Big Sandy Creek Watershed Based Plan

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1. Introduction

1.1 Purpose

This watershed-based plan covers the Big Sandy Creek watershed in West Virginia, including all tributaries (Figure 1). The main stem of Big Sandy Creek as well as 21 of its tributaries are impaired by Fe, Al, and/or pH. This document serves as a plan for Friends of the Cheat (FOC) and partnering agencies to implement projects that improve the water quality in the Big Sandy Creek and its tributaries. Funding for these projects will come from the Environmental Protection Agency under the Clean Water Act Section 319, Office of Surface Mining and Reclamation (OSMRE), West Virginia Department of Environmental Protection (WVDEP), non-government organizations, in-kind donations from interested persons, and volunteers.

This document outlines a restoration plan for the Big Sandy Creek watershed-based on the United States Environmental Protection Agency's Nine Elements of a Watershed-based Plan (1), focusing on the most significant water quality problem, acid mine drainage (AMD).

1.2 Background

From its headwaters in Randolph and Pocahontas Counties, West Virginia, the Cheat River flows 157 miles north to the Pennsylvania state line through Tucker and Preston counties. In its lower 20 miles, the river has been severely polluted by acid mine drainage. Much of this damage has been caused by coal mines that were abandoned before the passage of the Surface Mining Control and Reclamation Act in 1977. Despite efforts by Friends of the Cheat and its partners, the United States Environmental Protection Agency (USEPA), the West Virginia Department of Environmental Protection (WVDEP), and the United States Office of Surface Mining, Reclamation, and Enforcement (OSMRE), and others, the legacy of AMD persists through the loss of habitat and wildlife, deteriorated aesthetic value of polluted waterways, degraded drinking water, and economic losses from diminished recreation opportunities.

Big Sandy Creek, a direct tributary to the Cheat River, hosts a viable fishery and is nationally renowned for river recreation. For these reasons, Friends of the Cheat and its partners have targeted restoration activities in the Big Sandy Creek subwatersheds of Sovern Run and Beaver Creek. Previous AMD remediation projects include "Titchenell Road and Limestone Sands", "Sovern 62 and Bishoff Slag Bed", the "Clark" project, "McCarty Highwall", the "Big Bear Limestone Leachbed" project, and limestone sand additions to Beaver Creek by WV DNR. These projects were implemented with CWA §319 funds and have improved water quality within the watershed (2). The most recently completed project was "Sovern England" (June, 2018). Two additional AMD remediation projects are currently in progress: "Beaver Creek at Auman Road" and "Beaver Creek at McElroy Seep."

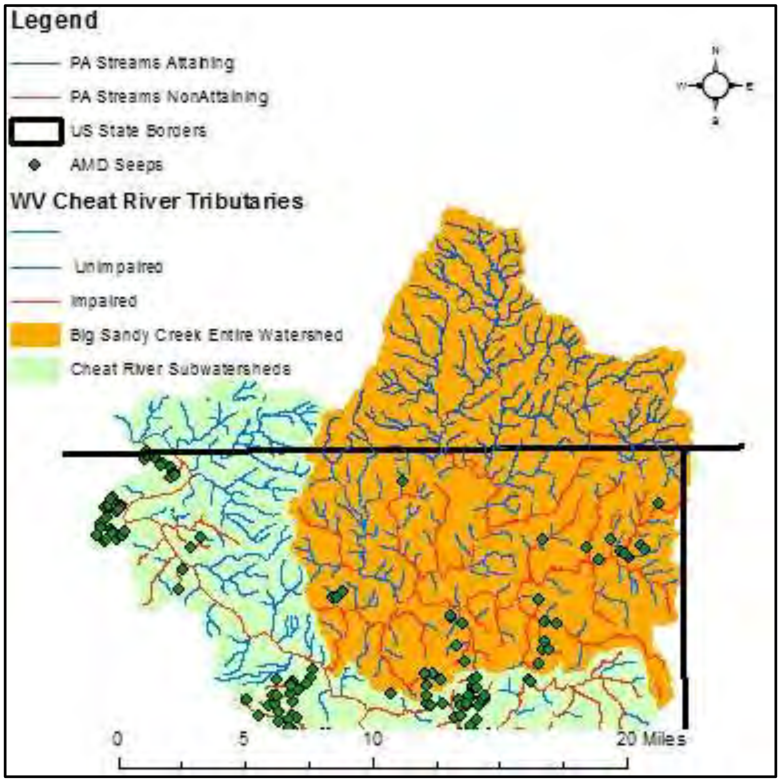
This plan prioritizes restoration efforts by focusing on the feasibility of meeting water quality standards based on the goals set by the 2011 Cheat River Basin TMDL and will guide FOC's restoration efforts based on feasibility and projected water quality success. A table of interested/cooperative landowners is listed in Appendix C.

Figure 1: Big Sandy Creek watershed map

2. Identification of causes and sources of impairment

The Clean Water Act section 303(d) requires states to identify and list streams that do not meet water quality standards. Water quality standards are based on the designated uses of the stream. The numeric water quality standards in Table 1 are relevant for the pollution problems addressed by this watershed-based plan. Impairments in the Big Sandy Creek Watershed include pH, Al, Fe, sedimentation, and fecal coliform. Fe, Al, and pH impairments are commonly a result of AMD (acid mine drainage) in this region. This watershed-based plan focuses on these AMD-caused impairments. This watershed-based plan focuses on streams and sources in West Virginia. After reviewing data provided by Pennsylvania Spatial Data Access website and the PA DEP, all but one segment of stream located in Fike Run of Big Sandy Creek is listed as Non-Attaining (Impaired). The source of impairment is listed as 'Source Unknown – Cause Unknown.' Since this watershed-based plan focuses on AMD-caused impairments, FOC is assuming PADEP will take responsibility to identify the cause and potentially treat the impairment of Fike Run. The rest of the tributaries to the Big Sandy Creek watershed that are in Pennsylvania are listed as Attaining – Supporting, which is interpreted as Non-Impaired for the purposes of this watershed-based plan. Figure 2 highlights the issues addressed above.

Figure 2: Big Sandy Pennsylvania tributaries - status



This plan also heavily utilizes the sampling of subwatersheds (SWS) to prioritize areas of concern and rule out low impact impaired streams. Subwatersheds are smaller watersheds that comprise larger watersheds, such as the Big Sandy Creek Watershed. FOC chose to focus on SWS sampling as "Implementation of BMPs and load reductions must be reported at the subwatershed (SWS) scale" (15).

Table 1 shows the water quality criteria for the state of West Virginia. Table 2 lists the streams that fail to meet standards for pH, dissolved Al, or Total Fe and required pollutant load reductions from AMLs (according to the TMDL). These streams are highlighted in red in Figure 3.

Table 1 : West Virginia Water Quality Criteria

<table>
<tr><th rowspan="4">Pollutant</th><th colspan="5">Designated Use</th></tr>
<tr><th colspan="4">Aquatic Life</th><th>Human Health</th></tr>
<tr><th colspan="2">Warm water Fisheries</th><th colspan="2">Trout waters</th><th rowspan="2">Contact Recreation & Public water Supply</th></tr>
<tr><th>Acute[a]</th><th>Chronic[b]</th><th>Acute[a]</th><th>Chronic[b]</th></tr>
<tr><td>Aluminum dissolved (µg/L)</td><td>750</td><td>750</td><td>750</td><td>87</td><td>--</td></tr>
<tr><td>Iron, total (mg/L)</td><td>--</td><td>1.5</td><td>--</td><td>0.5</td><td>1.5</td></tr>
<tr><td>pH</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td></tr>
</table>

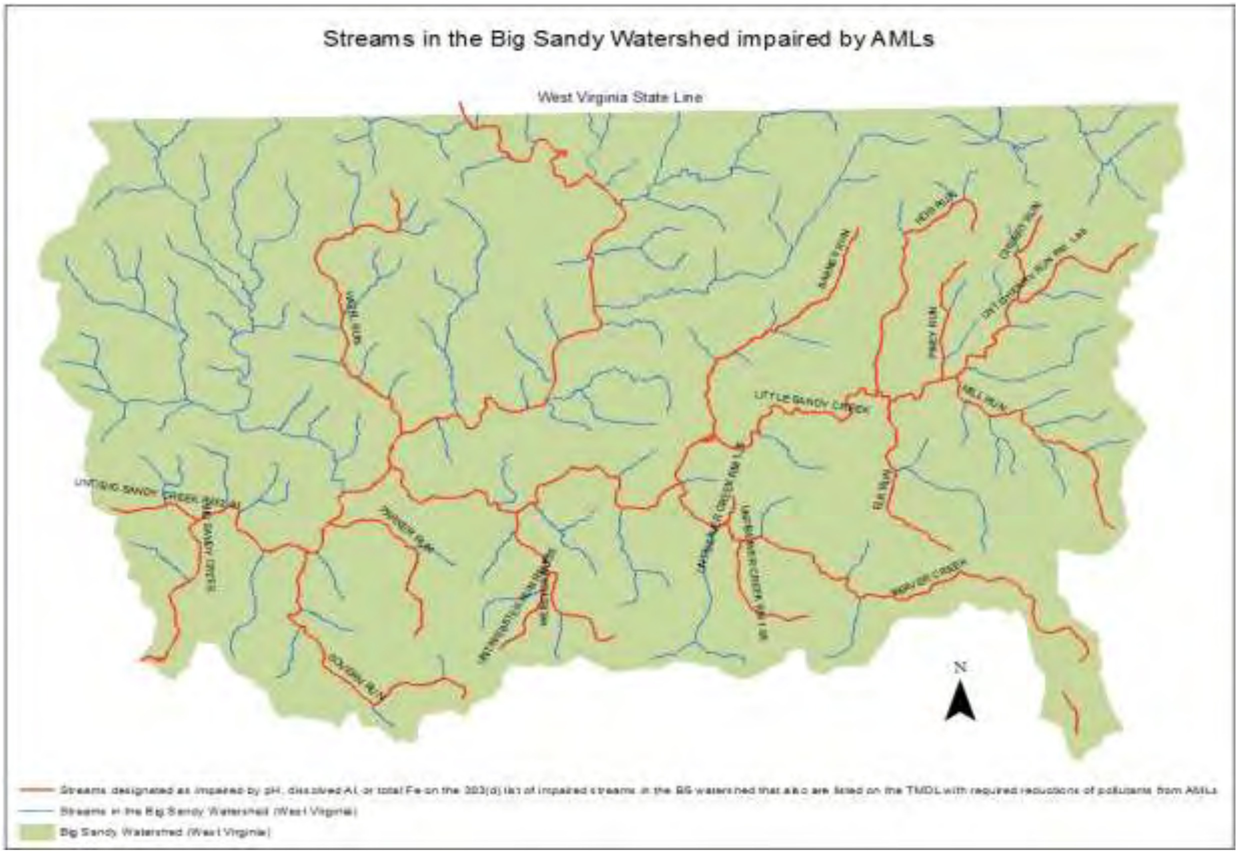
[a] One-hour average concentration not to be exceeded more than once every 3 years on the average.
[b] Four-day average concentration not to be exceeded more than once every 3 years on the average.
Source: 47 CSR, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards (3).*

Table 2 : Impaired streams

Stream Name	**WV Stream Code**	**WV NHD Stream Code**	**HUC 12 Code**	**pH**	**Fe**	**Al**
Barnes Run	WVMC-12-B-2	WV-MC-27-J-7	050200040603	X*		
Beaver Creek	WVMC-12-B-1	WV-MC-27-J-6	050200040603	X	X	X
Big Sandy Creek	WVMC-12	WV-MC-27	050200040602, 050200040604, 050200040605	X	X	
Cherry Run	WVMC-12-B-5	WV-MC-27-J-12	050200040603	X*	X	X
Elk Run	WVMC-12-B-4	WV-MC-27-J-10	050200040603	X		
Hazel Run	WVMC-12-C	WV-MC-27-K	050200040604	X	X	X
Hog Run	WVMC-12-B-3	WV-MC-27-J-9	050200040603	X*	X	X*
Little Sandy Creek	WVMC-12-B	WV-MC-27-J	050200040603	X*	X	X*
Mill Run	WVMC-12-B-6	WV-MC-27-J-13	050200040603	X*		
Parker Run	WVMC-12-0.7A	WV-MC-27-H	050200040605	X*	X	
Piney Run	WVMC-12-B-4.5	WV-MC-27-J-11	050200040603	X	X	X*
Sovern Run	WVMC-12-0.5A	WV-MC-27-F	050200040605	X	X*	X
UNT/Beaver Creek RM 1.25	WVMC-12-B-1-B	WV-MC-27-J-6-C	050200040603	X		
UNT/Beaver Creek RM 1.68 (Shown as the southern-most Glade Run on Figure 2)	WVMC-12-B-1-C	WV-MC-27-J-6-D	050200040603	X	X*	X
UNT/Big Sandy Creek RM 2.91	WVMC-12-0.2A	WV-MC-27-B	050200040605	X	X	X
UNT/Cherry Run RM 1.96	WVMC-12-B-5-C	WV-MC-27-J-12-D	050200040603	X	X	
UNT/Webster Run RM 1.25	WVMC-12-B-0.5-B	WV-MC-27-J-2-B	050200040603	X	X*	X
Webster Run	WVMC-12-B-0.5	WV-MC-27-J-2	050200040603	X*	X*	

An "X" identifies parameters that impair the stream. An "*" indicates impairment was modeled. Source: All are from the 2014 303(d) list Supplemental Tables B and E (WVDEP, 2014a). This table also includes the WV NHD Stream Code used in the 2011 Cheat TMDL and WV Stream codes in the 2014 303(d) list (4).

Figure 3: pH, Fe, and/or Al impaired streams in the Big Sandy Creek watershed



A total maximum daily load (TMDL) is the maximum amount of pollution a stream can receive and meet water quality standards. The goal of this watershed-based plan is to meet required reductions of Fe, Al, and acidity loads from AML seeps set by the 2011 Cheat River Basin TMDL, developed by the West Virginia Department of Environmental Protection. The endpoint goals of the TMDL are shown in Table 3. As explained in the "Expected Load Reductions" section, this watershed-based plan outlines plans to treat to the required reduction of metals set by 2011 Cheat River Basin TMDL with the understanding that this will also treat the pH. Therefore, pH is not included in Table 3. The TMDL accounts for waste load allocations (WLA) from permitted point sources and load allocations (LA) from nonpoint sources. The TMDL includes a margin of safety (MOS) to account for uncertainty in the TMDL process. The TMDL is expressed as, TMDL = ΣWLA + ΣLA + MOS (5).

Table 3: TMDL endpoints for applicable water quality criteria

Water Quality Criterion	Designated Use	Criterion Value	TMDL Endpoint
Total Iron	Aquatic life, warm water fisheries	1.5 mg/L (4-day average)	1.425 mg/L (4-day average)
Dissolved Aluminum	Aquatic life, trout waters	0.087 mg/L (4-day average)	0.0827 mg/L (4-day average)

TMDL Endpoints are used to establish the TMDL and are based on water quality standard 47 CSR, Series 2, Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards (3).

2.1 WLAs - Permitted sources of pollution

Wasteload allocations are for specific point sources, which require National Pollutant Discharge Elimination System (NPDES) permits. While many of these sites contribute significant amounts of AMD, they are not discussed in detail in this watershed-based plan as the focus is on nonpoint sources that do not have a responsible party for treatment. We expect that WVDEP, through its enforcement branches, will work with permittees to prevent permitted discharges from exceeding wasteload allocations.

Bond forfeiture sites

Bond Forfeiture (BF) sites are sites on which the operator did not sufficiently reclaim the land or water after mining. These occur when the operator abandons the property prior to reclamation, or when, due to violations, WVDEP forces operations to cease prior to reclamation. BF sites are point sources and are assigned waste load allocations. WVDEP will prevent these discharges from exceeding wasteload allocations.

Table 4 lists bond forfeiture sites in the sub-watersheds (SWS) of the Big Sandy Creek watershed that have load reduction goals in the TMDL. A GIS database from WVDEP Office of Special Reclamation (OSR) was used to check whether BF sites are meeting the TMDL reduced load goal according to the latest data from 2015.

New BF sites not included in the 2011 TMDL include Primrose Coal (permit 7-81), and Bull Run Mining Co. (permits U-1020-89 and EM-66). Treatment at Primrose Coal permit 7-81 is operating. Water is not yet being treated for the Bull Run Mining Co. permit U-1020-89. Bull Run Mining Co. permit EM-66 does not have water discharging from it according to investigations from July of 2017 by OSR.

Figure 4 shows all the BF sites in the watershed as of November 2017. The results of court decision *West Virginia Highlands Conservancy and West Virginia Rivers Coalition vs. Randy Huffman*, known as the "The Keeley Decision", requires these bond forfeiture sites to be treated by OSR to meet water quality standards. Therefore, this watershed-based plan will not provide pricing or restoration plans for these BF sites and will assume that they will meet required reduction.

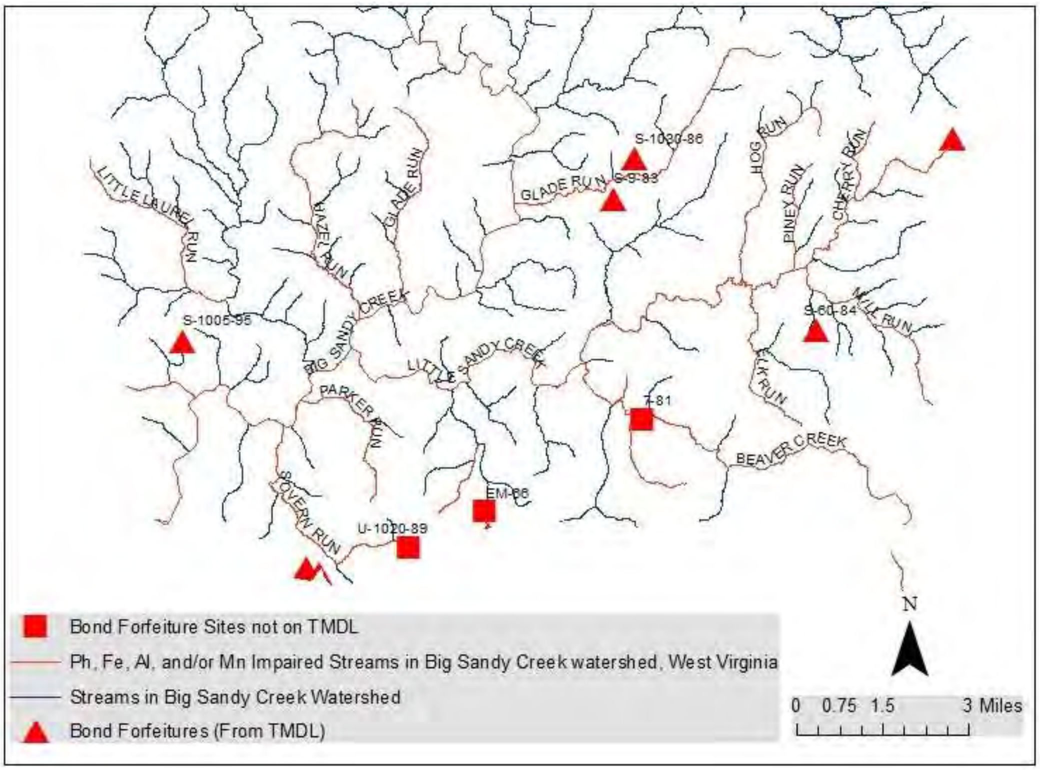
Table 4: Bond forfeiture sites from 2011 - Cheat River TMDL and OSR database

WV NHD Stream Code	Stream Name	SWS	PERMIT	Metal	Baseline Load (lbs/yr)	Reduced Load (lbs/yr)	Data Source	Status
WV-MC-27-J-6*	Beaver Creek	154	7-81		Unknown	Unknown		Active
WV-MC-27-T	Glade Run	181	S-1030-86	Al	207	207	TMDL	Active
				Fe	510	239		
WV-MC-27-T	Glade Run	181	S-9-83	Al	415	414	TMDL	Active
				Fe	1,021	478		
WV-MC-27-J-13	Mill Run	146	S-60-84	Al	425	424	TMDL	Active
				Fe	1,045	489		
WV-MC-27-F	Sovern Run	109	S-1035-86	Al	839	427	TMDL	Active
				Fe	2,064	967		
WV-MC-27-F*	Sovern Run	109			Unknown	Unknown		Not Active

			U-1020-89					
WV-MC-27-J-12-D	UNT/Cherry Run RM 1.96	144	60-79	Al	90	90	TMDL	Active
				Fe	222	104		
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	S-1005-95	Fe	887	415	TMDL	Active
WV-MC-27-J-2-C*	UNT/Webster Run RM 2.05	167	EM 66		Unknown	Unknown		Not Active, but no water discharging since at least 2010.

*sites on OSR database, but not listed in 2011 Cheat River Basin TMDL

Figure 4: Bond forfeiture site map



Active mining permits

Other point sources include active mining permits with NPDES permits (Table 5) and non-mining NPDES permits (Table 6).

Table 5: Active mining permits from 2011 Cheat River TMDL

Stream Code	Stream Name	Metal	SWS	PERMIT	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)
WV-MC-27-J-6	Beaver Creek	Aluminum	154	WV1006983	1,016	519
WV-MC-27-J-6	Beaver Creek	Iron	154	WV1006983	2,502	782
WV-MC-27	Big Sandy Creek	Aluminum	101	WV1007220	394	394

WV-MC-27	Big Sandy Creek	Iron	101	WV1007220	969	969
WV-MC-27-J	Little Sandy Creek	Aluminum	135	WV1002791	989	505
WV-MC-27-J	Little Sandy Creek	Iron	135	WV1002791	2,435	761
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	Aluminum	159	WV1006983	1,489	760
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	Iron	159	WV1006983	3,665	1,145

Active non-mining permits

Table 6 : Non-mining WLAs from the 2011 Cheat River TMDL

Stream Code	Stream Name	Metal	SWS	PERMIT	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	Permit Type
WV-MC-27-J-12	Cherry Run	Iron	142	WVG610807	114	114	Stormwater Industrial
WV-MC-27-T	Glade Run	Iron	181	WVG640080	32	32	Water Treatment Plant (GP)
WV-MC-27-J-9	Hog Run	Iron	136	WVG610269	61	61	Stormwater Industrial
WV-MC-27-J-9	Hog Run	Iron	136	WVG610741	77	77	Stormwater Industrial
WV-MC-27-J	Little Sandy Creek	Iron	135	WVG611281	83	83	Stormwater Industrial
WV-MC-27-J	Little Sandy Creek	Iron	138	WVG611175	69	69	Stormwater Industrial
WV-MC-27-N	UNT/Big Sandy Creek RM 10.23	Iron	177	WVG611205	16	16	Stormwater Industrial

2.2 Nonpoint source impairments

The model used to develop the 2011 Cheat River Basin TMDL considers land use and known features to estimate the acidity, Al, and Fe runoff from nonpoint sources like abandoned mines, harvested forest, oil and gas, barren land, urban areas, and roads. "Other nonpoint sources" and stream bank erosion are also considered in the total baseline load but excluded in the calculations of required load reduction (5).

According to the 2011 Cheat River Basin TMDL load allocations spreadsheet, the acidity, Fe, and Al loads from abandoned mines comprise the highest percentage of the nonpoint source baseline load of Fe and Al (other than the aforementioned "other nonpoint sources" and stream bank erosion) and require the highest reductions. Therefore, to remove the stream from the 303(d) list, this watershed-based plan aims to accomplish the total required reduction from AMLs in the stream as set by the 2011 Cheat Basin TMDL. This plan will only accomplish the load allocation for abandoned mine lands as set by the TMDL. Any remaining impairment will be addressed by a second phase of restoration to be guided with a new WBP focusing on sediment, stream bank protection, and other types of measures.

Abandoned mine lands

"Polluted Water, Agricultural and Industrial" points from the West Virginia Department of Environmental Protection Office of Abandoned Mine Lands and Reclamation (AML) site database were combined with AML discharges from the 2011 Cheat River Basin TMDL and seeps from the FOC database to form the following list of all of the known seeps in the watershed (Table 7). The baseline load and reduced loads are from the 2011 Cheat River Basin TMDL (5). The required reduction was calculated using the difference between the baseline load and reduced load. All the seeps from the FOC database and the AML database are geographically matched to seeps from the TMDL database. Appendix B displays maps of each 303(d) impaired watershed and the known AML sources.

Table 7: Causes and sources of impairment from AMLs

WV NHD Stream Code	Stream Name	SWS	Seep Name	Metal	Baseline Load (lbs/yr)	Reduced Load (lbs/yr)	Required Reduction (lbs/yr)
WV-MC-27-J-7	Barnes Run	134	MC27J-100-1	Al	1	1	0
				Fe	506	35	471
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-1	Al	86	3	82
				Fe	1	1	0
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-2	Al	1	1	0
				Fe	379	26	353
WV-MC-27-J-12	Cherry Run	142	MC27J12-200-1	Al	9	9	0
				Fe	376	129	247
WV-MC-27-J-6-B	Glade Run	160	MC27J6-100-1	Al	100	1	99
				Fe	411	2	409
WV-MC-27-K	Hazel Run	173	MC27K-100-1	Al	13	2	12
				Fe	253	18	235
WV-MC-27-J-9	Hog Run	136	MC27J9-100-1	Al	40	5	35
				Fe	758	53	706
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-1	Al	256	32	224
				Fe	73	42	30
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-2	Al	578	64	514
				Fe	77	77	0
WV-MC-27-J	Little Sandy Creek	138	MC27J-400-1	Al	0	0	0
				Fe	190	13	176
WV-MC-27-J-11	Piney Run	139	MC27J11-100-1	Al	43	5	38
				Fe	822	57	765
WV-MC-27-F	Sovern Run	109	MC27F-100-2	Al	1,516	563	953
				Fe	383	383	0
WV-MC-27-F	Sovern Run	109	MC27F-100-3	Al	9	3	6
				Fe	2	2	0
WV-MC-27-F	Sovern Run	109	MC27F-100-6	Al	288	40	248
				Fe	175	53	123
WV-MC-27-F	Sovern Run	109	MC27F-10-1	Al	7,474	119	7,355
				Fe	468	158	310
WV-MC-27-F	Sovern Run	109	MC27F-200-7	Al	74	74	0
				Fe	134	134	0

WV-MC-27-F	Sovern Run	109	MC27F-300-1	Al	5,899	198	5,702
				Fe	4,056	263	3,792
WV-MC-27-J-6-C	UNT/Beaver Creek RM 1.25	152	MC27J6-565-1	Al	231	231	0
				Fe	31	31	0
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-560-1	Al	1,668	69	1,599
				Fe	162	92	70
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-1	Al	1,873	100	1,772
				Fe	1,901	134	1,767
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-2	Al	1	1	0
				Fe	253	18	235
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-100-1	Al	11	11	0
				Fe	1,380	48	1,332
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-200-2	Al	176	44	131
				Fe	345	59	286
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-1	Al	16	16	0
				Fe	1	1	0
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-2	Al	13	13	0
				Fe	1	1	0
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-3	Al	16	16	0
				Fe	1	1	0
WV-MC-27-J-12-D	UNT/Cherry Run RM 1.96	144	MC27J12-400-1	Al	142	59	83
				Fe	491	79	412
WV-MC-27-J-2-B-1	UNT/UNT RM 0.30/Webster Run RM 1.25	170	MC27J2-100-1	Al	2,219	105	2,114
				Fe	152	140	11
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-1	Al	19,554	889	18,665
				Fe	7,348	1,185	6,163
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-2	Al	81	13	67
				Fe	99	18	81
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-3	Al	92	92	0
				Fe	23	23	0
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-4	Al	15	10	5
				Fe	125	13	112
WV-MC-27-J-2-B	UNT/Webster Run RM 1.25	169	MC27J2-200-1	Al	1,707	79	1,628
				Fe	337	105	232
WV-MC-27-J-2	Webster Run	164	MC27J-200-1	Al	8	8	0
				Fe	6	6	0

3. Expected load reductions

Load reductions, or "required reductions" are an estimate of how much of the current pollutant load must be removed for the pollutant loads to meet the load allocations set by the TMDL for the Cheat River watershed.

The required reductions for the seeps in the impaired SWSs are set by the 2011 Cheat River Basin TMDL to eliminate the excess load in that SWS. Therefore, load reduction goals are set by the load reductions of each seep on the TMDL and expected load reductions are listed for each seep and summed for each SWS in Table 8 and Table 9.

It is important it note that according to FOC's water quality data several SWSs met water quality standards despite being classified as 'Impaired' in West Virginia Department of Environmental Protection's Integrated Report for pH, Fe, Al. There are no functional AMD treatment sites to contribute this improvement in water quality to. The perceived improvement in water quality may be since some of the SWSs were modeled for impairment without physical data, or several years have passed since the most recent state sample event. Data was collected between 2006 and 2007 for the SWSs of Big Sandy Creek for the 2011 Cheat River Basin TMDL, allowing the possibility of changes in water quality conditions since 2007.

No reductions are planned for SWSs where mouth data collected by FOC showed that water quality standards were met specifically for Fe, Al, and pH. However, FOC plans to work with the WVDEP Watershed Improvement Branch and WVDEP Watershed Assessment Branch to develop a plan to continue to assess for future listing decisions for SWSs of Big Sandy Creek by WVDEP regarding Fe, Al, and pH.

Treatment is sized to reduce 100% of dissolved Al and total Fe for seeps for which FOC was able to gather water quality data. Proposed treatment measures are sized to remove 100% of total Fe and total Al for seeps for which FOC was not able to gather water data, because the TMDL data that are available for each seep only list total Al. Treatment to remove 100% of total Al will remove 100% of dissolved Al to meet WV water quality standards.

2011 Cheat River Basin TMDL states, "TMDLs for pH impairments were developed using a surrogate approach where it was assumed that reducing instream metal (iron and aluminum) concentrations allows for attainment of pH water quality criteria." (5) This watershed-based plan outlines plans to treat to the required reduction of metals set by 2011 Cheat River Basin TMDL with the understanding that this will also treat the pH.

Table 8 : Dissolved aluminum allocations, reductions required, and reductions achieved

WV NHD Stream Code	Stream Name	SWS	Discharge Number	Required Reduction of Seep (lbs/yr) as listed in TMDL	Reduction of Seeps (lbs/yr) from Management Measures	% Reduction	Notes
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-1	18,665	0	No reduction planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-2	68	0	No reduction planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-3	0	0	No reduction planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-4	5	0	No reduction planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	**TOTAL**	18,738	0	No reduction planned	
WV-MC-27-F	Sovern Run	109	MC27F-100-2	953	953	100%	Low Priority Current landowner uninterested. Will revisit if property changes ownership
WV-MC-27-F	Sovern Run	109	MC27F-100-3	6	6	Treated 100%	Existing FOC Treatment
WV-MC-27-F	Sovern Run	109	MC27F-100-6	248	248	Treated 100%	Existing FOC Treatment
WV-MC-27-F	Sovern Run	109	MC27F-10-1	7,355*	7,355	100%	Priority Treatment Site
WV-MC-27-F	Sovern Run	109	MC27F-200-7	0	Treated	Treated 100%	Existing FOC Treatment
WV-MC-27-F	Sovern Run	109	**TOTAL**	8,562	8,562	100%	
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-1	224*	224	100%	Priority Treatment Site
	Little Sandy Creek	129	MC27J-300-2	514*	514	100%	Priority Treatment Site

WV-MC-27-J

WV-MC-27-J	Little Sandy Creek	129	**TOTAL**	738	738	100%	
WV-MC-27-J-7	Barnes Run	134	MC27J-100-1	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-7	Barnes Run	134	**TOTAL**	0	0	No reduction Planned	
WV-MC-27-J-9	Hog Run	136	MC27J9-100-1	35	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-9	Hog Run	136	**TOTAL**	35	0	No reduction Planned	
WV-MC-27-J-11	Piney Run	139	MC27J11-100-1	38	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-11	Piney Run	139	**TOTAL**	38	0	No reduction Planned	
WV-MC-27-J-12	Cherry Run	142	MC27J12-200-1	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12	Cherry Run	142	**TOTAL**	0	0	No reduction necessary	
WV-MC-27-J-12-D	UNT/Cherry Run RM 1.96	144	MC27J12-400-1	83	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 1.97	144	**TOTAL**	83	0	No reduction Planned	
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-100-1	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-200-2	132	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards

WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-1	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-2	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-3	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	**TOTAL**	132	0	No reduction Planned	
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-1	83	83	100%	Water captured in OSR Treatment site
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-2	0	0	No reduction necessary	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-6	Beaver Creek	154	**TOTAL**	82	0	100%	
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-560-1	1,599*	1,599	100%	Priority Treatment Site
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-1	1,773	1,773	100%	FOC Project Underway
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-2	0	0	100%	Priority Treatment Site (for Fe)
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	**TOTAL**	3,372	3,372	100%	
WV-MC-27-J-6-B	Glade Run	160	MC27J6-100-1	99	0	100%	Planned treatment site (Lower Priority)
WV-MC-27-J-6-B	Glade Run	160	**TOTAL**	99	0	100%	
WV-MC-27-J-2-B	UNT/Webster Run RM 1.25	169	MC27J2-200-1	1,628	1,628	100%	Low Priority Current landowner uninterested. Will revisit if property changes ownership
WV-MC-27-J-2-B	UNT/Webster Run RM 1.25	169	**TOTAL**	1,628	1,628	100%	

WV-MC-27-J-2-B-1	UNT/UNT RM 0.30/Webster Run RM 1.25	170	MC27J2-100-1	2,114	0	No reduction planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-2-B-1	UNT/UNT RM 0.30/Webster Run RM 1.25	170	**TOTAL**	2,114	0	No reduction planned	
WV-MC-27-K	Hazel Run	173	MC27K-100-1	11	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-K	Hazel Run	173	**TOTAL**	11	0	No reduction Planned	

* Based on load data from BioMost, Inc. (6)

Table 9 : Total Iron allocations, reductions required, and reductions achieved

WV NHD Stream Code	Stream Name	SWS	Discharge Number	Required Reduction of Seep (lbs/yr) as listed in TMDL	Reduction of Seeps (lbs/yr) from Management Measures	% Reduction	
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-1	6163	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-2	81	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-3	0	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-4	112	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	**TOTAL**	6356	0	No reduction Planned	

WV-MC-27-F	Sovern Run	109	MC27F-100-2	0	0	100%	Low Priority (for Al)
WV-MC-27-F	Sovern Run	109	MC27F-100-3	0	0	100% Treated	Existing FOC Treatment
WV-MC-27-F	Sovern Run	109	MC27F-100-6	248	248	100% Treated	Existing FOC Treatment
WV-MC-27-F	Sovern Run	109	MC27F-10-1	310*	310	100%	Priority Treatment Site
WV-MC-27-F	Sovern Run	109	MC27F-200-7	0	0	100% Treated	Existing FOC Treatment
WV-MC-27-F	Sovern Run	109	**TOTAL**	558	558	100%	
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-1	31*	31	100%	Priority Treatment Site
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-2	0	0	100%	Priority Treatment Site (for Al)
WV-MC-27-J	Little Sandy Creek	129	**TOTAL**	31	31	100%	
WV-MC-27-J-7	Barnes Run	134	MC27J-100-1	471	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-7	Barnes Run	134	**TOTAL**	471	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-9	Hog Run	136	MC27J9-100-1	705	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-9	Hog Run	136	**TOTAL**	705	0	No reduction Planned	
WV-MC-27-J	Little Sandy Creek	138	MC27J-400-1	177	0	No reduction Planned	Seep location prohibits treatment
WV-MC-27-J	Little Sandy Creek	138	**TOTAL**	177	0	No reduction Planned	
WV-MC-27-J-11	Piney Run	139	MC27J11-100-1	765	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards

WV-MC-27-J-11	Piney Run	139	**TOTAL**	765	0	No reduction Planned	
WV-MC-27-J-12	Cherry Run	142	MC27J12-200-1	247	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12	Cherry Run	142	**TOTAL**	247	0	No reduction Planned	
WV-MC-27-J-12-D	UNT/Cherry Run RM 1.96	144	MC27J12-400-1	412	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-D	UNT/Cherry Run RM 1.96	144	**TOTAL**	412	0	No reduction Planned	
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-100-1	1322	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-200-2	286	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-1	0	0	No reduction Planned	No Required Reduction of Fe
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-2	0	0	No reduction Planned	No Required Reduction of Fe
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	MC27J12-300-3	0	0	No reduction Planned	No Required Reduction of Fe
WV-MC-27-J-12-A	UNT/Cherry Run RM 0.21	145	**TOTAL**	1608	0	No reduction Planned	
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-1	0	0	100% Treated	Water captured in OSR Treatment site

WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-2	353	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-6	Beaver Creek	154	**TOTAL**	353	0	100%	
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-560-1	70*	70	100%	Priority Treatment Site
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-1	1,767	1,767	100%	FOC Project Underway
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-2	235*	235	100%	Priority Treatment Site
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	**TOTAL**	2,072	2,072	100%	
WV-MC-27-J-6-B	Glade Run	160	MC27J6-100-1	409	409	100%	Planned treatment site (Lower Priority)
WV-MC-27-J-6-B	Glade Run	160	**TOTAL**	409	409	100%	
WV-MC-27-J-2-B	UNT/Webster Run RM 1.25	169	MC27J2-200-1	232	232	100%	Low Priority Current landowner uninterested. Will revisit if property changes ownership
WV-MC-27-J-2-B	UNT/Webster Run RM 1.25	169	**TOTAL**	232	232	100%	
WV-MC-27-J-2-B-1	UNT/UNT RM 0.30/Webster Run RM 1.25	170	MC27J2-100-1	12	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-J-2-B-1	UNT/UNT RM 0.30/Webster Run RM 1.25	170	**TOTAL**	12	0	No reduction Planned	
WV-MC-27-K	Hazel Run	173	MC27K-100-1	235	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards
WV-MC-27-K	Hazel Run	173	**TOTAL**	235	0	No reduction Planned	FOC SWS mouth data refutes need for treatment – SWS Mouth meets WQ standards

*Based on load data from BioMost, Inc. engineering plans (6

4. Proposed management measures

4.1 AMDTreat calculations

AMDTreat (5.0.2 + PHREEQ) was used to estimate cost for each of the AML discharges in the Big Sandy Creek watershed identified in the 2011 Cheat River Basin TMDL and for which FOC determined reductions were necessary (7). Although the program can design both active and passive treatment systems, only passive treatment was considered in this plan (Table 11).

AMDTreat contains default values for various components used in the cost estimations. Some defaults were adjusted based on actual costs for similar projects in northern West Virginia. For high priority sites, water quality data was collected at least twice at high flows to size the treatment systems appropriately. AMDTreat Calculations were performed by BioMost (Appendix D).

For other sites, water quality data for each AML discharge were obtained from the 2011 Cheat River Basin TMDL report (Appendix A). The flow (discharge) was converted to gallons per minute (GPM) and was input as the *Typical Flow*. The *Typical Flow* was multiplied by a 3x safety factor to estimate the *Design Flow. Total Iron, Total Aluminum, Manganese, pH,* and *Sulfate* were entered the program.

4.2 Capital cost estimations

For each AML discharge, a theoretical passive treatment was designed to contain a 100-ft oxic limestone channel, a limestone bed, and a settling pond. The limestone bed was sized based on the estimated tons of limestone required *based on acidity neutralization*, plus the estimated tons of limestone required *based on retention time*, entered as the estimated tons of limestone *based on tons of limestone entered*. This sizing method ensures the limestone bed maintains a retention time of 16 hours and adequate acidity neutralization capabilities for a 10-year system life. Additionally, a synthetic liner and AMDTreat Piping Costs were included to the capital cost for each limestone bed. Future site assessment may deem a liner unnecessary for individual systems. A settling pond was sized for a 48 hour retention time. A synthetic liner and baffle curtain were also included in the cost estimation.

4.3 Other cost estimations

In addition to the oxic limestone channel, limestone bed, and settling pond included in the capital cost estimate, a contingency cost of 10% of the capital cost was added to allow for variable economic fluctuations. Additionally, engineering cost was estimated as 10% of the capital cost.

Ancillary costs are included as a percentage of the estimated capital costs, based on site characterization (Table 10). Sites that are more remote and undeveloped require more ancillary cost than previously established sites. These costs include construction costs such as access road construction, clearing and grubbing, culverts and ditching, fencing and gates, incidental stone, mobilization, piping, regrading and revegetation, sediment control, etc. FOC hired BioMost, Inc. Mining and Reclamation Services to create conceptual designs for 5 high priority sites (Table 11). The method for cost estimation by BioMost is shown in Appendix D. Standardized cost estimates were used to establish treatment costs for remaining planned/ low priority sites (Table 12) and sites where no treatment is currently planned (Table 13).

4.4 Existing FOC treatment sites

Existing FOC treatment sites in the Big Sandy Creek watershed will eventually require maintenance, but calculated maintenance costs and methods are not outlined in this plan.

Table 10: Scheme for calculating ancillary costs, as a percentage of the capital cost of the passive treatment system.

% of estimated capital	Description
60%	New site; poor access; no AML activity anticipated
50%	Established access; no AML activity anticipated
40%	AML reclamation anticipated or completed
30%	Retrofit/improvements required to an existing treatment system

Table 11: Proposed treatment costs of high priority sites

Stream	SWS	Discharge	Capital Cost	Ancillary Cost	Contingency Cost	Total Cost
UNT/Beaver Creek RM 1.68	159	MC27J6-560-1	$ 541,343	$ 75,318	$ 54,134.30	$ 670,795.30
UNT/Beaver Creek RM 1.68	159	MC27J6-561-2	$ 191,365	$ 54,294	$ 19,136.50	$ 264,795.50
Little Sandy Creek	129	MC27J-300-1 MC27J-300-2	$ 583,745	$ 101,136	$ 58,374.50	$ 743,255.50
Sovern Run	109	MC27F-10-1	$ 884,364	$ 130,364	$ 88,436.40	$ 1,103,164.40
Total Treatment Cost for High Priority Sites						$ 2,782,010.70

Table 12: Proposed treatment costs of lower priority sites

Stream	SWS	Discharge	Ancillary %	Capital Cost	Ancillary Cost	Contingency Cost	Engineering Cost	Total Cost
Glade Run	160	MC27J6-100-1	50%	$ 24,050	$ 12,025	$ 2,405	$ 2,405	$ 40,885
UNT/Webster Run RM 1.25	169	MC27J2-200-1	60%	$ 117,329	$ 70,397.40	$ 11,732.90	$ 11,732.90	$ 211,192.20
Sovern Run	109	MC27F-100-2	40%	$ 472,716	$ 189,086.40	$ 47,271.60	$ 47,271.60	$ 756,345.60
Total Treatment Cost for Other Planned Sites								$ 1,008,422.80

Table 13: Treatment costs of sites with no planned treatment

Stream	SWS	Discharge	Ancillary %	Capital Cost	Ancillary Cost	Contingency Cost	Engineering Cost	Total Cost
UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	104	MC27B-100-1	50%	$ 1,037,128	$ 518,564	$ 103,712.80	$ 103,712.80	$ 1,763,117.60
UNT/UNT RM 0.54/Big Sandy Creek RM 2.92	104	MC27B-100-2	50%	$ 32,386	$ 16,193	$ 3,238.60	$ 3,238.60	$ 55,056.20
UNT/UNT RM 0.54/Big Sandy Creek RM 2.94	104	MC27B-100-4	50%	$ 29,414	$ 14,707	$ 2,941.40	$ 2,941.40	$ 50,003.80
Barnes Run	134	MC27J-100-1	50%	$ 48,940	$ 24,470	$ 4,894	$ 4,894	$ 83,198
Hog Run	136	MC27J9-100-1	60%	$ 60,958	$ 36,574.80	$ 6,095.80	$ 6,095.80	$ 109,724.40
Little Sandy Creek	138	MC27J-400-1	No pH in TMDL Data for AMD Treat Calculations, could not sample because of location of seep.					
Piney Run	139	MC27J11-100-1	60%	$ 64,302	$ 38,581.20	$ 6,430.20	$ 6,430.20	$ 115,743.60
Cherry Run	142	MC27J12-200-1	50%	$ 82,563	$ 41,281.50	$ 8,256.30	$ 8,256.30	$ 140,357.10
UNT/Cherry Run RM 1.96	144	MC27J12-400-1	60%	$ 81,446	$ 48,867.60	$ 8,144.60	$ 8,144.60	$ 146,602.80
UNT/Cherry Run RM 0.21	145	MC27J12-100-1	50%	$ 59,851	$ 29,925.50	$ 5,985.10	$ 5,985.10	$ 101,746.70
UNT/Cherry Run RM 0.21	145	MC27J12-200-2	50%	$ 66,380	$ 33,190	$ 6,638	$ 6,638	$ 112,846
UNT/Cherry Run RM 0.21	145	MC27J12-300-1	60%	$ 37,574	$ 22,544.40	$ 3,757.40	$ 3,757.40	$ 67,633.20
UNT/Cherry Run RM 0.21	145	MC27J12-300-2	50%	$ 34,656	$ 17,328	$ 3,465.60	$ 3,465.60	$ 58,915.20
UNT/Cherry Run RM 0.21	145	MC27J12-300-3	50%	$ 38,850	$ 19,425	$ 3,885	$ 3,885	$ 66,045
Beaver Creek	154	MC27J6-567-2	60%	$ 39,543	$ 23,725.80	$ 3,954.30	$ 3,954.30	$ 71,177.40
Webster Run	164	MC27J-200-1	60%	$ 124,858	$ 74,914.80	$ 12,485.80	$ 12,485.80	$ 224,744.40

UNT/UNT RM 0.30/Webster Run RM 1.25	170	MC27J2-100-1	50%	$ 129,310	$ 64,655	$ 12,931	$ 12,931	$ 219,827
Hazel Run	173	MC27K-100-1	60%	$ 32,245	$ 19,347	$ 3,224.50	$ 3,224.50	$ 58,041

4.5 Priority treatment implementation areas

Treatment of seeps in the following subwatersheds is planned and prioritized because:

A. The 303(d) list catalogues these streams as impaired by total Fe, dissolved Al, or pH.
B. The TMDL lists required reductions of Fe or dissolved Al from AMLs in these subwatersheds.
C. FOC data supports the stream impairments stated in the 303(d) list.

High Priority seeps selected for treatment have the following characteristics:

A. The landowner is interested in partnership*.
B. The seep is accessible for construction.
C. There is space and topsoil available for construction.
D. The seep flow is significant.
E. The pollutant load from the seep is significant.

Tables 14 through 17 summarize the known seeps in the sub-watersheds identified as priority treatment areas.

*Landowners designated as "interested in partnership", are designated as such because they were open to the discussion of treatment. They either accepted a landowner manual (8) or the monitoring coordinator (Ellie Bell) had a conversation with them. We did not go any further with developing partnership, because often the landowners expect a big project to be completed quickly and it can take much longer than they anticipate. Also, communications about projects is difficult when there is Monitoring Coordinator/Project Manager turnover at FOC. It has been most successful to maintain communication, but to develop the partnership relationship closer to the time of the project. Notes on the communication thus far are in Appendix C.

Beaver Creek

Priority Seeps for treatment in the Beaver Creek watershed include MC27J6-560-1, MC27J6-561-1, and MC27J561-2. Engineering is already underway for treatment of seep MC27J6-561-1 (Auman Road Project). By treating these seeps at 100%, FOC will accomplish 98% of the required load reduction in-stream within SWS 159, which will in turn improve water quality to the mainstem of Beaver Creek. Overall, treating these three seeps would remove 3542 lbs/yr of Al and 2316 lbs/yr Fe from SWS 159 and ultimately Beaver Creek. Current Baseline LA for SWS 159 for is 3810 lbs/year Al and 7315 lbs/yr Fe. Current TMDL for SWS 159 is 1231.99 lbs/yr Al and 6416.06 lbs/yr Fe. SWS 159 is predicted to meet water quality standards upon completion of the below proposed systems. FOC has monitored SWS 159 mouth 21 times since 2015. Lowest pH recorded was 3.18, and highest 7.25. Average pH was 4.74. FOC is confident that removing the two largest sources of acidity to SWS 159 will lead to restored water quality at SWS 159 mouth. FOC will conduct post monitoring after completion of priority sites in order to assess success and will work with WVDEP to assess future listing decisions of SWS 159 if supported by data.

Seep MC27J6-565-1 resides within SWS 152 within the Beaver Creek watershed, but current required load reductions are 0% for both Al and Fe. FOC Project McCarty Highwall is treating MC27J6-565-1.

No current site improvements are planned at this time. FOC will work with WVDEP to to assess future listing decisions SWS 152 with supporting data.

MC27J6-567-1 and MC27J6-567-2 are thought to be treated by WVDEP Primrose Bond Forfeiture site. SWS 154 is meeting water quality standards according to FOC water quality data. FOC will work with WVDEP to assess future listing decisions of SWS 154 with supporting data.

MC27J6-560-1

This seep can be treated with a passive system. The landowner is interested in partnership, because he wants to be able to use the water for his cows. There is sufficient topsoil and space to construct a treatment system. There is also adequate access to the site via existing roads. This seep contributes almost 50% of Al from AML seeps and 82% of Fe from AML seeps to SWS 159. The remaining 50% of Al and 7% of the remaining Fe from AML seeps is from a seep that will be treated by FOC's newest project, Beaver Creek at Auman Road (MC27J6-561-1). Because of landowner interest, available space and access, pollutant loads, and potential impact on the SWS, this site is prioritized.

MC27J6-561-2

MC27J6-561-2 is the other known seep in SWS 159. This seep contributes the remaining Al to the stream. Treatment of this seep in addition to MC27J6-560-1 and MC27J6-561-1 will accomplish 98% of the required reduction in-stream in this SWS. There is room for treatment at this site and the landowner is interested in partnership. Because of landowner interest, available space and access, pollutant loads, and potential impact on the SWS, this site is prioritized.

MC27J6-567-2

MC27J6-576-2 is the only remaining seep in SWS 154, since MC27J6-567-1 according to the WVDEP Office of Special Reclamation (OSR) being treated by the OSR Primrose treatment system. According to the TMDL MC27J6-567-2 contributes 99% of the Fe load from AML sites in SWS 154. However, FOC performed reconnaissance sampling on each drainage from the AML where this seep is located as well as the seep itself. Monitoring results from SWS 154 did not violate the water quality limits for pH, total Fe, or dissolved Al. Therefore, no restoration efforts are planned in SWS 154. Improvement in water quality in this SWS are likely due to the installment of the BF Primrose treatment site after the Cheat River Basin 2011 TMDL was written. Treatment of this seep is unnecessary and not planned.

MC27J6-100-1

The last known major seep in the Beaver Creek watershed is MC27J6-100-1. The seep, following land reclamation by AML, discharges from a pipe within ten feet of the stream. This seep has low flows and high metal loads. The landowner has contacted AML to clean out the clogged pipes that were installed to collect the AMD that leaks into his house. Once this maintenance occurs, higher flows are expected. Results from two sampling days in 2017 and 2018 at Glade Run mouth (Glade at Centenary) show that Glade Run is unimpaired. Monitoring will continue at the mouth of Glade Creek SWS 160 to check that Glade Run is unimpaired. FOC will budget in this watershed-based plan for passive treatment at this site based on TMDL data in case of changes in in-stream water quality after AML maintenance. This site is listed in the plan for treatment, but not prioritized for the first phase of project implementation.

Table 14: Known seeps in the Beaver Creek watershed

Stream Code	Stream Name	SWS	Discharge numbers	Notes
WV-MC-27-J-6-C	UNT/Beaver Creek RM 1.25	152	MC27J6-565-1	Existing FOC passive treatment project, McCarty Highwall
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-1	Treated by Primrose BFS
WV-MC-27-J-6	Beaver Creek	154	MC27J6-567-2	SWS 154 meets WQ standards according to FOC data. This is likely due to treatment of Primrose. Access to seep is extremely difficult. No treatment is planned.
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-560-1	Priority Treatment Site
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-1	FOC passive treatment project, Auman Road, will be treating this in 2019.
WV-MC-27-J-6-D	UNT/Beaver Creek RM 1.68	159	MC27J6-561-2	Priority Treatment Site
WV-MC-27-J-6-B	Glade Run	160	MC27J6-100-1	Secondary Treatment Site. Plan for eventual treatment after AML maintenance occurs at site.

Little Sandy Creek

Priority seeps for treatment in the Little Sandy Creek watershed include MC27J-300-1 and MC27J300-2, both within SWS 129. Treatment of these seeps at 100% reduction would result in the removal of 834 lbs/yr Al and 150 lbs/yr Fe. These are the only known direct sources of impairment from AMLs to Little Sandy Creek SWS 129. Many of the SWSs upstream of SWS 129 that have been listed for impairment for pH, Fe, and Al have been found by FOC water sampling efforts to not be impaired when collecting mouth samples. FOC will work with WVDEP to reevaluate the impairment of SWSs upstream of SWS 129. Water Quality instream in SWS 129 is expected to improve by treatment of these seeps. If SWS 129 is still impaired after treatment, FOC will reevaluate sources in SWSs upstream that contribute water to SWS 129 for future treatment in partnership with WVDEP.

MC27J-300-1 and MC27J-300-2

These seeps are the only known direct sources of impairment from AMLs to Little Sandy Creek SWS 129. They are close to each other, allowing for both to be treated in one system. Both landowners are interested in partnership, and there is plenty of space and top soil to construct a treatment system. The AML is not abated; however, the water is naturally channelized. Because of landowner interest, pollutant loads, and potential impact on the SWS, this site is prioritized.

MC27J-400-1

FOC has visited the Hog Run portals twice where this seep is mapped on the TMDL. FOC was unable to access the seep. It is likely over a fence without a nearby gate and is very close to the interstate. The access is too dangerous to fully assess them, and it is too close to the interstate for treatment.

Table 15: Known Seeps in Little Sandy Creek Subwatersheds

Stream Code	Stream Name	SWS	Discharge Number	Notes
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-1	Priority Treatment Site
WV-MC-27-J	Little Sandy Creek	129	MC27J-300-2	Priority Treatment Site
WV-MC-27-J	Little Sandy Creek	138	MC27J-400-1	Treatment is impossible. Too close to the interstate.

Sovern Run

FOC is already invested in the restoration of Sovern Run with three major passive treatment projects: "Titchenell Road and Limestone Sands", "Sovern 62 and Bishoff Slag Bed", and the "Clark" project. FOC's fourth project "Sovern England" was completed in July, 2018. Sovern Run has been named an EPA "success story" (9). FOC has collected data in 2017 to support that Sovern Run should be removed from the 303(d) list for impairments. However, in-stream data suggests that Sovern Run is still impaired in SWS 109. Therefore, FOC will continue to focus on treating remaining sources of AMD in the Sovern Run SWS 109. Seeps MC27F-100-3 and MC27F-100-6 are already being treated by FOC Passive AMD treatment systems and are monitored and maintained. Seeps MC27F-100-2 and MC27F-200-7 are not eligible for treatment or improvement projects currently due to landowner relations. If landowner changes, FOC will reconsider treatment at these sites. MC27F-300-1 is not in the Sovern Run watershed, it is in SWS 241. MC27F-10-1 remains the largest untreated contributor of AMD to the Sovern Run watershed, and FOC received EPA 319 funds to begin Phase 1 of construction of the future "Sovern Tom Clark" project. By treating this seep, FOC will remove 7474 lbs/yr Al and 468 lbs/yr Fe from SWS 109. When completed, FOC passive AMD treatment systems will remove loads from MC27F-100-3, MC27F-100-6 and MC27F-10-1 resulting in 7771 lbs/yr Al removed and 645 lbs/yr Fe removed. FOC is confident treating MC27F-10-1 will result in improved water quality for SWS 109 and will lead to an assessment of future listing decisions of SWS 109 based on FOC sample data. Based on data collected by BioMost, who was contracted by FOC, MC27F-10-1 contributes 152,318.15 lbs/yr acidity, 1200.25 lbs/yr total Fe, and 20242.9 lbs/yr dissolved Al during a high flow conditions. FOC has decided to build the future "Sovern Tom Clark" AMD remediation site for MC27F-10-1 with high flow conditions in mind and will scale to treat the above parameters. By comparison, a sample collected 5/14/2018 from "US Sovern Sands", a site downstream of MC27F-10-1 and upstream of a instream limestone fines site contributed 72761.68 lbs/yr acidity, 3464.84 lbs/year total Fe, and non-detect levels of dissolved Al, showing that MC27F-10-1 is certainly a large contributor to acidity, Fe, and Al. After project completion FOC will evaluate success and coordinate efforts with WVDEP to to assess future listing decisions of Sovern Run for impairments. If improvements are still needed, FOC will work to reevaluate remaining seeps and attempt to convince landowners of the importance of treating remaining seeps in SWS 109.

MC27F-10-1

This seep is a series of seeps across a hillside. This area of seeps produces 50% of the Al and 9% of the Fe from known AMLs in Sovern Run. The landowner is interested in partnership and there is available space for treatment. This site is high priority.

MC27F-300-1

Though listed in the Sovern Run watershed on the TMDL, this seep is not in the Sovern Run watershed. It is in SWS 241.

MC27F-100-2

This seep is located directly next to the existing FOC treatment site, "Titchenell Road and Limestone Sands" limestone bed. The landowner is not interested in any more space on his land being taken by treatment. Treatment of this seep is not possible and is not planned.

Table 16: Known seeps in Sovern Run watershed

WV NHD Stream Code	Stream Name	SWS	Discharge Number	Notes
WV-MC-27-F	Sovern Run	109	MC27F-100-2	Directly next to Sovern Titchenell Upper Limestone Bed. Treatment is not prioritized due to landowner. However, treatment is planned in case of changes.
WV-MC-27-F	Sovern Run	109	MC27F-100-3	FOC passive treatment site: Sovern Titchenell.
WV-MC-27-F	Sovern Run	109	MC27F-100-6	FOC Passive treatment site: Sovern 62.
WV-MC-27-F	Sovern Run	109	MC27F-10-1	Prioritized treatment site
WV-MC-27-F	Sovern Run	109	MC27F-200-7	FOC Passive treatment site: Clark. Improvements not possible due to landowner.
WV-MC-27-F	Sovern Run	109	MC27F-300-1	Not in Big Sandy Creek watershed.

Webster Run

FOC has not indicated any priority seeps for treatment in the Webster Run watershed. Seeps MC27J2-100-1 and MC27J-200-1 are not a priority as samples collected at the mouths of each corresponding SWS (SWS 164 and SWS 170) met water quality standards for each sampling effort conducted by FOC. Seep MC27J2-200-1 is a critical seep for treatment, however the current landowner is not interested in partnership at this time. FOC will attempt partnership if current landowner changes.

UNT/Webster Run RM 1.25

UNT/Webster Run RM 1.25 is impaired by pH, Fe (modeled), and Al on the 303(d) list. There are two seeps located in the UNT/Webster Run RM 1.25 watershed (SWS 168-170). One seep, MC27J12-100-1, is in the unimpaired unnamed tributary of UNT/Webster Run RM 1.25, UNT/UNT RM 0.30/Webster Run RM 1.25 that drains SWS 170. The other seep, MC27J2-200-1, is in impaired SWS 169 that drains UNT/Webster Run RM 1.25.

FOC sampled SWS 168 mouth downstream of the confluence of SWS 169 and 170. Neither of the samples violated the water quality limits for pH, total Fe, or dissolved Al.

FOC also performed reconnaissance monitoring on the AML where MC27J2-100-1 is located in SWS 170. There was no obvious flow at any point in the AML system, no obvious outlet from the system, and no identifiable seeps. The seeps from the reclaimed AML highwall called Webster Refuse are channelized through an underground limestone channel and then discharged to a pond. pH measurements taken downstream of the seep on UNT/UNT/Webster Run RM 1.25 read 6.45.

Our analysis indicates that pH, Fe, and Al meet water quality standards in SWS 168, no AMD was located in SWS 170 and instream monitoring shows a healthy pH in SWS 170, but pH measurements at the mouth of SWS 169 read 5.5. The landowner of the only known seep in SWS 169 is very elderly and not willing to allow FOC to access the property to investigate. Therefore, for the purposed of this plan we will design treatment based on the data that we have from the TMDL. FOC will try to gain access to this seep again in the future.

Table 17: Known seeps in the Webster Run watershed

WV NHD Stream Code	Stream Name	SWS	Discharge Number	Notes
WV-MC-27-J-2-B-1	UNT/UNT RM 0.30/WEBSTER RUN RM 1.25	170	MC27J2-100-1	SWS mouth meets WQ standards according to FOC data No AMD at TMDL seep site. No treatment planned
WV-MC-27-J-2-B	UNT/WEBSTER RUN RM 1.25	169	MC27J2-200-1	Landowner is not interested in partnership. Due to significance of pollution load, treatment is planned in case of changes.
WV-MC-27-J-2	Webster Run	164	MC27J-200-1	SWS mouth meets WQ standards according to FOC data.

Low priority sub-watersheds

The TMDL is produced using a model and limited samples, monitoring of which primarily occurred between June 2006 and June 2007. The following streams have measured impairments and/or modeled impairments in the 2014 303(d) list, but our analysis at the SWS mouths indicate that the streams meet water quality standards for the listed impairment (Table 18). Therefore, seeps in these SWSs are not prioritized for treatment.

Table 18: Low priority sub-watersheds

WV NHD Stream Code	Stream Name	Impairment	SWS	Lowest FOC lab pH	Highest FOC total Fe (mg/L)	Highest FOC dissolved Al (mg/L)
WV-MC-27-J-7	Barnes Run	pH*	134	6.73*		
WV-MC-27-J-6	Beaver Creek	pH, Fe, Al	154	7.64	0.183	0.063
WV-MC-27-J-13	Mill Run	pH*	146	7.22		
WV-MC-27-J-11	Piney Run	pH, Fe, Al*	139	7.21	0.577	0.0348
WV-MC-27-J-10	Elk Run	pH	149	7.08		
WV-MC-27-J-9	Hog Run	pH*, Fe, Al*	136	6.79	0.294	0.0425
WV-MC-27-K	Hazel Run	pH, Fe, Al	173	7.38	0.394	0.0213
WV-MC-27-H	Parker Run	pH*, Fe	114	6.9	1.35	
WV-MC-27-J-12-D	UNT/Cherry Run RM 1.96	pH, Fe	144	7.31	0.165	
WV-MC-27-B-1	UNT/UNT RM 0.54/Big Sandy Creek RM 2.91	pH, Fe, Al	104	5.5	0.229	0.0634

*Modeled impairment

Barnes Run

Barnes Run is impaired for pH on the 303(d) list and has load reduction requirements for Fe and Al on the TMDL. Since the goal of this plan is to ultimately remove watersheds from the 303(D) list for impairments, monitoring focused on the pH of Barnes Run. One sample was collected at the mouth of SWS 134 in 2017. The pH of this sample was 6.73. The owner of the property stated that trout had been caught just upstream of the sample location. The monitoring sweep also included a sample at the seep MC27J-100-1 and above stream of the seep. The sample taken in 2017 at the seep had a pH of 6.44. One other sample from FOC at the seep was taken in 2015 with a pH of 6.2. Since this seep is not producing acidity and our analysis indicates that pH meets water quality standards in SWS 134, no restoration efforts are planned. Further sampling is not feasible, because access to the site requires a four-wheeler on private property.

Cherry Run

Cherry Run is impaired for modeled pH, Fe and Al on the 303(d) list. FOC sampled the mouth twice and the data indicates that the stream meets water quality standards.

Mill Run

Mill Run is impaired for pH on the 303(d) list. This impairment was modeled. FOC sampled Mill Run at the mouth of SWS 146 four times from 2015 to 2017 at varying discharges. The lowest pH was 6.74. Therefore, our analysis indicates that pH meets water quality standards in SWS 146, so no restoration efforts are planned.

Piney Run

Piney Run is impaired by pH, Fe, and (modeled) Al. The watershed has one known seep. The stream and the seep have required reductions of Fe and Al listed in the TMDL. However, FOC sampled the mouth of SWS 139 twice at varying water levels. Neither of the samples exceeded the water quality limits for pH, total Fe, or dissolved Al. Therefore, no restoration efforts are planned in SWS 139.

Elk Run

Elk Run is impaired for pH on the 303(d) list and has load reduction requirements for Fe and Al on the TMDL. Since the goal of this plan is to ultimately remove watersheds from the 303(D) list for impairments and since FOC could not identify the source of Fe or Al loads from AMLs in the watershed, monitoring focused on the pH of Elk Run. Three samples were taken at the mouth of SWS 149 in 2016 and 2017 at varying discharge levels. The lowest pH was 6.93. Therefore, our analysis indicates that pH meets water quality standards in SWS 149. So, no restoration efforts are planned.

Hog Run

Hog Run is impaired for pH (modeled), Fe, and Al (modeled) on the 303(d) list. There is one known seep in the watershed. The stream and the seep have required reductions of Fe and Al listed in the TMDL. However, FOC sampled the mouth of SWS 136 five times between 2015 and 2017 at varying water levels. The samples never exceeded the water quality limits for pH, total Fe, or dissolved Al. Therefore, no restoration efforts are planned in SWS 136.

Hazel Run

Hazel Run is impaired by pH, Fe, and Al on the 303(d) list. There is one seep located in Hazel Run watershed, MC27K-100-1. There are required reductions of Fe and Al on the TMDL. FOC sampled the mouth of SWS 173 twice at varying discharges in 2016 and 2017. Neither of the samples exceeded the water quality limits for pH, total Fe, or dissolved Al. Therefore, no restoration efforts are planned in SWS 173.

Parker Run

Parker Run is impaired by pH (modeled) and Fe. FOC sampled the mouth of SWS 114 in 2016. The pH was 6.9. Samples were taken with non-detectable levels of Al and 0.398 mg/L dissolved Fe. Please note that there are no known seeps in the Parker Run watershed. In the future there could be a seep discovered, but with the information we have there is no way to plan for restoration.

UNT/Cherry Run RM 1.96

UNT/Cherry Run RM 1.96 is impaired by pH and Fe on the 303(d) list. The FOC samples did not exceed limits for pH or Fe. Therefore, no restoration efforts are planned in SWS 144.

UNT/UNT RM 0.54/Big Sandy Creek RM 2.91

Seep MC27B-100-1 produced the most Fe and Al of any of the seeps in the Big Sandy Creek watershed when the TMDL was written in 2011. However, with the construction of the Freeport BF treatment site S-1005-95 in 2011, the majority of the AMD from the Pisgah Highwall #2 AML is being captured and treated. Data gathered downstream of the confluence of UNT/UNT RM 0.54/BIG SANDY CREEK RM 2.91 where MC27B-100-1, MC27B-100-4, MC27B100-2 and MC27B-100-1 are located and UNT/BIG SANDY CREEK RM 2.91 proved that these seeps are not producing a significant load to the Big Sandy Creek main stem and UNT/BIG SANDY CREEK RM 2.91 is likely not impaired by pH, Al, or Fe as stated on the 303(d) list. Therefore, FOC will not focus restoration efforts on any of the seeps in this watershed.

Impaired SWSs without known AMD seeps

The SWSs listed in Table 19 have required reductions of Fe and Al from AMLs listed on the TMDL, but they do not have any known seeps. Therefore, restoration efforts will not be focused on these watersheds at this time. If we find a clear source of the impairment, we will take steps to install treatment systems.

Table 19: SWSs with required reductions for AMLs but without known AMD seeps

WV NHD Stream Code	Stream Name	SWS
WV-MC-27-B	UNT/Big Sandy Creek RM 2.91	103
WV-MC-27-F-2	UNT/Sovern Run RM 1.50	110
WV-MC-27	Big Sandy Creek	111
WV-MC-27-H	Parker Run	114
WV-MC-27-J	Little Sandy Creek	131
WV-MC-27-J	Little Sandy Creek	132

WV-MC-27-J-13	Mill Run	146
WV-MC-27-J-10	Elk Run	147
WV-MC-27-J-10-A	UNT/Elk Run RM 1.37	148
WV-MC-27-J-10	Elk Run	149
WV-MC-27-J-6	Beaver Creek	150
WV-MC-27-J-3	UNT/Little Sandy Creek RM 2.80	162
WV-MC-27-J-2	Webster Run	165
WV-MC-27-J-2	Webster Run	166
WV-MC-27-J-2-C	UNT/Webster Run RM 2.05	167
WV-MC-27-J-2-B	UNT/Webster Run RM 1.25	168
WV-MC-27	Big Sandy Creek	176
WV-MC-27-M	Glade Run	173

5. Technical and financial assistance needs

Technical and financial assistance is needed for water sample analysis at AMD sources for designing treatment projects and measuring the effectiveness of the projects, creating conceptual designs and detailed engineering designs, and managing the projects through bidding, construction, operation, and maintenance.

Financial assistance is needed to design and build the selected remediation projects (Table 20). Many funding sources (financial and/or in-kind) are available for nonpoint source AMD remediation on AMLs and for water quality monitoring, including:

- Section 319 funds,
- Abandoned Mine Reclamation (AMR) Fund, including money in the AMD Set-Aside Fund,
- Watershed Cooperative Agreement Program grants,
- Stream Partners Program grants,
- Local government contributions,
- Business contributions,
- Service donations from businesses,
- Private donations

Table 20: Engineering, construction, and monitoring costs for high priority sites

Stream	SWS	Discharge	Capital Cost	Ancillary Cost	Contingency Cost	Monitoring Cost	Total Cost
UNT/Beaver Creek RM 1.68	159	MC27J6-560-1	$ 541,343.00	$ 75,318.00	$ 54,134.30	$17,930.88	$ 688,726.18
UNT/Beaver Creek RM 1.68	159	MC27J6-561-2	$ 191,365.00	$ 54,294.00	$ 19,136.50	$17,930.88	$ 282,726.38
Little Sandy Creek	129	MC27J-300-1 MC27J-300-2	$ 583,745.00	$ 101,136.00	$ 58,374.50	$20,634.88	$ 763,890.38
Sovern Run	109	MC27F-10-1	$ 884,364.00	$ 130,364.00	$ 88,436.40	$36,792.64	$ 1,139,957.04
Total Treatment Cost for High Priority Sites							$ 2,875,299.98

Two WVDEP divisions will provide technical assistance. The Division of Water and Waste Management provides technical assistance for the use of BMPs, educates the public and land users on nonpoint source issues, enforces water quality laws that affect nonpoint sources, and restores impaired watersheds through its Watershed Improvement Branch (10).

Clean Water Act Section 319 funds are provided by 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 Big Sandy Creek Watershed. WVDEP's Watershed Improvement Branch sets priorities and administers the state Section 319 program (10).

A second division within WVDEP, the Office of Abandoned Mine Lands and Reclamation (OAMLR), directs technical resources to watersheds to address AMLs.

OAMLR also funds AML remediation projects via the AMR Fund. Before 1977 when the Surface Mining Control and Reclamation Act was enacted, coal mines generally did not manage acid-producing material to prevent AMD or treat the AMD that was produced. These "pre-law" mines continue to be significant AMD sources and are treated as nonpoint sources under the Clean Water Act.

To reclaim these AMLs, the Act established the AMR Fund. This fund, supported by a per-ton tax on mined coal, is allocated to coal mining states for remediation projects. WVDEP has funded many AMD remediation projects on AMLs, but these projects are typically not designed to meet stringent water quality goals. 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). The AMR Fund is slated to sunset in 2022, meaning that Fund allocations may not be sufficient to reclaim many AML sites—even for safety issues.

OAMLR also administers a closely linked source of funding: the AMD Set-Aside Fund. In the past, up to 10% of states' annual AMR Fund allocations could be reserved as an endowment for use on water quality projects. States can now reserve up to 30%. These funds are critically important, because while regular AMR Fund allocations can only be spent on capital costs, AMD Set-Aside Fund allocations can be spent on O&M.

Office of Surface Mining, Reclamation, and Enforcement

OSMRE has helped place summer interns and AmeriCorps*Volunteers in Service to America (OSM/VISTA) volunteers to assist with AMD-related projects.

OSM grants specifically for AMD remediation projects on AMLs are available through the WCAP, part of the Appalachian Clean Streams Initiative. Grants of up to $100,000 are awarded to not-for-profit organizations that have developed cooperative agreements with other entities to reclaim AML sites (11). A match from 319 funds is required to receive these grants and is sometimes met with money from the AMR Fund or WVDEP's Stream Restoration Fund.

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 and water quality monitoring, public education, stream restoration, and organizational development. Stream Partners grants will be pursued in the future to compliment nonpoint source research, education, and reclamation projects in the watershed (12).

6. Information, education, and public participation

State of the Cheat River watershed outreach event series

Friends of the Cheat completed a three-part series of outreach events for the public called the State of the Cheat River Watershed in 2017 and 2018 (13). This outreach initiative was aimed to educate the public about past challenges, current successes, and future goals to restore, preserve, and promote the watershed. The series highlighted remediation efforts including treatment projects and watershed-based plans and asked landowners to report known AMD on their property. Friends of the Cheat plans to continue this series annually.

Cheat River Festival

Every spring, for 24 years, FOC has been hosting the Cheat River Festival. This is FOC's largest outreach and fundraising event. Thousands of patrons come to learn about all aspects of FOC's mission, including restoration initiatives. FOC will have information regarding restoration successes and plans at the informational area in the festival. FOC also invited landowners and other restoration stake holders to learn more about how they can be involved and to teach the public about their current involvement in restoration.

Newsletters

FOC newsletters are distributed in print every quarter. They are also available online. Newsletters will continue to update readers about planned nonpoint source remediation projects and about remediation priorities.

Youth education

FOC has developed curriculum to teach kids about streams. FOC visits a local 4-H camp each year and many music festivals to teach kids about ecology and pollution in streams. Performing outreach and education to children is likely to be an effective strategy for building long-term support for the watershed's remediation priorities.

Website

FOC also maintains a website, www.cheat.org with information about remediation projects and priorities (14).

Landowner handbook

FOC created a handbook for landowners to describe the reclamation process and updated this book in 2017. The booklet describes monitoring, implementation, funding, and regulation to landowners and potential landowner partners (8).

River of Promise

River of Promise began in 1995. The premise was to bring together stakeholders including industry, state and federal agencies, watershed groups, and the public to share information and work on solving AMD issues. Quarterly River of Promise meetings are open to the public. Information on nonpoint source remediation projects and priorities will be freely available to all who attend these meetings.

7. Schedule and milestones

FOC hopes to secure funds to address and treat all priority sites between 2019 and 2027 in the Big Sandy Creek Watershed Based Plan. After each priority site is developed, the site and the subsequent SWS will be monitored through the course of one year to ensure the pollutant loads are appropriately reduced. If load is not appropriately reduced, low priority seeps will be revisited for proposals until proper load reduction for specific SWS is met. Sites in which landowner cooperation is not currently viable will be revisited if/when property changes ownership.

Milestones for the Big Sandy Watershed Based Plan are as follows:

- Secure Funding For Priority Sites
- Implement Site Design and Construction of Priority Sites
- Conduct Post Monitoring of Priority Sites
- Evaluate Success of Priority Sites
- Reassess Low Priority Sites and Site Ownership
- Secure Funding for Low Priority Sites as needed for Load Reduction
- Implement Site Design and Construction for Low Priority Sites as needed
- Conduct Post Monitoring of Low Priority Sites
- Routine Sampling of Sites to Ensure System Outs are Meeting Water Quality Standards

A general example of the timeline for a watershed project is provided in Table 21. Tables 22a - 22e provide anticipated schedule for the implementation of the high priority sites.

Table 21: General example of a watershed project timeline

	Pre	Year 1	Year2	Year3	Year 4	Year 5	Post
Planning							
Develop WBP	<--						
Collect Monitoring Data							
Assess Project Sites							
Feasibility Study							
Landowner Contact							
Apply for Funding							
Receive Funding							
Implementation							
Engineering Services							
Environmental Permitting							
Construction							
Operation and Maintenance							
Operation and Maintenance							

AMD Source: *MC27J6-560-1*
Stream: *UNT to Beaver Creek*
Project: *Beaver Creek at McElroy Passive Treatment*

	2017	2018				2019				2020				2021			
Implementation Schedule	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Submit§319 proposal	X																
Receive §319 funding					X												
Procure engineer							X	X	X	X	X	X	X	X			
Apply for match funding									X								
Obtain necessary landowner agreements									X								
Water quality monitoring					X	X	X	X	X	X	X	X	X	X	X	X	X
Obtain necessary construction permits							X	X	X	X	X						
Procure construction contractor											X						
Construct treatment system												X	X	X			
No water quality violations in the last 6 months from collection point at system out																	X

Table 22a: Implementation schedule for MC27J6-560-1

AMD Source: *MC27F10-1*
Stream: *Sovern Run*
Project: *Sovern Tom Clark Passive AMD Treatement System*

	2018	2019				2020				2021				2022			
Implementation Schedule	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase I																	
Submit§319 proposal for Phase I treatment system	X																
Receive §319 funding for Phase I				X													
Procure engineer to design all phases of Sovern Tom Clark AMD Treatment			X	X	X	X	X	X	X	X	X	X	X				
Apply for match funding					X												
Obtain necessary landowner agreements					X												
Water quality monitoring				X	X	X	X	X	X	X	X	X	X	X	X	X	X
Obtain necessary construction permits				X	X	X	X	X									
Procure construction contractor								X									
Construct Phase I treatment system									X	X	X	X	X				

Table 22b: Implementation schedule for MC27F10-1 (Phase I)

AMD Source: *MC27F10-1*
Stream: *Sovern Run*
Project: *Sovern Tom Clark Passive AMD Treatement System*

	2019	2020				2021				2022				2023			
Implementation Schedule	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase II																	
Submit§319	X																
Receive				X													
Apply for					X												
Obtain					X												
Water		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Obtain				X	X	X	X	X									
construction								X									
Phase II									X	X	X	X	X				

Table 22c: Implementation schedule for MC27F10-1 (Phase II)

Table 22d: Implementation schedule for MC27F10-1 (Phase III)

AMD Source: *MC27F10-1*
Stream: *Sovern Run*
Project: *Sovern Tom Clark Passive AMD Treatement System*

	2020	2021				2022				2023				2024			
Implementation Schedule	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase III (FINAL)																	
Submit§319 proposal for Phase III treatment system	X																
Receive §319 funding for Phase III				X													
Apply for match funding					X												
Obtain necessary landowner agreements					X												
Pre construction and construction water quality monitoring		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Obtain construction permits				X	X	X	X	X									
Procure construction contractor								X									
Construct Phase III treatment									X	X	X	X	X				
No water quality violations in the last 6 months from collection point at system out																	X

AMD Source: *MC27J6-561-2*
Stream: *UNT to Beaver Creek*
Project: *MC27J6-561-2 Passive Treatment*

	2021	2022				2023				2024				2025			
Milestones	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Submit§319 proposal	X																
Receive §319 funding				X													
Procure engineer			X	X	X	X	X	X	X	X	X	X	X				
Apply for match funding					X												
Obtain necessary landowner agreements					X												
Monitor water quality				X	X	X	X	X	X	X	X	X	X	X	X	X	X
Obtain necessary construction permits				X	X	X	X	X									
Procure construction contractor								X									
Construct Phase I treatment									X	X	X	X	X				
No water quality violations in the last 6 months from collection point at system out																	X

Table 22e: Implementation schedule for MC27J6-561-2

Table 22e: Implementation schedule for MC27J6-300-1/MC27J6-300-2

AMD Source: *MC27J6-300-1/300-2*
Stream: *Little Sandy Creek*
Project: *MC27J6-300-1/300-2 Passive Treatment*

	2022	2023				2024				2025				2026			
Milestones	Q2	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Submit §319 proposal	X																
Receive §319 funding				X													
Procure engineer			X	X	X	X	X	X	X	X	X	X	X				
Apply for match funding					X												
Obtain necessary landowner agreements					X												
Water quality monitoring				X	X	X	X	X	X	X	X	X	X	X	X	X	X
Obtain necessary construction permits				X	X	X	X	X									
Procure construction contractor								X									
Construct Phase I treatment									X	X	X	X	X				
No water quality violations in the last 6 months from collection point at system out																	X

8. Load reduction evaluation criteria

The long-term measurable goals are to achieve required reduction for each seep set by the TMDL and verified by FOC for iron, aluminum, and pH. Achieving these goals should lend to the resolution of in-stream pH, Al, Fe, biological, and sedimentation impairments, however it might not accomplish all West Virginia water quality standards in-stream since AMD is not the only source of these impairments.

Samples will be collected and analyzed quarterly for one year after construction to assess treatment effectiveness. FOC will assess to see if required load reductions are being met at system out. SWS mouth will also be sampled quarterly to evaluate impairment. If SWS is still impaired after all high priority projects in the SWS are completed, FOC will reconsider implementing low priority sites until load reduction is achieved.

Evaluation of load reduction will be accomplished by:

1. Comparing the instream water quality upstream of the seep and downstream of the seep
2. Comparing the pollutant loads in the water entering the system to the pollutant loads in the water exiting the system
3. Comparing the water quality at the SWS mouth before and after the treatment system is implemented.

9. Monitoring component

Monitoring parameters include temperature, flow, pH, conductivity, acidity, alkalinity, total dissolved solids, sulfate, total aluminum, dissolved aluminum, total iron, dissolved iron, total manganese, and dissolved manganese. FOC will monitor water quality pre-construction, during construction, and post-construction. During the pre-construction period FOC will collect and analyze upstream, downstream and seep samples monthly. During the construction period upstream, downstream, and seep samples will be collected and analyzed quarterly. Quarterly post construction samples will be collected and analyzed upstream of treatment, downstream of treatment and after each treatment component.

FOC uses a cost estimate of $250 per sampling effort and then factors in staff time cost using 8 hours per sampling visit per site. This includes, preparing, driving, sampling, returning the samples to the lab, cleaning up the equipment, entering the data, and initially analyzing the data.

Table 23 outlines the monitoring plan and Table 24 outlines the monitoring budget including staff time and lab fees to carry out the restoration efforts. Each of the sites that are selected for treatment in the Priority Implementation Section are listed in Table 23 and 24.

The order of the project implementation for those listed in Table 23 and Table 24 may be subject to change, based on landowner partnerships.

Table 23: Monitoring efforts per site per year

Site	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
MC27J6-560-1	7	12	4	2	2	2	2	2	2	2
MC27F-10-1	9	6	6	6	6	4	1	1	1	1
MC27J6-561-2	2	0	12	4	2	2	2	2	2	2
MC27J-300-1 and MC27J-300-2	2	0	0	12	4	2	2	2	2	2

Table 24: Monitoring budget

		Pre-Construction Sampling Cost				Construction Sampling Cost				Post Constuction Sampling Cost				Total Cost
Project Name	# Sample Sites	Travel	Lab	Personnel	Total	Travel	Lab	Personnel	Total	Travel	Lab	Personnel	Total	Grand Total
MC27F10-1	13	$ 147.84	$ 11,700.00	$ 1,949.40	$ 13,797.24	$ 49.28	$ 3,900.00	$ 649.80	$ 4,599.08	$ 246.40	$ 19,500.00	$ 3,249.00	$ 22,995.40	$ 36,792.64
MC27J6-560-1	6	$ 161.28	$ 5,400.00	$ 1,162.80	$ 6,724.08	$ 53.76	$ 1,800.00	$ 387.60	$ 2,241.36	$ 268.80	$ 9,000.00	$ 1,938.00	$ 11,206.80	$ 17,930.88
MC27J6-561-2	6	$ 161.28	$ 5,400.00	$ 1,162.80	$ 6,724.08	$ 53.76	$ 1,800.00	$ 387.60	$ 2,241.36	$ 268.80	$ 9,000.00	$ 1,938.00	$ 11,206.80	$ 17,930.88
MC27J-300-1/300-2	7	$ 161.28	$ 6,300.00	$ 1,276.80	$ 7,738.08	$ 53.76	$ 2,100.00	$ 425.60	$ 2,579.36	$ 268.80	$ 10,500.00	$ 2,128.00	$ 12,896.80	$ 20,634.88
		TOTAL:			$ 34,983.48				$ 11,661.16				$ 58,305.80	$ 93,289.28

10. References

1. **United States Environmental Protection Agency.** *Handbook for Developing Watershed Plans to Restore and Protect Our Waters, Chapter 2.* 2008.
2. **Friends of the Cheat.** *Big Sandy Watershed-based Planning and Project Design.* 2014.
3. **Department of Environmental Protection Water Resources.** *47 CSR, Series 2, Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards.* 2016.
4. **West Virginia Department of Environmental Protection .** *2012 Draft Section 303(d) List.* 2012.
5. **West Virginia Department of Environmental Protection.** *Total Maximum Daily Loads for Selected Streams in the Cheat River Watershed, West Virginia.* s.l. : Division of Water and Waste Management, Watershed Protection Branch, TMDL Section, 2011.
6. **BioMost, Inc.** Deliverables. 2018.
7. **Office of Surface Mining, Reclamation, and Enforcement.** AMD Treat. Pittsburgh, Pennsylvania : s.n., 2014.
8. **Friends of the Cheat.** *Landowner Handbook: What You Need to Know About Installing an AMD Treatment System on Your Property.*
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10. **West Virginia Department of Environmental Protection.** Nonpoint Source Web page. [Online] Division of Water and Waste Management, 2014. http://www.dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx.
11. **Office of Surface Mining Reclamation and Enforcement (OSMRE).** *Watershed Cooperative Agreement Program-Federal Assistance Manuel, Chapter 6-100.* 2010.
12. **West Virginia Department of Environmental Protection.** Stream Partners Web page. [Online] Division of Water and Waste Management, 2014. https://dep.wv.gov/WWE/getinvolved/WSA_Support/Pages/StreamPartners.aspx.
13. **Friends of the Cheat.** *State of the Cheat River Watershed.* 2017. https://www.cheat.org/archive/publications/.
14. **Friends of the Cheat.** www.cheat.org.
15. **West Virginia Department of Environmental Protection**. *SWS (TMDL subwatersheds).* Division of Water and Waste Management, 2019. https://dep.wv.gov/WWE/Programs/nonptsource/Pages/SWS.aspx

11. Appendix

Appendix A: TMDL seep data (5)

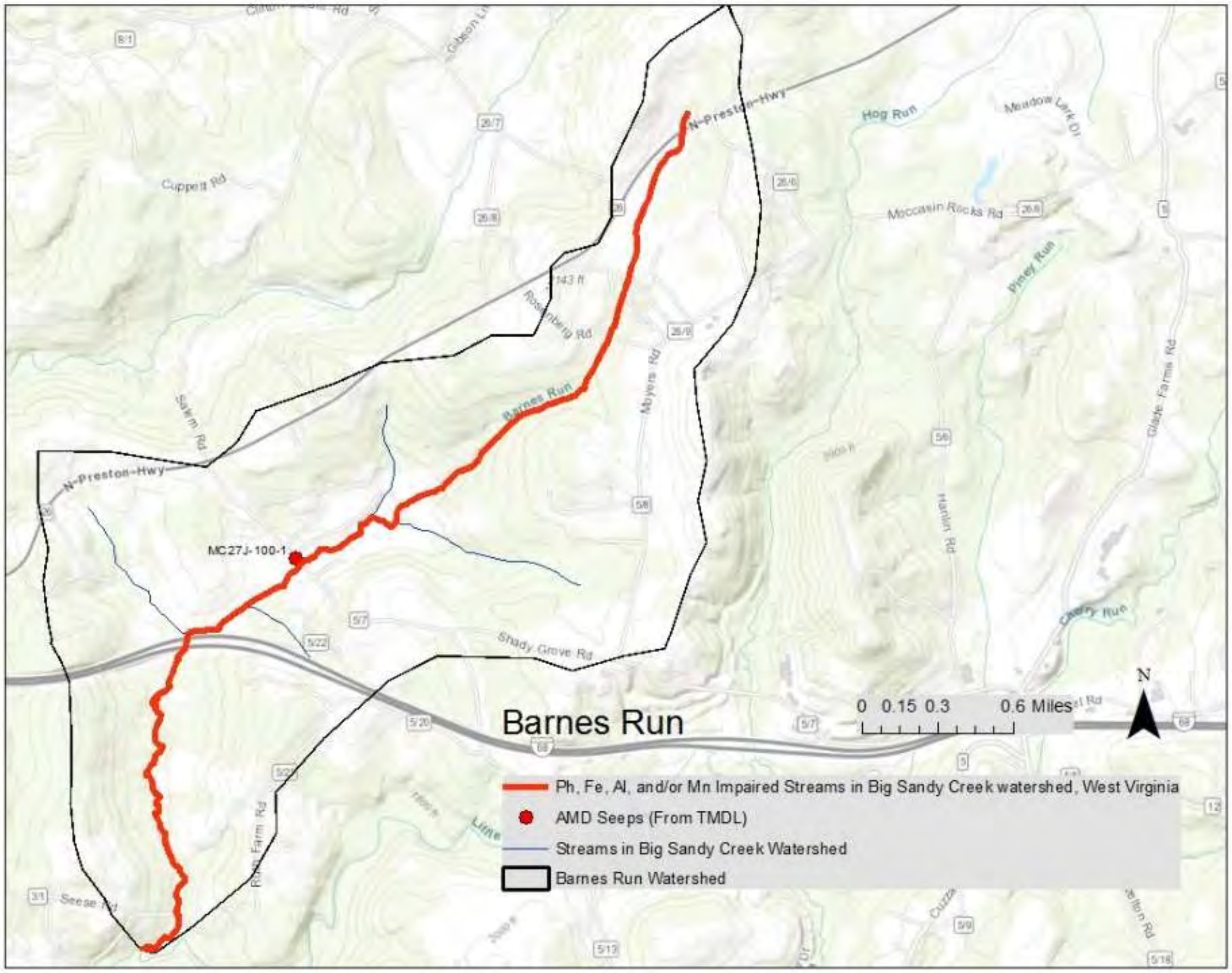
Discharge	Flow_CFS_	Flow_GPM	pH	Total_Al	Total_Fe	Total_Mn	ALKALINITY	SULFATE
MC27B-100-1	0.601562	269.9810256	3.41	16.5	6.2	5.08	0.1	613
MC27B-100-2	0.008912	3.9997056	6.2775	4.5875	5.61275	0.85125	0.1	265
MC27B-100-3	0.084664	37.9972032	7.28	0.55	0.14	1.06	32.6	642
MC27B-100-4	0.006684	2.9997792	6	1.1375	9.5025	0.83725	0.1	18
MC27F-100-2	0.38099	170.988312	4.4	2.02	0.51	1.8	0	71.9
MC27F-100-3	0.002228	0.9999264	4.3	2.02	0.51	1.8	0	71.9
MC27F-100-6	0.026736	11.9991168	4.6	5.46	3.33	2.28	0	239
MC27F-10-1	0.080208	35.9973504	3.71	47.3	2.96	4.54	0.1	532
MC27F-200-7	0.173067	77.6724696	6.162	0.218	0.392	0.508	21.234	242.58
MC27F-300-1	0.133681	59.9960328	3.75	22.4	15.4	1.92	0.1	451
MC27J-300-1	0.021537	9.6658056	3.426667	6.023333	1.716667	1.243333	0.1	349.333333
MC27J-300-2	0.043075	19.33206	3.7	6.8125	0.91175	1.17525	0.1	377
MC27J-100-1	0.017824	7.9994112	5.79	0.03	14.4	1.8	0.1	59
MC27J9-100-1	0.026736	11.9991168	5.79	0.03	14.4	1.8	0.1	59
MC27J-400-1	0.006684	2.9997792	0	0.03	14.4	1.8	0.1	59
MC27J11-100-1	0.028964	12.9990432	5.79	0.03	14.4	1.8	0.1	59
MC27J12-200-1	0.065423	29.3618424	6.814545	0.072727	2.916364	5.867273	58.656364	290.066364
MC27J12-400-1	0.040104	17.9986752	3.92	1.8	6.21	2.1	0.1	143
MC27J12-100-1	0.024508	10.9991904	6.633333	0.233333	28.590667	1.725333	0.1	86.666667
MC27J12-200-2	0.029998	13.4631024	3.6	2.97	5.84	4.65	1	145
MC27J12-300-1	0.01114	4.999632	4.2	0.73	0.06	0.336	0.1	78
MC27J12-300-2	0.008912	3.9997056	4.32	0.73	0.06	0.336	0.1	78
MC27J12-300-3	0.01114	4.999632	4.67	0.73	0.06	0.336	0.1	78
MC27J6-565-1	0.158189	70.9952232	5.43	0.74	0.1	1.68	10.92	167

MC27J6-567-1	0.002228	0.9999264	4.05	19.5	0.13	18.1	0.1	475
MC27J6-567-2	0.013368	5.9995584	5.79	0.03	14.4	1.8	0.1	59
MC27J6-560-1	0.046788	20.9984544	3.91	18.1	1.76	5.07	0.1	510
MC27J6-561-1	0.067954	30.4977552	3.57	13.99	14.2	4.7625	0.1	558.5
MC27J6-561-2	0.008912	3.9997056	6.26	0.03	14.4	1.8	0.1	59
MC27J6-100-1	0.001	0.4488	3.85	50.95	208.85	12.9	1	545
MC27J-200-1	0.058229	26.1331752	7.57	0.073033	0.05	0.01	128.193333	562.1
MC27J2-200-1	0.053472	23.9982336	3.35	16.2	3.2	1.22	0.1	558
MC27J2-100-1	0.071296	31.9976448	3.41	15.8	1.08	1.03	0.1	450
MC27K-100-1	0.008912	3.9997056	5.79	0.03	14.4	1.8	0.1	59

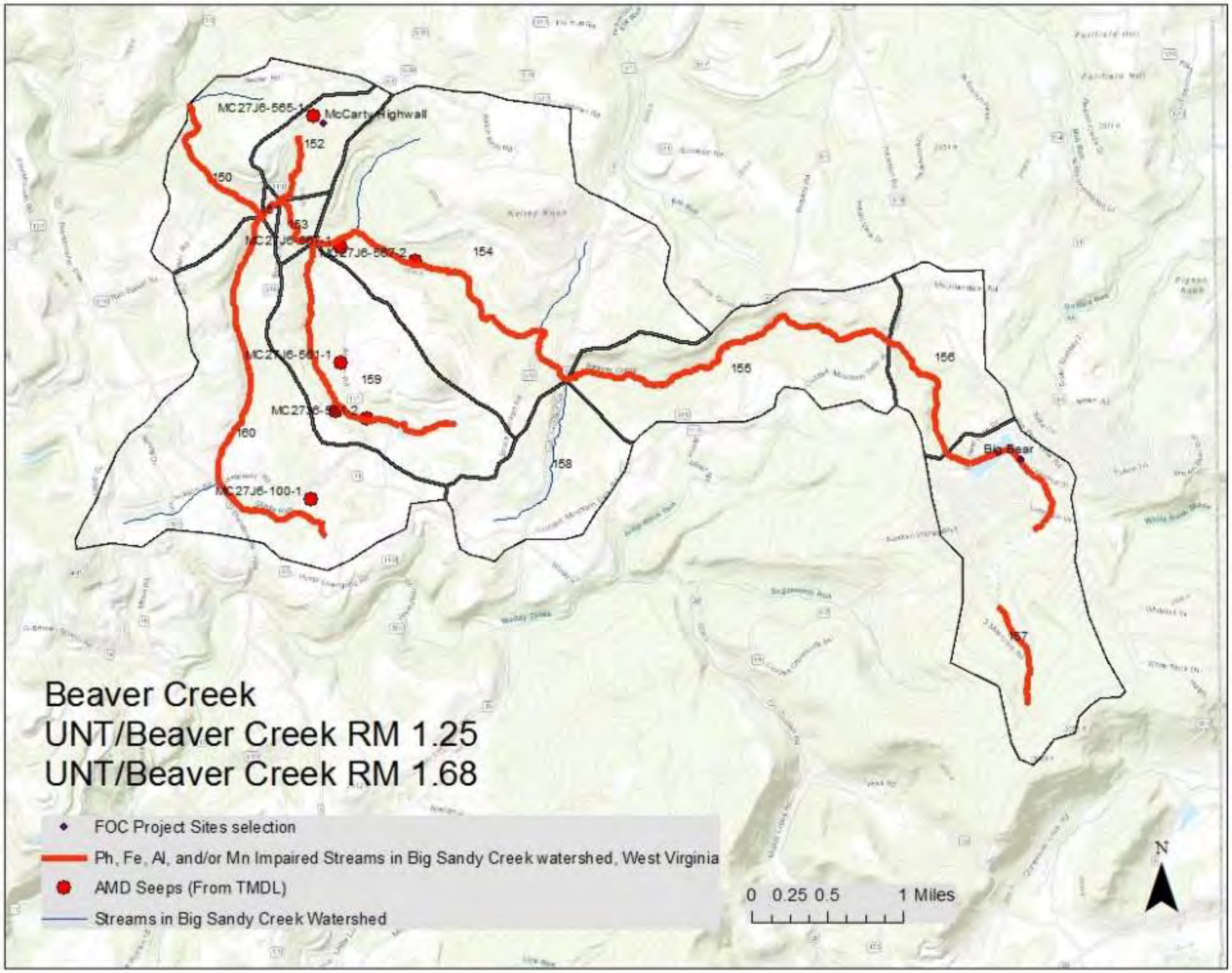
Source: TMDL GIS geodatabase

Appendix B: Maps of impaired sub-watersheds

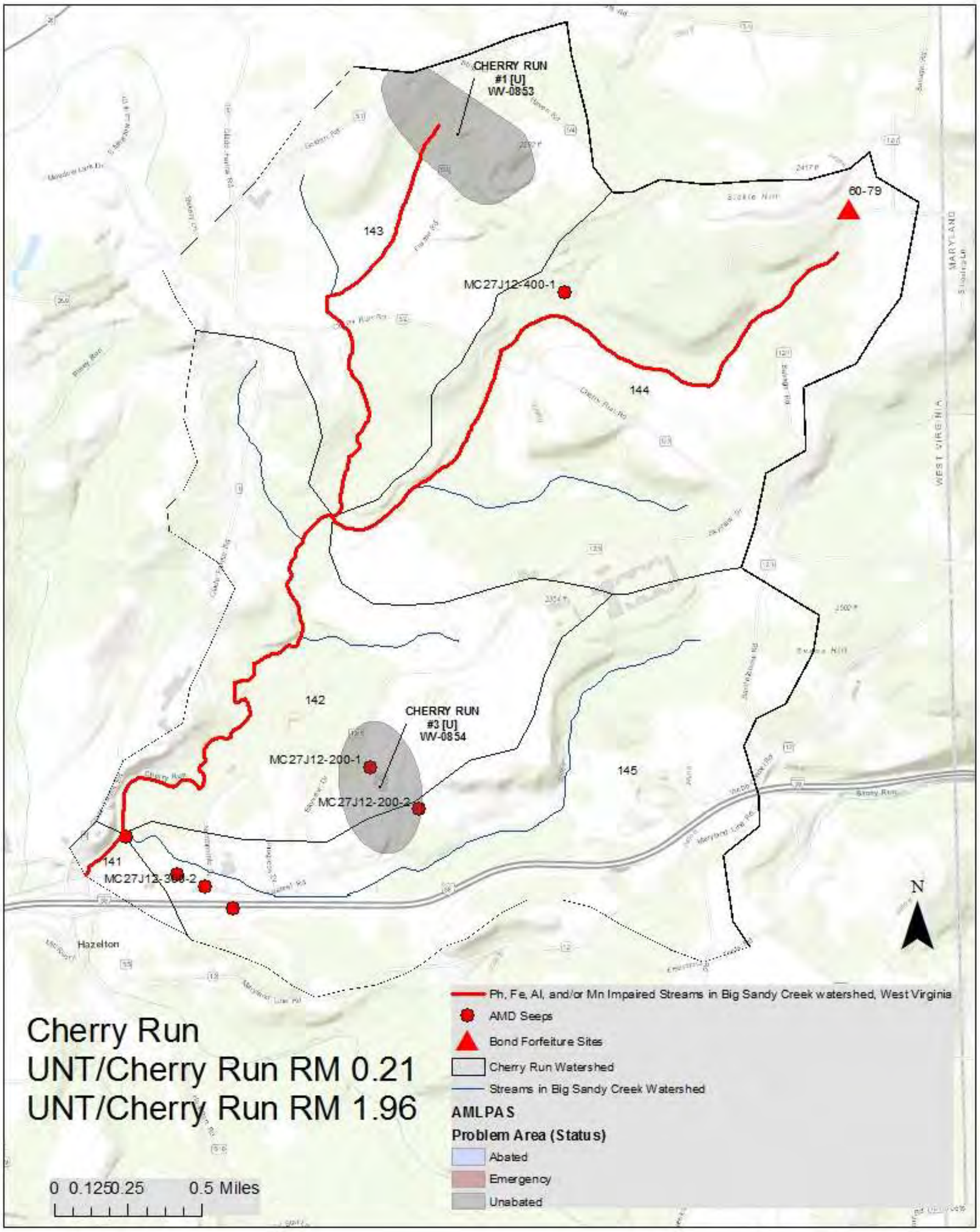
Barnes Run: WV-MC-27-J-7



Beaver Creek: WV-MC-27-J-6



Cherry Run: WV-MC-27-J-12



Elk Run: WV-MC-27-J-10

Hazel Run: WV-MC-27-K

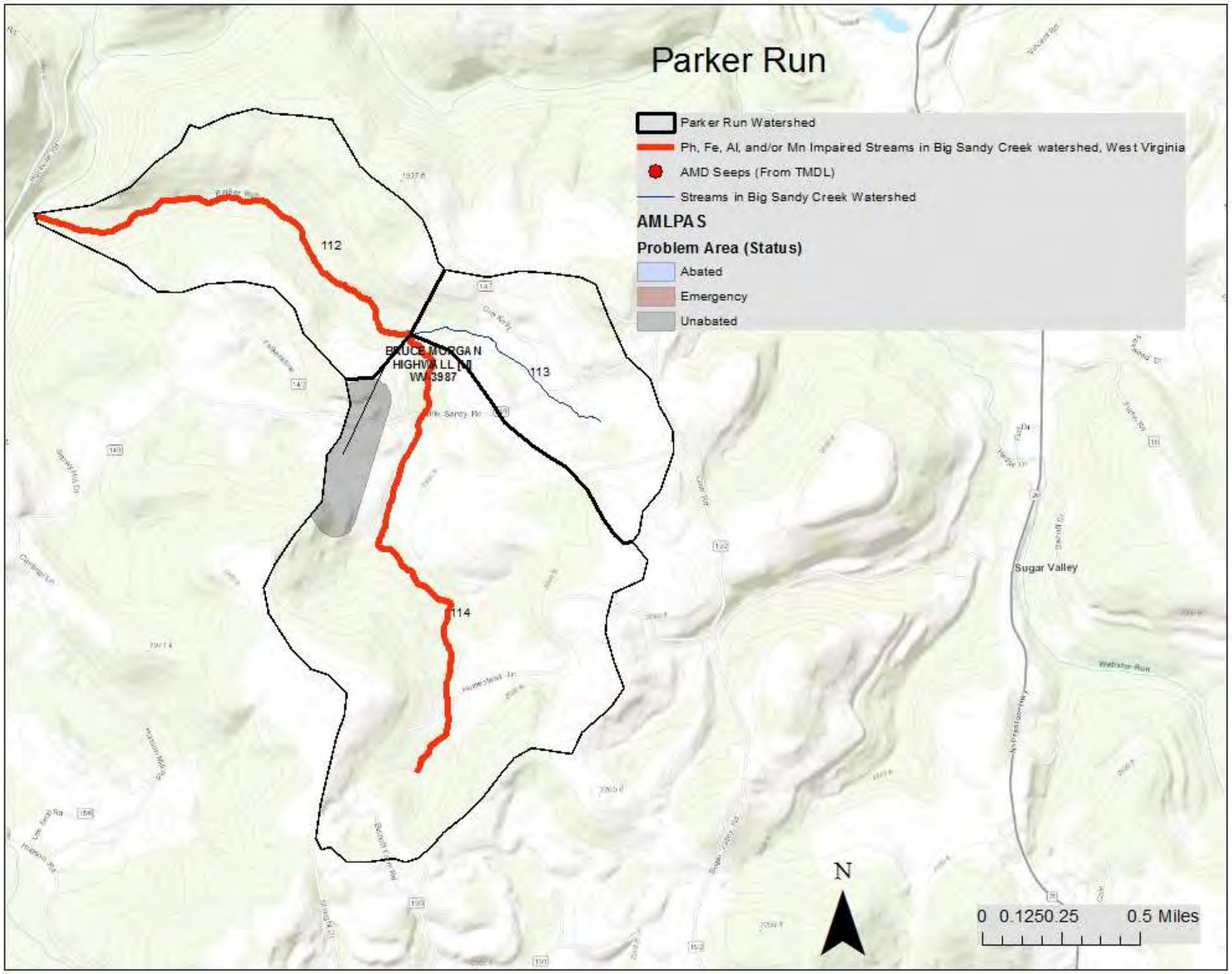
Hog Run: WV-MC-27-J-9

Little Sandy Creek: WV-MC-27-J

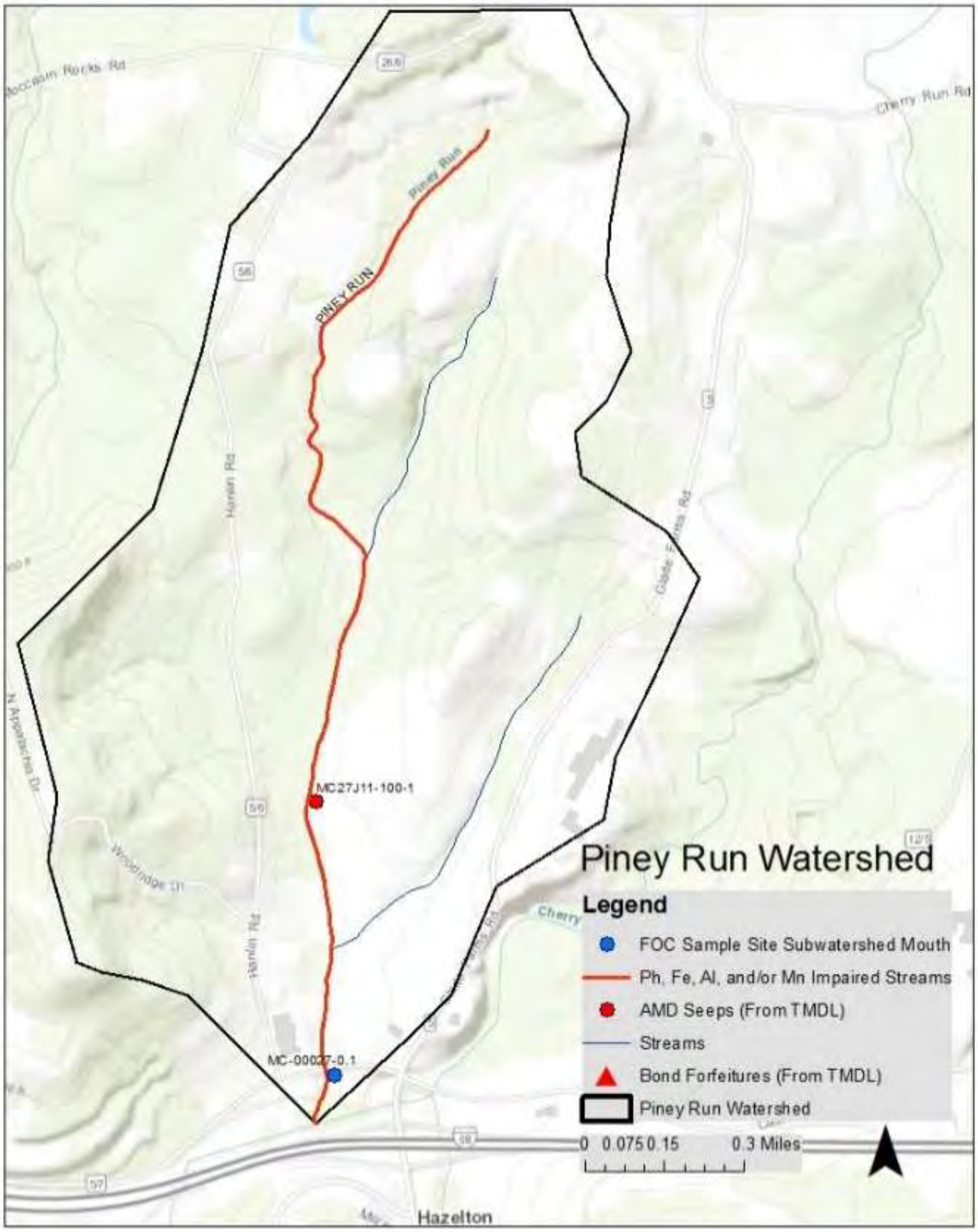

Little Sandy Creek Subwatershed 129
129
MC27J-300-2
MC27J-300-1
MC27J-200-1
MC27J2-100-1
MC27J2-200-1
Sugar Valley
0 0.125 0.25 0.5 Miles
Ph, Fe, Al, and/or Mn Impaired Streams in Big Sandy Creek watershed, West Virginia
Little Sandy Subwatershed 129
Little Sandy Creek Watershed
Streams in Big Sandy Creek Watershed
N

Mill Run: WV-MC-27-J-13

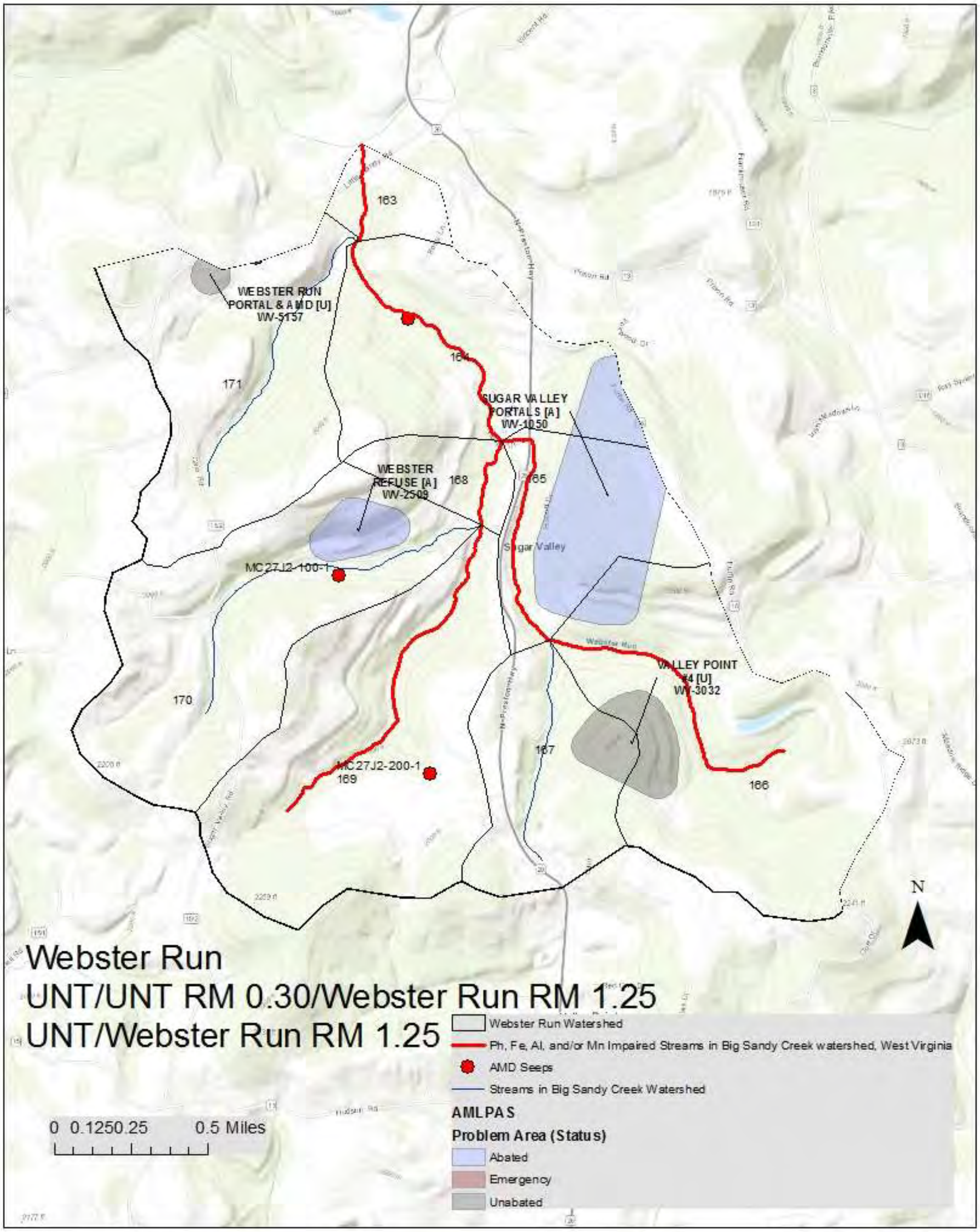
Parker Run: WV-MC-27-H



Piney Run: WVMC-12-B-4.5



Webster Run and Webster Run UNTs: WVMC-12-B-0.5 and WVMC-12-B-0.5-B



Appendix C: Landowners

Discharge Number	Name	Mailing Address	Parcel Address	Landowner Telephone	Landowner Notes	Email
MC27B-100-1	Dennis and Ida Nicklow	805 Russ Lee Rd Bruceton Mills, WV 26525	805 Russ Lee Rd	304-216-4592	The Nicklows are very welcoming. They are interested in cleaning up the water.	
MC27B-100-2	Dennis and Ida Nicklow	805 Russ Lee Rd Bruceton Mills, WV 26525	805 Russ Lee Rd	304-216-4592	The Nicklows are very welcoming. They are interested in cleaning up the water	
MC27B-100-3	Dennis and Ida Nicklow or Ronald Nolan			Nicklows 304-216-4592, Ronald Nolan 681-209-3464 or 304-379-7144, and Deb Nolan 304-288-9715	The Nicklows are very welcoming. They are interested in cleaning up the water	
MC27B-100-4	Dennis and Ida Nicklow	805 Russ Lee Rd Bruceton Mills, WV 26525	805 Russ Lee Rd	304-216-4592	The Nicklows are very welcoming. They are interested in cleaning up the water	
MC27F-100-2	Richard Titchenell				This is the seep next to the Titchenell Upper LSB at the existing FOC project. However, Richard Titchenell is not interested in another project because his property is already being taken over by wetland.	
MC27F-100-3	Richard Titchenell				This is the seep treated by the existing Titchenell FOC treatment system.	
MC27F-100-6	Norma Jean Bishoff				Existing FOC Sovern 62 Project	

MC27F-10-1	Tom and Brenda Clark			304-379-8903	Tommy is very nice and willing for us to propose a project on his property. He took me out and showed me all the seeps on his newly logged watershed. He worked in the mines, has an understanding, and knows that pH 3 water is no good.	tclark0655@gmail.com
MC27F-200-7	Dennis Clark				Existing FOC Clark Project. FOC is not permitted access to this property any longer.	
MC27F-300-1	Michael and Carla Miller		Harmony Grove Rd		This seep is not in the Big Sandy Creek watershed	
MC27J-100-1	Lowel Thomas	Bruceton Mills, WV past Dairy on Last house on the right (property neighbor told me).			He is bedridden. Low priority site.	
MC27J11-100-1	Moyers Rosellen C Moyers Perry H & Clarence W		Handlen Rd		Low priority subwatershed	
MC27J12-100-1	Hazelton Wastewater Treatment Plant				The operator (I can't remember his name) granted me access to sample behind the plant. He is very friendly and seemed willing to work with us is necessary.	
MC27J12-200-1	Frazee Resource Management LLC -	Ludwik and Billy Frazee	Casteel Rd. or Rt 12/5	(304) 329-2752 Ext. 12	Joyce Bernatowitz oversees property. She is absolutely not interested in partnership. I met with her husband, Ludwik Bernatowitz, with Billy Frazee, on site. They showed me the ponds.	
MC27J12-200-2	Larry Sisler			301-616-8276	Not at all interested in partnership	

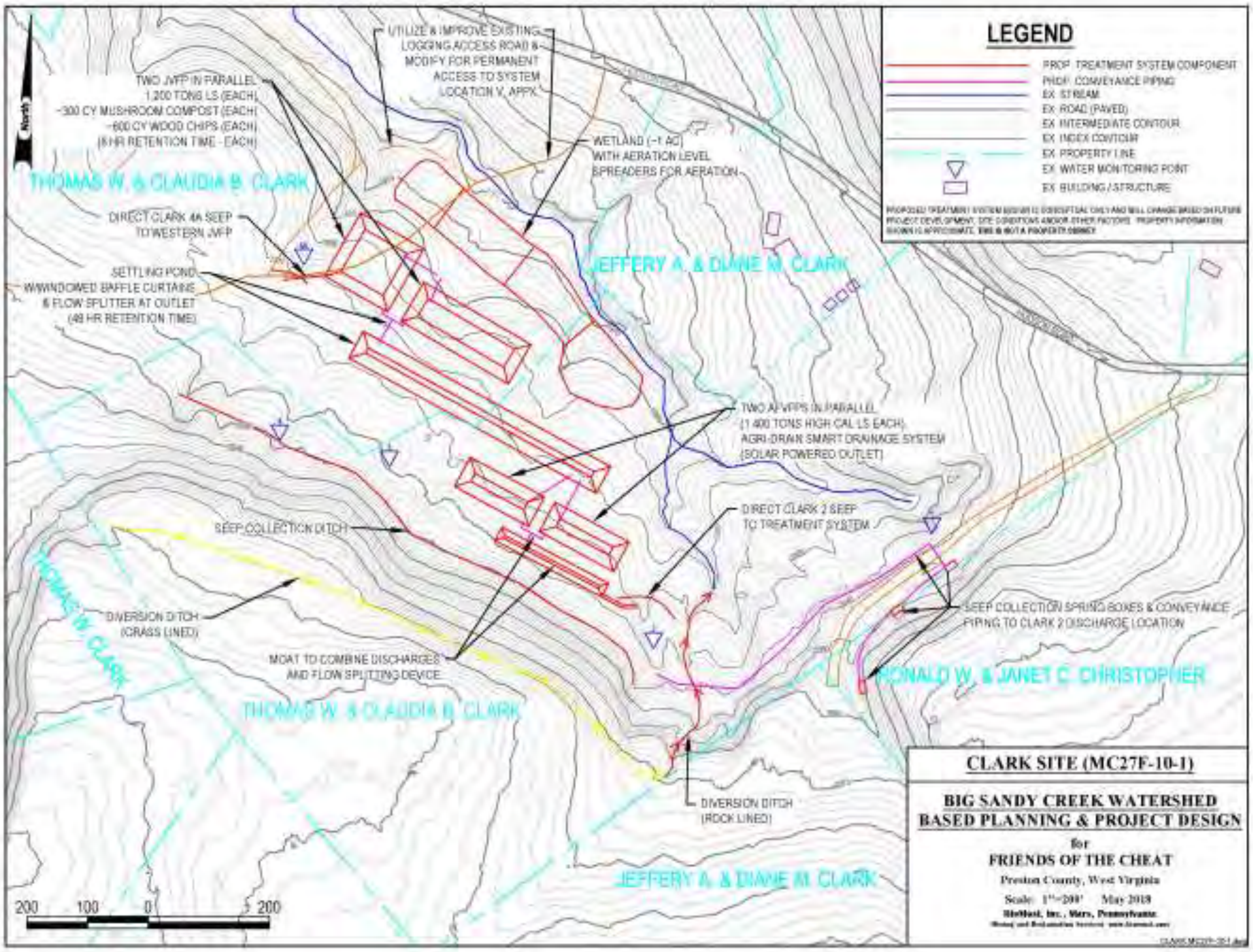
MC27J-200-1					Low priority subwatershed	
MC27J2-100-1	Deberry Cleedis M Sterling Michael A Et Al or Rebecca Telerico	654 Camp Meeting Rd. Sewickley, PA 15143	N Preston Hwy	Cleedis Deberry 412-741-4427, Rebecca Talerico 304-292-6777	I spoke with Rebecca Talerico, She granted me permission to access the property to better understand the drainage.	
MC27J2-200-1	Deberry Cleedis M Sterling Michael A Et Al			412-741-4427	I spoke with Cleedis. He is not interested in learning more or granting us access to sample.	
MC27J-300-1	Richard and Martha Deberry	106 Windy Ghoul Dr Beaver, PA 15009	Little Sandy Rd	724-728-1110	Mr. Deberry is interested in fixing the water. I sent him a landowner’s handbook. He is 85 so he can't make it to an onsite meeting. He grants us permission to develop a conceptual for treatment. I asked if an expert could visit the property the winter and spring to analyze the landscape and water quality. He said yes.	
MC27J-400-1	Department of Highways					
MC27J6-100-1	Laurence McElroy - CL Auto Repair				The owner was friendly and allowed John and I to go to the pipe where the seep discharges behind his shop. The seep is very close to the stream, though and it is in his backyard. There is not room for treatment. However, He gave me permission to sample the seep throughout the spring. Stop in and say hello when you arrive. He is slightly annoyed at AML because the pipe is clogged and backing up into his basement. FOC called AML and told them that the pipe needs cleaned in the Spring of 2017.	

MC27J6-560-1	Doug and Veda McElroy	440 Jim Jackson Rd. Albright, WV 26519	Auman Rd	304-379-4703, 304-435-8066 - cell	Knew of standing water that is there year round, sometimes flows in wet season, water smells, it is right below unreclaim spoil pile, showed me 2 seeps on property. Very interested in reclamation. Wants clean water available for his cows.	truckerddm@aol.com, and veda4703@frontier.com
MC27J6-561-1	Vickie Corbin		Auman Rd		FOC Auman Road Project	
MC27J6-561-2	Ellifritz Crystal G and Muscari Paul M	1593 Tyrone Rd. Morgantown, WV 26508	Auman Rd	(304) 680-6567	I spoke with Crystal. Granted me access to sample the stream (I didn't mention the seep yet)	
MC27J6-565-1	McCarty Highwall - Pat and Michael Deberry		Auman Rd	304-282-5727	Wants to show me other seeps on his property. Great landowner to know. He knows most of the other landowners in the watershed. He gave me permission to access the Guthrie property via his property.	
MC27J6-567-1	Guthrie Ward B HRS	15802 South Gilbert Rd. #1 Chandler, AZ 85225	Bruce Reckart Rd	480-242-0739	Ward B Guthrie Family Estate is managed by Sarah Guthrie. Gave me permission to access property. Wants to know more about partnership. Sent Landowner handbook. Pat Deberry gave me permission to access Guthrie property through his property.	Sarahag84@msn.com
MC27J6-567-2	Guthrie Ward B HRS	15802 South Gilbert Rd. #1 Chandler, AZ 85225	Bruce Reckart Rd	480-242-0739	Ward B Guthrie Family Estate is managed by Sarah Guthrie. Gave me permission to access property. Wants to know more about partnership. Sent Landowner handbook. Pat Deberry gave me permission to	Sarahag84@msn.com

					access Guthrie property through his property.	
MC27J9-100-1	Ida and Freda Yoder		Moyers Rd	301-933-0384	Ida hung up the phone on me. I called Robert Yoder who owns the parcel next to mine. He granted me permission to sample the seep if needed. He might be the person to work with if we need to install something like a limestone fines pile.	
MC27K-100-1					Low priority subwatershed	
Titchenell Road Seep	John "June" and Terrie Peaslee			304-379-2724	Very friendly and interested in seeing conceptual from an engineer. They are relatives of the owners of the Bishoff property and were very happy with working with us. The parcel might belong to Frontier communications, but they sold it to them years ago and they think the agreement was if they don't use it within a certain number of years, the sale is off. "As long as the project won't create more wetland in their hayfield"	
	Elizabeth Butcher			304-288-3838	Can help with any landowner contact in UNT/Little Sandy, rides her horse on everyone’s land	

Appendix D: Engineering plans, cost, monitoring data and fact sheets

Clark MC27F-10-1 conceptual design



Clark cost calculation

Printed on 04/27/2018

Company Name Friends of the Cheat
Project Clark Site
Site Name Clark

AMDTREAT

AMD TREAT
AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	2	0	$324,914
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands	1	0	$80,151
Manganese Removal Bed			$0
Oxic Limestone Channel			$0
Limestone Bed	2	0	$139,822
BIO Reactor			$0
Passive Subtotal:			$544,887
Active Treatment			
Caustic Soda			$0
Hydrated Lime			$0
Pebble Quick Lime			$0
Ammonia			$0
Oxidants			$0
Soda Ash			$0
Active Subtotal:			$0
Ancillary Cost			
Ponds	1	0	$42,113
Roads			$0
Land Access			$0
Ditching	3	0	$28,636
Engineering Cost	1	0	$60,000
Ancillary Subtotal:			$130,749
Other Cost (Capital Cost)			$104,364
Total Capital Cost:			$780,000
Annual Costs			
Sampling			$0
Labor			$0
Maintenance			$0
Pumping			$0
Chemical Cost			$0
Oxidant Chem Cost			$0
Sludge Removal			$0
Other Cost (Annual Cost)			$0
Land Access (Annual Cost)			$0
Total Annual Cost:			$0
Other Cost	1	0	

Water Quality

Design Flow	238.00	gpm
Typical Flow	80.00	gpm
Total Iron	1.15	mg/L
Ferrous Iron	0.00	mg/L
Aluminum	20.00	mg/L
Manganese	1.50	mg/L
pH	3.51	su
Alkalinity	0.00	mg/L
TIC	0.00	mg/L

(•) Calculate Net Acidity
( ) Enter Hot Acidity manually

Acidity 132.46 mg/L

Sulfate	450.00	mg/L
Chloride	0.00	mg/L
Calcium	0.00	mg/L
Magnesium	0.00	mg/L
Sodium	0.00	mg/L
Water Temperature	20.00	C
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.01	mg/L
Typical Acid Loading	23.2	tons/yr

Total Annual Cost: per 1000 Gal of H2O Treated $0.000

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

COMMENTS:

High/Design Flow: 238 gpm

"Avg/Typical" Flow: 80

All estimates are approximate cost opinions.

Liners included on select ponds and may not be needed.

Preliminary engineering/permitting cost estimate included.

Includes 10% contingency.

Company Name: Friends of the Cheat

Project: Clark Site

Site Name: Clark

Printed on 04/27/2016

AMDTREAT

AMD TREAT
VERTICAL FLOW POND (VFP)

VFP Name: JVFP 1

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	132.46	mg/L
Alkalinity	0.00	mg/L
(•) Calculate Net Acidity (Acid-Alkalinity)		
( ) Enter Net Acidity manually		
Net Acidity (Hot Acidity)	132.46	mg/L
Design Flow	238.00	gpm
Typical Flow	80.00	gpm
Total Iron	1.75	mg/L
Aluminum	20.00	mg/L
Manganese	1.50	mg/L

Record Number
1 of 2

SIZING METHODS Select One

1. Tons of Limestone Needed	2,705	VFP Based on Acidity Neutralization		
2. Tons of Limestone Needed	3,349	( ) VFP Based on Retention Time	6. Retention Time	hours
3. Tons of Limestone Needed	6,977	( ) VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate	g/m2/day
4. Tons of Limestone Needed	1,200	(•) VFP Based on Tons Limestone Entered	8. Limestone Needed: 1,200	tons
5. Tons of Limestone Needed	1,584	( ) VFP Based on Dimensions	9. Length at Top of Freeboard (ft); 10. Width at Top of Freeboard (ft)	

11. % Void Space of LS. Bed	43.00	%
12. System Life	20.00	years
13. Limestone Purity	85.00	%
14. Limestone Efficiency	60.00	%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	25.00	$/ton
17. LS Placement Unit Cost	5.00	$/yd3
18. Slope of Pond Sides (Run of Slope / Rise of Slope)	2.0 / 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	4.0	ft
22. Organic Matter Unit Cost	25.00	$/yd3
23. Organic Matter Spreading Unit Cost	6.50	$/yd3
24. Limestone Depth	2.0	ft
25. Excavation Unit Cost	7.50	$/yd3

Liner Cost

(•) No Liner
( ) Clay Liner
11. Clay Liner Unit Cost ____ $/yd3
12. Thickness of Clay Liner ____ ft
( ) Synthetic Liner
13. Synthetic Liner Unit Cost ____ $/yd2

☑ 29. Clearing and Grubbing?

(•) 30a. Land Multiplier	1.50	ratio
( ) 30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1300.00	$/acre
32. Nbr. of Valves	4	nbr
33. Unit Cost of Valves	150.00	$ ea

(•) AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe	20	ft
35. Pipe Install Rate	11.00	ft/hr
36. Labor Rate	35.00	$/hr
37. Segment Len. of Trunk Pipe	20	ft/pipe seg
38. Trunk Pipe Cost	15.00	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	7.00	$/ft
41. Spur Coupler Cost	3.00	$/spur
42. "T" Connector Cost	90.00	$/T coupler
43. Segment Len. of Spur Pipe	20	ft/pipe seg
44. Spur Pipe Spacing	10.0	ft

( ) Custom Piping Costs

	Length	Diameter	Unit Cost
45. Pipe #1	ft	in	$
46. Pipe #2	ft	in	$
47. Pipe #3	ft	in	$

VFP Sizing Summaries

48. Length at Top of Freeboard	197.51	ft
49. Width at Top of Freeboard	114.75	ft
50. Freeboard Volume	1,587	yd3
51. Water Surface Area	20,231	ft2
52. Total Water Volume	1,412	yd3
53. Organic Matter Volume	2,336	yd3
54. Limestone Surface Area	13,697	ft2
55. Limestone Volume	982.81	yd3
56. Excavation Volume	4,691.1	yd3
57. Clear and Grub Area	0.7	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	5.73	hrs

VFP Cost Summaries

60. Organic Matter Cost	58,402	$
61. Limestone Cost	30,000	$
62. Limestone and Organic Matter Placement Cost	17,561	$
63. Excavation Cost	35,183	$
64. Liner Cost	0	$
65. Clear and Grub Cost	1,014	$
66. Valve Cost	600	$
67. Pipe Cost	19,696	$
68. Total Cost	162,457	$

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

Printed on: 04/27/2018

AMD TREAT

DITCHING

AMDTREAT

Ditching Name: Diversion Ditch 1

1. Ditch Length Rock	1021	ft
2. Ditch Length Grass	1021	ft
3. Bottom Width of Ditch	3.0	ft
4. Ditch Depth	2.50	ft
5. Geo Textile Unit Cost	3.00	\$/yd2
6. Length of Geo Textile	0	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		\$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	1300.00	\$/acre

Record Number 1 of 3

13. Ditch Depth of Rock	0.00	ft
14. Cost of Ditch Surface Rock	20.00	\$/yd3
15. Cost to Place Rock	12.00	\$/yd3
16. Excavation Unit Cost	7.00	\$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	1.15	\$/ft
19. Revegetation Unit Cost	1500.00	\$/acre

Ditching Sub-Totals

20. Excavation Cost	10,588	\$
21. Survey Cost	0	\$
22. Clear and Grub Cost	951	\$
23. Aggregate Cost	0	\$
24. Filter Fabric Cost	0	\$
25. Silt Fence Cost	0	\$
26. Revegetation Cost	698	\$
27. Total Cost	12,237	\$

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

Printed on 04/27/2018

AMD TREAT

PONDS

AMDTREAT

Pond Name: Settling Pond / Fush Pond

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect Ponds

Calculated Acidity 132.46 mg/L

Alkalinity 0.00 mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)

( ) Enter Net Acidity manually

Net Acidity (Hot Acidity) 0.00 mg/L

Design Flow 238.00 gpm

Typical Flow 80.00 gpm

Total Iron 1.15 mg/L

Aluminum 20.00 mg/L

Manganese 1.50 mg/L

Record Number
1 of 1

Pond Design Based On:

( ) Retention Time

1. Desired Retention Time [ ] hours

☐

3. Sludge Removal Frequency [ ] times/year

☐ 4. Titration?

5. Sludge Rate [ ] gal sludge/gal H2O

6. Percent Solids [ ] %

7. Sludge Density [ ] lbs./gal

(•) Pond Size

8. Pond Length at Top of Freeboard 465.000 ft

9. Pond Width at Top of Freeboard 50.000 ft

	Run	Rise	
10. Slope Ratio of Pond Sides	2.0	1	
11. Freeboard Depth	2.0		ft
12. Water Depth	8.0		ft
13. Excavation Unit Cost	7.50		$/yd3
14. Total Length of Effluent / Influent Pipe	100.00		ft
15. Unit Cost of Pipe	12.00		$/ft

Liner Cost

( ) No Liner

(•) Clay Liner

16. Clay Liner Unit Cost 5.00 $/yd3

17. Thickness of Clay Liner 1.0 ft

( ) Synthetic Liner

18. Synthetic Liner Unit Cost [ ] $/yd2

☑ 19. Clearing and Grubbing?

(•) 20. Land Multiplier 1.50 ratio

( ) 21. Clear/Grub Acres [ ] acres

22. Clear and Grub Unit Cost 1300.00 $/acre

23. Revegetation Cost 1500.00 $/acre

24. Cost of Baffles 2000 $

Calculated Pond Dimensions per Pond

25. Length at Top of Freeboard	465	ft
26. Width at Top of Freeboard	50	ft
27. Freeboard Volume	4,993	yd3
28. Water Volume	3,422	yd3
29. Estimated Annual Sludge	0	yd3/yr
30. Volume of Sludge per Removal	0	yd3/removal
31. Excavation Volume	2.12	acre ft
32. Excavation Volume	3,422	yd3
33. Clear and Grub Area	0.80	acres
34. Liner Area	3,297	yd2
35. Calculated Retention Time	48	hours

Ponds Sub-Totals per Pond

36. Excavation Cost	32,750	$
37. Pipe Cost	1,200	$
38. Liner Cost	4,720	$
39. Clearing and Grubbing Cost	1,040	$
40. Revegetation Cost	400	$
41. Baffle Cost	2,000	$

42. Estimated Cost 42,113 $

Company Name: Friends of the Cheat
Project: Clark Site
Site Name: Clark

Printed on 04/27/2018

AMDTREAT

AMD TREAT
LIMESTONE BED (LSB)

Limestone Bed Name: AFVFP 2

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect LSB

Calculated Acidity: 132.46 mg/L
Alkalinity: 0.00 mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)
( ) Enter Net Acidity manually
Net Acidity (Hot Acidity): 132.46 mg/L

Design Flow: 238.00 gpm
Typical Flow: 80.00 gpm
Total Iron: 1.15 mg/L
Aluminum: 20.00 mg/L
Manganese: 1.50 mg/L

Record Number
2 of 2

SIZING METHODS Select One

1. Tons of Limestone Needed	2,705	LSB Based on Acidity Neutralization		
2. Tons of Limestone Needed	3,349	( ) LSB Based on Retention Time	6. Retention Time	hours
3. Tons of Limestone Needed	27,808	( ) LSB Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate	g/m2/day
4. Tons of Limestone Needed	1,400	(•) LSB Based on Tons Limestone Entered	8. Limestone Needed 1,400	tons
5. Tons of Limestone Needed	1,297	( ) LSB Based on Dimensions	9. Length at Top of Freeboard ft; 10. Width at Top of Freeboard	ft

11. % Void Space of LS Bed	43.00	%
12. System Life		years
13. Limestone Purity	85.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	25.00	$/ton
17. LS Placement Unit Cost	5.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	0.0	ft
24. Limestone Depth	8.0	ft
25. Excavation Unit Cost	7.50	$/yd3
23. Siphon System Cost	10000.0	$

Liner Cost

( ) No Liner
( ) Clay Liner
11. Clay Liner Unit Cost: $/yd3
12. Thickness of Clay Liner: ft
(•) Synthetic Liner
13. Synthetic Liner Unit Cost: 5.50 $/yd2

☑ 29. Clearing and Grubbing?

(•) 30a. Land Multiplier	1.50	ratio
( ) 30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1300.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	3500.00	$ ea.

( ) AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe		ft
35. Pipe Install Rate		ft/hr
36. Labor Rate		$/hr
37. Segment Len. of Trunk Pipe		ft/pipe seg
38. Trunk Pipe Cost		$/ft
39. Trunk Coupler Cost		$/coupler
40. Spur Cost		$/ft
41. Spur Coupler Cost		$/spur
42. "T" Connector Cost		$/T coupler
43. Segment Len. of Spur Pipe		ft/pipe seg
44. Spur Pipe Spacing		ft

( ) Custom Piping Costs

	Length	Diameter	Unit Cost
45. Pipe #1	ft	in	$
46. Pipe #2	ft	in	$
47. Pipe #3	ft	in	$

LSB Sizing Summaries

48. Length at Top of Freeboard	117.53	ft
49. Width at Top of Freeboard	62.76	ft
50. Freeboard Volume	494	yd3
51. Water Surface Area	5,999	ft2
52. Total Water Volume	0	yd3
54. Limestone Surface Area	5,999	ft2
55. Limestone Volume	1,099.72	yd3
56. Excavation Volume	1,099.7	yd3
57. Clear and Grub Area	0.2	acr
58. Liner Area	1,406.1	ft2
59. Theoretical Retention Time	6.68	hrs

LSB Cost Summaries

60. Siphon System Cost	10,000	$
61. Limestone Cost	35,000	$
62. Limestone Placement Cost	5,499	$
63. Excavation Cost	8,248	$
64. Liner Cost	7,733	$
65. Clear and Grub Cost	330	$
66. Valve Cost	0	$
67. Pipe Cost	3,100	$
68. Total Cost	69,911	$

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

Printed on 04/27/2018

AMDTREAT

AMD TREAT
LIMESTONE BED (LSB)

Limestone Bed Name: AFVFP 1

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect LSB

Calculated Acidity: 132.46 mg/L

Alkalinity: 0.00 mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)

( ) Enter Net Acidity manually

Net Acidity (Hot Acidity): 132.46 mg/L

Design Flow: 238.00 gpm

Typical Flow: 80.00 gpm

Total Iron: 1.15 mg/L

Aluminum: 20.00 mg/L

Manganese: 1.50 mg/L

Record Number

1 of 2

SIZING METHODS Select One

1. Tons of Limestone Needed	2,705	LSB Based on Acidity Neutralization
2. Tons of Limestone Needed	3,349	( ) LSB Based on Retention Time
3. Tons of Limestone Needed	27,908	( ) LSB Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	1,400	(•) LSB Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,297	( ) LSB Based on Dimensions

6. Retention Time: ___ hours

7. Alkalinity Generation Rate: ___ g/m2/day

8. Limestone Needed: 1,400 tons

9. Length at Top of Freeboard: ___ ft

10. Width at Top of Freeboard: ___ ft

11. % Void Space of LS. Bed	43.00	%
12. System Life		years
13. Limestone Purity	85.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	25.00	$/ton
17. LS Placement Unit Cost	5.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	0.0	ft
24. Limestone Depth	8.0	ft
25. Excavation Unit Cost	7.50	$/yd3
23. Siphon System Cost	10000.0	$

Liner Cost

( ) No Liner

( ) Clay Liner

11. Clay Liner Unit Cost: ___ $/yd3

12. Thickness of Clay Liner: ___ ft

(•) Synthetic Liner

13. Synthetic Liner Unit Cost: 5.50 $/yd2

☑ 29. Clearing and Grubbing?

(•) 30a. Land Multiplier	1.50	ratio
( ) 30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1300.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	3500.00	$ ea.

( ) AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe		ft
35. Pipe Install Rate		ft/hr
36. Labor Rate		$/hr
37. Segment Len. of Trunk Pipe		ft/pipe seg.
38. Trunk Pipe Cost		$/ft
39. Trunk Coupler Cost		$/coupler
40. Spur Cost		$/ft
41. Spur Coupler Cost		$/spur
42. "T" Connector Cost		$/T coupler
43. Segment Len. of Spur Pipe		ft/pipe seg.
44. Spur Pipe Spacing		ft

( ) Custom Piping Costs

	Length (ft)	Diameter (in)	Unit Cost ($)
45. Pipe #1			
46. Pipe #2			
47. Pipe #3			

LSB Sizing Summaries

48. Length at Top of Freeboard	117.53	ft
49. Width at Top of Freeboard	62.76	ft
50. Freeboard Volume	494	yd3
51. Water Surface Area	5,999	ft2
52. Total Water Volume	0	yd3
54. Limestone Surface Area	5,999	ft2
55. Limestone Volume	1,099.72	yd3
56. Excavation Volume	1,099.7	yd3
57. Clear and Grub Area	0.2	acr
58. Liner Area	1,406.1	ft2
59. Theoretical Retention Time	6.68	hrs

LSB Cost Summaries

60. Siphon System Cost	10,000	$
61. Limestone Cost	35,000	$
62. Limestone Placement Cost	5,499	$
63. Excavation Cost	8,248	$
64. Liner Cost	7,733	$
65. Clear and Grub Cost	330	$
66. Valve Cost	0	$
67. Pipe Cost	3,100	$
68. Total Cost	69,911	$

Company Name: Friends of the Cheat

Project: Clark Site

Site Name: Clark

Printed on 04/27/2018

AMDTREAT

AMD TREAT

AEROBIC WETLANDS

Aerobic Wetlands Name: Wetland

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect Aerobic Wetlands

Calculated Acidity	132.46	mg/L
Alkalinity	0.00	mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)

( ) Enter Net Acidity manually

Net Acidity (Hot Acidity)	132.46	mg/L
Design Flow	238.00	gpm
Typical Flow	80.00	gpm
Total Iron	1.15	mg/L
Aluminum	20.00	mg/L
Manganese	1.50	mg/L
pH	3.51	su

SIZING METHODS Select One

( ) Aerobic Wetland Based on Metal Removal Rates — 1. Iron Removal Rate: ____ g/m2/day; 2. Mn Removal Rate: ____ g/m2/day

(•) Aerobic Wetland Based on Dimensions — 3. Top Length at Freeboard: 520 ft; 4. Top Width at Freeboard: 84 ft

( ) Aerobic Wetland Based on Iron Oxidation Kinetics — 5. Rate Constant: ____ moles/sec; 6. Effluent Fe Concentration: ____ mg/l; 7. Dissolved Oxygen: ____ mg/l; 8. H2O Temperature: ____ °C

	Length	Width	
9. Length to Width Ratio			
	Run of Slope	Rise of Slope	
10. Slope of Wetland Sides	2.0	1.000	
11. Freeboard Depth	2.50		ft
12. Free Standing Water Depth	0.50		ft
13. Organic Matter Depth	1.00		ft
14. Organic Matter Unit Cost	20.00		$/yd3
15. Organic Matter Spreading Unit Cost	4.50		$/yd3
16. Excavation Unit Cost	6.00		$/yd3
17. Wetland Planting Unit Cost	3700		$/acre

Liner Cost

( ) No Liner

( ) Clay Liner

18. Clay Liner Unit Cost: ____ $/yd3

19. Thickness of Clay Liner: ____ ft

(•) Synthetic Liner

20. Synthetic Liner Unit Cost: 5.50 $/yd2

☑ 21. Clearing and Grubbing?

(•) 22. Land Multiplier: 1.5 ratio

( ) 23. Clear/Grub Acres: ____ acres

24. Clear and Grub Unit Cost: 1300 $/acre

Aerobic Wetland Sizing Summaries

25. Length at Top of Freeboard	520.00	ft
26. Width at Top of Freeboard	84.00	ft
27. Freeboard Volume	5,767	yd3
28. Water Surface Area	37,740	ft2
29. Water Volume	688	yd3
30. Organic Matter Volume	1,311	yd3
31. Excavation Volume	2,000	yd3
32. Clear and Grub Area	1.5	acres
33. Liner Area	5,517	ft2
34. Retention Time	9	hrs

Aerobic Cost Summaries

35. Organic Matter Cost	32,142	$
36. Excavation Cost	12,000	$
37. Liner Cost	30,344	$
38. Clear and Grub Cost	1,955	$
39. Wetland Planting Cost	3,710	$
40. Total Cost	80,151	$

Record Number 1 of 1

Company Name: Friends of the Cheat

Project: Clark Site

Site Name: Clark

Printed on: 04/27/2018

AMDTREAT

AMD TREAT
VERTICAL FLOW POND (VFP)

VFP Name: JVFP 2

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	132.46	mg/L
Alkalinity	0.00	mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)
( ) Enter Net Acidity manually

Net Acidity (Hot Acidity)	132.46	mg/L
Design Flow	238.00	gpm
Typical Flow	80.00	gpm
Total Iron	1.15	mg/L
Aluminum	20.00	mg/L
Manganese	1.50	mg/L

Record Number
2 of 2

SIZING METHODS Select One

1. Tons of Limestone Needed	2,705	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	3,349	( ) VFP Based on Retention Time
3. Tons of Limestone Needed	6,977	( ) VFP Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	1,200	(•) VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,684	( ) VFP Based on Dimensions

6. Retention Time		hours
7. Alkalinity Generation Rate		g/m2/day
8. Limestone Needed	1,200	tons
9. Length at Top of Freeboard		ft
10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	43.00	%
12. System Life		years
13. Limestone Purity	85.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	25.00	$/ton
17. LS Placement Unit Cost	5.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	4.0	ft
22. Organic Matter Unit Cost	25.00	$/yd3
23. Organic Matter Spreading Unit Cost	5.50	$/yd3
24. Limestone Depth	2.0	ft
25. Excavation Unit Cost	7.50	$/yd3

Liner Cost

(•) No Liner
( ) Clay Liner

11. Clay Liner Unit Cost		$/yd3
12. Thickness of Clay Liner		ft

( ) Synthetic Liner

13. Synthetic Liner Unit Cost		$/yd2

☑ 29. Clearing and Grubbing?

(•) 30a. Land Multiplier	1.50	ratio
( ) 30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1300.00	$/acre
32. Nbr. of Valves	4	nbr
33. Unit Cost of Valves	150.00	$ ea.

(•) AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe	20	ft
35. Pipe Install Rate	11.00	ft/hr
36. Labor Rate	35.00	$/hr
37. Segment Len. of Trunk Pipe	20	ft/pipe seg.
38. Trunk Pipe Cost	15.00	$/ft
39. Trunk Coupler Cost	8.60	$/coupler
40. Spur Cost	7.00	$/ft
41. Spur Coupler Cost	3.00	$/spur
42. "T" Connector Cost	60.00	$/T coupler
43. Segment Len. of Spur Pipe	20	ft/pipe seg.
44. Spur Pipe Spacing	10.0	ft

( ) Custom Piping Costs

	Length (ft)	Diameter (in)	Unit Cost ($)
45. Pipe #1			
46. Pipe #2			
47. Pipe #3			

VFP Sizing Summaries

48. Length at Top of Freeboard	197.51	ft
49. Width at Top of Freeboard	114.75	ft
50. Freeboard Volume	1,587	yd3
51. Water Surface Area	20,231	ft2
52. Total Water Volume	1,412	yd3
53. Organic Matter Volume	2,336	yd3
54. Limestone Surface Area	13,897	ft2
55. Limestone Volume	942.61	yd3
56. Excavation Volume	4,691.1	yd3
57. Clear and Grub Area	0.7	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	5.73	hrs

VFP Cost Summaries

60. Organic Matter Cost	58,402	$
61. Limestone Cost	30,000	$
62. Limestone and Organic Matter Placement Cost	17,561	$
63. Excavation Cost	35,183	$
64. Liner Cost	0	$
65. Clear and Grub Cost	1,014	$
66. Valve Cost	600	$
67. Pipe Cost	19,698	$
68. Total Cost	162,457	$

Printed on 04/27/2018

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

AMD TREAT

OTHER COST

Oher Cost Name: Other Costs

	A. Description of Item	B. Unit Cost Per Item	C. Quantity	D. Total Item Cost	E. Capital Cost / Annual Cost
1.	E&S Controls (compost filter sock)	10.00	800	8,000	(•) Capital Cost ( ) Annual Cost
2.	Seep Collection Drains	2,000.00	3	6,000	(•) Capital Cost ( ) Annual Cost
3.	Conveyance Piping (Clark 1) - pipe only	6.00	785	4,710	(•) Capital Cost ( ) Annual Cost
4.	E&S Controls (MSC)	1.00	2000	2,000	(•) Capital Cost ( ) Annual Cost
5.	Access Road Modification & Improvements	10,000.00	1	10,000	(•) Capital Cost ( ) Annual Cost
6.	Contingency (10%)	70,635.00	1	70,635	(•) Capital Cost ( ) Annual Cost
7.	Misc/other/rounding	3,019.00	1	3,019	(•) Capital Cost ( ) Annual Cost
8.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
9.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
10.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
11.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
12.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
13.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
14.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
15.		0.00	0	0	(•) Capital Cost ( ) Annual Cost

Record Number 1 of 1

Curent Capital Cost	104,364	Total Capital Cost	104,364
Current Annual Cost	0	Total Annual Cost	0

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

Printed on 04/27/2018

AMDTREAT

AMD TREAT

ENGINEERING COST

1. Capital Cost *	720,001	$
◯ 2. Per Cent of Capital Cost		%
◉ 3. Actual Engineering Cost	60,000	$
4. Total Engineering Cost	60,000	$

*** Total Capital Cost minus Engineering and Land Access Capital Cost**

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

Printed on 04/27/2018

AMDTREAT

AMD TREAT

DITCHING

Ditching Name: Conveyance Piping Cost

1. Ditch Length Rock	0	ft
2. Ditch Length Grass	800	ft
3. Bottom Width of Ditch	2.0	ft
4. Ditch Depth	3.00	ft
5. Geo Textile Unit Cost	3.00	$/yd2
6. Length of Geo Textile	0	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	1.50 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	1300.00	$/acre

Record Number 3 of 3

13. Ditch Depth of Rock	0.00	ft
14. Cost of Ditch Surface Rock	20.00	$/yd3
15. Cost to Place Rock	12.00	$/yd3
16. Excavation Unit Cost	5.50	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	1.15	$/ft
19. Revegetation Unit Cost	1500.00	$/acre

Ditching Sub-Totals

20. Excavation Cost	3,178	$
21. Survey Cost	0	$
22. Clear and Grub Cost	315	$
23. Aggregate Cost	0	$
24. Filter Fabric Cost	0	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	424	$
27. Total Cost	3,917	$

Company Name Friends of the Cheat

Project Clark Site

Site Name Clark

Printed on 04/27/2018

AMD TREAT

DITCHING

Ditching Name: Diversion Ditch 2

1. Ditch Length Rock	315	ft
2. Ditch Length Grass	0	ft
3. Bottom Width of Ditch	3.0	ft
4. Ditch Depth	2.50	ft
5. Geo Textile Unit Cost	3.00	$/yd2
6. Length of Geo Textile	315	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	1300.00	$/acre

Record Number 2 of 3

13. Ditch Depth of Rock	1.50	ft
14. Cost of Ditch Surface Rock	25.00	$/yd3
15. Cost to Place Rock	12.00	$/yd3
16. Excavation Unit Cost	7.00	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	1.15	$/ft
19. Revegetation Unit Cost	1500.00	$/acre

Ditching Sub-Totals

20. Excavation Cost	1,633	$
21. Survey Cost	0	$
22. Clear and Grub Cost	147	$
23. Aggregate Cost	9,182	$
24. Filter Fabric Cost	1,489	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	31	$
27. Total Cost	12,482	$

Clark Site Fact Sheet

Influent water characteristics

Sample ID	Flow (gpm) *['Avg'/Max]*	Acidity (mg/L)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Acid Load (lb/day)	Diss. Fe Load (lb/day)	Diss. Al Load (lb/day)
Clark 1	20/95	30	< 0.1	4.3	34.3	ND	4.9
Clark 2	44/85	272	1.7	36.3	277.5	1.8	37.1
Clark 3	7/27	291	3.4	37.5	94.5	1.1	12.2
Clark 4	5/5	183	2.0	21.4	11.0	0.1	1.3
Clark 4A	4/26	53	0.6	4.8	16.5	0.2	1.5
Combined	80/238	146	1.0	19.4	417.3	3.0	55.5

All concentration and loading data represents values recorded on 3/30/2018 and correspond to the maximum flowrate that is presented above. Please note that the 'average' flow value is the flow measured on 3/15/2018. The sample set for this project only contains 2 water monitoring events due to the scope and time restraints associated with the project (both water monitoring events were captured in relatively high flow times of a particularly wet year - yielding conservative estimates). Please also note that the 'combined' water characteristics represent Clark 1-4 except for flowrate (which includes Clark 1-4 and 4A). Due to its physical location Clark 4A is planned for inclusion to the system at JVFPs not combined into the system influent.

Metals load removed (maximum)

- The proposed treatment system is anticipated to remove 85-100% of targeted contaminants (Acidity, Iron, and Aluminum).
- For calculation purposes, 95% removal of Iron & Aluminum is assumed; however, actual rates of removal will vary depending on site conditions, influent water quality, and flowrate.
- 100% removal of acidity is expected, as the proposed system is expected to produce an effluent with circumneutral pH, low metals concentrations, and containing measurable alkalinity.

Projected maximum pollutant load reduction

Sample ID	Flow (gpm) *[Max Design]*	Acidity (mg/L)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Acid Load (lb/day)	Diss. Fe Load (lb/day)	Diss. Al Load (lb/day)
System Influent	238	146	1.0	19.4	417.3	3.0	55.5
Projected Removal (%)	-	≥ 100	95	95	-	-	-
Estimated Load Reduction	-	-	-	-	≥ 417.3	2.9	52.7

Projected effluent water quality

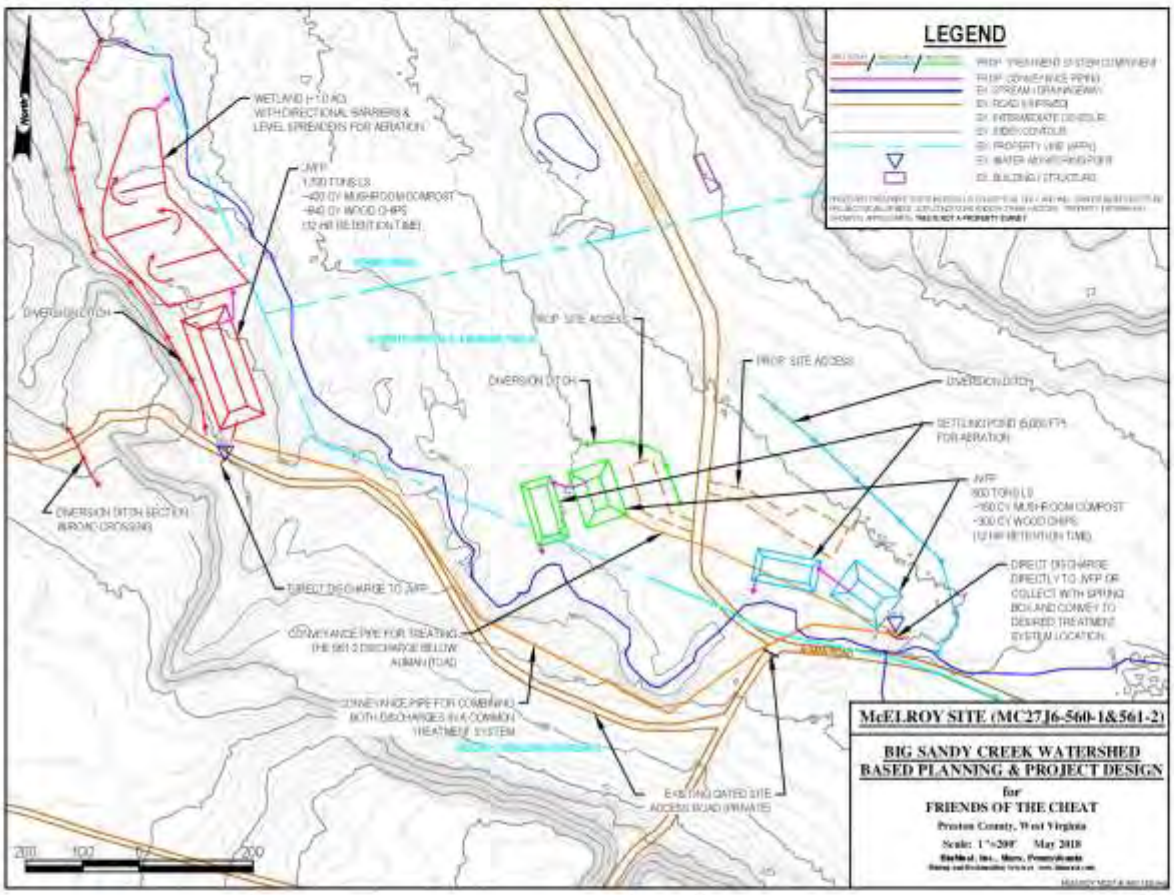
- pH 6 – 8
- Negative Acidity
- Metals concentrations for Iron and Aluminum of < 1 mg/L

Pond liner considerations

- Clay or synthetic liners may/can be incorporated into the design for treatment components susceptible to leakage. Ultimate decisions on liner application shall be made during final design process based on site specific test pit information. Expenses related to installing clay liners in the pond-type components have been included in the cost estimate but may not be needed.

- Test pits are recommended to be conducted during the design process to confirm existing soil conditions prior to construction efforts. The test pits will aid in determining potential need for lining of treatment component(s), as well as confirming the presence/absence of on-site clay sources to be used for liner construction.

McElroy MC27J6-560-1 and 561-2 conceptual design



McElroy 560-1 cost calculation

Printed on 05/07/2018

Company Name: Friends of the Cheat
Project: Big Sandy Plan
Site Name: McELROY SITE (560-1)

AMD TREAT
AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$208,167
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands	1	0	$117,172
Manganese Removal Bed			$0
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$325,339**
Active Treatment			
Caustic Soda			$0
Hydrated Lime			$0
Pebble Quick Lime			$0
Ammonia			$0
Oxidants			$0
Soda Ash			$0
Active Subtotal:			**$0**
Ancillary Cost			
Ponds			$0
Roads	1	0	$4,822
Land Access			$0
Ditching	1	0	$20,496
Engineering Cost	1	0	$50,000
Ancillary Subtotal:			**$75,318**
Other Cost (Capital Cost)			$70,343
Total Capital Cost:			**$471,000**
Annual Costs			
Sampling			$0
Labor			$0
Maintenance			$0
Pumping			$0
Chemical Cost			$0
Oxidant Chem Cost			$0
Sludge Removal			$0
Other Cost (Annual Cost)			$0
Land Access (Annual Cost)			$0
Total Annual Cost:			**$0**
Other Cost	1	0	

Water Quality

Design Flow	81.00	gpm
Typical Flow	36.00	gpm
Total Iron	0.40	mg/L
Ferrous Iron	0.00	mg/L
Aluminum	10.00	mg/L
Manganese	3.00	mg/L
pH	3.50	su
Alkalinity	0.00	mg/L
TIC	0.00	mg/L

(•) Calculate Net Acidity
( ) Enter Hot Acidity manually

Acidity	77.94	mg/L
Sulfate	370.00	mg/L
Chloride	0.00	mg/L
Calcium	0.00	mg/L
Magnesium	0.00	mg/L
Sodium	0.00	mg/L
Water Temperature	20.00	C
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.01	mg/L
Typical Acid Loading	6.1	tons/yr

Total Annual Cost: per 1000 Gal of H2O Treated **$0.000**

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Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY SITE (560-1)

AMD TREAT

OTHER COST

AMDTREAT

Oher Cost Name: Other Costs (560-1)

A. Description of Item	B. Unit Cost Per Item	C. Quantity	D. Total Item Cost	E. Capital Cost / Annual Cost
1. Direct Flow to Treatment System	1,000.00	1	1,000	Capital Cost
2. PVC z-pile Barriers (WL)	40.00	195	7,800	Capital Cost
3. Conveyance Piping System	4.00	450	1,800	Capital Cost
4. Road Crossing Culverts	20.00	40	800	Capital Cost
5. E&S Controls	2,000.00	1	2,000	Capital Cost
6. JVFP Underdrain Stone	30.00	450	13,500	Capital Cost
7. Contingency (10%)	42,755.00	1	42,755	Capital Cost
8. Misc/Other/Rounding	688.00	1	688	Capital Cost
9.	0.00	0	0	Capital Cost
10.	0.00	0	0	Capital Cost
11.	0.00	0	0	Capital Cost
12.	0.00	0	0	Capital Cost
13.	0.00	0	0	Capital Cost
14.	0.00	0	0	Capital Cost
15.	0.00	0	0	Capital Cost

Record Number 1 of 1

Curent Capital Cost 70,343 $
Current Annual Cost 0 $

Total Capital Cost 70,343 $
Total Annual Cost 0 $

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY SITE (560-1)

Printed on 05/07/2018

AMDTREAT

AMD TREAT

ENGINEERING COST

1. Capital Cost *	421,000	$
2. Per Cent of Capital Cost		%
3. Actual Engineering Cost	50,000	$
4. Total Engineering Cost	50,000	$

* Total Capital Cost minus Engineering and Land Access Capital Cost

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY SITE (560-1)

Printed on 05/07/2018

AMD TREAT

DITCHING

AMDTREAT

Ditching Name: Diversion Ditch

1. Ditch Length Rock	400	ft
2. Ditch Length Grass	500	ft
3. Bottom Width of Ditch	3.0	ft
4. Ditch Depth	3.00	ft
5. Geo Textile Unit Cost	1.00	$/yd2
6. Length of Geo Textile	400	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	2000.00	$/acre
13. Ditch Depth of Rock	1.50	ft
14. Cost of Ditch Surface Rock	25.00	$/yd3
15. Cost to Place Rock	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	2.00	$/ft
19. Revegetation Unit Cost	2000.00	$/acre

Ditching Sub-Totals

20. Excavation Cost	7,200	$
21. Survey Cost	0	$
22. Clear and Grub Cost	744	$
23. Aggregate Cost	11,309	$
24. Filter Fabric Cost	730	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	513	$
27. Total Cost	20,496	$

Record Number 1 of 1

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY SITE (560-1)

Printed on 05/07/2018

AMD TREAT

ROADS

AMDTREAT

Road Name: Select Road Improvements

1. Road Length	300	ft
2. Road Width	15	ft
3. Road Depth	1.00	ft
4. Aggregate Unit Cost	20.00	$/yd3
5. GeoTextile Length	0	ft
6. GeoTextile Unit Cost	1.00	$/yd2
7. Length of Silt Fence	0	ft
8. Unit Cost of Silt Fence	2.00	$/ft
☐ 9. Surveying?		
10. Survey Rate		acres/day
11. Survey Unit Cost		$/day
☑ 12. Clearing and Grubbing?		
13. Clear and Grub Cost	2000	$/acre

Record Number 1 of 1

14. Reveg Unit Cost	2000.00	$/acre
15. Culvert Unit Cost	30.00	$/ft
16. Culvert Length	40	ft

Roads Sub-Totals

17. Road Surface Cost	3,333	$
18. GeoTextile Cost	0	$
19. Silt Fence Cost	0	$
20. Culvert Cost	1,200	$
21. Revegetation Cost	41	$
22. Survey Cost	0	$
23. Clear and Grub Cost	248	$
24. Total Cost	4,822	$

Company Name Friends of the Cheat
Project Big Sandy Plan
Site Name McELROY SITE (560-1)

Printed on 05/07/2018

AMDTREAT

AMD TREAT

AEROBIC WETLANDS

Aerobic Wetlands Name: Wetland (560-1)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect Aerobic Wetlands

Calculated Acidity	77.94	mg/L
Alkalinity	0.00	mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)
( ) Enter Net Acidity manually

Net Acidity (Hot Acidity)	77.94	mg/L
Design Flow	61.00	gpm
Typical Flow	36.00	gpm
Total Iron	0.40	mg/L
Aluminum	10.00	mg/L
Manganese	3.00	mg/L
pH	3.50	su

SIZING METHODS Select One

( ) Aerobic Wetland Based on Metal Removal Rates — 1. Iron Removal Rate [ ] g/m2/day; 2. Mn Removal Rate [ ] g/m2/day
(•) Aerobic Wetland Based on Dimensions — 3. Top Length at Freeboard 383 ft; 4. Top Width at Freeboard 120 ft
( ) Aerobic Wetland Based on Iron Oxidation Kinetics — 5. Rate Constant [ ] moles/sec; 6. Effluent Fe Concentration [ ] mg/l; 7. Dissolved Oxygen [ ] mg/l; 8. H2O Temperature [ ] °C

	Length	Width
9. Length to Width Ratio		

	Run of Slope	Rise of Slope
10. Slope of Wetland Sides	2.0	1.000

11. Freeboard Depth	2.00	ft
12. Free Standing Water Depth	0.50	ft
13. Organic Matter Depth	1.00	ft
14. Organic Matter Unit Cost	30.00	$/yd3
15. Organic Matter Spreading Unit Cost	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Wetland Planting Unit Cost	3700	$/acre

Liner Cost

( ) No Liner
(•) Clay Liner

18. Clay Liner Unit Cost	40.00	$/yd3
19. Thickness of Clay Liner	0.50	ft

( ) Synthetic Liner

20. Synthetic Liner Unit Cost		$/yd2

☑ 21. Clearing and Grubbing?

(•) 22. Land Multiplier	1.5	ratio
( ) 23. Clear/Grub Acres		acres
24. Clear and Grub Unit Cost	2000	$/acre

Aerobic Wetland Sizing Summaries

25. Length at Top of Freeboard	383.00	ft
26. Width at Top of Freeboard	120.00	ft
27. Freeboard Volume	3,085	yd3
28. Water Surface Area	39,780	ft2
29. Water Volume	727	yd3
30. Organic Matter Volume	1,404	yd3
31. Excavation Volume	2,131	yd3
32. Clear and Grub Area	1.5	acres
33. Liner Area	5,359	ft2
34. Retention Time	30	hrs

Aerobic Cost Summaries

35. Organic Matter Cost	50,546	$
36. Excavation Cost	17,054	$
37. Liner Cost	42,872	$
38. Clear and Grub Cost	3,000	$
39. Wetland Planting Cost	3,700	$
40. Total Cost	117,172	$

Record Number 1 of 1

Company Name: Friends of the Cheat

Project: Big Sandy Plan

Site Name: McELROY SITE (560-1)

Printed on 05/07/2018

AMDTREAT

AMD TREAT
VERTICAL FLOW POND (VFP)

VFP Name: JVFP (560-1)

☐ **Opening Screen Water Parameters**

SIZING METHODS Select One

1. Tons of Limestone Needed	541	VFP Based on Acidity Neutralization	
2. Tons of Limestone Needed	1,139	◯ VFP Based on Retention Time	6. Retention Time [ ] hours
3. Tons of Limestone Needed	1,397	◯ VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate [ ] g/m2/day
4. Tons of Limestone Needed	1,700	◉ VFP Based on Tons Limestone Entered	8. Limestone Needed 1,700 tons
5. Tons of Limestone Needed	1,684	◯ VFP Based on Dimensions	9. Length at Top of Freeboard [ ] ft; 10. Width at Top of Freeboard [ ] ft

Influent Water Parameters that Affect VFP

Calculated Acidity	77.94	mg/L
Alkalinity	0.00	mg/L

◉ Calculate Net Acidity (Acid-Alkalinity)

◯ Enter Net Acidity manually

Net Acidity (Hot Acidity)	77.94	mg/L
Design Flow	81.00	gpm
Typical Flow	36.00	gpm
Total Iron	0.40	mg/L
Aluminum	10.00	mg/L
Manganese	3.00	mg/L

11. % Void Space of LS. Bed	43.00	%
12. System Life	20.00	years
13. Limestone Purity	85.00	%
14. Limestone Efficiency	60.00	%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	30.00	$/ton
17. LS Placement Unit Cost	8.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	4.3	ft
21. Organic Matter Depth	1.7	ft
22. Organic Matter Unit Cost	30.00	$/yd3
23. Organic Matter Spreading Unit Cost	6.00	$/yd3
24. Limestone Depth	2.0	ft
25. Excavation Unit Cost	8.00	$/yd3

Liner Cost

◯ No Liner

◉ Clay Liner

11. Clay Liner Unit Cost	40.00	$/yd3
12. Thickness of Clay Liner	0.5	ft

◯ Synthetic Liner

13. Synthetic Liner Unit Cost		$/yd2

☑ 29. Clearing and Grubbing?

◉ 30a. Land Multiplier	1.50	ratio
◯ 30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	2000.00	$/acre
32. Nbr. of Valves	4	nbr
33. Unit Cost of Valves	150.00	$ ea

◉ AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe	20	ft
35. Pipe Install Rate	11.00	ft/hr
36. Labor Rate	35.00	$/hr
37. Segment Len. of Trunk Pipe	20	ft/pipe seg
38. Trunk Pipe Cost	15.00	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	7.00	$/ft
41. Spur Coupler Cost	3.00	$/spur
42. "T" Connector Cost	90.00	$/T coupler
43. Segment Len. of Spur Pipe	20	ft/pipe seg
44. Spur Pipe Spacing	10.0	ft

◯ Custom Piping Costs

	Length	Diameter	Unit Cost
45. Pipe #1	ft	in	$
46. Pipe #2	ft	in	$
47. Pipe #3	ft	in	$

VFP Sizing Summaries

48. Length at Top of Freeboard	227.88	ft
49. Width at Top of Freeboard	129.93	ft
50. Freeboard Volume	2,088	yd3
51. Water Surface Area	26,808	ft2
52. Total Water Volume	3,817	yd3
53. Organic Matter Volume	1,271	yd3
54. Limestone Surface Area	19,181	ft2
55. Limestone Volume	1,325.37	yd3
56. Excavation Volume	6,424.0	yd3
57. Clear and Grub Area	1.0	acr.
58. Liner Area	4,442.4	ft2
59. Theoretical Retention Time	23.86	hrs

VFP Cost Summaries

60. Organic Matter Cost	38,148	$
61. Limestone Cost	51,000	$
62. Limestone and Organic Matter Placement Cost	15,641	$
63. Excavation Cost	51,392	$
64. Liner Cost	23,042	$
65. Clear and Grub Cost	2,039	$
66. Valve Cost	600	$
67. Pipe Cost	26,304	$
68. Total Cost	208,167	$

Record Number

1 of 1

Company Name <u>Friends of the Cheat</u>

Project <u>Big Sandy Plan</u>

Site Name <u>McELROY SITE (560-1)</u>

COMMENTS: 3 options exist: for treating the 561-2 discharge out by the road, these options are color coded on the conceptual design.

McElroy 560-2 cost calculation

Printed on 05/07/2018

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY - 561-2

AMDTREAT

AMD TREAT

OTHER COST

Oher Cost Name: Other Costs McELROY (561-2)

	A. Description of Item	B. Unit Cost Per Item	C. Quantity	D. Total Item Cost	E. Capital Cost / Annual Cost
1.	E&S Controls	2,000.00	1	2,000	Capital Cost
2.	Spring Box Seep Collection	2,000.00	1	2,000	Capital Cost
3.	Conveyane Piping (Discharge to site)	8.00	550	4,400	Capital Cost
4.	Site piping (JVFP to Settling Pond)	3.00	100	300	Capital Cost
5.	JVFP Underdrain Stone	30.00	120	3,600	Capital Cost
6.	Contingency (10%)	14,894.00	1	14,894	Capital Cost
7.	Misc/Rounding/Other	171.00	1	171	Capital Cost
8.		0.00	0	0	Capital Cost
9.		0.00	0	0	Capital Cost
10.		0.00	0	0	Capital Cost
11.		0.00	0	0	Capital Cost
12.		0.00	0	0	Capital Cost
13.		0.00	0	0	Capital Cost
14.		0.00	0	0	Capital Cost
15.		0.00	0	0	Capital Cost

Record Number 1 of 1

Curent Capital Cost 27,365 $
Current Annual Cost 0 $

Total Capital Cost 27,365 $
Total Annual Cost 0 $

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY - 561-2

Printed on 05/07/2018

AMDTREAT

AMD TREAT

ENGINEERING COST

1. Capital Cost *	134,000	$
2. Per Cent of Capital Cost		%
3. Actual Engineering Cost	30,000	$
4. Total Engineering Cost	30,000	$

*** Total Capital Cost minus Engineering and Land Access Capital Cost**

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY - 561-2

Printed on 05/07/2018

AMDTREAT

AMD TREAT

DITCHING

Ditching Name: Conveyance Piping (Ditch Cost)

1. Ditch Length Rock	0	ft
2. Ditch Length Grass	530	ft
3. Bottom Width of Ditch	2.0	ft
4. Ditch Depth	3.00	ft
5. Geo Textile Unit Cost	3.00	$/yd2
6. Length of Geo Textile	0	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	2000.00	$/acre

Record Number 2 of 2

13. Ditch Depth of Rock	1.50	ft
14. Cost of Ditch Surface Rock	25.00	$/yd3
15. Cost to Place Rock	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	1.15	$/ft
19. Revegetation Unit Cost	2000.00	$/acre

Ditching Sub-Totals

20. Excavation Cost	3,769	$
21. Survey Cost	0	$
22. Clear and Grub Cost	409	$
23. Aggregate Cost	0	$
24. Filter Fabric Cost	0	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	450	$
27. Total Cost	4,628	$

Company Name Friends of the Cheat
Project Big Sandy Plan
Site Name McELROY - 561-2

Printed on 05/07/2018

AMD TREAT

DITCHING

AMDTREAT

Ditching Name: Diversion Ditch

1. Ditch Length Rock	0	ft
2. Ditch Length Grass	250	ft
3. Bottom Width of Ditch	3.0	ft
4. Ditch Depth	3.00	ft
5. Geo Textile Unit Cost	1.00	$/yd2
6. Length of Geo Textile	250	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	2000.00	$/acre

Record Number 1 of 2

13. Ditch Depth of Rock	1.50	ft
14. Cost of Ditch Surface Rock	25.00	$/yd3
15. Cost to Place Rock	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	2.00	$/ft
19. Revegetation Unit Cost	2000.00	$/acre

Ditching Sub-Totals

20. Excavation Cost	2,000	$
21. Survey Cost	0	$
22. Clear and Grub Cost	207	$
23. Aggregate Cost	0	$
24. Filter Fabric Cost	456	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	226	$
27. Total Cost	2,889	$

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY - 561-2

Printed on 05/07/2018

AMDTREAT

AMD TREAT

ROADS

Road Name: Site Access Road & Parking (561-2)

1. Road Length	175	ft
2. Road Width	20	ft
3. Road Depth	1.00	ft
4. Aggregate Unit Cost	25.00	$/yd3
5. GeoTextile Length	175	ft
6. GeoTextile Unit Cost	1.00	$/yd2
7. Length of Silt Fence	0	ft
8. Unit Cost of Silt Fence	2.00	$/ft
☐ 9. Surveying?		
10. Survey Rate		acres/day
11. Survey Unit Cost		$/day
☑ 12. Clearing and Grubbing?		
13. Clear and Grub Cost	2000	$/acre

Record Number 1 of 1

14. Reveg Unit Cost	2000.00	$/acre
15. Culvert Unit Cost	30.00	$/ft
16. Culvert Length	20	ft

Roads Sub-Totals

17. Road Surface Cost	3,241	$
18. GeoTextile Cost	389	$
19. Silt Fence Cost	0	$
20. Culvert Cost	600	$
21. Revegetation Cost	32	$
22. Survey Cost	0	$
23. Clear and Grub Cost	193	$
24. Total Cost	4,455	$

Company Name Friends of the Cheat
Project Big Sandy Plan
Site Name McELROY - 561-2

Printed on 05/07/2018

AMDTREAT

AMD TREAT

PONDS

Pond Name: Settling Pond

Opening Screen Water Parameters

Influent Water Parameters that Affect Ponds

Calculated Acidity	33.66	mg/L
Alkalinity	0.00	mg/L

- (selected) Calculate Net Acidity (Acid-Alkalinity)
- Enter Net Acidity manually

Net Acidity (Hot Acidity)	0.00	mg/L
Design Flow	30.00	gpm
Typical Flow	7.00	gpm
Total Iron	0.10	mg/L
Aluminum	4.60	mg/L
Manganese	1.50	mg/L

Record Number
1 of 1

Pond Design Based On:

- Retention Time

1. Desired Retention Time		hours
3. Sludge Removal Frequency		times/year
4. Titration?		
5. Sludge Rate		gal sludge/ gal H2O
6. Percent Solids		%
7. Sludge Density		lbs./gal

- (selected) Pond Size

8. Pond Length at Top of Freeboard	113.000	ft
9. Pond Width at Top of Freeboard	56.000	ft

	Run	Rise	
10. Slope Ratio of Pond Sides	2.0	1	
11. Freeboard Depth	2.0		ft
12. Water Depth	4.0		ft
13. Excavation Unit Cost	8.00		$/yd3
14. Total Length of Effluent / Influent Pipe	20.00		ft
15. Unit Cost of Pipe	10.00		$/ft

Liner Cost

- No Liner
- (selected) Clay Liner

16. Clay Liner Unit Cost	40.00	$/yd3
17. Thickness of Clay Liner	1.0	ft

- Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☑ 19. Clearing and Grubbing?

(selected) 20. Land Multiplier	1.50	ratio
21. Clear/Grub Acres		acres
22. Clear and Grub Unit Cost	2000.00	$/acre

23. Revegetation Cost	2000.00	$/acre
24. Cost of Baffles	0	$

Calculated Pond Dimensions per Pond

25. Length at Top of Freeboard	113	ft
26. Width at Top of Freeboard	56	ft
27. Freeboard Volume	996	yd3
28. Water Volume	577	yd3
29. Estimated Annual Sludge	0	yd3/yr
30. Volume of Sludge per Removal	0	yd3/ removal
31. Excavation Volume	0.35	acre ft
32. Excavation Volume	577	yd3
33. Clear and Grub Area	0.21	acres
34. Liner Area	589	yd2
35. Calculated Retention Time	64	hours

Ponds Sub-Totals per Pond

36. Excavation Cost	5,776	$
37. Pipe Cost	200	$
38. Liner Cost	5,764	$
39. Clearing and Grubbing Cost	435	$
40. Revegetation Cost	145	$
41. Baffle Cost	0	$
42. Estimated Cost	12,322	$

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY - 561-2

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AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: JVFP (561-2)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	33.66	mg/L
Alkalinity	0.00	mg/L

(•) Calculate Net Acidity (Acid-Alkalinity)

( ) Enter Net Acidity manually

Net Acidity (Hot Acidity)	33.66	mg/L
Design Flow	30.00	gpm
Typical Flow	7.00	gpm
Total Iron	0.10	mg/L
Aluminum	4.80	mg/L
Manganese	1.50	mg/L

Record Number

1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	86	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	422	( ) VFP Based on Retention Time
3. Tons of Limestone Needed	223	( ) VFP Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	600	(•) VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,684	( ) VFP Based on Dimensions

6. Retention Time		hours
7. Alkalinity Generation Rate		g/m2/day
8. Limestone Needed	600	tons
9. Length at Top of Freeboard		ft
10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	43.00	%
12. System Life	20.00	years
13. Limestone Purity	85.00	%
14. Limestone Efficiency	60.00	%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	30.00	$/ton
17. LS Placement Unit Cost	6.00	$/yd3
18. Slope of Pond Sides (Run of Slope / Rise of Slope)	2.0 / 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	4.3	ft
21. Organic Matter Depth	1.7	ft
22. Organic Matter Unit Cost	30.00	$/yd3
23. Organic Matter Spreading Unit Cost	6.00	$/yd3
24. Limestone Depth	2.0	ft
25. Excavation Unit Cost	8.00	$/yd3

Liner Cost

( ) No Liner

(•) Clay Liner

11. Clay Liner Unit Cost	40.00	$/yd3
12. Thickness of Clay Liner	0.5	ft

( ) Synthetic Liner

13. Synthetic Liner Unit Cost		$/yd2

☑ 29. Clearing and Grubbing?

(•) 30a. Land Multiplier	1.50	ratio
( ) 30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	2000.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	3500.00	$ ea.

(•) AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe	20	ft
35. Pipe Install Rate	11.00	ft/hr
36. Labor Rate	35.00	$/hr
37. Segment Len. of Trunk Pipe	20	ft/pipe seg.
38. Trunk Pipe Cost	15.00	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	7.00	$/ft
41. Spur Coupler Cost	3.00	$/spur
42. "T" Connector Cost	90.00	$/T coupler
43. Segment Len. of Spur Pipe	20	ft/pipe seg.
44. Spur Pipe Spacing	10.0	ft

( ) Custom Piping Costs

	Length	Diameter	Unit Cost
45. Pipe #1	ft	in	$
46. Pipe #2	ft	in	$
47. Pipe #3	ft	in	$

VFP Sizing Summaries

48. Length at Top of Freeboard	150.77	ft
49. Width at Top of Freeboard	91.38	ft
50. Freeboard Volume	950	yd3
51. Water Surface Area	11,905	ft2
52. Total Water Volume	1,602	yd3
53. Organic Matter Volume	483	yd3
54. Limestone Surface Area	7,054	ft2
55. Limestone Volume	471.30	yd3
56. Excavation Volume	2,558.6	yd3
57. Clear and Grub Area	0.4	ac
58. Liner Area	2314.8	ft2
59. Theoretical Retention Time	22.74	hrs

VFP Cost Summaries

60. Organic Matter Cost	14,498	$
61. Limestone Cost	18,000	$
62. Limestone and Organic Matter Placement Cost	5,727	$
63. Excavation Cost	20,453	$
64. Liner Cost	10,913	$
65. Clear and Grub Cost	948	$
66. Valve Cost	0	$
67. Pipe Cost	11,800	$
68. Total Cost	82,341	$

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name McELROY - 561-2

COMMENTS: 3 options exist: for treating the 561-2 discharge out by the road, these options are color coded on the conceptual design. The cost estimate provided is for the preferred option of building the system on the lower side of Auman Road (collecting the discharge via spring box and piping it to the treatment system.

Printed on 05/07/2019

Company Name Friends of the Cheat
Project Big Sandy Plan
Site Name McELROY - 561-2

AMDTREAT

AMD TREAT

Costs — AMD TREAT MAIN COST FORM

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$82,341
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed			$0
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$82,341**
Active Treatment			
Caustic Soda			$0
Hydrated Lime			$0
Pebble Quick Lime			$0
Ammonia			$0
Oxidants			$0
Soda Ash			$0
Active Subtotal:			**$0**
Ancillary Cost			
Ponds	1	0	$12,322
Roads	1	0	$4,455
Land Access			$0
Ditching	2	0	$7,517
Engineering Cost	1	0	$30,000
Ancillary Subtotal:			**$54,294**
Other Cost (Capital Cost)			$27,365
Total Capital Cost:			**$164,000**
Annual Costs			
Sampling			$0
Labor			$0
Maintenance			$0
Pumping			$0
Chemical Cost			$0
Oxidant Chem Cost			$0
Sludge Removal			$0
Other Cost (Annual Cost)			$0
Land Access (Annual Cost)			$0
Total Annual Cost:			**$0**
Other Cost	1	0	

Water Quality

Design Flow	30.00	gpm
Typical Flow	7.00	gpm
Total Iron	0.10	mg/L
Ferrous Iron	0.00	mg/L
Aluminum	4.80	mg/L
Manganese	1.50	mg/L
pH	4.10	su
Alkalinity	0.00	mg/L
TIC	0.00	mg/L

(•) Calculate Net Acidity
( ) Enter Hot Acidity manually

Acidity	33.66	mg/L
Sulfate	120.00	mg/L
Chloride	0.00	mg/L
Calcium	0.00	mg/L
Magnesium	0.00	mg/L
Sodium	0.00	mg/L
Water Temperature	20.00	C
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.01	mg/L
Typical Acid Loading	0.5	tons/yr

Total Annual Cost: per 1000 Gal of H2O Treated $0.000

McElroy site fact sheet

Influent water characteristics

Sample ID	Flow (gpm) *['Avg'/Max]*	Acidity (mg/L)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Acid Load (lb/day)	Diss. Fe Load (lb/day)	Diss. Al Load (lb/day)
560-1	36/81	84	0.4	10.0	82.2	0.4	9.7
561-2	7/30	7	< 0.1	4.9	2.4	ND	1.8

All concentration and loading data represents values recorded on 3/30/2018 and correspond to the maximum flowrate that is presented above. Please note that the 'average' flow value is the flow measured on 3/15/2018. The sample set for this project only contains 2 water monitoring events due to the scope and time restraints associated with the project (both water monitoring events were captured in relatively high flow times of a particularly wet year - yielding conservative estimates).

Metals load removed (maximum)

- The proposed treatment system is anticipated to remove 85-100% of targeted contaminants (Acidity, Iron, and Aluminum).
- For calculation purposes, 95% removal of Iron & Aluminum is assumed; however, actual rates of removal will vary depending on site conditions, influent water quality, and flowrate.
- 100% removal of acidity is expected, as the proposed system is expected to produce an effluent with circumneutral pH, low metals concentrations, and containing measurable alkalinity.

Projected maximum Pollutant load reduction

Sample ID	Flow (gpm) *[Max Design]*	Acidity (mg/L)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Acid Load (lb/day)	Diss. Fe Load (lb/day)	Diss. Al Load (lb/day)
System Influent (560-1)	81	84	0.4	10.0	82.2	0.4	9.7
System Influent (561-2)	30	7	< 0.1	4.9	2.4	ND	1.8
Projected Removal (%)	-	≥ 100	95	95	-	-	-
Estimated Load Reduction (560-1)	-	-	-	-	≥ 82.2	0.38	9.2
Estimated Load Reduction (561-2)	-	-	-	-	≥ 82.2	ND	1.7

Projected Effluent Water Quality

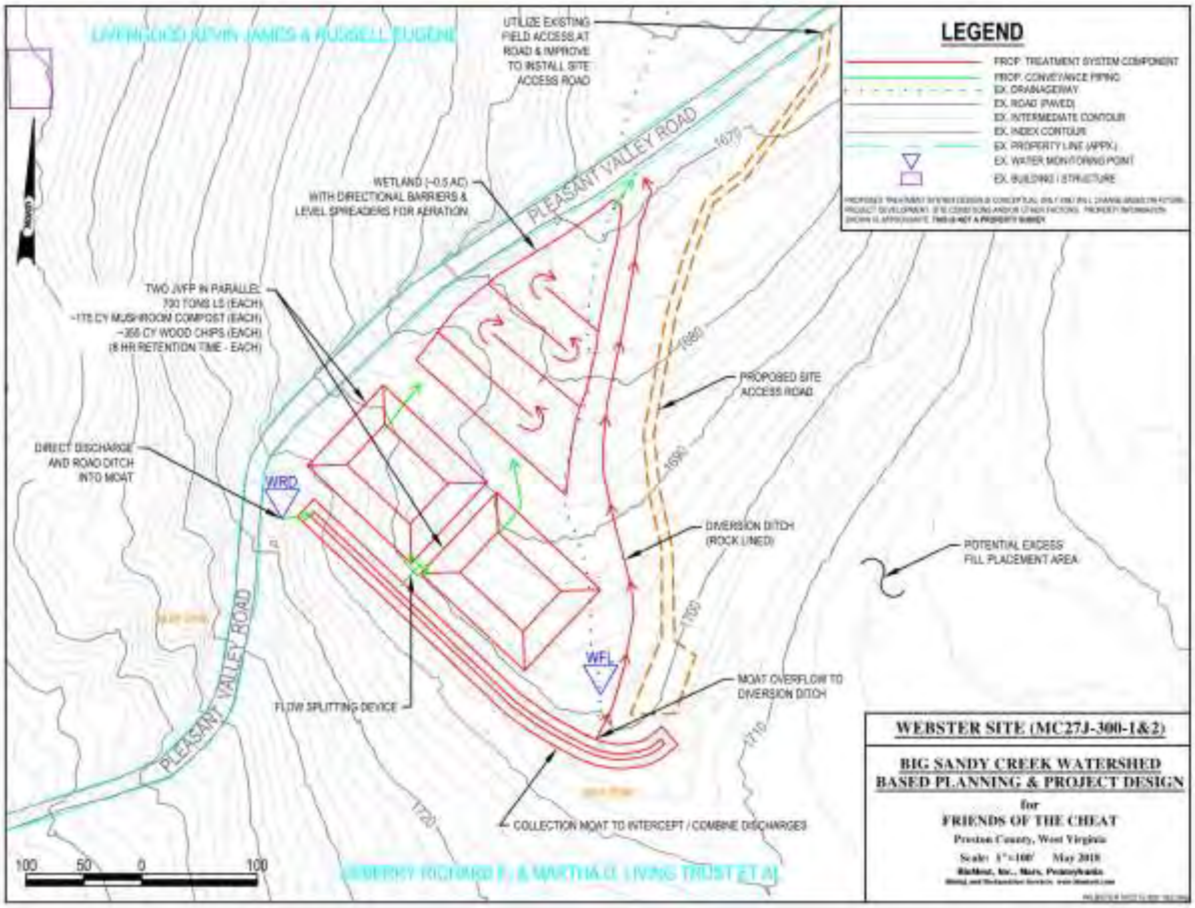
- pH 6 – 8
- Negative acidity
- Metals concentrations for Iron and Aluminum of < 1 mg/L

Pond Liner Considerations

- Clay or synthetic liners may/can be incorporated into the design for treatment components susceptible to leakage. Ultimate decisions on liner application shall be made during final design process based on site specific test pit information. Expenses related to installing clay liners in the pond-type components have been included in the cost estimate, but may not be needed.

- Test pits are recommended to be conducted during the design process to confirm existing soil conditions prior to construction efforts. The test pits will aid in determining potential need for lining of treatment component(s), as well as confirming the presence/absence of on-site clay sources to be used for liner construction.

Webster MC27J-300-1 & 2 conceptual design



Webster cost calculation

Printed on 05/07/2018

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

AMD TREAT

OTHER COST

AMDTREAT

Oher Cost Name Other Costs

	A. Description of Item	B. Unit Cost Per Item	C. Quantity	D. Total Item Cost	E. Capital Cost Annual Cost
1.	E&S Controls	15,000.00	1	15,000	(•) Capital Cost ( ) Annual Cost
2.	Flow splitter	5,000.00	1	5,000	(•) Capital Cost ( ) Annual Cost
3.	4" JVFP to WL	3.00	400	1,200	(•) Capital Cost ( ) Annual Cost
4.	Direct Water to Moat	3,000.00	1	3,000	(•) Capital Cost ( ) Annual Cost
5.	PVC Z-pile (WL barriers)	40.00	230	9,200	(•) Capital Cost ( ) Annual Cost
6.	JVFP Underdrain Stone	30.00	500	15,000	(•) Capital Cost ( ) Annual Cost
7.	Contingency (10%)	44,466.00	1	44,466	(•) Capital Cost ( ) Annual Cost
8.	Misc/Other/Rounding	879.00	1	879	(•) Capital Cost ( ) Annual Cost
9.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
10.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
11.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
12.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
13.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
14.		0.00	0	0	(•) Capital Cost ( ) Annual Cost
15.		0.00	0	0	(•) Capital Cost ( ) Annual Cost

Record Number
1 of 1

Curent Capital Cost 93,745 $
Current Annual Cost 0 $

Total Capital Cost 93,745 $
Total Annual Cost 0 $

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

Printed on 05/07/2018

AMDTREAT

AMD TREAT

ENGINEERING COST

1. Capital Cost *	440,001	$
○ 2. Per Cent of Capital Cost		%
◉ 3. Actual Engineering Cost	50,000	$
4. Total Engineering Cost	50,000	$

*** Total Capital Cost minus Engineering and Land Access Capital Cost**

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

Printed on 05/07/2018

AMD TREAT

DITCHING

AMDTREAT

Ditching Name: Stream / Diversion

1. Ditch Length Rock	500	ft
2. Ditch Length Grass	0	ft
3. Bottom Width of Ditch	5.0	ft
4. Ditch Depth	3.00	ft
5. Geo Textile Unit Cost	3.00	$/yd2
6. Length of Geo Textile	505	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
8. Surveying?	☐	
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
11. Clearing and Grubbing?	☑	
12. Clear and Grub Cost	2000.00	$/acre

Record Number 2 of 2

13. Ditch Depth of Rock	2.00	ft
14. Cost of Ditch Surface Rock	25.00	$/yd3
15. Cost to Place Rock	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	2.00	$/ft
19. Revegetation Unit Cost	2000.00	$/acre

Ditching Sub-Totals

20. Excavation Cost	4,889	$
21. Survey Cost	0	$
22. Clear and Grub Cost	468	$
23. Aggregate Cost	21,145	$
24. Filter Fabric Cost	3,100	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	85	$
27. Total Cost	29,687	$

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

Printed on 05/07/2018

AMD TREAT

DITCHING

AMDTREAT

Ditching Name: MOAT COLLECTION

1. Ditch Length Rock	0	ft
2. Ditch Length Grass	400	ft
3. Bottom Width of Ditch	5.0	ft
4. Ditch Depth	5.00	ft
5. Geo Textile Unit Cost	0.00	$/yd2
6. Length of Geo Textile	0	ft
7. Slope Ratio of Ditch Sides (Run : Rise)	2.00 : 1.00	
☐ 8. Surveying?		
9. Survey Rate		acres/day
10. Survey Unit Cost		$/day
☑ 11. Clearing and Grubbing?		
12. Clear and Grub Cost	2000.00	$/acre
13. Ditch Depth of Rock	0.00	ft
14. Cost of Ditch Surface Rock	25.00	$/yd3
15. Cost to Place Rock	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Length of Silt Fence	0.00	ft
18. Unit Cost of Silt Fence	2.00	$/ft
19. Revegetation Unit Cost	2000.00	$/acre

Record Number 1 of 2

Ditching Sub-Totals

20. Excavation Cost	8,889	$
21. Survey Cost	0	$
22. Clear and Grub Cost	551	$
23. Aggregate Cost	0	$
24. Filter Fabric Cost	0	$
25. Silt Fence Cost	0	$
26. Revegetation Cost	603	$
27. Total Cost	10,043	$

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

Printed on 05/07/2018

AMD TREAT

ROADS

AMDTREAT

Road Name: Site Access Road

1. Road Length	700	ft
2. Road Width	12	ft
3. Road Depth	1.00	ft
4. Aggregate Unit Cost	30.00	$/yd3
5. GeoTextile Length	700	ft
6. GeoTextile Unit Cost	1.00	$/yd2
7. Length of Silt Fence	0	ft
8. Unit Cost of Silt Fence	2.00	$/ft
☐ 9. Surveying?		
10. Survey Rate		acres/day
11. Survey Unit Cost		$/day
☑ 12. Clearing and Grubbing?		
13. Clear and Grub Cost	2000	$/acre

Record Number 1 of 1

14. Reveg Unit Cost	2000.00	$/acre
15. Culvert Unit Cost	30.00	$/ft
16. Culvert Length	20	ft

Roads Sub-Totals

17. Road Surface Cost	9,333	$
18. GeoTextile Cost	933	$
19. Silt Fence Cost	0	$
20. Culvert Cost	600	$
21. Revegetation Cost	77	$
22. Survey Cost	0	$
23. Clear and Grub Cost	463	$
24. Total Cost	11,406	$

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

Printed on 05/07/2018

AMDTREAT

AMD TREAT

AEROBIC WETLANDS

Aerobic Wetlands Name: Wetland

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect Aerobic Wetlands

Calculated Acidity	24.64	mg/L
Alkalinity	0.00	mg/L
(•) Calculate Net Acidity (Acid-Alkalinity)		
( ) Enter Net Acidity manually		
Net Acidity (Hot Acidity)	24.64	mg/L
Design Flow	110.00	gpm
Typical Flow	29.00	gpm
Total Iron	1.10	mg/L
Aluminum	2.50	mg/L
Manganese	0.40	mg/L
pH	3.85	su

SIZING METHODS Select One

( ) Aerobic Wetland Based on Metal Removal Rates — 1. Iron Removal Rate ___ g/m2/day; 2. Mn Removal Rate ___ g/m2/day

(•) Aerobic Wetland Based on Dimensions — 3. Top Length at Freeboard 200 ft; 4. Top Width at Freeboard 110 ft

( ) Aerobic Wetland Based on Iron Oxidation Kinetics — 5. Rate Constant ___ moles/sec; 6. Effluent Fe Concentration ___ mg/l; 7. Dissolved Oxygen ___ mg/l; 8. H2O Temperature ___ °C

9. Length to Width Ratio (Length : Width)	:	
10. Slope of Wetland Sides (Run of Slope : Rise of Slope)	2.0 : 1.000	
11. Freeboard Depth	2.00	ft
12. Free Standing Water Depth	0.50	ft
13. Organic Matter Depth	1.00	ft
14. Organic Matter Unit Cost	30.00	$/yd3
15. Organic Matter Spreading Unit Cost	6.00	$/yd3
16. Excavation Unit Cost	8.00	$/yd3
17. Wetland Planting Unit Cost	10000	$/acre

Liner Cost

( ) No Liner

(•) Clay Liner

18. Clay Liner Unit Cost	40.00	$/yd3
19. Thickness of Clay Liner	1.00	ft

( ) Synthetic Liner

20. Synthetic Liner Unit Cost		$/yd2

☑ 21. Clearing and Grubbing?

(•) 22. Land Multiplier	1.5	ratio
( ) 23. Clear/Grub Acres		acres
24. Clear and Grub Unit Cost	1300	$/acre

Aerobic Wetland Sizing Summaries

25. Length at Top of Freeboard	200.00	ft
26. Width at Top of Freeboard	110.00	ft
27. Freeboard Volume	1,539	yd3
28. Water Surface Area	19,584	ft2
29. Water Volume	357	yd3
30. Organic Matter Volume	682	yd3
31. Excavation Volume	1,039	yd3
32. Clear and Grub Area	0.7	acres
33. Liner Area	2,777	ft2
34. Retention Time	10	hrs

Aerobic Cost Summaries

35. Organic Matter Cost	24,567	$
36. Excavation Cost	8,317	$
37. Liner Cost	44,446	$
38. Clear and Grub Cost	985	$
39. Wetland Planting Cost	5,051	$
40. Total Cost	83,366	$

Record Number 1 of 1

Company Name: Friends of the Cheat
Project: Big Sandy Plan
Site Name: Webster Site

Printed on 05/07/2018

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: JVFP 2

Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	232	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	1,547	VFP Based on Retention Time — 6. Retention Time [ ] hours
3. Tons of Limestone Needed	599	VFP Based on Alkalinity Generation Rate — 7. Alkalinity Generation Rate [ ] g/m2/day
4. Tons of Limestone Needed	700	(selected) VFP Based on Tons Limestone Entered — 8. Limestone Needed 700 tons
5. Tons of Limestone Needed	1,684	VFP Based on Dimensions — 9. Length at Top of Freeboard [ ] ft; 10. Width at Top of Freeboard [ ] ft

Influent Water Parameters that Affect VFP

Calculated Acidity	24.64	mg/L
Alkalinity	0.00	mg/L
(selected) Calculate Net Acidity (Acid-Alkalinity)		
Enter Net Acidity manually		
Net Acidity (Hot Acidity)	24.64	mg/L
Design Flow	110.00	gpm
Typical Flow	29.00	gpm
Total Iron	1.10	mg/L
Aluminum	2.50	mg/L
Manganese	0.40	mg/L

11. % Void Space of LS. Bed	43.00	%
12. System Life		years
13. Limestone Purity	85.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	30.00	$/ton
17. LS Placement Unit Cost	6.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	4.3	ft
21. Organic Matter Depth	1.7	ft
22. Organic Matter Unit Cost	30.00	$/yd3
23. Organic Matter Spreading Unit Cost	6.00	$/yd3
24. Limestone Depth	2.0	ft
25. Excavation Unit Cost	8.00	$/yd3

Liner Cost

- No Liner
- (selected) Clay Liner

11. Clay Liner Unit Cost	40.00	$/yd3
12. Thickness of Clay Liner	1.0	ft

- Synthetic Liner

13. Synthetic Liner Unit Cost		$/yd2

☑ 29. Clearing and Grubbing?

(selected) 30a. Land Multiplier	1.50	ratio
30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	2000.00	$/acre
32. Nbr. of Valves	3	nbr
33. Unit Cost of Valves	150.00	$ ea.

(selected) AMDTreat Piping Costs

34. Total Length of Effluent / Influent Pipe	20	ft
35. Pipe Install Rate	11.00	ft/hr
36. Labor Rate	35.00	$/hr
37. Segment Len. of Trunk Pipe	20	ft/pipe seg.
38. Trunk Pipe Cost	15.00	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	7.00	$/ft
41. Spur Coupler Cost	3.00	$/spur
42. "T" Connector Cost	90.00	$/T coupler
43. Segment Len. of Spur Pipe	20	ft/pipe seg.
44. Spur Pipe Spacing	10.0	ft

Custom Piping Costs

	Length	Diameter	Unit Cost
45. Pipe #1	ft	in	$
46. Pipe #2	ft	in	$
47. Pipe #3	ft	in	$

VFP Sizing Summaries

48. Length at Top of Freeboard	159.81	ft
49. Width at Top of Freeboard	95.90	ft
50. Freeboard Volume	1,061	yd3
51. Water Surface Area	13,346	ft2
52. Total Water Volume	1,812	yd3
53. Organic Matter Volume	556	yd3
54. Limestone Surface Area	8,168	ft2
55. Limestone Volume	549.86	yd3
56. Excavation Volume	2,919.0	yd3
57. Clear and Grub Area	0.5	acr.
58. Liner Area	2,530.2	ft2
59. Theoretical Retention Time	7.23	hrs

VFP Cost Summaries

60. Organic Matter Cost	16,690	$
61. Limestone Cost	21,000	$
62. Limestone and Organic Matter Placement Cost	6,637	$
63. Excavation Cost	23,353	$
64. Liner Cost	24,218	$
65. Clear and Grub Cost	1,055	$
66. Valve Cost	450	$
67. Pipe Cost	12,474	$
68. Total Cost	105,876	$

Record Number 2 of 2

Company Name Friends of the Cheat

Project Big Sandy Plan

Site Name Webster Site

Printed on 05/07/2018

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: JVFP 1

☐ Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	232	VFP Based on Acidity Neutralization	
2. Tons of Limestone Needed	1,647	◯ VFP Based on Retention Time	6. Retention Time [ ] hours
3. Tons of Limestone Needed	599	◯ VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate [ ] g/m2/day
4. Tons of Limestone Needed	700	◉ VFP Based on Tons Limestone Entered	8. Limestone Needed 700 tons
5. Tons of Limestone Needed	1,684	◯ VFP Based on Dimensions	9. Length at Top of Freeboard [ ] ft; 10. Width at Top of Freeboard [ ] ft

Influent Water Parameters that Affect VFP

Calculated Acidity	24.64	mg/L
Alkalinity	0.00	mg/L

◉ Calculate Net Acidity (Acid-Alkalinity)

◯ Enter Net Acidity manually

Net Acidity (Hot Acidity)	24.64	mg/L
Design Flow	110.00	gpm
Typical Flow	20.00	gpm
Total Iron	1.10	mg/L
Aluminum	2.50	mg/L
Manganese	0.40	mg/L

11. % Void Space of LS. Bed	43.00	%
12. System Life	20.00	years
13. Limestone Purity	85.00	%
14. Limestone Efficiency	60.00	%
15. Density of Loose Limestone	94.30	lbs/ft3
16. Limestone Unit Cost	30.00	$/ton
17. LS Placement Unit Cost	6.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	2.00	ft
20. Free Standing Water Depth	4.3	ft
21. Organic Matter Depth	1.7	ft
22. Organic Matter Unit Cost	30.00	$/yd3
23. Organic Matter Spreading Unit Cost	6.00	$/yd3
24. Limestone Depth	2.0	ft
25. Excavation Unit Cost	8.00	$/yd3

Liner Cost

◯ No Liner

◉ Clay Liner

11. Clay Liner Unit Cost	40.00	$/yd3
12. Thickness of Clay Liner	1.0	ft

◯ Synthetic Liner

13. Synthetic Liner Unit Cost		$/yd2

☑ 29. Clearing and Grubbing?

◉ 30a. Land Multiplier	1.50	ratio
◯ 30b. Clear/Grub Acres		acres
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◉ AMDTreat Piping Costs

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36. Labor Rate	35.00	$/hr
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◯ Custom Piping Costs

	Length	Diameter	Unit Cost
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47. Pipe #3	ft	in	$

VFP Sizing Summaries

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49. Width at Top of Freeboard	95.90	ft
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51. Water Surface Area	13,346	ft2
52. Total Water Volume	1,812	yd3
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55. Limestone Volume	549.86	yd3
56. Excavation Volume	2,919.0	yd3
57. Clear and Grub Area	0.5	acr
58. Liner Area	2,530.2	ft2
59. Theoretical Retention Time	7.23	hrs

VFP Cost Summaries

60. Organic Matter Cost	16,690	$
61. Limestone Cost	21,000	$
62. Limestone and Organic Matter Placement Cost	6,637	$
63. Excavation Cost	23,353	$
64. Liner Cost	24,216	$
65. Clear and Grub Cost	1,055	$
66. Valve Cost	450	$
67. Pipe Cost	12,474	$
68. Total Cost	105,876	$

Record Number 1 of 2

Printed on 05/07/2018

Company Name	Friends of the Cheat
Project	Big Sandy Plan
Site Name	Webster Site

AMD TREAT

AMD TREAT MAIN COST FORM

AMDTREAT

Costs

Passive Treatment	A	S	
Vertical Flow Pond	2	0	$211,753
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands	1	0	$83,366
Manganese Removal Bed			$0
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$295,119**
Active Treatment			
Caustic Soda			$0
Hydrated Lime			$0
Pebble Quick Lime			$0
Ammonia			$0
Oxidants			$0
Soda Ash			$0
Active Subtotal:			**$0**
Ancillary Cost			
Ponds			$0
Roads	1	0	$11,406
Land Access			$0
Ditching	2	0	$39,730
Engineering Cost	1	0	$50,000
Ancillary Subtotal:			**$101,136**
Other Cost (Capital Cost)			$93,745
Total Capital Cost:			**$490,000**
Annual Costs			
Sampling			$0
Labor			$0
Maintenance			$0
Pumping			$0
Chemical Cost			$0
Oxidant Chem Cost			$0
Sludge Removal			$0
Other Cost (Annual Cost)			$0
Land Access (Annual Cost)			$0
Total Annual Cost:			**$0**
Other Cost	1	0	

Water Quality

Design Flow	110.00	gpm
Typical Flow	29.00	gpm
Total Iron	1.10	mg/L
Ferrous Iron	0.00	mg/L
Aluminum	2.50	mg/L
Manganese	0.40	mg/L
pH	3.85	su
Alkalinity	0.00	mg/L
TIC	0.00	mg/L

- (●) Calculate Net Acidity
- ( ) Enter Hot Acidity manually

Acidity	24.64	mg/L
Sulfate	297.00	mg/L
Chloride	0.00	mg/L
Calcium	0.00	mg/L
Magnesium	0.00	mg/L
Sodium	0.00	mg/L
Water Temperature	20.00	C
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.01	mg/L
Typical Acid Loading	1.5	tons/yr

Total Annual Cost: per 1000 Gal of H2O Treated **$0.000**

Webster site fact sheet

Influent water characteristics

Sample ID	Flow (gpm) *['Avg'/Max]*	Acidity (mg/L)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Acid Load (lb/day)	Diss. Fe Load (lb/day)	Diss. Al Load (lb/day)
WRD	18/73	15	0.4	1.7	12.9	0.3	1.5
WFL	11/37	64	2.2	3.9	28.7	1.0	1.8
WRD & WFL COMBINED	110 [Max Design]	31	1.0	2.5	41.6	1.3	3.3

All concentration and loading data represents values recorded on 3/30/2018 and correspond to the maximum flowrate that is presented above. Please note that the 'average' flow value is the flow measured on 3/15/2018. The sample set for this project only contains 2 water monitoring events due to the scope and time restraints associated with the project (both water monitoring events were captured in relatively high flow times of a particularly wet year - yielding conservative estimates).

Metals load removed (maximum)

- The proposed treatment system is anticipated to remove 85-100% of targeted contaminants (Acidity, Iron, and Aluminum).
- For calculation purposes, 95% removal of Iron & Aluminum is assumed; however, actual rates of removal will vary depending on site conditions, influent water quality, and flowrate.
- 100% removal of acidity is expected, as the proposed system is expected to produce an effluent with circumneutral pH, low metals concentrations, and containing measurable alkalinity.

Projected maximum pollutant load reduction

Sample ID	Flow (gpm) *[Max Design]*	Acidity (mg/L)	Diss. Fe (mg/L)	Diss. Al (mg/L)	Acid Load (lb/day)	Diss. Fe Load (lb/day)	Diss. Al Load (lb/day)
System Influent	110	31	1.0	2.5	41.6	1.3	3.3
Projected Removal (%)	-	≥ 100	95	95	-	-	-
Estimated Load Reduction	-	-	-	-	≥ 41.6	1.2	3.1

Projected effluent water quality

- pH 6 – 8
- Negative Acidity
- Metals concentrations for Iron and Aluminum of < 1 mg/L

Pond liner considerations

- Clay or synthetic liners may/can be incorporated into the design for treatment components susceptible to leakage. Ultimate decisions on liner application shall be made during final design process based on site-specific test pit information. Expenses related to installing clay liners in the pond-type components have been included in the cost estimate but may not be needed.

- Test pits are recommended to be conducted during the design process to confirm existing soil conditions prior to construction efforts. The test pits will aid in determining potential need for lining of treatment component(s), as well as confirming the presence/absence of on-site clay sources to be used for liner construction.