Metals and pH TMDLs for the Cheat River Watershed West Virginia

U.S. Environmental Protection Agency
Region 3
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Date

Decision Rationale
Total Maximum Daily Loads
for Metals and pH for the
Cheat River Watershed
West Virginia

I. Introduction

This document sets forth the Environmental Protection Agency's (EPA) rationale for establishing the Total Maximum Daily Loads (TMDLs) for metals (aluminum, iron, manganese, and zinc) and pH for the Cheat River watershed. The public comment period for the proposed TMDLs began on December 15, 2000, and ended January 31, 2001. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR Part 130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. There is reasonable assurance that the TMDLs can be met.
8. The TMDLs have been subject to public participation

II. Summary

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting designated uses under technology-based controls. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. By following the TMDL process, states can establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (EPA, 1991b).

The West Virginia Division of Environmental Protection (WVDEP) has identified the Cheat River watershed as being impaired by acid mine drainage, as reported on the 1996 section 303(d) list of water quality limited waters (WVDEP, 1996). The 1997 consent decree, established in conjunction with the West Virginia TMDL lawsuit, requires that a minimum of 100 TMDLs for mine drainage impacted waters be established by September 30, 1999. West Virginia and EPA selected the Cheat River watershed as 55 of the required 100 mine impacted waters for TMDLs. However, EPA requested, and the plaintiffs agreed to, an 18-month extension to the due date, or until March 30, 2001.

Table 1. Section 303(d) listed waterbodies and corresponding impairments

Stream Name	Listed Segment ID	Length (mi)	Trout Waters	pH	Al	Fe	Mn	Zn
Unnamed Tributary #1 to Cheat Lake	MC-?	0		X	X	X	X	
Unnamed Tributary #2 to Cheat Lake	MC-?	0		X	X	X	X	
Unnamed Tributary #3 to Cheat Lake	MC-?	0		X	X	X	X	
Crammeys Run, tributary to Cheat Lake	MC-3	1.4			X	X	X	
Bull Run, tributary to Cheat River	MC-11	6.2		X	X	X	X	
Middle Run, tributary to Bull Run	MC-11-A	1.7		X	X	X	X	
Unnamed Tributary #1 to Bull Run	MC-11-.1A	1.4		X	X			
Mountain Run, tributary to Bull Run	MC-11-B	2.4		X	X	X	X	
Lick Run, tributary to Bull Run	MC-11-C	1.5		X	X	X	X	
Unnamed Tributary #2 to Bull Run	MC-11-C-0.1	1.4		X	X	X	X	
Right Fork of Bull Run	MC-11-E	1.8		X	X	X	X	
Big Sandy Creek, tributary to Cheat River	MC-12	19.0		X	X	X	X	
Unnamed Tributary to Big Sandy Creek	MC-12-?	0		X	X	X	X	
Sovern Run, tributary to Big Sandy Creek	MC-12-0.5	14.0		X	X	X	X	
Little Sandy Creek, trib. to Big Sandy Creek	MC-12-B	3.0	X	X	X	X	X	
Webster Run, tributary to Little Sandy Cr	MC-12-B-0.5	7.4		X	X	X	X	
Beaver Creek, tributary to Little Sandy Cr	MC-12-B-1	2.8		X	X	X	X	
Glade Run, tributary to Beaver Creek	MC-12-B-1-A	0	X	X	X	X	X	
Unnamed Tributary #2 to Beaver Creek	MC-12-B-1-?	4.6		X	X	X	X	
Hog Run, tributary to Little Sandy Creek	MC-12-B-3	3.0	X	X	X	X	X	
Cherry Run, tributary to Little Sandy Creek	MC-12-B-5	5.6	X	X	X	X	X	
Hazel Run, tributary to Big Sandy Creek	MC-12-C	4.7		X	X	X	X	
Conner Run, tributary to Cheat River	MC-13.5	2.9	X	X	X	X	X	
Greens Run, tributary to Cheat River	MC-16	8.2		X	X	X	X	
South Fork of Greens Run	MC-16-A	4.3			X	X	X	
Middle Fork of Greens Run	MC-16-A-.1	2.4			X	X	X	
Muddy Creek, tributary to Cheat	MC-17	2.4	X	X	X	X	X	
Martin Creek, tributary to Muddy Creek	MC-17-A	15.6		X	X	X	X	
Fickey Run, tributary to Martin Creek	MC-17-A-0.5	2.6		X	X	X	X	
Glade Run, tributary to Martin Creek	MC-17-A-1	2.8		X	X	X	X	
Unnamed Tributary #1 to Glade Run	MC-17-A-1.1	3.6		X	X	X	X	
Unnamed Tributary #2 to Glade Run	MC-17-A-1.2	1.0		X	X	X	X	
Roaring Creek, tributary to Cheat	MC-18	1.2		X	X	X	X	

Stream Name	Listed Segment ID	Length (mi)	Trout Waters	pH	Al	Fe	Mn	Zn
Morgan Run, tributary to Cheat River	MC-23	9.2		X	X	X	X	
Unnamed Tributary #1 to Morgan Run	MC-23-0.2-A	4.6		X	X		X	
Church Creek, tributary to Morgan Run	MC-23-A	2.3		X	X	X	X	
Left Fork of Unnamed Trib. to Church Cr	MC-23-A-0.1-A	4.0		X	X	X	X	
Right Fork of Unnamed Trib. To Church Cr	MC-23-A-0.1-B	1.8		X	X	X	X	
Heather Run, tributary to Cheat River	MC-24	1.0		X	X	X	X	
Unnamed Tributary #1 to Heather R	MC-24-A	1.8		X	X	X	X	
Lick Run, tributary to Cheat River	MC-25	3.4		X	X	X	X	
Joes Run, tributary to Cheat River	MC-26	1.0			X	X	X	
Pringle Run, tributary to Cheat River	MC-27	4.0		X	X	X	X	
Left Fork of Pringle Run	MC-27-A	2.8		X	X	X	X	
Right Fork of Pringle Run	MC-27-B	4.7		X	X	X	X	
Tub Run, tributary to Blackwater River	MC-60-D-2	4.0		X	X	X	X	
Finley Run, tributary to Blackwater River	MC-60-D-2.7	3.0		X	X	X	X	
North Fork of Blackwater River	MC-60-D-3	2.8		X	X	X	X	
Long Run, tributary to North Fork	MC-60-D-3-A	0.7		X	X	X	X	
Middle Run, tributary to North Fork	MC-60-D-3-B	4.0		X	X	X	X	
Snyder Run, tributary to North Fork	MC-60-D-3-C	3.6		X	X	X	X	
Beaver Creek, tributary to Blackwater River	MC-60-D-5	13.8		X	X	X	X	
Hawkins Run, tributary to Beaver Creek	MC-60-D-5-C	2.8		X	X	X	X	
Lower Blackwater River, trib. to Cheat R.	MC-60-D	13.8	X		X	X		
Cheat River (at Cheat Lake)	MC	20.0		X	X	X	X	X

All WV 303(d) listed stream segment identification numbers end in -1998, not shown in the table.
All segment identification numbers are official WV stream codes for listed stream segments.

Beginning in 1998, Systech Engineering and the electric power industry, Allegheny Power, Electric Power Research Institute (EPRI), and the American Electric Power, approached Region III with a proposal to provide a calibrated watershed model for use in developing TMDLs in the Cheat River watershed, West Virginia. The model to be used was WARMF, Watershed Analysis Risk Management Framework, a proprietary computer program developed by Systech Engineering, Inc., under the sponsorship of EPRI.

Allegheny Power owns and operates Albright Power Station located on, and discharging to, the Cheat River mainstem at Albright, WV. In addition, industrial, municipal, and mining NPDES dischargers to the watershed are Allegheny customers and could be adversely affected by the outcome of the TMDL development.

On March 3, 1999 EPA sent a letter to Richard S. Herd, Allegheny Power, outlining conditions under which Region III might accept the WARMF offer. On March 12, 1999

Allegheny Power and on April 26, 1999 American Electric Power responded to EPA's letter agreeing to EPA's, and the federal government's constraints:

1. The services must be provided with no expectation of future payment,
2. There is no commitment from EPA that WARMF would actually be used in the Cheat River basin or elsewhere for TMDL development,
3. Any actual or potential conflicts of interest must be disclosed,
4. That Systech Engineering would not actually develop load and wasteload allocations for the TMDLs,
5. That EPA is under a time schedule mandated by a Consent Decree, and
6. Several other procedural and technical concerns.

Allegheny Power, EPRI, and Systech Engineering agreed, and Systech Engineering proceeded to develop an engineering module predicting the generation of acid mine drainage (AMD) for WARMF. Concurrently with the AMD module development, Systech Engineering attended public meetings to demonstrate WARMF and seek information outside of the State's files.

EPA, through the Office of Science and Technology, requested peer review of WARMF. EPRI agreed to fund the peer review which was conducted by Arturo Keller, Donald Bren School of Environmental Science & Management, University of California, Santa Barbara, CA. The *Peer Review Report of the Watershed Analysis Risk Management Framework (WARMF) Model*, May 2000, generally concluded that the model was adequate for its intended use to study fate and transport processes at the watershed scale although users needed to be aware of key assumptions, issues with data needs and quality, and the evaluation of the model performance. This peer review was conducted on WARMF prior to the AMD module development. A second peer review was performed on the AMD module. The majority of reviewers felt that WARMF is suitable for addressing AMD in the context of developing TMDLs. The key assumptions and processes considered by the model are adequate for modeling AMD. The main concerns expressed with the framework are common to watershed-scale models; *e.g.*, large-scale averaging of processes and necessary simplification of mathematical formulations to reduce data needs. Other important issues include gaps in model documentation. EPA, Region III, commented that WARMF had a major short coming, the inability to trace the contribution of a particular land use or point source to the instream pollution. The AMD peer review report has not yet been released. In light of EPA's comments, EPRI and Systec Engineering agreed to modify WARMF.

Use of the existing model to develop allocation schemes is cumbersome and requires some simplification of the process. In order to determine the significance of this process, EPA expects to re-visit this TMDL, using a modified WARMF model, in the near future. If this re-analysis results in modified waste load allocations, additional public participation will be conducted.

The *Metals and pH TMDLs for the Cheat River Watershed, West Virginia*, March 2001 (TMDL Report), presents the TMDLs for each of the listed segments in the Cheat River watershed. In order to develop the TMDLs and other pertinent watershed and waterbody information, the watershed was divided into 10 regions (Figure 2). These regions represent hydrologic units. Each region was further divided into subwatersheds (351 total for the entire Cheat River watershed) for modeling purposes. The 10 regions and their respective subwatersheds provide a basis for georeferencing pertinent source information, monitoring data, and presenting TMDLs. This information is presented in Appendices A-1 through A-10 of the TMDL Report. Numeric designation for each Appendix A section corresponds to the same numerically-identified region of the Cheat River watershed (*e.g.*, A-3 corresponds to region 3 of the Cheat River watershed).

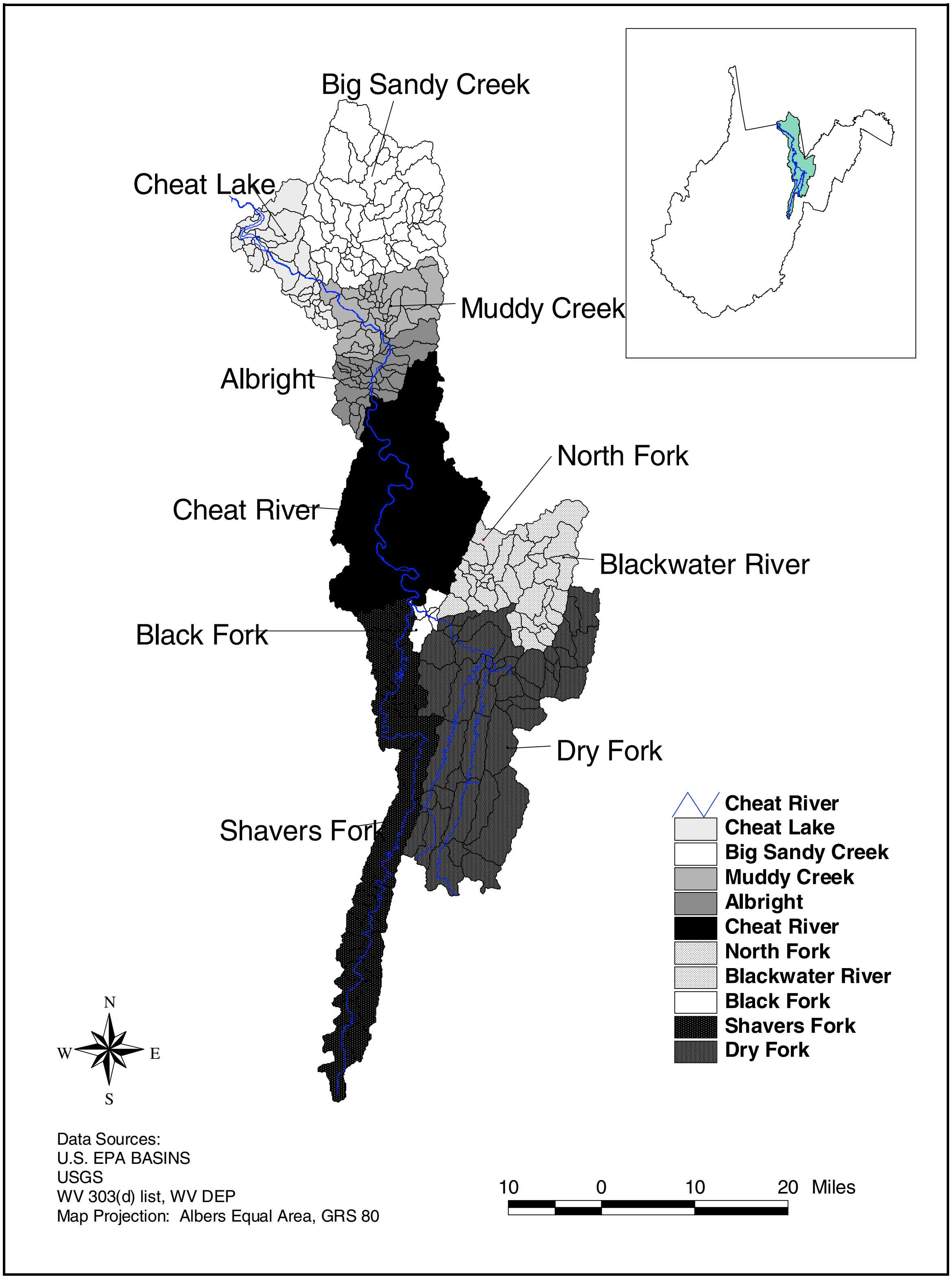

Figure 1. The Cheat River watershed, its 10 major regions, and 351 modeled subwatersheds

Tables 2 through 5 present the TMDLs developed for this report. The WLAs and LAs (Table 6) are presented as annual loads, in terms of pounds per year and as permit discharge concentrations. They are presented on an annual basis (as an average annual load), because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. The values may be converted to daily loads by dividing by 365 days/year, *e.g.,* 2,539 lbs/yr ÷ 365 day/yr = 6.9 lbs/day.

Table 2. TMDLs, load, and waste load allocations for aluminum

Aluminum					
WV Stream Code	**Stream Name**	**TMDL (lbs Al/yr)**	**ΣLAs (lbs Al/yr)**	**ΣWLAs (lbs Al/yr)**	**MOS**
MC-?	Unnamed Trib.# 1 To Cheat River Lake	1,288	169	1,120	Implicit
MC-?	Unnamed Trib.# 2 To Cheat River Lake	725	725	0	Implicit
MC-?	Unnamed Trib.# 3 To Cheat River Lake	280.80	280.80	0.00	Implicit
MC-3	Crammeys Run, Trib. To Cheat Lake	145.60	145.60	0.00	Implicit
MC-11	Bull Run, Trib. To Cheat River	13,606.80	12,664.80	942.00	Implicit
MC-11-A	Middle Run, Trib. To Bull Run	1,400.80	689.60	711.20	Implicit
MC-11-.1A	Unnamed Trib. #1 to Bull Run	1,034.00	1,034.00	0.00	Implicit
MC-11-B	Mountain Run, Trib. To Bull Run	1,170.00	1,170.00	0.00	Implicit
MC-11-C	Lick Run, Trib. To Bull Run	3,124.60	3,124.60	0.00	Implicit
MC-11-C-0.1	Unnamed Trib. #2 to Bull Run	885.10	885.10	0.00	Implicit
MC-11-E	Right Fork of Bull Run	2,175.00	2,175.00	0.00	Implicit
MC-12	Big Sandy Creek, Trib. To Cheat River	100,327.30	72,305.40	28,021.90	Implicit
MC-12-?	Unnamed Trib. To Big Sandy Creek	555.20	55.80	499.40	Implicit
MC-12-0.5	Sovern Run, Trib. To Big Sandy Creek	1,136.20	1,136.20	0.00	Implicit
MC-12-B	Little Sandy Creek, Trib. To Big Sandy Creek	49,037.10	21,514.60	27,522.50	Implicit
MC-12-B-0.5	Webster Run, Trib. To Little Sandy Creek	6,292.60	6,292.60	0.00	Implicit
MC-12-B-1	Beaver Creek, Trib. To Little Sandy Creek	8,690.50	8,690.50	0.00	Implicit
MC-12-B-1-A	Glade Run, Trib. To Little Sandy Creek	573.70	573.70	0.00	Implicit
MC-12-B-1-?	Unnamed Trib.#2 To Beaver Creek	508.60	508.60	0.00	Implicit
MC-12-B-3	Hog Run, Trib. To Little Sandy Creek	1,062.20	1,062.20	0.00	Implicit
MC-12-B-5	Cherry Run, Trib. To Little Sandy Creek	1,690.60	1,690.60	0.00	Implicit
MC-12-C	Hazel Run Trib. To Big Sandy Creek	197.20	197.20	0.00	Implicit
MC-13.5	Conner Run, Trib. To Cheat River	639.10	639.10	0.00	Implicit
MC-16	Greens Run, Trib. To Cheat River	4,445.20	3,965.50	479.70	Implicit
MC-16-A	South Fork of Greens Run	2,399.70	2,399.70	0.00	Implicit
MC-16-A-.1	Middle Fork of Greens Run	638.90	638.90	0.00	Implicit
MC-17	Muddy Creek, Trib. To Cheat	7,531.80	7,147.00	384.80	Implicit
MC-17-A	Martin Creek, Trib. To Muddy Creek	3,967.40	3,582.60	384.80	Implicit
MC-17-A-0.5	Ficky Run, Trib. To Martin Creek	1,322.40	937.60	384.80	Implicit
MC-17-A-1	Glade Run, Trib. To Martin Creek	1,816.40	1,816.40	0.00	Implicit
MC-17-A-1.1	Unnamed Trib. #1 to Glade Run	322.70	322.70	0.00	Implicit
MC-17-A-1.2	Unnamed Trib.#2 To Glade Run	551.50	551.50	0.00	Implicit
MC-18	Roaring Creek, Trib. To Cheat	6,767.40	6,767.40	0.00	Implicit
MC-23	Morgan Run Trib. To Cheat River	4,319.30	4,319.30	0.00	Implicit
MC-23-0.2-A	Unnamed Trib.#1 to Morgan Run	73.90	73.90	0.00	Implicit
MC-23-A	Church Creek, Trib. To Morgan Run	3,122.70	3,122.70	0.00	Implicit
MC-23-A-0.1-A	Left Fk of unnamed Trib. to Church Creek	691.20	691.20	0.00	Implicit
MC-23-A-0.1-B	Right Fork of unnamed Trib. To Church River	404.80	404.80	0.00	Implicit
MC-24	Heather Run, Trib. To Cheat River	1,590.90	1,590.90	0.00	Implicit

Aluminum					
WV Stream Code	**Stream Name**	**TMDL (lbs Al/yr)**	**ΣLAs (lbs Al/yr)**	**ΣWLAs (lbs Al/yr)**	**MOS**
MC-24-A	Unnamed Trib. #1 to Heather Run	23.20	23.20	0.00	Implicit
MC-25	Lick Run, Trib. To Cheat River	4,291.30	4,242.90	48.40	Implicit
MC-26	Joes Run, Trib. To Cheat River	533.30	70.80	462.50	Implicit
MC-27	Pringle Run, Trib. To Cheat River	6,440.80	6,440.80	0.00	Implicit
MC-27-A	Left Fork of Pringle Run	2,063.10	2,063.10	0.00	Implicit
MC-27-B	Right Fork of Pringle Run	1,046.10	1,046.10	0.00	Implicit
MC-60-D-2	Tub Run, tributary to Blackwater River	398.30	398.30	0.00	Implicit
MC-60-D-2.7	Finley Run, tributary to Blackwater River	217.30	217.30	0.00	Implicit
MC-60-D	Lower Blackwater River trib. To Cheat River	46,140.30	23,119.70	23,020.60	Implicit
MC-60-D-3	North Fork of Blackwater River	5,600.50	4,686.80	913.70	Implicit
MC-60-D-3-A	Long Run, tributary to North Fork	804.70	422.30	382.40	Implicit
MC-60-D-3-B	Middle Run, tributary to North Fork	107.80	107.80	0.00	Implicit
MC-60-D-3-C	Snyder Run, tributary to North Fork	658.20	126.80	531.40	Implicit
MC	Cheat River from Pringle Run to Cheat Lake	277,222.40	211,897.60	65,324.80	Implicit

Table 3. TMDLs, load, and waste load allocations for iron

Iron					
WV Stream Code	**Stream Name**	**TMDLS (lbs Fe/yr)**	**ΣLAs (lbs Fe/yr)**	**ΣWLAs (lbs Fe/yr)**	**MOS**
MC-?	Unnamed Trib.# 1 To Cheat River Lake	2,355	644	1,710	Implicit
MC-?	Unnamed Trib.# 2 To Cheat River Lake	1,436	1,436	0	Implicit
MC-?	Unnamed Trib.# 3 To Cheat River Lake	554	554	0	Implicit
MC-3	Crammeys Run, Trib. To Cheat Lake	85	85	0	Implicit
MC-11	Bull Run, Trib. To Cheat River	23,886	22,002	1,884	Implicit
MC-11-A	Middle Run, Trib. To Bull Run	2,792	1,370	1,423	Implicit
MC-11-.1A	Unnamed Trib. #1 to Bull Run	1,965	1,965	0	Implicit
MC-11-B	Mountain Run, Trib. To Bull Run	1,828	1,828	0	Implicit
MC-11-C	Lick Run, Trib. To Bull Run	3,570	3,570	0	Implicit
MC-11-C-0.1	Unnamed Trib. #2 to Bull Run	2,155	2,155	0	Implicit
MC-11-E	Right Fork of Bull Run	4,045	4,045	0	Implicit
MC-12	Big Sandy Creek, Trib. To Cheat River	177,255	173,191	4,064	Implicit
MC-12-?	Unnamed Trib. To Big Sandy Creek	681	65	615	Implicit
MC-12-0.5	Sovern Run, Trib. To Big Sandy Creek	788	788	0	Implicit
MC-12-B	Little Sandy Creek, Trib. To Big Sandy Creek	59,265	55,816	3,449	Implicit
MC-12-B-0.5	Webster Run, Trib. To Little Sandy Creek	34,287	34,287	0	Implicit
MC-12-B-1	Beaver Creek, Trib. To Little Sandy Creek	17,985	17,985	0	Implicit
MC-12-B-1-A	Glade Run, Trib. To Little Sandy Creek	263	263	0	Implicit
MC-12-B-1-?	Unnamed Trib.#2 To Beaver Creek	2,414	2,414	0	Implicit
MC-12-B-3	Hog Run, Trib. To Little Sandy Creek	1,207	1,207	0	Implicit
MC-12-B-5	Cherry Run, Trib. To Little Sandy Creek	604	604	0	Implicit
MC-12-C	Hazel Run Trib. To Big Sandy Creek	231	231	0	Implicit
MC-13.5	Conner Run, Trib. To Cheat River	451	451	0	Implicit
MC-16	Greens Run, Trib. To Cheat River	10,594	9,634	959	Implicit
MC-16-A	South Fork of Greens Run	5,693	5,693	0	Implicit
MC-17-A	Martin Creek, Trib. To Muddy Creek	8,759	7,990	770	Implicit
MC-17-A-0.5	Ficky Run, Trib. To Martin Creek	2,632	1,862	770	Implicit
MC-17-A-1	Glade Run, Trib. To Martin Creek	4,494	4,494	0	Implicit

Iron					
WV Stream Code	Stream Name	TMDLS (lbs Fe/yr)	ΣLAs (lbs Fe/yr)	ΣWLAs (lbs Fe/yr)	MOS
MC-17-A-1.1	Unnamed Trib. #1 to Glade Run	641	641	0	Implicit
MC-17-A-1.2	Unnamed Trib.#2 To Glade Run	1,096	1,096	0	Implicit
MC-18	Roaring Creek, Trib. To Cheat	6,623	6,623	0	Implicit
MC-23	Morgan Run Trib. To Cheat River	10,541	10,541	0	Implicit
MC-23-0.2-A	Unnamed Trib.#1 to Morgan Run	126	126	0	Implicit
MC-23-A	Church Creek, Trib. To Morgan Run	8,201	8,201	0	Implicit
MC-23-A-0.1-A	Left Fork of unnamed Trib. To Church Creek	2,458	2,458	0	Implicit
MC-23-A-0.1-B	Right Fork of unnamed Trib. To Church River	1,717	1,717	0	Implicit
MC-24	Heather Run, Trib. To Cheat River	2,822	2,822	0	Implicit
MC-24-A	Unnamed Trib. #1 to Heather Run	104	104	0	Implicit
MC-25	Lick Run, Trib. To Cheat River	8,876	8,840	36	Implicit
MC-26	Joes Run, Trib. To Cheat River	1,008	83	925	Implicit
MC-27	Pringle Run, Trib. To Cheat River	13,594	13,594	0	Implicit
MC-27-A	Left Fork of Pringle Run	4,098	4,098	0	Implicit
MC-27-B	Right Fork of Pringle Run	2,929	2,929	0	Implicit
MC-60-D-2	Tub Run, tributary to Blackwater River	154	154	0	Implicit
MC-60-D-2.7	Finley Run, tributary to Blackwater River	543	543	0	Implicit
MC-60-D-5	Beaver Creek, tributary to Blackwater River	6,626	2,265	4,362	Implicit
MC-60-D-5-C	Hawkins Run, tributary to Beaver Creek	1,030	1,030	0	Implicit
MC-60-D	Lower Blackwater River trib. To Cheat River	46,551	28,431	18,120	Implicit
MC-60-D-3	North Fork of Blackwater River	9,865	8,191	1,675	Implicit
MC-60-D-3-A	Long Run, tributary to North Fork	1,368	794	574	Implicit
MC-60-D-3-B	Middle Run, tributary to North Fork	81	81	0	Implicit
MC-60-D-3-C	Snyder Run, tributary to North Fork	4,192	3,091	1,101	Implicit
MC	Cheat River from Pringle Run to Cheat Lake	696,675	613,697	82,978	Implicit

Table 4. TMDLs, load, and waste load allocations for manganese

Manganese					
WV Stream Code	Stream Name	TMDLs (lbs Mn/yr)	ΣLAs (lbs Mn/yr)	ΣWLAs (lbs Mn/yr)	MOS
MC-?	Unnamed Trib.# 1 To Cheat River Lake	1,875	806	1,069	Implicit
MC-?	Unnamed Trib.# 2 To Cheat River Lake	1,011	1,011	0	Implicit
MC-?	Unnamed Trib.# 3 To Cheat River Lake	394	394	0	Implicit
MC-3	Crammeys Run, Trib. To Cheat Lake	363	363	0	Implicit
MC-11	Bull Run, Trib. To Cheat River	19,229	17,973	1,256	Implicit
MC-11-A	Middle Run, Trib. To Bull Run	1,865	916	948	Implicit
MC-11-.1A	Unnamed Trib. #1 to Bull Run	1,357	1,357	0	Implicit
MC-11-B	Mountain Run, Trib. To Bull Run	1,761	1,761	0	Implicit
MC-11-C	Lick Run, Trib. To Bull Run	4,324	4,324	0	Implicit
MC-11-C-0.1	Unnamed Trib. #2 to Bull Run	1,523	1,523	0	Implicit
MC-11-E	Right Fork of Bull Run	3,344	3,344	0	Implicit
MC-12	Big Sandy Creek, Trib. To Cheat River	80,691	66,075	14,616	Implicit
MC-12-?	Unnamed Trib. To Big Sandy Creek	1,127	307	820	Implicit
MC-12-0.5	Sovern Run, Trib. To Big Sandy Creek	5,580	5,580	0	Implicit
MC-12-B	Little Sandy Creek, Trib. To Big Sandy Creek	44,032	30,236	13,796	Implicit

Manganese					
WV Stream Code	Stream Name	TMDLs (lbs Mn/yr)	ΣLAs (lbs Mn/yr)	ΣWLAs (lbs Mn/yr)	MOS
MC-12-B-0.5	Webster Run, Trib. To Little Sandy Creek	7,714	7,714	0	Implicit
MC-12-B-1	Beaver Creek, Trib. To Little Sandy Creek	11,283	11,283	0	Implicit
MC-12-B-1-A	Glade Run, Trib. To Little Sandy Creek	1,679	1,679	0	Implicit
MC-12-B-1-?	Unnamed Trib.#2 To Beaver Creek	1,392	1,392	0	Implicit
MC-12-B-3	Hog Run, Trib. To Little Sandy Creek	2,824	2,824	0	Implicit
MC-12-B-5	Cherry Run, Trib. To Little Sandy Creek	2,742	2,742	0	Implicit
MC-12-C	Hazel Run Trib. To Big Sandy Creek	1,520	1,520	0	Implicit
MC-13.5	Conner Run, Trib. To Cheat River	2,856	2,856	0	Implicit
MC-16	Greens Run, Trib. To Cheat River	5,957	5,318	640	Implicit
MC-16-A	South Fork of Greens Run	3,229	3,229	0	Implicit
MC-16-A-.1	Middle Fork of Greens Run	889	889	0	Implicit
MC-17	Muddy Creek, Trib. To Cheat	10,338	9,825	513	Implicit
MC-17-A	Martin Creek, Trib. To Muddy Creek	5,724	5,211	513	Implicit
MC-17-A-0.5	Ficky Run, Trib. To Martin Creek	1,759	1,246	513	Implicit
MC-17-A-1	Glade Run, Trib. To Martin Creek	2,869	2,869	0	Implicit
MC-17-A-1.1	Unnamed Trib. #1 to Glade Run	429	429	0	Implicit
MC-17-A-1.2	Unnamed Trib.#2 To Glade Run	733	733	0	Implicit
MC-18	Roaring Creek, Trib. To Cheat	5,585	5,585	0	Implicit
MC-23	Morgan Run Trib. To Cheat River	6,303	6,303	0	Implicit
MC-23-0.2-A	Unnamed Trib.#1 to Morgan Run	492	492	0	Implicit
MC-23-A	Church Creek, Trib. To Morgan Run	4,325	4,325	0	Implicit
MC-23-A-0.1-A	Left Fork of unnamed Trib. To Church Creek	1,108	1,108	0	Implicit
MC-23-A-0.1-B	Right Fork of unnamed Trib. To Church River	524	524	0	Implicit
MC-24	Heather Run, Trib. To Cheat River	2,084	2,084	0	Implicit
MC-24-A	Unnamed Trib. #1 to Heather Run	61	61	0	Implicit
MC-25	Lick Run, Trib. To Cheat River	6,494	6,471	23	Implicit
MC-26	Joes Run, Trib. To Cheat River	692	75	617	Implicit
MC-27	Pringle Run, Trib. To Cheat River	8,721	8,721	0	Implicit
MC-27-A	Left Fork of Pringle Run	2,741	2,741	0	Implicit
MC-27-B	Right Fork of Pringle Run	1,569	1,569	0	Implicit
MC-60-D-2	Tub Run, tributary to Blackwater River	931	931	0	Implicit
MC-60-D-5-C	Hawkins Run, tributary to Beaver Creek	751	751	0	Implicit
MC-60-D	Lower Blackwater River trib. To Cheat River	62,290	48,317	13,973	Implicit
MC-60-D-3	North Fork of Blackwater River	6,297	5,227	1,071	Implicit
MC-60-D-3-A	Long Run, tributary to North Fork	1,185	803	382	Implicit
MC-60-D-3-B	Middle Run, tributary to North Fork	208	208	0	Implicit
MC-60-D-3-C	Snyder Run, tributary to North Fork	2,929	2,241	688	Implicit
MC	Cheat River from Pringle Run to Cheat Lake	729,538	662,796	66,743	Implicit

Table 5. TMDLs, load, and waste load allocations fo zinc

Zinc					
WV Stream Code	Stream Name	TMDLs (lbs Zn/yr)	ΣLAs (lbs Zn/yr)	ΣWLAs (lbs Al/yr)	MOS
MC	Cheat River from Pringle Run to Cheat Lake	102,804	102,804	0	Implicit

Table 6. Allocation for permitted point sources

		Aluminum		Iron		Manganese	
Watershed ID	PERMIT ID	WLA (lbs Al/yr)	Concentration (mg Al/L)	WLA (lbs Fe/yr)	Concentration (mg Fe/L)	WLA (lbs Mn/yr)	Concentration (mg Mn/L)
699	h000463	71.1	1.1	154.8	1.5	189.9	1.8
699	h000499	19.4	1.1	42.2	1.5	51.8	1.8
662	o004583	56.8	4.3	44.7	3.2	34.5	2
699	o009783	652.6	1.1	1505.3	3.2	1160.8	2
662	o009783	1912.4	4.3	1421.4	1.5	1743.5	1.8
662	o200695	530.2	4.3	417.3	3.2	321.8	2
314	p102298	48.4	4.3	36.0	3.2	22.5	2
662	p200499	0.0	4.3	0.0	3.2	0.0	2
699	p200499	0.0	1.1	0.0	1.5	0.0	1.8
662	p200500	0.0	4.3	0.0	3.2	0.0	2
699	p200500	0.0	1.1	0.0	1.5	0.0	1.8
662	q002574	1401.2	4.3	1102.9	3.2	850.5	2
678	q002574	382.5	1	898.3	1.5	574.2	1
677	q002574	490.1	0.75	573.7	1.5	382.5	1
264	r067300	359.0	0.75	328.2	0.5	218.8	1
1052	r067300	164.1	0.75	718.1	1.5	478.7	1
263	r067300	359.0	0.75	718.1	1.5	478.7	1
662	s000780	7384.6	4.3	5812.4	3.2	4482.3	2
134	s000981	6827.6	0.75	990.3	1.5	3561.2	1
97	s000981	9026.2	3.9	1131.1	0.5	4524.4	2
318	s001483	462.6	0.75	925.2	1.5	616.8	1
662	s006185	1325.4	4.3	1043.3	3.2	804.5	2
662	s007379	662.7	4.3	521.6	3.2	402.3	2
662	s007476	2556.2	4.3	2012.0	3.2	1551.6	2
662	s014677	1382.2	4.3	1088.0	3.2	839.0	2
97	s014879	9026.2	3.9	990.3	1.5	3561.2	1
134	s014879	6827.6	0.75	1131.1	0.5	4524.4	2
134	s100188	1358.0	0.75	197.0	1.5	708.3	1
1052	s100299	39.0	0.75	77.9	0.5	51.9	1
396	s100393	93.1	0.75	186.2	1.5	124.1	1
134	s100488	1697.5	0.75	246.2	1.5	885.4	1
135	s100595	499.5	1.2	601.8	1.5	2164.3	1
134	s100595	4149.4	0.75	615.4	1.5	820.5	2
1052	s100989	70.8	0.75	141.7	0.5	94.4	1
396	s101389	386.7	0.75	773.3	1.5	515.6	1
1052	s101588	99.2	0.75	198.3	0.5	132.2	1
57	s102887	711.4	0.75	1422.7	1.5	948.5	1
56	s102887	942.2	0.75	1884.4	1.5	1256.2	1
699	s200398	239.1	1.05	520.7	1.5	638.7	1.8
677	s200595	423.8	0.75	953.8	3.2	735.6	2
682	s200595	531.5	1.5	776.9	1.5	496.6	1
662	s200595	1211.8	4.3	1101.5	3.2	688.4	2
662	s200796	189.3	4.3	149.0	3.2	114.9	2
662	s201888	1742.0	4.3	1371.1	3.2	1057.4	2
699	s201888	594.5	1.1	1294.7	1.5	1588.2	1.8
662	s201892	340.8	4.3	268.3	3.2	206.9	2
662	s202392	1079.3	4.3	849.5	3.2	655.1	2
662	u003885	1249.7	4.3	983.6	3.2	758.5	2
699	u003885	426.5	1.1	928.8	1.5	1139.3	1.8

263	u051900	25.8	0.75	23.6	0.5	15.7	1
264	u051900	25.8	0.75	51.7	1.5	34.4	1
1052	u051900	11.8	0.75	51.7	1.5	34.4	1
134	z000781	7167.1	0.75	1039.5	1.5	3738.3	1
97	z000781	9475.1	3.9	1187.3	0.5	4749.4	2
28	z001881	1120.0	2.1	1710.6	3.2	1069.1	2

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to modeling as pH. While stream flow and the metals may be modeled, including instream processes, compliance with the pH is assumed when the metals are at or below their water quality standard. This was demonstrated by the use of MINTEQA2, a geochemical equilibrium speciation model.

While EPA developed these TMDLs, the WVDEP played an integral role in their development. A majority of permit-specific information was obtained from State files. The Office of Water Resources and Office of Mining and Reclamation developed policies regarding waste load allocations, including future growth.

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and uncertainty in the margin of safety. It is possible that, in the future, conditions and/or available data may change, or the understanding of the natural processes may change, sometimes in ways not accounted for by the margin of safety. The option is always available to modify or refine the TMDL based on new information. EPA is aware that WVDEP's plan for achieving a comprehensive, statewide watershed assessment which was developed and implemented 1996. After completion of the initial assessments, WVDEP's long-range goal is to reassess all waters on a five-year cycle. The TMDL should not be modified at the expense of achieving water quality standards expeditiously. Nevertheless, the TMDL may be modified when modification is warranted by new information, subject to an appropriate public participation process and EPA's approval.

In addition, EPA intends to review the TMDLs and allocations when the revised WARMF is available.

III. Background

The Cheat River is located in northeastern West Virginia. The drainage area is approximately 1,420 square miles and the main stem is approximately 162 miles long. The headwaters of the Cheat River (Shavers Fork, Glady Fork and Laurel Fork) begin in Pocahontas and Randolph counties. The main stem of the Cheat River flows north from the confluence of Shavers Fork and Black Fork and discharges into Cheat Lake, near Morgantown, WV. From Cheat Lake, the water flows to the Monongahela River in Pennsylvania.

The mainstem Cheat River, together with 54 waterbodies within the watershed, were placed on the State of West Virginia's 1996 section 303(d) list of water quality impaired waterbodies resulting from aluminum, iron, manganese, zinc, and/or pH from abandoned mine discharges. Water quality data, and visual observations, show that the metal concentrations

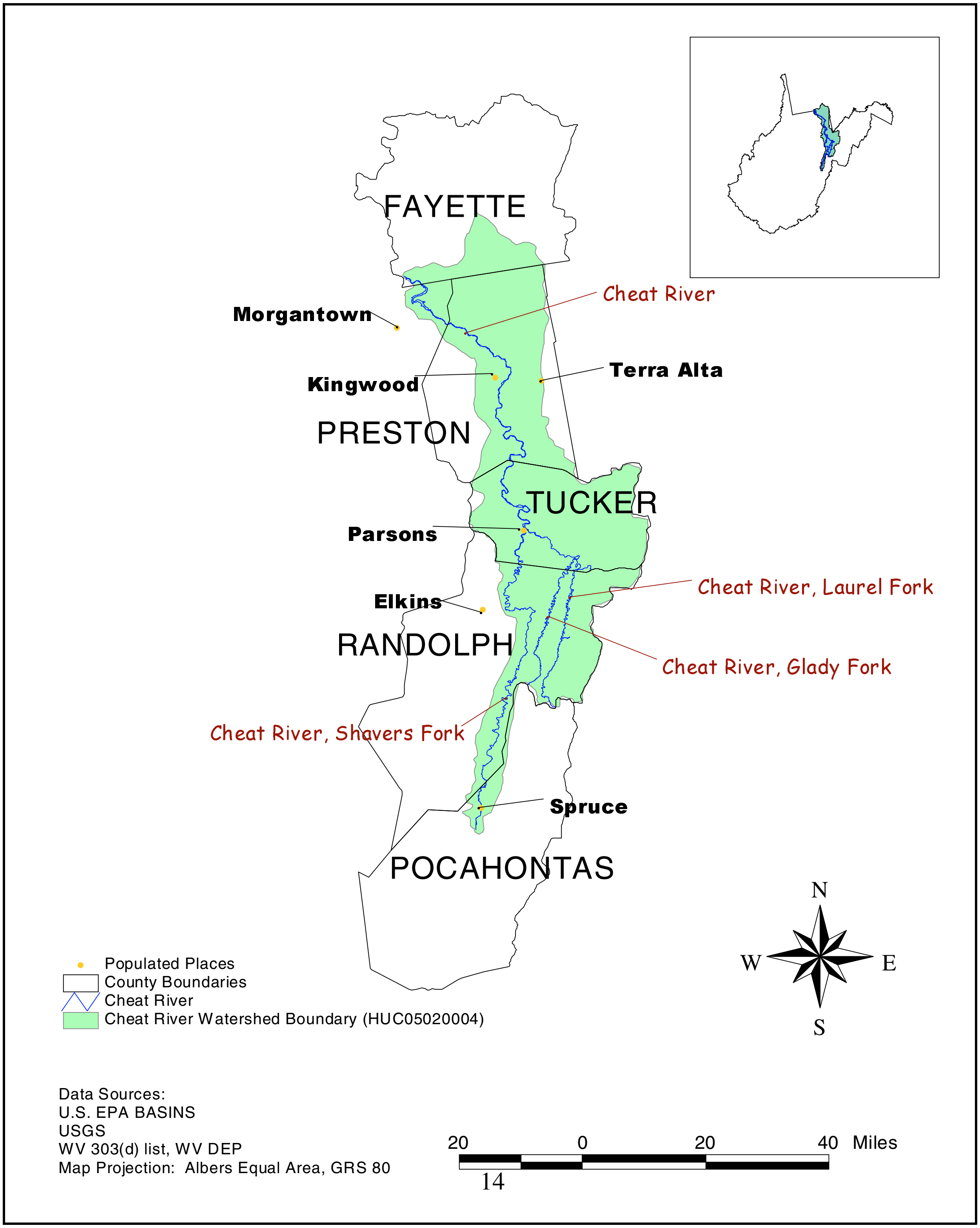

Figure 2. Location of the Cheat River watershed

exceed the State's standards and that pH is below the State's standards. The watershed is dominated by forest and agricultural lands and common practices include coal mining, timber harvesting, recreational development, and agricultural activities. Many of the counties in the watershed contain active surface and deep mining operations. The majority of coal fields in the watershed contain abandoned coal mines, especially in the northern counties (Preston, Monongalia and Tucker). The watershed's population is widely distributed throughout small towns and rural unincorporated communities. The largest communities (less than 5,000 residents) in the watershed are Parsons and Kingwood (Chen and Herr, 2000).

On December 15, 2000, a public notice was published in the following papers; *Preston Co. News, Parsons Advocate, Dominion Post, Inter-Mountain, Mountain Statesman, Barbour Democrat*, and *Record Delta* newspapers and posted the notice, together with the draft TMDLs, on the EPA Region III TMDL web page. The draft TMDLs were revised in *Metals and pH TMDLs for the Cheat River Watershed, West Virginia,* March 2001 (TMDL Report).

Technical Approach

Deep coal mining may result in extensive underground tunnel systems in which, after the mine workings have been abandoned, the tunnels often collapse, fill up with water, and some discharge to the surface. Discharges from abandoned mine lands include tunnel discharges, seeps, and surface runoff.

Acid mine drainage (AMD) occurs when surface and subsurface water percolates through coal bearing minerals containing high concentrations of pyrite and, less commonly, marcasite, which are crystalline forms of iron sulfide (FeS_2). It is these chemical reactions of the pyrite which generate[1] acidity in water. A synopsis of these reactions is as follows: Exposure of pyrite to air and water causes the oxidation of pyrite. The sulfur component of pyrite is oxidized releasing dissolved ferrous (Fe^{2+}) ions and also hydrogen (H^+) ions. It is these H^+ ions which cause the acidity. The intermediate reaction with the dissolved Fe^{2+} ions generates a precipitate, ferric hydroxide [$Fe(OH)_3$], and also releases more H^+ ions, thereby causing more acidity. Another reaction is one between the pyrite and generated ferric (Fe^{3+}) ions, in which more acidity (H^+) is released as well as Fe^{2+} ions, which then can enter the reaction cycle (Stumm and Morgan, 1996).

Establishing the relationship between the instream water quality targets and source loadings is a critical component of TMDL development. It allows for evaluation of management options that will achieve the desired source load reductions. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. Currently, there is no widely used model for AMD TMDLs.

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[1]If the carbonate rock overlies the coal, alkaline mine discharge can be generated.

WARMF was used to develop TMDLs for the Cheat watershed. WARMF is a decision support system designed for a watershed approach to TMDL calculation (Herr et al., 2000, Systech, 1998). The system consists of engineering, data, consensus, TMDL, and knowledge modules integrated into a Windows-based graphical user interface (GUI).

WARMF contains catchment, river, and reservoir models that use meteorology, air quality, managed flow, observed hydrology and water quality, land use, and point source data to support TMDL development on a subwatershed basis. Refer to *Users' Guide to WARMF* (Herr et al., 2000) for a more detailed discussion of simulated processes and model parameters.

Adaptation of WARMF to Calculate TMDLs for the Acid Mine Impaired Cheat River, West Virginia (Chen and Herr, 2000) describes the modeling approach for the Cheat watershed in detail. Configuration of WARMF involved the subdivision of the Cheat watershed into modeling units and continuous simulation of flow and water quality for these units using meteorological, land use, stream, mining, and pollutant-specific data. Pollutants that were simulated include metals, dissolved and suspended solids, carbon, nutrients, fecal coliform, dissolved oxygen, alkalinity, and pH.

After the model was configured, calibration was performed at multiple locations throughout the Cheat watershed. Calibration refers to the adjustment or fine-tuning of modeling parameters to reproduce observations. Model calibration focused on two main areas: hydrology and water quality. Model calibration is also described in the report *Adaptation of WARMF to Calculate TMDLs for the Acid Mine Impaired Cheat River, West Virginia* (Chen and Herr, 2000).

Nonpoint Sources

In addition to the pH and metals generated by water percolated through coal bearing rocks, the lower mainstem of the Cheat River (Pringle Run to Cheat Lake) is impaired due to high zinc concentrations. Instream water quality data from EPA's STORET database were analyzed to characterize potential sources of zinc within the entire Cheat watershed. Upstream of undisturbed areas or abandoned mine lands (AMLs) were shown to have low instream zinc concentrations. However, higher instream zinc concentrations were observed adjacent to or downstream of mining areas or AMLs. Assuming that zinc behaves like other divalent metals (*e.g*. iron(II), aluminum, manganese, etc.), this increase in concentration could indicate that active mining activities and AMLs, influence instream zinc concentrations in the Cheat watershed.

WARMF used land use data compiled from EPA's BASINS database and mining maps for deep mines and their drainage points provided by the State. The BASINS number of land use classifications were reduced by combining some classifications according to Table 6 which applied to the subwatersheds as shown in Table 7. The following table summarizes land use in the Cheat River watershed.

Table 7. WARMF land use categories

Reclassified Land Use	BASINS (GIRAS) Land Use
Deciduous Forest	Orchards, Groves, Vineyards and Nurseries
	Deciduous Forest Lands
	Forested Wetlands
Mixed Forest	Mixed Forest Land
Coniferous Forest	Coniferous Forest Land
Grassland/Pasture	Cropland and Pasture
	Other Agricultural Land
	Shrub and Brush Rangeland
Marsh	Non Forested Wetlands
Strip Mines	Strip Mines, Quarries and Gravel Pits
Barren	Confined Feeding Operations
	Transitional Areas
Residential	Residential
Commercial/Industrial	Commercial Services
	Industrial
	Transportation, Communications
	Industrial and Commercial
	Mixed Urban or Built-Up Land
	Other Urban or Built-Up Land

Table 8. Land use distribution and contributing area for each impaired stream

No.	Name	Area (mi^2)	Decid.	Mixed	Conif.	Past.	Marsh	Mines	Barr.	Resid.	Com.
1	Unnamed Tributary #1 to Cheat Lake	1.55	77.3%	0.0%	0.0%	3.1%	0.0%	5.5%	0.0%	14.2%	0.0%
2	Unnamed Tributary #2 to Cheat Lake	0.82	69.4%	0.0%	0.0%	13.5%	0.0%	17.1%	0.0%	0.0%	0.0%
3	Unnamed Tributary #3 to Cheat Lake	0.46	61.5%	0.0%	0.0%	22.6%	0.0%	15.9%	0.0%	0.0%	0.0%
4	Crammeys Run, tributary to Cheat Lake	1.34	64.1%	0.0%	0.0%	35.3%	0.0%	0.6%	0.0%	0.0%	0.0%
5	Bull Run, tributary to Cheat River	11.22	65.9%	1.7%	0.0%	22.6%	0.0%	8.7%	1.0%	0.0%	0.0%
6	Middle Run, tributary to Bull Run	0.88	79.6%	0.0%	0.0%	1.1%	0.0%	19.2%	0.0%	0.0%	0.0%
7	Unnamed Tributary #1 to Bull Run	0.83	98.2%	0.0%	0.0%	0.0%	0.0%	1.8%	0.0%	0.0%	0.0%
8	Mountain Run, tributary to Bull Run	1.37	67.5%	0.0%	0.0%	32.5%	0.0%	0.0%	0.0%	0.0%	0.0%
9	Lick Run, tributary to Bull Run	1.28	39.9%	0.0%	0.0%	54.2%	0.0%	5.9%	0.0%	0.0%	0.0%
10	Unnamed Tributary #2 to Bull Run	1.05	70.0%	0.0%	0.0%	20.9%	0.0%	9.1%	0.0%	0.0%	0.0%
11	Right Fork of Bull Run	1.51	53.2%	0.0%	0.0%	19.7%	0.0%	19.5%	7.6%	0.0%	0.0%
12	Big Sandy Creek, tributary to Cheat River	206.27	57.0%	12.0%	3.6%	25.2%	0.0%	1.3%	0.5%	0.1%	0.3%
13	Unnamed Tributary to Big Sandy Creek	1.82	78.6%	0.8%	0.0%	7.1%	0.0%	11.9%	0.0%	0.0%	1.5%
14	Sovern Run, tributary to Big Sandy Creek	5.35	44.3%	9.0%	0.0%	42.0%	0.0%	4.6%	0.0%	0.0%	0.0%
15	Little Sandy Creek, trib. to Big Sandy Ck	52.96	33.1%	24.0%	0.5%	37.7%	0.0%	2.7%	1.4%	0.0%	0.6%
16	Webster Run, tributary to Little Sandy Ck	4.19	55.5%	3.0%	0.0%	34.9%	0.0%	6.6%	0.0%	0.0%	0.0%
17	Beaver Creek, tributary to Little Sandy Ck	12.6	25.0%	30.6%	0.9%	40.1%	0.0%	1.1%	1.9%	0.0%	0.4%
18	Glade Run, tributary to Beaver Creek	2.44	40.2%	0.0%	0.0%	59.8%	0.0%	0.0%	0.0%	0.0%	0.0%
19	Unnamed Tributary #2 to Beaver Creek	1.25	39.6%	0.0%	0.0%	57.2%	0.0%	3.2%	0.0%	0.0%	0.0%
20	Hog Run, tributary to Little Sandy Creek	3.91	48.3%	4.5%	0.0%	40.7%	0.0%	5.9%	0.1%	0.4%	0.0%
21	Cherry Run, tributary to Little Sandy Ck	4.33	47.6%	20.4%	0.0%	27.9%	0.0%	4.0%	0.0%	0.0%	0.0%
22	Hazel Run, tributary to Big Sandy Creek	6.22	25.2%	34.9%	0.2%	38.6%	0.0%	0.8%	0.4%	0.0%	0.0%
23	Conner Run, tributary to Cheat River	2.46	48.5%	8.2%	0.0%	35.6%	0.0%	7.7%	0.0%	0.0%	0.0%
24	Greens Run, tributary to Cheat River	11.5	67.6%	0.0%	0.0%	23.5%	0.0%	3.9%	0.4%	3.7%	1.0%
25	South Fork of Greens Run	3.74	69.9%	0.0%	0.0%	14.8%	0.0%	2.4%	0.0%	9.9%	3.0%
26	Middle Fork of Greens Run	1.43	78.2%	0.0%	0.0%	15.6%	0.0%	6.2%	0.0%	0.0%	0.0%
27	Muddy Creek, tributary to Cheat River	33.48	34.6%	28.6%	0.5%	31.0%	0.0%	4.9%	0.2%	0.0%	0.1%
28	Martin Creek, tributary to Muddy Creek	7.24	46.6%	0.0%	0.0%	39.4%	0.0%	13.2%	0.0%	0.2%	0.6%
29	Fickey Run, tributary to Martin Creek	1.68	49.9%	0.0%	0.0%	33.6%	0.0%	16.5%	0.0%	0.0%	0.0%

No.	Name	Area (mi^2)	Decid.	Mixed	Conif.	Past.	Marsh	Mines	Barr.	Resid.	Com.
30	Glade Run, tributary to Martin Creek	3.75	33.9%	0.0%	0.0%	49.5%	0.0%	15.1%	0.0%	0.3%	1.2%
31	Unnamed Tributary #1 to Glade Run	0.46	49.0%	0.0%	0.0%	34.2%	0.0%	16.8%	0.0%	0.0%	0.0%
32	Unnamed Tributary #2 to Glade Run	0.83	32.4%	0.0%	0.0%	46.2%	0.0%	21.4%	0.0%	0.0%	0.0%
33	Roaring Creek, tributary to Cheat River	15.12	62.9%	9.7%	0.8%	21.4%	0.0%	5.0%	0.0%	0.1%	0.0%
34	Morgan Run, tributary to Cheat River	7.98	71.2%	0.0%	0.0%	15.3%	0.0%	8.8%	0.0%	3.1%	1.6%
35	Unnamed Tributary #1 to Morgan Run	1.81	58.6%	0.0%	0.0%	24.6%	0.0%	0.0%	0.0%	9.7%	7.0%
36	Church Creek, tributary to Morgan Run	3.32	76.9%	0.0%	0.0%	10.7%	0.0%	11.1%	0.0%	1.3%	0.0%
37	Left Fork of Unnamed Trib. to Church Ck	0.23	96.5%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	0.0%	0.0%
38	Rt. Fork of Unnamed Trib. to Church Ck	0.63	71.1%	0.0%	0.0%	9.1%	0.0%	19.8%	0.0%	0.0%	0.0%
39	Heather Run, tributary to Cheat River	2.21	78.1%	0.0%	0.0%	16.7%	0.0%	3.8%	0.0%	1.3%	0.0%
40	Unnamed Tributary #1 to Heather Run	0.5	64.0%	0.0%	0.0%	27.0%	0.0%	9.0%	0.0%	0.0%	0.0%
41	Lick Run, tributary to Cheat River	4.93	85.7%	0.0%	0.0%	12.8%	0.0%	0.9%	0.0%	0.6%	0.0%
42	Joes Run, tributary to Cheat River	2.45	94.0%	0.0%	0.0%	0.6%	0.0%	5.5%	0.0%	0.0%	0.0%
43	Pringle Run, tributary to Cheat River	9.57	85.5%	0.0%	0.5%	5.4%	0.0%	6.2%	0.0%	2.2%	0.2%
44	Left Fork of Pringle Run	1.59	92.6%	0.0%	0.0%	2.9%	0.0%	4.5%	0.0%	0.0%	0.0%
45	Right Fork of Pringle Run	3.51	80.3%	0.0%	1.5%	6.0%	0.0%	5.7%	0.0%	6.0%	0.5%
46	Tub Run, tributary to Blackwater River	1.95	0.0%	92.3%	0.0%	0.0%	0.0%	7.7%	0.0%	0.0%	0.0%
47	Finley Run, tributary to Blackwater River	0.28	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
48	North Fork of Blackwater River	18.13	32.6%	57.3%	0.3%	1.7%	0.0%	6.5%	0.0%	1.0%	0.6%
49	Long Run, tributary to North Fork	2.48	0.0%	94.1%	0.0%	0.0%	0.0%	5.9%	0.0%	0.0%	0.0%
50	Middle Run, tributary to North Fork	0.88	0.0%	91.8%	0.0%	0.0%	0.0%	8.2%	0.0%	0.0%	0.0%
51	Snyder Run, tributary to North Fork	4.74	10.5%	79.8%	0.0%	0.0%	0.0%	9.7%	0.0%	0.0%	0.0%
52	Beaver Creek, trib. to Blackwater River	22.39	69.5%	14.9%	4.2%	0.0%	0.0%	10.0%	1.3%	0.1%	0.1%
53	Hawkins Run, tributary to Beaver Creek	1.89	89.3%	0.0%	0.0%	0.0%	0.0%	10.7%	0.0%	0.0%	0.0%
54	Lower Blackwater River, trib. to Cheat R.	136.9	50.2%	32.0%	1.0%	5.6%	6.6%	3.5%	0.2%	0.1%	0.6%
55	Cheat River (at Cheat Lake)	1343.5	58.5%	25.0%	1.1%	12.7%	0.7%	1.3%	0.2%	0.3%	0.3%

Point Sources

There are no non-mining point sources in the Cheat watershed permitted for iron, aluminum, manganese, or zinc discharges. Therefore, the non-mining facilities were not considered in the modeling effort.

WARMF includes as point sources only those discharges where there was sufficient flow and concentration data, *i.e.*, the T & T Mine[2]. WARMF treats all other sources as nonpoint sources, including permitted surface mine discharges that are precipitation driven. WVDEP confirmed that the surface mine discharges and a many of the deep mine discharges do respond to precipitation events.

Mining related point source discharges, from both deep, surface, and other mines, typically contain low pH values and high concentrations of iron, aluminum and manganese and, less commonly, zinc. Permits for mining related activities commonly limit iron and manganese concentrations and require reporting aluminum concentrations. Mining facilities are not required

[2]The T & T Mine was closed and the portal sealed. However, the mine seal failed and the ensuing flow turned both Muddy Run and the Cheat River red. The State's Special Reclamation Group is applying active treatment to the discharge.

to report zinc discharges. A spatial coverage of mining permit locations was provided by West Virginia Office of Mining and Reclamation (OMR) which includes both active and inactive mining facilities, which are classified by type of mine and facility status. The mines were classified into eight different types: coal surface mine, coal underground mine, haul road, coal preparation plant, coal reprocessing, prospect, quarry, and other. The haul road and prospect categories represent mining access roads and potential coal mining areas, respectively. The permits were also classified by mining status (seven categories) describing the status of each permitted discharge. OMR provided a brief description regarding classification and associated potential impact on water quality. Mining types and status descriptions are shown Table 9.

Table 9. Classification of mining permit type and status

Type of Mining	Status Code	Description
Coal surface mine Coal underground mine Haul road Coal preparation plant Coal reprocessing Prospect mine Quarry Other	Completely Released	Completely reclaimed, re-vegetated, should not be any associated water quality problems
	Phase II Released	Sediment and ponding are gone, partially re-vegetated, very little water quality impact
	Phase I Released	Re-graded and re-seeded, initial phase of the reclamation process, could potentially impact water quality
	Renewed	Active mining facility, assumed to be discharging according to the permit limits
	New	Newly issued permit, could be currently active or inactive, assumed to be discharging according to permit limits
	Inactive	Currently inactive, could become active anytime, assumed to be discharging according to discharge limits
	Revoked	Bond forfeited, forfeiture may be caused by poor water quality, highest impact to water quality

These sites have permits for loading of total iron, total manganese, total nonfilterable residue, and pH. They are also required to list total aluminum discharges. However, limestone quarry permits do not contain limits for loading of total iron and total manganese, but some are required to report total aluminum discharges. There are a total of 128 active mining discharge permits for the Cheat watershed. A complete listing of the active mining point source discharges is located in Appendix B.

Allocation

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs can be expressed in terms of mass per time or by other appropriate measures. TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

TMDL endpoints represent the instream water quality targets used in quantifying TMDLs and their individual components. Different TMDL endpoints are necessary for each impairment type (*i.e.*, aluminum, iron, manganese, zinc, and pH). West Virginia's numeric water quality criteria for aluminum, iron, manganese, zinc, and pH, and a MOS were used to identify endpoints for TMDL development.

The TMDL endpoint with the MOS for aluminum was selected as 712.5 ug/L (based on the 750 ug/L criterion for Aquatic Life minus a 5% MOS). The endpoint with MOS for iron was selected as 0.475 mg/L (based on the 0.5 mg/L criterion for Aquatic Life—Trout Waters minus a 5% MOS) and 1.425 mg/L (based on the 1.5 mg/L criterion for Aquatic Life minus a 5% MOS). The endpoint with MOS for manganese was selected as 0.95 mg/L (based on the 1.0 mg/L criterion for human health minus a 5% MOS). The TMDL with MOS endpoint for zinc was selected as 0.085 mg/L (based on the Aquatic Life criterion minus a 5% MOS). This was calculated using a hardness concentration (as $CaCO_3$) representative of the Cheat watershed. Components of the TMDLs for aluminum, iron, manganese, and zinc are presented in terms of mass per time.

The water quality criterion for pH require it to be equal to or above 6 and equal to or below 9. In the case of acid mine drainage, pH is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near neutral pH (~7) but containing elevated concentrations of dissolved ferrous (Fe^{2+}) ions can become acidic after oxidation and precipitation of the iron (PADEP, 2000). Therefore, a more practical approach to meeting the water standards of pH is to use the concentration of metal ions as a surrogate for pH. Through reducing instream metals, namely aluminum and iron, to meet water quality criteria (or TMDL endpoints), it is assumed that a pH will result meeting the WQS. This assumption is based on application of MINTEQA2, a geochemical equilibrium speciation model, to aqueous systems representative of waterbodies in the Cheat watershed. By inputting into the model the dissolved concentrations of metals, a pH value can be predicted. See the TMDL Report, Appendix C, for a more detailed discussion.

The calibrated WARMF model provided the basis for performing the allocation analysis. The first step in this analysis involved simulation of existing conditions. Existing conditions represent current conditions in the watershed.

The calibrated WARMF model was run for the period October 1, 1989 through September 30, 1997 to represent existing conditions or current conditions in the watershed. This was the starting point for the allocation analysis. Predicted instream concentrations of aluminum, iron, manganese, and zinc for the impaired waterbodies in the Cheat watershed were compared directly to the TMDL endpoints which include the MOS. This comparison allowed evaluation of the expected magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods.

A top-down methodology was followed to develop the TMDLs and allocate loads to sources. Impaired headwaters were first analyzed, because their impact frequently had a profound effect on downstream water quality. The WARMF TMDL module was run in order to estimate the TMDL for each impaired segment. This module is described in *User's Guide to WARMF* (Herr et al., 2000).

Each TMDL represents the total load from all upstream sources that are predicted to attain the water quality criteria for the entire modeling period (1989-1997). The TMDL endpoints considering the MOS were assigned when running the TMDL module. When appropriate, the averaging period was considered during these assessments (*e.g.*, a four-day average was used for iron).

After running the TMDL module for headwaters, the module was then run for subsequent downstream impaired waters. Therefore, when TMDLs were developed for downstream impaired waterbodies, upstream contributions that impact upstream impaired waterbodies were represented under allocation conditions. Thus, impaired upstream waterbodies were assumed to meet water quality criteria prior to calculation of TMDLs for downstream waterbodies. Using this method, contributions from all sources were weighted equitably. In some situations, reductions in sources impacting unimpaired headwaters were required in order to meet downstream water quality criteria. In other situations, reductions in sources impacting impaired headwaters ultimately led to improvements far downstream. This effectually decreased required loading reductions from many potential downstream sources.

The TMDL value provided by the WARMF Cheat watershed model represents the total TMDL for the impaired waterbody, however, it does not distinguish between WLAs and LAs. The total load derived from WARMF is designated as the total load available for allocation in the TMDL. WARMF does not explicitly output contributions from all individual permitted sources in the watershed, therefore, contributions from applicable permitted sources were estimated based on the available information on permitted facilities.

Because flow contributions from most permitted mining facilities in the watershed are precipitation driven, it is assumed that their contributions will follow a similar pattern as the overall predicted watershed flow. The flow from each permitted mine was estimated as a percentage of its corresponding watershed's flow. The percentage was based on the ratio of the mine's area (presented in OMR's coverage of mining permit data) to the area of the watershed in which it is located. WLAs were made for all permitted facilities (for aluminum, iron and manganese) except for those with a completely released or Phase 2 release classification and limestone quarries. For TMDL purposes these point sources are assumed to be compliant with water quality criteria. Loading from revoked permitted facilities was represented as nonpoint source loading based on the lack of a permittee or permit. Zinc LAs were assigned because insufficient monitoring data were available throughout the Cheat watershed to determine which, or if, point sources are responsible for the zinc loads. EPA is recommending to WVDEP that mining permits require monitoring for zinc to determine if point sources are the source. If so, the TMDL for zinc may need to be re-allocated and submitted to EPA for approval.

The proposed WLA for individual facilities was derived based on considering the magnitude of the estimated WLA relative to the estimated total TMDL load. The remaining load was compared to typical background loading to identify areas where remediation of abandoned mine lands was likely to be required, as part of achieving the LA. Assuming control of the nonpoint sources (LA), the remaining required controls were derived incrementally by reducing concentrations at permitted discharges until the TMDL was achieved. Each permittee was assigned a WLA (as a concentration) within a range of discharge concentrations, the minimum reflecting the instream water quality criteria and the maximum limit was derived using the EPA's *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991) to find the monthly average discharge concentration. The ranges are as follows: Al: 0.75-4.3mg/L, Fe: 0.5 or 1.5 -3.2mg/L, Mn: 1.0-2.0 mg/L. The allocated WLAs must be converted to permit average monthly limits and maximum daily limits according to the technical support document which considers the type of water quality criteria (acute, chronic, human health, maximum allowable, four-day average, etc.), effluent variability, and monitoring requirements. For an iron WLA of 3.2 mg/l, the average monthly value is 3.0 mg/l, the maximum daily limit is 5.2 mg/l, the assumed effluent variability is 0.6, and two samples per month are required. A manganese WLA equal to 2.0 mg/L translates into an average monthly limit of 2.0 mg/L and a maximum daily limit of 3.5 mg/L. Presently aluminum is not limited in permits but will be required in any new or reissued permits. An aluminum WLA equal to 4.3 mg/L translates into an average monthly limit of 2.5 mg/L and a maximum daily limit of 4.3 mg/L.

Future Growth

WVDEP has chosen not to include specific future growth allocations for each subwatershed. Because of the general allocation philosophy used in this TMDL, such allocations would be made at the expense of active mining point sources in the watershed. However, the absence of specific future growth allocations does not prohibit new mining in the watershed. Future growth could occur in the watershed under the following scenarios:

- A new facility could be permitted anywhere in the watershed, provided that effluent limitations are based upon the achievement of water quality standards end-of-pipe for the pollutants of concern in the TMDL.

- Remining could occur without a specific allocation to the new permittee, provided that the requirements of existing State remining regulations are achieved. Remining activities are viewed as a partial nonpoint source load reduction from Abandoned Mine Lands.

- Reclamation and release of existing permits could provide an opportunity for future growth provided that permit release is conditioned upon achieving discharge quality better than the wasteload allocation prescribed by the TMDL.

It is also possible that the TMDL may be refined in the future through remodeling. Such refinement may incorporate new information and/or to the redistribute pollutant loads. Trading may provide an additional opportunity for future growth, contingent upon the WVDEP's development of a statewide or watershed-based trading program.

Trading

This TMDL neither prohibits nor authorizes trading in the Cheat River watershed. Both the WVDEP and EPA generally endorse the concept of trading, and recognize that it may become an effective tool for TMDL implementation. However, significant regulatory framework development is necessary before large-scale trading in West Virginia may be realized. EPA will cooperate with the WVDEP in their development of a statewide or watershed-based trading program consistent with the objectives and requirements of the Clean Water Act. Further, EPA supports program development assisted by a consensus-based stakeholder process.

Prior to the development of a formal trading program, it is conceivable that the regulation of specific point source to point source trades may be feasible under the framework of the NPDES program. EPA will cooperate with the WVDEP to facilitate such trades if opportunities arise that are proven to be environmentally beneficial and consistent with the objectives and requirements of the Clean Water Act.

Tables 1 through 4 in Section II-Summary, present the sum of the WLAs for each of the 55 impaired waterbodies. The WLAs for aluminum, iron, manganese, and zinc are presented as annual loads, in terms of pounds per year. Also presented in Section II (Table 6) are the annual loads by individual facility and the corresponding WLA concentrations for each facility (for aluminum, iron and manganese). Loads are presented on an annual basis (as an average annual load), because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

Load allocations (LAs) were made as gross allotments including a combination of abandoned mine land, rural, and urban land uses. Each of the 55 waterbody's LAs for aluminum, iron, manganese and zinc is presented in Tables D-1 through D-4 in the TMDL Report, Appendix D. The LAs are presented as annual loads, in terms of pounds per year.

Aluminum, iron, manganese, and zinc concentrations were input into MINTEQA2 to simulate various scenarios including conditions with metals concentrations meeting water quality standards and conditions in proximity to mining activities. MINTEQA2 was run twice using the two different iron standards for aquatic life and trout waters. Based on the inputs (described in more detail in Appendix C), pH was estimated to be 7.74 for the aquatic life iron standard of 1.5

mg/L and 7.77 for the trout waters standard of 0.5 mg/L. For the scenario representative of mining areas, typical instream metals concentrations were used, and pH was estimated to be 4.38. Results from MINTEQA2 imply that pH will meet the West Virginia pH criteria of equal to or above 6 and equal to or below 9 if metals concentrations meet water quality criteria.

III. Discussion of Regulatory Conditions

As noted above, the TMDL is a scientifically-based plan and analysis established to ensure that a water body will attain and maintain water quality standards. It considers current and foreseeable conditions, the best available data, and uncertainty in the margin of safety (MOS). Conditions and/or available data change, or the understanding of the natural processes change, sometimes more than anticipated by the MOS. The option is always available to refine the TMDL for re-submittal to EPA for approval. WVDEP's plan for achieving a comprehensive, statewide watershed approach was developed and implemented in 1996. After completion of the initial assessments, the long-range goal is to reassess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted.

EPA finds that sufficient information has been provided to meet all of the eight basic regulatory requirements for establishing pH and metal TMDLs in the Cheat River watershed.

1. The TMDL is designed to meet the applicable water quality standards.

The applicable water quality standards for the Cheat River are:

Table 11. Applicable West Virginia water quality criteria

POLLUTANT	USE DESIGNATION				
	Aquatic Life				Human Health
	B1, B4		B2		A [c]
	Acute [a]	Chronic [b]	Acute [a]	Chronic [b]	
Aluminum, Total (µg/L)	750	-	750	-	-
Iron, Total (mg/L)	-	1.5	-	0.5	1.5
Manganese, Total (mg/L)	-	-	-	-	1.0
pH	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0
Zinc, dissolved (mg/L)	$(0.978)(e^{[(0.8473)(\ln[\text{hardness}\dagger]) + 0.8604]})$	$(0.978)(e^{[(0.8473)(\ln[\text{hardness}\dagger]) + 0.7614]})$	$(0.978)(e^{[(0.8473)(\ln[\text{hardness}\dagger]) + 0.8604]})$	$(0.978)(e^{[(0.8473)(\ln[\text{hardness}\dagger]) + 0.7614]})$	-

Source: WVSOS, 1999; B1 = Warm water fishery streams, B4 = Wetlands, B2 = Trout waters, A = Water supply, public
[a] One hour average concentration not to be exceeded more than once every three years on the average,
[b] Four-day average concentration not to be exceeded more than once every three years on the average,
[c] Not to exceed
† Hardness as calcium carbonate (mg/L). The minimum hardness allowed for use in this equation shall not be less than 25 mg/l, even if the actual ambient hardness is less than 25 mg/l. The maximum hardness value for use in this equation shall not exceed 400 mg/l even if the actual hardness is greater than 400 mg/l.

All waters of West Virginia are designated for the propagation and maintenance of fish and other aquatic life and for water contact recreation as part of State water quality standards (WV 46-1-6.1). In addition, the tributaries to the Cheat River has been designated as Water Use Category A – public water supply (WV 46-1-7.2.a) and must be protected for this use.

These TMDLs have been developed based on WVDEP's designation of each impacted waterbody as a warm water fishery or trout stream and the above water quality criteria.

The water quality criteria for pH requires it to be equal to or above 6 and equal to or below 9. In the case of acid mine drainage, pH, is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near neutral pH (~7) but containing elevated concentrations of dissolved ferrous (Fe^{2+}) ions can become acidic after oxidation and precipitation of the iron (PADEP, 2000). Therefore, a more practical approach to meeting the water quality standard of pH is to use the concentration of metal ions as a surrogate for pH. Through reducing instream metals, namely aluminum and iron, to meet water quality criteria (or TMDL endpoints), it is assumed that the pH will result in meeting the WQS. This assumption is based on the application of MINTEQA2, a geochemical equilibrium speciation model, to aqueous systems representative of waterbodies in the Cheat watershed. By inputting into the model the dissolved concentrations of metals, a pH value can be predicted.

MINTEQA2 was run using typical instream metals concentrations found in the vicinity of mining activities (10 mg/L for total Fe, 10 mg/L for Al, 5 mg/L for Mn, 0.085 mg/L for Zn, and 18 mg/L as $CaCO_3$ for alkalinity), resulting in a predicted equilibrium pH of 4.38. MINTEQA2 was run with input values for Fe, Al, and Mn were based on TMDL endpoints (maximum allowable limits), the alkalinity value was based on average in-stream concentrations (or literature values if necessary) for rivers relatively unimpacted by mining activities in the Cheat River watershed, and set to equilibrium with atmospheric CO_2. The resultant equilibrium pH was estimated to be 7.74 using the aquatic life standard (1.5 mg/L total Fe) and 7.76 using the trout waters standard (0.5 mg/L total Fe).

Results from MINTEQA2 imply that pH will be within the West Virginia criteria of equal to or above 6 and equal to or below 9, provided that instream metals concentrations simultaneously meet applicable water quality criteria.

2. The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for non-point sources, and natural background levels. In addition, the TMDL must include a Margin of Safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The TMDLs represent the maximum load that a receiving water can assimilate while still achieving water quality standards. The TMDL is allocated into WLAs for point sources, LAs for non-point sources, and the Margin of Safety (MOS) components. The TMDL divides allowable loading into separate categories corresponding to point sources (which enter the river from a well-defined source location) and nonpoint (diffuse) sources. The TMDL defines allowable point source permit limits (called wasteload allocations) and necessary reductions in non-point and background sources (called load allocations). These sources must be characterized so that the waste load and load allocations can be assigned to ensure compliance with the TMDL.

For purposes of this set of TMDLs only, point sources are identified as permitted discharge points and nonpoint sources are other discharges from abandoned mine lands which includes tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. As such, the discharges associated with these land uses were assigned load allocations (as opposed to wasteload allocations). The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

No WLAs were made for zinc because of insufficient data to locate the source(s). Available monitoring suggests mines or AMLs may be the source, therefore, EPA is recommending that WVDEP include three years of monitoring for zinc in the next round of mining permits.

3. The TMDLs consider the impacts of background pollutant contributions.

The impact of background contributions is an integral part of the watershed modeling. The model is calibrated to observed instream water quality observations at multiple locations throughout the watershed. The calibration dataset was applied to areas where calibration data were not available.

4 & 5. The TMDLs consider critical and seasonal environmental conditions.

A TMDL must consider critical and seasonal variation in the derivation of the allocation. For the Cheat River watershed metals TMDLs, critical and seasonal variation was considered in the formulation of the modeling analysis. By using continuous simulation (modeling over a period from October 1, 1989 to September 30, 1997, seasonal hydrologic and source loading variability was inherently considered. The metals concentrations simulated on a daily time step by the model were compared to TMDL endpoints. An allocation which meets these endpoints throughout the year was developed.

6. The TMDLs include a margin of safety.

The Clean Water Act and federal regulations require TMDLs to include a MOS to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggest two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

A 5% implicit MOS was selected in identifying endpoints to account for potential inaccuracies in the modeling process. A relatively small MOS is acceptable in that the TMDL development used a dynamic model for simulating daily loading over a wide range of hydrologic and environmental conditions, and long-term flow and water quality data was used in the model calibration and validation.

TMDL endpoints represent the instream water quality targets used in quantifying TMDLs and their individual components. Different TMDL endpoints are necessary for each impairment type, *i.e.*, aluminum, iron, manganese, and pH. West Virginia's numeric water quality criteria for aluminum, iron, manganese, zinc, and pH and an implicit MOS were used to identify endpoints for TMDL development.

The TMDL endpoint with MOS for aluminum is 712.5 ug/L (based on the 750 ug/L criterion for aquatic life minus a 5% MOS). The endpoint for iron is either as 0.475 mg/L (based on the 0.5 mg/L criterion for aquatic life-trout waters minus a 5% MOS) or 1.425 mg/L (based on the 1.5 mg/L criteria for aquatic life minus a 5% MOS). And the endpoint with MOS for manganese is 0.95 mg/L (based on the 1.0 mg/L criterion for human health minus a 5% MOS). The endpoint for zinc is 0.085 mg/L (based on the calculated criterion as a function of hardness minus a 5% MOS).

7. There is reasonable assurance that the proposed TMDLs can be met.

Federal regulations at 40 CFR § 130.7(a) require that WLAs, LAs, and TMDLs be incorporated into the states' water quality management plans and NPDES permits. WLAs were developed for all known permittees in the Cheat River watershed. Any new or reissued NPDES permit must convert the WLAs into permit limits. EPA's *Technical Support Document for Water Quality-based Toxics Control*, March 1991, provides guidance for developing permit limits. Permitting, together with WVDEP's efforts to reclaim abandoned mines, will be the focal points in water quality improvement.

Mining facilities currently do not monitor for and are not required to report zinc discharges. Instream water quality data from EPA's STORET database were analyzed to characterize potential sources of zinc within the entire Cheat watershed. Although higher in-stream zinc concentrations were observed adjacent to or downstream of mining areas and abandoned mine lands (AMLs), there is uncertainty regarding the sources of zinc within the Cheat watershed. Because uncertainty as to the source of the zinc remains, WVDEP will include a requirement in permits issued to mining operations discharging to the Cheat watershed to monitor for and report zinc discharges for a period of three years. This TMDL can then be modified if new data so warrants.

Two distinct units of WVDEP reclaim land and water resources impacted by abandoned mines. The Office of Abandoned Mine Lands and Reclamation remedies eligible sites under Title IV of the Surface Mining Control and Reclamation Act of 1977. The Office of Mining and Reclamation's Special Reclamation Program remedies sites where operating permits and bonds have been revoked. Funding of the Office of Abandoned Mine Lands and Reclamation is derived from a federal tax on coal producers. The Special Reclamation Program is funded by the Special Reclamation Fund, which has primary sources of income from civil penalties, forfeited bonds, and a three-cent per ton fee on all coal produced.

The Office of Abandoned Mine Lands and Reclamation is responsible for implementation of Title IV of the Surface Mining Control and Reclamation Act (Public Law 95-87) is designed to help reclaim and restore coal mine areas abandoned prior to August 3, 1977. The AML Program supplements existing state programs and allows the State of West Virginia to correct many abandoned mine related problems that would otherwise not be addressed.

The major purpose of the AML Program is to reclaim and restore abandoned mine areas so as to protect the health, safety, and general welfare of the public and the environment. The first priority is the protection of pubic health, safety, general welfare, and property from extreme danger resulting from past coal mining conditions. These conditions include unsafe refuse piles, treacherous highwalls, pollution of domestic water supplies from mine drainage, mine fires, subsidence and other problems.

The AML Program is now also focused on treating and abating water quality problems associated with abandoned mine lands but is not required by law or any statutory authority to do so. By recognizing the need to protect, and in many cases, improve the quality of the state's water resources from the impacts of mine drainage pollution from abandoned coal mines, coordinated efforts are now being employed to deal with this source of pollution problem.

Although OAML&R has been actively involved in the successful remediation of mine drainage pollution, inadequate funding and the lack of cost-effective mine drainage pollution treatment and abatement technologies have limited water quality improvement efforts. In 1990, the Surface Mining Control and Reclamation Act was amended to include a provision allowing states and tribes to establish an Acid Mine Drainage Treatment and Abatement Program and Fund. States and tribes may set aside up to 10% of their annual grant to begin to address abandoned polluted coal mine drainage problems. Money from the Acid Mine Drainage Treatment and Abatement Fund can be utilized to clean up mine drainage pollution at sites where mining ceased prior to August 3, 1977, and where no continuing reclamation responsibility can be determined. In order to qualify and be eligible, qualified hydrologic units or watersheds must be identified and water quality must adversely impact biological resources. A plan must be prepared and presented to the Natural Resources Conservation Service for review and the Office of Surface Mining for approval. Plans that include the most cost-effective treatment and abatement alternatives, the greatest downstream benefits to the ecosystem, and diverse cooperators and stakeholders, will be the highest priority for approval.

OAML&R has created an Acid Mine Drainage Abatement Policy to guide efforts in treating and abating mine drainage pollution. The Policy acts to guide the expenditure of funds in order to achieve the maximum amount of mine drainage pollution treatment within the boundaries imposed by budgetary and statutory constraints. The goal is to utilize existing technologies and practical economic considerations to maximize the amount of treatment for dollars expended.

A special reclamation group deals with revoked mines. When notice of permit revocation is received from the Director, a liability estimate is completed within 60 days of the revocation. The liability estimate notes any special health and safety characteristics of the site and calculates the cost to complete reclamation according to the permit reclamation plan. At sites where acid mine drainage is present, the permit is flagged for water quality characterization and a priority index assigned.

The reclamation plan at all sites includes the application of the best professional judgment to address the site specific problems including acid mine drainage. Any change or modification to the permit reclamation plan is done by or under the supervision of a Registered Professional Engineer. All construction requires application of best management practices to insure quality work and protect the environment.

8. The TMDLs have been subject to public participation.

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each state must, therefore, provide for public participation consistent with its own continuing planning process and public participation requirements. As a result, it is the intent of the WVDEP to solicit public input by providing opportunities for public comment and review of the draft TMDLs. The public meetings pertaining to the Cheat River watershed occurred as follows:

- January 25, 1999 — EPA provided a summary of the TMDL process, requirements of the consent decree, guidance for using HSPF, and outlined steps for the development of the TMDL
- July 27, 1999 — Systech Engineering presented the WARMF model.
- January 25, 2000 — Systech presented an 80 percent calibrated WARMF model for the Cheat watershed and a public meeting was held. West Virgina DEP was represented at the meeting. The Canaan Valley Institute and stakeholders of the Cheat watershed were also present.
- February 14, 2000 — EPA representatives were present for a public meeting which involved discussion of stakeholder concerns.
- October 12, 2000 — Public meeting presented by WVDEP, EPA, and Tetra Tech.
- January 16, 2001 — Public hearing presented by WVDEP, EPA, and Tetra Tech.

In addition to EPA's meetings with the public, the Canaan Valley Institute funded Evan Hansen from Downstream Strategies, as well as a technical committee, to review WARMF and its application the Cheat watershed. Mr. Hansen held many meetings, some of which EPA representatives attended, and provided written comments and recommendations from the Cheat TMDL Stakeholder Group to EPA regarding TMDL development and TMDL allocations in the watershed.

On December 15, 2000, a public notice was published in the following newspapers; *Preston Co. News, Parsons Advocate, Dominion Post, Inter-Mountain, Mountain Statesman, Barbour Democrat*, and *Record Delta* newspapers and posted the notice, together with the draft TMDLs, on the EPA Region III TMDL web page. The documents available for review on EPA, Region III, web page included *Adaption of WARMF to Calculate TMDLs for the Acid Mine Impaired Cheat River*, undated, *Peer Review Report on the Watershed Analysis Risk Framework*, May 2000, and the *User's Guide to WARMF (Documentation of Graphical User Interface,* July 2000. The draft TMDLs were revised in *Metals and pH TMDLs for the Cheat River Watershed, West Virginia,* March 2001 (TMDL Report).