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ATTACHMENTS

APPLICATION FOR STREAM VARIANCE IN MAPLE RUN, LEFT FORK LITTLE SANDY CREEK, AND TRIBUTARIES THEREOF.

1.0 SUMMARY

WVDEP Office of Special Reclamation (OSR) is submitting this application for variance from water quality standards pursuant to 46 SCR 1, section 8.3. This variance is being requested based on human-caused conditions which prohibit the full attainment of any designated use. It is important to note that these streams have never been able to meet their designated use as a result of human-caused conditions (pre-law mining) that were in existence before the stream designations were assigned. A stream use inventory is currently ongoing and will be supplied once it has been completed.

A report by the Save the Tygart Watershed Association (*Sandy Creek of the Tygart Valley River Watershed-based plan, August 8, 2012*) evaluated AMD treatment cost (both passive and active) for the watersheds in question. It is important to note that "Save the Tygart has expressed a clear preference for active treatment because it is cheaper and more dependable" (Sandy Creek of the Tygart Valley River Watershed-based plan *pg. 17*). The results of this study are shown in the table below. The cost of doser[1] installation, and operation and maintenance is based on costs associated with a doser installed in a nearby watershed. 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.

OSR is proposing the strategic placement of in-stream dosers to increase alkalinity and pH and remove dissolved metals within the stream, thereby enhancing the overall stream quality. Precipitation of metals within the stream channel immediately below the doser is anticipated. Periodic flushing of these sediments will occur due to high flow events which will eventually disperse the sediments throughout the entire stream system. Highly soluble hydrated lime, or lime slurry (liquefied lime) will be used to treat the streams. Dosing rates will be regulated by pH sensors placed downstream of the dosers. The sensors will measure the pH of the stream and send a signal back to the doser that will enable the

[1] For purposes of this document a doser is defined as a silo that holds a chemical reagent; hydrated lime, or lime slurry, that is dispensed into the stream at a regulated rate.

dosing rate to increase or decrease accordingly. The treatment systems will be powered by electricity with a generator backup.

To measure the success of the restoration project, benthic macro-invertebrate sampling and fish surveys will be conducted at designated stream locations within the Sandy Creek watershed prior to full implementation of in-stream treatment and one year following. Water quality monitoring stations and parameters will be established in the permit. The proposed in-stream treatment sites will be visited and maintained as needed (at least once a week) to ensure that the doser's are functioning properly as well as assuring there are no other maintenance issues with the facility. This information is documented on inspection forms and submitted to regional office. A regional maintenance contractor is under contract to provide necessary equipment and manpower to ensure the maintenance of the treatment facility. The maintenance contractor is required to have necessary equipment readily available for any required site maintenance.

OSR, in cooperation with the Save the Tygart Watershed Group and the Laurel Run/Fellowsville Area Clean Watershed Association have set a restoration goal of improving the lower 7 miles of Sandy Creek and restoring 9.5 miles of Little Sandy Creek to its designated stream usage by decreasing the water quality impairment from pre and post law coal mine discharges within the watershed. This will effectively reestablish biological connectivity throughout an estimated 73 miles of stream within the Sandy Creek watershed.

2.0 INTRODUCTION

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).

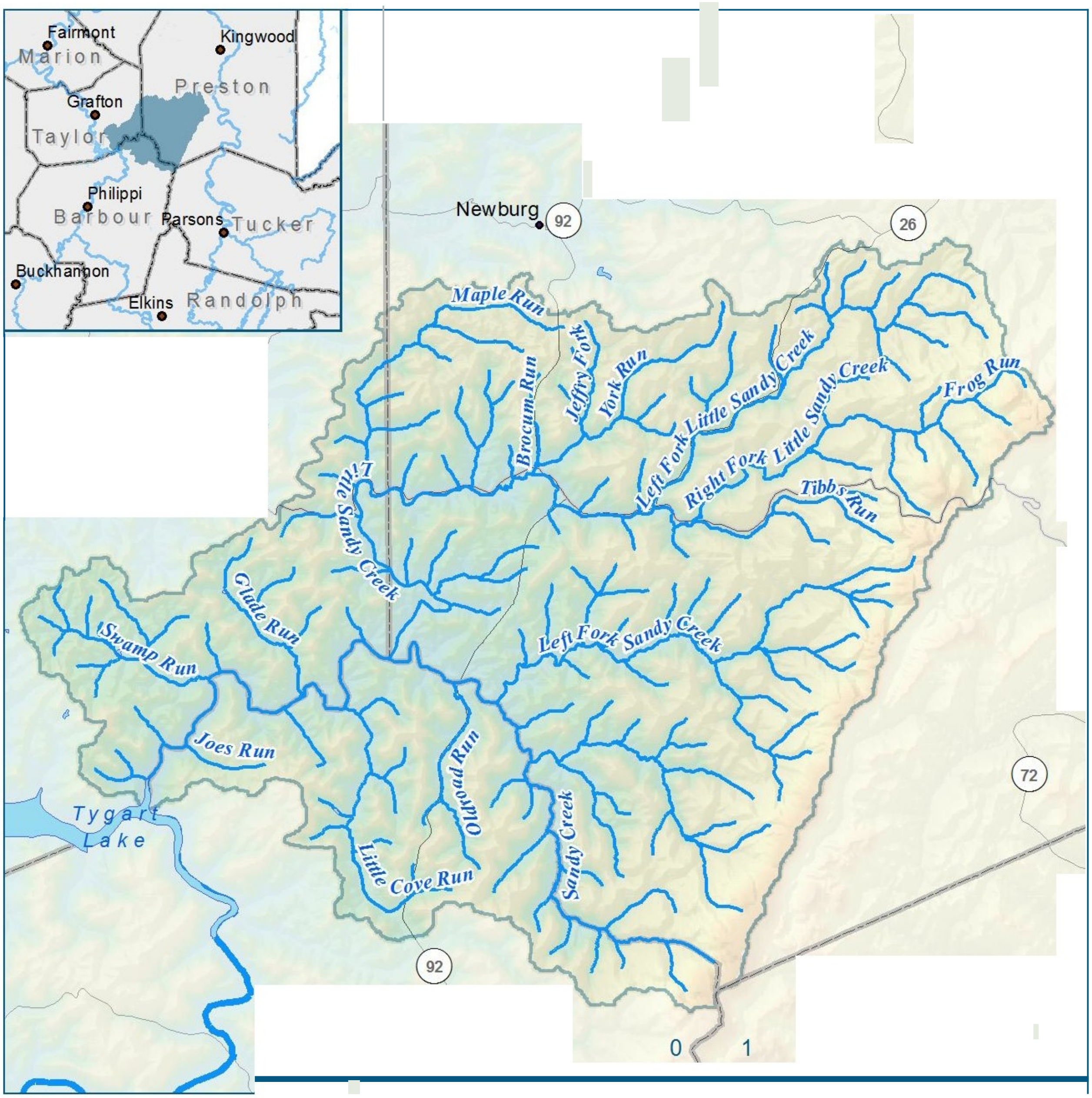
As documented by the West Virginia Department of Environmental Protection (WVDEP):

> 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)

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)



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.

> 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 Maple 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).

3.0 REGULATORY BASIS FOR VARIANCE APPLICATION

Streams have designated uses which are described in §47-2-6.2 and include: water supply public, propagation and maintenance of fish and other aquatic life, water contact recreation, agriculture and wildlife, and water supply industrial/water transport/cooling and power. Water use categories are supported by both numeric and narrative criteria. Procedural Rules for Site-Specific Revisions to Water Quality Standards are described in 46 CSR 6 and include rules for promulgation of designated use reclassifications, site-specific criteria, and variances. WVDEP Office of Special Reclamation is proposing the following:

7.2.d.11.1. A variance pursuant to 46 CSR 6, Section 5.1, based on human-caused conditions which prohibit the full attainment of any designated use and cannot be immediately remedied, shall apply to WV DEP Division of Land Restoration's Office of Special Reclamation's discharges into Maple Run, Left Fork Little Sandy Creek, and their unnamed tributaries. The following existing conditions will serve as instream interim criteria while this variance is in place: For Maple Run, pH range of 3.3-9.0, 2 mg/L total iron, and 12 mg/L dissolved aluminum; for Left Fork Little Sandy Creek, pH range of 2.5-9.0, 14 mg/L total iron, and 33 mg/L dissolved aluminum. Alternative restoration measures, as described in the variance application submitted by WV DEP Division of Land Restoration's Office of Special Reclamation, shall be used to achieve significant improvements to existing conditions in these waters during the variance period. Conditions will be evaluated and reported upon during each triennial review throughout the variance period. This variance shall remain in effect until action by the Secretary to revise the variance or until July 1, 2025, whichever comes first.

Alternative restoration measures, as described in the variance application submitted by WV DEP Division of Land Restoration's Office of Special Reclamation, shall be used to achieve significant improvements to existing conditions in these waters during the variance period. Conditions will be evaluated and reported upon during each triennial review throughout the variance period. This variance shall remain in effect until action by the Secretary to revise the variance or until July 1, 2025, whichever comes first.

4.0 REQUIRED INFORMATION

Pursuant to §46-6-3.1 a-g, the following information is required to be included in an application seeking reclassification of a designated use, a variance from numeric water quality criteria, or a site specific numeric criterion:

a. *A USGS 7.5 minute map showing those stream segments to be affected and showing all existing and proposed discharge points. In addition, the alphanumeric code of the affected stream, if known*:

A USGS 7.5 minute map showing the stream segments to be affected and showing all existing and proposed discharge points for Maple Run (MC-5), Left Fork Little Sandy (MC-12-B),and Left Fork Sandy Creek (MT-18-E-3) have been provided; please refer to Attachment 1 at the end of this application.

b. *Existing water quality data for the stream or stream segment. Where adequate data are unavailable, additional studies may be required by the Board*:

LEFT FORK OF LITTLE SANDY (EXISTING CONDITIONS)

STREAM_NAME	SAMPLE_DATE	Al Dissolved	Fe Total	PH
Left Fork/Little Sandy	7/12/2012	32.6	14.1	2.59
Left Fork/Little Sandy	9/13/2012	29.8	13	2.78
Left Fork/Little Sandy	10/24/2012	21.8	11.7	3.05
Left Fork/Little Sandy	12/5/2012	5.67	5.04	3.55
Left Fork/Little Sandy	1/16/2013	1.53	3.22	4.38
Left Fork/Little Sandy	2/6/2013	6.77	11.8	3.2
Left Fork/Little Sandy	2/27/2013	4.13	6.1	3.56
Left Fork/Little Sandy	3/26/2013	7.42	12.1	3.37
Left Fork/Little Sandy	4/24/2013	7.17	7.48	3.34
Left Fork/Little Sandy	5/16/2013	5.22	8.05	3.49
Left Fork/Little Sandy	7/2/2013	4.31	3	3.58
Left Fork/Little Sandy	7/22/2013	13.6	8.87	2.85

MAPLE RUN (EXISTING CONDITIONS)

STREAM_NAME	SAMPLE_DATE	Al Dissolved	Fe Total	PH
Maple Run	7/12/2012	10.8	1.55	3.74
Maple Run	9/12/2012	12.2	0.75	3.6
Maple Run	10/18/2012	11.3	1.01	3.76
Maple Run	11/30/2012	9.65	1.69	3.61
Maple Run	1/15/2013	3.15	0.76	4.85
Maple Run	2/14/2013	4.67	1.45	3.83
Maple Run	2/27/2013	3.07	1.26	4.81
Maple Run	3/12/2013	3.25	1.23	4.6
Maple Run	4/3/2013	3.9	1	
Maple Run	5/15/2013	4.66	0.85	4.22
Maple Run	7/3/2013	2.85	0.66	4.37
Maple Run	7/22/2013	7.79	1.4	3.36

Please refer to the following pages for historical water data as provided in the Sandy Creek of the Tygart Valley River Watershed-based plan prepared by Downstream Strategies on behalf of Save the Tygart Watershed Association. Also water data has been supplied as provide from DWWM.

c. *General land uses (e.g., mining, agricultural, recreation, residential, commercial, industrial, etc.) as well as specific land uses adjacent to the waters for the length of the segment proposed to be revised*:

A Total Maximum Daily Load (TMDL) was developed for the Tygart Valley River watershed, the land use coverage are as follows:

Maple Run, Left Fork Little Sandy, and Left Fork of Sandy Creek were calculated together and show 4% crop, 76% Forest, 17% Pasture, and 3% other.

d. The existing and designated uses of the receiving waters into which the segment in question discharges and the location where those downstream uses begin to occur:

Maple Run, Left Fork Little Sandy, and tributaries thereof is designated as follows:

- Category A (Water Supply, Public), the closest downstream drinking water intake is greater than 5 miles downstream of our bond forfeiture site,

- Category B (Warm Aquatic Life), and
- Category C (Water Contact Recreation);

however, it is important to note that these streams have never been able to meet their designated use as a result of human-caused conditions (pre-law mining) that were in existence before the stream designations were assigned.

e. *General physical characteristics of the stream segment including, but not limited to, width, depth, bottom composition, and slope*:

Maple Run is located in Preston County and the watershed is approximately 4.75 square miles. The widths of the stream vary along its reach, 1 foot to 18 feet with the average width of 10 feet. Stream bed substrate is comprised of mainly boulder and cobble; however, bedrock is more prominent in the upper reaches and gravel components increase towards the lower reaches. Maple Run as a stream gradient is approximately 27,682 feet and has an overall slope of 1.39%.

Left Fork Little Sandy is located in Preston County and the watershed is approximately 7.91 square miles. The widths of the stream vary along its reach, 3 feet to 19 feet with the average width of 13.8 feet. The average instream water depth is approximately .36 foot deep. Stream bed substrate is comprised of mainly boulder and cobble; however, bedrock is more prominent in the upper reaches and gravel components increase towards the lower reaches. Left Fork Little Sandy as a stream gradient is approximately 38,358 feet and has an overall slope of 2.09%.

f. *The average flow rate in the segment, the amount of flow at a designated control point, and a statement regarding whether the flow of the stream is ephemeral, intermittent, or perennial*:

Maple Run is a perennial stream with a watershed area of approximately 4.75 square miles. Average flow data for this stream is approximately 0.01cfs.

Left Fork Little Sandy is a perennial stream with a watershed area of approximately 7.91 square miles. Average flow data for this stream is approximately .12cfs

g. *An assessment of aquatic life in the stream segment in question and in the adjacent upstream and downstream segments*:

WVDEP 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.

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. 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)

5.0 ADDITIONAL REQUIRED INFORMATION

The following information is provided to support preparation of an information sheet (as is required under W.Va. C.S.R. 46-6-5.3), which summarizes the information in the application pertinent to the Board's Decision.

a. *The designated use categories outlined in 46 CSR 1 which apply to the stream*:

Maple Run, Left Fork Little Sandy, and tributaries thereof is designated as follows:

- Category A (Water Supply, Public), the closest downstream drinking water intake is greater than 5 miles downstream of our bond forfeiture site,
- Category B (Warm Aquatic Life), and
- Category C (Water Contact Recreation);

b. *The existing numeric water quality criterion which applies to the stream and for which the applicant seeks a variance, and the alternative numeric water quality criterion desired by the applicant*:

The existing numeric water quality criterion for these streams and tributaries thereof are as follows: Iron = 1.5 mg/l, Aluminum = 0.75 mg/l, pH = 6-9 su. The existing numeric water quality standards in the stream have never been able to be obtained as a result of human-caused conditions (pre-law mining) that were in existence before the criterions were assigned. The current existing conditions for the Maple Run watershed are 2 mg/l Fe, 12 mg/l dissolved Al, and 3.3 pH. The current existing conditions for the Left Fork of Little Sandy water shed are 14 mg/l Fe, 33 mg/l dissolved Al, and 2.5 pH. The purpose of this variance is not to meet existing numeric water quality criterion but to show overall improvement to the Sandy Creek watershed as a whole.

c. *Identification of the specific criterion outlined in section 3.1 a-f above which render the existing numeric water quality criterion unattainable*:

Refer to above for current existing conditions in the Maple Run and Left Fork of Little Sandy watershed.

d. *Identification of the specific circumstances which render the discharger unable to meet the existing numeric water quality criteria which apply to the stream*:

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)
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> 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).

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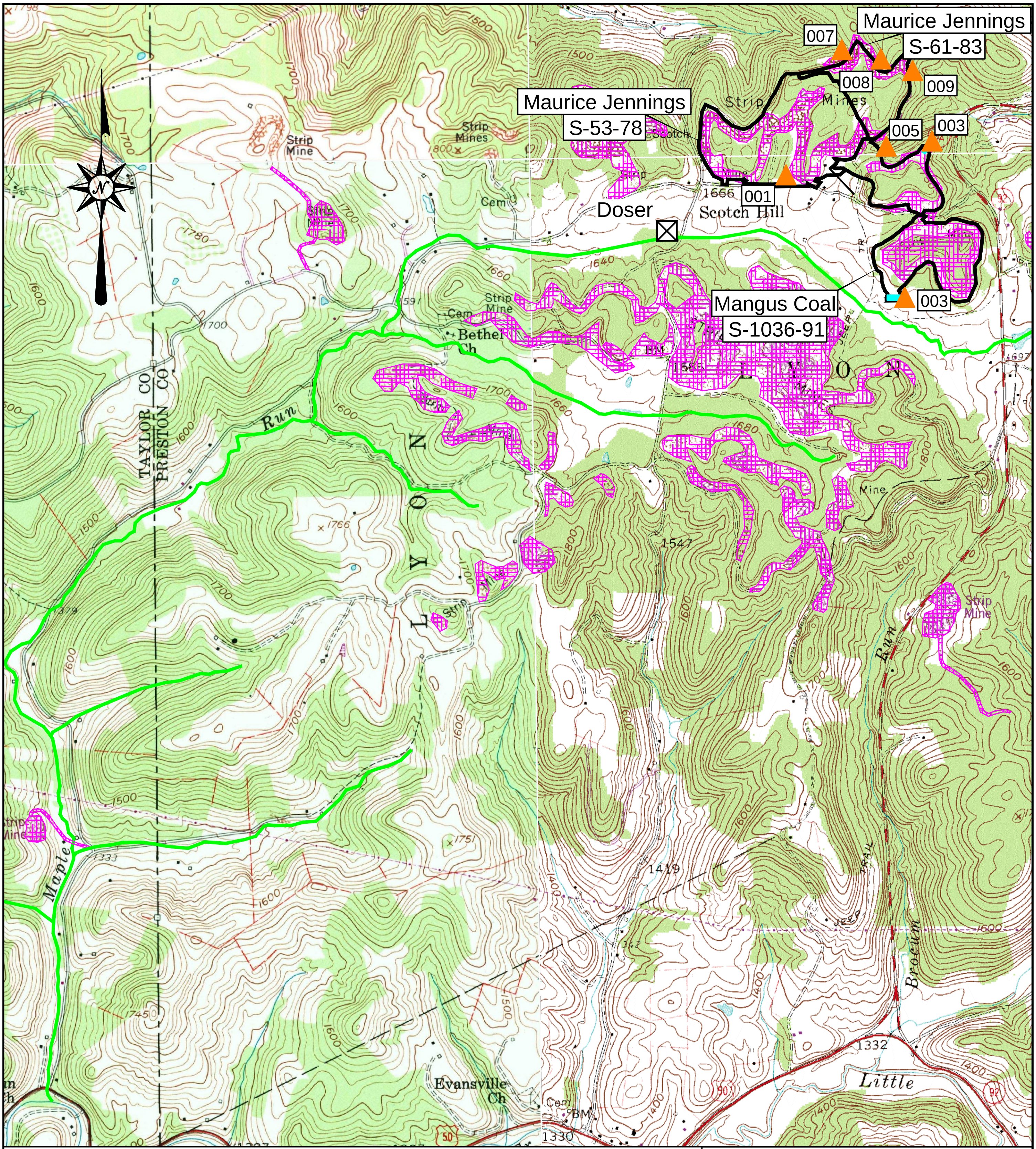


Legend

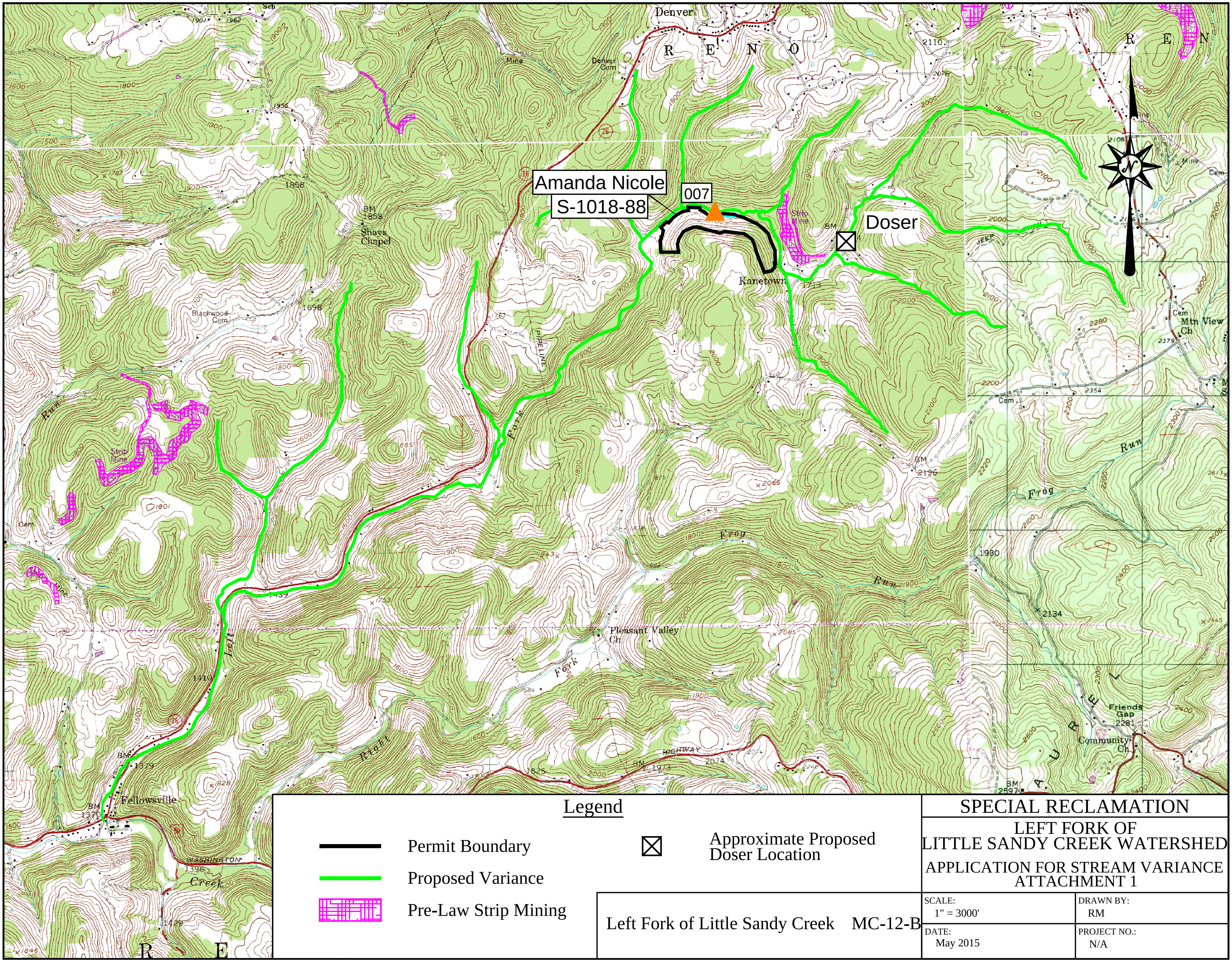
Permit Boundary		☒	Approximate Proposed Doser Location
Proposed Variance			
Pre-Law Strip Mining			

SPECIAL RECLAMATION

MAPLE RUN WATERSHED
APPLICATION FOR STREAM VARIANCE
ATTACHMENT 1

Maple Run MC-5

SCALE: 1" = 2000'	DRAWN BY: RM
DATE: May 2015	PROJECT NO.: N/A



Legend

Permit Boundary

Proposed Variance

Pre-Law Strip Mining

Approximate Proposed Doser Location

SPECIAL RECLAMATION

LEFT FORK OF LITTLE SANDY CREEK WATERSHED

APPLICATION FOR STREAM VARIANCE ATTACHMENT 1

Left Fork of Little Sandy Creek MC-12-B

SCALE: 1" = 3000'	DRAWN BY: RM
DATE: May 2015	PROJECT NO.: N/A

Table 19: Site 1 data

Date	LFLS-1800			LFLS-1900			LFLS-2000			LFLS-2100			LFLS-2200		
	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

	LFLS-2300			LFLS-2400		
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)
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

Date	LFLS-1000			LFLS-1100			LFLS-1200			LFLS-1300			LFLS-1400		
	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

Date	MRP-1100			MRP-1200			MRP-1300			MRP-1400			MRP-1500		
	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.