Sandy Creek of the Tygart Valley River

Watershed-based plan



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ABOUT THIS DOCUMENT

This watershed-based plan addresses mining-related water quality impairments in the Sandy Creek watershed of the Tygart Valley River. The plan includes an inventory of abandoned mine lands and bond forfeiture sites within the watershed, offers cost estimates for active and passive treatment of abandoned mine lands, presents a schedule for implementation and monitoring, and discusses outreach and education efforts by Save the Tygart and other organizations.

ACKNOWLEDGEMENTS

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ABBREVIATIONS

AMD	acid mine drainage
AML	abandoned mine land
BFS	bond forfeiture site
CNA	condition not allowable
MPPRP	Maryland Power Plant Research Project
NA	not applicable
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OAMLR	Office of Abandoned Mine Lands and Reclamation (WVDEP)
OLC	open (or oxic) limestone channel
O&M	operations and maintenance
OSM	Office of Surface Mining, Reclamation and Enforcement
OSR	Office of Special Reclamation (Division of Land Restoration, WVDEP)
PAD	problem area description
RAPS	reducing and alkalinity-producing system
RM	river mile
SRG	Stream Restoration Group
SWS	subwatershed
TMDL	total maximum daily load
UNT	unnamed tributary
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VISTA	Volunteer In Service To America
WCAP	Watershed Cooperative Agreement Program
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources

1. INTRODUCTION

This watershed-based plan covers the Sandy Creek watershed of the Tygart Valley River in West Virginia, as shown in Figure 1. Sandy Creek runs along the Barbour County border with Preston and Taylor counties, with tributaries in all three counties. Sandy Creek is impaired by acid mine drainage (AMD) pollutants. This watershed-based plan has been written to allow incremental Section 319 funds to be spent in the Sandy Creek watershed to clean up nonpoint sources that contribute to these pollution problems.

This plan documents nonpoint sources of AMD, as well as past and current plans to address this pollution. Where data allow, costs of remediating sites that still discharge AMD 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.

1.1 General information

Sandy Creek is a subwatershed in the lower section of the Tygart Valley River basin. The Lower Tygart basin lies within the Allegheny Plateau section of the Appalachian Plateau Physiographic Province (USACE, 1996).

> A wide variety of stream types ranging from steep gradients and rocky channels in the mountainous areas, to low gradient streams in the lowlands, are common in the Tygart River basin. The Tygart River originates on Cheat Mountain near Spruce in Pocahontas County, and flows northward. The lower Tygart [—of which Sandy Creek watershed is a part—] extends from the Buckhannon River to the confluence with the West Fork River at Fairmont ([River mile (RM)] 50.4 to RM 0.0). Key tributaries in this segment include the Buckhannon River, Sandy Creek, Three Fork Creek, and Fords Run. (USACE, 1996, p. V-2)

The Sandy Creek watershed drains over 57,000 acres and flows into Tygart Lake (WVDEP, 2003a).

As documented by the West Virginia Department of Environmental Protection (WVDEP):

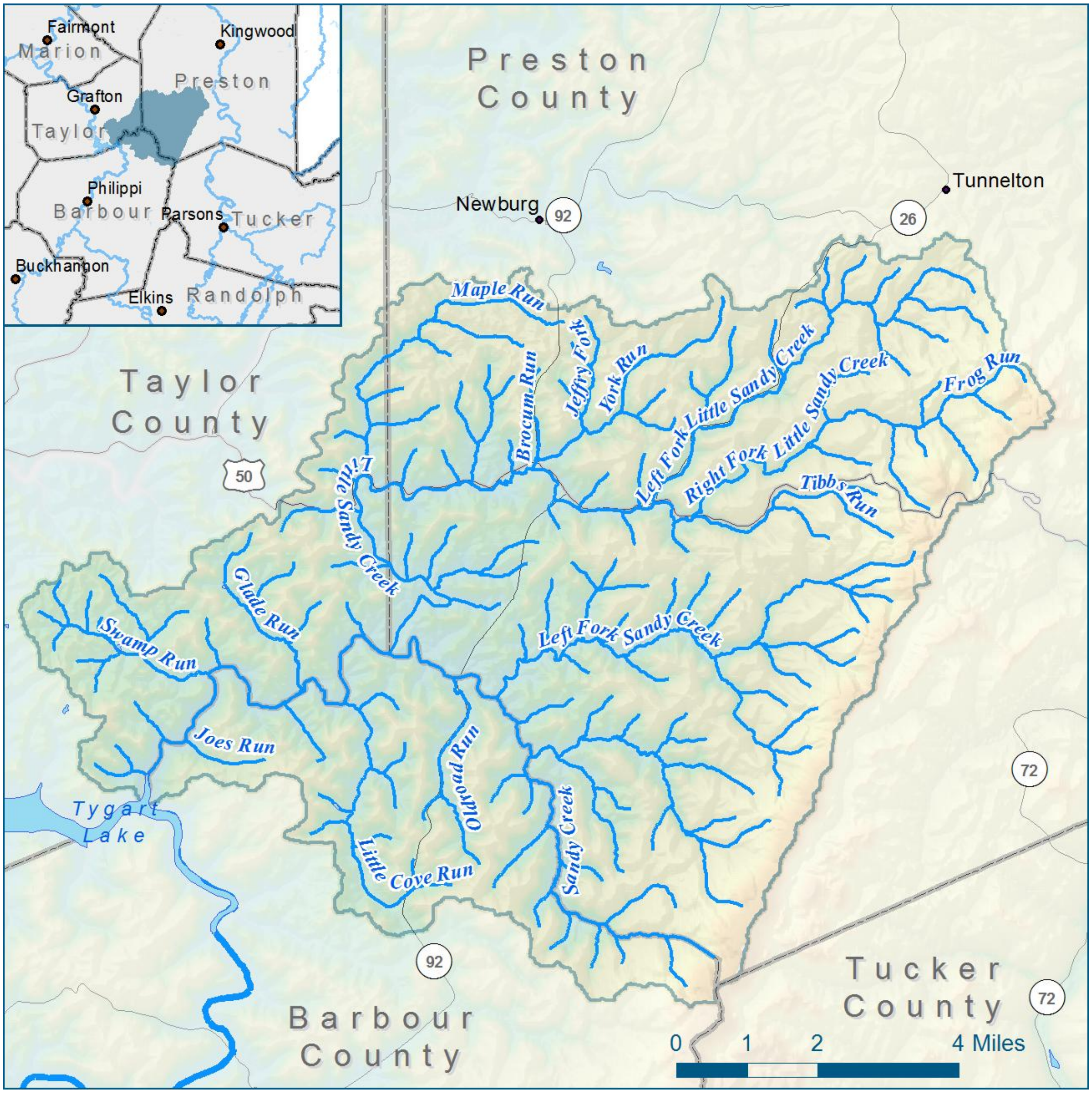
> Sandy Creek arises from the western slope of Laurel Mountain near the junction of Preston and Barbour Counties. As it flows northwestward forming the boundary between Preston and Barbour Counties, it incorporates the nearly equivalent flow of the Left Fork. (WVDEP, 1987, p. 5)

1.2 Historical conditions

Historically, various sources have documented AMD-related impairments in the watershed. For example:

> As a result of past coal mining activity 29 miles of the watershed has been severely degraded because of abandoned mines draining highly acidic and mineralized waters. Potential usage of its waters has been eliminated by this pollution. This chronic acid mine drainage causes damage to municipal water supplies, barges, boats, instream facilities, culverts, bridges, industrial water users, agricultural water supplies, aquatic life, water-based recreation, and waterfront property values. (WVDEP, 1987, p. 3)
>
> Sandy Creek watershed was documented in the 1982 Tygart Valley River Subbasin Abandoned Mine Drainage Assessment as contributing 49.5% of the total acid load to the Tygart between Philippi, WV and the mouth at Fairmont, WV. Water quality data collected during the assessment found 9325 lbs/day of acid being discharged into Tygart Reservoir from Sandy Creek. (WVDEP, 1987, p. 3)

Figure 1: Sandy Creek watershed



> Sandy Creek flows into the Tygart Reservoir which serves as a municipal water supply for the City of Grafton and the vicinity southwest of the City. The Tygart Reservoir also provides a source of recreation to the public in the form of boating, fishing and swimming. Because of the dilution effect of the large body of impounded water, Sandy Creek has not as yet caused serious problems related to the functions of the lake. With the increasingly acidic conditions of the Tygart Valley River occurring upstream, the potential for future damage due to acid slugs is an imminent threat (WVDEP, 1987, p.5).

WVDEP also describes ecological conditions in the watershed:

> The two streams, Sandy Creek and Little Sandy Creek, had impaired benthic communities. Three smaller streams not included on the 303(d) list were sampled as well and found supporting unimpaired benthic communities.
>
> The site on Sandy Creek is upstream of its confluence with Left Fork and almost 10 miles upstream from Tygart Lake. The water quality appeared to be unimpaired, but the habitat was likely limiting the benthic macroinvertebrate colonization potential. The substrate where the benthic sample was collected consisted of 90% gravel or smaller particles and the larger particles were over 75% embedded with sand and/or silt. The total [rapid bioassessment protocol] habitat score was within the suboptimal range, but it may have been recorded lower than it actually was, due to the assessment team's apparent confusion.
>
> The team entered conflicting information on the assessment form. Eight riffle/run kick samples were collected and both the average riffle depth and the average run depth were recorded as 0.1 meter. However, the recorder also indicated on the [rapid bioassessment protocol] habitat assessment that shallow habitats less than 0.5 meters were entirely missing. Black fly larvae (*Simuliidae*) and midges (*Chironomidae*) comprised over 86 percent of the total number of organisms collected. Because there was only one site sampled on this 13 mile long stream, that site should not be used to extrapolate a judgment of impairment status over the entire stream. The sample site had very little riffle/run habitat, yet only a few miles in either direction, where the stream's gradient is much steeper, such habitat was abundant. *Sandy Creek should be sampled at several locations to determine the extent of mine drainage impacts.* The available data indicate that upstream of Little Sandy Creek, the mainstem may not have been negatively impacted by mine drainage.
>
> Little Sandy Creek was sampled less than half a mile from its mouth, near the point where Preston, Taylor, and Barbour counties meet. The pH was 3.5 and the net acidity was 89 mg/L on the day of sampling. This site had the highest concentration of aluminum measured in the entire Tygart Valley River watershed (10.0 mg/L). The iron concentration was also in violation of the state water quality standard. These data indicate this stream should remain on the 303(d) list. There was no riffle/run habitat, therefore the benthos were collected from woody snags and submerged aquatic plants. None of the organisms collected were from the [*Ephemeroptera, Plecotera,* and *Trichoptera*] orders (i.e., orders considered somewhat sensitive to pollution). (WVDEP, 2003a, p. 77-78, emphasis added)

1.3 Land cover

WVDEP describes land cover across the broader Tygart Valley River watershed:

> Current land uses in the Tygart Valley River watershed consist of a mixture of coal mining, timber harvesting, agriculture, oil/gas extraction, quarrying, and recreational activities. Since the 19th century, industrial activities in the central and lower portions of the watershed included primarily coal mining, agriculture, and logging… Agriculture is fairly common in the valleys throughout the watershed and, in the central and lower portions of the watershed, rounded ridges also provide suitable sites for pasture and hay. Commercial use of the steeper slopes and ridges is mostly limited to logging. The entire Tygart Valley River watershed has been timbered at least once since the Civil War.
>
> There are numerous opportunities for outdoor recreation in the Tygart Valley watershed including hunting, fishing, hiking, camping, and picnicking. National forest land encompasses about 23,600 acres and Kumbrabow State Forest offers nearly 9,500 acres. Tygart Lake State Park, Audra State Park, and Valley Falls State Park are also located within the watershed (WVDEP, 2003a, p.16).

Of the Level IV ecoregions within the Tygart Valley River Watershed, Sandy Creek watershed is in the Central Appalachians:

> The Central Appalachians ecoregion covers the central portion of the watershed from north to south. This ecoregion is primarily a high, dissected, rugged plateau composed of materials such as conglomeratic sandstone, shale, and coal. Agricultural activities are generally limited to hay and pasture in this ecoregion as a result of its rugged terrain, cool climate, and infertile soils (WVDEP, 2003a, p.15).

As documented by WVDEP:

> The Sandy Creek subwatershed drains over 57,000 acres and empties directly into Tygart Lake. Swamp Run and Little Cove Run sub-watersheds, as well as the central parts of the Sandy Creek sub-watershed had large percentages of land in agricultural use. Mining activities were present in several of the headwater drainage areas (WVDEP, 2003a, p. 77).

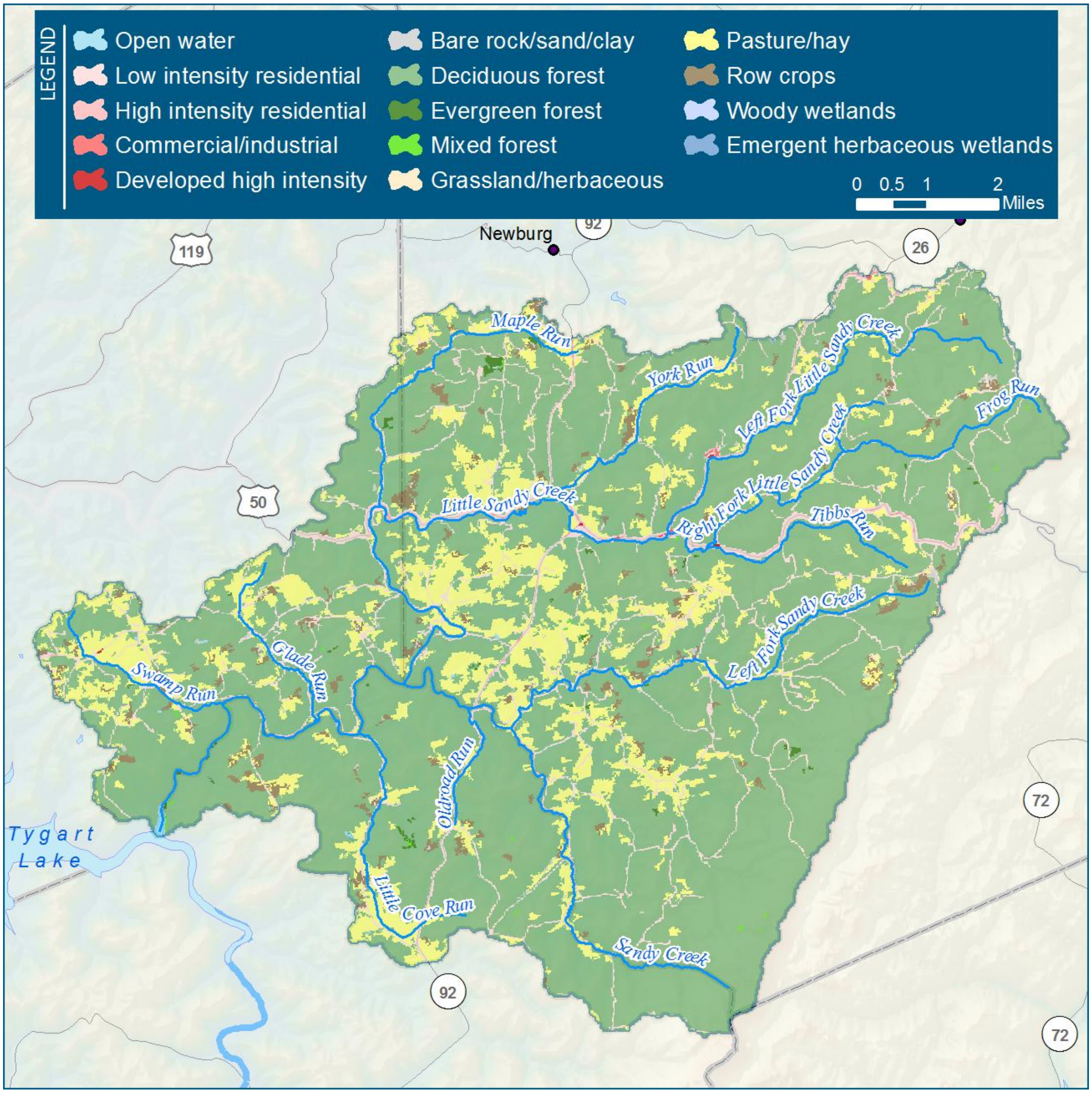
Land cover in the Sandy Creek watershed is predominantly forest with significant pasture and developed land. Distribution of land cover categories is reported in Table 1 and Figure 2.

Table 1: Land cover in the Sandy Creek watershed

Land cover	Acres	Percent
Forest	44,684	78.2%
Pasture and grassland	7,525	13.2%
Low intensity residential	3,419	6.0%
Row crops	1,165	2.0%
Bare rock/sand/clay	139	0.2%
High intensity developed	110	0.2%
Open water	59	0.1%
Wetlands	4	0.0%
Total	**57,105**	**100.0%**

Source: Fry et al. (2011). Note: High intensity developed includes high intensity residential, commercial/industrial, and developed high intensity; forest includes deciduous, evergreen, and mixed forest; pasture and grassland includes pasture/hay and grassland/herbaceous; wetlands includes both woody and emergent herbaceous wetlands.

Figure 2: Land cover in the Sandy Creek watershed



Source: Fry et al. (2011).

1.4 Major tributaries

Figure 1 shows the locations of major tributaries; of particular interest are Left Fork Sandy Creek and Little Sandy Creek and two of its tributaries: Left Fork Little Sandy Creek and Maple Run.

1.4.1 *Left Fork Sandy Creek*

Since the mid-1990s, Left Fork Sandy Creek has been—and continues to be—a focus of attention for a coalition of watershed residents; angered at the AMD pollution caused by the forfeited F & M coal mine, the coalition brought suit against the mine and its insurance company. Through this action, the group secured $4 million for treatment of AMD on this tributary. This fund is currently jointly managed by the Office of Special Reclamation (OSR) within the WVDEP Division of Land Restoration and the Laurel Mountain/Fellowsville Area Clean Watershed Association (Christ, 2011).

According to the Laurel Mountain/Fellowsville Area Clean Watershed Association, a significant population of freshwater mussels existed in Left Fork Sandy Creek before the pollution associated with the F & M mine.

1.4.2 *Little Sandy Creek*

The other major tributary to Sandy Creek, Little Sandy Creek, includes two of its own tributaries of interest—Left Fork Little Sandy Creek and Maple Run:

> Sandy Creek drains an area of 90.3 square miles, and flows directly into the tailwaters of Tygart Lake. [The West Virginia Department of Natural Resources (WVDNR)] (1982) reported that 49.5% of the acid load in the lower Tygart River originates in the Sandy Creek watershed, and identified a number of problem areas in the Maple Run and Little Sandy Creek subbasins that contribute to water quality problems in Sandy Creek.
>
> WVDNR (1982) reported acid loads of 4496 lb/day at the mouth of Little Sandy Creek, and 3929 lb/day at the mouth of Maple Run in May 1981. Sandy Creek near its mouth exhibited 10 mg/l of acidity and 10 mg/l of alkalinity, with an acid load of 0 lb/day at this time. [The United States Army Corps of Engineers (USACE)] reported a mean annual pH value of 4.3 for 1973 and a mean annual pH of 4.2 in 1983. The mouth of Sandy Creek was sampled in March 1995 by WVDEP. Acidity exceeded alkalinity by 4 mg/l on this date, but the flow was too high to measure and loadings could not be determined (USACE, 1996, p. V-7).

WVDEP provides additional information about Maple Run:

> Water collection data within the Little Sandy Creek drainage area reveals that [M]aple Run makes up an average 20% of the flow of Little Sandy Creek. Samples collected along Maple Run show the mainstem to be contaminated with acid mine drainage throughout its entirety with the sources of pollution concentrated in the upper half of the watershed.
>
> Six sources of AMD were located within the Maple Run Drainage Area (WVDEP, 1987, p. 18).

In addition to the F & M site on Left Fork Sandy Creek, OSR is conducting reclamation work on two sites on Maple Run (Baker, 2011). The Amanda Nicole bond forfeiture site (BFS) on Left Fork Little Sandy Creek is also undergoing remediation efforts (Christ, 2011).

A native Brook Trout population was present on Tibbs Run of Right Fork Little Sandy Creek (Baker, 2011).

2. MEASUREABLE WATER QUALITY GOALS AND IMPAIRMENTS

The goal of this watershed-based plan is to provide a road map toward meeting West Virginia's numeric and narrative water quality criteria by eliminating nonpoint source pollution. Point source pollution is addressed by other means, such as appropriate discharge limits in National Pollutant Discharge Elimination System (NPDES) permits for active mines and BFSs and enforcement of these permits. Streams not meeting water quality standards are placed on a statewide list of impaired streams called the 303(d) list. Implementing this plan will improve water quality so these streams are once again clean and can be removed from this list.

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 3 and Figure 3 summarize the impairments and pollutants impacting Sandy Creek and its tributaries. WVDEP listed six streams in the watershed as impaired in its first 303(d) list in 1998. These include Sandy Creek itself as well as Glade Run, Little Sandy Creek, Maple Run, Left Fork Little Sandy Creek, and Left Fork Sandy Creek. In that original list, Left Fork Sandy Creek was listed for metals only, and the other five streams were listed for metals and pH (WVDEP, 1998).

The 2002 303(d) list is consistent with the 1998 list, except it clarifies that the metals impairments specifically include iron, aluminum (total), and manganese (WVDEP, 2003b). This list also notes that total maximum daily loads (TMDLs) were completed in March 2001.

In 2003, the state water quality standard for aluminum was changed from total to dissolved aluminum. In its 2004 list, WVDEP only maintained aluminum listings if dissolved aluminum data were available and those data indicated impairment (WVDEP, 2004). Five of the six streams previously listed for total aluminum were therefore delisted, and the 2004 list only included a single impaired stream in the watershed for dissolved aluminum: Little Sandy Creek. It also listed the same creek as being biologically impaired.

A second change in state water quality standards also impacts TMDL implementation in the Sandy Creek watershed: the manganese criterion was modified to apply only within five miles upstream of known water supply intakes. The 2010 303(d) list was the first to explicitly create a separate table, Supplemental Table E, for manganese TMDLs that are no longer effective. All six streams in the Sandy Creek watershed with previous manganese listings were placed on this list, indicating that WVDEP considers these TMDLs to be obsolete and no longer effective (WVDEP, 2010a).

In summary, all streams shown as impaired in Figure 3 are impaired for both iron and pH, with the exception of Left Fork Sandy Creek, which is impaired for iron only. Little Sandy Creek has two additional impairments: dissolved aluminum and biological impairments. To quantify the narrative water quality standard for biological impairments, WVDEP uses surveys of benthic macroinvertebrate communities. A West Virginia Stream Condition Index score is generated from this survey. Streams with scores of 60.6 or less are considered biologically impaired and placed on the list. The entire length of Little Sandy Creek has been listed for biological impairment (WVDEP, 2010a). The dissolved aluminum and biological impairments on Little Sandy Creek are the only two that were not addressed in the TMDL.

To help cross-reference this report with the TMDL report and 303(d) list, Table 4 shows the primary stream codes and TMDL subwatersheds associated with each subwatershed displayed in Figure 3 and discussed in this report.

Table 2: Selected West Virginia water quality standards

Parameter	Section	Aquatic life		Human health	
		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 750 µg/L (chronic and acute)	Not to exceed 750 µg/L (acute) or 87 µg/L (chronic)	None	None
Biological impairment	3.2.i	[N]o significant adverse impact to the…biological [component] of aquatic ecosystems shall be allowed.			
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
pH	8.24	No values below 6.0 nor above 9.0. Higher values due to photosynthetic activity may be tolerated.			

Source: 47 Code of State Rules Series 2. Sections refer to this rule.

Table 3: Impaired streams in the Sandy Creek watershed

Stream	Impairments	Pollutants	TMDL?
Sandy Creek	Iron	Iron	Yes
	pH	Aluminum, iron, manganese	Yes
Glade Run	Iron	Iron	Yes
	pH	Aluminum, iron, manganese	Yes
Little Sandy Creek	Aluminum (d)	Aluminum (d)	No
	CNA-biological	Unknown	No
	Iron	Iron	Yes
	pH	Aluminum, iron, manganese	Yes
Maple Run	Iron	Iron	Yes
	pH	Aluminum, iron, manganese	Yes
Left Fork Little Sandy Creek	Iron	Iron	Yes
	pH	Aluminum, iron, manganese	Yes
Left Fork Sandy Creek	Iron	Iron	Yes

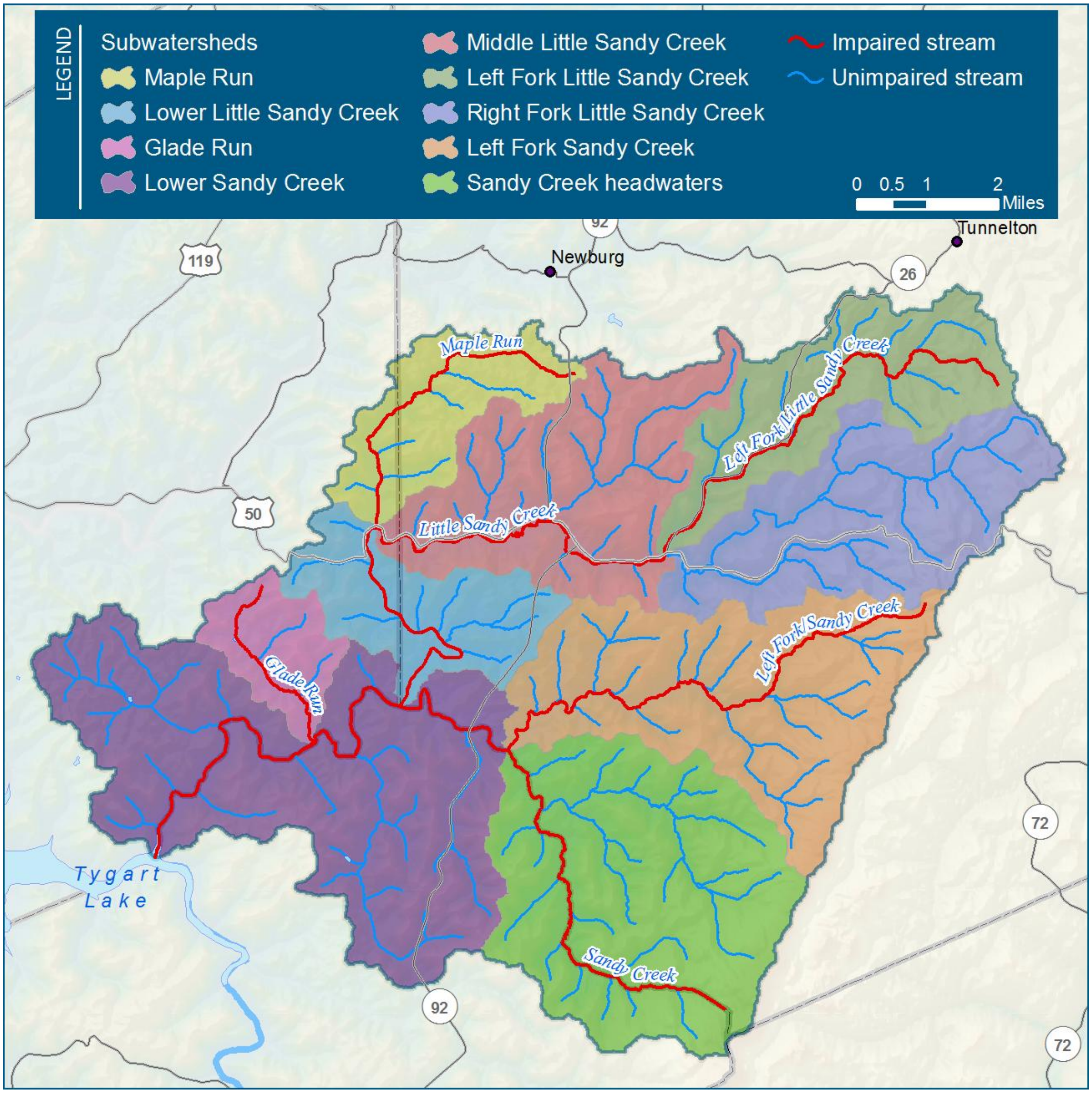
Source: WVDEP (2010a). Note: CNA=condition not allowable.

Table 4: Sandy Creek subwatersheds and corresponding TMDL subwatersheds

Subwatershed name	Primary stream code	TMDL subwatersheds
Lower Sandy Creek	MT-18	167, 168, 169, 172, 173, 174, 175, 177, 178, 179, 192, 193, 199
Sandy Creek Headwaters	MT-18	171, 183, 185, 186, 187, 188, 189, 194, 195
Glade Run	MT-18-C	176
Lower Little Sandy Creek	MT-18-E	156, 157, 166
Middle Little Sandy Creek	MT-18-E	114, 115, 118, 119, 124, 127, 132
Maple Run	MT-18-E-1	132
Left Fork Little Sandy Creek	MT-18-E-3	103, 104, 122
Left Fork Sandy Creek	MT-18-G	158, 159
Right Fork Little Sandy Creek	MT-18-H	94, 95, 96, 97, 123, 125, 128

Source: USEPA (2001). TMDL=total maximum daily load.

Figure 3: Impaired streams and project subwatersheds



3. POLLUTANT REDUCTIONS FROM THE TMDL

The TMDL for the Tygart Valley River watershed, which includes the Sandy Creek watershed, set goals for pollutant reductions from nonpoint and point source activities that, if enacted, should improve water quality so that the impaired stream segments are removed from the 303(d) list and meet standards (USEPA, 2001). Load reductions required by the TMDL are summarized in Table 5, Table 6, and Table 7. As shown in these tables, abandoned mine lands (AMLs) are the only nonpoint source of AMD targeted by the TMDL in the watershed.

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 for each TMDL subwatershed.

If all wasteload and load allocations for aluminum, iron, and manganese are met, the TMDL asserts that the water quality criteria for pH will also be met. Therefore, pH-specific allocations are not provided by the TMDL (USEPA, 2001). As noted in Chapter 2, the aluminum and manganese criteria have become more lenient since the TMDL was approved. The aluminum and manganese TMDL targets may therefore be more stringent than required to meet current water quality standards.

However, treating for pH impairments will also reduce metals concentrations. Treatment for pH is the basis for the calculations in this plan. In AMD, iron, aluminum, and manganese interact with hydrogen ions. The hydrogen ions and dissolved metals impart acidity to the water. If waters are to have pH values greater than 6, dissolved metals must be substantially removed. Otherwise, they will react with water to release additional hydrogen ions back into solution, lowering the pH.

Therefore, even though changes in water quality criteria have removed aluminum and manganese impairments from streams in the watershed, metals must be addressed in order to meet the pH criterion.

The TMDL analysis does not directly address biological impairments in the Sandy Creek watershed because it was completed before WVDEP listed Little Sandy Creek as being biologically impaired. However, in the absence of other known biological stressors, and with the knowledge that AMD is impairing this creek, it is presumed, as with pH, that addressing the metals impairments is likely to concurrently solve the biological impairment.[1] If WVDEP performs a full stressor analysis when completing the TMDL to address the biological impairment on Little Sandy Creek and determines that other stressors are causing this impairment, then the watershed-based plan will be updated.

Figure 4 and Figure 5illustrate the reductions required in the TMDL for iron, manganese, and aluminum from AMLs, BFSs, and the one mining operation active when the TMDL was written: the Maurice Jennings site in the Maple Run subwatershed. Its permit has since been forfeited and it is now slated for treatment by OSR. Treatment at this site, however, will not fully address the impairments in Maple Run. The active operation in the Left Fork Little Sandy Creek watershed, the Whitetail mine, is currently in the reclamation phase.

This plan focuses on AMLs. For iron and manganese, AML reductions are required in three locations: the Maple Run subwatershed, the headwaters of Left Fork Little Sandy Creek, and the headwaters of Left Fork Sandy Creek (Figure 4). While Glade Run is impaired for iron, the TMDL does not identify any reductions for iron and we therefore do not consider it in this report. Similarly, the TMDL does not identify any metals reductions in Sandy Creek above Left Fork Sandy Creek.

For aluminum, AML reductions are required in the same three locations: the Maple Run subwatershed, the headwaters of Left Fork Little Sandy Creek, and the headwaters of Left Fork Sandy Creek (Figure 5).

A total of 20 AMLs are documented in the Sandy Creek watershed and are listed in Appendix A. The problem area descriptions (PADs) and other

[1] Treated metals that precipitate out of solution and drop to the stream bed may harm aquatic life near the treatment site.

documentation of these sites indicate that only those 10 AMLs in Table 8 discharge AMD (WVDEP, Various dates).

The methods used to identify sites in Table 8 are not foolproof. If new information indicates that an AML that was left out of Table 8 does, in fact, discharge AMD, the watershed-based plan will be updated as appropriate.

Sandy Creek is also impaired by BFSs that discharge AMD. 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. BFSs are not listed by watershed in the TMDL. Table 9 lists permits from WVDEP's database that have a permit status of "Revoked." Of about 12 mining complexes in the watershed found in WVDEP's database, which have been permitted since 1977, all but three have been forfeited. 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, because OSR is responsible for performing treatment on all AMD-discharging BFSs.

Table 5: Specific reductions required for iron (pounds/year)

		Abandoned mine lands			Bond forfeiture sites			Active mines		
Stream	SWS	Base-line	Allo-cation	% reduction	Base-line	Allo-cation	% reduction	Base-line	Allo-cation	% reduction
Left Fork	103	-	-	-	-	-	-	4,555*	2,818	38
Little Sandy	104	130,042	3,984	97	1,790	1,790	-	-	-	-
Maple Run	132	27,821	476	98	-	-	-	1,642	1,642	-
Left Fork	158	3,932	366	91	7,577	5,001	34	-	-	-
Sandy Creek	159	571	571	-	2,785	2,028	27	-	-	-

Source: USEPA (2001). SWS=subwatershed in the TMDL. *Two mining permits with baseline loads of 4,264 and 291 pounds/year of iron were each assigned 38% reductions. Since the TMDL was released, active mines may have changed status to become bond forfeiture sites.

Table 6: Specific reductions required for aluminum (pounds/year)

		Abandoned mine lands			Bond forfeiture sites			Active mines		
Stream	SWS	Base-line	Allo-cation	% reduction	Base-line	Allo-cation	% reduction	Base-line	Allo-cation	% reduction
Left Fork	103	-	-	-	-	-	-	6,120*	1,212	80
Little Sandy	104	8,702	784	91	1,790	1,790	-	-	-	-
Maple Run	132	7,081	185	97	-	-	-	2,206	1,662	33
Left Fork	158	3,841	35	99	7,577	1,742	77	-	-	-
Sandy Creek	159	414	414	-	2,785	1,070	62	-	-	-
Glade Run	176	-	-	-	2,162	1,297	40	-	-	-

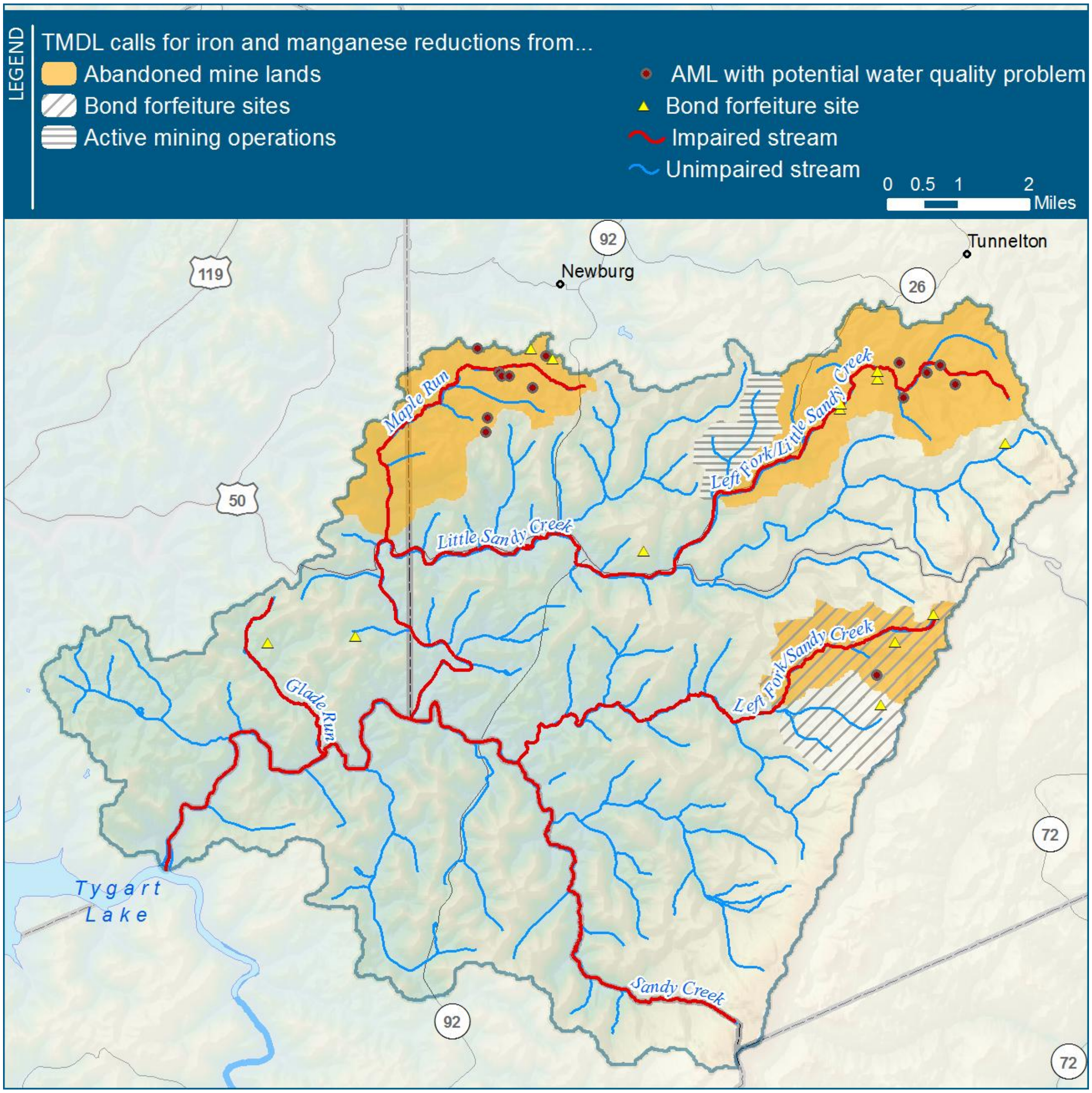
Source: USEPA (2001). SWS=subwatershed in the TMDL. *Two mining permits with baseline loads of 5,729 and 391 pounds/year of aluminum were each assigned 80% reductions. Since the TMDL was released, active mines may have changed status to become bond forfeiture sites.

Table 7: Specific reductions required for manganese (pounds/year)

		Abandoned mine lands			Bond forfeiture sites			Active mines		
Stream	SWS	Base-line	Allo-cation	% reduction	Base-line	Allo-cation	% reduction	Base-line	Allo-cation	% reduction
Left Fork	103	-	-	-	-	-	-	2,441*	1,620	34
Little Sandy	104	8,343	1,048	87	1,024	1,024	-	-	-	-
Maple Run	132	4,288	151	96	-	-	-	881	881	0
Left Fork	158	4,419	225	95	4,335	2,601	40	-	-	-
Sandy Creek	159	317	317	-	1,595	1,085	32	-	-	-

Source: USEPA (2001). SWS=subwatershed in the TMDL. *Two mining permits with baseline loads of 2,285 and 156 pounds/year of manganese were each assigned 34% reductions. Since the TMDL was released, active mines may have changed status to become bond forfeiture sites.

Figure 4: Iron and manganese reductions in the TMDL



Note: At the time of the TMDL all streams shown as impaired were listed as impaired for metals and pH, except for Left Fork Sandy Creek, which was listed for metals only. Currently, the same streams shown here are listed as impaired for iron and pH (WVDEP, 2010a). Little Sandy Creek is on the 303(d) list for CNA–biological and dissolved aluminum. No streams in the Sandy Creek watershed are impaired for manganese under the new standard.

Figure 5: Aluminum reductions in the TMDL

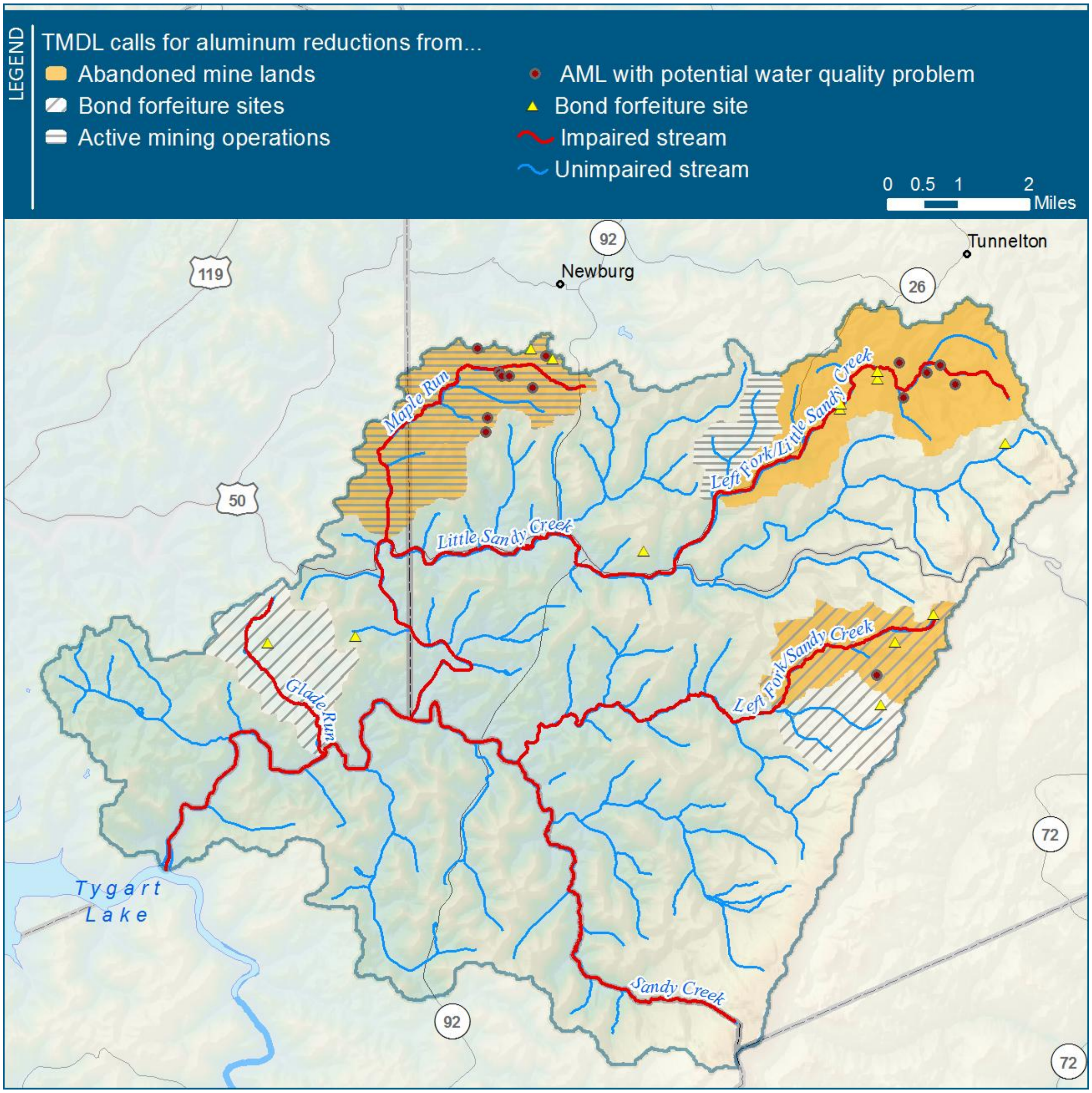


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Table 8: Abandoned mine lands known to discharge acid mine drainage

Watershed	Name	Problem area
Left Fork Little Sandy Creek	Left Fork of Little Sandy	1080
	Left Fork of Little Sandy #1	1236
Left Fork Sandy Creek	Ridenour Portals	4396
Maple Run	Maple Run #4	0896
	Maple Run Portals (Maple Run #1 and #2)	0900
	Maple Run #6	1081
	Maple Run #5	1082
	Maple Run #7	1761
	Maple Run #3	1762
	Maple Run #8	1763

Source: WVDEP (Various dates). Because the F & M site was determined to contribute to the drainage from Ridenour Portals, this site is no longer eligible for Abandoned Mine Reclamation Fund grants and instead must be treated along with the remainder of the drainage from the BFS (Hansen et al., 2008).

Table 9: Bond forfeiture sites

Watershed	Permit	Permittee	Type
Glade Run	S103886	B & D Coal Co	Surface
Left Fork Little Sandy	S101888	Amanda Nicole Fuels Inc	Surface
	U004384	Preston Energy Inc	Underground
	U010383	Preston Energy Inc	Underground
	U102688	F & M Coal Company Limited Partnership	Underground
	S104487	F & M Coal Company Limited Partnership	Surface
	S005784	F & M Coal Company Limited Partnership	Surface
Lower Little Sandy Creek	S004483	Falco Coal Co	Surface
Maple Run	S103691	Mangus Coal, Inc.	Surface
	S006183	Maurice Jennings	Surface
	S005378	Maurice Jennings	Surface
Middle Little Sandy Creek	S010980	Pontorero & Sons Coal Co Inc	Surface
Right Fork Little Sandy Creek	U100289	Eastern Mountain Mining Co Inc	Underground

Source: All mines listed as “RV, revoked” in the per_status field of the Mining Permits, Point Locations GIS layer (WVDEP, 2009).

4. NONPOINT SOURCE MANAGEMENT MEASURES

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

4.1 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 Sandy Creek watershed, this method is unlikely to eliminate acid loads 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 of reclaimed areas. On the other hand, a measurement of AMD loads frequently shows such seeps are small compared to loads from nearby underground 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 open (or oxic) limestone channels (OLCs), discussed below.

4.2 Passive acid mine drainage treatment

- **Reducing and alkalinity-producing systems (RAPSs) (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.
- **Sulfate-reducing bioreactors (40 g acidity/m^2).** These systems also consist of organic matter and limestone, but in sulfate-reducing bioreactors, the materials are all mixed in a single cell. Some of the organic material included is of a coarser nature, such as sawdust or woodchips. Reactions in these systems are similar to those in RAPSs: compost eliminates oxygen and drives the iron and sulfur to reduced

forms. The coarser organic matter may serve to protect hydraulic conductivity and may retain metals as various organic complexes.

- **Manganese removal beds (to 2 mg/L).** Manganese may be removed from AMD either by active treatment or by manganese removal beds. In these systems, water is passed over a wide limestone bed, and dissolved manganese oxidizes and precipitates from solution.
- **Open (or oxic) 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 OLCs so that they do not 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 leachbeds (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. Engineers have recently added automated flushing valves to these leachbeds, an innovation that maintains their effectiveness for a longer time.
- **Steel slag leachbeds (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 great 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, Maryland, decreased acidity by 50% (MPPRP, 2000).

4.3 Active acid mine drainage treatment

- **Treating (100+%).** A variety of active 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 passed through ponds, allowing metal hydroxides to settle out as sludge.

5. COSTS AND LOAD REDUCTIONS

Nonpoint source load reductions required by the TMDL are summarized above in Table 5, Table 6, and Table 7. In this chapter, we calculate costs to implement these load reductions.

Table 10 summarizes the estimated costs for both passive and active treatment alternatives. While we present costs for both options, Save the Tygart has expressed a clear preference for active treatment because it is cheaper and more dependable, as documented in its meeting minutes from 2011 (Save the Tygart, 2011). Active treatment using dosers is therefore the preferred management measure in this plan.

5.1 Passive treatment and land reclamation costs

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 is determined according to the acres of land requiring reclamation.

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 nearby watersheds is a 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 the use of anoxic limestone drains. It is also assumed that deep mine AMD sources that have not been carefully examined will also produce water requiring RAPSs. RAPSs are sized according to the acidity load from the AMD source.

As suggested by the reduction tables above, three streams in the Sandy Creek watershed contribute the vast majority of mine-related pollution to the creek. In order of contribution, these are Left Fork Little Sandy Creek, Maple Run, and Left Fork Sandy Creek. The following sections describe past work on these watersheds as well as possibilities and costs for future remediation.

In order to calculate costs of RAPSs, hot acidity and flow measurements taken in 1995-2007 were used to calculate average daily acid loads at each of six sites. Sites 1 through 3 are in the Left Fork Little Sandy watershed, and Sites 4 through 6 are in the Maple Run watershed. These values were entered into the Office of Surface Mining, Reclamation and Enforcement's (OSM's) AMDTreat software to determine material and labor requirements and associated costs. An additional 20% was added to cover engineering expenses. Detailed sizing and cost assumptions are included in the appendices.

5.2 Active treatment costs

Save the Tygart prefers active treatment using dosers. The cost of doser installation, operation, and maintenance is based on costs associated with a recently installed doser in the nearby Raccoon Creek watershed (See Section 5.6). Annual costs are based on the tons of quicklime projected to be used each year.

Table 10: Summary of estimated future costs for passive and active treatment alternatives

Stream	Passive treatment (RAPSs)	Active treatment (dosers)
Left Fork Little Sandy Creek	$11,240,000	$204,000 + $142,170 annually
Maple Run	$2,030,000	$204,000 + $25,200 annually
Left Fork Sandy Creek	Not calculated	Not calculated

Source: Passive treatment estimates from AMDTreat calculations. Active treatment estimates from Connolly (2011). RAPs=reducing and alkalinity-producing systems. Left Fork Sandy Creek costs are not estimated because it is assumed that remaining pollution in this stream will be treated at the F & M bond forfeiture site.

5.3 Left Fork Little Sandy Creek

Left Fork Little Sandy Creek is comprised of TMDL subwatersheds 103, 104, and 122. The PAD for the Left Fork of Little Sandy problem area (WV-1080) asserts that this stream contributes 91% of the acid loading downstream (WVDEP, various dates). In addition to the Whitetail Mine complex, which is in the reclamation phase, and the Amanda Nicole BFS, there are numerous AMLs in the watershed. Known AMLs, shown in Figure 6, are grouped into Sites 1, 2, and 3. These AMLs collectively discharge thousands of gallons per day of metals-rich, high-acidity water. The pH of Left Fork Little Sandy Creek above the first known AMD discharge is 6.2; below the discharges, the pH is around 3 (Downstream Strategies, 2011).

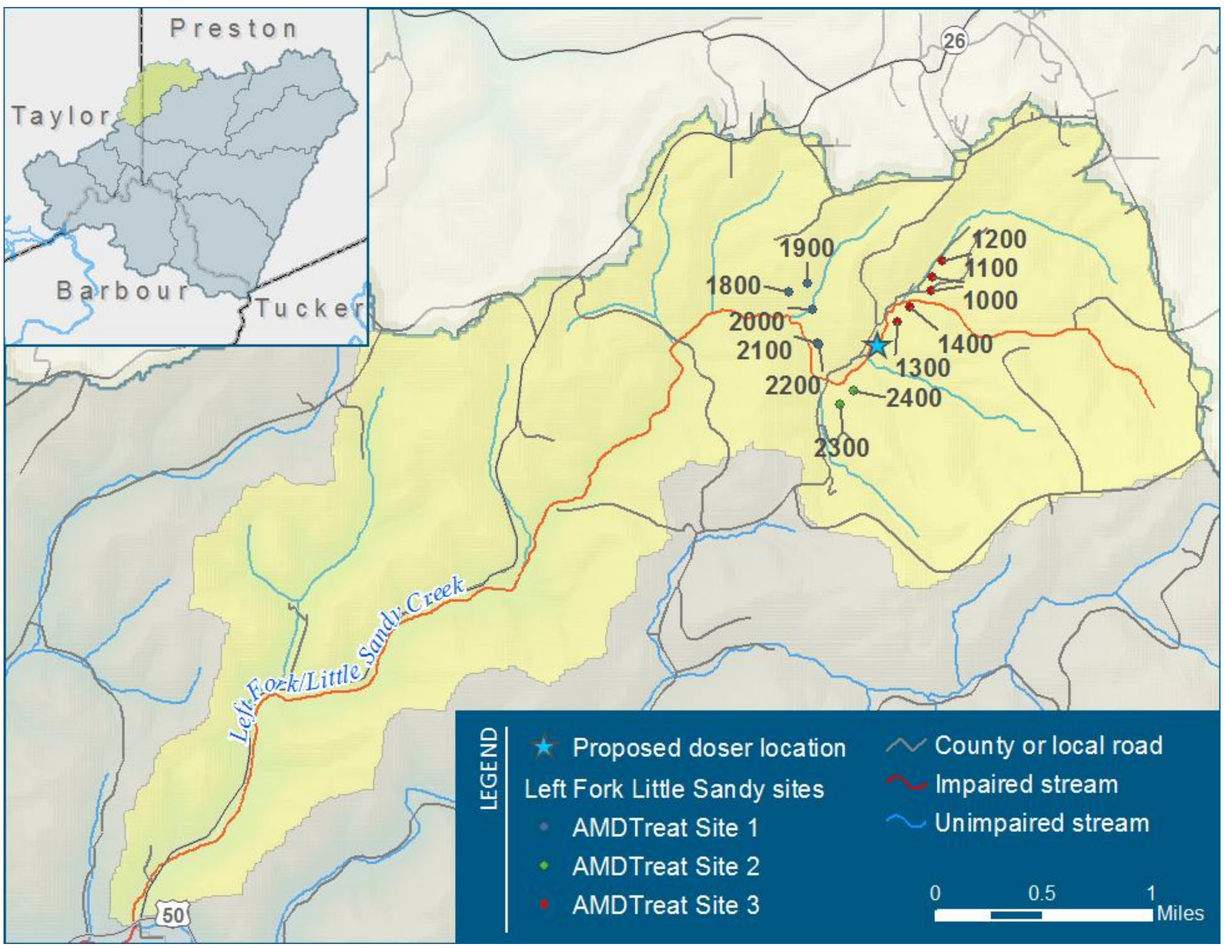
5.3.1 *Work completed*

The WVDEP Office of Abandoned Mine Lands and Reclamation (OAMLR) completed several projects in the Left Fork Little Sandy Creek watershed in 1999. This work included wet seals at WV-1236 in addition to wet seals, underdrains, and limestone channels at WV-1080 (Table 11).

WV-1236 is further upstream. Its discharging portals are scattered amongst private residences. WV-1080 is about three-quarters of a mile downstream from WV-1236; the site is currently occupied by a gas drilling operation and is across a small tributary from the Amanda Nicole BFS.

Work is currently underway on Amanda Nicole to address AMD from the BFS that was revoked in the early 1990s.

Figure 6: Abandoned mine lands in Left Fork Little Sandy Creek



Note: Discharge locations mapped are all part of site “LFLS” in WVDEP’s Stream Restoration Group database (WVDEP, 2007). Sites 1 and 2 are associated with problem area WV-1080; Site 3 with WV-1236.

Table 11: Past abandoned mine lands remediation in Left Fork Little Sandy Creek watershed

Site name (problem area number)	Past reclamation cost	Site and cost description
Left Fork of Little Sandy (1080)	$398,000	Regrading highwalls, installing wet seals and underdrains; building limestone channels at WV-1080 and WV-1236

Source: WVDEP (various dates). Note: WV-1236 is lumped with WV-1080 in more recent WVDEP documents.

5.3.2 *Work remaining*

In order to restore the stream to conditions that meet state water quality standards, AMD sources must either be stopped from discharging or treated on-site, or an in-stream treatment system must be installed.

One option is to install passive treatment systems. Three sites in Left Fork Little Sandy Creek are currently contributing an estimated total of 4,985 pounds of acidity daily to Sandy Creek, as calculated from available Stream Restoration Group (SRG) data (WVDEP, 2007; see Appendix B). AMDTreat calculations estimate that about $11 million would be necessary to treat discharge from the three sites (Table 12).

A second option is to install an active treatment system. The cost of a doser is presented in Table 15 in Section 5.6. The proposed location of the doser is shown in Figure 6. This location was chosen based on its proximity to the discharges and its suitability for doser installation and maintenance.

Because a doser is significantly less expensive than three RAPSs, and because Save the Tygart has a preference for active treatment, installing a doser in Left Fork Little Sandy Creek is the preferred treatment method.

This doser is sized to neutralize the full acid load in Left Fork Little Sandy Creek. We assume that this will result in 100% load reductions for iron, aluminum, and manganese. Assuming a 94% purity rating and 80% mixing efficiency, 677 tons/year of quicklime will be needed to reduce the acid load to zero. Because the proposed project does not include a settling pond, metals will likely precipitate in the receiving stream over a relatively short distance below the doser. These impacts will be monitored after the doser is in operation; if significant amounts of sludge are found or if these metals are impairing the receiving stream, additional funding will be sought to upgrade the system. Similar instream dosers without settling ponds have been installed frequently by WVDEP at BFSs.

Table 12: Estimated costs of passive remediation options in Left Fork Little Sandy Creek watershed

Site name (problem area number)	AMDTreat site	Estimated cost	Passive remediation option
Left Fork of Little Sandy (1080)	1	$5,990,000	Reducing and alkalinity-producing system
Left Fork of Little Sandy (1080)	2	$20,000	Reducing and alkalinity-producing system
Left Fork of Little Sandy (1236)	3	$5,230,000	Reducing and alkalinity-producing system
Total		**$11,240,000**	

Source: Estimated costs calculated using AMDTreat. Note: AMDTreat allows a maximum of 1,000 feet of effluent/influent pipe. Site 1 would require an estimated 2,800 feet; Site 2 would require an estimated 2,000 feet, so the cost estimates for these sites are low.

5.4 Maple Run

The Maple Run watershed is the same as TMDL subwatershed 132. Two BFSs—Maurice Jennings and Mangus Coal—are located in its headwaters on either side of Scotch Hill Road, just west of Route 92. Additionally, several wet-sealed portals from AMLs are located near Hunt Cemetery. All known Maple Run AMLs are in the upper half of the watershed in three sites, labeled as Sites 4, 5, and 6 in Figure 7.

5.4.1 *Work completed*

The AML discharges near Hunt Cemetery were addressed in the 2001 reclamation work known as

Maple Run Portals (Table 13). This work involved backfilling several highwalls, installing several wet seals, and creating a few limestone channels. This work reduced AMD flow rates at some sites but otherwise failed to significantly improve water quality along Maple Run.

Other work completed in the Maple Run subwatershed includes three limestone channels feeding into a series of two wetland cells, just west of Old Evansville Pike south of Scotch Hill Road.

While much work has already been done in the Maple Run watershed to address health and safety issues at AMLs, numerous water quality issues persist. Maple Run contributes an estimated 882 pounds of acidity daily to Little Sandy Creek, as calculated from available SRG data (WVDEP, 2007; see Appendix B).

5.4.2 *Work remaining*

OSR has two projects in the design phase that will affect Maple Run. Maurice Jennings is primarily situated north of Scotch Hill Road in the very headwaters of Maple Run, and Mangus Coal is located south of Scotch Hill Road. The Mangus Coal site absorbed the AML called Maple Run #4 (WV-0896) when it was in operation, so both should now be treated together.

In addition to these BFSs, several AMLs continue to discharge large volumes of AMD. Maple Run itself has a pH around 3 downstream of the AMLs (Downstream Strategies, 2011).

In order to restore the stream so that it meets state water quality standards, additional treatment is needed. One option is to install passive treatment systems. AMDTreat calculations estimate that about $2 million would be necessary to treat discharges from the three sites using passive treatment (Table 14).

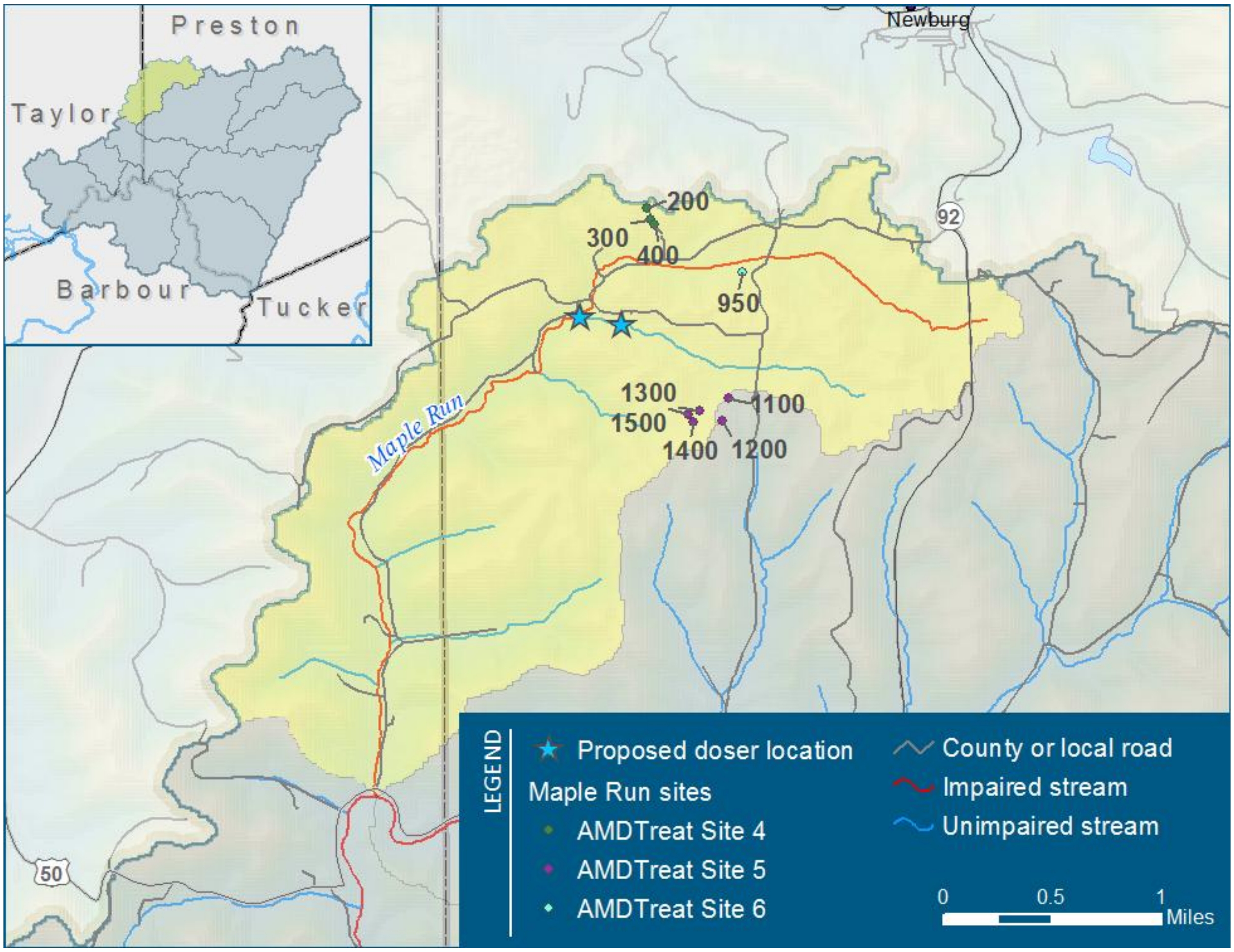
A second option is to install an active treatment system. The cost of a doser is presented in Table 15 in Section 5.6.

Because a doser is significantly less expensive, and because Save the Tygart has a preference for active treatment, installing a doser in Maple Run is the preferred treatment method. Possible locations for the doser are shown in Figure 7. A final determination regarding the most appropriate location for the doser will be made after OSR has completed their aforementioned projects in the Maple Run headwaters. If treatment from these projects is highly successful, the preferred doser location will be on the furthest upstream unnamed tributary to Maple Run.

However, if a substantial nonpoint source pollution load remains in Maple Run following the OSR work, the doser will likely be placed on Maple Run near the confluence with the unnamed tributary.

This doser is sized to neutralize the full acid load in Maple Run. We assume that this will result in 100% load reductions for iron, aluminum, and manganese. Assuming a 94% purity rating and 80% mixing efficiency, 120 tons/year of quicklime will be needed to reduce the acid load to zero. Because the proposed project does not include a settling pond, metals will likely precipitate in the receiving stream over a relatively short distance below the doser. These impacts will be monitored after the doser is in operation; if significant amounts of sludge are found or if these metals are impairing the receiving stream, additional funding will be sought to upgrade the system. Similar instream dosers without settling ponds have been installed frequently by WVDEP at BFSs.

Figure 7: Abandoned mine lands in Maple Run watershed



Note: Discharge locations mapped are all part of site "MRP" in WVDEP's Stream Restoration Group database (WVDEP, 2007). Site 4 is associated with problem area WV-0900; site 5 with problem area WV-1082; and site 6 with problem area WV-1762.

Table 13: Past abandoned mine lands remediation in Maple Run watershed

Site name (problem area number)	Past reclamation cost	Site and cost description
Maple Run Portals (0900)	$225,000	Wet seals installed; highwalls backfilled
Maple Run #3 (1762)	$10,000	Wet seal installed; impoundment drained
Maple Run #3 (1762)	Unknown	Limestone channel and wetland cells
Maple Run #5 (1082)	$18,000	Limestone channel and revegetation
Maple Run #7 (1761)	N/A	None known

Source: WVDEP (various dates).

Figure 8: An iron-stained pond that exists only after heavy rains at one site of WV-0900

Photo: Sera Janson Zegre.

Figure 9: Two wetland cells filter discharge from Maple Run #3

Photo: Sera Janson Zegre.

Table 14: Estimated costs of passive remediation options in Maple Run watershed

Site name (problem area number)	AMDTreat site	Estimated cost	Passive remediation option
Maple Run Portals (0900)	4	$1,380,000	Reducing and alkalinity-producing system
Maple Run #5 (1082)	5	$490,000	Reducing and alkalinity-producing system
Maple Run #3 (1762)	6	$160,000	Reducing and alkalinity-producing system
Total		**$2,030,000**	

Source: Estimated costs calculated using AMDTreat. Note: AMDTreat allows a maximum of 1,000 feet of effluent/influent pipe. Site 5 would require an estimated 2,000 feet, so the cost estimate for this site is low.

5.5 Left Fork Sandy Creek

Left Fork Sandy Creek is comprised of TMDL subwatersheds 158, 159, 160, 161, 162, 163, and 170.

An extensive project has been completed in the headwaters of Left Fork Sandy Creek related to the F & M Coal BFS. This includes three dosers that treat runoff from the affected area (Hansen et al., 2008). Because the F & M site was determined to contribute to the drainage from the older AML known as the Ridenour Portals, this AML is no longer eligible for Abandoned Mine Reclamation Fund grants and instead must be treated along with the remainder of the drainage from the BFS (Hansen et al., 2008).

5.6 Estimated cost of a doser

While the previous sections estimate the costs for remediating AMLs using passive water remediation technologies, a second option is considerably less expensive and preferred by Save the Tygart: instream dosers. Instream dosers mix alkaline materials with a small flow of water diverted from the polluted stream, and route this mixture back into the stream. The alkalinity reacts with metals to precipitate them out of solution, raising the downstream pH. Such a doser was installed in the neighboring Raccoon Run watershed in 2011 and serves as a model for what can be installed in two of the impacted Sandy Creek watersheds: Left Fork Little Sandy Creek and Maple Run.

The Raccoon Run doser was activated in April 2011, with funding from OAMLR and support from Save the Tygart; OAMLR is responsible for the operation and maintenance of the doser, as well as some water quality monitoring (WVDEP, 2011).

This doser cost an estimated $204,089 to install and $40,320 for its first year of delivered lime (Table 15). These costs do not reflect actual labor and maintenance costs, such as volunteer labor for monitoring and making adjustments; costs also do not include heating the unit, which includes a heating unit, propane tank, and actual propane (Connolly, 2011).

We use these figures as the estimated costs for dosers in the Left Fork Little Sandy Creek and Maple Run watersheds. Each doser is custom-made for the specific location, so costs will vary based on factors such as watershed size, acidity, and other site-specific issues. However, for planning purposes, the cost of the Raccoon Run doser provides a recent approximation of the cost that can be anticipated for dosers in the Sandy Creek watershed.

When calculating refined estimates in the future, it will also be important to include additional resources from Save the Tygart such as donated equipment. In 2011, Save the Tygart acquired two new lime dosers—valued at $45,000 each—from a Clarksburg, West Virginia-based company, Lime Doser Consulting, LLC (Robbins, 2011).

Table 15: Estimated costs for doser installation and one year of operation

Item	Estimated cost
Installation	
Bore and jack steel casing (10-inch)	$8,000
Construction layout	$2,125
Conveyance pipe	$672
Crusher run stone (1.5-inch)	$7,721
Doser unit and silo	$110,000
Feed line and cleanouts	$18,900
Fence	$1,000
Grouted discharge channel (4-foot)	$1,840
Intake riser unit	$5,000
Mobilization/demobilization	$17,500
Quality control	$2,000
Revegetation	$1,250
Safety work	$2,738
Sediment control	$125
Site preparation	$8,750
Stainless steel liner	$1,625
Stone (3-inch)	$7,799
Streambank protection	$2,004
Underdrain (3-foot by 3-foot)	$5,040
Subtotal, Installation	**$204,089**
Operation	
Granulated lime, delivered annually	$40,320
Total	**$244,408**

Source: Connolly (2011). Notes: Costs are based on both estimated and actual costs. Certain costs are not included in this estimate, including heating and ongoing labor. Granulated lime calculation made by multiplying $210 per delivered ton of line by 16 tons per month and by 12 months per year. The annual costs for the two dosers proposed in this plan are calculated by multiplying $210 per ton by the number of tons projected to be used each year.

6. ASSISTANCE NEEDED

A combination of federal and state agencies, academic institutions, watershed organizations, consultants, and citizens will be involved in providing technical and financial assistance for Sandy Creek watershed projects. The technical and financial assistance chapter focuses on AMD only. If other sources of impairment are identified in the watershed, this section will be updated to include technical and financial options to address those issues. Funding sources in West Virginia for on-the-ground construction of AMD projects is very limited; it is even scarcer for operations and maintenance (O&M).

Technical assistance is needed for the following tasks related to AMD:

- 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, tracking their progress, and providing ongoing project operation and maintenance; and
- monitoring instream and source water quality following the installation of remediation projects to document their effectiveness.

Financial assistance is needed to design, build, operate, and maintain the selected remediation projects. Many funding sources are available for nonpoint source AMD remediation on AMLs and for water quality monitoring, including:

- Section 319 funds,
- the Abandoned Mine Reclamation Fund, including money in the AMD Set-Aside Fund,
- OSM's Watershed Cooperative Agreement Program grants,
- the Stream Restoration Fund,
- mitigation fees,
- USACE Section 206 funds,
- Natural Resources Conservation Service (NRCS) Public Law 566 funds,
- Stream Partners Program grants, and
- local government contributions.

6.1 Save the Tygart

While many organizations and agencies will play a role in implementing this watershed-based plan, Save the Tygart will take a leading role. Save the Tygart's mission is: "To save the Tygart Valley River from Acid Mine Drainage and other pollution thereby insuring a clean source of water for ourselves, our children and future generations to enjoy."

Save the Tygart will locate and apply for funding, partner with agencies to implement AMD reclamation projects, collect data to determine the effectiveness of reclamation projects, monitor impaired streams, assist with ongoing project operation and maintenance plans, and inform the local community and watershed stakeholders about reclamation efforts and water quality achievements.

Save the Tygart has leveraged support through volunteer labor in the field and through its in-house laboratory located in Grafton, West Virginia. The organization has also provided the use of vehicles.

6.2 West Virginia Department of Environmental Protection

Two WVDEP divisions will provide technical assistance. The Division of Water and Waste Management educates the public and landowners on nonpoint source issues, enforces water quality laws that affect nonpoint sources, and restores impaired watersheds through its Nonpoint Source Program (WVDEP, 2006b).

A second division within WVDEP, OAMLR, directs technical resources to watersheds to address AMLs. Within OAMLR, SRG conducts extensive source monitoring of AMLs—as well as instream monitoring—before remediation systems are designed.

6.2.1 *Section 319 funds*

Clean Water Act Section 319 funds are provided by the United States Environmental Protection Agency (USEPA) to WVDEP, and can be used for reclamation of nonpoint source AMD sources. This watershed-based plan is being developed so that these funds can be allocated to the Sandy Creek watershed. WVDEP's Nonpoint Source Program sets priorities and administers the state Section 319 program (WVDEP, 2006b). Save the Tygart intends to prepare Section 319 proposals focused on the Sandy Creek watershed for WVDEP to include in its submittals to USEPA.

6.2.2 *Abandoned Mine Reclamation Fund*

OAMLR also funds AML remediation projects via the Abandoned Mine Reclamation Fund. Before the 1977 Surface Mining Control and Reclamation Act was enacted, coal mines generally did not manage acid-producing material to prevent or treat AMD. These "pre-law" mines, commonly referred to as AMLs, continue to be significant AMD sources and are treated as nonpoint sources under the Clean Water Act. AMLs targeted for reductions in the TMDL are "pre-law" mines.

To reclaim these AMLs, the Act established the Abandoned Mine Reclamation 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. In 2006, this very important source of funding for AMD remediation was reauthorized.

WVDEP has funded many AMD remediation projects on AMLs; however, 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 OLCs, 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).

While the Abandoned Mine Reclamation Fund is an important funding source, it is not likely to be adequate to solve the AMD problems across the Sandy Creek watershed on its own. Furthermore, if the fund is not reauthorized after its planned sunset date in 2022, this important source of funding may disappear completely.

6.2.3 *Acid Mine Drainage Set-Aside Fund*

OAMLR administers another closely linked source of funding: the AMD Set-Aside Fund.

The AMD Set-Aside Fund may be very important to the Sandy Creek watershed because dosers are the preferred management measure for the Sandy Creek watershed. The AMD Set-Aside Program allows states to reserve up to 30% of their annual Abandoned Mine Reclamation Fund allocations as an endowment for use on water quality projects. These funds are critically important, because while regular Abandoned Mine Reclamation Fund allocations can only be spent on capital costs, AMD Set-Aside Fund allocations can be spent on O&M.

As of October 27, 2011, $28 million resided in the West Virginia AMD Set-Aside Fund (Coberly, 2011). Long-term commitments have been made to fund O&M on many AML projects across the state. If WVDEP continues to add money to this fund and if interest rates are sufficiently high, funds may be available for projects in the Sandy Creek watershed. These funds cannot be allocated to a watershed until after a Hydrologic Unit Plan is developed. A new Hydrologic Unit Plan will be needed for the Sandy Creek watershed.

6.2.4 *Mitigation funds*

Mitigation programs exist to restore, create, enhance, or preserve wetlands and aquatic resources to compensate for unavoidable impacts. Polluters receive Section 404 permits from USACE that include compensatory mitigation tasks under the Clean Water Act. In West Virginia, WVDEP administers this program through two divisions: the Division of Mining and Reclamation for coal mitigation and the Division of Water and Waste Management for all other mitigation.

Mitigation can be achieved through projects or payments; the payments go into in-lieu fee programs that fund projects performed by other parties. The WVDEP fee program is evolving, and policies outlining criteria for project acceptance and procedures for obtaining funds should be forthcoming. In the past, funding has been provided for AMD projects.

The Stream Restoration Fund is a special account that holds mitigation funds for use in the restoration and enhancement of the state's waters affected by coal mining or AMD.

6.2.5 *Stream Partners Program*

WVDEP is one of several agencies that administer the Stream Partners Program. The Stream Partners 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, water quality monitoring, public education, stream restoration, and organizational development. This program has provided funding for Save the Tygart projects in the past. Stream Partners grants will be pursued in the future to complement nonpoint source research, education, and reclamation projects in the watershed.

6.3 Office of Surface Mining Reclamation and Enforcement

In the past, OSM has helped place summer interns and AmeriCorps*Volunteers In Service To America (OSM/VISTA) volunteers with watershed groups across West Virginia to assist with AMD-related projects. It is possible that OSM will play a similar role in the future in the Sandy Creek watershed.

6.3.1 *Watershed Cooperative Agreement Program grants*

OSM also provides grants specifically for AMD remediation projects on AMLs through its Watershed Cooperative Agreement Program (WCAP). This program is part of the Appalachian Clean Streams Program. Grants of up to $100,000 are awarded to nonprofit organizations that have developed cooperative agreements with other entities to reclaim AMLs (OSM, 2006). To receive WCAP funds, approximately 70% of the project funding must be acquired through other funding sources. The 70% is typically met with money from the Section 319 program and the state's Abandoned Mine Reclamation Fund.

6.4 United States Environmental Protection Agency

6.4.1 *Brownfields grants*

At the federal level, Brownfields grants of up to $200,000 are available from USEPA through a competitive process; these grants can be applied to mine-scarred lands. Competitive site assessment grants can be used for inventory, planning, quantification of environmental risks, and development of risk management or remedial action plans. Competitive remediation grants can then be used to build treatment systems. Eligible entities include local and regional governments, quasi-government organizations, state agencies, and nonprofit organizations.

At the state level, two main sources of state Brownfields assistance exist: WVDEP and the state Brownfields Assistance Centers. WVDEP provides assistance through its Division of Land Restoration. One site-specific grant available in the state is the Targeted Brownfield Assessment Grant, funded through WVDEP or USEPA Region III. WVDEP also provides assistance through its state voluntary remediation program. In addition, two regional Brownfields Assistance Centers provide technical assistance to revitalize the state's brownfields. The Northern West Virginia Brownfields Assistance Center serves the 33 northern counties, and is located at the West Virginia Water Research Institute at West Virginia University. The centers assist communities in identifying technical assistance from WVDEP and provide education, outreach, and planning assistance to communities. The centers also help groups solicit grants and low-interest loans for site assessments, cleanups, and environmental job training.

6.5 United States Army Corps of Engineers

Using Section 206 funds, USACE funded an AMD ecosystem restoration study in the nearby lower Cheat River watershed in northern West Virginia (USACE, 1997). The success of this project will help determine whether or not similar funds could be pursued for future AML reclamation projects in the Sandy Creek watershed.

6.6 Natural Resources Conservation Service

NRCS funded AMD remediation in the Deckers Creek watershed in north-central West Virginia though a Public Law-566 watershed restoration project. While future funding of this program is uncertain, it is possible that it could be used in the future in the Sandy Creek watershed.

6.7 State and local governments

The State of West Virginia, as well as Preston, Taylor, and Barbour counties, will be approached to provide in-kind support for Sandy Creek projects. These government units may also be approached to take ownership of any property in the watershed that may be acquired by Save the Tygart.

6.8 Local universities

A number of the colleges and individuals at West Virginia University may provide assistance for projects in the watershed. The National Mine Land Reclamation Center, housed at the university, has experience providing conceptual site designs for reclamation projects and monitoring water quality produced by AMLs before and after projects are installed. Technical assistance may also be provided by departments within the university with expertise in fisheries and wildlife resources, engineering, mine land reclamation, and water quality improvement. As in the past, help will also be solicited from colleges and individuals at Fairmont State University and Alderson Broaddus College.

6.9 Other resources

Save the Tygart also expects to make use in financial and in-kind contributions from local individuals and businesses. These donations may include equipment; Save the Tygart currently has two donated dosers to be used to implement this plan. These contributions may also include in-kind services such as volunteer support. Save the Tygart may approach the following entities for volunteer support: the Laurel Mountain/Fellowsville Area Clean Watershed Association, the Department of Corrections (status offenders), the Boy Scouts of America, and 4-H. Past monitoring has been supported by student volunteers from Fairmont State University and OSM/VISTA volunteers.

It is also possible that remediation funding can be provided by:

- the Laurel Mountain/Fellowsville Area Clean Watershed Association or
- special appropriations from the West Virginia Legislature.

7. IMPLEMENTATION SCHEDULE, MILESTONES, AND MEASURABLE GOALS

Significant AMD pollutant reductions are still needed in the Sandy Creek 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 phases and no final end date is projected for implementing all of the reductions in this watershed-based plan.

The long-term goal of remediation in the Sandy Creek watershed is for all major tributaries and for Sandy Creek to meet water quality standards, which will in turn support recreation and fisheries on these streams. Save the Tygart will focus its first restoration efforts on the tributaries of Little Sandy Creek that can benefit the most from AMD remediation and that can be removed from the 303(d) list with relatively little effort. These tributaries include Left Fork Little Sandy Creek and Maple Run.

The first priority is the significantly impaired Left Fork Little Sandy Creek; this project is included in Phase I.

The second priority, also in Phase I, is the significantly impaired Maple Run. The BFS projects on Maple Run may also contribute to mitigation efforts there. Reduction of pollutant loads from these tributaries will also benefit the mainstem of Sandy Creek.

The Left Fork Sandy Creek generally meets water quality standards associated with AMD pollutants. In the past, this creek was impaired by AMD from three F & M Coal permits; however, OSR currently treats discharges from these permits as a result of a legal decision. Because these discharges are now treated to effluent limitations imposed by an NPDES permit, this tributary to Sandy Creek should be more dependably and consistently protected. Left Fork Sandy Creek is therefore excluded from the goals in this plan.

Details are provided for Phase I; however, far fewer details are given for Phase II.

7.1 Phase I: 2012-2019

Implementation of this watershed-based plan will start with the activities shown in Table 16. Phase I tasks include collecting data, planning and coordinating activities among agencies and organizations, securing funding, and building dosers on Left Fork Little Sandy Creek and Maple Run.

Table 16: Schedule for Phase I monitoring, funding, and construction

Year	Monitoring	General activities	Left Fork Little Sandy Creek	Maple Run
2012	• Initiate monthly source monitoring on Left Fork Little Sandy Creek • Initiate quarterly Sandy Creek watershed instream monitoring • Watershed Assessment Program scheduled	• Secure approval of this watershed-based plan • Coordinate development of a Hydrologic Unit Plan • Research additional funding opportunities	• Obtain landowner permission • Submit AMD Set-Aside Fund request for O&M costs • Submit Fiscal Year 2013 319 proposal for portion of capital costs	
2013	• Complete Left Fork Little Sandy Creek source monitoring • Continue instream monitoring	• Research additional funding opportunities	• Submit Watershed Cooperative Agreement Program proposal for portion of capital costs • Watershed Cooperative Agreement Program notification • Fiscal Year 2013 319 notification	
2014	• Continue instream monitoring	• Complete Hydrologic Unit Plan • Research additional funding opportunities	• Develop conceptual plans • Procure engineer	
2015	• Continue instream monitoring	• Research additional funding opportunities	• Install doser, resulting in 100% load reduction of iron, aluminum, and manganese	
2016	• Initiate monthly source monitoring on Maple Run • Continue instream monitoring	• Research additional funding opportunities		• Obtain landowner permission • Submit AMD Set-Aside Fund request for O&M costs • Submit Fiscal Year 2017 319 proposal for portion of capital costs
2017	• Complete Maple Run source monitoring • Continue instream monitoring • Watershed Assessment Program scheduled	• Research additional funding opportunities		• Submit WCAP proposal for portion of capital costs • WCAP notification • Fiscal Year 2017 319 notification
2018	• Continue instream monitoring	• Research additional funding opportunities		• Develop conceptual plans • Procure engineer
2019	• Continue instream monitoring	• Research additional funding opportunities • Reassess watershed-based plan		• Install doser, resulting in 100% load reduction of iron, aluminum, and manganese

Note: AMD=acid mine drainage. WCAP=Watershed Cooperative Agreement Program.

7.1.1 *Measurable goals for Phase I*

The goals for Phase I are to fund and install two dosers: one on the highest-priority remediation project on Left Fork Little Sandy Creek, and the other on the second priority project in Maple Run. This will allow for currently scheduled work that may influence future projects to be completed by OSR on Maple Run before the new doser is designed and installed.

Tasks include the following: identify actual site; develop conceptual plans; obtain landowner permission; collect data; plan and coordinate activities among agencies and organizations; seek and secure funding for the design, installation, and operation and maintenance of two dosers; and build the dosers. Following implementation, Save the Tygart will monitor and reevaluate to determine what additional AMD loads need treatment, if any, for the streams to meet standards.

By the end of Phase I, the following measurable goals will be achieved:

- A doser will be installed on Left Fork Little Sandy Creek. This project will be functioning well enough so that water discharged from this site meets technology-based effluent limitations for pH and iron.
- A doser will be installed on Maple Run. This project will be functioning well enough so that water discharged from this site meets technology-based effluent limitations for pH and iron.
- In the first two years after the installation of each doser, instream water chemistry measurements in the immediate receiving streams will show improvement, but may still not meet standards. Based on these results, doser operations may be adjusted, if necessary.
- After two full years of treatment, instream water chemistry measurements will show that the immediate receiving streams meet water quality standards for pH and iron.
- Measurements in the Sandy Creek mainstem will also show improvement, but may still not meet standards.

7.1.2 *Collect data*

- **Monitor streams for AMD pollutants.** Save the Tygart will collect quarterly instream monitoring data starting in 2012, and will continue to identify discharge sites, as it has in the Tygart Valley watershed since 2004. This program will track the condition of major drainages within the Sandy Creek watershed and will help refine remediation priorities for Phase II. This monitoring program is described further in Chapter 8.
- **Collect monthly source data**. To inform the design of treatment systems, additional monitoring will occur at AMD discharges in the Left Fork Little Sandy Creek and Maple Run watersheds. This monitoring will occur monthly for one year in accordance with OSM guidance (OSM, 2010a).

7.1.3 *Plan and coordinate activities*

- **Convene a group of cooperators.** Save the Tygart will convene individuals and agencies with missions related to water quality improvement to plan and coordinate remediation activities. These meetings will either be integrated with regular monthly meetings or will be scheduled separately.
- **Coordinate development of a Hydrologic Unit Plan.** A Hydrologic Unit Plan is required prior to submitting an application to the AMD Set-Aside Fund. It is envisioned that this Fund will pay for O&M of the two new dosers.
- **Develop plans for new and improved reclamation projects.** Save the Tygart and partners will agree on plans to install new and to improve existing reclamation projects in the watershed, if necessary.
- **Track progress of existing projects**. Save the Tygart will coordinate with OSR and OAMLR to incorporate updated information on the agencies' ongoing work in Maple Run to inform plans for Save the Tygart's Maple Run doser.
- **Reassess the big picture.** At the end of this phase, Save the Tygart and partners will reassess the strategic priorities for AMD

remediation in the watershed. This assessment will be used to track improvements over time and to help plan remediation and O&M priorities for the next phase.

7.1.4 *Secure funding*

- **Secure funds for capital costs**. Save the Tygart and partners will secure funds to pay capital costs from the 319 program and WCAP. The schedule for securing funding for the initial priority sites is shown in Table 16. Save the Tygart acquired two new lime dosers—valued at $45,000 each—from a West Virginia-based company, Lime Doser Consulting, LLC (Robbins, 2011). The 319 proposal will include a detailed plan for O&M and an analysis of instream treatment and mixing zones to address precipitated metals in the receiving stream.
- **Secure funds for O&M**. Save the Tygart and partners will make all reasonable efforts to secure a commitment that the AMD Set-Aside Fund can be used to fund O&M on the dosers installed in Phase I. If such funding is not available or sufficient, Save the Tygart will continue to research additional sources of funding for O&M.
- **Investigate other funding sources**. NRCS Public Law 566 and USACE funds will also be investigated.

7.1.5 *Install remediation projects*

- **Build new projects**. According to the construction schedule in Table 16, the first high priority project will be built by 2015 and the second project by 2019.
- **Add water quality improvements to existing projects**. In many cases, OAMLR builds remediation projects with Abandoned Mine Reclamation Fund grants that address health and safety hazards but that do not wholly address AMD. Wherever possible, Save the Tygart and its partners will add on to these remediation projects to directly address water quality.
- **Operate and maintain existing sites**. After Set-Aside funds are obtained, O&M will be performed on sites where necessary. Save the Tygart will engage in discussions with the appropriate offices within WVDEP to agree on an O&M plan. This plan will clarify not just the funding sources, but also will clarify which organization has what responsibility for inspecting, operating, and maintaining the dosers. While Save the Tygart is local and may be able to provide frequent inspections, the organization intends to request that WVDEP maintain financial responsibility for ongoing expenses and that WVDEP provide staff labor for operating and maintaining these dosers. Depending on the number of dosers installed in the general vicinity, WVDEP may be able to service many dosers with a single employee.

7.2 Phase II: 2020-2025

Phase II is described in less detail than Phase I because of the uncertainty of what will be completed in Phase I of the plan.

In Phase II, Save the Tygart and partners will undertake the same four categories of activities:

- collect additional water quality monitoring data in receiving streams and on AML sites;
- develop plans to build, operate, and maintain at least one new reclamation project;
- secure capital funds for new and improved reclamation projects, and ensure that sufficient O&M funds are available to meet the needs of the watershed; and
- operate and maintain the dosers installed in Phase I.

As part of the WVDEP Watershed Assessment Program's five-year rotating monitoring program, the Tygart Valley watershed—of which Sandy Creek watershed is a part—is scheduled for assessments in 2012, 2017, and 2022.

If instream water quality standards are not met by the end of Phase II, an adaptive management approach will be used to initiate new strategies that will lead to the achievement of standards.

8. MONITORING

Save The Tygart has conducted water quality monitoring in the Tygart Valley watershed since 2004, with monitoring beginning on the mainstem of the Tygart, and then monitoring of Three Fork Creek starting the following year. New water monitoring locations, including those within the major tributaries the Sandy Creek watershed, are located on Left Fork Sandy Creek, Maple Run, Little Sandy Creek, and Left Fork Little Sandy Creek and are scheduled to begin in 2012. Sampling sites will include those listed in Table 17 and mapped in Figure 10.

To process water samples, Save the Tygart uses its in-house laboratory or sends water samples to Alternative Testing Labs—an environmental consulting, monitoring, and testing company from Latrobe, Pennsylvania.

Past monitoring has included temperature, flow, pH, conductivity, dissolved oxygen, clarity, bacteria, iron, aluminum, chloride, and manganese.

Instream monitoring is important to gage the recovery of streams after remediation projects are installed and is also crucial as partners engage in periodic 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.

Monitoring results will be analyzed on a quarterly basis to identify trends, sources, and the effects of any remediation activity. The results will be measured against baseline data as well as state criteria. These results will be used to determine cumulative percent attainment relating to water quality goals.

Additional data will be compiled, including WVDEP's Watershed Assessment Program data, which are collected on a five-year cycle.

8.1 Instream monitoring

Several agencies and organizations are now monitoring within the Tygart Valley watershed and will continue to do so in the future.

8.1.1 *Save the Tygart*

Starting in 2012, Save the Tygart will conduct quarterly instream monitoring to capture a variety of hydrologic conditions. This monitoring will be conducted at key sites throughout the watershed (See Table 17 and Figure 10). Instream monitoring will also be conducted above and below each proposed AMD project; because the precise project locations have not been identified yet, these monitoring locations are not shown. This monitoring will assess progress at the project sites prior to and after AMD project implementation, for a period of five years. Monitoring protocols will follow those outlined by WVDEP (2010b) in its Standard Operating Procedures. Additional monitoring materials can also serve as reference (WVDEP, 2006a; USEPA, 2008). Monitoring will include the following field measurements:

- pH,
- temperature,
- conductivity,
- dissolved oxygen, and
- stream flow.

Additionally, laboratory analyses will include:

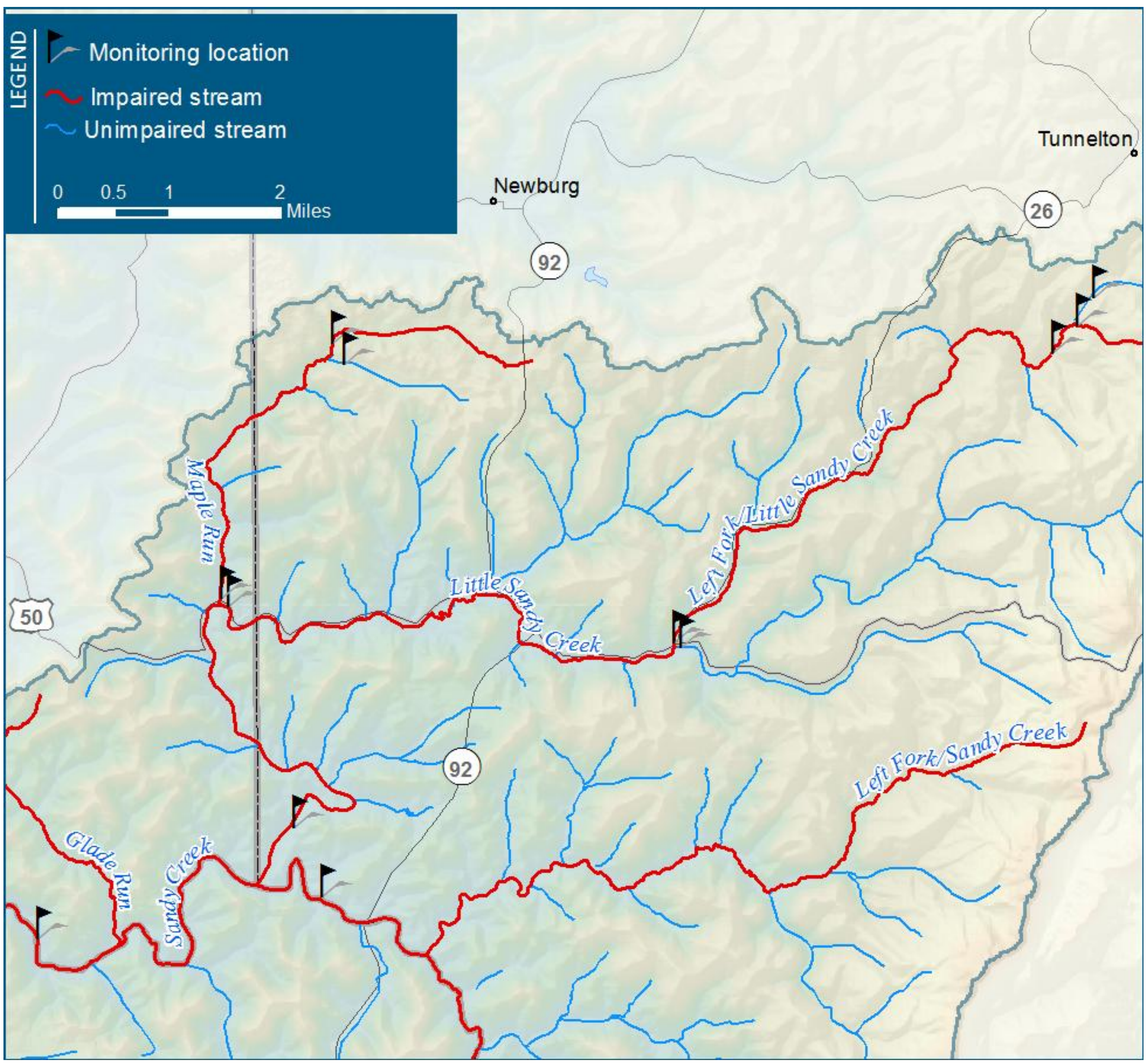
- pH;
- conductivity;
- acidity and alkalinity;
- sulfate; and
- total and dissolved metals including iron, aluminum, and manganese.

Table 17: Sandy Creek watershed monitoring sites

Stream	Place	Latitude	Longitude
Left Branch Left Fork Little Sandy Ck	Upstream from upstream AMD discharge (LFLS-1200)	39.3748	-79.7539
Right Branch Left Fork Little Sandy Ck	Upstream from AMD discharges	39.3711	-79.7567
Left Fork Little Sandy Creek	Under side road coming into Kane Town	39.367671	-79.760849
Left Fork Little Sandy Creek	Upstream from confluence with Right Fork	39.330551	-79.825204
Right Fork Little Sandy Creek	Upstream from confluence with Left Fork	39.329843	-79.823821
Little Sandy Creek	Upstream from confluence with Maple Run	39.335865	-79.900004
Maple Run	Mouth (confluence with Little Sandy Creek)	39.336765	-79.90117
Little Sandy Creek	Upstream from confluence with Sandy Creek	39.307437	-79.889546
Sandy Creek	Upstream from confluence with Little Sandy Creek	39.297728	-79.884945
Sandy Creek	Bridge in Hiram	39.292922	-79.932636
Maple Run	Upstream from Tributary #6	39.370133	-79.881723
Tributary #6 to Maple Run	Upstream from mouth	39.3674	-79.880108

Note: Latitude and longitude are both represented in decimal degrees.

Figure 10: Sandy Creek watershed monitoring sites



8.1.2 *Watershed Assessment Program*

According to WVDEP's five-year watershed management framework cycle, the agency performs in-depth monitoring of the state's major watersheds every five years. 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 and fecal coliform data to determine biological and bacteria impairments. Technicians also perform sediment-related assessments. WVDEP also uses these data, plus data collected by other agencies and organizations, to make impairment decisions for the next 303(d) list.

In the Tygart Valley watershed—of which Sandy Creek watershed is a part—monitoring is scheduled for 2012, 2017, and 2022.

8.2 Source monitoring

8.2.1 *Save the Tygart*

Save the Tygart and its cooperators will also conduct the monitoring necessary to develop plans and secure funding for specific water remediation projects. As required by OSM WCAP guidelines, Save the Tygart will collect one year of monthly monitoring data including flow, pH, acidity, total and ferrous iron, and aluminum (OSM, 2010a). These data will be used to determine loads of metals and acidity from all AMD sources at targeted sites in order to design appropriate treatment systems. For Left Fork Little Sandy Creek, this monthly monitoring will commence in 2012; for Maple Run, this monthly monitoring will commence in 2016. After installation, treatment systems will be visited at least monthly to ensure proper functionality.

8.2.2 *Stream Restoration Group*

SRG, which works within OAMLR, collects source data when WVDEP is designing a remediation project.

8.2.3 *National Mine Land Reclamation Center*

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. OUTREACH AND EDUCATION

Save the Tygart has been performing outreach and education on water quality issues since its founding in 2001. Save the Tygart will continue these initiatives, which enhance public understanding and encourage early and continued participation in implementing nonpoint source management measures. Save the Tygart will integrate information about nonpoint source remediation projects into outreach and educational efforts.

WVDEP also contributes to outreach and education for the elements of this plan. Prior to initiating its regular five-year monitoring effort, 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.

9.1 Meetings

Save the Tygart meetings are held monthly. These meetings update members and other invited stakeholders about planned nonpoint source remediation projects and about remediation priorities. These regularly scheduled meetings offer an opportunity for members of the public to learn about Save the Tygart's efforts to remediate AMD in the Sandy Creek watershed. These meetings will be held at strategic places throughout the watershed. The watershed group will also meet with Laurel Mountain/Fellowsville Area Clean Watershed Association, which is jointly administering settlement funding with WVDEP to treat AMD on Left Fork Sandy Creek.

9.2 Press, media, and Internet

Save the Tygart submits press releases to local newspapers and television stations so that information on AMD remediation topics can be broadcast to a wide audience. Local newspapers, such as the Mountain Statesman in Grafton and the Times West Virginian, will be used for these efforts. Beyond traditional media outlets, Save the Tygart maintains a Web site, www.savethetygart.org, and a Facebook page that both contain information about projects and priorities.

9.3 Public education

Save the Tygart uses a number of other efforts to provide public education and is actively involved in educating residents and stakeholders about the Sandy Creek watershed. In the course of learning how to make observations, collect samples, analyze results, and help with restoration projects, participants in the Stream Partners Program develop an understanding of the interconnectedness of activities and impacts in the watershed while helping to monitor the streams.

Save the Tygart has engaged various residents and stakeholders in education, including foresters, anglers, and local residents, as well as recreationalists, developers, and farmers. This public education has included:

- printing and distributing trifold brochures with background on Save the Tygart and its AMD remediation efforts;
- giving speeches to the Grafton Rotary and other local civic organizations;
- collaborating with science teachers at the Taylor County High School so that AMD remediation topics can be presented at school and so that students can volunteer for field work with Save the Tygart;
- hosting a Save the Tygart fishing tournament on Tygart Lake State Park in 2011; and
- participating in the "Hooked on Fishing" project, a kids fishing demonstration with USACE at Tygart Lake in 2011.

Future public education efforts may include similar efforts as in the past, as well as:

- speaking at city council and county commission meetings about the project and the group's water quality goals and work accomplished;
- working with boy scouts to install fish attractors in the lake; and
- developing a PowerPoint presentation about Save the Tygart and its goals and progress to present to students at Grafton High School, local middle schools, and Fairmont State University.

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APPENDIX A: ABANDONED MINE LANDS

Table 18 lists all AMLs in the Sandy Creek watershed. Those known to discharge AMD are also listed in Table 8 and are the focus of this plan.

Table 18: All abandoned mine lands in the Sandy Creek watershed

Watershed name	TMDL SWS	Problem area number	Problem area name	Problem types
Left Fork Little Sandy Creek	104	006197	Buckeye, Blazer & Kanetown Waterline Extension	Waterline extension
	104	006271	Denver (Phillips) Vertical Opening	VO
	104	005483	Kanetown (Layton) Subsidence [E]	S
	104	001236	Left Fork Little Sandy #1	P, DI, VO
	104	001080	Left Fork of Little Sandy [A]	DPE, SA, VO, PWAI, DH, DI, P
	104	004398	Tunnelton (Goff) Vertical Opening [E]	VO
Little Sandy Creek	115	001807	Blackwood Strip	H, GO
	118	000895	Brocum Run #1	P
	124	001081	Maple Run #6	PWHC, P
Maple Run	132	001811	Bethel Church Strip	GO
	132	002765	Fellowsville #1—Completed	DH
	132	002766	Fellowsville #2—Remined and Reclaimed	DH
	132	001762	Maple Run #3	HWB
	132	000896	Maple Run #4	SA
	132	001082	Maple Run #5	PWHC
	132	001761	Maple Run #7	PWHC, BE, SA
	132	001763	Maple Run #8	SA, PI, WA
	132	000900	Maple Run Portals (Maple Run #1 and #2)	P, DI, DH, PWAI, H
	132	005453	Scotch Hill/Miller Hill Waterline [E]	PWHC
Left Fork Sandy Creek	158	004396	Ridenour Portals	P, DI

Note: TMDL SWS=subwatershed in the total maximum daily load, BE=bench, CS=clogged streams, DH=dangerous highwall, DI=dangerous impoundments, DPE=dangerous pile and embankment, GO=GOB piles, H=highwall, HWB=hazardous water body, P=portals, PWAI=polluted water: agricultural and industrial, PWHC=polluted water: human consumption, S=subsidence, SA=spoil area, VO=vertical opening, and WA=water problems.

APPENDIX B: LOAD CALCULATIONS FOR ABANDONED MINE LANDS WITH WATER QUALITY PROBLEMS

Data collected by SRG between 1994 and 2007 were used to calculate net acidity loads. Nearby portals were grouped together in order to more efficiently address treatment. AMD discharges were grouped into sites based on location—all discharges within a site are within 1,000 feet of other discharges in the same site.

Sites 1-3 are in the Left Fork Little Sandy Creek watershed. Sites 1 and 2 are associated with problem area WV-1080; Site 3 is associated with WV-1236, which is absorbed into WV-1080 in some WVDEP documents.

Sites 4-6 are in the Maple Run watershed. Site 4 is associated with problem area WV-0900, Site 5 with WV-1082, and Site 6 with WV-1762.

AMDTreat is a computer program developed by OSM to help plan AMD treatment systems and estimate associated costs based on water quality data, AMD volume, land area, and other factors (OSM, 2010b). This program was used to size the RAPSs that are considered as passive treatment options in the Sandy Creek watershed. It was also used to estimate costs.

In its help section, AMDTreat suggests that systems 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 order to approximate design flow, acidity loads were multiplied by 120%.

Table 19: Site 1 data

	LFLS-1800			LFLS-1900			LFLS-2000			LFLS-2100			LFLS-2200		
Date	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)
8/30/1995							617	0.23	347,193						
4/3/1997										103	0.03	7,560	44	0.02	2,153
4/23/1997							1,220	0.33	984,990	156	0.003	1,145	43	0.003	316
4/25/1997				1,150	0.02	56,271	1,170	0.37	1,059,121	136	0.002	665	37	0.005	453
5/16/1997				918	0.01	22,460	935	0.43	983,644	139	0.003	1,020	17	0.004	166
5/20/1997	66	0.01	1,615	870	0.04	85,141	1,030	0.66	1,663,179	130	0.01	3,181	53	0.02	2,593
8/31/2001	1,168.2	0.002	5,716	1,349.3	0.39	1,287,452	326	0.001	798						
Average			3,665			362,831			839,821			2,714			1,136

Source: WVDEP (2007).

Table 20: Site 1 parameters

Total acidity load (g/day)	Total acidity load (lb/day)	120% of design flow acidity load (g/day)	Vertical flow pond area (m^2)	Vertical flow pond area (ft^2)	Vertical flow pond side dimension (ft)	Pipe needed (ft)
1,210,167	2,668	1,452,201	58,088	625,315	799	2,800

Source: Acidity load from previous table. RAPS dimensions from AMDTreat. Pipe needed from assumption that polluted water must be piped to the furthest downstream discharge within this site.

Table 21: Site 2 data

Date	LFLS-2300			LFLS-2400		
	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)
4/25/1997	61	0.007	1,045	106	0.007	1,815
5/16/1997	66	0.001	161	123	0.006	1,806
5/20/1997	59	0.001	144	98	0.004	959
Average			450			1,527

Source: WVDEP (2007).

Table 22: Site 2 parameters

Total acidity load (g/day)	Total acidity load (lb/day)	120% of design flow acidity load (g/day)	Vertical flow pond area (m^2)	Vertical flow pond area (ft^2)	Vertical flow pond side dimension (ft)	Pipe needed (ft)
1,977	4	2,372	95	1,021	40*	500

Source: Acidity load from previous table. RAPS dimensions from AMDTreat. Pipe needed from assumption that polluted water must be piped to the furthest downstream discharge within this site.

Table 23: Site 3 data

	LFLS-1000			LFLS-1100			LFLS-1200			LFLS-1300			LFLS-1400		
Date	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)
8/30/1995	328	0.03	24,074	320	0.007	5,480	389	0.003	2,855	439	0.07	75,183			
4/3/1997	324	0.54	428,052	299	0.57	416,969				438	0.43	460,787	57	0.01	1,395
4/23/1997	407	0.19	189,193	354	0.15	129,913	348	0.02	17,028	569	0.34	473,314	116	0.008	2,270
4/25/1997	396	0.07	67,819	339	0.24	199,053	336	0.008	6,576	545	0.18	240,009	106	0.001	259
5/16/1997	399	0.4	390,473	364	0.67	596,670	320	0.02	15,658	509	0.78	971,338	63	0.009	1,387
5/20/1997	426	0.58	604,499	374	0.66	603,912	311	0.04	30,435	539	0.41	540,668	65	0.008	1,272
8/31/2001	577.82	0.3	424,103	495.86	0.03	36,395	637.14	0.02	31,176	723.68	0.19	336,402	225.24	0.001	551
Average			304,031			284,056			17,288			442,529			1,189

Source: WVDEP (2007).

Table 24: Site 3 parameters

Total acidity load (g/day)	Total acidity load (lb/day)	120% of design flow acidity load (g/day)	Vertical flow pond area (m^2)	Vertical flow pond area (ft^2)	Vertical flow pond side dimension (ft)	Pipe needed (ft)
1,049,092	2,313	1,258,911	50,356	542,085	744	2,000

Source: Acidity load from previous table. RAPS dimensions from AMDTreat. Pipe needed from assumption that polluted water must be piped to the furthest downstream discharge within this site.

Table 25: Site 4 data

	MRP-200			MRP-300			MRP-400			MRP-500		
Date	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)
2/4/1998	316	0.009	6,958	320	0.007	5,480	325	0.005	3,976	178		0
3/19/1998	404	0.02	19,768	299	0.57	416,969	288	0.004	2,818			
8/20/1998	300			354	0.15	129,913	240	0.002	1,174			
3/1/1999	314	0.002	1,536	339	0.24	199,053						
4/10/2003	514.47	0.02	25,174	364	0.67	596,670						
Average			13,359			269,617			2,656			0

Source: WVDEP (2007).

Table 26: Site 4 parameters

Total acidity load (g/day)	Total acidity load (lb/day)	120% of design flow acidity load (g/day)	Vertical flow pond area (m^2)	Vertical flow pond area (ft^2)	Vertical flow pond side dimension (ft)	Pipe needed (ft)
285,632	630	342,759	13,710	147,591	392	500

Source: Acidity load from previous table. RAPS dimensions from AMDTreat. Pipe needed from assumption that polluted water must be piped to the furthest downstream discharge within this site.

Table 27: Site 5 data

	MRP-1100			MRP-1200			MRP-1300			MRP-1400			MRP-1500		
Date	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)	Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)
3/19/1998	226	0.004	2,212	284	0.04	27,793	440	0.008	8,612	465	0.07	79,636	261	0.01	6,386
8/20/1998	130	0.001	318	300	0.004	2,936				700					
3/1/1999				439	0.02	21,481	446	0.003	3,274	422	0.003	3,097	304	0.003	2,231
Average			1,265			17,403			5,943			41,367			4,308

Source: WVDEP (2007).

Table 28: Site 5 parameters

Total acidity load (g/day)	Total acidity load (lb/day)	120% of design flow acidity load (g/day)	Vertical flow pond area (m^2)	Vertical flow pond area (ft^2)	Vertical flow pond side dimension (ft)	Pipe needed (ft)
70,286	155	84,343	3,374	36,318	199.00	2,000

Source: Acidity load from previous table. RAPS dimensions from AMDTreat. Pipe needed from assumption that polluted water must be piped to the furthest downstream discharge within this site.

Table 29: Site 6 data

Date	MRP-950 Hot acidity (mg/L as $CaCO_3$)	Flow (cfs)	Acidity (g/day)
3/7/2002	121.3	0.05	14,838
4/10/2003	253.2	0.08	49,558
6/3/2003	368.96	0.25	225,672
9/27/2005	119	0.004	1,165
3/10/2006	317	0.074	57,392
6/8/2006	269	0.024	15,795
9/7/2006	184	0.014	6,302
3/12/2007	253	0.0711	44,010
6/7/2007	220	0.0341	18,354
9/5/2007	210	0.0122	6,268
Average			43,935

Source: WVDEP (2007).

Table 30: Site 6 parameters

Total acidity load (g/day)	Total acidity load (lb/day)	120% of design flow acidity load (g/day)	Vertical flow pond area (m^2)	Vertical flow pond area (ft^2)	Vertical flow pond side dimension (ft)	Pipe needed (ft)
43,935	97	52,722	2,109	22,702	159	20

Source: Acidity load from previous table. RAPS dimensions from AMDTreat. Pipe needed from assumption that polluted water must be piped to the furthest downstream discharge within this site.

APPENDIX C: COST CALCULATIONS FOR ABANDONED MINE LANDS WITH WATER QUALITY PROBLEMS

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

1. Construction of a RAPS,
2. Construction of pipes to merge adjacent discharges, and
3. Engineering and project management costs.

Costs are rounded to nearest $10,000 to reflect the precision of the method used to estimate costs. Decisions about the sizing of AMD treatment measures and the amounts of reclamation were chosen using the rules detailed below. A summary of costs is presented in Table 31.

Table 31: Summary of costs by site

Site	Construction	Engineering and management	Total
1	$4,990,000	$1,000,000	**$5,990,000**
2	$20,000	<$10,000	**$20,000**
3	$4,360,000	$870,000	**$5,230,000**
4	$1,150,000	$230,000	**$1,380,000**
5	$410,000	$80,000	**$490,000**
6	$140,000	$30,000	**$160,000**
Total	**$11,100,000**	**$2,210,000**	**$13,280,000**

Note: All values rounded to nearest $10,000. Totals may not sum due to rounding.

C.1 Reducing and alkalinity producing systems

RAPSs were included whenever flows of AMD were identified and quantified. When AMD discharges were present, a RAPS was sized according to two parameters: design flow and acidity, using the "Vertical Flow Pond" module in the computer program AMDTreat (OSM, 2010b). This module allows a number of sizing methods. The one chosen was "Vertical Flow Pond Based on Dimensions." Water quality parameter values other than acidity were not used by AMDTreat. Inputs were limited to "Length and Width at Top of Freeboard" and "Total Length of Effluent/Influent Pipe."

The default alkalinity generation rate, 25 grams/m^2/day (as $CaCO_3$) was used to calculate dimensions necessary to address acidity loads derived from SRG data. Conditions for cost determination included:

- synthetic liner to prevent leaking,
- no clearing and grubbing, and
- standard piping costs.

C.2 Piping

As mentioned in Appendix B, nearby portals were grouped together in order to more efficiently address treatment. Pipe length was measured between SRG data points under the assumption that all discharges would be piped to meet the furthest downstream discharge of the group. AMDTreat allows a maximum of 1,000 feet of effluent per influent pipe. If a greater length of pipe was calculated to be necessary, a value of 1,000 feet was entered in AMDTreat because the program only allows a maximum of 1,000 feet of effluent/influent pipe.

C.3 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.