seal. The project that OAMLR completed did not include any water treatment other than the wet seal.	$90,000
Campground Refuse and Portals (1059)	$44,540 by OAMLR	The OSM-51 indicates that the site contained 2 mine portals with AMD and 1 acre of coal refuse. The project summary states that in 2001, two mine seals were installed, gob was reclaimed, and ditches were installed. Water treatment measures at this site included a wet seal and riprap channels.	$40,000
Blazer Portals (1063)	$760,000 by OAMLR	The AML Inventory Update Form indicates that this site contained two open portals with AMD and highwall. The site has been reclaimed, but there is no indication that the project addressed the water quality complaint.	$180,000
Jessop Strip #4 (1546)	$0	The AML Inventory Update Form for this site indicates there are 13 portals, four with AMD and dangerous highwalls associated with this abandoned mine land.	$90,000
Jessop Strip #2 (1698)	$0	The AML Inventory Update Form for this site indicates that twelve portals exist throughout the site, five of which are discharging AMD, a small pond, and a 0.01 acre burning gob pile. During a site visit in 2002 all of the portals were dry and an AMD seep was discharging from the coal seam.	>$1,000,000
Pringle Run PA #2 (1817)	$0	According to the PAD this AML contains two sites. Site #1 contains ½ acre of refuse and three mine portals with AMD. Site #2 contains refuse piles, six deep mine portals, a ½ acre pond, and AMD. The SRG measured drainage from 6 portals, which is used as the number of wet seals necessary.	$80,000
Blaser Refuse & Portals (1829)	$198,025 by OAMLR	OAMLR is currently constructing a treatment for this site. Until post-construction water quality data are available, the treatment is assumed effective, and the remaining cost is not known.	No estimate possible
Jessop Highwall #10 (2412)	$0	The AML Inventory Update Form indicates that this site contains a dangerous highwall and a collapsed portal with AMD.	$150,000
Jessop Portals #1 (3056)	$0	The PAD data indicates that this site contains eight portals and extensive highwall. Although the PAD calls for 8 wet seals, costs are estimated for only 3, because the investigation indicated only three portals with flow.	$620,000
Jessop Portal #2 (3058)	$0	According to the AML Inventory Update Form this site contains nine collapsed portals and a highwall. Five of the portals are seeping AMD. In September 2002 another inspection detected no evidence of mine drainage, and the assessment that the site does not damage the Cheat River.	No estimate possible
Tunnelton Portal (4609)	$0	According to the PAD, this site contains a partially collapsed portal. No AMD is mentioned in the PAD, but the suggested reclamation involves wet sealing the portal, indicating that mine drainage may be present. Lack of any effort to quantify the AMD suggests that the pollution load from this site is minor.	No estimate possible
Tunnelton Mine Drainage (4992)	$51,480 by OAMLR	The OSM-51 indicates that this site originally contained two seeps discharging AMD from a collapsed portal. The project summary indicates that in 2000 the portal was wet sealed and an underdrain was installed. The only water analysis reported after the site was treated indicates net alkaline water. Therefore, no additional treatment is needed on this site and remaining costs are unknown.	No estimate possible
Pringle Run (Pace) AMD (5875)	$157,500 by FOC	According to FOC, construction on this site was completed in November 2004. Treatment consists of a vertical flow pond to remove oxygen, and anoxic limestone drain, and a settling basin. Until post-construction data are available, remaining costs are unknown.	No estimate possible
		Total, Pringle Run subwatershed	**>$2,250,000**

Source: Past reclamation costs and site and cost descriptions from WVDEP (various dates), OSM (2004b), and Pitzer (2004b). Past reclamation costs may include acid mine drainage remediation and/or highwall elimination, regrading, or other land reclamation costs. Future costs calculated for this plan.

6. TECHNICAL AND FINANCIAL ASSISTANCE

A combination of federal and state agencies, academic institutions, watershed organizations, consultants, and citizens will be involved in providing technical and financial assistance for lower Cheat watershed projects.

While this Watershed Based Plan considers other pollutants too, the technical and financial assistance section focuses on AMD only. Before technical and financial assistance can be secured for biological, bacteria, and sediment impairments, further research is needed to more accurately identify the scope of the problems and the specific nonpoint sources of pollution.

6.1 Technical Assistance Providers

Technical assistance is needed for the following tasks:

- coordinating and applying for the various funding sources;
- collecting data at AMD sources in preparation for the design of remediation projects;
- creating conceptual designs of remediation projects;
- creating detailed engineering designs of remediation projects;
- performing project management, including putting projects out for bid, managing projects, and tracking their progress; and
- monitoring instream and source water quality following the installation of remediation projects to document their effectiveness.

6.1.1 River of Promise

River of Promise is a stakeholder group comprised of state and federal agencies, academics, consultants, local government officials, and citizens who collaborate to improve the water quality of the lower Cheat watershed. At quarterly meetings, which are organized and chaired by Friends of the Cheat (FOC), members share information, target remediation sites, choose appropriate technologies, and develop matching funds. A technical subcommittee plays a significant role in evaluating the past performance of installed treatment systems and recommending systems for new projects.

6.1.2 Friends of the Cheat

FOC's mission is to restore, preserve, and promote the outstanding natural qualities of the Cheat River watershed. FOC will locate and apply for funding resources, partner with agencies to implement AMD reclamation projects, collect water quality data to determine the effectiveness of reclamation projects, monitor impaired streams, and inform the local community and watershed stakeholders about reclamation efforts and water quality achievements. FOC will also continue to chair the River of Promise committee.

6.1.3 West Virginia Department of Environmental Protection

Two WVDEP divisions will provide technical assistance; both divisions are frequent participants in River of Promise. The Division of Water and Waste Management monitors the water quality of the Cheat watershed through its Watershed Assessment Program and its pre-TMDL monitoring program (WVDEP, 2004e). This division also provides technical assistance for the use of best management practices (BMPs), educates the public and land users on nonpoint source issues, enforces water quality laws that affect nonpoint sources, and restores impaired watersheds through its Non-Point Source Program (WVDEP, 2004f).

WVDEP's OAMLR directs technical resources to watersheds to address AMLs. Through their Stream Restoration Group, the office conducts extensive source monitoring of AMLs—as well as instream monitoring—before remediation systems are designed.

6.1.4 Office of Surface Mining, Reclamation and Enforcement

OSM provides technical assistance by participating actively in River of Promise meetings.

6.1.5 West Virginia University

A number of the colleges and individuals at the university may provide assistance for projects in the watershed. The National Mine Land Reclamation Center (NMLRC), housed at West Virginia University will provide conceptual site designs for AMD reclamation projects and monitor the quality of water produced by AMLs before and after the installation of reclamation projects. NMLRC is dedicated to developing innovative AMD treatment technologies. Technical assistance may also be provided by multiple university colleges related to fisheries and wildlife resources, mine land reclamation, and water quality improvement.

6.1.6 Other technical assistance providers

Other agencies and organizations may also provide technical assistance. Natural Resources Conservation Service engineers have designed AMD remediation projects in nearby watersheds and may be available for assistance. Local conservation districts may also be a repository of information and assistance. In addition, USEPA staff with expertise in AMD from Region 3 and from headquarters sometimes participate in River of Promise and may provide technical assistance.

6.2 Funding Sources

Several funding sources are available for nonpoint source AMD remediation on AMLs and for water quality monitoring, including:

- Section 319 funds,
- the Abandoned Mine Land Trust Fund,
- the 10% AMD Set-Aside Fund,
- Watershed Cooperative Agreement Program grants,
- United States Army Corps of Engineers (USACE) Section 206 funds,
- NRCS Public Law 566 funds,
- Stream Partners Program grants
- private and corporate foundation grants, and
- local government contributions.

These funding sources are described in turn below.

6.2.1 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 2005 and beyond can be allocated to the lower Cheat watershed. WVDEP's Division of Water Resources Non-Point Source Program sets priorities and administers the state Section 319 program (WVDEP, 2004f).

6.2.2 The Abandoned Mine Land Trust Fund

Before 1977, when the Surface Mining Control and Reclamation Act was enacted, coal mines generally did not manage acid-producing material to prevent AMD or treat the AMD that was produced. Many operators chose to abandon these mines rather than bring them up to the new reclamation standards. These “pre-law” mines continue to be significant AMD sources and are treated as nonpoint sources under the Clean Water Act.

To reclaim these abandoned mine lands (AMLs), the Act established the AML Trust Fund. This fund, supported by a per-ton tax on mined coal, has been allocated to coal mining states for remediation projects, according to a formula that takes states’ current coal production into account. Authorization for this tax expired on September 30, 2004, and if a permanent reauthorization is not secured, this very important source of funding for AMD remediation may be lost.[4]

For many reasons, the AML Trust Fund has failed to address AMD at a rapid pace:

- The priorities for disbursed monies places health and safety hazards ahead of water quality issues.
- Even though OSM allows states to assign water quality problems a priority equal to that of potential health and safety problems, WVDEP has been slow to change its priorities accordingly.
- Only part of the AML Trust Fund’s income is disbursed each year, so that less money is available for remediation than the legislation initially envisioned.
- Some of the money that is disbursed from interest generated by the fund pays for health benefits for former miners.
- At least half of the AML fees collected in each state are allocated back to the state of origin, and are not available for AML reclamation in other states; therefore, much of the AML monies are earmarked for states with few AML problems.
- Some of the money allocated to West Virginia from the AML Trust Fund is used for water-line extensions, because deep mines are responsible for the failure of a number of private wells.
- Funds that are sent back to West Virginia are spent on agency staff salaries in addition to on-the-ground remediation.

Still, WVDEP has funded many AMD remediation projects on AMLs. But these projects are typically not designed to meet stringent water quality goals like those set out in this Watershed Based Plan. The agency typically uses a small number of cost-effective techniques, such as open limestone channels, and chooses the layout for these measures based on how much land is available (for example, the distance between a mine portal and the boundary of properties for which the agency has right-of-entry agreements).

Unless significantly more money were allocated to West Virginia’s AML program and these augmented funds were spent on water quality problems, the AML Trust Fund will not be sufficient to implement the AML pollutant reductions in the Cheat TMDL and to meet the goals of this Watershed Based Plan in the foreseeable future. And if the fund is not reauthorized, this important source of funding may disappear completely.

OAMLR administers West Virginia’s use of AML Trust Fund grants.

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[4] Reauthorization of the AML Trust Fund, which expired on September 30, 2004, is still not settled. At the time that this document is being written, the fund has been temporarily reauthorized through June 2005. A new OSM rule published in September 2004 also reauthorizes a much smaller per-ton tax. It is still not clear what shape a final reauthorization will take.

6.2.3 10% AMD Set-Aside Fund

The 10% AMD Set-Aside Program allows states to reserve up to 10% of their annual AML Trust Fund allocations as an endowment for use on water quality projects. These funds are critically important, because while regular AML Trust Fund allocations can only be spent on capital costs, 10% AMD Set-Aside Fund allocations can be spent on operations and maintenance.

WVDEP has added $14.2 million to the WV Set-Aside fund as of March 31, 2004 (Miller, 2004). The agency only spends the interest; therefore, the amount available for AMD projects varies with interest rates. In fiscal year 2001 the fund had the highest amount of interest available: $760,000. As of fiscal year 2003 the interest available has fallen to $211,000 (Miller, 2004). Long term commitments have been made to fund the Blackwater Limestone Drum Station and limestone fine additions to the Middle Fork of the Tygart River. If WVDEP continues to add money to this fund and if interest rates increase, funds may be available for projects in the lower Cheat watershed.

Funds cannot be allocated to a watershed until after a Hydrologic Unit Plan is developed and approved by OSM. Plans are currently under development for five lower Cheat subwatersheds: Heather Run, Lick Run, Morgan Run, Pringle Run, and Sovern Run. These plans are scheduled to be completed in 2005.

6.2.4 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 are awarded to not-for-profit organizations that have developed cooperative agreements with other entities to reclaim AML sites. (OSM, 2004a). FOC has received a number of these grants for AMD reclamation projects in the lower Cheat watershed and plans to pursue WCAP grants in the future. A match is required to receive these grants and is typically met with money from the AML Trust Fund and/or the 319 program.

6.2.5 U.S. Army Corps of Engineers Section 206 funds

USACE has funded an AMD ecosystem restoration study in the lower Cheat watershed (USACE, 1997) and is planning to fund remediation work to address Lick Run Portal #4 (1820). The success of this project will help determine whether or not USACE funds are pursued for future AML reclamation projects in the watershed.

6.2.6 Natural Resources Conservation Service Public Law 566 funds

Although they have not been active in AMD remediation in the lower Cheat watershed, NRCS is funding AMD remediation in the neighboring Deckers Creek watershed though a Public Law-566 watershed restoration project. NRCS engineers have experience developing conceptual designs and detailed engineering designs for AMD remediation projects.

6.2.7 Stream Partners Program

This program offers grants of up to $5,000 to watershed organizations in West Virginia. Grants can be used for range of projects including small watershed assessments and water quality monitoring, public education, stream restoration, and organizational development. This grant has regularly provided funding for FOC projects in the past. Stream Partners grants will be pursued in the future to compliment nonpoint source research, education, and reclamation projects in the watershed.

6.2.8 Local governments

Local county commissions or city councils have generally been unwilling or unable to devote their resources toward the remediation of AMD from AMLs. In the past, however, local governments have been willing to serve as local sponsors for projects requiring local government oversight, and have offered letters of support and endorsement.

7. IMPLEMENTATION SCHEDULE, MILESTONES AND MEASURABLE GOALS FOR ACID MINE DRAINAGE

Because this Watershed Based Plan focuses on AMD, a detailed schedule with milestones and measurable goals is first laid out for these pollutants. Other pollutants are addressed in the following chapter.

Significant AMD pollutant reductions are still needed in the lower Cheat watershed. Because of the uncertainty of securing the required funds from a variety of agencies in a short period of time, the schedule, milestones, and measurable goals are divided into five-year phases and no final end date is projected for implementing all of the reductions in this Watershed Based Plan.

Many details are provided for Phase 1, which lasts from 2005 through 2009, because cleanup efforts are ongoing. The schedule, milestones, and goals are designed to expand upon these existing efforts. Far fewer details are given for Phase 2, because of the difficulty of predicting how many remediation projects will be funded.

7.1 Phase 1: 2005 through 2009

The broad goals for AMD remediation in Phase 1 are to continue collecting data, planning and coordinating activities among agencies and organizations, securing funding for remediation projects, constructing new projects, and maintaining existing projects.

7.1.1 Collect data

- **Monitor streams for AMD pollutants.** Continue monitoring streams that are impacted by AMD, as described in Chapter 9. At a minimum, new data will be collected to update calculation of the watershed’s acid load by major tributary. These data will be collected early in Phase 1 and will be used to help guide the planning process. They will also be collected again in 2009 to gage progress toward meeting the goals of this plan.
- **Monitor reclaimed AML sites for operation and maintenance needs.** Monitoring will take place at reclaimed sites located within watersheds eligible for operation and maintenance funding (see 7.1.2). Monitoring data will be used to develop an operation and maintenance plan.
- **Monitor reclaimed AML sites where water quality was not adequately addressed.** Monitoring will occur at reclaimed AML sites were acid mine drainage was not adequately addressed during past reclamation. Monitoring priority will be given to sites located within the watersheds of focus (see 7.1.2).
- **Monitor unreclaimed AML sites for AMD pollutants.** Monitoring will also occur at sites that have not been reclaimed, as described in the following chapter. Data will be used to design appropriate treatment systems.

7.1.2 Plan and coordinate activities

- **Continue River of Promise meetings.** Key organizations and agencies working on AMD remediation in the lower Cheat watershed meet quarterly at River of Promise meetings. Friends of the Cheat will continue to facilitate these meetings to allow partners to track progress, plan new projects, and to identify strategic priorities.
- **Complete FOC’s mapping project.** In 2003, FOC initiated a project to map all known data on AMLs and other AMD sources in the lower Cheat watershed. After this project is completed in 2005, it will be used as a foundation to decide where more field reconnaissance is needed (e.g., to find loads that are not accounted for by existing monitoring data) and to help choose future reclamation priorities.

- **Complete the development of Hydrologic Unit Plans.** Hydrologic Unit Plans are required for the use of 10% AMD Set-Aside funds for operation and maintenance of remediation projects on AMLs. Plans are currently under development for five lower Cheat subwatersheds: Heather Run, Lick Run, Morgan Run, Pringle Run, and Sovern Run. These plans will be completed in 2005.
- **Develop an operation and maintenance plan for eligible watersheds.** Once the Hydrologic Unit Plans are completed, River of Promise will develop an operation and maintenance plan for AML sites within eligible watersheds.
- **Finish coordinating the remediation of the Big Sandy Subwatershed.** The Big Sandy subwatershed was identified by River of Promise as its first priority in 1995. Since then, many reclamation projects have been installed and water quality has improved. However, the some stretches of the creek still do not support a healthy community of aquatic life. River of Promise will re-focus on the Big Sandy to finally finish what has been started. This will require identifying all remaining important AMD sources in the subwatershed, developing conceptual designs for remediation projects, and implementing them.
- **Focus efforts in watersheds currently receiving reclamation projects.** River of Promise, FOC and WVDEP are currently focusing a majority of their reclamation efforts on certain tributaries, including Pringle Run, Muddy Creek, and Greens Run. A focus will remain on these streams through 2009 to promote a more efficient improvement in water quality. Tributary focused strategies will also be the basis for future reclamation efforts.
- **Reassess the big picture.** At the end of this five-year period, River of Promise will reassess the strategic priorities for AMD remediation in the lower Cheat watershed. This assessment will be used to track improvements over time and to help plan remediation and operation and maintenance priorities for the next five-year period.

7.1.3 Secure funding

- **Secure 319 funds.** Each year, FOC will work with WVDEP through River of Promise to include lower Cheat watershed reclamation projects in the state 319 funding requests to EPA.
- **Secure AML Trust Fund funds.** FOC will work with WVDEP through River of Promise to include lower Cheat watershed reclamation projects in OAMLR's annual funding requests for remediation projects on AMLs.[5]
- **Secure OSM WCAP funds.** To supplement the 319 and AML Trust Fund grants, FOC will work with OSM through River of Promise to submit funding requests for OSM WCAP grants.
- **Secure 10% Set-Aside funds.** After the Hydrologic Unit Plans are approved by OSM, FOC will work through River of Promise to request funds for operations and maintenance at existing AMLs in the lower Cheat watershed that need repair or upkeep.
- **Investigate other funding sources.** USACE Section 206 funds and NRCS Public Law 566 funds will also be investigated for their usefulness in funding AML reclamation in the watershed. If feasible, FOC will work with these agencies through River of Promise to obtain funds.

7.1.4 Install remediation projects

- **Finish projects that are planned for the immediate future.** Conceptual designs have been completed, funding has been secured, and contractors have been hired to install several remediation projects. Construction will be completed on these projects, which include: Pringle Run Pace AMD (5875), Sovern Run (Clark) (5947), Sovern Run (Titchnell) (5977), and Muddy Creek (upper) (5948). USACE, in partnership with River of Promise, also plans to install a

[5] The future status of the AML Trust Fund is unclear at this time. AML funds will be used if possible to continue funding reclamation in the lower Cheat watershed.

remediation system at Lick Run Portal #4 (1820), but it is unclear when this project will begin. All of these projects will be built during Phase 1.

- **Build projects for which source data are already being collected.** FOC and NMLRC are currently looking at a number of sites to be considered for work in 2005 or 2006. These sites include: Beaver Creek/Auman Road (5784), Valley Point #11 (1455), Muddy Creek Tipple I (1046), Martin Creek Refuse (4542), Jessop Portals #1 (3056), and a site in the Morgan Run watershed.[6] Improvement of the of the NF of Greens Run (5899) reclamation project is also planned.
- **Complete reclamation of the Big Sandy subwatershed.** Based on the coordination described above, River of Promise partners will install remediation projects at remaining sites in this subwatershed so that its streams finally meet water quality standards and support healthy communities of aquatic life.
- **Add water quality improvements to sites in subwatersheds targeted by OAMLR.** In many cases, OAMLR designs and builds remediation projects with AML Trust Fund grants that do not wholly address AMD. River of Promise partners will track OAMLR progress and, wherever possible, will find additional funds such as OSM WCAPs to add on to these remediation projects so that they directly address water quality on a subwatershed-by-subwatershed basis.
- **Operate and maintain existing sites.** Because Hydrologic Unit Plans have not been completed for the lower Cheat watershed, little operations and maintenance work has been completed for installed projects. After these plans are approved and 10% AMD Set-Aside funds are obtained, operations and maintenance will be performed on sites with pressing needs.

7.1.5 Measurable goals for Phase 1

By the end of Phase 1 in December 2009, the following measurable goals will be achieved:

- AMD remediation projects will have been installed on at least fifteen AMLs across the lower Cheat watershed. These projects will be functioning well enough so that water discharged from these sites meet technology-based effluent limitations for pH, iron, and manganese.
- Instream water chemistry measurements across the Big Sandy subwatershed will show that all subwatershed streams are meeting water quality standards for pH, iron, manganese, and aluminum. In addition, biological monitoring will document improvements between 2005 and 2009.
- Tributary-by-tributary data collected in 2009 will be compared with similar data collected in 2005. Total acid loads to the Cheat River watershed will have decreased by at least 25% at the end of Phase 1.

7.2 Phase 2: 2010 through 2014

Phase 2 is described in less detail than Phase 1, because of the uncertainty in what will be finished by 2009. Still, the same four categories of activities will be undertaken.

7.2.1 Collect data

- **Monitor water quality to assess goals.** Monitoring of instream water quality and source water quality at reclaimed sites to determine the impacts of sources that have not been reclaimed. Data will be used to determine if the goals set for Phase 1 have been achieved and to set goals for Phase 2.
- **Monitor reclaimed AML sites for operation and maintenance needs.** Monitoring of AMLs reclaimed during Phase 1 and in earlier years will take place to determine the need for operation

[6] It is not clear whether this is one of the AMLs listed in Table 4, another known AML, or an un-inventoried site.

and maintenance at these sites. Only sites in watersheds with approved Hydrologic Unit Plans will be monitored.

- **Monitor unreclaimed AML sites for AMD pollutants.** Monitoring will also occur at sites that have not been reclaimed, as described in Chapter 9. Data will be used to design appropriate treatment systems.
- **Monitor reclaimed AML sites where water quality was not adequately addressed.** Monitoring will occur at reclaimed AML sites were acid mine drainage was not adequately addressed during past reclamation in Phase 1 or earlier years. Monitoring will occur at sites located in priority watershed as determined by the goals developed for Phase 2.

7.2.2 Plan and coordinate activities

- **Revise the Cheat AMD TMDL.** The TMDL may need to be updated based on progress achieved in Phase 1. Many additional AMLs and BFSs will have been reclaimed and a considerable amount of new data will have been collected. A new TMDL will be able to integrate this new information and may also be able to improve on the old one by assigning specific nonpoint source load reduction goals to individual AMLs.
- **Continue River of Promise meetings.** Key organizations and agencies working on AMD remediation in the lower Cheat watershed meet quarterly at River of Promise meetings. Friends of the Cheat will continue to facilitate these meetings to allow partners to track progress, plan new projects, and to identify strategic priorities.
- **Utilize the FOC mapping project to coordinate projects.** The FOC mapping is set to be complete during Phase 1. This interactive map will be utilized to determine the achievements of Phase 1 and set the measurable goals for Phase 2.
- **Implement and update operation and maintenance plans for eligible watersheds.** Implementation of operation and maintenance projects will begin in watersheds with developed Hydrologic Unit Plans if funding is available. The operation and maintenance plan will be updated to include any watershed with a Hydrologic Unit Plan developed during Phase 2.
- **Complete the development of Hydrologic Unit Plans.** Develop Hydrologic Unit Plans for tributaries left after Phase 1.
- **Focus efforts in priority watersheds.** River of Promise will focus their efforts based on the measurable goals laid out at the beginning of Phase 2.
- **Reassess the big picture.** At the end of this five-year period, River of Promise will reassess the strategic priorities for AMD remediation in the lower Cheat watershed. This assessment will be used to track improvements over time and to help plan remediation and operation and maintenance priorities for the next five-year period.

7.2.3 Secure funding

Continue to pursue available funding as listed above.

7.2.4 Install remediation projects

Install remediation projects as outline in the measurable goals determined at the start of Phase 2.

7.2.5 Measurable goals for Phase 2

Measurable goals will be determined at the start of Phase 2. Goals will be developed around the achievements of Phase 1 and the desired goals for Phase 2.

8. IMPLEMENTATION SCHEDULE, MILESTONES AND MEASURABLE GOALS FOR OTHER POLLUTANTS

In addition to AMD, this plan also addresses biological impairments, fecal coliform, and sediment. Much less information is readily available on these water quality problems. For this reason, the schedule outlined below does not call for implementation of pollutant reductions until more data have been collected and TMDLs, if ultimately required, are developed.

8.1 Phase 1: 2005 through 2009

8.1.1 Collect data

- **Confirm fecal coliform impairments.** As documented in Chapter 3, data from the mid-1990s suggests that many lower Cheat watershed streams may be impaired by fecal coliform. More recent data contradicts these results and WVDEP does not include these streams on its 2004 303(d) list. WVDEP will collect more fecal coliform data through their regular Watershed Assessment Program data collection process in 2006.
- **Confirm sediment impairments.** As documented in Chapter 3, data from the mid-1990s suggests that many lower Cheat watershed streams may be impaired by sediment. However, WVDEP does not include these streams on its 2004 303(d) list. WVDEP will collect more sediment-related data through their regular Watershed Assessment Program data collection process in 2006.

8.1.2 Measurable goals for Phase 1

No measurable water quality goals are set for Phase 1 because this phase focuses solely on confirming impairments rather than cleaning them up.

8.2 Phase 2: 2010 through 2014

8.2.1 Collect data

- **For biologically impaired streams, collect data to support the TMDL development process.** WVDEP has scheduled biological TMDLs for 2014 in the lower Cheat watershed. WVDEP will collect data to identify the causes of these impairments and to support the TMDL development process. According to WVDEP's current schedule, data collected for 2014 TMDLs will be collected in 2011 and 2012.
- **If fecal coliform impairments are confirmed, locate sources.** If data collected in 2006 confirm fecal coliform impairments, WVDEP will include those waters on the 303(d) list and schedule TMDLs for development in 2014 so that they can be done together with lower Cheat watershed biological TMDLs. If fecal coliform TMDLs are indeed scheduled for 2014, WVDEP will collect additional data in 2011 and 2012 for use in the TMDL analysis.
- **If sediment impairments are confirmed, locate sources.** If data collected in 2006 confirm sediment impairments, WVDEP will include those waters on the 303(d) list and schedule TMDLs for development in 2014 so that they can be done together with lower Cheat watershed biological TMDLs. If sediment TMDLs are indeed scheduled for 2014, WVDEP will collect additional data in 2011 and 2012 for use in the TMDL analysis.

8.2.2 Plan and coordinate activities

- **For biologically impaired streams, complete TMDLs.** WVDEP already plans to develop TMDLs for the seven biologically impaired streams on the 2004 303(d) list in 2014.
- **For fecal coliform-impaired streams, complete TMDLs.** If impairments are found, complete TMDLs by 2014.
- **For sediment-impaired streams, complete TMDLs.** If impairments are found, complete TMDLs by 2014.

8.2.3 Secure funding

Funding will not be needed during Phase 2 to implement loading reductions.

8.2.4 Install remediation projects

Remediation projects will not be installed during Phase 2.

8.2.5 Measurable goals for Phase 2

No measurable water quality goals are set for Phase 2 because this phase focuses only on collecting data and developing TMDLs, if required.

8.3 Phase 3: 2015 through 2019

8.3.1 Secure funding

- **For biologically impaired streams, secure 319 funds.** If nonpoint source reductions are necessary, obtain sufficient 319 funds to implement the TMDLs.
- **For fecal coliform-impaired streams, secure 319 funds.** Assuming TMDLs have been completed and nonpoint source reductions are necessary, obtain sufficient 319 funds to implement the TMDLs.
- **For sediment-impaired streams, secure 319 funds.** Assuming TMDLs have been completed and nonpoint source reductions are necessary, obtain sufficient 319 funds to implement the TMDLs.

8.3.2 Install remediation projects

- **For biologically impaired streams, implement pollutant reductions.** Implement the pollutant reductions required by the TMDLs.
- **For fecal coliform-impaired streams, implement pollutant reductions.** Implement the pollutant reductions required by the TMDLs.
- **For sediment-impaired streams, implement pollutant reductions.** Implement the pollutant reductions required by the TMDLs.

8.3.3 Measurable goals for Phase 3

Measurable water quality goals are appropriate for Phase 3 if TMDLs are actually developed in Phase 2 and if these TMDLs target nonpoint sources for pollution reductions. Because it is not known at this time which types of TMDLs might be completed, much less which sources are targeted for reductions, measurable goals are not included at this early stage. The TMDLs, if completed, will target specific sources for reductions and this Watershed Based Plan will then be updated to include realistic goals for the implementation of the TMDL.

9. MONITORING

Instream monitoring is important to gage the recovery of streams after remediation projects are installed, and is also crucial as River of Promise partners engage in periodic strategic planning of their reclamation priorities.

Monitoring of AMD sources is also necessary to understand which sources are discharging how much pollution. These data are used to help decide on priorities, and are essential for the design of realistic treatment systems.

9.1 Instream monitoring

Several agencies and organizations are now monitoring the lower Cheat watershed, and will continue to do so in the future.

9.1.1 WVDEP Watershed Assessment Program.

According to WVDEP's five-year watershed management framework cycle, the agency performs in-depth monitoring of the state's watersheds every five years. The next monitoring year for the lower Cheat watershed is scheduled to begin in summer 2006. These monitoring data will be helpful to show whether streams are improving or declining in quality. In addition to AMD water chemistry, technicians collect benthic macroinvertebrates to determine biological impairments, fecal coliform data to determine bacteria impairments. Technicians also perform sediment-related assessments. WVDEP will then use these data, plus data collected by other agencies and organizations, to make impairment decisions for the next 303(d) list.

9.1.2 WVDEP ambient monitoring

WVDEP also performs ambient monitoring on large streams across West Virginia. In the lower Cheat watershed, quarterly monitoring is performed at two sites: in Albright and below the Cheat Lake dam. Data are collected for pollutants covered by this Watershed Based Plan: AMD pollutants (aluminum, dissolved iron, total iron, manganese, dissolved zinc, pH), fecal coliform, and suspended solids. Data on parameters not covered by this plan are also collected. These parameters include dissolved cadmium, dissolved copper, dissolved lead, dissolved nickel, dissolved oxygen, dissolved silver, Kjeldahl nitrogen, nitrate and nitrite, specific conductance, total chloride, total hardness, total phosphorus, total sulfate, and water temperature (WVDEP, 2004d).

9.1.3 WVDEP and WVDNR Cheat mainstem datalogger

WVDEP and WVDNR installed a datalogger in May 2004 at the headwaters of Cheat Lake, downstream from most acid tributaries in the lower Cheat watershed. The datalogger measures temperature, conductivity, and pH at frequent intervals each day. Measurements are downloaded periodically to a laptop computer and compiled. It is expected that this data collection effort will continue into the foreseeable future. Although only three parameters are collected, the data give a clear indication of how water quality varies over time within single days, and therefore adds important context to help interpret the grab samples that are typically used to measure AMD-related parameters. These data can also be correlated with easily-accessible rainfall data to provide even more useful information about how AMD pollutants vary with rainfall.

9.1.4 Friends of the Cheat chemical and benthic monitoring

In 2003, FOC instituted a volunteer program to monitor water chemistry and benthic macroinvertebrates on three streams that are impaired, but that may be candidates for restoration of trout fisheries if reclamation were completed. This project is funded into 2005 and FOC hopes to keep it going indefinitely. Targeted streams include Beaver Creek (of Little Sandy Creek of Big Sandy Creek), North Fork of Greens Run, and Buffalo Run. Collecting linked chemistry and benthic data is valuable to assess what reduced pollutant loads are required for streams to return to true ecological health. Funding permitting, these efforts will be used as prototypes for other streams in the watershed.

9.2 Source monitoring

9.2.1 WVDEP Stream Restoration Group

The Stream Restoration Group (SRG), which works within OAMLR, collects source data when WVDEP is designing a remediation project. It is anticipated that SRG will continue to play this valuable role in the future.

9.2.2 National Mine Land Reclamation Center at West Virginia University

In some situations, NMLRC has collected source data in anticipation of creating conceptual designs for treatment systems. When appropriate, it is anticipated that NMLRC will continue to play this valuable role.

9.2.3 Friends of the Cheat

Although it has not performed this function in the past, FOC has applied for grant funding to be able to independently collect source monitoring data to be used to create conceptual designs for treatment systems. This project will allow the collection of more comprehensive site specific water quality data, so that more effective treatment systems can be designed. New data will also complement FOC’s water quality mapping project, filling in some gaps in existing data. FOC expects to know whether or not this funding has been provided by late 2004. If funded, source monitoring could commence in early 2005.

10. OUTREACH AND EDUCATION

Most outreach and education for this Watershed Based Plan will be performed by Friends of the Cheat. River of Promise and WVDEP will also play a role.

10.1 Friends of the Cheat

FOC has been performing outreach and education on AMD issues since its founding in 1995. Friends of the Cheat will continue with their outreach and education initiatives and will integrate information about nonpoint source remediation projects into these efforts.

10.1.1 Cheat River Festival

Every May, FOC hosts the Cheat River Festival, a day-long gathering of thousands of river enthusiasts who celebrate the Cheat River and learn about remediation projects. These festivals have been held each year since 1995 and will continue into the future.

10.1.2 Newsletters

FOC newsletters are distributed to about 500 members every quarter. Newsletters will continue to update readers about planned nonpoint source remediation projects and about remediation priorities.

10.1.3 Newspaper inserts

Every spring, FOC produces newspaper inserts that go to about 9,000 residents of the watershed. FOC will continue producing inserts that include educational information about the status of nonpoint source remediation projects.

10.1.4 Youth education

Through its AmeriCorps*VISTA workers, FOC has developed an AMD curriculum and is implementing this curriculum in schools in Preston County. Fifth graders and high school students learn about stream water quality and benthic macroinvertebrates in lessons that include field trips and kick net exercises. Starting in 2004, FOC also provides stream education to a boy scout camp (100 children) and a 4-H camp (about 250 children). Performing outreach and education to children is likely to be an effective strategy for building long-term support for the River of Promise remediation priorities.

10.1.5 Web site

FOC also maintains a Web site, www.cheat.org, with information about remediation projects and priorities.

10.2 River of Promise

Quarterly River of Promise meetings are open to the public. Information on nonpoint source remediation projects and priorities will be freely available to all who attend these meetings.

10.3 West Virginia Department of Environmental Protection

Prior to initiating its regular five-year monitoring effort in 2006, WVDEP will hold a public meeting in the watershed to gather suggestions for monitoring locations. WVDEP will include information at this meeting on the status of plans for remediating nonpoint source pollution in the watershed.

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APPENDIX A. ALL ABANDONED MINE LANDS IN THE LOWER CHEAT WATERSHED

Many AMLs do not discharge polluted water. Table 4 in Chapter 3 lists those AMLs known to discharge AMD. Table 23 lists the sites in Table 4 plus all other sites that have been inventoried by WVDEP. Although the PADs and other information available at OAMLR office suggest that many of these sites do not discharge AMD, they are included in this plan in case new data show otherwise.

Table 23: All abandoned mine lands in the lower Cheat watershed

Stream code	Problem area no.	Problem area name	Tributary	Source
Cheat River				
MC	201	Sugar Grove I,II,III	Cheat Lake and DS of Lake	3
MC	1146	Sugar Grove School Portals IV	UNT/Cheat River DS of Lake	1
MC	3015	Masontown #9	Cheat River	1
MC	1325	Preston Refuse	Cheat River	1
MC	1824	St. Joe Refuse	Cheat River	1
Cheat Lake				
MC-(L1)	83	Mt. Union Mine	UNT/Cheat Lake	3
MC-(L1)	84	Canyon Refuse	UNT/Cheat Lake	3
MC-(L1)	202	Sugar Grove School Portals II	UNT/Cheat River DS of Lake	1
MC-(L1)	203	Sugar Grove School Portals III	UNT/Cheat River DS of Lake	1
MC-(L1)	219	Pt. Marion Maintenance	Cheat Lake	3
MC-(L1)	220	Cunningham HW-Openings	Cheat Lake	3
MC-(L1)	221	Hunter Subsidence	UNT/Cheat Lake	3
MC-(L1)	403	Tavaglione-Cox-George Highwall	UNT/Cheat Lake	1
MC-(L1)	404	Elton Lyons-Deangelis	UNT/Cheat Lake	3
MC-(L1)	683	Mt. Union Mine	UNT/Cheat Lake	1
MC-(L1)	684	Canyon Refuse	UNT/Cheat Lake	1
MC-(L1)	1128	St. Clair Portals	UNT/Cheat Lake	3
MC-(L1)	1147	Sugar Grove School	UNT/Cheat Lake	3
MC-(L1)	1149	Sugar Grove School Refuse	Cheat Lake	1
MC-(L1)	1791	Canyon Refuse and Dump	UNT/Cheat Lake	3
MC-(L1)	2194	Weltner	UNT/Cheat Lake	1
MC-(L1)	2616	Morgantown (Skidmore) Subsidence	UNT/Cheat Lake	1
MC-(L1)	2977	Skidmore Site (Canyon Mine) Maint.	UNT/Cheat Lake	3
MC-(L1)	3791	Fairfield Highwall	UNT/Cheat Lake	3
MC-(L1)	3861	Turner Highwall	UNT/Cheat Lake	1
MC-(L1)	3862	Hunter Highwall	UNT/Cheat Lake	1
MC-(L1)	3863	Colebank Highwall	UNT/Cheat Lake	1
MC-(L1)	3912	Davidson Highwall	UNT/Cheat Lake	3
MC-(L1)	3937	B&O Highwall #1	Cheat Lake	1
MC-(L1)	3938	B&O Highwall #2	Cheat Lake	1
MC-(L1)	3939	Cheat Lake Highwall	UNT/Cheat Lake	3
MC-(L1)	3940	Lake Lynn Complex	Cheat Lake	2
MC-(L1)	3941	Peninsula Highwall #1	Cheat Lake	1
MC-(L1)	3942	Peninsula Highwall 2	Cheat Lake	3
MC-(L1)	4013	Sunnyside Highwall and Subsidence	UNT/Cheat Lake	3
MC-(L1)	4409	Washington Road Drainage	UNT/Cheat Lake	3
MC-(L1)	5586	Canyon Road (Galloway) Portal	UNT/Cheat Lake	3
MC-(L1)	5828	Cheat Neck (Lenhart) Landslide	Cheat Lake	3
Morgan Run				
MC-2-0.5-A	1151	Chestnut Ridge Strip	Blaney Hollow/ Morgan Run	1
Kelly Run				
MC-2.7	1152	Coopers Rock Strip Mines	Kelly Run	1
Crammeys Run				
MC-3	226	Robert F. Judy	UNT/Crammeys	1
MC-3	3911	Stockett Highwall	UNT/Crammeys	3
MC-3	3913	Crammeys Run Highwall	UNT/Crammeys	1
Whites Run				
MC-4	1097	Avery Church Refuse	UNT/Whites Run	1
MC-4	1133	Wolfe Highwall	Whites Run	3
MC-4	2059	Forman	Whites Run	1

(continued on next page)

Table 23: All abandoned mine lands in the lower Cheat watershed (continued)

Stream code	Problem area no.	Problem area name	Tributary	Source
Scott Run				
MC-7	865	Pisgah Highwall	Scott Run	3
Bull Run				
MC-11	1027	Bull Run #14	Bull Run	1
MC-11	1028	Bull Run Portal & Refuse	Bull Run	3
MC-11	1029	Bull Run #13	Bull Run	1
MC-11	1031	Bull Run #17	Bull Run	1
MC-11	1032	Bull Run #15	Bull Run	1
MC-11	1033	Bull Run #18	Bull Run	1
MC-11	1049	Bull Run #19	Bull Run	1
MC-11	1755	Rosati Mine Drg./Herring Complex	UNT/Bull Run	3
MC-11	1756	Bull Run PA #37	UNT/Bull Run	3
MC-11	1765	Bull Run #35	Bull Run	3
MC-11	2790	Masontown #1	Bull Run	3
MC-11	2821	Masontown #4	Bull Run	3
MC-11	2822	Masontown #5	Bull Run	1
MC-11	3029	Valley Point #1	UNT/Bull Run	1
MC-11	3031	Valley Point #2	Bull Run	3
MC-11	4912	Masontown Refuse & Portal	Bull Run	3
MC-11-A	1764	Bull Run #27	Middle Run/Bull Run	3
MC-11-A	2788	Masontown #2	Middle Run	1
MC-11-B-1	1030	Mountain Run Portals	Mountain Run/Bull Run	1
MC-11-B-1	2789	Masontown #3	Lick Run/Mountain Run	3
Big Sandy Creek				
MC-12	858	Locust Grove Strip #1	Big Sandy Creek	1
MC-12	859	Locust Grove Strip #2	Big Sandy Creek	1
MC-12	860	Locust Grove Strip #3	Big Sandy Creek	3
MC-12	3178	Bruceton Mills #1	Big Sandy Creek	1
MC-12-0.5A	1454	Valley Point #10	UNT/Sovern Run	1
MC-12-0.5A	5112	Sovern Run Mine Drainage	Sovern Run	3
MC-12-0.5A	5785	Sovern Run Site #62	Sovern Run	3
MC-12-0.5A	5947	Sovern Run (Clark)	Sovern Run	3
MC-12-0.5A	5977	Sovern Run (Titchnell)	Sovern Run	3
MC-12-0.7A	3987	Bruce Morgan Highwalls	Parker Run	1
MC-12-A	866	Pisgah Strip #2	Lick Run/Laurel Run	1
MC-12-B	855	Hazelton Strip #28	Little Sandy Creek	1
MC-12-B	856	Hog Run Portals	Little Sandy Creek	1
MC-12-B	863	Colebank Highwall	Little Sandy Creek	3
MC-12-B	864	Little Sand Strip #2	Little Sandy Creek	3
MC-12-B	2258	Lewis K Vincent	Little Sandy Creek	1
MC-12-B	2808	4-H Camp HW #22		3
MC-12-B	2809	Shaffer HW #29		3
MC-12-B	3179	Bruceton Mills #2	Little Sandy Creek	1
MC-12-B	4915	Livengood Water Supply	Little Sandy Creek	3
MC-12-B	5157	Webster Run Portal & AMD	Little Sandy Creek	3
MC-12-B-0.5	1050	Sugar Valley Portals	Webster Run/Little Sandy Creek	3
MC-12-B-0.5	2509	Webster Refuse	Webster Run/Little Sandy Creek	3
MC-12-B-0.5	3032	Valley Point #4	Webster Run/Little Sandy Creek	1
MC-12-B-1	1086	Beaver Creek Pit	Beaver Creek/Little Sandy	1
MC-12-B-1	2757	Livengood Highwall #10	Beaver Creek/Little Sandy Creek	1
MC-12-B-1	2763	Livengood Highwall #19	Beaver Creek/Little Sandy Creek	1
MC-12-B-1	2810	McCarthy Highwall #18	Beaver Creek/Little Sandy Creek	1
MC-12-B-1	3014	Delaney Highwall #20	Beaver Creek/Little Sandy Creek	1
MC-12-B-1	4975	Livengood Water Supply	Beaver Creek/Little Sandy	1
MC-12-B-1	5135	Parnell Cemetery Highwall	Beaver Creek/Little Sandy	1
MC-12-B-1	5784	Beaver Creek/Auman Road	Beaver Creek/Little Sandy Creek	3
MC-12-B-1	5821	McCarty Highwall	Beaver Creek/Little Sandy Creek	3
MC-12-B-1-A	5150	Livengood Highwall & AMD	Glade Run/Beaver Ck/Little Sandy Ck	3
MC-12-B-2	1087	Barnes Run Strip	Barnes Run/Little Sandy Creek	1
MC-12-B-3	857	Hog Run Strip	Hog Run/Little Sandy Creek	1
MC-12-B-3	2811	West Hog Run Highwall #11	Hog Run/Little Sandy Creek	3
MC-12-B-4	2812	Lewis Highwall #28	UT/Elk Run/Little Sandy Creek	1
MC-12-B-4	2863	White Highwall #25	Elk Run/Little Sandy Creek	1
MC-12-B-4	2866	Lewis Highwall #27	UNT/Elk Run/Little Sandy Creek	1
MC-12-B-4	3065	Shaffer Highwall #12	Elk Run/Little Sandy Creek	1
MC-12-B-5	853	Cherry Run PA #1	Cherry Run/Little Sandy Creek	1
MC-12-B-5	854	Cherry Run #3	Cherry Run/Little Sandy Creek	3
MC-12-B-5	4039	Cherry Run #1	Cherry Run/Little Sandy Creek	3

(continued on next page)

Table 23: All abandoned mine lands in the lower Cheat watershed (continued)

Stream code	Problem area no.	Problem area name	Tributary	Source
Conner Run				
MC-13.5	5153	Hudson Road Highwall	Conner Run	3
Greens Run				
MC-16	309	Greens Run Highwall	Greens Run	3
MC-16	311	Ruthbelle Surface Burning	Greens Run	3
MC-16	341	Demoss/Goines Proper	Greens Run	3
MC-16	1048	Greens Run Refuse and AMD	Greens Run	3
MC-16	1065	Groine's Water Supply	Greens Run	1
MC-16	1066	Greens Run #39	Greens Run	1
MC-16	1456	Valley Point #12	Greens Run	1
MC-16	1457	Valley Point #13	Greens Run	1
MC-16	1815	Middle Fork Greens Run	Greens Run	3
MC-16	2617	Kingwood (Gower) Subsidence	Greens Run	3
MC-16	3030	Valley Point #3	Greens Run	1
MC-16	3068	Valley Highwall #3	Greens Run	1
MC-16	4406	Hayes Highwall	Greens Run	3
MC-16	4802	Kingwood Rt. 7 Highwall	Greens Run	3
MC-16	5899	North Fork of Greens Run	Greens Run	3
MC-16-A	466	Manown Subsidence	UNT/ SF Greens Run	1
MC-16-A	1064	Kingwood (Pace) Portals	SF Greens Run	3
MC-16-A	1814	South Fork Greens Run #2	UNT/ SF Greens Run	2
MC-16-A	4681	Kingwood (Rt.7) Portals	SF Greens Run	3
Muddy Creek				
MC-17	883	Cuzzart Highwall	UNT/Muddy Creek	3
MC-17	1041	Muddy Creek #15	Muddy Creek	1
MC-17	1046	Muddy Creek Tipple I	Muddy Creek	3
MC-17	1766	Centenary Seepage	UNT/Muddy Creek	1
MC-17	1767	Centenary Portal #20	Muddy Creek	1
MC-17	1768	Centenary Portal #19	UNT/Muddy Creek	1
MC-17	1769	Lynda's Portals	Muddy Creek	1
MC-17	2756	James Wagner Highwall #31	UNT/Muddy Creek	1
MC-17	2759	Reckart Highwall #22	UNT/Muddy Creek	1
MC-17	3067	Lawson Highwall #35	UNT/Muddy Creek	3
MC-17	4011	Muddy Creek Watershed	UNT/Muddy Creek	1
MC-17	4026	Kyle Highwall	Muddy Creek	3
MC-17	4288	Christa Highwall	UNT/Muddy Creek	3
MC-17	5948	Muddy Creek (Upper)	Muddy Creek	3
MC-17	1316	Cuzzart Strip	Muddy Creek	3
MC-17-0.5A	1452	Valley Point #8	Sypolt Run	3
MC-17-0.7A	1042	Crab Orchard Run 32	Crab Orchard Creek	1
MC-17-0.7A	1051	Crab Orchard Run #1	Crab Orchard Creek	1
MC-17-0.7A	1758	Crab Orchard Portals	Crab Orchard Creek	1
MC-17-0.7A	2761	Burns Hunt Club Highwall #41	Crab Orchard Creek	1
MC-17-0.7A	3061	Lennox Church Highwall #39	Crab Orchard Creek	1
MC-17-A	1450	Valley Point #6	Martin Creek	1
MC-17-A	1759	Martin Creek Seepage	Martin Creek	1
MC-17-A	4542	Martin Creek Refuse	Martin Creek	3
MC-17-A-0.5	1453	Valley Point #9	Fickey Run/Martin Creek	3
MC-17-A-0.5	1757	Fickey Run Portals & Auger Holes	Fickey Run/Martin Creek	1
MC-17-A-0.5	1760	Fickey Run Portals & Refuse	Fickey Run/Martin Creek	3
MC-17-A-0.5	4937	Refuse & Drainage	Fickey Run/Martin Creek	1
MC-17-A-1	340	Glade Run (AMD) II	Glade Run/Martin	3
MC-17-A-1	1451	Valley Point #7	Glade Run/Martin Creek	3
MC-17-A-1	1455	Valley Point #11	UNT/Glade Run/Martin Creek	1
MC-17-A-1	2682	Benson Highwall #20	UNT/Glade Run/Martin Creek	2
MC-17-A-1	3033	Valley Point #5	Glade Run/Martin Creek	3
MC-17-A-1	4027	Conners Highwall	Glade Run/Martin Creek	3
MC-17-A-1	5056	Valley Point Portals & Drainage	Glade Run/Martin Creek	3
Roaring Creek				
MC-18	1034	Roaring Creek #3	Roaring Creek	1
MC-18	1039	Roaring Creek #2	Roaring Creek	3
MC-18	1040	Roaring Creek #4	Roaring Creek	3
MC-18	2716	Morgan Highwall #44	Roaring Creek	1
MC-18	2760	Lenox Church Highwall #37	Roaring Creek	1
MC-18	2762	Sisler Highwall #50	Roaring Creek	1
MC-18	3007	Morgan Highwall #46	Roaring Creek	1

(continued on next page)

Table 23: All abandoned mine lands in the lower Cheat watershed (continued)

Stream code	Problem area no.	Problem area name	Tributary	Source
Elsey Run				
MC-20	1828	Elsey Run Strip	Elsey Run	1
Buffalo Run				
MC-22	1061	Beatty Church/Whetsell Rd. HW & Prtl	Buffalo Run	3
MC-22	3468	Whetsell Road Highwall #2	Buffalo Run	1
MC-22	3485	Whetsell Rd. Hw #1	Buffalo Run	3
MC-22	5151	Beatty Church Highwall	Buffalo Run	3
Morgan Run				
MC-23	307	Snider Portal	Morgan Run	3
MC-23	398	Mararra Spoil Area	Morgan Run	3
MC-23	490	Snider Highwall	Morgan Run	3
MC-23	543	Shatzer	Morgan Run	3
MC-23	1055	Morgan Run Portal &Gob	Morgan Run	1
MC-23	1770	Morgan Run PA #2	Morgan Run	3
MC-23	2731	Morgan Run Highwall	Morgan Run	1
MC-23	4407	Snider Impoundment	Morgan Run	1
MC-23-A	397	Irona Refuse Pile	Church Creek	3
MC-23-A	1054	Morgan Run #6	Church Creek	1
MC-23-A	1056	Church Creek/Manown Highwall	Church Creek/Morgan Run	3
MC-23-A	1060	Church Creek Gob Pile	Church Creek	1
MC-23-A	1062	Morgan Run PA #3	Church Creek/Morgan Run	3
MC-23-A	1827	Irona Church Refuse	Church Creek	1
MC-23-A	2573	Kingwood Lewis Blowout	Church Creek	1
MC-23-A	2730	St. Joseph Church Highwall	Church Creek/Morgan Run	3
MC-23-A	3349	Greaser Highwall	Church Creek	1
MC-23-A	5548	Kingwood (Lamar) Subsidence	Church Creek/Morgan Run	3
Heather Run				
MC-24	1057	Heather Run Area #1	Heather Run	3
MC-24	1058	Heather Run Area #2	Heather Run	3
MC-24	1823	Snider Church Strip	Heather Run	1
MC-24	1825	Preston Refuse	Heather Run	3
MC-24	3488	Borgman Highwall	Heather Run	3
Lick Run				
MC-25	1548	Howesville Site	UNT/Lick Run	3
MC-25	1819	Lick Run Strip	UNT/Lick Run	1
MC-25	1820	Lick Run Portal #4	Lick Run	3
MC-25	1821	Lick Run Portals #3	Lick Run	1
MC-25	1822	Lick Run #2	Lick Run	3
MC-25	2014	Tunne Hun Subsidence	UNT/Lick Run	1
MC-25	2745	Philip Thorn Highwall & Portals	Lick Run	3
MC-25	3735	Lick Run Highwall	Lick Run	3
Joes Run				
MC-26	325	Dailey	Joes Run	1
MC-26	3826	Joes Run Highwall	Joes Run	1

(continued on next page)

Table 23: All abandoned mine lands in the lower Cheat watershed (continued)

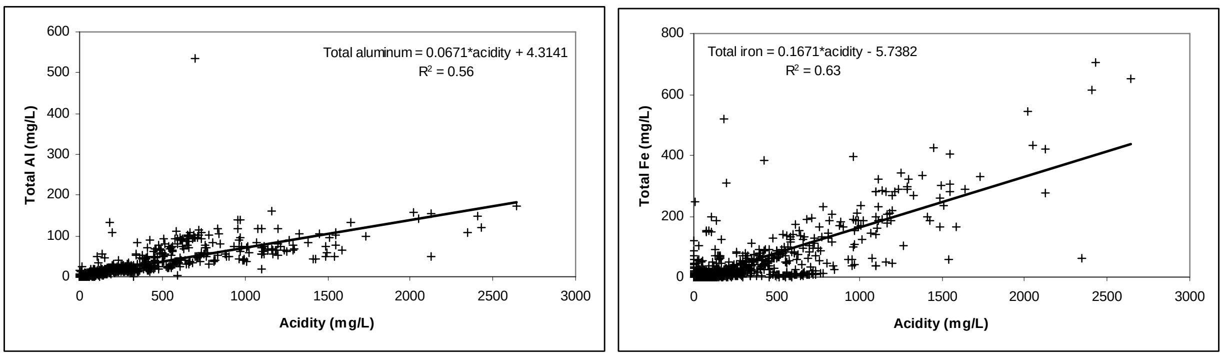
Stream code	Problem area no.	Problem area name	Tributary	Source
Pringle Run				
MC-27	308	Tunnelton Tipple	Pringle Run	3
MC-27	541/544	R & R/Burke Coal & Coke	Pringle Run	3
MC-27	1052	Tunnelton Gob	Pringle Run	3
MC-27	1053	Miller Cemetery Area & Lick Run Portals #1	Lick Run	1
MC-27	1059	Camp Ground Refuse And Portal	UNT/Pringle Run	3
MC-27	1063	Blazer Portals	UNT/Pringle Run	3
MC-27	1546	Jessop Strip #4	UNT/Pringle Run	3
MC-27	1698	Jessop Strip #2	UNT/Pringle Run	3
MC-27	1808	Mountain View Portals	UNT/Pringle Run	1
MC-27	1816	Pringle Run #3	Pringle Run	1
MC-27	1817	Pringle Run PA #2	Pringle Run	3
MC-27	1818	Pringle Run #1	Pringle Run	1
MC-27	1829	Blaser Refuse	UNT/Pringle Run	3
MC-27	2250	Wade N. Ruggles	UNT/Pringle Run	1
MC-27	2251	Francis Shaffer	Pringle Run	1
MC-27	2259	Robert Chambers	Pringle Run	1
MC-27	2407	Jessop Highwall #9	UNT/Pringle Run	3
MC-27	2412	Jessop Highwall #10	UNT/Pringle Run	3
MC-27	3056	Jessop Portals #1	UNT/Pringle Run	3
MC-27	3058	Jessop Portals #2	UNT/Pringle Run	3
MC-27	3736	Pringle Run Highwall	Pringle Run	3
MC-27	3825	Cobun Highwall	UNT/Pringle Run	1
MC-27	3827	Pringle Run Highwall #2	Pringle Run	1
MC-27	4374	Tunnelton Subsidence	Pringle Run	3
MC-27	4609	Tunnelton Portal	UNT/Pringle Run	3
MC-27	4992	Tunnelton Mine Drainage	Pringle Run	3
MC-27	5875	Pringle Run Pace AMD	Pringle Run	3
Buckhorn Run				
MC-31	2189	Hazel Sanders Highwall	Buckhorn Run	3

Sources: (1) OAMLR maps; (2) Hansen et al., 2004; (3) Zambelli, 2004a.

APPENDIX B. DETAILED LOAD REDUCTION CALCULATIONS FOR AMLS WITH WATER QUALITY PROBLEMS

For each AML, metal loads were calculated by multiplying average flows for the various AMD sources by metal concentrations. Concentrations were determined from regression equations. The regression equations were based on iron, aluminum and acidity analyses of 830 solution samples taken from various AMD sources in the Cheat watershed. These data are included in the Stream Restoration Group database, and are indicated with sample identification numbers between 100 and 1000. As shown in Figure 14, regressions of aluminum and iron concentrations against acidities are reasonably strong. A similar regression for manganese, not shown in this report, had an R^2 of only 0.1. The average manganese value of 3.4 mg/L was therefore used to estimate loads.

Figure 14: Regressions of acidity against aluminum and iron



Source: WVDEP, 2004h.

Table 24: Load calculations for each abandoned mine land that discharges acid mine drainage

Site name (Problem area no.)	Avg. flow (gpm)	Acidity (mg/L)	Concentration (mg/L) Al	Fe	Mn		Load (lb/yr) Al	Fe	Mn
Cheat Lake									
Pt. Marion Maintenance (219)	9	1140	81	196	3		3,200	7,800	100
St. Clair Portals (1128)	443	437	34	79	3		65,400	153,200	6,600
Skidmore Site (Canyon Mine) Maint. (2977)									
Davidson Highwall (3912)	30	1075	76	185	3		10,100	24,400	400
Lake Lynn Complex (3940)	25	1100	78	190	3		8,600	20,800	400
Washington Road Drainage (4409)									
						Total	87,300	206,100	7,600
Bull Run									
Rosatti Mine Drainage-Herring Complex (1755)	36	532	40	95	3		6,300	15,000	500
Bull Run PA #37 (1756)	100	91	10	21	3		4,600	9,200	1,500
Bull Run #27 (1764)	300	150	14	31	3		18,900	40,600	4,500
Bull Run #35 (1765)	60	32	6	11	3		1,700	2,900	900
Masontown #4 (2821)	150	37	7	12	3		4,500	7,800	2,200
Masontown Refuse and Portals (4912)	10	171	16	34	3		700	1,500	100
						Total	36,700	77,000	9,800
Big Sandy									
Cherry Run #3 (854)	147	9	5	7	3		3,200	4,700	2,200
Livengood Water Supply (4915)									
Sovern Run Mine Drainage (5112)	131	375	29	68	3		17,000	39,300	2,000
Livengood Highwall & AMD (5150)	72	156	15	32	3		4,700	10,100	1,100

Site name (Problem area no.)	Avg. flow (gpm)	Acidity (mg/L)	Concentration (mg/L)				Load (lb/yr)		
			Al	Fe	Mn		Al	Fe	Mn
Webster Run Portal and AMD (5157)	70	193	17	38	3		5,300	11,700	1,000
Beaver Creek/Auman Road (5784)									
Sovern Run Site #62 (5785)									
McCarty Highwall (5821)									
Sovern Run (Clark) (5947)									
Sovern Run (Titchnell) AMD (5977)									
						Total	30,100	65,700	6,300
Greens Run									
Greens Run Refuse & AMD (1048)	20	337	27	62	3		2,400	5,400	300
Greens Run #41 (1064)	583	1380	97	236	3		248,200	605,300	8,700
South Fork of Greens Run #2 (W1814)	50	0							
Middle Fork Greens Run (1815)	150	1120	79	193	3		52,300	127,000	2,200
North Fork of Greens Run(5899)						Total	302,900	737,800	11,200
Muddy Creek									
Glade Run (AMD) II (340)	73	345	27	63	3		8,800	20,400	1,100
Muddy Creek Tipple (1046)									
Valley Point #9 (1453)									
Valley Point #11 (1455)									
Crab Orchard Portals (1758)									
Martin Creek Seepage (1759)									
Fickey Run Portals & Refuse (1760) combined with Darwin Titchnell Refuse and Drainage (4937)	54	602	45	106	3		10,600	25,200	800
Valley Point #5 (3033)									
Lawson Highwall #35 (3067)	35	602	45	106	3		6,900	16,300	500
Conners Highwall (4027)		35							
Martin Creek Refuse (4542)	58	600	45	106	3		11,300	27,000	900
Valley Point Portals and Drainage (5056)	40	157	15	32	3		2,600	5,600	600
Muddy Creek (Upper) (5948)						Total	40,200	94,500	3,900
Roaring Creek									
Roaring Creek #2 (1039)									
Morgan Run									
Snider Portal(307)	269	11	5	8	3		6,000	8,900	4,000
Irona Refuse Pile(397)	673	410	32	74	3		94,000	219,400	10,000
Church Creek/Manown Highwall(1056)	300	373	29	68	3		38,600	89,600	4,500
Morgan Run PA #2 (1770)	30	540	41	96	3		5,300	12,600	400
						Total	144,000	330,600	19,000
Heather Run									
Heather Run Area I (1057)		45							
Heather Run #2 (1058)	200	520	39	93	3		34,400	81,300	3,000
Borgman Highwall (3488)	5	465	36	83	3		800	1,800	100
						Total	35,200	83,200	3,100
Lick Run									
Howesville Site (1548)	178	15.6	5	8	3		4,200	6,500	2,700
Lick Run Portal #4(1820)	987	1065	76	184	3		328,300	795,900	14,700
Lick Run #2 (1822)	83	709.9	52	124	3		18,900	45,300	1,200
Philip Thorn Highwall and Portals (2745)	45	522.7	39	93	3		7,800	18,300	700
						Total	359,200	866,100	19,300
Pringle Run									
Burke Coal & Coke (544) combined with R & R (541)									
Tunnelton Gob (1052)	20	111	12	24	3		1,000	2,100	300
Campground Refuse and Portals (1059)	2	417	32	75	3		300	700	0
Blazer Portals (1063)	35	122	13	26	3		1,900	4,000	500

Site name (Problem area no.)	Avg. flow (gpm)	Acidity (mg/L)	Concentration (mg/L)				Load (lb/yr)		
			Al	Fe	Mn		Al	Fe	Mn
Jessop Strip #4 (1546)	27	22	6	9	3		700	1,100	400
Jessop Strip #2 (1698)	368	167	16	34	3		25,100	54,300	5,500
Pringle Run PA #2 (1817)	31	177	16	35	3		2,200	4,800	500
Blaser Refuse & Portals (1829)									
Jessop Highwall #10 (2412)	10	483	37	86	3		1,600	3,800	100
Jessop Portals #1 (3056)	130	137	14	29	3		7,700	16,300	1,900
Jessop Portal #2 (3058)									
Tunnelton Portal (4609)									
Tunnelton Mine Drainage (4992)									
Pringle Run (Pace) AMD (5875)									
						Total	40,500	87,200	9,300

Note: Loads are rounded to the nearest one hundred to reflect the rough nature of these calculations. Loads are only estimated if flows and acidities are available. Subwatershed totals may not match due to rounding.

APPENDIX C. DETAILED COST CALCULATIONS FOR AMLS WITH WATER QUALITY PROBLEMS

Costs for eliminating AMD from each AML are sums of six components:

1. Construction of a RAPS,
2. Construction of an MRB,
3. Reclamation of acres of acid producing material,
4. Construction of mine seals,
5. Construction of OLCs, and
6. Engineering and project management costs.

Decisions about the sizing of AMD treatment measures and the amounts of reclamation and of OLCs were chosen using the rules detailed below. Various exceptions to these rules are noted for individual sites, as described in Table 25.

C.1 Reducing and alkalinity producing systems

RAPSs were included whenever AMD flowed from deep mine portals. If site descriptions suggested that AMD came only from surface materials, the cost of a RAPS was not included. When appropriate AMD sources were present, a RAPS was sized according to two parameters: design flow and acidity, using the "Vertical Flow Pond" (VFP) module in the computer program AMDTreat. This module allows a number of sizing methods. The one chosen was "VFP based on Alkalinity Generation Rate." The default alkalinity generation rate, 25 g m^{-2} day^{-1} (as $CaCO_3$) was used. Conditions for cost determination included:

- No liner for the system,
- No clearing and grubbing, and
- Standard piping costs.

In its help section, AMDTreat suggests that a RAPS should be sized according to "design flow," or "the maximum flow that the treatment system is expected to handle." Determination of a true design flow would require a large number of flow measurements taken under a variety of flow conditions. In most cases, the only flow measurement available was a single, visual estimate by WVDEP inspector. In such cases, these flow estimates were doubled to obtain a design flow.

SRG has gathered data on water quality and quantity for many of the sites (WVDEP, 2004h). When those data were available, they, rather than the visual estimates, were used. When SRG data contained multiple flow measurements for a particular site, either the maximum measured flow, or twice the average was used as the design flow, based on the judgment of the authors. A site with all flows taken during the summer, for example would be sized for twice the average, rather than for the maximum measured flow. If measurements for a particular site included multiple sources (such as multiple abandoned portals) for multiple dates, flows were added for each date, and either the maximum sum or twice the average sum was used for a design flow.

The SRG data, however, often had inadequate spatial resolution to determine whether a particular sampling site included the waters of an upstream source. It was often, therefore, not possible to identify which measurement represented the total output from the site. In such cases, visual estimates had to be used. In some cases, differences in flow from upstream sampling points to downstream sampling points were used.

Absence of any flow information prevented estimation of a cost for a RAPS.

SRG data include measurements of “hot” acidity (acidity following oxidation of reduced metals, Fe^{2+} and Mn^{2+}, with hydrogen peroxide). These values were used to determine acidity values. If data for more than one source at a particular site were available, the acidity of the mixture, A_{mix}, would be calculated as

$$A_{mix} = \Sigma(A_i \cdot D_i) / \Sigma D_i$$

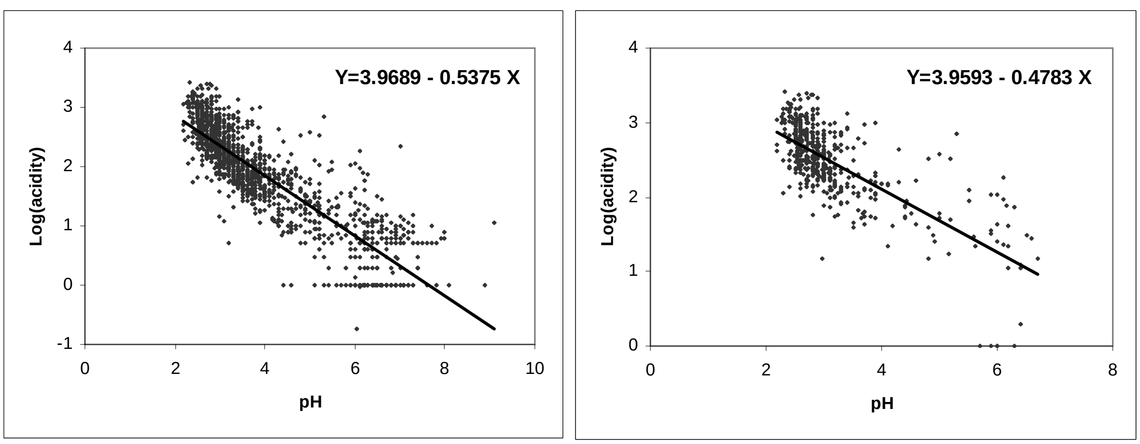
where A_i is the average acidity of one of the contributing sources, and D_i is the average discharge of that source, and the sum is taken over all the sources.

If SRG data were not available, and if site descriptions contained no acidity values, acidity was estimated in one of three ways:

- Using acidity values measured at other, nearby sites,
- Using a regression equation of acidity against pH, or
- Using a regression equation of acidity against pH for samples with iron concentrations ≥ 10 mg/L.

Regressions are illustrated in Figure 15.

Figure 15: Regressions of log(acidity) against field pH



Source: WVDEP, 2004h. Regressions are for all SRG samples in Cheat watershed (left) and for all samples with iron concentration ≥ 10 mg/L (right).

C.2 Manganese removal beds

MRBs are sized using AMDTreat’s default parameters for a 24 hour retention time.

C.3 Land reclamation

Many AMLs contain a number of problems which may or may not contribute AMD. Many site descriptions contain areas of spoil, but provide no information as to whether AMD is running off that spoil or not. For this plan, spoil reclamation was given a cost of $10,000 per acre (Bess, 2004). Cost of reclamation was added in if the site description indicated areas of spoil, and if the site was known to produce any AMD. PADs from OAMLR occasionally did not estimate acres of spoil, but only amounts of highwall to be reclaimed. When it appears that benches below highwalls contained spoil requiring reclamation, the area was estimated as the area that would have to be filled to create a 2:1 slope to the highwall:

$$\text{Area} = \text{length (feet)} \times \text{height (feet)} \times 2 / (43{,}560 \text{ feet}^2/\text{acre})$$

C.4 Mine seals

Wet seals of mine portals are important for water treatment because they establish a predictable route by which water can leave a mine and enter some kind of treatment system. They are also crucial for public safety because they stabilize portals and prevent people from entering and encountering various dangers of the underground mine environment.

The cost of a mine seal with water discharges (a “wet seal”) was estimated at $5,000/seal. The number of seals per site was taken from site descriptions in OAMLR documents, especially PADs and environmental assessments.

C.5 Oxic limestone channels

The price of constructing OLCs was set at $35/linear foot (Bess, 2004). The required length was estimated as 100 feet for each wet seal. If the footprint of a large reclamation area could be identified on a map, the length of OLC required to traverse the area (from upslope to downslope) three times was added to the length required for OLCs.

C.6 Engineering and project management costs

A 10% amount to be paid for the costs of developing blueprints and a 10% cost to pay for project management, including putting the project out for bid and inspecting the work as it takes place, have also been added to the costs.

When the cost for a site was calculated to exceed $1 million, it is recorded as “>$1 million.” This is done because data used for cost calculations, as already noted, are often so sparse as to make the calculations imprecise. This method ensures that estimates based on questionable data do not make the results too unreliable. Costs are rounded to nearest $10 thousand to reflect the precision of the method used to estimate costs.

Table 25: Cost calculations for each abandoned mine land that discharges acid mine drainage

Site name (Problem area no.)	AMD problems	Estimated future cost for water remediation	Avg/ max flow (gpm)	Acidity (mg/L)	Cost of RAPS	Mn removal		Reclamation		Wet seals		OLCs		Engineering and project mgt. cost
						Notes	Cost	Area (acres)	Cost	Count	Cost	Feet	Cost	
Cheat Lake														
Pt. Marion Maintenance (219)	Completed project with AMD remaining	$185,200	9/ 12	1140	$148,975		$5,358	0	$0	0	$0	0	$0	$30,867
St. Clair Portals (1128)	Twelve portals, AMD, and an area of refuse requiring reclamation	>$1,000,000	443/ 965	437	$4,298,638		$430,887	14	$140,000	12	$60,000	2500	$87,500	$1,003,405
Skidmore Site (Canyon Mine) Maint. (2977)		Insufficient data												
Davidson Highwall (3912)	Three portals with AMD and areas requiring reclamation	>$1,000,000	30/ 63	1075	$705,672		$28,130	8	$80,000	3	$15,000	500	$17,500	$169,260
Lake Lynn Complex (3940)	Five portals with AMD and reclamation of area below highwall.	$785,478	25/ 50	1100	$574,740		$22,325	1.5	$15,000	5	$25,000	500	$17,500	$130,913
Washington Road Drainage (4409)	AMD flowing from deep mine	Insufficient data												
Bull Run														
Rosatti Mine Drainage-Herring Complex (1755)	AMD still flows from a reclaimed site and requires treatment	$490,000	36/ 67	532	$375,916		$29,917	0	$0	0	$0	0	$0	$81,167
Bull Run PA #37 (1756)	Two portals with AMD	$350,000	100/ 200	91	$195,393		$89,303	0	$0	2	$10,000	200	$7,000	$60,339
Bull Run #27 (1764)	AMD still flows from a reclaimed site and requires treatment	>$1,000,000	300/ 655	150	$1,306,968		$292,021	0	$0	0	$0	0	$0	$319,798
Bull Run #35 (1765)	AMD still flows from a reclaimed site and requires treatment	$50,000	60/ 115	32	$42,880	Low Mn	$0	0	$0	0	$0	0	$0	$8,576
Masontown #4 (2821)	AMD still flows from a reclaimed site and requires treatment	$310,000	150/ 300	37	$121,688		$133,955	0	$0	0	$0	0	$0	$51,129
Masontown Refuse and Portals (4912)	One portal with AMD and reclamation	$100,000	10/ 20	171	$40,277		$8,930	3	$30,000	1	$5,000	100	$3,500	$17,541
Big Sandy														
Cherry Run #3 (854)	AMD still flows from a reclaimed site and requires treatment	$126,220	147/ 188	9	$21,238		$83,945	0	$0	0	$0	0	$0	$21,037

Site name (Problem area no.)	AMD problems	Estimated future cost for water remediation	Avg/ max flow (gpm)	Acidity (mg/L)	Cost of RAPS	Mn removal		Reclamation		Wet seals		OLCs		Engineering and project mgt. cost
						Notes	Cost	Area (acres)	Cost	Count	Cost	Feet	Cost	
Livengood Water Supply (4915)	Contaminated spring	Insufficient data												
Sovern Run Mine Drainage (5112)	AMD still flows from a reclaimed site and requires treatment	>$1,000,000	131/ 377	375	$1,456,508		$168,336	0	$0	0	$0	0	$0	$324,969
Livengood Highwall & AMD (5150)	AMD still flows from a reclaimed site and requires treatment	$365,527	72/ 144	156	$240,308		$64,298	0	$0	0	$0	0	$0	$60,921
Webster Run Portal and AMD (5157)	Three portals with AMD	$421,436	70/ 130	193	$267,650		$58,047	0	$0	3	$15,000	300	$10,500	$70,239
Beaver Creek/Auman Road (5784)		Insufficient data												
Sovern Run Site #62 (5785)		Insufficient data												
McCarty Highwall (5821)		Insufficient data												
Sovern Run (Clark) (5947)		Insufficient data												
Sovern Run (Titchnell) AMD (5977)	FOC project will address three underground AMD sources	Insufficient data												
Greens Run														
Greens Run Refuse & AMD (1048)	AMD still flows from a reclaimed site and requires treatment	$90,000	20/ 40	337	$75,696	Low Mn	$0	0	$0	0	$0	0	$0	$15,139
Greens Run #41 (1064)	Two portals with AMD	>$1,000,000	583/ 1167	1380	$16,301,251		$521,084	0	$0	3	$15,000	300	$10,500	$3,369,567
South Fork of Greens Run #2 (W1814)	No portals mentioned, reclamation only.	$120,000	50	0	$0		$0	10	$100,000	0	$0	600	$21,000	$24,200
Middle Fork Greens Run (1815)	One portal with AMD	>$1,000,000	150/ 300	1120	$3,565,105		$133,955	0	$0	0	$0	100	$3,500	$740,512
North Fork of Greens Run(5899)		Insufficient data												
Muddy Creek														
Glade Run (AMD) II (340)	AMD still flows from a reclaimed site and requires treatment	$562,121	73/ 115	345	$417,084		$51,350	0	$0	0	$0	0	$0	$93,687
Muddy Creek Tipple (1046)	AMD still flows from a reclaimed site and requires treatment	Insufficient data												
Valley Point #9 (1453)	Insufficient data	Insufficient data												

Site name (Problem area no.)	AMD problems	Estimated future cost for water remediation	Avg/ max flow (gpm)	Acidity (mg/L)	Cost of RAPS	Mn removal		Reclamation		Wet seals		OLCs		Engineering and project mgt. cost
						Notes	Cost	Area (acres)	Cost	Count	Cost	Feet	Cost	
Valley Point #11 (1455)		Insufficient data												
Crab Orchard Portals (1758)	Two portals with AMD	Insufficient data												
Martin Creek Seepage (1759)	Reclamation only	$162,000						10.0	$100,000	0	$0	1000	$35,000	$27,000
Fickey Run Portals & Refuse (1760) combined with Darwin Titchnell Refuse and Drainage (4937)	AMD still flows from a reclaimed site and requires treatment	$969,362	54/ 122	602	$763,597		$44,205	0	$0	0	$0	0	$0	$161,560
Valley Point #5 (3033)	Two portals with AMD and reclamation below highwall	Insufficient data						3.8	$37,844	2	$10,000	200	$7,000	$0
Lawson Highwall #35 (3067)	Two portals with AMD and reclamation below highwall	$592,789	35/ 70	602	$443,235		$31,256	1.1	$11,000	1	$5,000	100	$3,500	$98,798
Conners Highwall (4027)	AMD still flows from a reclaimed site and requires treatment	Insufficient data		35										
Martin Creek Refuse (4542)	AMD still flows from a reclaimed site and requires treatment	$707,423	ND/ 94	600	$589,519	Low Mn	$0	0	$0	0	$0	0	$0	$117,904
Valley Point Portals and Drainage (5056)	AMD still flows from a reclaimed site and requires treatment	$206,741	40/ 80	157	$136,563		$35,721	0	$0	0	$0	0	$0	$34,457
Muddy Creek (Upper) (5948)	To be added	Insufficient data												
Roaring Creek														
Roaring Creek #2 (1039)	Insufficient data	Insufficient data												
Morgan Run														
Snider Portal(307)	One portal with AMD	$90,701	269/ 538	11	$67,084	Low Mn	$0	0	$0	1	$5,000	100	$3,500	$15,117
Irona Refuse Pile(397)	No known AMD problem	>$1,000,000	ND/ 673	410	$2,821,792	Low Mn	$0		$0	0	$0	0	$0	$564,358
Church Creek/Manown Highwall(1056)	Three portals with AMD and reclamation below highwall	>$1,000,000	ND/ 300	373	$1,156,430		$133,955	4.4	$44,000	3	$15,000	300	$10,500	$271,977
Morgan Run PA #2 (1770)	One portal with AMD	$453,224	30/ 60	540	$342,396		$26,791	0	$0	1	$5,000	100	$3,500	$75,537

Site name (Problem area no.)	AMD problems	Estimated future cost for water remediation	Avg/ max flow (gpm)	Acidity (mg/L)	Cost of RAPS	Mn removal		Reclamation		Wet seals		OLCs		Engineering and project mgt. cost
						Notes	Cost	Area (acres)	Cost	Count	Cost	Feet	Cost	
Heather Run														
Heather Run Area I (1057)	One seepage source to seal, AMD treatment and spoil reclamation	$10,200		45	$0	Small amt. of AMD	$0	0	$0	1	$5,000	100	$3,500	$1,700
Heather Run #2 (1058)	17 portals with AMD and reclamation below highwall	$2,792,678	200/ 400	520	$2,132,732	Low Mn	$0	5	$50,000	17	$85,000	1700	$59,500	$465,446
Borgman Highwall (3488)	Seal three portals, treat AMD, reclaim below highwall	$141,873	5/ 10	465	$53,483		$4,465	3.47796 1433	$34,780	3	$15,000	300	$10,500	$23,646
Lick Run														
Howesville Site (1548)	16 portals with AMD and water treatment	$360,000	178/ 356	15.6	$62,884		$158,959	0	$0	16	$80,000	1600	$56,000	$71,569
Lick Run Portal #4(1820)	Three portals with AMD and reclamation	>$1,000,000	987/ 1768	1065	$19,046,184	Low Mn	$0	3	$30,000	5	$25,000	500	$17,500	$3,823,737
Lick Run #2 (1822)	AMD still flows from a reclaimed site and requires treatment	>$1,000,000	83/ 166	709.9	$1,217,214		$74,122	0	$0	0	$0	0	$0	$258,267
Philip Thorn Highwall and Portals (2745)	AMD still flows from a reclaimed site and requires treatment	$590,000	45/ 90	522.7	$491,703	Low Mn	$0	0	$0	0	$0	0	$0	$98,341
Pringle Run														
Burke Coal & Coke (544) combined with R & R (541)	No data	Insufficient data												
Tunnelton Gob (1052)	AMD still flows from a reclaimed site and requires treatment	$93,330	20/ 40	111	$51,414		$17,861	0	$0	1	$5,000	100	$3,500	$15,555
Campground Refuse and Portals (1059)	AMD still flows from a reclaimed site and requires treatment	$37,543	2/ 4	417	$21,000		$1,786	0	$0	1	$5,000	100	$3,500	$6,257
Blazer Portals (1063)	Two portals with AMD and reclamation	$183,410	35/ 70	122	$94,586		$31,256	1	$10,000	2	$10,000	200	$7,000	$30,568
Jessop Strip #4 (1546)	Four portals with AMD	$88,487	27/ 54	22	$15,627		$24,112	0	$0	4	$20,000	400	$14,000	$14,748
Jessop Strip #2 (1698)	Three portals or other water sources with AMD and land reclamation	>$1,000,000	368/ 736	167	$1,267,538		$328,636	1	$10,000	3	$15,000	300	$10,500	$326,335
Pringle Run PA #2 (1817)	Six portals with AMD and reclamation	$83,974	31/ 62	177	$13,978	Low Mn	$0	0.5	$5,000	6	$30,000	600	$21,000	$13,996

Site name (Problem area no.)	AMD problems	Estimated future cost for water remediation	Avg/ max flow (gpm)	Acidity (mg/L)	Cost of RAPS	Mn removal		Reclamation		Wet seals		OLCs		Engineering and project mgt. cost
						Notes	Cost	Area (acres)	Cost	Count	Cost	Feet	Cost	
Blaser Refuse & Portals (1829)	Project in construction	Insufficient data												
Jessop Highwall #10 (2412)	One portal with AMD	$148,418	10/ 20	483	$106,252		$8,930	0	$0	1	$5,000	100	$3,500	$24,736
Jessop Portals #1 (3056)	Three portals with AMD	$620,743	130/ 260	137	$375,692		$116,094	0	$0	3	$15,000	300	$10,500	$103,457
Jessop Portal #2 (3058)	Five portals with AMD	Insufficient data												
Tunnelton Portal (4609)	Portal with AMD	Insufficient data												
Tunnelton Mine Drainage (4992)	No treatment needed													
Pringle Run (Pace) AMD (5875)	Project in construction	Insufficient data												