WATERSHED BASED PLAN FOR THE THREE FORK CREEK WATERSHED IN THE TYGART VALLEY RIVER DRAINAGE, WEST VIRGINIA

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TABLE OF CONTENTS

1. INTRODUCTION 1
   - 1.1 GENERAL INFORMATION 1
   - 1.2 LAND USE AND LAND COVER 1
   - 1.3 MAJOR TRIBUTARIES 2
2. MEASURABLE WATER QUALITY GOALS 4
3. SOURCES OF NON-POINT SOURCE POLLUTION THAT MUST BE CONTROLLED 5
4. NONPOINT SOURCE MANAGEMENT MEASURES 10
   - 4.1 LAND RECLAMATION 10
   - 4.2 PASSIVE AMD TREATMENT 10
   - 4.3 ACTIVE AMD TREATMENT 11
5. LOAD REDUCTIONS AND COSTS 12
   - 5.1 DIRECT DRAINS TO THREE FORK CREEK 14
   - 5.2 RACCOON CREEK 15
   - 5.3 LITTLE RACCOON CREEK 17
   - 5.4 BRAINS CREEK 18
   - 5.5 BIRDS CREEK 20
   - 5.6 SQUIRES CREEK 22
   - 5.7 STREAMS NOT LISTED AS IMPAIRED 24
6. TECHNICAL AND FINANCIAL ASSISTANCE 26
   - 6.1 TECHNICAL ASSISTANCE PROVIDERS 26
   - 6.2 FUNDING SOURCES 27
7. IMPLEMENTATION SCHEDULE, MILESTONES AND MEASURABLE GOALS 30
   - 7.1 PHASE 1: 2006 THROUGH 2010 30
   - 7.2 PHASE 2: 2011 THROUGH 2015 32
8. MONITORING 34
   - 8.1 INSTREAM MONITORING 34
   - 8.2 SOURCE MONITORING 35
9. OUTREACH AND EDUCATION 36
   - 9.1 SAVE THE TYGART 36
   - 9.2 WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION 36

APPENDIX A. ALL ABANDONED MINE LANDS IN THE THREE FORK WATERSHED 39

APPENDIX B. LOAD CALCULATIONS FOR AMLS WITH WATER QUALITY PROBLEMS 41

APPENDIX C. COST CALCULATIONS FOR AMLS WITH WATER QUALITY PROBLEMS 45

APPENDIX D. AMDTREAT OUTPUTS 50

TABLE OF TABLES

Table 1: Selected West Virginia water quality standards ... 4
Table 2: Stream segments impaired by acid mine drainage in the Three Fork watershed ... 5
Table 3: Abandoned mine lands known to discharge acid mine drainage ... 7
Table 4: Bond forfeiture sites in that discharge acid mine drainage ... 8
Table 5: Known and likely sources of acid mine drainage by subwatershed ... 9
Table 6: Reductions required to meet TMDL targets for abandoned mine lands ... 13
Table 7: Summary of costs and stream miles improved ... 13
Table 8: Costs and descriptions of abandoned mine lands in direct drains to Three Fork Creek ... 14
Table 9: Costs and descriptions of abandoned mine lands in the Raccoon Creek watershed ... 16
Table 10: Costs and descriptions of abandoned mine lands in the Brains Creek watershed ... 19
Table 11: Costs and descriptions of abandoned mine lands in the Birds Creek watershed ... 21
Table 12: Costs and descriptions of abandoned mine lands in the Squires Creek watershed ... 23
Table 13: Costs and descriptions of abandoned mine lands in subwatersheds not listed as impaired ... 25
Table 14: Phase 1 monitoring, funding, and construction schedule ... 31
Table 15: All abandoned mine lands in the Three Fork watershed ... 39
Table 16: Load calculations for abandoned mine lands with sufficient data ... 44
Table 17: Cost calculations for each abandoned mine land that discharges acid mine drainage ... 47

TABLE OF FIGURES

Figure 1: Location and major tributaries of the Three Fork watershed ... 3
Figure 2: Impaired streams in the Three Fork watershed ... 6
Figure 3: Abandoned mine lands in direct drains to Three Fork Creek ... 14
Figure 4: Abandoned mine lands in the Raccoon Creek watershed ... 15
Figure 5: Abandoned mine lands in the Brains Creek watershed ... 18
Figure 6: Abandoned mine lands in the Birds Creek watershed ... 20
Figure 7: Abandoned mine lands in the Squires Creek watershed ... 22
Figure 8: Abandoned mine lands in subwatersheds not listed as impaired ... 24
Figure 9: Relationship between pH values and acidity in samples of AMD from the lower Cheat watershed ... 42
Figure 10: Relationship between acidity and concentrations of Al and Fe in samples of AMD from the lower Cheat watershed ... 42

SUGGESTED REFERENCE

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ABBREVIATIONS

Al	aluminum
AMD	acid mine drainage
AML	abandoned mine land
AMLIS	Abandoned Mine Land Inventory System
BFS	bond forfeiture site
dis.	dissolved
Fe	iron
g	gram
gpm	gallon per minute
L	liter
m^2	square meter
mg/L	milligram per liter
Mn	manganese
MPPRP	Maryland Power Plant Research Project
MRB	manganese removal bed
NMLRC	National Mine Land Reclamation Center
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
OAMLR	Office of Abandoned Mine Lands and Reclamation
OLC	oxic (or open) limestone channel
OSM	Office of Surface Mining, Reclamation and Enforcement
PAD	problem area description
RAPS	reducing and alkalinity producing system
SRG	Stream Restoration Group
TMDL	total maximum daily load
tot.	total
ug/L	microgram per liter
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WCAP	Watershed Cooperative Agreement Program
WV	West Virginia
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources

1. INTRODUCTION

This Watershed Based Plan covers the Three Fork Creek watershed ("Three Fork") of the Tygart Valley River in West Virginia, from its headwaters in Preston County to its mouth in Grafton. Three Fork is impaired by acid mine drainage (AMD) pollutants. This Watershed Based Plan has been written to allow incremental Section 319 funds to be spent in the Three Fork watershed to clean up nonpoint sources that contribute to these pollution problems.

This plan focuses on AMD in Three Fork—by far the most significant water quality problem—and documents the nonpoint sources of AMD. Where data allow, costs of remediating each site are calculated. This plan also addresses technical and financial assistance needs, proposes an implementation schedule with milestones and measurable goals, and documents an outreach and education program that will help make this plan a reality.

1.1 General information

Figure 1 shows the location of the Three Fork Creek watershed. As documented in a recent United States Army Corps of Engineers (USACE) report:

> "The Three Fork Creek watershed drains an area 103 mi^2 and covers portions of Monongalia, Preston, and Taylor Counties. Three Fork Creek enters the Tygart at the town of Grafton, downstream of the Tygart Lake dam. It flows approximately 19 miles, starting at the confluence of Birds Creek and Squires Creek in western Preston County. Headwater streams of Three Fork Creek have elevations up to 2200'; the mouth of Three Fork Creek is at elevation 1000'. The main tributaries of this creek are Squires Creek, Fields Creek, Birds Creek, Laurel Run, and Raccoon Creek. All of these tributaries, except for Laurel Run are impacted with AMD. WVDNR [West Virginia Division of Natural Resources]…determined that Three Fork Creek was the second highest contributor of AMD in the Monongahela River system. In 1977, there were 124 abandoned mines identified in the Three Forks drainage. It has become a contributor to fish kills in the Tygart mainstem during a period when there was low flow from Tygart Lake and high flow from Three Fork…" (USACE, 1997, Appendix F, p. 12)

1.2 Land use and land cover

According to the same report:

> "Land use within Three Fork Creek's watershed is primarily farming and mining. Several small communities exist along the stream and its main tributaries; these include Gladesville, Independence, Newburg, Denver, and Thornton. Grafton and Blueville are located at the mouth of Three Fork Creek." (USACE, 1997, Appendix F, p 12)
>
> "In the upstream reaches of the Three Fork Creek mainstem much of the stream is bordered with woody riparian vegetation. The riparian areas contain species such as sugar maple, red maple, river birch, oak, and rhododendron. From the community of Three Fork Bridge (two miles downstream of the beginning of Three Fork Creek) to one mile downstream, the creek is bordered by residential areas on one side and by forested hillside on the other. Downstream, the creek is inaccessible by road (for about three miles) until Martin Run near Victoria. This is the only section of the creek that is not bordered by a road. There are three islands in the creek downstream of Victoria. Hemlock, sycamore, and white pine vegetate these islands. Downstream

to the mouth of Raccoon Creek, the riparian area includes trees such as elm, hemlock, sycamore, sugar maple, redbud, and willow." (USACE, 1997, Appendix F, p. 12)

1.3 Major tributaries

Figure 1 also shows the locations of the major tributaries. According to the same report:

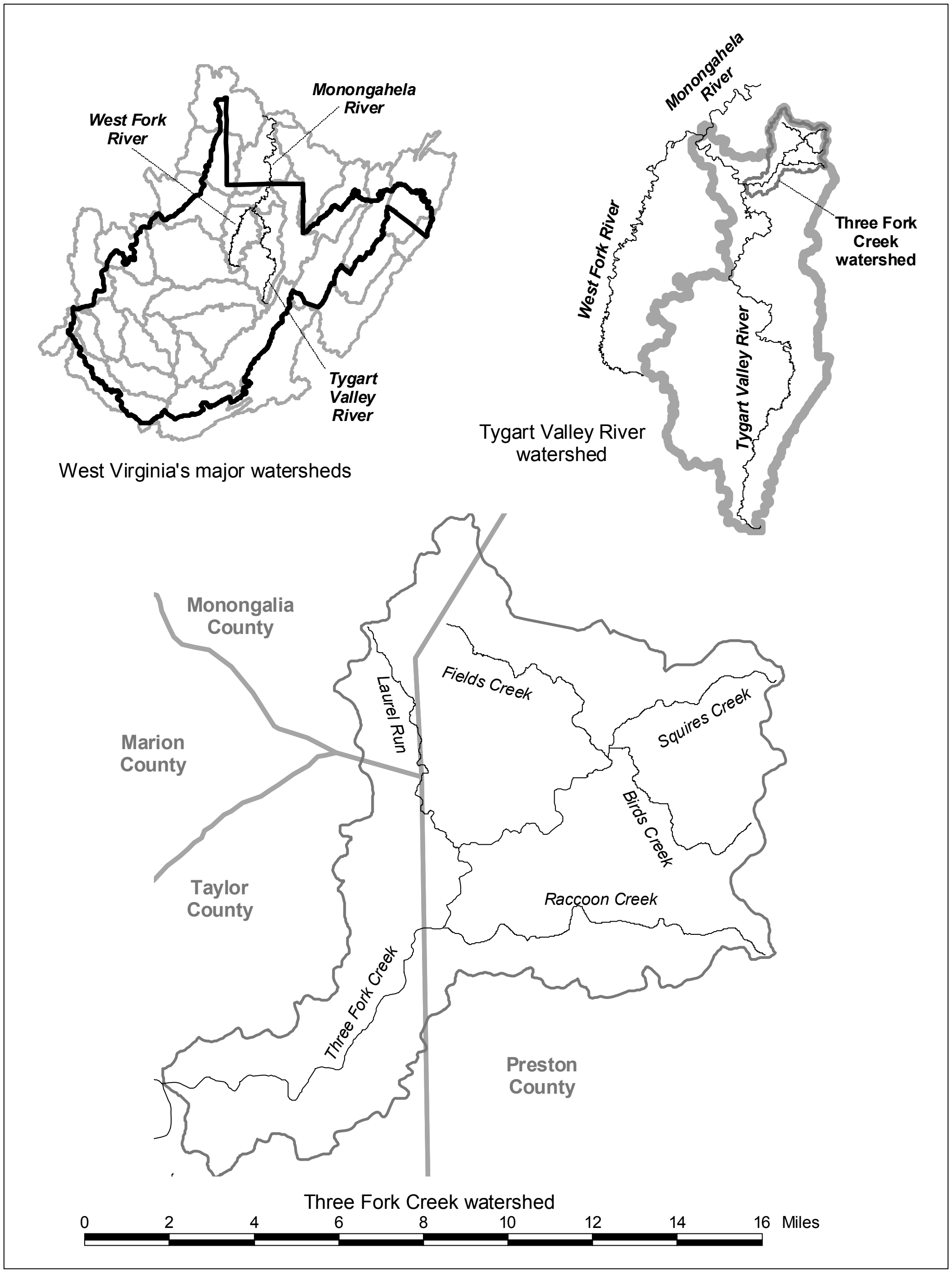
> "Fields Creek begins in western Preston County, north of Gladesville, at elevation of 1830' and flows east/southeast approximately five and one-half miles before it joins with Birds Creek, elevation 1340'. The three main tributaries of Fields Creek are Boyd Run, Brains Creek, and Stoney Run." (USACE, 1997, Appendix F, pp. 12-13)

> "Over two and a half miles of lower Fields Creek is undeveloped and inaccessible by road. NWI [National Wetland Inventory] maps show Fields Creek is bordered by four wetlands between the mouth and Brains Creek…. [Brains Creek]…is bordered by several wetlands in an area inaccessible by road…" (USACE, 1997, Appendix F, p. 13)

> "Squires Creek flows west through steeply narrow ravines to join Birds Creek near WV Route 92 south of Browns Mill in Preston County. Squires Creek, including three unnamed tributaries contains approximately 11 miles of perennial streams. Elevations range from 2200' to about 1340'." (USACE, 1997, Appendix F, p. 13)

> "Birds Creek flows northwest for five miles from Jessop on WV Route 26, Preston County, to the confluence with Squires Creek. One thousand feet below this confluence, Birds Creek enters Fields Creek. Birds Creek has nine tributaries, the largest is eight miles long. Elevation ranges from 2020' to 1320'. Raccoon Creek starts near Tunnelton in Preston County and flows west through Newburg and Independence to its confluence with Three Fork Creek near the Taylor/Preston County line at Hardman. The main tributaries of Raccoon Creek are Little Raccoon Creek and Cooks Run. The nine mile long creek is bordered by a highway, except for the lower one and one-half miles where it is bordered by a railroad grade. Elevations range from 2000' to 1100'." (USACE, 1997, Appendix F, p. 13)

Figure 1: Location and major tributaries of the Three Fork watershed



2. MEASURABLE WATER QUALITY GOALS

All stream segments in the Three Fork watershed should, at a minimum, be fishable and swimmable, and should be clean enough to contain healthy communities of indigenous aquatic species. The federal Clean Water Act, state Water Pollution Control Act, and federal and state regulations have determined a set of interlinked water quality goals. Designated uses for the streams in the Three Fork watershed include public water supply (Category A), maintenance and propagation of aquatic life (warm water fishery streams) (Category B1), maintenance and propagation of aquatic life (trout waters) (Category B2), and water contact recreation (Category C). The numeric and narrative water quality standards shown in Table 1 are relevant for the nonpoint source pollution problems addressed by this Watershed Based Plan.

Table 1: Selected West Virginia water quality standards

		Aquatic life		Human health	
Parameter	**Section**	**Category B1 (Warm water fishery streams)**	**Category B2 (Trout waters)**	**Category A (Public water supply)**	**Category C (Water contact recreation)**
Aluminum (dissolved)	8.1	Not to exceed 87 µg/L (chronic) or 750 µg/L (acute)		None	None
Iron (total)	8.15	Not to exceed 1.5 mg/L (chronic)	Not to exceed 0.5 mg/L (chronic)	Not to exceed 1.5 mg/L	None
Manganese (total)	8.17	None	None	Not to exceed 1.0 mg/L	None
pH	8.23	No values below 6.0 nor above 9.0. Higher values due to photosynthetic activity may be tolerated.			
Turbidity	8.32	No point or non-point source to West Virginia's waters shall contribute a net load of suspended matter such that the turbidity exceeds 10 NTUs over background turbidity when the background is 50 NTU or less, or have more than a 10% increase in turbidity (plus 10 NTU minimum) when the background turbidity is more than 50 NTUs.			

Source: 46 Code of State Rules Series 1. Sections refer to this rule. When the TMDL was approved, the manganese criterion applied to all waters. The United States Environmental Protection Agency (USEPA) has recently approved a modification to this criterion: “The manganese human health criterion shall only apply within the five-mile zone immediately upstream above a known public or private water supply used for human consumption.” When the TMDL was approved, an acute total aluminum criterion of 750 µg/L was in effect. Since then, the aluminum criterion was changed to dissolved aluminum, and a chronic criterion was added. Also, the chronic dissolved aluminum criterion of 87 µg/L has been suspended in all but trout waters until July 2007. USEPA has still not approved or disapproved this suspension. See Sections 8.32 and 8.32.1 for special circumstances for the turbidity standard. ug/L = micrograms per liter. NTU = nephelometric turbidity unit.

As explained in the notes for Table 1, the aluminum and manganese criteria have become more lenient since 2001, when the total maximum daily load (TMDL) for this watershed was approved. Therefore, the TMDL’s aluminum and manganese load reduction requirements may be more stringent than required to meet current water quality standards.

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

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

The most important nonpoint source pollution in the Three Fork watershed is AMD from abandoned mine lands (AMLs). The West Virginia Department of Environmental Protection's (WVDEP's) most recent 303(d) list (WVDEP, 2004) lists specific segments of the watershed as impaired by high concentrations of iron, aluminum, and manganese, and by low pH from AMD. Table 2 lists these AMD-impaired streams, and Figure 2 draws them as thick, grey lines.

Table 2: Stream segments impaired by acid mine drainage in the Three Fork watershed

Stream code	Stream name	Miles impaired	Al (dis.)	Al (tot.)	Fe	Mn	pH
MT-12	Three Fork Creek	19	x	X	x	x	x
MT-12-C	Raccoon Creek	8.8	x	X	x	x	x
MT-12-C-2	Little Raccoon Creek	2.6		X	x	x	
MT-12-G-2	Brains Creek	4.9		X	x	x	x
MT-12-H	Birds Creek	5.5		X	x	x	x
MT-12-H-1	Squires Creek	4.5		X	x	x	x

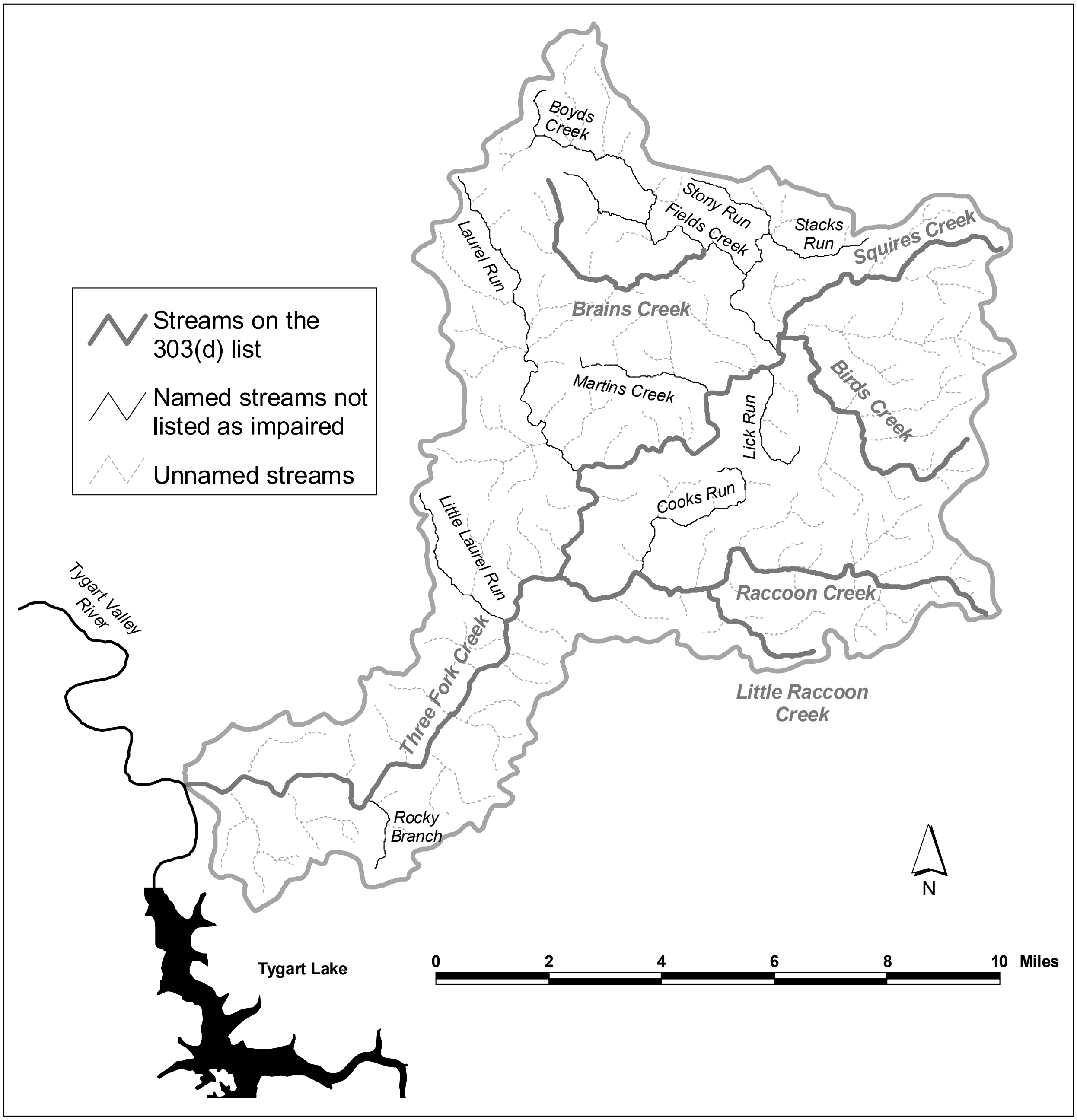
Source: All impairments except total aluminum are from the 2004 303(d) list Supplemental Tables B and E (WVDEP, 2004), which lists 19 impaired miles for dissolved aluminum for Three Fork Creek, but no mileages for the any other AMD impairments. Total aluminum impairments are from the 2002 303(d) list, which does not provide any mileages (WVDEP, 2003). Impaired mileages for all streams are from the 1998 303(d) list (WVDEP, 1998), which lists all streams as impaired by pH and metals from mine drainage.

A total of 80 AMLs are documented in the Three Fork watershed and are listed in Appendix A. The problem area descriptions (PADs) and other documentation of these sites indicate that only those 38 AMLs in Table 3 discharge AMD (WVDEP, Various dates).

Other AMLs likely do not discharge AMD; therefore, they are only listed in Appendix A. The methods used to identify sites in Table 3 and Appendix A are not foolproof. If new information indicates that an AML that was left out of Table 3 does, in fact, discharge AMD, the Watershed Based Plan will be updated as appropriate.

Three Fork is also impaired by bond forfeiture sites (BFSs) that discharge AMD, as shown in Table 4. These sites often contribute a significant amount of AMD and in some cases may account for most or all of the pollution in a subwatershed. However, BFSs are considered to be point sources and are not eligible for Section 319 funding. These sites are therefore not covered in detail in this plan.

Figure 2: Impaired streams in the Three Fork watershed



Source: WVDEP (2004, 2003, and 1998).

Table 3: Abandoned mine lands known to discharge acid mine drainage

Site name (Problem area no.)	Notes	TMDL subwatershed
Direct drains to Three Fork Creek		
Three Forks #2 (982)	Between Raccoon and Laurel	66
Three Forks #3 (983)	Between Raccoon and Laurel	66
Irontown Refuse (1723)	Downstream of Raccoon	79
Raccoon Creek		
West End Portals and Structures (470)		58
Maple Run Portals & AMD (900)		67
West End #1 (1547)		58
Raccoon Creek Refuse #2 (1728)		67
Austen Refuse (1738)		56
Cooks Run Refuse (1741)		54
Newburg Tipple and Refuse (1746)		64
Austen Highwall #2 (2410)		56
Austen Highwall #3, Refuse (2411)		56
Knotts Strip #1 (3547)	Also drains to Birds	56, 54, 37
Raccoon Creek Highwall (3548)		55
Raccoon Creek Refuse and Coke Ovens (4971)		56
Brains Creek		
Browns Chapel Strips (1777)		11
Summers (2351)		11
Birds Creek		
Birds Creek #7 (1077)		19
Birds Creek #4 (1083)		38
Bird's Creek Portals (1085)		19
Howesville Portals (1743)		15
Hopewell Church Refuse and Drainage (1744)		15
Hopewell Strip #2 (2414)		16
Concord (Conley) Highwall (2919)		37
Irish Ridge #2 (2920)		16
Jessop Strip #1 (2984)		41
Jessop Portal & Highwall (3362)		41
Shaffer Strip (3454)		41
Squires Creek		
Pell School Strip #2 & Portal (1078)		8
Bethlehem Church Refuse (1745)		7
Paul Ellison (2196)		10
Mt. Phoebe Portal and Highwall (2406)		7
Borgman Refuse and Portals (5409)		7
Squires Creek Refuse & Portals (5758)		7
STREAMS NOT LISTED AS IMPAIRED		
Little Laurel Run		
Three Forks Refuse #4 & #5 (1731)	Also drains to Three Fork	78, 79
Cooks Run		
Sharp's Highwall (2409)		62
Cooks Run AMD, Highwall & Portals (5004)		62
Fields Creek		
Boyd Run Strip South (2785)		5

Source: WVDEP (Various dates). TMDL subwatersheds are enumerated in USEPA (2001).

Table 4: Bond forfeiture sites in that discharge acid mine drainage

Company	Mining permit	Construction date	TMDL subwatershed
Raccoon Creek			
Inter-State Lumber Company, Inc.	S-52-83		55
Beefsteak Mining Co.	S-1087-86		57
Maurice Jennings	53-78	9/08	67
Little Raccoon Creek			
Maurice Jennings	S-61-83	9/08	65
Brains Creek			
ED-E Development Co., Inc.	S-10-81		11
VMS, LTD.	S-1045-87	6/07	11
Birds Creek			
Inter-State Lumber Company, Inc.	S-96-82	6/06	41
K. C. & M. Coal Company, Inc.	S-1023-88	6/07	15
Preston Energy, Inc.	O-1035-87		40
Preston Energy, Inc.	O-43-85		41
Preston Energy, Inc.	O-86-82		15
Squires Creek			
ED-E Development Co., Inc.	S-1032-86		7

Source: McCarthy (2005). If construction dates are not shown, projects have been contracted or completed. TMDL subwatersheds are enumerated in USEPA (2001).

Table 5 summarizes whether AMLs, BFSs, or both discharge AMD to each impaired stream segment. Ten of the thirteen subwatersheds for which the TMDL requires load reductions are known to receive AMD from nonpoint source AMLs. These ten watersheds are highlighted in Table 5 and are the focus of the Watershed Based Plan. Eleven additional subwatersheds have AML sources of AMD but do not have load reductions assigned by the TMDL. Because the data resolving pollutant loads to subwatersheds are sparse, these additional eleven subwatersheds are also assumed to require treatments to reduce pollutant loads.

Table 5: Known and likely sources of acid mine drainage by subwatershed

Stream code	Stream name	TMDL Sub-watershed	TMDL requires reductions: Al	Fe	Mn	AMD sources: BFS	AML
MT-12	Three Fork between Raccoon and Laurel	66					x
MT-12	Three Fork downstream of Raccoon	79					x
MT-12-C	Raccoon Creek	54					x
		55	x	x	x	x	x
		56	x	x	x		x
		57	x	x	x	x	
		58	x	x	x		x
		64					x
		67				x	x
MT-12-C-2	Little Raccoon Creek	65				x	
MT-12-G-2	Brains Creek	11	x	x	x	x	x
MT-12-H	Birds Creek	15	x	x	x	x	x
		16	x	x	x		x
		17	x	x	x		
		19		x	x		x
		37					x
		38					x
		40	x	x	x	x	
		41	x	x	x	x	x
MT-12-I	Squires Creek	7	x	x	x	x	x
		8	x	x	x		x
		10					x
Streams not listed as impaired							
MT-12-B	Little Laurel Run	78					x
MT-12-C-1	Cooks Run	62					x
MT-12-G	Fields Creek	5					x

Source: TMDL subwatersheds and pollutants that require reductions are enumerated in USEPA (2001). BFS information from Table 4. AML information from Table 3. TMDL subwatersheds are shaded if the TMDL requires reductions and if AMLs are known to discharge AMD.

4. NONPOINT SOURCE MANAGEMENT MEASURES

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

4.1 Land reclamation

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

4.2 Passive AMD treatment

- **Reducing and Alkalinity Producing Systems (RAPSs) (25 g acidity/m^2).** In these systems, also known as “successive alkalinity producing systems” and “vertical flow ponds,” water encounters two or more treatment cells in series. First, water passes through organic material to deplete dissolved oxygen. Several helpful reactions take place in the anoxic environment. First, bacteria reduce sulfate in an alkalinity producing reaction. Second, ferric iron, which comes into contact with pyrite, should reoxidize the sulfur and turn to ferrous iron. In a second cell, the anoxic solution comes into contact with limestone. H^+ acidity is neutralized through contact with the limestone. Additional alkalinity dissolves into the water as well. Iron does not armor the limestone because it is the ferrous form. Water then runs through an aeration and settling pond, in which ferrous iron oxidizes and then precipitates out of solution as ferric hydroxide. The acidity released in this process is neutralized by the alkalinity that has accumulated in the solution.
- **Sulfate-reducing bioreactors (40 g acidity/m^2).** These systems also consist of organic matter and limestone, but in sulfate-reducing bioreactors, the materials are all mixed in a single cell. Some of the organic material included is of a coarser nature, such as sawdust or woodchips. Reactions in these systems are similar to those in RAPSs: compost eliminates oxygen, and drives the iron and sulfur to reduced forms. The coarser organic matter may serve to protect hydraulic conductivity and may retain metals as various organic complexes.

- **Manganese removal beds (MRBs) (to 2 mg/L).** Manganese may be removed from AMD either by active treatment (Section 4.1.3) or by MRBs. In MRBs, water is passed over a wide limestone bed, and dissolved manganese oxidizes and precipitates from solution.
- **Oxic (or Open) limestone channels (30%).** Research to estimate the efficacy of OLCs is active. OLCs have the advantage that continually moving water may erode any armoring from limestone, and that water flow should remove precipitates from OLCs so that they do not interfere with acid neutralization. In practice, the efficacy of OLCs may suffer because they are too short, most limestone may be placed so as to react with water only at high flows, and fluctuating water levels enhance armoring. Recent research suggests that the acid neutralization that takes place in OLCs is actually greater than can be accounted for by limestone dissolution
- **Limestone leachbeds (50%).** Limestone leachbeds are most effective when water has a pH of 3 or less, and when water retention times are short (~90 minutes). The low pH promotes rapid limestone dissolution, but the short retention time prevents armoring.
- **Steel slag leachbeds (addition of alkalinity).** Steel slag leachbeds are not exposed to AMD. Rather, circumneutral feed water passes through these leachbeds, and that water is then mixed with AMD to reduce its acidity drastically.
- **Compost wetlands (wide range).** Constructed wetlands can serve multiple functions in AMD treatment. Wide areas of exposure to the atmosphere allow metals in solution to oxidize. Slower waters allow precipitates to fall out of suspension. Anaerobic zones in sediments allow for sulfate reduction, which consumes acidity. Inclusion of limestone in the substrate provides an additional alkalinity source and helps maintain conditions that support sulfate reduction.
- **Grouting (50%).** Setting up grout walls or curtains in deep mines has great potential to solve AMD problems. Ideally, such barriers may serve to keep water from entering mines and interacting with acid-forming materials. They must be constructed carefully so as not to build water pressures near a weak point and to avoid blowouts. Also, fractures in bedrock always allow some water into mines, even if flows are eliminated. A grouting project at Winding Ridge, near Friendsville, Maryland, decreased acidity by 50% (MPPRP, 2000).

4.3 Active AMD treatment

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

5. LOAD REDUCTIONS AND COSTS

The TMDL for the Tygart Valley River watershed, which includes the Three Fork watershed, set goals for pollutant reductions from nonpoint and point source activities that, if enacted, should improve water quality so that the stream segments are removed from the 303(d) list and meet standards (USEPA, 2001). While the TMDL calls for wasteload allocations for specific point sources, load allocations for nonpoint sources are not tied to specific AMLs. Instead, the load allocations are provided for each TMDL subwatershed. If all wasteload and load allocations for aluminum, iron, and manganese are met, the TMDL asserts that the water quality criteria for pH will also be met (USEPA, 2001).

As noted in Chapter 2, the aluminum and manganese criteria have become more lenient since the TMDL was approved. The aluminum and manganese TMDL targets therefore may be more stringent than required to meet current water quality standards, and the costs calculated in this chapter may be overestimates. In particular, for streams in which the manganese criterion no longer applies, the costs of MRBs may be entirely avoided. Because the TMDL has not been updated to account for these water quality standard changes, this Watershed Based Plan calculates load reductions and costs based on the standards in place when the TMDL was approved.

Table 6 lists the load allocations from the TMDL in the "TMDL target" column. Current loads for each site are also estimated using four different methods. Calculations are described in Appendix B. The treatment measures proposed for each site are sized with the goal of reducing the loads to meet the TMDL targets; therefore, implementation of this Watershed Based Plan should reduce loads to meet the TMDL targets. If measures are implemented and targets are still not met, it may be necessary to collect more data and to design additional treatment measures.

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

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

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

Because RAPSs are not designed to treat manganese, MRBs are also included in the cost estimates. MRBs are sized to achieve a 24-hour retention time, which has proven effective for manganese removal. Detailed sizing and cost assumptions for MRBs are also included in Appendix C.

The Office of Surface Mining, Reclamation and Enforcement's (OSM's) AMDTreat computer program is used to calculate costs for both RAPSs and MRBs. Table 7 summarizes the cost calculations performed in this Watershed Based Plan: To meet TMDL targets for 45.3 miles of impaired streams, it will cost more than $7.38 million.

Table 6: Reductions required to meet TMDL targets for abandoned mine lands

			Current load estimates (pounds/year)					
Stream code	Stream name	Pollutant	Sum of AML discharges	Save the Tygart monitoring data	WVDEP monitoring data	TMDL baseline	TMDL target (pounds/ year)	Required reduction
MT-12	Three Fork Creek	Al			~0	23,466	4,720	80%
		Fe			~0	69,446	12,373	82%
		Mn			64,600	20,140	7,219	89%
MT-12-C	Raccoon Creek	Al	59,511	256,708	91,600	6,820	1,229	100%
		Fe	87,884	58,734	6,800	20,148	3,891	96%
		Mn	12,179	73,586	22,100	4,339	1,622	98%
MT-12-C-2	Little Raccoon Creek	Al			700	38	38	95%
		Fe			100	35	35	65%
		Mn			900	57	57	94%
MT-12-G-2	Brains Creek	Al			18,800	15	15	100%
		Fe			0	14	14	0%
		Mn			10,200	22	22	100%
MT-12-H	Birds Creek	Al	9,372		174,900	9,287	2,313	99%
		Fe	11,775		12,900	26,885	6,008	78%
		Mn	2,298		42,000	10,874	3,962	91%
MT-12-H-1	Squires Creek	Al	37,909		99,200	6,801	615	99%
		Fe	62,932		25,600	21,786	1,847	97%
		Mn	6,492		25,300	4,164	872	97%

Note: Sum of AML discharges calculations are shown in Appendix B. Save the Tygart monitoring data consist of eight samples collected between January 2004 and October 2005. WVDEP monitoring data consists of a single sampling sweep in October 2000. According to these monitoring data, virtually all of the acidity, Al, and Fe loads to the Three Fork watershed as a whole may be traced to its tributaries; therefore, Al and Fe load estimates are zero. TMDL targets are load allocations for each pollutant in each subwatershed from USEPA (2001). Required reduction calculations assume the highest load is correct.

Table 7: Summary of costs and stream miles improved

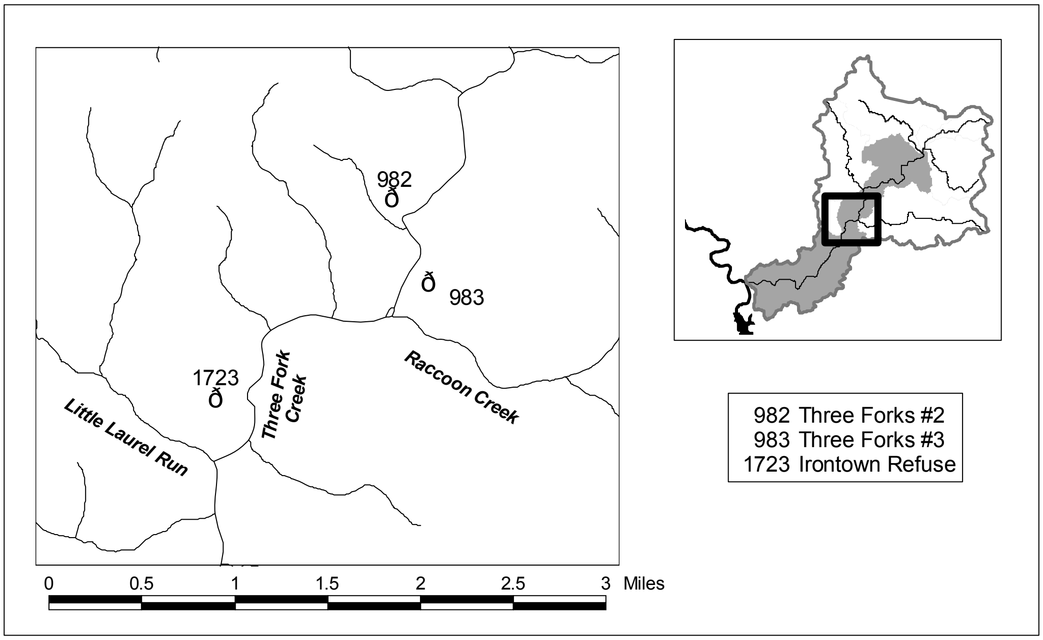
Stream name	Stream code	Impaired miles	Estimated future cost for water remediation
Three Fork Creek	MT-12	19	$160,000
Raccoon Creek	MT-12-C	8.8	>$2,430,000
Little Raccoon Creek	MT-12-C-2	2.6	No estimate possible
Brains Creek	MT-12-G-2	4.9	$860,000
Birds Creek	MT-12-H	5.5	>$1,180,000
Squires Creek	MT-12-H-1	4.5	>$2,260,000
Streams not listed as impaired	MT-12-B, MT-12-C-1, MT-12-G	0	$490,000
Total		**45.3**	**>$7,380,000**

Source: Impaired miles from Table 2. Estimated future costs for water remediation are calculated in this Watershed Based Plan, as detailed below. Subwatersheds not listed as impaired include Little Laurel Run, Cooks Run, and Fields Creek. These tributaries are not listed even though AMLs discharging AMD are present. It is likely that further monitoring will reveal some impairment.

5.1 Direct drains to Three Fork Creek

Direct drains to Three Fork Creek (MT-12) include TMDL subwatersheds 66 and 79.

Figure 3: Abandoned mine lands in direct drains to Three Fork Creek



Note: Symbols are located at coordinates given by the Abandoned Mine Land Inventory System (AMLIS) database. AMLs usually encompass surrounding areas.

Table 8: Costs and descriptions of abandoned mine lands in direct drains to Three Fork Creek

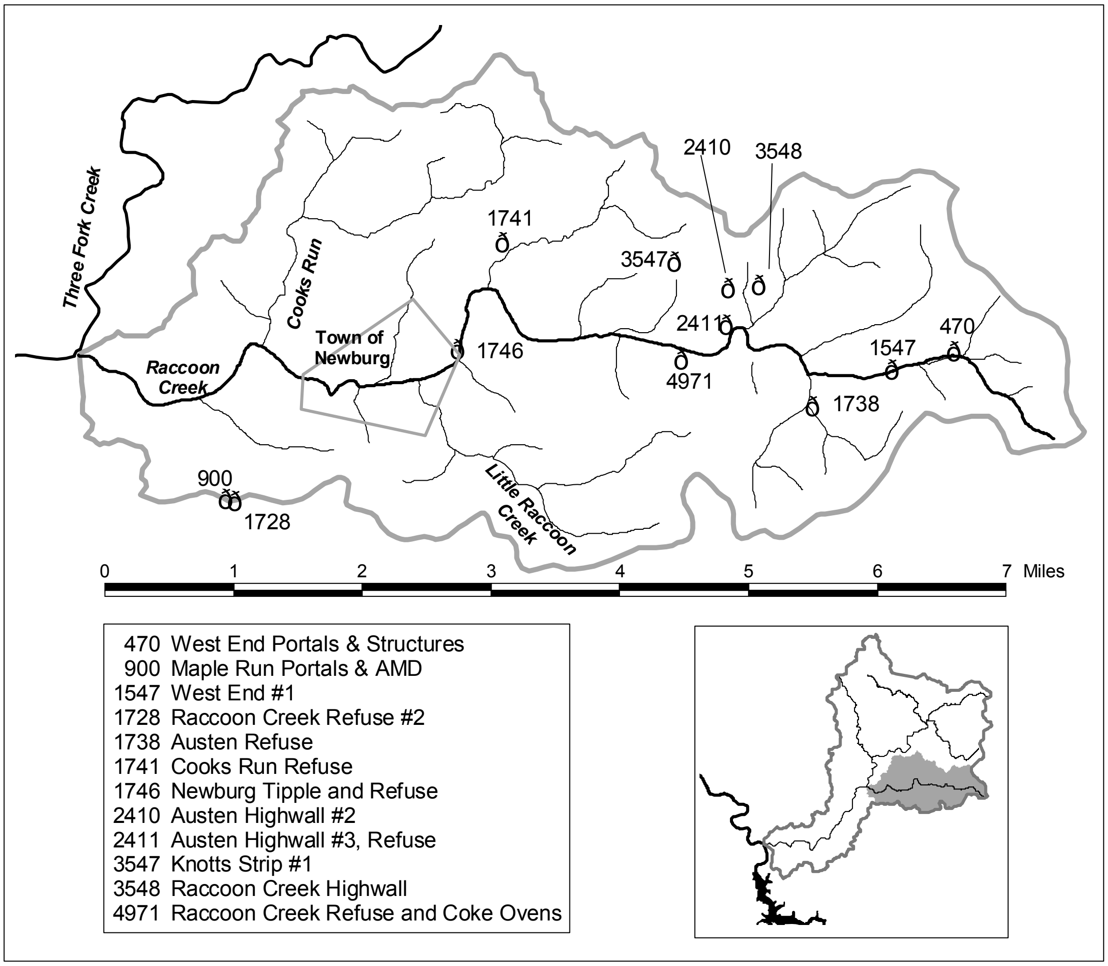
Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
Three Forks #2 (982)	$0	AMD is impounded within portals but is not flowing out. Reclaim sufficient area to give this water some alkalinity and prevent it from interacting with acid materials.	$110,000
Three Forks #3 (983)	$0	A small amount of refuse coal must be reclaimed.	$30,000
Irontown Refuse (1723)	$0	A small amount of refuse coal must be reclaimed.	$20,000
		Total, Direct drains to Three Fork Creek	**$160,000**

Source: Past reclamation costs from OSM (2005a). Site and cost descriptions from OSM (2005a) and WVDEP (Various dates). Estimated future costs for water remediation calculated in this plan.

5.2 Raccoon Creek

Raccoon Creek (MT-12-C) includes TMDL subwatersheds 54-59, 63, 64, and 67.

Figure 4: Abandoned mine lands in the Raccoon Creek watershed



Note: Symbols are located at coordinates given by the AMLIS database. AMLs usually encompass surrounding areas.

Table 9: Costs and descriptions of abandoned mine lands in the Raccoon Creek watershed

Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
West End Portals & Structures (470)	$1,497,493	Complaints that were addressed at this site include highwall, impoundments, clogged streams, piles and embankments, and hazardous facilities, but not water pollution. AMD flowing from portals must be addressed. This site is currently being monitored by Save the Tygart in preparation for a remediation project.	$120,000
Maple Run Portals & AMD (900)	$224,662	This problem area has three sites, only one of which is in the Three Fork watershed. No work was completed on that site, where portals discharge AMD.	$490,000
West End #1 (1547)	$0	Reclaimed, at least in part, with Austen Highwall #3, Refuse (2411).	See 2411
Raccoon Creek Refuse #2 (1728)	$0	A small refuse coal area must be reclaimed.	$20,000
Austen Refuse (1738)	$0	A small flow of AMD requires passive treatment, and refuse coal must be reclaimed.	$100,000
Cooks Run Refuse (1741)	$0	Refuse coal must be reclaimed.	$240,000
Newburg Tipple and Refuse (1746)	$0	Refuse coal must be reclaimed.	$50,000
Austen Highwall #2 (2410)	$45,000	A coal processing area ("slurry") must be reclaimed.	$110,000
Austen Highwall #3, Refuse (2411)	$578,673	Extensive reclamation work on this site together with West End #1 (1547) did not address the water pollution complaints at these sites. Large passive treatment systems would be needed.	>$1,000,000
Knotts Strip #1 (3547)	$0	There is a small flow of AMD requiring passive treatment. In addition, areas where water gathers should be reclaimed to prevent the water from becoming polluted.	$190,000
Raccoon Creek Highwall (3548)	$0	Areas where water gathers should be reclaimed to prevent the water from becoming polluted.	$50,000
Raccoon Creek Refuse and Coke Ovens (4971)	$0	Refuse coal must be reclaimed.	$60,000
		Total, Raccoon Creek watershed	**>$2,430,000**

Source: Past reclamation costs from OSM (2005a). Site and cost descriptions from OSM (2005a) and WVDEP (Various dates). Estimated future costs for water remediation calculated in this plan.

5.3 Little Raccoon Creek

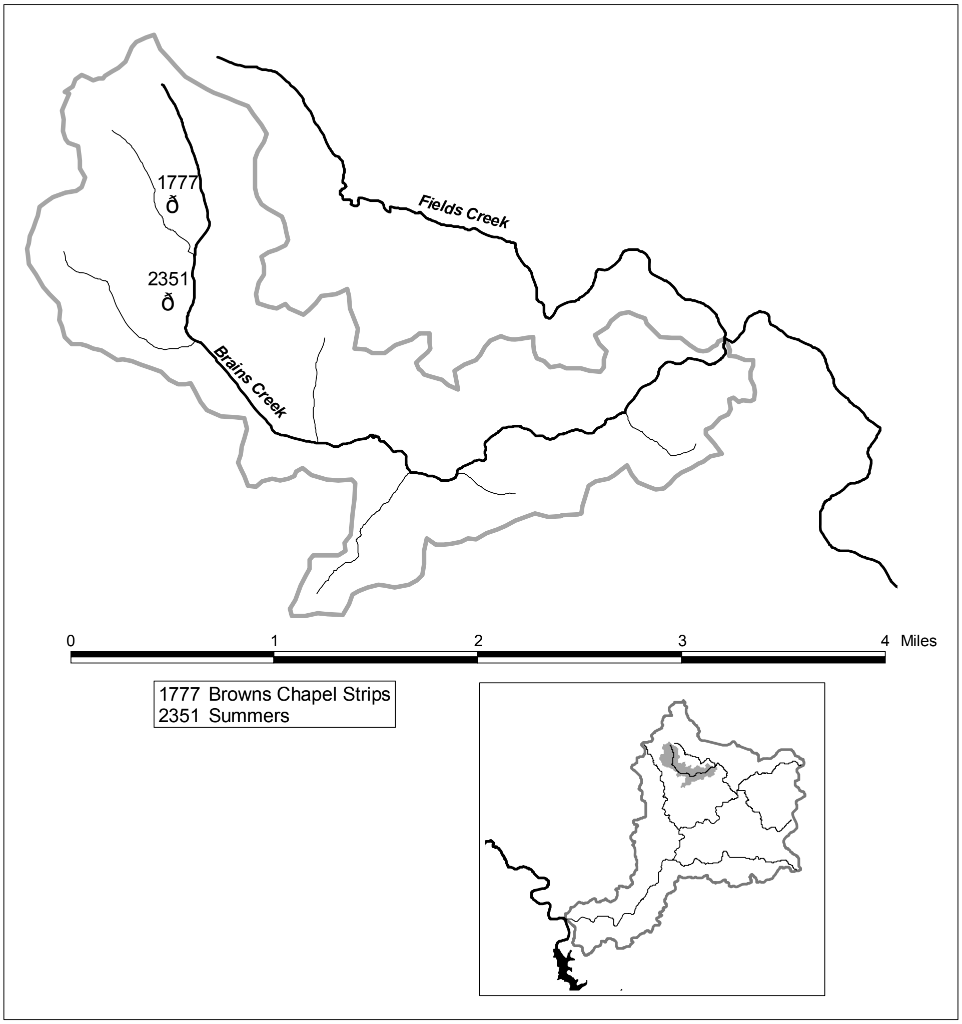
Little Raccoon Creek (MT-12-C-2) includes TMDL subwatershed 65. No problem areas were identified that contribute to Little Raccoon Creek. Furthermore, although it is impaired, the TMDL does not call for load reductions in SWS 65. SRG data (WVDEP, 2005c) indicate that the stream is only mildly impaired, with pH values ranging from 5.7 to 6.6. SRG's single measurement of metal loads exceeds the TMDLs for the subwatershed.

Additional monitoring in this subwatershed will be required before it can be treated and removed from the 303(d) list. However, it is probably not adding significantly to the pollution loads in Raccoon Creek.

5.4 Brains Creek

Brains Creek (MT-12-G-2) includes TMDL subwatershed 11.

Figure 5: Abandoned mine lands in the Brains Creek watershed



Note: Symbols are located at coordinates given by the AMLIS database. AMLs usually encompass surrounding areas.

Table 10: Costs and descriptions of abandoned mine lands in the Brains Creek watershed

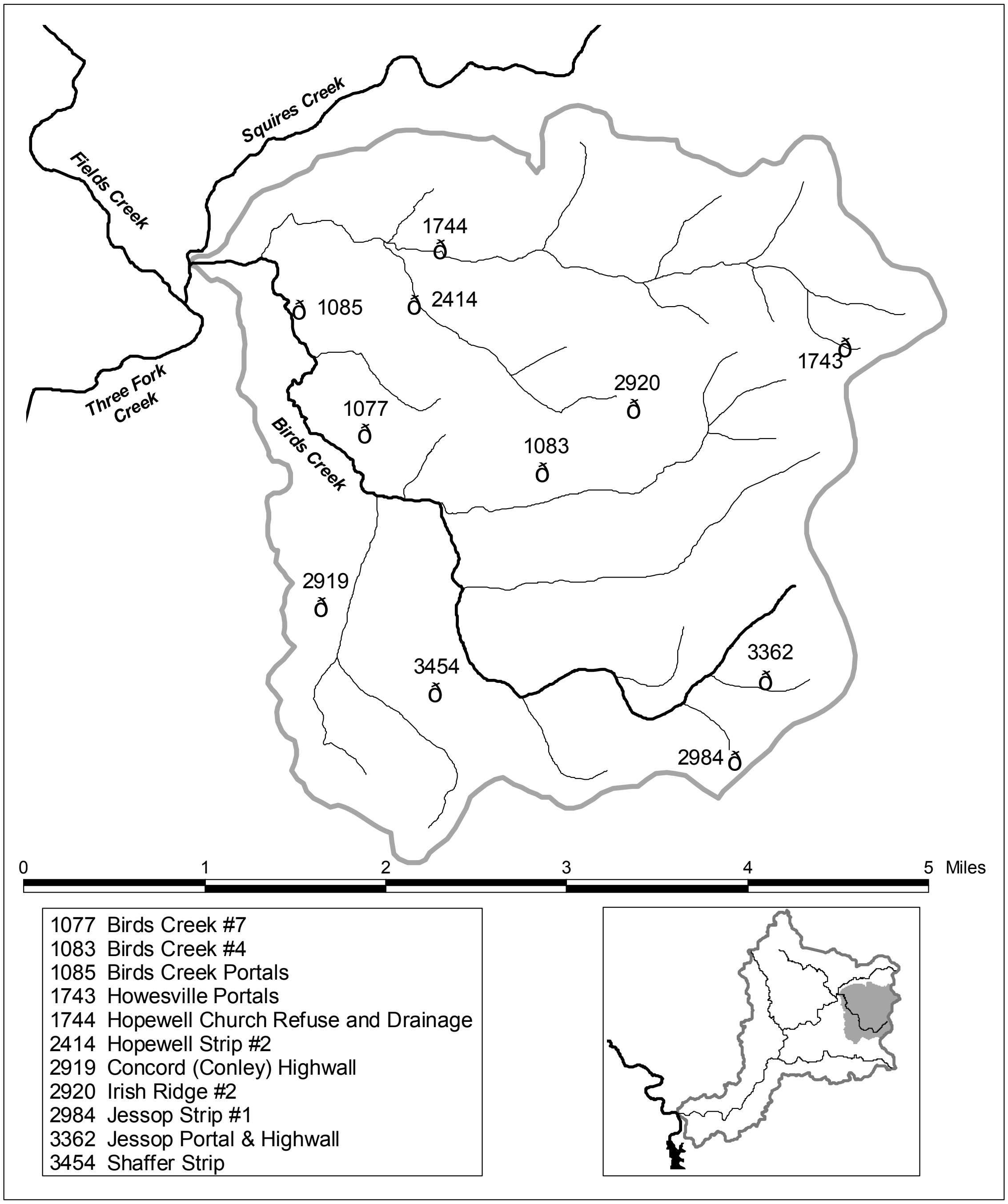
Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
Browns Chapel Strips (1777)	$0	Refuse and spoil are mixed over a 50-acre area.	$810,000
Summers (2351)	$0	AMD is reported to come out of the ground, probably from refuse that needs to be reclaimed. No flows were estimated.	$50,000
		Total, Brains Creek watershed	**$860,000**

Source: Past reclamation costs from OSM (2005a). Site and cost descriptions from OSM (2005a) and WVDEP (Various dates). Estimated future costs for water remediation calculated in this plan.

5.5 Birds Creek

Birds Creek (MT-12-H) includes TMDL subwatersheds 15-17, 19, 20, 34, and 37-41.

Figure 6: Abandoned mine lands in the Birds Creek watershed



Note: Symbols are located at coordinates given by the AMLIS database. AMLs usually encompass surrounding areas.

Table 11: Costs and descriptions of abandoned mine lands in the Birds Creek watershed

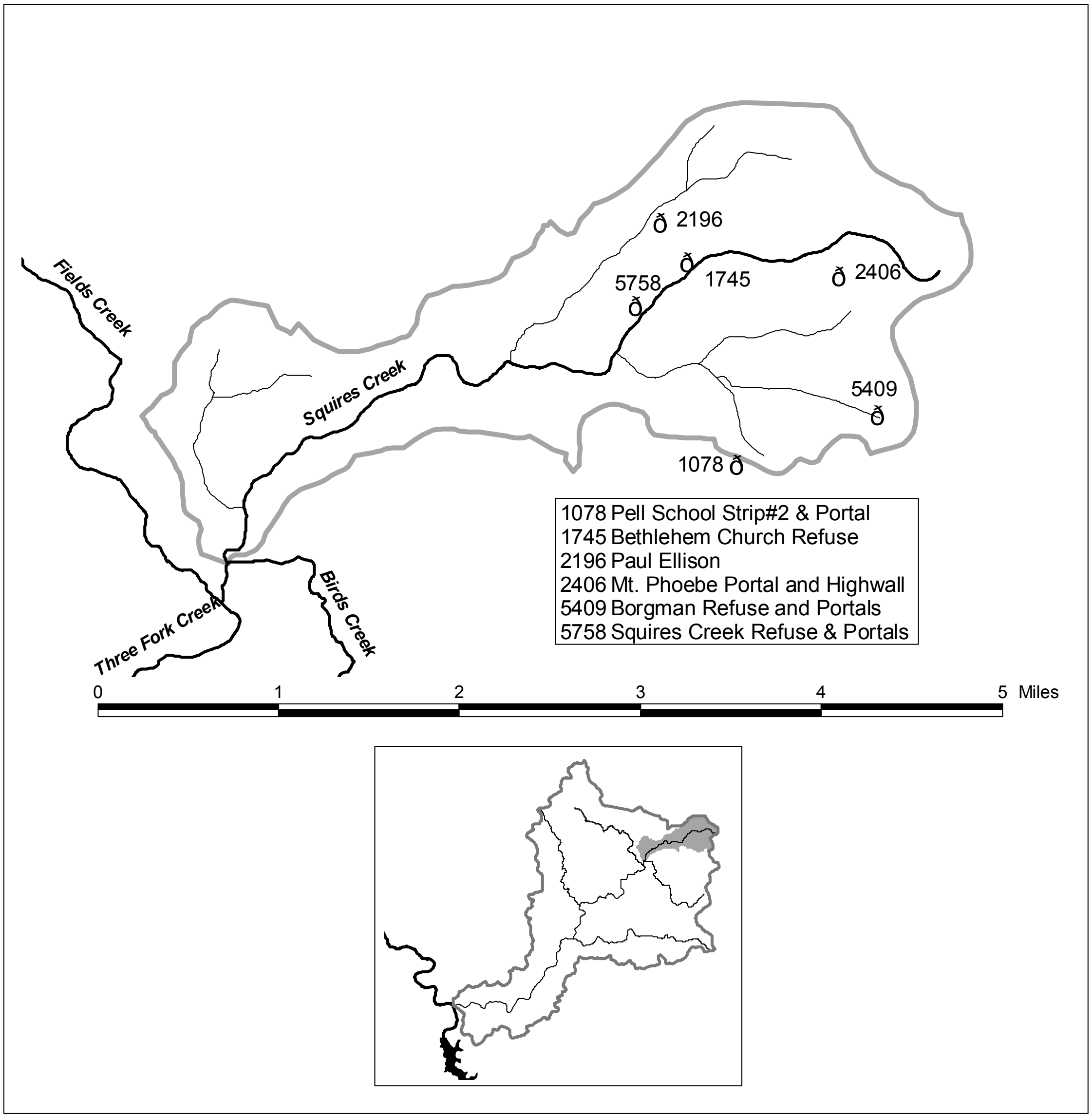
Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
Birds Creek #7 (1077)	$0	A small amount of AMD flows from two portals. Reclamation of the area near those portals should generate enough alkalinity to neutralize the acidity.	$50,000
Birds Creek #4 (1083)	$0	A small amount of AMD flows from two portals. Reclamation of the area near those portals should generate enough alkalinity to neutralize the acidity.	$80,000
Bird's Creek Portals (1085)	$0	Four portals discharge AMD at a moderate rate, and some refuse coal must be reclaimed.	$200,000
Howesville Portals (1743)	$0	There is a portal discharging AMD, but neither chemical nor flow data are available.	No estimate possible
Hopewell Church Refuse and Drainage (1744)	$0	There is a small AMD flow to treat passively and refuse coal to be reclaimed.	$130,000
Hopewell Strip #2 (2414)	$0	There is a small AMD flow to treat passively and refuse coal to be reclaimed.	$100,000
Concord (Conley) Highwall (2919)	$0	Refuse coal must be reclaimed.	$20,000
Irish Ridge #2 (2920)	$0	Problem area description (PAD) indicates that there is a discharge, but no flow or chemistry data are available	No estimate possible
Jessop Strip #1 (2984)	$0	There is a small AMD flow of 2 gpm, but no chemistry data.	No estimate possible
Jessop Portal & Highwall (3362)	$0	Seven portals are discharging AMD that requires treatment.	$520,000
Shaffer Strip (3454)	$0	There is a small AMD flow to treat passively and refuse coal to be reclaimed.	$80,000
		Total, Birds Creek watershed	**>$1,180,000**

Source: Past reclamation costs from OSM (2005a). Site and cost descriptions from OSM (2005a) and WVDEP (Various dates). Estimated future costs for water remediation calculated in this plan.

5.6 Squires Creek

Squires Creek (WVMT-12-I) includes TMDL subwatersheds 7, 8, 10, 12, and 18.

Figure 7: Abandoned mine lands in the Squires Creek watershed



Note: Symbols are located at coordinates given by the AMLIS database. AMLs usually encompass surrounding areas.

Table 12: Costs and descriptions of abandoned mine lands in the Squires Creek watershed

Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
Pell School Strip #2 & Portal (1078)	$481,194	Previous work at this site did not address the water pollution complaint, but no chemistry or flow data are available to evaluate the site.	$210,000
Bethlehem Church Refuse (1745)	Unknown	35 acres of refuse were reclaimed at this site, but approximately one acre of refuse still requires reclamation.	$10,000
Paul Ellison (2196)	$0	AMD flows from six auger holes, which should be sealed like portals, and the AMD treated with passive methods. Refuse coal, in an area assumed similar to that of the bench, must be reclaimed.	$400,000
Mt. Phoebe Portal and Highwall (2406)	$0	AMD from a single portal must be treated.	$540,000
Borgman Refuse and Portals (5409)	$0	Water is discharging from a portal at site 3, and must be treated. There is also refuse coal to be reclaimed.	>$1,000,000
Squires Creek Refuse & Portals (5758)	$0	AMD has gathered in front of portals, but was not flowing. Use reclamation to make sure that any small amount of water flowing does not become acidic through interaction with pyritic material.	$100,000
		Total, Squires Creek watershed	**>$2,260,000**

Source: Past reclamation costs from OSM (2005a). Site and cost descriptions from OSM (2005a) and WVDEP (Various dates). Estimated future costs for water remediation calculated in this plan.

5.7 Streams not listed as impaired

Streams not listed as impaired, but which still have AMLs discharging AMD, include Little Laurel Run, Cooks Run, and Fields Creek. Little Laurel Run (MT-12-B) includes TMDL subwatershed 78, Cooks Run (MT-12-C-1) includes TMDL subwatershed 62, and Fields Creek (MT-12-G) includes TMDL subwatershed 5.

Figure 8: Abandoned mine lands in subwatersheds not listed as impaired

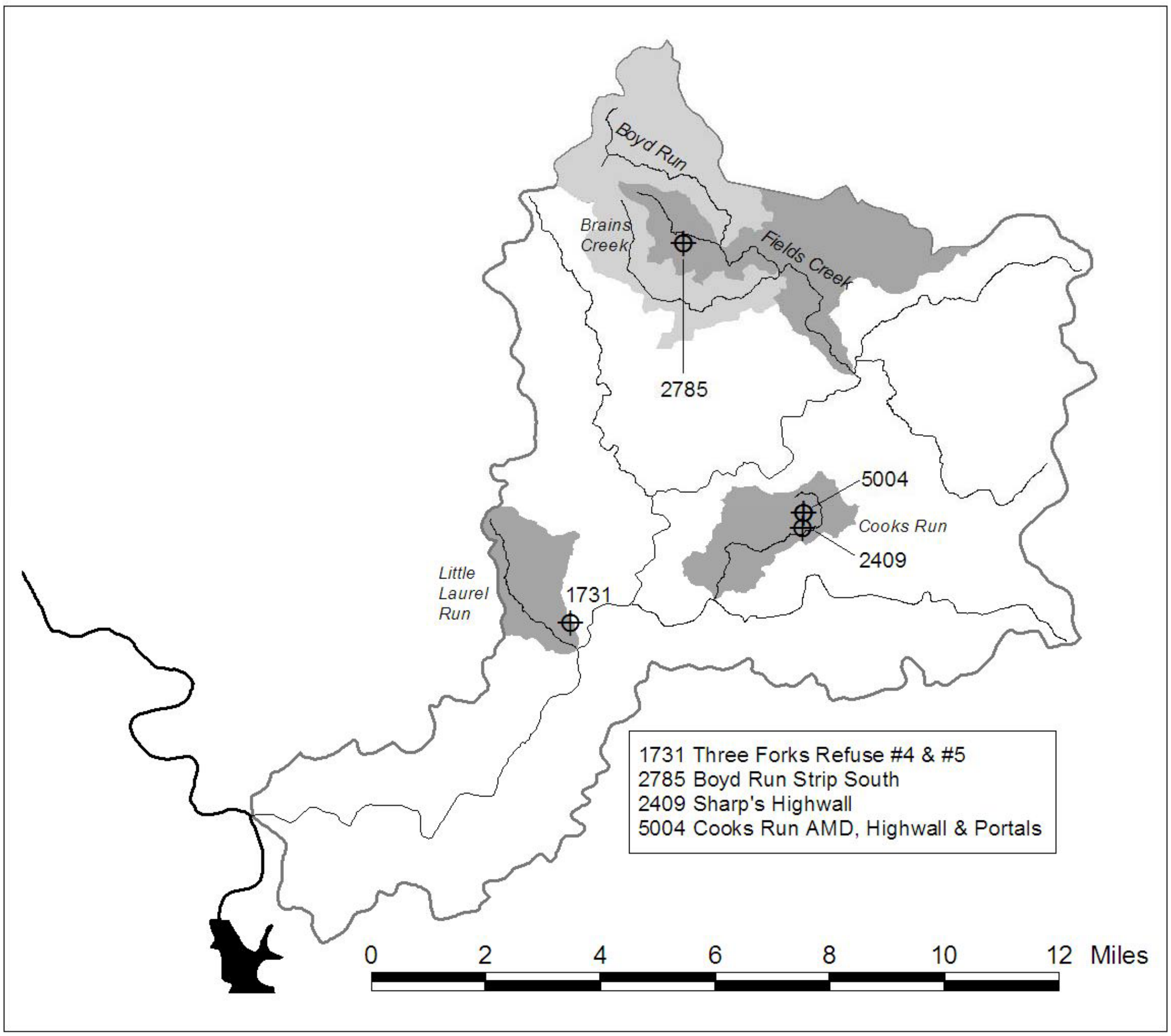


Table 13: Costs and descriptions of abandoned mine lands in subwatersheds not listed as impaired

Site name (Problem area no.)	Past reclamation cost	Site and cost description	Estimated future cost for water remediation
Little Laurel Run			
Three Forks Refuse #4 & #5 (1731)	$0	A small area of refuse coal must be reclaimed.	$30,000
Cooks Run			
Sharp's Highwall (2409)	$0	Water pools on some of the mined area, which includes spoil piles. Reclaim the site to make sure water does not interact with acidic materials.	$30,000
Cooks Run AMD, Highwall & Portals (5004)	$0	There are three collapse portals discharging AMD. The site requires wet seals, OLCs and RAPSs.	$280,000
Fields Creek			
Boyd Run Strip South (2785)	$0	Site actually drains to Fields Creek rather than Boyd Run. Refuse coal must be reclaimed.	$150,000
		Total, Subwatersheds not listed as impaired	**$490,000**

Source: Past reclamation costs from OSM (2005a). Site and cost descriptions from OSM (2005a) and WVDEP (Various dates). Estimated future costs for water remediation calculated in this plan.

6. TECHNICAL AND FINANCIAL ASSISTANCE

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

The technical and financial assistance chapter focuses on AMD only. If other sources of impairment are identified in the watershed this section will be updated to include other sources of technical and financial assistance to address those issues.

6.1 Technical Assistance Providers

Technical assistance is needed for the following tasks:

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

6.1.1 West Virginia Department of Environmental Protection

Two WVDEP divisions will provide technical assistance. The Division of Water and Waste Management monitors the water quality of the watershed through its Watershed Assessment Program and its pre-TMDL monitoring program (WVDEP, 2005a). This division also provides technical assistance for the use of best management practices, educates the public and land users on nonpoint source issues, enforces water quality laws that affect nonpoint sources, and restores impaired watersheds through its Non-Point Source Program (WVDEP, 2005b).

WVDEP's Office of Abandoned Mine Lands and Reclamation (OAMLR) directs technical resources to watersheds to address AMLs. Through their Stream Restoration Group (SRG), the office conducts extensive source monitoring of AMLs—as well as instream monitoring—before remediation systems are designed.

6.1.2 Office of Surface Mining, Reclamation and Enforcement

OSM provides technical assistance by sharing their knowledge and experience in designing and financing AML remediation projects.

6.1.3 West Virginia University

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

6.1.4 *Other technical assistance providers*

Other agencies and organizations may also provide technical assistance. Natural Resources Conservation Service (NRCS) engineers have designed AMD remediation projects in some West Virginia watersheds and may be available for assistance. Local conservation districts may also be a repository of information and assistance. In addition, USEPA staff with expertise in AMD from Region 3 and from headquarters may provide technical assistance.

6.2 Funding Sources

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

- Section 319 funds,
- the Abandoned Mine Land Trust Fund,
- the 10% AMD Set-Aside Fund,
- Watershed Cooperative Agreement Program grants,
- Stream Partners Program grants,
- Brownfields grants,
- other government funding sources, and
- private foundation grants.

These funding sources are described in turn below.

6.2.1 *Section 319 funds*

Clean Water Act Section 319 funds may be provided by USEPA to WVDEP to be used for reclamation of nonpoint source AMD sources. This Watershed Based Plan is being developed so that these funds can be allocated to the Three Fork watershed. WVDEP's Division of Water Resources Non-Point Source Program sets priorities and administers the state Section 319 program (WVDEP, 2005b).

6.2.2 *The Abandoned Mine Land Trust Fund*

Before 1977, when the Surface Mining Control and Reclamation Act was enacted, coal mines generally did not manage acid-producing material to prevent AMD or treat the AMD that was produced. 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 AML Trust Fund. This fund, supported by a per-ton tax on mined coal, has been allocated to coal mining states for remediation projects, according to a formula that takes states' current coal production into account. Authorization for this tax expired and has been temporarily extended, and if a permanent reauthorization is not secured, this very important source of funding for AMD remediation may be lost.[1]

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

- The priorities for disbursed monies place health and safety hazards ahead of water quality issues.
- Even though OSM allows states to assign water quality problems a priority equal to that of potential health and safety problems, WVDEP has been slow to change its priorities accordingly.

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[1] Reauthorization of the AML Trust Fund, which expired on September 30, 2004, is still not settled. At the time that this document is being written, the fund has been temporarily reauthorized through June 2006. A new OSM rule published in September 2004 also reauthorizes a much smaller per-ton tax. It is still not clear what shape a final reauthorization might take.

- Only part of the AML Trust Fund's income is disbursed each year, so that less money is available for remediation than the legislation initially envisioned.
- Some of the money that is disbursed from interest generated by the fund pays for health benefits for former miners.
- At least half of the AML fees collected in each state are allocated back to the state of origin, and are not available for AML reclamation in other states; therefore, much of the AML monies are earmarked for states with few AML problems.
- Some of the money allocated to West Virginia from the AML Trust Fund is used for water-line extensions, because deep mines are responsible for the failure of a number of private wells.
- Funds that are sent back to West Virginia are spent on agency staff salaries in addition to on-the-ground remediation.

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

Unless significantly more money were allocated to West Virginia's AML program and these augmented funds were spent on water quality problems, the AML Trust Fund will not be sufficient to implement the AMD pollutant reductions shown in Table 6 in the foreseeable future. And if the fund is not reauthorized, this important source of funding may disappear completely. OAMLR administers West Virginia's use of AML Trust Fund grants.

6.2.3 10% AMD Set-Aside Fund

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

As of March 14, 2005, $14.7 million remains in the West Virginia Set-Aside Fund (Darnell, 2005). The agency typically only spends the interest; therefore, the amount available for AMD projects varies with interest rates. In fiscal year 2001 the fund had the highest amount of interest available: $760 thousand. As of fiscal year 2003 the interest available has fallen to $211 thousand, and in subsequent years interest has fallen even further (Darnell, 2005). Long term commitments have been made to fund operations and maintenance on many AML projects across the state. If WVDEP continues to add money to this fund and if interest rates increase, funds may be available for projects in the Three Fork watershed.

These funds cannot be allocated to a watershed until after a Hydrologic Unit Plan is developed and approved by OSM. A new Hydrologic Unit Plan will be needed for the Three Fork watershed.

6.2.4 Watershed Cooperative Agreement Program

Grants specifically for AMD remediation projects on AMLs are available through OSM's Watershed Cooperative Agreement Program (WCAP). The WCAP is part of the Appalachian Clean Streams Initiative. Grants of up to $100,000 are awarded to not-for-profit organizations that have developed cooperative agreements with other entities to reclaim AML sites (OSM, 2004). A match is required to receive these grants and is typically met with Section 319 funds.

6.2.5 Stream Partners Program

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

6.2.6 Brownfields grants

Brownfields grants of up to $200 thousand are available through a competitive process; these grants can be applied to mine scarred lands. Competitive site assessment grants can be used for inventory, planning, quantification of environmental risks, and development of risk management or remedial action plans. Competitive remediation grants can then be used to build treatment systems.

6.2.7 Other government funding sources

NRCS is funding AMD remediation in the Deckers Creek watershed in north-central West Virginia though a Public Law-566 watershed restoration project. USACE has funded an AMD study and is planning to fund AMD remediation work in the lower Cheat watershed. Pending successful outcomes of these projects, these federal agencies might be potential funders for AMD remediation in the Three Fork watershed.

7. IMPLEMENTATION SCHEDULE, MILESTONES AND MEASURABLE GOALS

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

Some details are provided for Phase 1, which lasts from 2006 through 2010, because cleanup efforts have recently started. The schedule, milestones, and goals are designed to expand upon these existing efforts. Far fewer details are given for Phase 2, because of the difficulty of predicting how many remediation projects will be funded.

7.1 Phase 1: 2006 through 2010

Implementation of this watershed based plan will follow the schedule shown in Table 14. The goals for AMD remediation in Phase 1 are to collect data, plan and coordinate activities among agencies and organizations, secure funding for remediation projects, construct new projects, and maintain existing projects, as described below.

The overarching goal of remediation in the Three Fork Creek watershed is to reduce pollutant loads in the mainstem. Save the Tygart will focus its first restoration efforts on smaller tributaries that can benefit the most from AMD remediation and that can be removed from the 303(d) list with relatively little effort: Brains Creek and Cooks Run. Reduction of pollutant loads from these tributaries will also benefit the mainstem. Second priorities include significantly impaired tributaries of Three Fork Creek: Raccoon Creek, Squires Creek, and Birds Creek. In these subwatersheds, tributaries of the tributaries will receive greater attention if remediation will result in the delisting of these smaller streams.

7.1.1 Collect data

- **Monitor streams for AMD pollutants.** Save the Tygart will continue to collect instream monitoring data and will continue to identify sites, as it has since January 2004. This program will track the condition of major drainages within the Three Fork Creek watershed, and will help refine remediation priorities. This monitoring program is described further in Section 8.
- **Monitor reclaimed AML sites.** Monitoring at reclaimed sites will be used to develop operations and maintenance plans and to characterize additional treatment needs at sites that were not adequately addressed during past reclamation.
- **Monitor unreclaimed AML sites.** Monitoring will also occur at sites that have not been reclaimed, as described in the following chapter. Data will be used to design appropriate treatment systems.

Table 14: Phase 1 monitoring, funding, and construction schedule

Year	Quarter	Monitoring	Funding	Construction
2006	1			
	2	Approval of WBP Raise funds for monitoring	Submit FY07 319 proposal for Summers (2351)	
	3	Site and instream monitoring	Develop conceptual plans and landowner permission for Summers (2351)	
	4	Site and instream monitoring		
2007	1	Site and instream monitoring	Submit WCAP proposal for Summers (2351).	
	2	Site and instream monitoring	Submit FY08 319 proposal for Sharp's Highwall (2409)	
	3	Site and instream monitoring	Develop conceptual plans and landowner permission for Sharp's Highwall (2409)	Build project for Summers (2351).
	4	Site and instream monitoring		
2008	1	Site and instream monitoring	Submit WCAP proposal for Sharp's Highwall (2409)	
	2	Site and instream monitoring	Submit FY09 319 proposal for Cooks Run AMD, Highwall & Portals (5004)	
	3	Site and instream monitoring	Develop conceptual plans and landowner permission for Cooks Run AMD, Highwall & Portals (5004)	Build project for Sharp's Highwall (2409)
	4	Site and instream monitoring		
2009	1	Site and instream monitoring	Submit WCAP proposal for Cooks Run AMD, Highwall & Portals (5004)	
	2	Site and instream monitoring	Submit FY10 319 proposal for Browns Chapel Strips (1777)	
	3	Site and instream monitoring	Develop conceptual plans and landowner permission for Browns Chapel Strips (1777)	Build project for Cooks Run AMD, Highwall & Portals (5004)
	4	Site and instream monitoring		
2010	1	Site and instream monitoring	Submit WCAP proposal for Browns Chapel Strips (1777)	
	2	Site and instream monitoring		
	3	Site and instream monitoring		Build project for Browns Chapel Strips (1777)
	4	***- - - - - - - - - - Reassessment of Watershed Based Plan - - - - - - - - - -***		

7.1.2 Plan and coordinate activities

- **Convene a group of cooperators.** Save the Tygart will convene a group of individuals and agencies with missions related to water quality improvement to plan and coordinate remediation activities. These meetings will either be integrated with regular monthly meetings or will be scheduled separately.
- **Develop a Hydrologic Unit Plan.** A Hydrologic Unit Plan is required so that the Set-Aside Fund can be used to pay for operations and maintenance of sites in the Three Fork watershed.

- **Develop plans for new and improved reclamation projects.** Save the Tygart and partners will agree on plans to install new and to improve existing reclamation projects in the watershed.
- **Develop operations and maintenance plans.** Once the Hydrologic Unit Plan is completed, Save the Tygart and partners will develop operations and maintenance plans for AML sites where reclamation has succeeded. These plans will be coordinated with OAMLR's plans for using the Set-Aside Fund.
- **Reassess the big picture.** At the end of this five-year period, Save the Tygart and partners will reassess the strategic priorities for AMD remediation in the watershed. This assessment will be used to track improvements over time and to help plan remediation and operations and maintenance priorities for the next five-year period.

7.1.3 Secure funding

- **Secure funds for reclamation projects.** Save the Tygart and partners will secure funds to pay capital costs from the 319 program, the AML Trust Fund, and the OSM WCAP. The initial four priority sites, and the schedule for securing 319 and WCAP funds, are shown in Table 14.
- **Secure funds for operations and maintenance.** Save the Tygart and partners will also ensure that sufficient operations and maintenance funds are spent from the Set-Aside Fund and other potential sources to keep all projects in the watershed functioning properly.
- **Investigate other funding sources.** NRCS Public Law 566 and USACE funds will also be investigated.

7.1.4 Install remediation projects

- **Build new projects.** As funds are secured, new projects will be built. According to the construction schedule in Table 14, four projects will be built by 2010.
- **Add water quality improvements to existing projects.** In many cases, OAMLR designs and builds remediation projects with AML Trust Fund grants that do not wholly address AMD. Wherever possible, Save the Tygart and partners will add on to these remediation projects so that they directly address water quality.
- **Operate and maintain existing sites.** After Set-Aside funds are obtained, operations and maintenance will be performed on sites where necessary.

7.1.5 Measurable goals for Phase 1

By the end of Phase 1 in December 2010, the following measurable goals will be achieved:

- AMD remediation projects will have been installed on one AML per year from 2007 through 2010, for a total of four AMLs in the Three Fork watershed. These projects will be functioning well enough so that water discharged from these sites meet technology-based effluent limitations for pH, iron, and manganese.
- Instream water chemistry measurements will show that the immediate receiving streams for these AMLs meet water quality standards for pH, iron, manganese, and aluminum. Measurements in the Three Fork Creek mainstem will also show improvements, but will still not meet standards.

7.2 Phase 2: 2011 through 2015

Phase 2 is described in less detail than Phase 1, because of the uncertainty in what will be finished by 2010. Even though it is a measurable goal for Phase 1 to complete reclamation on five sites, new information or problems in securing funding may make it necessary to continue this process in Phase 2. Save the Tygart and partners will undertake the same four categories of activities in Phase 2:

- Collect more data in receiving streams and on AML sites;

- Develop plans for new and improved reclamation projects and for operations and maintenance;
- Secure capital funds for new and improved reclamation projects, and ensure that sufficient operations and maintenance funds are available to meet the needs of the watershed;
- Build new and improved projects and operate and maintain existing sites.

8. MONITORING

Instream monitoring is important to gage the recovery of streams after remediation projects are installed, and is also crucial as partners engage in periodic planning of their reclamation priorities. Monitoring of AMD sources is also necessary to understand which sources are discharging how much pollution. These data are used to help decide on priorities, and are essential for the design of realistic treatment systems.

8.1 Instream monitoring

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

8.1.1 Save the Tygart

Save the Tygart will continue to collect instream monitoring data, as it has since January 2004. This program will track the condition of major drainages within the Three Fork Creek watershed, and will help set remediation priorities. This monitoring run will take place quarterly, and will include analyses of pH, conductivity, alkalinity and/or acidity, sulfate, dissolved aluminum, total iron, total manganese, and fecal coliform bacteria. Sampling sites will include:

- Tygart Valley River upstream from Three Fork Creek,
- Tygart Valley River downstream from Three Fork Creek,
- Three Fork Creek near the mouth,
- Three Fork Creek at Thornton (U.S. 50),
- Raccoon Creek near the mouth (Railroad crossing at Hardman),
- Cooks Run near mouth in Independence (Road 33),
- Three Fork Creek upstream from Raccoon (Road 7),
- Little Raccoon near mouth in Newburg,
- Raccoon Creek upstream from Little Raccoon in Newburg,
- Raccoon Creek at West End,
- Laurel Run near mouth,
- Three Fork Creek upstream from Laurel Run (Road 33/11),
- Fields Creek near mouth,
- Birds Creek near mouth,
- Squires Creek near mouth,
- Brains Creek near mouth, and
- Fields Creek upstream from Brains Creek.

8.1.2 WVDEP Watershed Assessment Program

According to WVDEP's five-year watershed management framework cycle, the agency performs in-depth monitoring of the state's watersheds every five years. The next monitoring year for the Three Fork watershed is scheduled to begin in 2007. These monitoring data will be helpful to show whether streams are improving or declining in quality. In addition to AMD water chemistry, technicians collect benthic macroinvertebrates to determine biological impairments and fecal coliform data to determine bacteria impairments. Technicians also perform sediment-related assessments. WVDEP will then use these data, plus data collected by other agencies and organizations, to make impairment decisions for the next 303(d) list.

8.2 Source monitoring

8.2.1 Save the Tygart

Save the Tygart and its cooperators will also conduct the monitoring necessary to develop plans and secure funding for specific water remediation projects. As required by OSM WCAP guidelines, monthly monitoring for a year will determine loads of metals and acidity from all AMD sources at targeted sites. Data will be used to design appropriate treatment systems. Save the Tygart's source monitoring will begin with the four projects in the current schedule, and will start in summer 2006.

8.2.2 WVDEP Stream Restoration Group

SRG, which works within OAMLR, collects source data when WVDEP is designing a remediation project. The only sampling that SRG is planning for the near future in the Three Fork watershed is at the headwaters of Squires Creek in conjunction with the Borgman Refuse and Portals (5409) site. All pre-construction sampling has been completed there, but quarterly sampling will resume upon completion of the project. Construction of this project is temporarily on hold (Vukovich, 2005).

8.2.3 National Mine Land Reclamation Center

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

9. OUTREACH AND EDUCATION

9.1 Save the Tygart

Save the Tygart has undertaken a range of outreach and education activities, and plans to continue these activities as this plan is implemented. Outreach and education activities include:

- Submitting press releases to local newspapers and television stations so that information on AMD remediation topics can be broadcast to a wide audience;
- Printing and distributing brochures with background on Save the Tygart and their efforts to clean up AMD;
- Giving speeches to the Grafton Rotary and other organizations;
- Collaborating with science teachers at the Taylor County High School so that AMD remediation topics can be presented at school and so that students can volunteer for field work with Save the Tygart;
- Creating a large artistic rendering of the watershed and exhibiting it at schools and at meetings. The rendering will show water monitoring sampling points, local landmarks such as schools and churches, and will show three dimensional topography.
- Holding regularly scheduled monthly public meetings, at which members of the public can come and learn about Save the Tygart's efforts to remediate AMD on Three Fork Creek.

9.2 West Virginia Department of Environmental Protection

Prior to initiating its regular five-year monitoring effort in 2007, WVDEP will hold a public meeting in the watershed to gather suggestions for monitoring locations. WVDEP will include information at this meeting on the status of plans for remediating nonpoint source pollution in the watershed.

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APPENDIX A. ALL ABANDONED MINE LANDS IN THE THREE FORK WATERSHED

Many AMLs do not discharge polluted water. Table 3 in Chapter 3 lists those AMLs known to discharge AMD. Table 15 lists the sites in Table 3 plus all other sites that have been inventoried by WVDEP. Although the PADs and other information available at OAMLR office suggest that many of these sites do not discharge AMD, they are included in this plan in case new data show otherwise.

Table 15: All abandoned mine lands in the Three Fork watershed

Problem area no.	Problem area name	Map	AM-LIS	PAD	Stream name	Stream code	TMDL subwa-tershed
470	West End Portals & Structures	Y	Y	Y	Raccoon	MT-12-C	58
471	Birds Creek Tipple	Y	Y	Y	Birds	MT-12-H	20
490	Snider Highwall	Y	Y	Y	Birds	MT-12-H	15
868	Birds Creek Drainage	Y	N	N	Birds	MT-12-H	19
899	Maple Run #1	Y	N	Y	Raccoon	MT-12-C	67
900	Maple Run Portals and AMD	Y	Y	Y	Raccoon	MT-12-C	67
982	Three Forks #2	Y	Y	Y	Three Fork	MT-12	66
983	Three Forks #3	Y	Y	Y	Three Fork	MT-12	66
989	Three Forks #1	Y	Y	Y	Rocky	MT-12-A	143
1054	Bird's Creek #3	N	Y	N	Birds	MT-12-H	37
1075	Birds Creek #8	Y	Y	Y	Birds	MT-12-H	19
1076	Birds Creek Tipple II	Y	N	Y	Birds	MT-12-H	41
1077	Birds Creek #7	Y	Y	Y	Birds	MT-12-H	19
1078	Pell School Strip #2 & Portal	N	Y	Y	Squires	MT-12-I	8
1079	St. Josephs School Gob	N	N	Y	Birds	MT-12-H	15
1083	Birds Creek #4	Y	Y	Y	Birds	MT-12-H	38
1085	Birds Creek Portals	Y	Y	Y	Birds	MT-12-H	19
1506	Jessop Strip #3	Y	Y	Y	Birds	MT-12-H	41
1547	West End #1	Y	Y	Y	Raccoon	MT-12-C	58
1548	Howesville Site	Y	Y	N	Birds	MT-12-H	41
1723	Irontown Refuse	Y	Y	Y	Three Fork	MT-12	79
1728	Raccoon Creek Refuse #2	Y	Y	Y	Raccoon	MT-12-C	67
1730	Boyd Run Strip East	Y	Y	Y	Fields	MT-12-G	5
1731	Three Forks Refuse #4 & #5	Y	Y	Y	Three Fork	MT-12	79
					Little Laurel	MT-12-B	78
1738	Austen Refuse	Y	Y	Y	Raccoon	MT-12-C	56
1739	Austen Refuse #2	Y	N	Y	Raccoon	MT-12-C	55
1741	Cooks Run Refuse	Y	N	Y	Raccoon	MT-12-C	54
1742	Cooks Run Portals	Y	N	Y	Cooks	MT-12-C-1	62
1743	Howesville Highwall	Y	Y	Y	Birds	MT-12-H	15
1744	Hopewell Church Refuse and Drainage	Y	Y	Y	Birds	MT-12-H	15
1745	Bethlehem Church Refuse	Y	Y	Y	Squires	MT-12-I	7
1746	Newburg Tipple and Refuse	Y	Y	Y	Raccoon	MT-12-C	64
1747	Lick Run Refuse	Y	N	Y	Lick Run	MT-12-F	27
1749	Squires Creek Refuse	Y	Y	Y	Squires	MT-12-I	18
1777	Browns Chapel Strips	Y	N	Y	Brains	MT-12-G-2	11
1796	Boyd Run Refuse	Y	Y	Y	Boyd	MT-12-G-3	2
2190	Donnie Thorn Highwall	Y	Y	Y	Birds	MT-12-H	16
2193	Kerns Highwall	Y	Y	Y	Fields	MT-12-G	5
2196	Paul Ellison	Y	Y	Y	Squires	MT-12-I	10
2226	N. WV Railroad Highwall	Y	Y	Y	Birds	MT-12-H	15
2351	Summers	Y	N	Y	Brains	MT-12-G-2	11
2406	Mt. Phoebe Portal and Highwall	Y	Y	Y	Squires	MT-12-I	7

(Continued on following page)

Table 15: All abandoned mine lands in the Three Fork watershed (continued)

Problem area no.	Problem area name	Map	AM-LIS	PAD	Stream name	Stream code	TMDL subwa-tershed
2408	Miller Highwall	Y	Y	Y	Birds	MT-12-H	40
2409	Sharp's Highwall	Y	Y	Y	Cooks Run	MT-12-C-1	62
2410	Austen Highwall #2	Y	Y	Y	Raccoon	MT-12-C	56
2411	Austen Highwall #3	Y	Y	Y	Raccoon	MT-12-C	56
2413	West End #2	Y	Y	Y	Raccoon	MT-12-C	57
2414	Hopewell Strip #2	Y	Y	Y	Birds	MT-12-H	16
2415	Pell School Strip #2	Y	N	Y	Squires	MT-12-I	18
2416	Spiker Highwall	Y	Y	Y	Birds	MT-12-H	15
2768	Brown Chapel Highwall	Y	N	N	Brains	MT-12-G-2	11
2769	Browns Chapel Highwall	Y	N	Y	Fields	MT-12-G	5
2785	Boyd Run Strip South	Y	Y	Y	Fields	MT-12-G	5
2786	Boyd Run Strip West	Y	Y	Y	Fields	MT-12-G	5
2818	Hardman Highwall	N	Y	Y	Raccoon	MT-12-C	67
2819	Racoon Creek Highwall	Y	Y	Y	Raccoon	MT-12-C	67
2844	Three Forks Creek Watershed	Y	Y	Y	Three Fork	MT-12	All
2898	Hardman Highwall	Y	N	N	Raccoon	MT-12-C	67
2917	Irish Ridge #1	Y	Y	Y	Birds	MT-12-H	19
2919	Concord (Conley) Highwall	Y	Y	Y	Birds	MT-12-H	37
2920	Irish Ridge #2	Y	Y	Y	Birds	MT-12-H	16
2984	Jessop Strip #1	Y	Y	Y	Birds	MT-12-H	41
3362	Jessop Portal & Highwall	N	Y	Y	Birds	MT-12-H	41
3364	Weaver Slide	Y	Y	Y	Birds	MT-12-H	41
3366	Knott's Strip #2	Y	Y	Y	Birds	MT-12-H	37
3367	Plum Heirs Highwall	Y	N	Y	Birds	MT-12-H	37
3371	Concord Cemetary Highwall	Y	Y	Y	Raccoon	MT-12-C	54
3453	Hopewell Church Highwall	N	Y	N	Birds	MT-12-H	Unknown
3454	Shaffer Strip	Y	Y	Y	Birds	MT-12-H	41
3547	Knotts Strip #1	Y	Y	Y	Raccoon	MT-12-C	54, 56
					Birds	MT-12-H	37
3548	Racoon Creek Highwall	Y	Y	Y	Raccoon	MT-12-C	55
4340	Birds Creek Refuse	Y	Y	Y	Birds	MT-12-H	37
4641	Raccoon Creek Mine Blowout	N	Y	Y	Raccoon	MT-12-C	56
4971	Racoon Creek Refuse and Coke Ovens	Y	Y	Y	Raccoon	MT-12-C	56
5004	Cooks Run AMD, Highwall & Portals	Y	Y	Y	Cooks	MT-12-C-1	62
5240	Racoon Creek (Pyles) Highwall	Y	Y	Y	Raccoon	MT-12-C	56
5409	Borgman Refuse And Portals	N	Y	N	Squires	MT-12-I	7
5614	St. Joseph (Price) Subsidence	N	Y	Y	Squires	MT-12-I	8
5758	Squires Creek Refuse & Portals	N	Y	Y	Squires	MT-12-I	7
6072	Gladesville Road Portal	N	Y	N	Brains	MT-12-G-2	11

Source: OSM (2005a) and WVDEP (Various dates). Map column refers to the mylar maps available from the WVDEP. Maps depict location of many AML sites, but not all. AMLIS column indicates whether or not problem area is included in the AMLIS database. PAD column indicates whether or not a PAD has been located for this site within the WVDEP files.

APPENDIX B. LOAD CALCULATIONS FOR AMLS WITH WATER QUALITY PROBLEMS

Few measurements are available for determining pollutant loads from AMLs and other sources of AMD. Measurements include those given in PADs, measurements of loads in streams made by SRG, a few additional measurements made in conjunction with a USACE study, and measurements made by Save the Tygart. These measurements, however, still do not estimate loads for subwatersheds or AMLs. Although SRG made four rounds of measurements in the Three Fork watershed, concentrations of metals were measured in only one of the sweeps. Save the Tygart had no way to measure stream flow for about one year of its measurements.

Load calculations, therefore, depend on the observations, measurements and estimates of WVDEP personnel who wrote the PADs. When describing water problems, PADs often include an estimate of the flow in gallons per minute (gpm), a pH measurement, and occasionally a determination of total iron concentration, using a method that only measures up to 10 mg/L.

Such measurements were converted to loads according to the following assumptions. First, the observed flow was accurate and was close to the annual average flow. Second, the chemical characteristics of the AMD samples in the Three Fork watershed are similar to those found in the lower Cheat River watershed. Two facts support the assumption: Mines in the Upper Freeport coal seam have produced most of the AMD in both watersheds, and the two areas are contiguous. Third, there are reasonably close relationship between acidity and metals concentrations.

We therefore used regressions between pH and acidity and between acidity and metals concentrations from samples in the Cheat River watershed to estimate acidity in waters from the Three Fork watershed. The regression equation for the relationship between acidity and pH is:

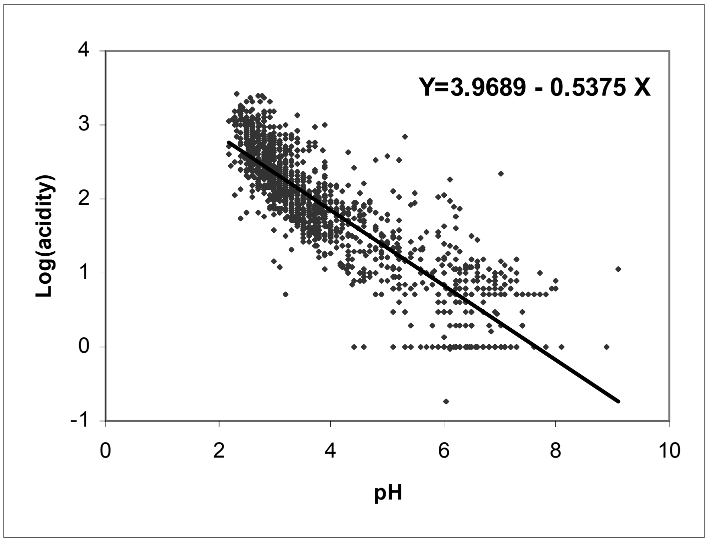
$$\log(\text{acidity}) = 3.9689 - 0.5375 * \text{pH}$$

or

$$\text{acidity} = 10^{(3.9689 - 0.5375 * \text{pH})}$$

Where acidity is expressed as mg/L of $CaCO_3$. Figure 9 contains the data from which the relationship was derived.

Figure 9: Relationship between pH values and acidity in samples of AMD from the lower Cheat watershed



Source: Pavlick et al. (2005).

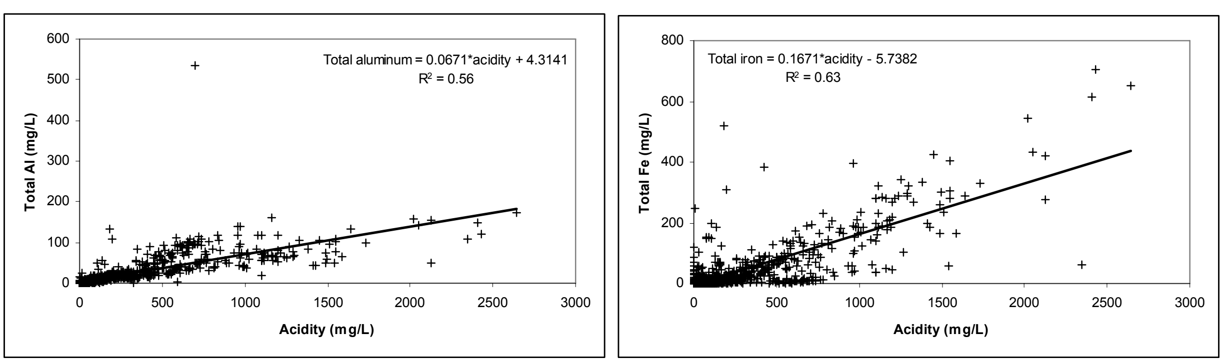
Concentrations of Al and Fe were related to acidity in AMD from the lower Cheat according to the following equations:

$$Al = 0.0671 * acidity + 4.3141$$

$$Fe = 0.1671 * acidity – 5.7382$$

The data for these regressions appear in Figure 10. No relationship was found between acidity and Mn in AMD samples from the Cheat watershed. Where there are no measurements, therefore, Mn concentration is set at the average value of 3.4 mg/L.

Figure 10: Relationship between acidity and concentrations of Al and Fe in samples of AMD from the lower Cheat watershed



Source: Pavlick et al. (2005).

When measurements of Al, Fe, and Mn were available for AMD in the Three Fork watershed, those values were preferred over those determined by the regressions. Load calculations for abandoned mine lands with sufficient data are shown in Table 16.

Table 16: Load calculations for abandoned mine lands with sufficient data

Problem area name (Problem area number)	Avg. flow *(gpm)*	pH *(SU)*	Acidity *(mg/L)*	Method	Estimated loads Al	Fe	Mn	Expected reductions Al	Fe	Mn
					-----	*lbs/yr*	-----	-----	*lbs/yr*	-----
Direct drains to Three Fork Creek				*Insufficient data for load calculations*						
Raccoon Creek										
West End Portals & Structures (470)	15	2.7	247	Acidity, Fe measured, Al, Mn from regression	1,375	1,060	224	1,238	954	202
Maple Run Portals & AMD (900)	50	2.8	291	Regression	5,233	9,414	746	4,710	8,473	671
West End #1 (1547)	338	3.35	147	Regression	21,068	28,013	5,045	18,961	25,212	4,541
Austen Refuse (1738)	3	2.9	257	Regression	284	490	45	256	441	41
Austen Highwall #3, Refuse (2411)	400	3.1	201	Regression	31,227	48,826	5,970	28,104	43,943	5,373
Knotts Strip #1 (3547)	10	4.3	45	Regression	323	82	149	291	74	134
				Total	**59,511**	**87,884**	**12,179**	**53,560**	**79,096**	**10,961**
Brains Creek				*Insufficient data for load calculations*						
Birds Creek										
Bird's Creek Portals (1085)	30	3.2	177	Regression	2,136	3,148	448	1,922	2,833	403
Hopewell Church Refuse and Drainage (1744)	10	4.6	31	Regression	282	132	149	254	119	134
Hopewell Strip #2 (2414)	5	2.7	329	Regression	580	1082	75	522	974	68
Jeesop Portal & Highwall (3362)	99	3.41	134	Regression	5,782	7,237	1,478	5,204	6,513	1,330
Shaffer Strip (3454)	10	3.5	137	Acidity, Fe measured, Al, Mn from regression	593	176	149	534	158	134
				Total	**9,372**	**11,775**	**2,298**	**8,435**	**10,598**	**2,068**
Squires Creek										
Pell School Strip #2 & Portal (1078)	75	4	66	Regression	2,876	1,736	1,119	2,588	1,562	1,007
Paul Ellison (2196)	85	4	66	Regression	3,260	1,968	1,269	2,934	1,771	1,142
Mt. Phoebe Portal and Highwall (2406)	50	2.6	373	Regression	6,436	12,411	746	5,792	11,170	671
Borgman Refuse and Portals (5409)	225	2.7	318	Regression	25,336	46,816	3,358	22,802	42,134	3,022
				Total	**37,909**	**62,932**	**6,492**	**34,118**	**56,639**	**5,843**
STREAMS NOT LISTED AS IMPAIRED										
Little Laurel Run				*Insufficient data for load calculations*						
Cooks Run										
Cooks Run AMD, Highwall & Portals (5004)	15	2.7	583	Acidity, Fe measured, Al, Mn from regression	2,860	4,965	224	2,574	4,469	202
				Total	**2,860**	**4,965**	**224**	**2,574**	**4,469**	**202**
Fields Creek				*Insufficient data for load calculations*						

APPENDIX C. COST CALCULATIONS FOR AMLS WITH WATER QUALITY PROBLEMS

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

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

In some cases, however, reclamation has taken place, and OLCs and wet seals have been installed.

Costs are rounded to nearest $10 thousand to reflect the precision of the method used to estimate costs. When the cost for a site is calculated to exceed $1 million, it is recorded as “>$1,000,000.” This is done because data used for cost calculations, as already noted, are often so sparse as to make the calculations imprecise. This method ensures that estimates based on questionable data do not make the results too unreliable. A ceiling for passive treatment by RAPS has been set for several reasons. First, larger systems become more difficult to maintain. Poorly maintained systems are likely to experience uneven flows, and water may short circuit the system and emerge without being fully treated. In addition, the risks of failure with RAPS are not completely predictable, and the losses should an expensive RAPS fail is too great. Finally, as treatment sums start to number in the millions, it becomes possible to consider financing long-term, active treatment.

Decisions about the sizing of AMD treatment measures and the amounts of reclamation and of OLCs were chosen using the rules detailed below. Various exceptions to these rules are noted for individual sites, as described in Table 12.

C.1 Reducing and alkalinity producing systems

RAPSs were included whenever flows of AMD were identified and quantified. If site descriptions suggested that AMD came only from surface materials, the cost of a RAPS was not included. When appropriate AMD sources were present, a RAPS was sized according to two parameters: design flow and acidity, using the “Vertical Flow Pond” module in the computer program AMDTreat (OSM, 2005b). This module allows a number of sizing methods. The one chosen was “Vertical Flow Pond based on Alkalinity Generation Rate.” The default alkalinity generation rate, 25 g m^{-2} day^{-1} (as $CaCO_3$) was used. Conditions for cost determination included:

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

In its help section, AMDTreat suggests that a RAPS should be sized according to “design flow,” or “the maximum flow that the treatment system is expected to handle.” Determination of a true design flow would require a large number of flow measurements taken under a variety of flow conditions. The only flow measurement available was a single, visual estimate by WVDEP inspector. The design flows chosen were double these estimates. Acidity values were either taken from the PADs or were calculated using the regression described in Appendix B.

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

C.2 Manganese removal beds

MRBs are sized using AMDTreat's default parameters for a 24 hour retention time. Cost of an MRB was calculated for only one site. Other sites had Mn levels that would not violate in-stream water quality standards

C.3 Land reclamation

Land reclamation costs were calculated at $10,000 per acre. The acreage chosen was that of refuse coal described in the PAD. If spoil was mentioned at a highwall but no acreage was supplied, the area that would be filled in highwall reclamation was used as an area estimate. This "footprint" was calculated as the length of the highwall times twice its height. When stagnant AMD was found in portals, the reclamation needed to prevent that water from being acidic as it left the site was one acre per portal.

C.4 Mine seals

Where mine seals were not already constructed, the cost of $5,000/seal was used (Bess, 2004). This cost was also used for auger holes that were discharging AMD.

C.5 Oxic limestone channels

The price of constructing OLCs was set at $35/linear foot (Bess, 2004). The required length was estimated as 100 feet for each wet seal, and 100 feet for each acre of reclamation.

C.6 Engineering and project management costs

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

Table 17: Cost calculations for each abandoned mine land that discharges acid mine drainage

Site name (Problem area no.)	Summary	Avg flow (gpm)	Design flow (gpm)	pH	Acidity (mg/L)	RAPS cost	Portal seals	Recl. area (acres)	OLC (ft)	MRB cost	Total const. cost	Engineering & project management	Grand total (Rounded)
Direct drains to Three Fork Creek													
Three Forks #2 (982)	Reclaim 4 acres and seal 4 portals						4	4	800		$88,000	$17,600	$110,000
Three Forks #3 (983)	Reclaim 2 acres gob							2	200		$27,000	$5,400	$30,000
Irontown Refuse (1723)	Reclaim a little gob							1	100		$13,500	$2,700	$20,000
Raccoon Creek													
West End Portals & Structures (470)	Reclamation is done, must fix AMD from portals	15	30	2.7	247	$84,111	0	0	0	$13,395	$97,506	$19,501	$120,000
Maple Run Portals & AMD (900)	Fix AMD from portals	50	100	2.8	291	$312,139	6		600	$44,652	$407,791	$81,558	$490,000
West End #1 (1547)	This complaint and the costs for its remediation is included under PA 2411.												See 2411
Raccoon Creek Refuse #2 (1728)	Reclaim a little gob							1	100		$13,500	$2,700	$20,000
Austen Refuse (1738)	Address small flow, take care of refuse	3	5	2.9	257	$16,964	1	4	500	$2,232	$81,696	$16,339	$100,000
Cooks Run Refuse (1741)	Address refuse							15	1500		$202,500	$40,500	$240,000
Newburg Tipple and Refuse (1746)	Reclaim 3 acres							3	300		$40,500	$8,100	$50,000
Austen Highwall #2 (2410)	Reclaim slurry area							7	700		$94,500	$18,900	$110,000
Austen Highwall #3, Refuse (2411)	Assume land work is done but water pollution complaint in AMLIS has no completed costs: portals must be addressed	400	800	3.1	201	$1,671,187	0	0	0	$357,212	$2,028,399	$405,680	$2,430,000
Knotts Strip #1 (3547)	Reclaim bench and treat water	10	20	4.3	45	$12,630	0	10	1000	$8,930	$156,560	$31,312	$190,000
Raccoon Creek Highwall (3548)	Reclaim bench							3	300		$40,500	$8,100	$50,000
Raccoon Creek Refuse and Coke Ovens (4971)	Reclaim spoil							4	400		$54,000	$10,800	$60,000
Brains Creek													
Browns Chapel Strips (1777)	Lots of refuse. Apparently sparse over 50 acres							50	5000		$675,000	$135,000	$810,000
Summers (2351)	AMD coming from ground, nothing but reclaim							3	300		$40,500	$8,100	$50,000

Site name (Problem area no.)	Summary	Avg flow (gpm)	Design flow (gpm)	pH	Acidity (mg/L)	RAPS cost	Portal seals	Recl. area (acres)	OLC (ft)	MRB cost	Total const. cost	Engineering & project management	Grand total (Rounded)
Birds Creek													
Birds Creek #7 (1077)	Reclaim two acres and two portals to make sure water does not become acidic.						2	2	400		$44,000	$8,800	$50,000
Birds Creek #4 (1083)	Reclaim, get enough alkalinity to be sure about the water						3	3	600		$66,000	$13,200	$80,000
Bird's Creek Portals(1085)	Moderate flows, chemistry iffy	30	60	3.2	177	$118,562	4	1	500		$166,062	$33,212	$200,000
Howesville Portals (1743)	No estimate possible												
Hopewell Church Refuse and Drainage (1744)	address small flows and refuse	10	20	4.6	31	$9,237	5	4	900		$105,737	$21,147	$130,000
Hopewell Strip #2 (2414)	Reclaim gob and treat water	5	10	2.7	329	$39,588	1	2	300	$4,465	$79,553	$15,911	$100,000
Concord (Conley) Highwall (2919)	Reclaim spoil							1	100		$13,500	$2,700	$20,000
Irish Ridge #2 (2920)	No estimate possible												
Jessop Strip #1 (2984)	No estimate possible												
Jessop Portal & Highwall (3362)	Treat water from 7 portals	99	198	3.41	134	$284,979	7		700	$88,410	$432,889	$86,578	$520,000
Shaffer Strip (3454)	Reclaim bench and treat water	10	20	3.5	137	$33,471	1	1	200	$8,930	$64,401	$12,880	$80,000
Squires Creek													
Pell School Strip #2 & Portal (1078)	Site was reclaimed, but water quality complaint was not addressed. A large discharge of AMD from a three portals must be addressed.	75	150	4	66	$110,678				$66,977	$177,655	$35,531	$210,000
Bethlehem Church Refuse (1745)	Reclaim one acre							1	100		$13,500	$2,700	$20,000
Paul Ellison (2196)	There is auger hole water and maybe spoil, but the new calculations are for reclaiming highwall. No specific area of spoil is known	85	170	4	66	$124,492	5	7	1200	$75,907	$337,399	$67,480	$400,000
Mt. Phoebe Portal and Highwall (2406)	There is a portal here with a large, acidic flow.	50	100	2.6	373	$397,582	1		100	$44,652	$450,734	$90,147	$540,000
Borgman Refuse and Portals (5409)	Treat water from portals at site 3 and reclaim spoil at all sites	225	450	2.7	318	$1,489,098	4	4	800	$200,932	$1,778,030	$355,606	$2,130,000
Squires Creek Refuse & Portals (5758)	Reclaim 6 acres of spoil							6	600		$81,000	$16,200	$100,000

Site name (Problem area no.)	Summary	Avg flow (gpm)	Design flow (gpm)	pH	Acidity (mg/L)	RAPS cost	Portal seals	Recl. area (acres)	OLC (ft)	MRB cost	Total const. cost	Engineering & project management	Grand total (Rounded)
Streams not listed as impaired													
Cooks Run													
Sharp's Highwall (2409)	Reclaim 1/2 of bench. No load							2	200		$27,000	$5,400	$30,000
Cooks Run AMD, Highwall & Portals (5004)	Build treatment for water from portal	15	30	2.7	583	$190,909	3	0	300	$13,395	$229,804	$45,961	$280,000
Fields Creek													
Boyd Run Strip South (2785)	Reclaim refuse							9	900		$121,500	$24,300	$150,000
Little Laurel Run													
Three Forks Refuse #4 & #5 (1731)	Reclaim a little gob							2	200		$27,000	$5,400	$30,000

APPENDIX D. AMDTREAT OUTPUTS

This appendix contains output from AMDTreat 4.0 for sites where costs were estimated using that program. In most cases, costs were only estimated for RAPSs, which are referred to as vertical flow ponds in AMDTreat. However, in a few cases, costs for manganese removal beds (MRB) were included as well.

For each site, output includes one summary page ("AMD TREAT MAIN COST FORM"), one page estimating the price of a RAPS, and, where necessary, one page estimating the cost of an MRB.

In the summary pages, engineering cost is calculated at 20%, and includes both design and project management costs.

WEST END PORTALS AND STRUCTURES (470)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name W End Prtls & Structures (470)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$84,111
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$13,395
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$97,506**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$97,506**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	247.00	mg/L
Design Flow	30.00	gpm
Typical Flow	15.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	2.70	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name W End Prtls & Structures (470)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: West End Portals and Structures (470)

Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity 0.00 mg/L

Alkalinity 0.00 mg/L

Calculate Net Acidity (Acid-Alkalinity)

Enter Net Acidity manually

Net Acidity (Hot Acidity) 247.00 mg/L

Design Flow 30.00 gpm

Typical Flow 15.00 gpm

Total Iron 0.00 mg/L

Aluminum 0.00 mg/L

Manganese 3.40 mg/L

Record Number
1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	600	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	591	VFP Based on Retention Time
3. Tons of Limestone Needed	2,805	VFP Based on Alkalinity Generation Rate (selected)
4. Tons of Limestone Needed	1,192	VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,921	VFP Based on Dimensions

6. Retention Time ____ hours

7. Alkalinity Generation Rate 25.0 g/m2/day

8. Limestone Needed ____ tons

9. Length at Top of Freeboard ____ ft

10. Width at Top of Freeboard ____ ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/yd3

Liner Cost

- No Liner (selected)
- 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? (checked)

30a. Land Multiplier (selected)	1.50	ratio
30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ ea.

AMDTreat Piping Costs (selected)

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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	219.45	ft
49. Width at Top of Freeboard	121.72	ft
50. Freeboard Volume	2,746	yd3
51. Water Surface Area	22,764	ft2
52. Total Water Volume	1,593	yd3
53. Organic Matter Volume	729	yd3
54. Limestone Surface Area	19,102	ft2
55. Limestone Volume	1,932.33	yd3
56. Excavation Volume	4,255.5	yd3
57. Clear and Grub Area	0.9	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	75.88	hrs

VFP Cost Summaries

60. Organic Matter Cost	13,859	$
61. Limestone Cost	33,661	$
62. Limestone and Organic Matter Placement Cost	2,552	$
63. Excavation Cost	19,150	$
64. Liner Cost	0	$
65. Clear and Grub Cost	1,155	$
66. Valve Cost	0	$
67. Pipe Cost	13,733	$
68. Total Cost	84,111	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name W End Prtls & Structures (470)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: West End Portals & Structures

SIZING METHODS Select One

Tons of Limestone Needed	887.12	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	247.00	mg/L
Design Flow	30.00	gpm
Typical Flow	15.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides — Run 2.0 : Rise 1

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	192.65	ft
23. Top Width at Freeboard	100.32	ft
25. Freeboard Volume	1,346	yd3
26. Limestone Surface Area	17,048.6	ft2
27. Limestone Volume	611.1	yd3
28. Tons of Limestone	887	tons
29. Excavation Volume	611	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	10,645	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	2,750	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	13,395	$

Record Number 1 of 1

MAPLE RUN PORTALS & AMD (900)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Maple Run Portals & AMD (900)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$312,139
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$44,652
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$356,791**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$356,791**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

● Enter Net Acidity manually

Net Acidity (Hot Acidity)	291.00	mg/L
Design Flow	100.00	gpm
Typical Flow	50.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	2.80	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Maple Run Portals & AMD (900)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Maple Run Portals & AMD (900)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	291.00	mg/L
Design Flow	100.00	gpm
Typical Flow	50.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number 1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	2,358	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	1,971	○ VFP Based on Retention Time
3. Tons of Limestone Needed	11,015	◉ VFP Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	4,330	○ VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,921	○ VFP Based on Dimensions

6. Retention Time		hours
7. Alkalinity Generation Rate	25.0	g/m2/day
8. Limestone Needed		tons
9. Length at Top of Freeboard		ft
10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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 (ft)	Diameter (in)	Unit Cost ($)
45. Pipe #1			
46. Pipe #2			
47. Pipe #3			

VFP Sizing Summaries

48. Length at Top of Freeboard	402.56	ft
49. Width at Top of Freeboard	213.28	ft
50. Freeboard Volume	9,134	yd3
51. Water Surface Area	78,613	ft2
52. Total Water Volume	5,649	yd3
53. Organic Matter Volume	2,696	yd3
54. Limestone Surface Area	71,655	ft2
55. Limestone Volume	7,588.50	yd3
56. Excavation Volume	15,934.1	yd3
57. Clear and Grub Area	2.9	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	89.40	hrs

VFP Cost Summaries

60. Organic Matter Cost	51,227	$
61. Limestone Cost	132,191	$
62. Limestone and Organic Matter Placement Cost	9,436	$
63. Excavation Cost	71,704	$
64. Liner Cost	0	$
65. Clear and Grub Cost	3,713	$
66. Valve Cost	0	$
67. Pipe Cost	43,867	$
68. Total Cost	312,139	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Maple Run Portals & AMD (900)

AMDTREAT

AMD TREAT
MANGANESE REMOVAL BED

MN Removal Bed Name: Maple Run Portals & AMD (900)

SIZING METHODS Select One

Tons of Limestone Needed	2,957.07	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	291.00	mg/L
Design Flow	100.00	gpm
Typical Flow	50.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides — Run 2.0 : Rise 1

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	342.65	ft
23. Top Width at Freeboard	175.32	ft
25. Freeboard Volume	4,298	yd3
26. Limestone Surface Area	55,998.6	ft2
27. Limestone Volume	2,037.0	yd3
28. Tons of Limestone	2,957	tons
29. Excavation Volume	2,037	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	35,485	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	9,167	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	44,652	$

Record Number 1 of 1

AUSTEN REFUSE (1738)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Austen Refuse (1738)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$16,964
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$2,232
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$19,196**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$19,196**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	257.00	mg/L
Design Flow	5.00	gpm
Typical Flow	3.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	0.00	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Austen Refuse (1738)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Austen Refuse (1738)

☐ Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	104	VFP Based on Acidity Neutralization	
2. Tons of Limestone Needed	98	○ VFP Based on Retention Time	6. Retention Time ___ hours
3. Tons of Limestone Needed	486	◉ VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate 25.0 g/m2/day
4. Tons of Limestone Needed	202	○ VFP Based on Tons Limestone Entered	8. Limestone Needed ___ tons
5. Tons of Limestone Needed	1,921	○ 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	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	257.00	mg/L
Design Flow	5.00	gpm
Typical Flow	3.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	110.56	ft
49. Width at Top of Freeboard	67.28	ft
50. Freeboard Volume	713	yd3
51. Water Surface Area	5,449	ft2
52. Total Water Volume	359	yd3
53. Organic Matter Volume	148	yd3
54. Limestone Surface Area	3,746	ft2
55. Limestone Volume	335.09	yd3
56. Excavation Volume	843.3	yd3
57. Clear and Grub Area	0.2	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	78.96	hrs

VFP Cost Summaries

60. Organic Matter Cost	2,823	$
61. Limestone Cost	5,837	$
62. Limestone and Organic Matter Placement Cost	520	$
63. Excavation Cost	3,795	$
64. Liner Cost	0	$
65. Clear and Grub Cost	321	$
66. Valve Cost	0	$
67. Pipe Cost	3,668	$
68. Total Cost	16,964	$

Record Number 1 of 1

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Austen Refuse (1738)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Austen Refuse (1738)

SIZING METHODS Select One

Tons of Limestone Needed	147.85	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	257.00	mg/L
Design Flow	5.00	gpm
Typical Flow	3.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3
15. Slope of Pond Sides	Run 2.0 : Rise 1	

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	85.15	ft
23. Top Width at Freeboard	46.57	ft
25. Freeboard Volume	256	yd3
26. Limestone Surface Area	2,976.1	ft2
27. Limestone Volume	101.8	yd3
28. Tons of Limestone	147	tons
29. Excavation Volume	101	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	1,774	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	458	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	2,232	$

Record Number 1 of 1

AUSTEN HIGHWALL #3, REFUSE (2411)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Austen HW #3, Refuse (2411)

AMD TREAT

Costs — AMD TREAT MAIN COST FORM

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$1,671,187
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$357,212
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$2,028,399**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$2,028,399**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	201.00	mg/L
Design Flow	800.00	gpm
Typical Flow	400.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	3.10	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart
Project ThreeFork Watershed Based Plan
Site Name Austen HW #3, Refuse (2411)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Austen Highwall #3, Refuse (2411)

Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	13,033	VFP Based on Acidity Neutralization	
2. Tons of Limestone Needed	15,771	VFP Based on Retention Time	6. Retention Time: hours
3. Tons of Limestone Needed	60,871	VFP Based on Alkalinity Generation Rate (selected)	7. Alkalinity Generation Rate: 25.0 g/m2/day
4. Tons of Limestone Needed	28,804	VFP Based on Tons Limestone Entered	8. Limestone Needed: tons
5. Tons of Limestone Needed	1,921	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	0.00	mg/L
Alkalinity	0.00	mg/L
Calculate Net Acidity (Acid-Alkalinity)		
Enter Net Acidity manually (selected)		
Net Acidity (Hot Acidity)	201.00	mg/L
Design Flow	800.00	gpm
Typical Flow	400.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/yd3

Liner Cost

- No Liner (selected)
- 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? (checked)		
30a. Land Multiplier (selected)	1.50	ratio
30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ ea.
AMDTreat Piping Costs (selected)		
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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	901.77	ft
49. Width at Top of Freeboard	462.88	ft
50. Freeboard Volume	45,475	yd3
51. Water Surface Area	401,187	ft2
52. Total Water Volume	29,321	yd3
53. Organic Matter Volume	14,365	yd3
54. Limestone Surface Area	385,243	ft2
55. Limestone Volume	41,932.35	yd3
56. Excavation Volume	85,620.2	yd3
57. Clear and Grub Area	14.3	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	61.75	hrs

VFP Cost Summaries

60. Organic Matter Cost	272,954	$
61. Limestone Cost	730,456	$
62. Limestone and Organic Matter Placement Cost	50,280	$
63. Excavation Cost	385,291	$
64. Liner Cost	0	$
65. Clear and Grub Cost	18,053	$
66. Valve Cost	0	$
67. Pipe Cost	214,152	$
68. Total Cost	1,671,187	$

Record Number 1 of 1

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Austen HW #3, Refuse (2411)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Austen Highwall #3, Refuse (2411)

SIZING METHODS Select One

Tons of Limestone Needed	23,656.60	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	201.00	mg/L
Design Flow	800.00	gpm
Typical Flow	400.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3
15. Slope of Pond Sides (Run : Rise)	2.0 : 1	

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	949.08	ft
23. Top Width at Freeboard	478.54	ft
25. Freeboard Volume	33,221	yd3
26. Limestone Surface Area	442,817.9	ft2
27. Limestone Volume	16,296.2	yd3
28. Tons of Limestone	23,656	tons
29. Excavation Volume	16,296	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	283,879	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	73,333	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	357,212	$

Record Number 1 of 1

KNOTTS STRIP #1 (3547)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Knotts Strip #1 (3547)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$12,630
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$8,930
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$21,560**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$21,560**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	45.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	4.30	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Knotts Strip #1 (3547)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Knotts Strip #1 (3547)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	45.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number
1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	72	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	394	○ VFP Based on Retention Time
3. Tons of Limestone Needed	340	● VFP Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	467	○ VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,921	○ VFP Based on Dimensions

6. Retention Time		hours
7. Alkalinity Generation Rate	25.0	g/m2/day
8. Limestone Needed		tons
9. Length at Top of Freeboard		ft
10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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 (ft)	Diameter (in)	Unit Cost ($)
45. Pipe #1			
46. Pipe #2			
47. Pipe #3			

VFP Sizing Summaries

48. Length at Top of Freeboard	97.88	ft
49. Width at Top of Freeboard	60.94	ft
50. Freeboard Volume	562	yd3
51. Water Surface Area	4,203	ft2
52. Total Water Volume	272	yd3
53. Organic Matter Volume	109	yd3
54. Limestone Surface Area	2,729	ft2
55. Limestone Volume	234.69	yd3
56. Excavation Volume	617.1	yd3
57. Clear and Grub Area	0.2	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	13.82	hrs

VFP Cost Summaries

60. Organic Matter Cost	2,080	$
61. Limestone Cost	4,088	$
62. Limestone and Organic Matter Placement Cost	383	$
63. Excavation Cost	2,777	$
64. Liner Cost	0	$
65. Clear and Grub Cost	257	$
66. Valve Cost	0	$
67. Pipe Cost	3,044	$
68. Total Cost	12,630	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Knotts Strip #1 (3547)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Knotts Strip #1 (3547)

SIZING METHODS Select One

Tons of Limestone Needed	591.41	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	45.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3
15. Slope of Pond Sides	Run 2.0 : Rise 1	

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	159.31	ft
23. Top Width at Freeboard	83.65	ft
25. Freeboard Volume	916	yd3
26. Limestone Surface Area	11,448.6	ft2
27. Limestone Volume	407.4	yd3
28. Tons of Limestone	591	tons
29. Excavation Volume	407	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	7,097	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	1,833	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	8,930	$

Record Number 1 of 1

BIRDS CREEK PORTALS (1085)

AMDTreat output includes:

- Main cost page
- Vertical flow pond

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Bird's Creek Portals (1085)

Printed on **04/09/200**

AMDTREAT

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$118,562
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:			**$118,562**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$118,562**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	177.00	mg/L
Design Flow	60.00	gpm
Typical Flow	30.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	3.20	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Bird's Creek Portals (1085)

Printed on 04/09/2006

AMD TREAT

VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name Bird's Creek Portals (1085)

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ◯ Calculate Net Acidity (Acid-Alkalinity)
- ◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	177.00	mg/L
Design Flow	60.00	gpm
Typical Flow	30.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number

1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	860	VFP Based on Acidity Neutralization		
2. Tons of Limestone Needed	1,182	◯ VFP Based on Retention Time	6. Retention Time	hours
3. Tons of Limestone Needed	4,020	◉ VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate 25.0	g/m2/day
4. Tons of Limestone Needed	2,043	◯ VFP Based on Tons Limestone Entered	8. Limestone Needed	tons
5. Tons of Limestone Needed	1,921	◯ VFP Based on Dimensions	9. Length at Top of Freeboard ___ ft	10. Width at Top of Freeboard ___ ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	256.23	ft
49. Width at Top of Freeboard	140.11	ft
50. Freeboard Volume	3,730	yd3
51. Water Surface Area	31,291	ft2
52. Total Water Volume	2,209	yd3
53. Organic Matter Volume	1,024	yd3
54. Limestone Surface Area	26,966	ft2
55. Limestone Volume	2,769.41	yd3
56. Excavation Volume	6,003.2	yd3
57. Clear and Grub Area	1.2	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	54.38	hrs

VFP Cost Summaries

60. Organic Matter Cost	19,471	$
61. Limestone Cost	48,243	$
62. Limestone and Organic Matter Placement Cost	3,586	$
63. Excavation Cost	27,015	$
64. Liner Cost	0	$
65. Clear and Grub Cost	1,552	$
66. Valve Cost	0	$
67. Pipe Cost	18,694	$
68. Total Cost	118,562	$

HOPEWELL CHURCH REFUSE & DRAINAGE (1744)

AMDTreat output includes:

- Main cost page
- Vertical flow pond

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Hopewell Ch Rfse & Drng (1744)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$9,237
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:			**$9,237**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$9,237**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	31.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	4.60	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Hopewell Ch Rfse & Drng (1744)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Hopewell Church Refuse and Drainage (1744)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	31.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number
1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	50	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	394	○ VFP Based on Retention Time
3. Tons of Limestone Needed	234	● VFP Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	444	○ VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,921	○ VFP Based on Dimensions

6. Retention Time		hours
7. Alkalinity Generation Rate	25.0	g/m2/day
8. Limestone Needed		tons
9. Length at Top of Freeboard		ft
10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	86.80	ft
49. Width at Top of Freeboard	55.40	ft
50. Freeboard Volume	444	yd3
51. Water Surface Area	3,246	ft2
52. Total Water Volume	207	yd3
53. Organic Matter Volume	80	yd3
54. Limestone Surface Area	1,972	ft2
55. Limestone Volume	161.67	yd3
56. Excavation Volume	448.9	yd3
57. Clear and Grub Area	0.1	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	9.52	hrs

VFP Cost Summaries

60. Organic Matter Cost	1,524	$
61. Limestone Cost	2,816	$
62. Limestone and Organic Matter Placement Cost	280	$
63. Excavation Cost	2,020	$
64. Liner Cost	0	$
65. Clear and Grub Cost	208	$
66. Valve Cost	0	$
67. Pipe Cost	2,389	$
68. Total Cost	9,237	$

HOPEWELL STRIP #2 (2414)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Hopewell Strip #2 (2414)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$39,588
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$4,465
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$44,053**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$44,053**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
● Enter Net Acidity manually

Net Acidity (Hot Acidity)	329.00	mg/L
Design Flow	10.00	gpm
Typical Flow	5.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	2.70	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Hopewell Strip #2 (2414)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Hopewell Strip #2 (2414)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	329.00	mg/L
Design Flow	10.00	gpm
Typical Flow	5.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number

1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	266	VFP Based on Acidity Neutralization		
2. Tons of Limestone Needed	197	( ) VFP Based on Retention Time	6. Retention Time	hours
3. Tons of Limestone Needed	1,245	(•) VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate 25.0	g/m2/day
4. Tons of Limestone Needed	463	( ) VFP Based on Tons Limestone Entered	8. Limestone Needed	tons
5. Tons of Limestone Needed	1,921	( ) VFP Based on Dimensions	9. Length at Top of Freeboard ft; 10. Width at Top of Freeboard	ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	157.20	ft
49. Width at Top of Freeboard	90.60	ft
50. Freeboard Volume	1,422	yd3
51. Water Surface Area	11,414	ft2
52. Total Water Volume	780	yd3
53. Organic Matter Volume	343	yd3
54. Limestone Surface Area	8,872	ft2
55. Limestone Volume	857.94	yd3
56. Excavation Volume	1,982.3	yd3
57. Clear and Grub Area	0.4	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	101.08	hrs

VFP Cost Summaries

60. Organic Matter Cost	6,529	$
61. Limestone Cost	14,945	$
62. Limestone and Organic Matter Placement Cost	1,202	$
63. Excavation Cost	8,920	$
64. Liner Cost	0	$
65. Clear and Grub Cost	616	$
66. Valve Cost	0	$
67. Pipe Cost	7,376	$
68. Total Cost	39,588	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Hopewell Strip #2 (2414)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Hopewell Strip #2 (2414)

SIZING METHODS Select One

Tons of Limestone Needed	295.70	(●) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(●) Enter Net Acidity manually

Net Acidity (Hot Acidity)	329.00	mg/L
Design Flow	10.00	gpm
Typical Flow	5.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3
15. Slope of Pond Sides (Run : Rise)	2.0 : 1	

Liner Cost

(●) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	115.87	ft
23. Top Width at Freeboard	61.93	ft
25. Freeboard Volume	480	yd3
26. Limestone Surface Area	5,818.2	ft2
27. Limestone Volume	203.7	yd3
28. Tons of Limestone	295	tons
29. Excavation Volume	203	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	3,548	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	917	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	4,465	$

Record Number 1 of 1

JESSOP PORTAL & HIGHWALL (3362)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on 04/09/200

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Jessop Prtl & Highwall (3362)

AMD TREAT

Costs — AMD TREAT MAIN COST FORM

AMDTREAT

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$284,979
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$88,410
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$373,389**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$373,389**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	134.00	mg/L
Design Flow	198.00	gpm
Typical Flow	99.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	3.41	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Jessop Prtl & Highwall (3362)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Jessop Portal & Highwall (3362)

☐ Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	2,150	VFP Based on Acidity Neutralization			
2. Tons of Limestone Needed	3,903	○ VFP Based on Retention Time	6. Retention Time		hours
3. Tons of Limestone Needed	10,043	◉ VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate	25.0	g/m2/day
4. Tons of Limestone Needed	6,053	○ VFP Based on Tons Limestone Entered	8. Limestone Needed		tons
5. Tons of Limestone Needed	1,921	○ 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	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	134.00	mg/L
Design Flow	198.00	gpm
Typical Flow	99.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number
1 of 1

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	385.87	ft
49. Width at Top of Freeboard	204.93	ft
50. Freeboard Volume	8,398	yd3
51. Water Surface Area	72,136	ft2
52. Total Water Volume	5,177	yd3
53. Organic Matter Volume	2,465	yd3
54. Limestone Surface Area	65,478	ft2
55. Limestone Volume	6,918.83	yd3
56. Excavation Volume	14,561.4	yd3
57. Clear and Grub Area	2.7	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	41.16	hrs

VFP Cost Summaries

60. Organic Matter Cost	46,845	$
61. Limestone Cost	120,525	$
62. Limestone and Organic Matter Placement Cost	8,629	$
63. Excavation Cost	65,526	$
64. Liner Cost	0	$
65. Clear and Grub Cost	3,420	$
66. Valve Cost	0	$
67. Pipe Cost	40,034	$
68. Total Cost	284,979	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Jessop Prtl & Highwall (3362)

AMD TREAT
MANGANESE REMOVAL BED

MN Removal Bed Name: Jessop Portal & Highwall (3362)

SIZING METHODS Select One

Tons of Limestone Needed	5,855.00	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	134.00	mg/L
Design Flow	198.00	gpm
Typical Flow	99.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3
15. Slope of Pond Sides	Run 2.0 : Rise 1	

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	477.68	ft
23. Top Width at Freeboard	242.84	ft
25. Freeboard Volume	8,380	yd3
26. Limestone Surface Area	110,303.7	ft2
27. Limestone Volume	4,033.3	yd3
28. Tons of Limestone	5,855	tons
29. Excavation Volume	4,033	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	70,260	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	18,150	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	88,410	$

Record Number 1 of 1

SHAFFER STRIP (3454)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on 04/09/200

Company Name Save the Tygart
Project ThreeFork Watershed Based Plan
Site Name Shaffer Strip (3454)

AMD TREAT

AMD TREAT MAIN COST FORM

AMDTREAT

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$33,471
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$8,930
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$42,401**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$42,401**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	137.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	3.50	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Shaffer Strip (3454)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Shaffer Strip (3454)

☐ Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	222	VFP Based on Acidity Neutralization		
2. Tons of Limestone Needed	394	◯ VFP Based on Retention Time	6. Retention Time	hours
3. Tons of Limestone Needed	1,037	◉ VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate 25.0	g/m2/day
4. Tons of Limestone Needed	616	◯ VFP Based on Tons Limestone Entered	8. Limestone Needed	tons
5. Tons of Limestone Needed	1,921	◯ 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	0.00	mg/L
Alkalinity	0.00	mg/L

◯ Calculate Net Acidity (Acid-Alkalinity)

◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	137.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	146.34	ft
49. Width at Top of Freeboard	85.17	ft
50. Freeboard Volume	1,235	yd3
51. Water Surface Area	9,829	ft2
52. Total Water Volume	668	yd3
53. Organic Matter Volume	290	yd3
54. Limestone Surface Area	7,483	ft2
55. Limestone Volume	714.51	yd3
56. Excavation Volume	1,673.7	yd3
57. Clear and Grub Area	0.4	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	42.09	hrs

VFP Cost Summaries

60. Organic Matter Cost	5,528	$
61. Limestone Cost	12,447	$
62. Limestone and Organic Matter Placement Cost	1,018	$
63. Excavation Cost	7,532	$
64. Liner Cost	0	$
65. Clear and Grub Cost	539	$
66. Valve Cost	0	$
67. Pipe Cost	6,407	$
68. Total Cost	33,471	$

Record Number 1 of 1

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Shaffer Strip (3454)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Shaffer Strip (3454)

SIZING METHODS Select One

Tons of Limestone Needed	591.41	(●) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(●) Enter Net Acidity manually

Net Acidity (Hot Acidity)	137.00	mg/L
Design Flow	20.00	gpm
Typical Flow	10.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides: Run 2.0 : Rise 1

Liner Cost

(●) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	159.31	ft
23. Top Width at Freeboard	83.65	ft
25. Freeboard Volume	916	yd3
26. Limestone Surface Area	11,448.6	ft2
27. Limestone Volume	407.4	yd3
28. Tons of Limestone	591	tons
29. Excavation Volume	407	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	7,097	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	1,833	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	8,930	$

Record Number 1 of 1

PELL SCHOOL STRIP #2 & PORTAL (1078)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on 04/09/200

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Pell Sch Strp #2 & Prtl (1078)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$110,678
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$66,977
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$177,655**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$177,655**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

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

Net Acidity (Hot Acidity)	66.00	mg/L
Design Flow	150.00	gpm
Typical Flow	75.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	4.00	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Pell Sch Strp #2 & Prtl (1078)

Printed on 04/09/2006

AMD TREAT

VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Pell School Strip #2 & Portal (1078)

Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L
Calculate Net Acidity (Acid-Alkalinity)		
Enter Net Acidity manually (selected)		
Net Acidity (Hot Acidity)	66.00	mg/L
Design Flow	150.00	gpm
Typical Flow	75.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number 1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	802	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	2,957	VFP Based on Retention Time
3. Tons of Limestone Needed	3,747	VFP Based on Alkalinity Generation Rate (selected)
4. Tons of Limestone Needed	3,759	VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,921	VFP Based on Dimensions

6. Retention Time ___ hours
7. Alkalinity Generation Rate 25.0 g/m2/day
8. Limestone Needed ___ tons
9. Length at Top of Freeboard ___ ft
10. Width at Top of Freeboard ___ ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/yd3

Liner Cost

- No Liner (selected)
- 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 (selected)	1.50	ratio
30b. Clear/Grub Acres		acres
31. Clear and Grub Unit Cost	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ ea.

AMDTreat Piping Costs (selected)

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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	248.53	ft
49. Width at Top of Freeboard	136.26	ft
50. Freeboard Volume	3,511	yd3
51. Water Surface Area	29,393	ft2
52. Total Water Volume	2,071	yd3
53. Organic Matter Volume	958	yd3
54. Limestone Surface Area	25,207	ft2
55. Limestone Volume	2,581.65	yd3
56. Excavation Volume	5,612.3	yd3
57. Clear and Grub Area	1.1	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	20.27	hrs

VFP Cost Summaries

60. Organic Matter Cost	18,217	$
61. Limestone Cost	44,972	$
62. Limestone and Organic Matter Placement Cost	3,355	$
63. Excavation Cost	25,256	$
64. Liner Cost	0	$
65. Clear and Grub Cost	1,464	$
66. Valve Cost	0	$
67. Pipe Cost	17,413	$
68. Total Cost	110,678	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Pell Sch Strp #2 & Prtl (1078)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Pell School Strip #2 & Portal (1078)

SIZING METHODS Select One

Tons of Limestone Needed	4,435.61	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	66.00	mg/L
Design Flow	150.00	gpm
Typical Flow	75.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides: Run 2.0 : Rise 1

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	417.19	ft
23. Top Width at Freeboard	212.59	ft
25. Freeboard Volume	6,385	yd3
26. Limestone Surface Area	83,722.2	ft2
27. Limestone Volume	3,055.5	yd3
28. Tons of Limestone	4,435	tons
29. Excavation Volume	3,055	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	53,227	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	13,750	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	66,977	$

Record Number 1 of 1

PAUL ELLISON (2196)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on 04/09/200

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Paul Ellison (2196)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$124,492
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$75,907
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$200,399**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$200,399**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	66.00	mg/L
Design Flow	170.00	gpm
Typical Flow	85.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	4.00	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Paul Ellison (2196)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Paul Ellison (2196)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L
○ Calculate Net Acidity (Acid-Alkalinity)		
● Enter Net Acidity manually		
Net Acidity (Hot Acidity)	66.00	mg/L
Design Flow	170.00	gpm
Typical Flow	85.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number
1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	909	VFP Based on Acidity Neutralization			
2. Tons of Limestone Needed	3,351	○ VFP Based on Retention Time	6. Retention Time		hours
3. Tons of Limestone Needed	4,247	● VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate	25.0	g/m2/day
4. Tons of Limestone Needed	4,260	○ VFP Based on Tons Limestone Entered	8. Limestone Needed		tons
5. Tons of Limestone Needed	1,921	○ VFP Based on Dimensions	9. Length at Top of Freeboard		ft
			10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	262.45	ft
49. Width at Top of Freeboard	143.22	ft
50. Freeboard Volume	3,911	yd3
51. Water Surface Area	32,867	ft2
52. Total Water Volume	2,323	yd3
53. Organic Matter Volume	1,079	yd3
54. Limestone Surface Area	28,431	ft2
55. Limestone Volume	2,925.87	yd3
56. Excavation Volume	6,328.6	yd3
57. Clear and Grub Area	1.2	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	20.27	hrs

VFP Cost Summaries

60. Organic Matter Cost	20,514	$
61. Limestone Cost	50,968	$
62. Limestone and Organic Matter Placement Cost	3,778	$
63. Excavation Cost	28,479	$
64. Liner Cost	0	$
65. Clear and Grub Cost	1,625	$
66. Valve Cost	0	$
67. Pipe Cost	19,127	$
68. Total Cost	124,492	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Paul Ellison (2196)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Paul Ellison (2196)

SIZING METHODS Select One

Tons of Limestone Needed	5,027.02	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	66.00	mg/L
Design Flow	170.00	gpm
Typical Flow	85.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides — Run 2.0 : Rise 1

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	443.43	ft
23. Top Width at Freeboard	225.71	ft
25. Freeboard Volume	7,217	yd3
26. Limestone Surface Area	94,800.9	ft2
27. Limestone Volume	3,462.9	yd3
28. Tons of Limestone	5,027	tons
29. Excavation Volume	3,462	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	60,324	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	15,583	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	75,907	$

Record Number 1 of 1

MT. PHOEBE PORTAL & HIGHWALL (2406)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Mt Phoebe Prtl and HW (2406)

AMD TREAT

Costs

AMD TREAT MAIN COST FORM

AMDTREAT

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$397,582
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$44,652
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$442,234**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$442,234**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

- ○ Calculate Net Acidity (Acid-Alkalinity)
- ● Enter Net Acidity manually

Net Acidity (Hot Acidity)	373.00	mg/L
Design Flow	100.00	gpm
Typical Flow	50.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	2.60	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Mt Phoebe Prtl and HW (2406)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Mt. Phoebe Portal and Highwall (2406)

☐ Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	3,023	VFP Based on Acidity Neutralization	
2. Tons of Limestone Needed	1,971	○ VFP Based on Retention Time	6. Retention Time ___ hours
3. Tons of Limestone Needed	14,120	● VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate 25.0 g/m2/day
4. Tons of Limestone Needed	4,994	○ VFP Based on Tons Limestone Entered	8. Limestone Needed ___ tons
5. Tons of Limestone Needed	1,921	○ 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	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

● Enter Net Acidity manually

Net Acidity (Hot Acidity)	373.00	mg/L
Design Flow	100.00	gpm
Typical Flow	50.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	451.41	ft
49. Width at Top of Freeboard	237.70	ft
50. Freeboard Volume	11,468	yd3
51. Water Surface Area	99,177	ft2
52. Total Water Volume	7,151	yd3
53. Organic Matter Volume	3,430	yd3
54. Limestone Surface Area	91,340	ft2
55. Limestone Volume	9,726.84	yd3
56. Excavation Volume	20,308.5	yd3
57. Clear and Grub Area	3.6	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	114.59	hrs

VFP Cost Summaries

60. Organic Matter Cost	65,183	$
61. Limestone Cost	169,440	$
62. Limestone and Organic Matter Placement Cost	12,007	$
63. Excavation Cost	91,388	$
64. Liner Cost	0	$
65. Clear and Grub Cost	4,640	$
66. Valve Cost	0	$
67. Pipe Cost	54,923	$
68. Total Cost	397,582	$

Record Number 1 of 1

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Mt Phoebe Prtl and HW (2406)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Mt. Phoebe Portal and Highwall (2406)

SIZING METHODS Select One

Tons of Limestone Needed	2,957.07	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	373.00	mg/L
Design Flow	100.00	gpm
Typical Flow	50.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3
15. Slope of Pond Sides (Run : Rise)	2.0 : 1	

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	342.65	ft
23. Top Width at Freeboard	175.32	ft
25. Freeboard Volume	4,298	yd3
26. Limestone Surface Area	55,998.6	ft2
27. Limestone Volume	2,037.0	yd3
28. Tons of Limestone	2,957	tons
29. Excavation Volume	2,037	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	35,485	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	9,167	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	44,652	$

Record Number 1 of 1

BORGMAN REFUSE & PORTALS (5409)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on 04/09/200

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Borgman Refuse & Prtls (5409)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$1,489,098
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$200,932
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$1,690,030**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$1,690,030**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)
◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	318.00	mg/L
Design Flow	450.00	gpm
Typical Flow	225.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	2.70	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Borgman Refuse & Prtls (5409)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Borgman Refuse and Portals (5409)

☐ Opening Screen Water Parameters

Influent Water Parameters that Affect VFP

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

◉ Enter Net Acidity manually

Net Acidity (Hot Acidity)	318.00	mg/L
Design Flow	450.00	gpm
Typical Flow	225.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number
1 of 1

SIZING METHODS Select One

1. Tons of Limestone Needed	11,599	VFP Based on Acidity Neutralization
2. Tons of Limestone Needed	8,871	○ VFP Based on Retention Time
3. Tons of Limestone Needed	54,170	◉ VFP Based on Alkalinity Generation Rate
4. Tons of Limestone Needed	20,470	○ VFP Based on Tons Limestone Entered
5. Tons of Limestone Needed	1,921	○ VFP Based on Dimensions

6. Retention Time		hours
7. Alkalinity Generation Rate	25.0	g/m2/day
8. Limestone Needed		tons
9. Length at Top of Freeboard		ft
10. Width at Top of Freeboard		ft

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	852.56	ft
49. Width at Top of Freeboard	438.28	ft
50. Freeboard Volume	40,662	yd3
51. Water Surface Area	358,317	ft2
52. Total Water Volume	26,168	yd3
53. Organic Matter Volume	12,805	yd3
54. Limestone Surface Area	343,259	ft2
55. Limestone Volume	37,316.66	yd3
56. Excavation Volume	76,290.4	yd3
57. Clear and Grub Area	12.8	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	97.70	hrs

VFP Cost Summaries

60. Organic Matter Cost	243,306	$
61. Limestone Cost	650,051	$
62. Limestone and Organic Matter Placement Cost	44,819	$
63. Excavation Cost	343,307	$
64. Liner Cost	0	$
65. Clear and Grub Cost	16,161	$
66. Valve Cost	0	$
67. Pipe Cost	191,454	$
68. Total Cost	1,489,098	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Borgman Refuse & Prtls (5409)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Borgman Refuse and Portals (5409)

SIZING METHODS Select One

Tons of Limestone Needed	13,306.83	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	318.00	mg/L
Design Flow	450.00	gpm
Typical Flow	225.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides — Run 2.0 : Rise 1

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

20. Land Multiplier		ratio
21. Clear/Grub Acres		acres
22. Clear and Grub Unit Cost		$/acre

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	714.56	ft
23. Top Width at Freeboard	361.28	ft
25. Freeboard Volume	18,805	yd3
26. Limestone Surface Area	249,614.3	ft2
27. Limestone Volume	9,166.6	yd3
28. Tons of Limestone	13,306	tons
29. Excavation Volume	9,166	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	159,682	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	41,250	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	200,932	$

Record Number 1 of 1

COOKS RUN AMD, HIGHWALL & PORTALS (5004)

AMDTreat output includes:

- Main cost page
- Vertical flow pond
- Manganese removal bed

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Cooks Run AMD HW Prtls (5004)

AMD TREAT

AMD TREAT MAIN COST FORM

Costs

Passive Treatment	A	S	
Vertical Flow Pond	1	0	$190,909
Anoxic Limestone Drain			$0
Anaerobic Wetlands			$0
Aerobic Wetlands			$0
Manganese Removal Bed	1	0	$13,395
Oxic Limestone Channel			$0
Limestone Bed			$0
BIO Reactor			$0
Passive Subtotal:			**$204,304**
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			$0
Land Access			$0
Ditching			$0
Engineering Cost			$0
Ancillary Subtotal:			**$0**
Other Cost (Capital Cost)			$0
Total Capital Cost:			**$204,304**
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			

Water Quality

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

○ Calculate Net Acidity (Acid-Alkalinity)

● Enter Net Acidity manually

Net Acidity (Hot Acidity)	583.00	mg/L
Design Flow	30.00	gpm
Typical Flow	15.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L
pH	2.70	su
Ferric Iron	0.00	mg/L
Ferrous Iron	0.00	mg/L
Sulfate	0.00	mg/L
Filtered Fe	0.00	mg/L
Filtered Al	0.00	mg/L
Filtered Mn	0.00	mg/L
Specific Conductivity	0.00	uS/cm
Total Dissolved Solids	0.00	mg/L
Dissolved Oxygen	0.00	mg/L

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

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Cooks Run AMD HW Prtls (5004)

Printed on 04/09/2006

AMD TREAT
VERTICAL FLOW POND (VFP)

AMDTREAT

VFP Name: Cooks Run AMD, Highwall & Portals (5004)

☐ Opening Screen Water Parameters

SIZING METHODS Select One

1. Tons of Limestone Needed	1,417	VFP Based on Acidity Neutralization			
2. Tons of Limestone Needed	591	○ VFP Based on Retention Time	6. Retention Time		hours
3. Tons of Limestone Needed	6,620	● VFP Based on Alkalinity Generation Rate	7. Alkalinity Generation Rate	25.0	g/m2/day
4. Tons of Limestone Needed	2,009	○ VFP Based on Tons Limestone Entered	8. Limestone Needed		tons
5. Tons of Limestone Needed	1,921	○ 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	0.00	mg/L
Alkalinity	0.00	mg/L
○ Calculate Net Acidity (Acid-Alkalinity)		
● Enter Net Acidity manually		
Net Acidity (Hot Acidity)	583.00	mg/L
Design Flow	30.00	gpm
Typical Flow	15.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

Record Number
1 of 1

11. % Void Space of LS. Bed	35.00	%
12. System Life		years
13. Limestone Purity	90.00	%
14. Limestone Efficiency		%
15. Density of Loose Limestone	107.53	lbs/ft3
16. Limestone Unit Cost	12.00	$/ton
17. LS Placement Unit Cost	0.00	$/yd3
18. Slope of Pond Sides (Run of Slope : Rise of Slope)	2.0 : 1	
19. Freeboard Depth	3.00	ft
20. Free Standing Water Depth	2.0	ft
21. Organic Matter Depth	1.0	ft
22. Organic Matter Unit Cost	19.00	$/yd3
23. Organic Matter Spreading Unit Cost	3.50	$/yd3
24. Limestone Depth	3.0	ft
25. Excavation Unit Cost	4.50	$/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	1256.00	$/acre
32. Nbr. of Valves	0	nbr
33. Unit Cost of Valves	0.00	$ 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	6.70	$/ft
39. Trunk Coupler Cost	6.60	$/coupler
40. Spur Cost	1.83	$/ft
41. Spur Coupler Cost	2.43	$/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	319.49	ft
49. Width at Top of Freeboard	171.74	ft
50. Freeboard Volume	5,774	yd3
51. Water Surface Area	49,122	ft2
52. Total Water Volume	3,501	yd3
53. Organic Matter Volume	1,650	yd3
54. Limestone Surface Area	43,659	ft2
55. Limestone Volume	4,560.92	yd3
56. Excavation Volume	9,712.8	yd3
57. Clear and Grub Area	1.8	acr.
58. Liner Area	0.0	ft2
59. Theoretical Retention Time	179.11	hrs

VFP Cost Summaries

60. Organic Matter Cost	31,351	$
61. Limestone Cost	79,451	$
62. Limestone and Organic Matter Placement Cost	5,775	$
63. Excavation Cost	43,708	$
64. Liner Cost	0	$
65. Clear and Grub Cost	2,373	$
66. Valve Cost	0	$
67. Pipe Cost	28,251	$
68. Total Cost	190,909	$

Printed on **04/09/200**

Company Name Save the Tygart

Project ThreeFork Watershed Based Plan

Site Name Cooks Run AMD HW Prtls (5004)

AMD TREAT
MANGANESE REMOVAL BED

AMDTREAT

MN Removal Bed Name: Cooks Run AMD, Highwall & Portals (5004)

SIZING METHODS Select One

Tons of Limestone Needed	887.12	(•) Based on Retention Time	1. Retention Time	1.00	days
Tons of Limestone Needed	200.00	( ) Based on Tons of Limestone	2. Limestone Needed		tons
Tons of Limestone Needed	919.45	( ) Based on Dimensions	3. Length at Top of Freeboard		ft
Tons of Limestone Needed	0.00	( ) Based on Kinetics	4. Width at Top of Freeboard		ft
			5. Rate Constant (k)		hr/ft

☐ **Opening Screen Water Parameters**

Influent Water Parameters that Affect MN Removal Bed

Calculated Acidity	0.00	mg/L
Alkalinity	0.00	mg/L

( ) Calculate Net Acidity (Acid-Alkalinity)

(•) Enter Net Acidity manually

Net Acidity (Hot Acidity)	583.00	mg/L
Design Flow	30.00	gpm
Typical Flow	15.00	gpm
Total Iron	0.00	mg/L
Aluminum	0.00	mg/L
Manganese	3.40	mg/L

6. Stone Diameter	1.00	inches
7. Effluent Mn Concentration	5.00	mg/l
8. % Void Space of Limestone Bed	35.00	%
9 Density of Loose Limestone	107.53	lbs/ft3
10. Limestone Unit Cost	12.00	$/ton
11. Limestone Placement Unit Cost	0.00	$/yd3
12. Freeboard Depth	2.00	ft
13. Limestone Depth	1.00	ft
14. Excavation Unit Cost	4.50	$/yd3

15. Slope of Pond Sides: Run 2.0 : Rise 1

Liner Cost

(•) No Liner

( ) Clay Liner

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

( ) Synthetic Liner

18. Synthetic Liner Unit Cost		$/yd2

☐ 19. Clearing and Grubbing?

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

Manganese Removal Bed Sizing Summaries

23. Top Length at Freeboard	192.65	ft
23. Top Width at Freeboard	100.32	ft
25. Freeboard Volume	1,346	yd3
26. Limestone Surface Area	17,048.6	ft2
27. Limestone Volume	611.1	yd3
28. Tons of Limestone	887	tons
29. Excavation Volume	611	yd3
30. Clear and Grub Area	0.0	acres
31. Liner Area	0	ft2
32. Theoretical Retention Time	1.00	days

Manganese Removal Bed Sub-Totals

33. Limestone Cost	10,645	$
34. Limestone Placement Cost	0	$
35. Excavation Cost	2,750	$
36. Liner Cost	0	$
37. Clear and Grub Cost	0	$
38. Total Cost	13,395	$

Record Number 1 of 1