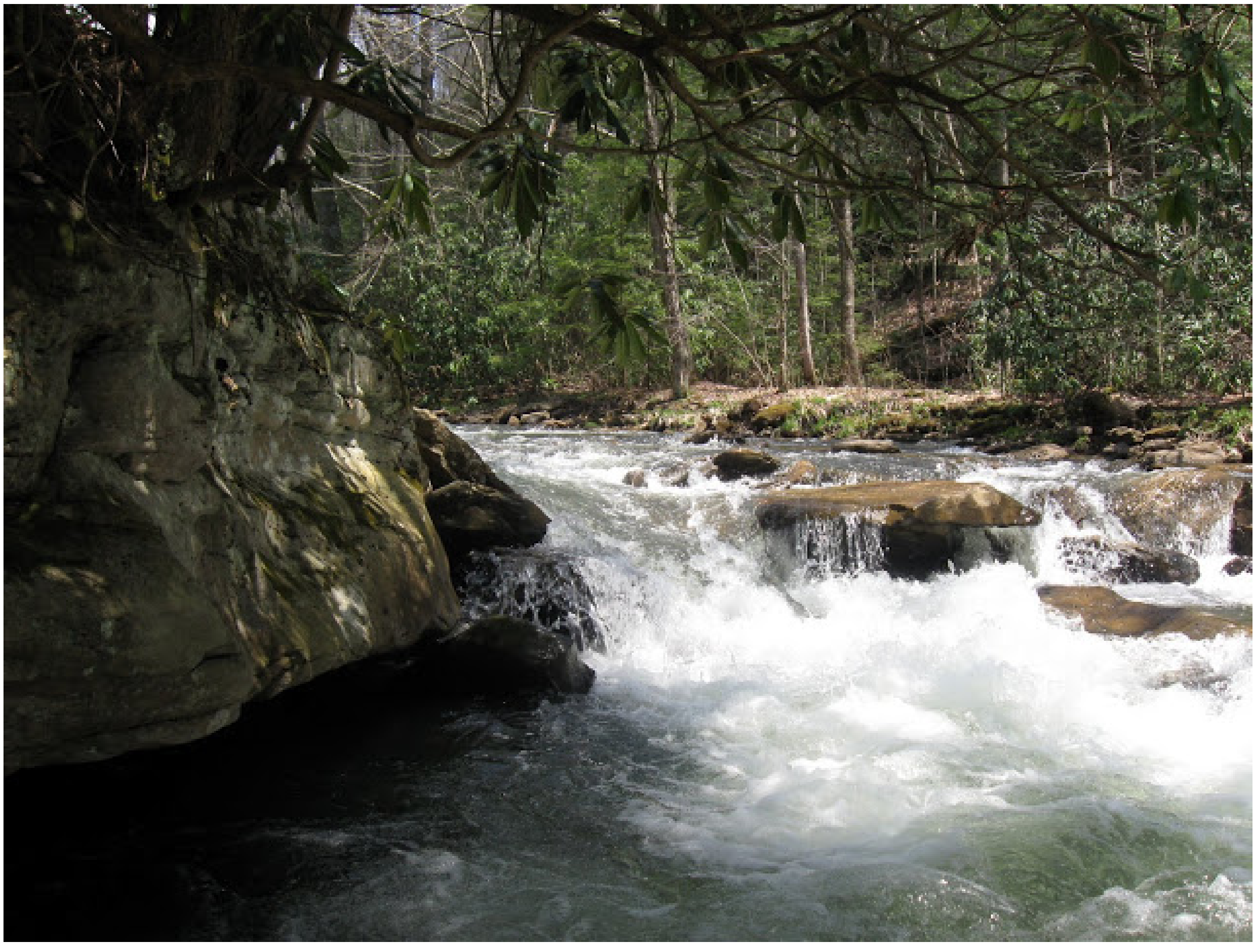
Upper Meadow River

Watershed Based Plan



Submitted by the

West Virginia Conservation Agency

2014

Watershed Based Plan for the Upper Meadow River

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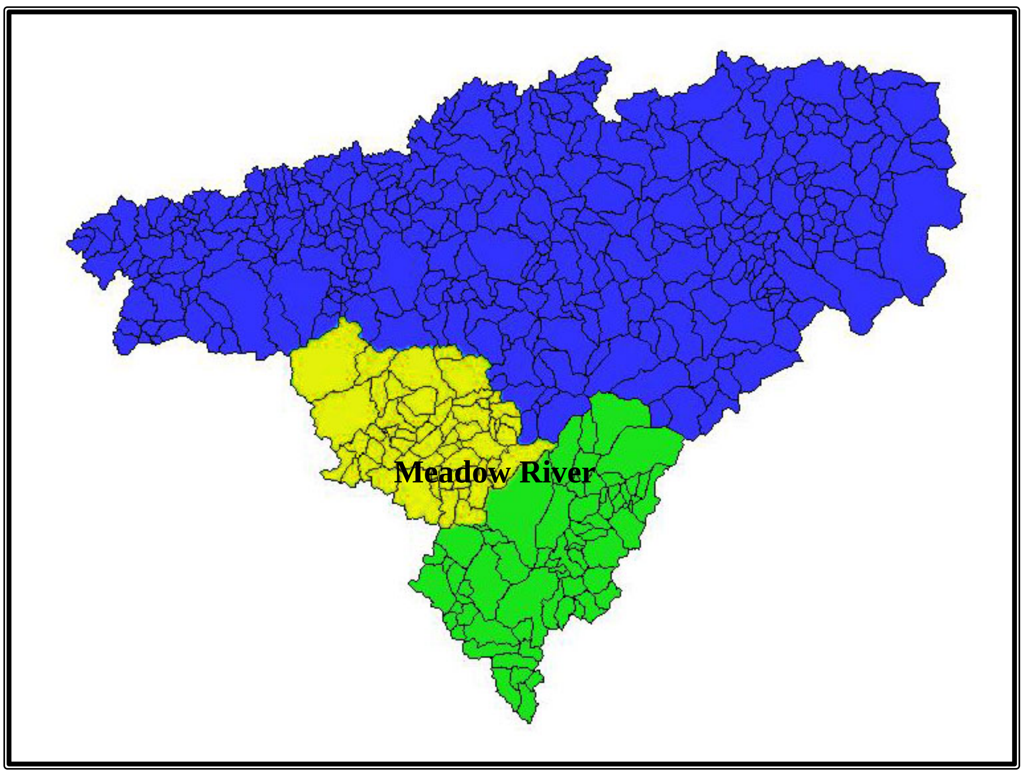
INTRODUCTION

The Meadow River gets its name from the extensive wetlands and meadows that characterize the headwaters of the river. From this wetland source the river eventually descends into a gorge and is characterized as a whitewater river. The lower half of the river is more rugged and remote with Class III to Class V rapids. The last five miles of the river, before it joins the Gauley River, is included in the Gauley River National Recreation Area. The Meadow River is a major tributary of Gauley River, which it joins downstream from Summersville Lake near Carnifex Ferry Battlefield State Park.

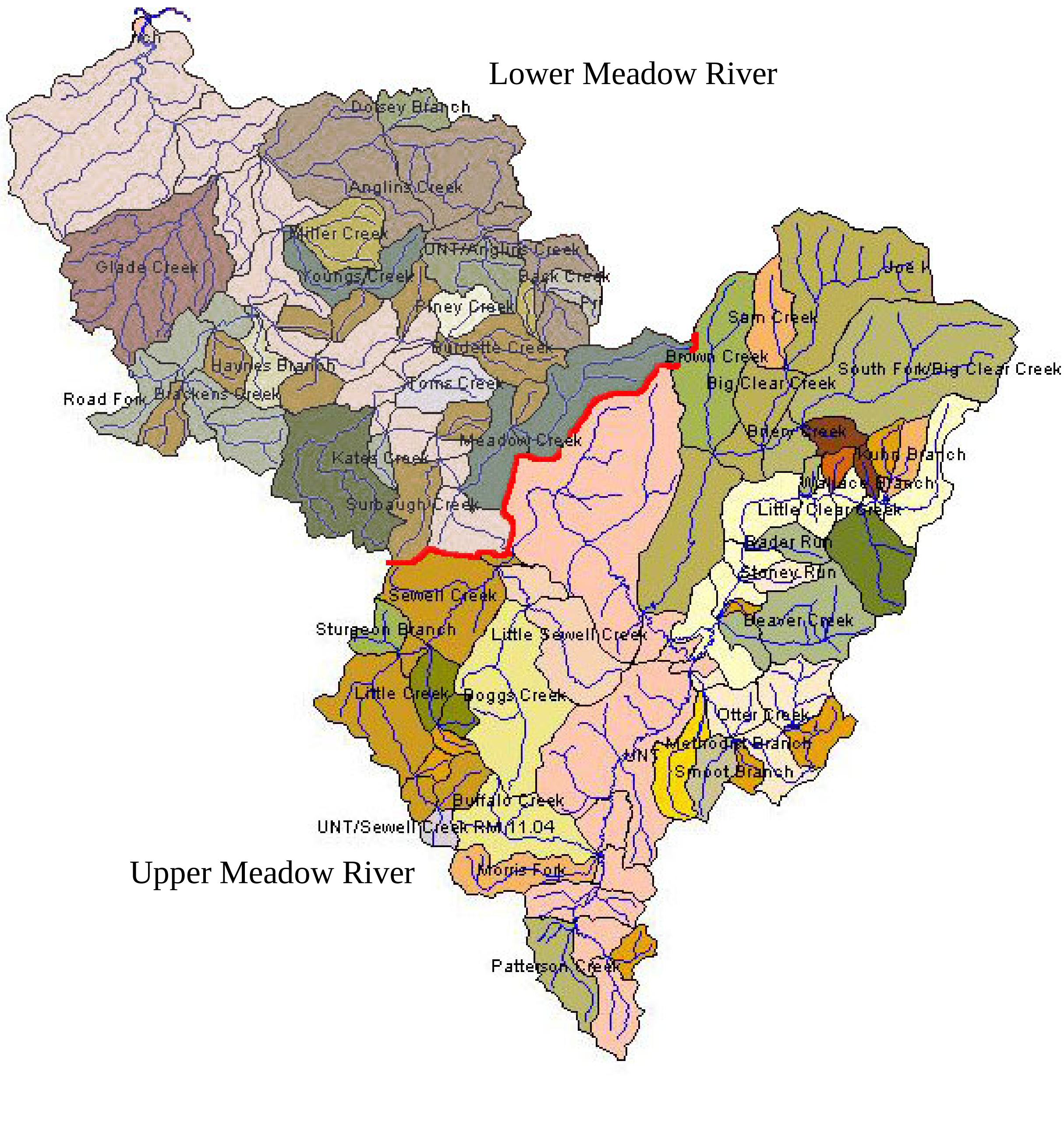
Meadow River's source is at an elevation of 3,945 feet and it enters the Gauley River at 1,182 feet, for a total descent of 2,763 feet. The lower section of Meadow River is a rocky, turbulent stream. The Meadow is 52.6 miles long, with a watershed of 365 square miles (233,388 acres). The major tributaries of Meadow River are Anglins, Brackens, Glade, Meadow, Sewell and Little Sewell, and Big Clear and Little Clear creeks. Parts of three counties are in the watershed: Greenbrier, Fayette and Nicholas. The major towns are Rainell and Rupert some of the smaller towns are Russellville, Nallen, Charmco and Dawson. The state Meadow River Wildlife Management Area located near Rupert is 2385 acres of river bottom land and wet lands managed by the WV Department of Natural Resources (DNR).

Figure 1: Gauley and Meadow River Watersheds



The 2008 Gauley River TMDL approved by the US Environmental Protection Agency (EPA) contains the impaired streams in the 2006 303(d) list. Appendix 8 of the Gauley River TMDL is the TMDL for the Meadow River watershed. There are thirteen streams included with pollutant allocations most are in the Sewell Creek and Little Clear Creek drainages. Briery Creek is in the Clear Creek drainage. All of these streams are located in the upper half of the Meadow River watershed. There are no streams on the 303(d) list in the lower Meadow River. This watershed based plan (WBP) focuses on those thirteen streams in the upper Meadow River watershed. .

Figure 2: Meadow River Subwatersheds and Major Tributaries



In the TMDL the watershed is divided into subwatersheds. The entire watershed for smaller streams may be included in one subwatershed but larger streams may have multiple subwatersheds. Each subwatershed is assigned a number so, if necessary, it can be assigned a pollutant load allocation and tracked.

Figure 3: Upper Meadow River Subwatersheds

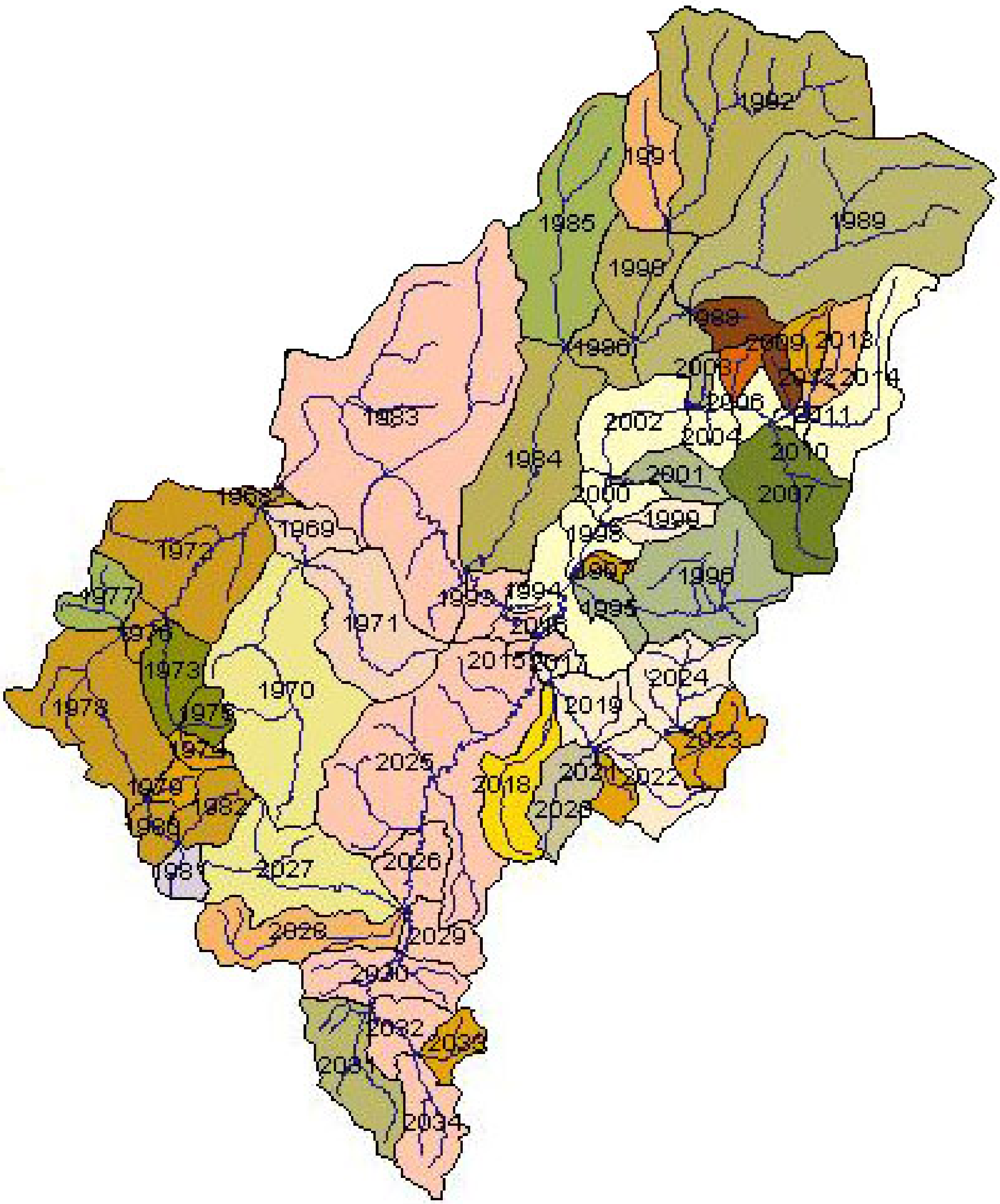


Table 1: TMDLs for Metals

Stream Code	Stream Name	Metal	LA (lbs/yr)	WLA (lbs/yr)	MOS (lbs/yr)	TMDL (lbs/yr)	% Red.
WVKG-19-Q	Sewell Creek	Iron	63,455.7	1,561.9	3,422.0	68,439.6	72.8
WVKG-19-Q-1	Little Sewell Creek	Iron	29,431.2	901.7	1,596.5	31,929.4	78.2
WVKG-19-Q-1-A	Boggs Creek	Iron	16,512.4	445.5	892.5	17,850.4	72.5
WVKG-19-U-2-A	Briery Creek	Aluminum	5,163.6	0.0	271.8	5,435.4	35.4
WVKG-19-V	Little Clear Creek	Iron	98,389.5	10,012.7	5,705.4	114,107.6	39.4
WVKG-19-V-1	Beaver Creek	Iron	18,533.8	4,212.8	1,197.2	23,943.8	47.8
WVKG-19-V-2	Stoney Run	Iron	3,485.7	271.3	197.7	3,954.8	20.7
WVKG-19-V-3	Rader Run	Iron	2,840.6	1,907.1	249.9	4,997.6	67.5
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	Iron	1,433.7	0.0	75.5	1,509.2	83.9
WVKG-19-V-4	Cutlip Branch	Iron	2,128.8	47.3	114.5	2,290.6	43.1
WVKG-19-V-5	Laurel Creek	Iron	14,410.8	469.3	783.2	15,663.3	8.0
WVKG-19-V-7	Kuhn Branch	Iron	7,480.7	905.5	441.4	8,827.6	51.5
WVKG-19-V-7-A	Joe Knob Branch	Iron	3,107.9	66.6	167.1	3,341.5	54.3

Table 2: TMDLs for Fecal coliform

Stream Code	Stream Name	LA (counts/yr)	WLA (counts/yr)	MOS (counts/yr)	TMDL (counts/yr)	% Reduction
WVKG-19-Q	Sewell Creek	3.87E+13	1.08E+13	2.61E+12	5.21E+13	99.45
WVKG-19-Q-1	Little Sewell Creek	1.38E+13		7.29E+11	1.46E+13	99.37

Table 3: TMDL for pH (Acid)

Stream Code	Stream Name	Allocated Average Annual Net Acidity Load (ton/yr)
WVKG-19-V-5	Laurel Creek	2.39
WVKG-19-V	Little Clear Creek	1.99

CAUSES AND SOURCES

CAUSES

Section 303(d) of the federal Clean Water Act requires states to identify waterbodies that do not meet water quality standards and to develop appropriate TMDLs. A Total Maximum Daily Load (TMDL) establishes the maximum allowable pollutant loading for a waterbody to achieve compliance with established water quality standards. It also distributes the load among pollutant sources establishing load reduction goals from each source.

Data obtained from pre-TMDL monitoring is compiled, and the impaired waters are modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards. A TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS) that accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving stream. TMDLs can be expressed in terms of mass per time or other appropriate units. TMDLs are calculated by the following equation:

TMDL = sum of WLAs + sum of LAs + MOS

The Meadow River is a tributary of the Gauley River and therefore was included in the Gauley River TMDL. A Meadow River appendix refined the TMDL for the Meadow River. The WVDEP performed monitoring in each of the impaired streams in the Meadow River watershed to better characterize water quality and impairment listings. Monthly samples were taken at 23 stations throughout the Meadow River watershed from July 1, 2003, through June 30, 2004. Streams impaired by metals and low pH were sampled monthly and analyzed for a suite of parameters including acidity, alkalinity, total iron, dissolved iron, total aluminum, dissolved aluminum, total suspended solids, pH, sulfate, total selenium, and specific conductance. Monthly samples from streams impaired by fecal coliform bacteria were analyzed for fecal coliform bacteria, pH, and specific conductance. The monitoring showed three causes of impairment in the Meadow River: fecal coliform, metals and pH.

The determination of impaired waters involves comparing instream conditions to applicable water quality standards. West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*. Water quality standards consist of three components: designated uses; narrative and/or numeric water quality criteria necessary to support those uses; and an antidegradation policy.

The basis of fecal coliform impairment is based on the WV standard for human health protection. "**Human Health Criteria** Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed

200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month."

Table 4: Water Quality Standards for Aluminum, Iron. pH and Fecal coliform

POLLUTANT	USE DESIGNATION				
	Aquatic Life				Human Health
	Warm water Fisheries		Trout waters		Contact Recreation/Public Water Supply
	Acute[a]	Chronic[b]	Acute[a]	Chronic[b]	
Aluminum, dissolved (µg/L)	750	750	750	87	--
Iron, total (mg/L)	--	1.5	--	0.5	1.5
Selenium, total (ug/L)	20	5	20	5	10[c]
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
Fecal coliform bacteria	Human Health Criteria Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.				

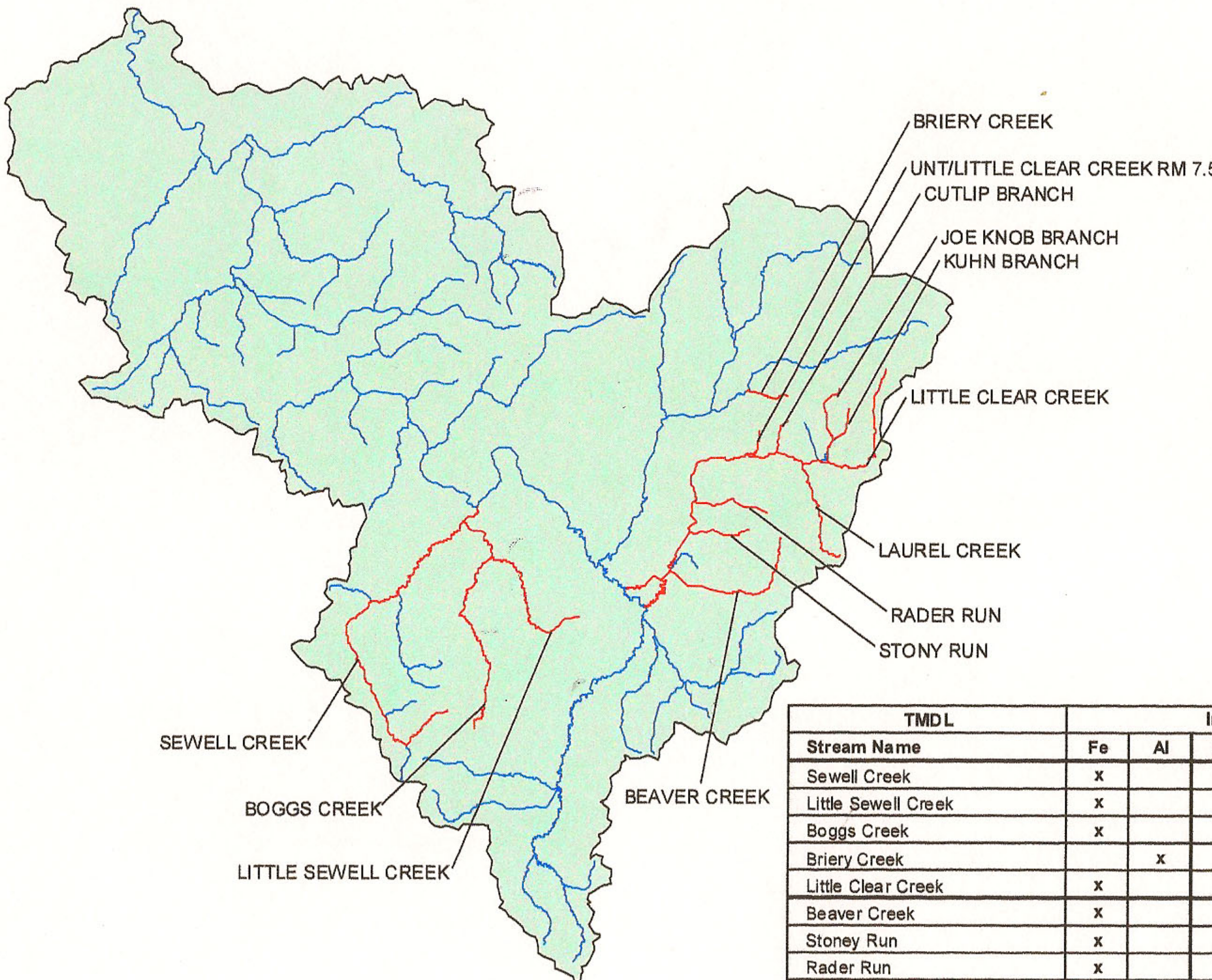
All of the streams listed as impaired and included in the TMDL are located in the upper Meadow River watershed. Most are in the Sewell Creek and Little Clear Creek subwatersheds. All of the causes of impairment have been determined by WVDEP to originate from multiple sources within these subwatersheds.

Table 5: Impaired Streams Segments in Meadow River

Subwatershed	Stream Name	Stream Code
1968	Sewell Creek	WVKG-19-Q
1969	Little Sewell Creek	WVKG-19-Q-1
1970	Boggs Creek	WVKG-19-Q-1-A
1971	Little Sewell Creek	WVKG-19-Q-1
1972	Sewell Creek	WVKG-19-Q
1973	Little Creek	WVKG-19-Q-3
1974	UNT	WVKG-19-Q-3-A
1975	Little Creek	WVKG-19-Q-3
1976	Sewell Creek	WVKG-19-Q
1977	Sturgeon Branch	WVKG-19-Q-4
1978	Sewell Creek	WVKG-19-Q

Subwatershed	Stream Name	Stream Code
1979	UNT	WVKG-19-Q-14
1980	Sewell Creek	WVKG-19-Q
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17
1982	Sewell Creek	WVKG-19-Q
1988	Briery Creek	WVKG-19-U-2-A
1988	Briery Creek	WVKG-19-U-2-A
1994	Little Clear Creek	WVKG-19-V
1995	Beaver Creek	WVKG-19-V-1
1996	Beaver Creek	WVKG-19-V-1
1997	UNT	WVKG-19-V-1.2
1998	Little Clear Creek	WVKG-19-V
1999	Stoney Run	WVKG-19-V-2
2000	Little Clear Creek	WVKG-19-V
2001	Rader Run	WVKG-19-V-3
2002	Little Clear Creek	WVKG-19-V
2003	UNT/Little Clear Creek RM 7.5	WVKG-19-V-3.8
2004	Little Clear Creek	WVKG-19-V
2005	Cutlip Branch	WVKG-19-V-4
2006	Little Clear Creek	WVKG-19-V
2007	Laurel Creek	WVKG-19-V-5
2008	Little Clear Creek	WVKG-19-V
2009	Wallace Branch	WVKG-19-V-6
2010	Little Clear Creek	WVKG-19-V
2011	Kuhn Branch	WVKG-19-V-7
2012	Joe Knob Branch	WVKG-19-V-7-A
2013	Kuhn Branch	WVKG-19-V-7
2014	Little Clear Creek	WVKG-19-V

Figure 1: Impairments to the Meadow River Watershed



TMDL	Impairment					
Stream Name	Fe	Al	pH	Se	FC	BIO
Sewell Creek	x				x	
Little Sewell Creek	x				x	
Boggs Creek	x					
Briery Creek		x	x			
Little Clear Creek	x		x			
Beaver Creek	x					
Stoney Run	x					
Rader Run	x					
UNT/Little Clear Creek RM 7.5	x					
Cutlip Branch	x					
Laurel Creek	x		x			
Kuhn Branch	x					
Joe Knob Branch	x					

From Appendix 8 Gauley River TMDL

SOURCES

Pollutant sources were identified using statewide geographic information system (GIS) coverages of point and nonpoint sources, and through field reconnaissance. All identified sources were mapped by GIS and applied with land use data to the TMDL model.

Fecal coliform

In the TMDL pollution sources are identified as either point sources requiring NPDES (National Pollution Discharge Elimination System) permits or nonpoint sources which do not require permits. Point sources are assigned waste load allocation (WLA) and nonpoint sources are assigned load allocations (LA) in the TMDL. The only point sources of fecal coliform bacteria in modeled areas are the permitted outlets of the Greenbrier Public Service District #2 Publicly Owned Treatment Works. Existing technology-based fecal coliform effluent limitations are more stringent than applicable water quality criteria and compliant discharges will not cause or contribute to water quality standard violations. Therefore no reductions are called for in the TMDL from these point sources.

In the TMDL there are three nonpoint sources of fecal coliform that have been assigned load reductions: agriculture, residential areas and failing septic systems. In the Meadow River failing septics is, by far, the predominant source.

Table 6: Sources of Fecal Coliform

Source	Baseline cfu/yr	% of Total
Failing Septics	8.94E+15	99.05%
Pasture/Grassland	7.58E+13	0.84%
Residential	9.94E+12	0.11%
Totals	9.03E+15	100.00%

Agriculture

The agricultural category identified in the TMDL is pasture and grassland. The significant agricultural impacts are located in the Sewell Creek subwatersheds. Runoff from grazing areas and livestock access to the streams are the primary mechanisms for the pollution entering the streams. WVDEP source tracking is used in the TMDL model to assign subwatersheds with an agricultural runoff potential. Pastures were categorized into three general types of runoff potential: high, moderate or low. In Sewell Creek, only the low and moderate ratings apply.

Table 7: TMDL Agricultural Load Allocations

Stream Name	Stream Code	Pasture/Grassland Baseline Load (counts/yr)	Pasture/Grassland Allocated Load (counts/yr)	Pasture/Grassland Percent Reduction
Boggs Creek	WVKG-19-Q-1-A	1.14E+13	9.42E+11	91.8
Little Sewell Creek	WVKG-19-Q-1	6.90E+12	5.68E+11	91.8
Sewell Creek	WVKG-19-Q	5.03E+12	3.78E+12	24.9
UNT	WVKG-19-Q-3-A	2.05E+12	2.09E+11	89.8
Little Creek	WVKG-19-Q-3	2.57E+12	2.61E+11	89.8
Sturgeon Branch	WVKG-19-Q-4	9.19E+12	9.41E+11	89.8
Sewell Creek	WVKG-19-Q	1.76E+13	1.10E+12	93.8
Sewell Creek	WVKG-19-Q	4.49E+12	4.57E+11	89.8
UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	3.85E+12	3.92E+11	89.8
Sewell Creek	WVKG-19-Q	1.14E+13	1.16E+12	89.8

Residential

The impacts from residential sources are concentrated in and near the town of Rainell in the lower portion of the Sewell Creek subwatershed. The TMDL explains the residential impact: "Sources of fecal coliform bacteria in residential/urban areas include wildlife and pets, particularly dogs. Much of the loading from urban areas is due to an increase in impervious surfaces relative to other landuses, and the resulting increase in runoff." The literature value initially used for the fecal coliform model calibration for domestic animals was 4.09E+09 counts/animal/day.

Table 8: TMDL Residential Load Allocations

Stream Name	Stream Code	Residential Baseline Load (counts/yr)	Residential Allocated Load (counts/yr)	Residential Percent Reduction
Sewell Creek	WVKG-19-Q	2.82E+11	2.10E+11	25.8
Little Sewell Creek	WVKG-19-Q-1	2.04E+12	1.14E+12	44.2
Little Sewell Creek	WVKG-19-Q-1	1.06E+12	7.68E+11	27.3
Sewell Creek	WVKG-19-Q	3.84E+12	7.12E+11	81.4
Little Creek	WVKG-19-Q-3	5.06E+11	2.06E+11	59.3

On-site Wastewater Systems

To calculate failing septic wastewater flows, the watersheds were divided into four septic failure zones during the source tracking process. Septic failure zones were delineated by geology, and defined by rates of septic system failure. Two types of failure were considered: complete failure and periodic failure. In the model a complete failure was defined as 50 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters. Periodic failure was defined as 25 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters. Pollutant source tracking by WVDEP personnel identified scattered areas of high population density without access to public sewers in the Meadow River watershed. Human sources of fecal coliform bacteria from these areas include sewage discharges from failing septic systems, and possible direct discharges of sewage from residences (straight pipes). A septic system failure rate derived from geology and soil type was applied to the number of unsewered homes to calculate nonpoint source fecal coliform loading from failing septic systems. The only subwatersheds found to contribute significant fecal coliform pollution from failing septic systems were in the Sewell Creek and Little Sewell Creek drainages.

Table 9: Septic failure rates in septic failure zones in the Gauley River watershed

	Zone 1	Zone 2	Zone 3	Zone 4
Percent Homes Complete Failure	10	28	24	5
Percent Homes Seasonal Failure	7	19	13	3

Table 10: Septic Failures

	Tot. # households not on public sewer	Septic Failure %	Seasonal Failure %	Septic flow
Subwatershed				(gal/day)
1970	25	10	7	168.75
1971	75	10	7	506.25
1972	22	10	7	148.5
1973	36	10	7	243
1974	2	10	7	13.5
1975	12	10	7	81
1976	8	28	19	150
1977	10	10	7	67.5
1978	27	10	7	1119
1978	50	28	19	
1980	18	10	7	121.5
1981	2	10	7	13.5
1982	23	10	7	155.25
Totals	310			2787.75
Zone 1				
Zone 2				

Table 11: On-Site Sewer Load Allocations

Stream Name	Stream Code	Subwatershed	Onsite Sewer Systems Baseline Load (counts/yr)	Onsite Sewer Systems Allocated Load (counts/yr)	Onsite Sewer Systems Percent Reduction	Total Reduction
Boggs Creek	WVKG-19-Q-1-A	1970	5.41E+14	0.00E+00	100	5.41E+14
Little Sewell Creek	WVKG-19-Q-1	1971	1.62E+15	0.00E+00	100	1.62E+15
Sewell Creek	WVKG-19-Q	1972	4.76E+14	0.00E+00	100	4.76E+14
Little Creek	WVKG-19-Q-3	1973	7.79E+14	0.00E+00	100	7.79E+14
UNT	WVKG-19-Q-3-A	1974	4.33E+13	0.00E+00	100	4.33E+13
Little Creek	WVKG-19-Q-3	1975	2.60E+14	0.00E+00	100	2.60E+14
Sewell Creek	WVKG-19-Q	1976	4.81E+14	0.00E+00	100	4.81E+14
Sturgeon Branch	WVKG-19-Q-4	1977	2.16E+14	0.00E+00	100	2.16E+14
Sewell Creek	WVKG-19-Q	1978	3.59E+15	0.00E+00	100	3.59E+15
Sewell Creek	WVKG-19-Q	1980	3.90E+14	0.00E+00	100	3.90E+14
UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	1981	4.33E+13	0.00E+00	100	4.33E+13
Sewell Creek	WVKG-19-Q	1982	4.98E+14	0.00E+00	100	4.98E+14
	Totals		**8.94E+15**	**0.00E+00**		**8.94E+15**

Metals

The WVDEP monitoring indicated that there are thirteen streams (38 subwatersheds) impaired by metals. Twelve are impaired by iron and one, Briery Creek, is impaired by aluminum. None of the streams had violations for selenium. Metals and pH point sources can be classified into two major categories: permitted non-mining point sources and permitted mining point sources. The point sources are regulated by NPDES permits with discharge limitations. The TMDL lists six categories of nonpoint sources for metal pollution: abandoned mine lands, mining bond forfeiture, forest harvest, roads, barren land and stream bank erosion.

Table 12: Sources for All Metals

Sources	Baseline (lbs/yr)	% of Total
AML	17,616	7.17%
Bond Forfeiture	17,170	6.98%
Forest Harvest	7,034	2.86%
Roads	4,922	2.00%
Barren Land	17,681	7.19%
Stream Bank Erosion	181,388	73.79%
Totals	245,810	100.00%

AML

Abandoned mine lands (AML) are those lands mined for coal prior to the 1977 Surface Mine Reclamation and Control Act (SMRCA) and abandoned without reclamation. This category includes both deep mines and strip mines which contain high walls. As such both discharges from abandoned deep mines and runoff from abandoned strip mines are included in this category.

Table 13: AML Allocations and Reductions

Stream Code	Stream Name	Subwatershed	Metal	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Total Lbs/yr reduction required
WVKG-19-Q	Sewell Creek	1968	Iron	15.6	0.2	99	15.4
WVKG-19-Q	Sewell Creek	1978	Iron	11,627.70	317.9	97.3	11309.8
WVKG-19-U-2-A	Briery Creek	1988	Aluminum	2,952.90	118.1	96	2834.8
WVKG-19-V-7	Kuhn Branch	2013	Iron	992	9.9	99	982.1
WVKG-19-V	Little Clear Creek	2014	Iron	1,937.90	19.4	99	1918.5
		Totals		**17526.1**	**465.5**		**17060.6**

Briery Creek is the only stream impaired by aluminum and listed in the Clear Creek drainage. The other four impaired subwatersheds are impaired for iron with two in the Sewel Creek drainage and two in the Little Clear Creek drainage.

Bond Forfeiture

The coal mining sites which were mined after 1977 but where the company abandoned the site and forfeited their bond are listed in the bond forfeiture category. The AML Program (WVAML) works to reclaim the AML sites while the Office of Special Reclamation (OSR) reclaims the bond forfeiture sites.

WVDEP's Division of Land Restoration, OSR, provided bond forfeiture information and data for the TMDL. This information included the status of both land reclamation and water treatment activities. There are 5 bond forfeiture sites that comprise approximately 318 acres included in the Sewell Creek and Little Clear Creek subwatersheds.

Table 14: Bond Forfeiture Allocations and Reductions

Stream Code	Stream Name	Subwatersheds	Metal	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Total Lbs/yr reduction required
WVKG-19-Q-1	Little Sewell Creek	1971	Iron	279	130.8	53.1	148.2
WVKG-19-Q	Sewell Creek	1978	Iron	220.2	103.3	53.1	116.9
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	2003	Iron	8,857.10	1,417.10	84	7440
WVKG-19-V-4	Cutlip Branch	2005	Iron	758	121.3	84	636.7
WVKG-19-V	Little Clear Creek	2014	Iron	7,055.20	1,128.80	84	5926.4
		Totals		**17169.5**	**2901.3**		**14268.2**

Forest Harvest

In 2003-2004 during TMDL sampling there were 10 registered sites that encompass 1,384 acres of active timber harvest in the impaired subwatersheds. Registered operations for 2013 include 25 operations encompassing 791 acres in the impaired subwatersheds. That is a 43% reduction in acres affected.

Table 15: Forest Harvest Allocations and Reductions

Stream Code	Stream Name	Subwatershed	Metal	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Total Lbs/yr reduction required
WVKG-19-Q	Sewell Creek	1972	Iron	107.4	53.7	50	53.7
WVKG-19-V	Little Clear Creek	1978	Iron	57.4	14.2	75.3	43.2
WVKG-19-V-4	Cutlip Branch	2005	Iron	1,235.90	294.6	76.2	941.3
WVKG-19-V-6	Wallace Branch	2009	Iron	613.6	144.8	76.4	468.8
WVKG-19-V	Little Clear Creek	2014	Iron	763.1	185.1	75.7	578
		Totals		**2777.4**	**692.4**		**2085**

Roads

Runoff from paved and unpaved roadways can contribute significant sediment loads to nearby streams. Heightened stormwater runoff from paved roads can increase erosion potential. Unpaved roads can contribute significant sediment loads through runoff, as they are both a source and easy pathway for sediment transport. Roads that traverse stream paths elevate the potential for direct deposition of sediment. Road construction and repair can further increase sediment loads if BMPs are not properly employed. There are 551.4 miles of paved roads and 464.3 miles of unpaved roads in the Meadow River watershed.

Table 16: Roads Allocation and Reductions

Stream Code	Stream Name	Subwatershed	Metal	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Total Lbs/yr reduction required
WVKG-19-Q	Sewell Creek	1968	Iron	11.2	5.6	50	5.6
WVKG-19-Q-1	Little Sewell Creek	1969	Iron	127.1	12.7	90	114.4
WVKG-19-Q-1-A	Boggs Creek	1970	Iron	416.9	208.5	50	208.4
WVKG-19-Q-1	Little Sewell Creek	1971	Iron	308.4	154.2	50	154.2
WVKG-19-Q	Sewell Creek	1972	Iron	184	92	50	92
WVKG-19-V	Little Clear Creek	1994	Iron	244.4	26.9	89	217.5
WVKG-19-V-1	Beaver Creek	1995	Iron	69.5	7.6	89	61.9
WVKG-19-V-1	Beaver Creek	1996	Iron	639.4	70.3	89	569.1
WVKG-19-V-1.2	UNT	1997	Iron	29.6	3.3	89	26.3
WVKG-19-V	Little Clear Creek	1998	Iron	111.3	12.2	89	99.1
WVKG-19-V-2	Stoney Run	1999	Iron	68.1	7.5	89	60.6
WVKG-19-V	Little Clear Creek	2000	Iron	103.9	11.4	89	92.5
WVKG-19-V-3	Rader Run	2001	Iron	276	30.4	89	245.6
WVKG-19-V	Little Clear Creek	2002	Iron	343.6	37.8	89	305.8
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	2003	Iron	55.4	5.5	90	49.9
WVKG-19-V	Little Clear Creek	2004	Iron	56.2	6.2	89	50
WVKG-19-V-4	Cutlip Branch	2005	Iron	78.8	8.7	89	70.1
WVKG-19-V	Little Clear Creek	2006	Iron	44.4	4.9	89	39.5
WVKG-19-V-5	Laurel Creek	2007	Iron	400.1	44	89	356.1
WVKG-19-V	Little Clear Creek	2008	Iron	37	4.1	89	32.9
WVKG-19-V-6	Wallace Branch	2009	Iron	25.3	2.8	89	22.5

WVKG-19-V	Little Clear Creek	2010	Iron	27.4	3	89	24.4
WVKG-19-V-7	Kuhn Branch	2011	Iron	59.6	6.6	89	53
WVKG-19-V-7-A	Joe Knob Branch	2012	Iron	55.8	6.1	89	49.7
WVKG-19-V-7	Kuhn Branch	2013	Iron	157.6	17.3	89	140.3
WVKG-19-V	Little Clear Creek	2014	Iron	429.8	47.3	89	382.5
		Totals		**4360.8**	**836.9**		**3523.9**

Barren Land

In the TMDL and the TMDL Technical Document the land use "barren land" is not described. The inference is that any modeled land that is not forested or included into any other land use is classified as "barren land".

Table 17: Barren Land Allocations and Reductions

Stream Code	Stream Name	Subwatersheds	Metal	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Total Lbs/yr reduction required
WVKG-19-Q-1-A	Boggs Creek	1970	Iron	308.6	154.3	50	154.3
WVKG-19-Q-1	Little Sewell Creek	1971	Iron	171.3	85.6	50	85.7
WVKG-19-V	Little Clear Creek	1994	Iron	3,339.40	367.3	89	2972.1
WVKG-19-V-1	Beaver Creek	1995	Iron	226.7	24.9	89	201.8
WVKG-19-V-1	Beaver Creek	1996	Iron	11.8	1.3	89	10.5
WVKG-19-V-1.2	UNT	1997	Iron	42.2	4.6	89	37.6
WVKG-19-V	Little Clear Creek	1998	Iron	254.4	28	89	226.4
WVKG-19-V-2	Stoney Run	1999	Iron	2.2	0.2	89	2
WVKG-19-V	Little Clear Creek	2000	Iron	61	6.7	89	54.3
WVKG-19-V-3	Rader Run	2001	Iron	3.3	0.4	89	2.9
WVKG-19-V	Little Clear Creek	2002	Iron	7	0.8	89	6.2
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	2003	Iron	0.4	0	90	0.4
WVKG-19-V	Little Clear Creek	2004	Iron	2.6	0.3	89	2.3
WVKG-19-V-4	Cutlip Branch	2005	Iron	1.1	0.1	89	1
WVKG-19-V	Little Clear Creek	2006	Iron	21.8	2.4	89	19.4
WVKG-19-V-5	Laurel Creek	2007	Iron	746.8	82.1	89	664.7
WVKG-19-V-6	Wallace Branch	2009	Iron	1.1	0.1	89	1

WVKG-19-V	Little Clear Creek	2010	Iron	0.4	0	89	0.4
WVKG-19-V-7	Kuhn Branch	2011	Iron	56.6	6.2	89	50.4
WVKG-19-V-7-A	Joe Knob Branch	2012	Iron	4,174.30	459.2	89	3715.1
WVKG-19-V-7	Kuhn Branch	2013	Iron	3,971.90	436.9	89	3535
WVKG-19-V	Little Clear Creek	2014	Iron	7.8	0.9	89	6.9
		Totals		**13412.7**	**1662.3**		**11750.4**

Stream Bank Erosion

The largest contributor of iron in the impaired waters of the Meadow River comes from stream bank erosion. This source alone accounts for 73.79% of the iron, far more than all other sources combined. The information for stream bank stability was provided by the WVDEP during the monitoring process using the Rapid Bioassessment Protocol. With few exceptions, most of the stream bank erosion is occurring in the more populated Sewell Creek drainage.

Table 18: Stream Bank Erosion Allocations and Reductions

Stream Code	Stream Name	Subwtershed	Metal	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Total Lbs/yr reduction required
WVKG-19-Q	Sewell Creek	1968	Iron	37,677.00	3,767.70	90	33909.3
WVKG-19-Q-1	Little Sewell Creek	1969	Iron	63,150.80	2,526.00	96	60624.8
WVKG-19-Q-1-A	Boggs Creek	1970	Iron	46,281.70	1,851.30	96	44430.4
WVKG-19-Q-1	Little Sewell Creek	1971	Iron	2,885.80	173.2	94	2712.6
WVKG-19-Q	Sewell Creek	1972	Iron	15,335.20	2,555.90	83.3	12779.3
WVKG-19-Q-3	Little Creek	1973	Iron	354.8	156.1	56	198.7
WVKG-19-Q	Sewell Creek	1976	Iron	5,364.70	858.4	84	4506.3
WVKG-19-Q-4	Sturgeon Branch	1977	Iron	574.5	344.7	40	229.8
WVKG-19-Q	Sewell Creek	1978	Iron	1,680.50	492.9	70.7	1187.6
WVKG-19-Q	Sewell Creek	1980	Iron	1,083.20	390	64	693.2
WVKG-19-Q-17	UNT/Sewell Creek RM 11.04	1981	Iron	348.6	209.1	40	139.5
WVKG-19-U-2-A	Briery Creek	1988	Iron	1,861.80	558.5	70	1303.3
WVKG-19-V	Little Clear Creek	2014	Iron	246.7	42	83	204.7
		Totals		**176,845.30**	**13,925.80**		**162,919.50**

pH

Three streams are listed in the TMDL as impaired for pH: Briery Creek, Laurel Creek and Little Clear Creek. Briery Creek is impaired by acid mine drainage while the other two are listed for acid deposition. According to the TMDL technical document, pH is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Therefore, a more practical approach to meeting the water quality criteria for pH is to use the concentration of metal ions as a surrogate for pH. It was assumed that reducing instream concentrations of metals (iron and aluminum) to meet water quality criteria (or TMDL endpoints) would result in meeting the water quality standard for pH. This assumption was verified by applying the DESC-R model.

Table 19: pH Allocations and Reductions

Stream Name	Stream Code	SWS	Median pH	Baseline Average Annual Net Acidity Load (ton/yr)	Allocated Average Annual Net Acidity Load (ton/yr)	Reduction (tons/yr)
Laurel Creek	WVKG-19-V-5	2007		3.49	2.39	1.10
Little Clear Creek above Kuhn Branch	WVKG-19-V	2014		3.33	1.99	1.34
Briery Creek	WVKG-19-U-2-A	1988	7.87			

LOAD REDUCTIONS REQUIRED

The load reductions being called for in this watershed based plan are based on the TMDL for the Gauley River watershed, specifically Appendix 8: Meadow River. The TMDL is a load allocation that expresses what is allowed to enter the stream. Load reduction (LR) targets are determined by subtracting the TMDL from baseline load (BL) levels:

LR= BL – TMDL

LR will be the accumulated reductions from practices installed during the implementation process. As such, it becomes the primary criteria for tracking environmental results.

As stated in the previous section there are three causes of impairment in the Meadow River watershed: fecal coliform, metals and pH. Only three streams are listed for a pH impairment, one, Briery Creek is also listed for both iron and aluminum impairments. As explained in the TMDL Technical Document the pH impairment is tied to the metals pollution. Therefore meeting the TMDL target for removing the metals should resolve the pH impairment. The other two streams have low buffering capacity and are impaired by atmospheric acid deposition. The acid load reductions needs to restore water quality are: Laurel Creek, 1.1 tons/yr (2,200 lbs/yr) and Little Clear Creek, 1.34 tons/yr (2,680 lbs/yr).

Fecal coliform load reductions needed to comply with the TMDL are listed by source in Table 23.

Table 20: Sources for Reductions in Fecal Coliform

Source	Reductions cfu/yr	% of Total
Failing Septics	8.94E+15	99.23
Pasture/Grassland	6.47E+13	0.72
Residential	4.69E+12	0.05
Totals	**9.01E+15**	**100**

On-site Wastewater Systems

Inadequate on-site wastewater systems including straight pipes and failing septic systems is by far the dominant source of fecal coliform. The TMDL calls for a 100% reduction in fecal coliform from these failing systems. This is because the West Virginia Bureau for Public Health (BPH) regulations prohibit the discharge of raw sewage into surface waters from all illicit discharges of human waste from failing septic systems and straight pipes. Therefore the load allocation is based on legal criteria not on water quality impacts. However in the impaired subwatersheds the predominant source of fecal coliform comes from failing septic systems.

In the entire Gauley River watershed for the TMDL model the calculated concentrations for 30 observations were averaged to yield a failing septic fecal coliform concentration of 1.78E+6 counts per 100 ml. This concentration was used as a starting point with further refinement during calibration of the model. The concentration for the Meadow River's septic impaired streams was a concentration of 1.98E+6 cfu/100ml.

Table 21: Number of Households Needing Septic Repair/Replacement

Stream Name	Subwatershed	Total # households not on public sewer	Complete Septic Failure %	Households with complete failure	Seasonal Septic Failure %	Households with seasonal failure
Boggs Creek	1970	25	10	2.5	7	1.75
Little Sewell Creek	1971	75	10	7.5	7	5.25
Sewell Creek	1972	22	10	2.2	7	1.54
Little Creek	1973	36	10	3.6	7	2.52
UNT	1974	2	10	0.2	7	0.14
Little Creek	1975	12	10	1.2	7	0.84
Sewell Creek	1976	8	28	2.24	19	1.52
Sturgeon Branch	1977	10	10	1	7	0.7
Sewell Creek	1978	27	10	2.7	7	1.89
Sewell Creek	1978	50	28	14	19	9.5
Sewell Creek	1980	18	10	1.8	7	1.26
UNT/Sewell Creek RM 11.04	1981	2	10	0.2	7	0.14
Sewell Creek	1982	23	10	2.3	7	1.61
	Totals	310		48		35
	Total households needing septic work				83	
	Zone 1					
	Zone 2					

Table 18 above shows the modeled number of homes needing septic system repairs (seasonal failure) or replacement (complete septic failure) by subwatershed. During implementation a fraction of a home cannot be done so to meet the TMDL the totals must be rounded up. There are 48 homes with completely failing septic systems, 35 with seasonally failing systems for a total of 83 homes needing an installation or repair of their septic systems. The total load reductions by subwatershed are shown in Table 11. The total reduction of fecal coliform needed from this source is 8.94E+15 cfu/year.

Agriculture

The Gauley River TMDL and the Meadow River Appendix do not consider agriculture a widespread source of fecal coliform. However there are isolated instances of pastures and feedlots near impaired segments that potentially have significant localized impacts on in-stream bacteria levels. As shown in Table 3 agriculture only accounts for 0.84% of the baseline load of fecal coliform, according to the TMDL.

Within the streams requiring load reductions from agricultural sources, there is an estimated 1253 animal units of grazing livestock. Considering the baseline load from the TMDL of 7.45E+13 as the starting point, this would give a load of 5.94E+10 counts per year per AU. The Average farm in this watershed maintains approximately 50 AU, this indicates that 26 conservation plans with water quality protections practices at a 92% efficiency rate will need to be implemented to obtain the load reductions.

Table 22: Conservation Plans Needed

Subwatersheds	Stream Name	Pasture/Grassland Baseline Load (counts/yr)	Animal Units Per Sub Watershed	Implemented Conservation Plans Needed	Total Load Reduction Expected
1970	Boggs Creek	1.14E+13	192	4	1.05E+13
1971	Little Sewell Creek	6.90E+12	116	2	6.33E+12
1972	Sewell Creek	5.03E+12	85	2	1.25E+12
1974	UNT	2.05E+12	35	1	1.84E+12
1975	Little Creek	2.57E+12	43	1	2.31E+12
1977	Sturgeon Branch	9.19E+12	155	3	8.25E+12
1978	Sewell Creek	1.76E+13	296	6	1.65E+13
1980	Sewell Creek	4.49E+12	76	2	4.03E+12
1981	UNT/Sewell Creek RM 11.04	3.85E+12	65	1	3.46E+12
1982	Sewell Creek	1.14E+13	192	4	1.02E+13
	Totals	**7.45E+13**	**1255**	**26**	**6.47E+13**

Residential

Residential sources are not very significant for the TMDL accounting for only 0.11% of the baseline load and 0.05% of the targeted load reductions. The total reduction from this category in the TMDL is 4.69 E+12 with 93.6% of that coming from Rainell and surrounding neighborhoods. The load reductions will have to come from the residents following the suggested practices suggested in an awareness campaign as well as the local communities implementing stormwater practices. Estimating load reductions from these efforts will be difficult due to the variability of numbers of animals and the consistency of following suggested BMPs. Monitoring the affected subwatersheds will be the best way of determining environmental results.

Table 23: Fecal Coliform Reductions

Subwatersheds	Stream Name	Stream Code	Pasture/Grassland Reductions (cfu/yr)	Onsite Sewer Systems Reductions (cfu/yr)	Residential Reductions (cfu/yr)
1968	Sewell Creek	WVKG-19-Q	0.00E+00	0.00E+00	7.27E+10
1969	Little Sewell Creek	WVKG-19-Q-1	0.00E+00	0.00E+00	9.00E+11
1970	Boggs Creek	WVKG-19-Q-1-A	1.05E+13	5.41E+14	0.00E+00
1971	Little Sewell Creek	WVKG-19-Q-1	6.33E+12	1.62E+15	2.88E+11
1972	Sewell Creek	WVKG-19-Q	1.25E+12	4.76E+14	3.13E+12
1973	Little Creek	WVKG-19-Q-3	0.00E+00	7.79E+14	3.00E+11
1974	UNT	WVKG-19-Q-3-A	1.84E+12	4.33E+13	0.00E+00
1975	Little Creek	WVKG-19-Q-3	2.31E+12	2.60E+14	0.00E+00
1976	Sewell Creek	WVKG-19-Q	0.00E+00	4.81E+14	0.00E+00
1977	Sturgeon Branch	WVKG-19-Q-4	8.25E+12	2.16E+14	0.00E+00
1978	Sewell Creek	WVKG-19-Q	1.65E+13	3.59E+15	0.00E+00
1979	UNT	WVKG-19-Q-14	0.00E+00	0.00E+00	0.00E+00
1980	Sewell Creek	WVKG-19-Q	4.03E+12	3.90E+14	0.00E+00
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	3.46E+12	4.33E+13	0.00E+00
1982	Sewell Creek	WVKG-19-Q	1.03E+13	4.98E+14	0.00E+00
	Totals		**6.47E+13**	**8.94E+15**	**4.69E+12**

Reductions in total metals needed to comply with the TMDL are listed by source in Table 24. The table shows that nearly 77% of the reductions should come from stabilizing eroding stream banks.

Table 24: Sources for Total Reductions in All Metals

Sources	Reduction (lbs/yr)	% of Total
AML	17,061	8.06
Bond Forfeiture	14,268	6.74
Forest Harvest	2,085	0.99
Roads	3,524	1.67
Barren Land	11,750	5.55
Stream Bank Erosion	162,919	76.99
Totals	**211,607**	**100**

AML

Abandoned mine lands TMDL reductions account for 8.06% of the total reductions needed. However 100% of the aluminum reductions called for is coming from an AML source in Briery Creek (SWS 1998). The called for aluminum reductions is 2834.7 lbs/yr. All other metal reductions for metal impaired streams are for iron, 14,225.8

lbs/yr. Briery Creek is the only designated AML discharge site. The other AML sites are highwalls and refuse areas. So, 83% of the AML reductions will come from land reclamation requiring a sediment reduction of 17.78 tons/yr.

The WVAML program is now actively working on an AML source called the Burdett Complex which is in the lower part of the watershed. This project site is primarily highwall elimination but it does contain a large refuse pile. Refuse piles are known sources of metals and coal related sediment. This project will help protect the water quality of the unimpaired lower Meadow River.

Bond Forfeiture

The OSR is responsible for restoration of bond forfeiture sites. There are 1097.8 acres of bond forfeiture sites within the impaired subwatersheds. The OSR is treating AMD discharges with dosing or passive treatment systems. Land reclamation techniques are used to prevent runoff from eroding metals and acid into the stream. To achieve the 14,268 lbs/yr iron reduction requires a 17.84 tons/yr reduction in sediment.

Forest Harvest

The number acres being logged in 2013 in the impaired subwatersheds is 43% less than in 2004 when data was collected for the TMDL. The logging impact is due to erosion from roads, landings and disturbed hillsides. If this disturbance is 43% less than 2004 it can be assumed the impact is also 43% less by modeling. The baseline load in 2004 was 2777.4 lbs/yr of iron, a 43% reduction would result in a baseline of 1194.3 lbs/yr iron. The load allocation is 692.4 lbs/yr which means the load reduction required would be 501.8 lbs/yr of iron, or 0.63 tons/yr of sediment. This load reduction and more will be accomplished by the revegetation of roads and landings before the companies are released from their LSCA requirements by the DOF.

The combination of reduced logging and enforcement of the LSCA will accomplish the TMDL. However logging is a variable and usually a short-lived activity. Over time the loadings, locations and reductions from this source will change.

Roads

This source category is one of the most challenging to deal with. Implementing stormwater BMPs can be installed but are likely to

Sediment to iron conversion

Some of the mining and all of the non-mining sources for iron are due to erosion of disturbed areas. As the TMDL Technical Document explains "It was determined that all of the sediment-impaired streams exhibited impairments pursuant to total iron water quality criteria, and that sediment reductions were necessary to ensure compliance with iron criteria exceed those necessary to resolve biological impairments." Therefore iron became a surrogate for sediment impairments. To determine the amount of iron per ton of sediment the TMDL model needed a percentage of iron in sediment. The resource used was the U.S. Geological Survey (USGS) document Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. This document provides an average percentage of iron in soil in the eastern United States of 2.5%. Estimating the tons of sediment stabilized by a BMP is the more traditional and accepted parameter for determining the environmental impact of BMP implementation. So, determining sediment loads and reductions will be a necessary part of project proposals and reporting. The estimated sediment loads can then be converted to lbs/yr of iron.

produce small environmental benefits. Dirt roads are the biggest problem because off-road vehicle and ATV use never allows them to "heal" naturally. Road restoration would require blocking vehicle use or protecting the surface with gravel.

It is very difficult to estimate the restoration needed due to the wide variability in slope and precipitation events. A study done by the Center for Dirt and Gravel Road Studies has resulted in an average 5.6 lbs of sediment for a 100 foot section for an approximate ½ inch rain event. Assuming an average of 39 inches or rain per year as indicated in the TMDL and using the Center's average 32,268 feet (6.1 miles) of dirt roads needs to be restored to accomplish the required load reduction of 3,523.7 lbs/yr of iron, or 70.5 tons/yr of sediment.

Barren Land

There is 1,881.36 acres listed as barren land in the impaired subwatersheds. By using the TMDL baseline for barren land in these subwatersheds that would give an estimate of 7.13 lbs/yr/acre eroding into these streams. To achieve the estimated load reduction for iron of 11,750 lbs/yr it would require vegetating 1648 acres. This will require a reduction of 470,000 lbs/yr, or 235 tons/yr, of sediment.

Stream Bank Erosion

Erosion rates on stream banks are determined by a variety of factors so the first action needed in this category is a more thorough assessment of the stream banks to determine the most vulnerable areas. An estimated 29.29 acres of eroding stream banks and 46,787 linear feet of stream exist in the thirteen subwatersheds the TMDL has identified as needing stream bank stabilization.

The Bank Erodibility Hazard Index (BEHI) will be used to classify the erodibility of the banks. Assuming an average Moderate score and using estimates and research done in other areas an estimated load reduction for sediment of 0.07 tons/yr or 140 lbs/yr per linear foot can be expected. The largest reduction of iron is expected from this source, 162,919.5 lbs/yr of iron. This will require an estimated sediment load reduction of 6,516,780 lbs/yr or 3,258.4 tons/yr. This will require approximately 46,548 linear feet of stream bank being stabilized.

Other Sources

Pastures and grasslands were not listed for reductions in iron due to sediment. However it is known that installing BMPs for livestock to reduce fecal coliforms can also result in reductions in sediment. It is expected that removing livestock from the stream and protecting riparian zones will produce a "bonus" of sediment load reductions.

pH

Two subwatersheds have been listed as impaired due to acidic deposition requiring 2.44 tons/yr of acid neutralization. At this time the most cost effective way of treating atmospheric acid impaired streams is with limestone fines at a one to one ration of acid to calcium carbonate ($CaCO_3$). Assuming an average 85% $CaCO_3$ content for limestone fines a treatment of 2.87 tons/yr would be required.

✱ *TMDL load reductions for metals and pH are listed by source and subwatershed in Tables 13 – 19.*

MANAGEMENT MEASURES

All point sources are regulated according to the type of point source. The TMDL has identified the sources of the pollutants of concern as nonpoint sources. To correct these sources BMPs or restoration projects must be implemented. All management measures to be installed to restore these streams must come about with the voluntary cooperation of the landowners. To do this the project managers will offer a variety of practices which can be specifically designed or combined to suit the circumstances for each project site.

Agriculture

The BMPs to be established for restoration of the agriculturally impaired watersheds will be designed based on an assessment of the farm, consultation with the farmer and an assessment of the impact to the stream. A conservation plan for each farm will prescribe a combination of practices which will have a shared efficiency not a cumulative one for preventing pollution. For example: the establishment of a protected riparian zone with removing livestock access from the stream requires the proper placement of alternative watering facilities for the livestock.

The goal of these plans will be to install practices that will reduce the time livestock spend in or near a stream or ephemeral drainage. These practices will also have the intent of dispersing the livestock to avoid serious damage from trampling and manure build up. These management measures will be planned to assure they meet the overall load reduction required by the TMDL. These BMPs will be implemented through sound conservation planning and funded by various State programs, Federal Farm Bill Programs, Section 319 grants and landowner contributions. Where appropriate, these practices will be combined with the stream bank restoration work already in progress. The result will be a comprehensive conservation plan for each farm.

Conservation Plans: A record of landowners' decisions combined with a combination of agronomic, management and engineered practices that protect and improve soil productivity and water quality; the plan must meet agency technical standards. These plans include technical advice prepared by a certified conservation planner. All practices included in the USDA Natural Resources Conservation Service Field Office Technical Guide are eligible to be included in a conservation plan.

Nutrient Management Plan (NMP): A nutrient management plan is a written site specific plan which describes how the major plant nutrients (nitrogen, phosphorus and potassium) are to be managed annually. The goal of nutrient management planning is to minimize adverse environmental effects, primarily upon water quality, and avoid unnecessary nutrient applications above the point where long run net farm financial returns are optimized.

The plan will address the most critical farm nutrient problems through measures to manage fertilizers and animal manures to reduce runoff, erosion and nutrient loss. A nutrient management plan should provide for the safe on-farm or off- farm transport of one-hundred percent of the animal manures produced or used on the farm. NMPs are considered a land use change in the CBP model and are assigned no efficiency.

Land Application: Land application guidelines should be based on an assessment of the farm's nutrient status of nitrogen or phosphorus. Application should not be based on field access, storage capacity or the lack thereof. Annual production estimates should also be considered. A manure analysis should be performed annually. A soil analysis should be performed every three years when your nutrient management plan is updated.

Manures or litter should not be applied to land with more than 25 percent slope unless sufficient vegetative cover is present to retain and utilize the applied nutrients. Manure or litter should not be applied within 50 feet of any water source or sink-hole or within 100 feet of a well head. Timing should be based on nutrient requirements of the crop, field conditions and weather. Land application on fallow, dormant crops or frozen/snow covered or saturated land is not recommended.

Animal Waste Management Systems: Livestock and Poultry operators design practices for proper storage, handling, and use of wastes generated from confined animal operations. This includes a means of collecting, scraping, or washing wastes and contaminated runoff from confinement areas into appropriate waste storage structures. For poultry operations, litter sheds are typically used. Livestock feedlots and dairies commonly utilize waste lagoons or move animal feeding areas away from the streamside.

Runoff Control: This is a class of BMPs designed to direct water away from pollution sources and slow down and filter that runoff before it enters the stream. These BMPs can include guttering, diversion ditches, grass swales, wetlands, runoff storage and filter strips.

Alternative watering sources, with fencing: To reduce occurrences of livestock coming into direct contact with a stream or other waterway, a narrow strip of land along the stream bank can be fenced off. Alternative watering sources, such as spring development and wells with pipelines and troughs, must then be provided for the livestock. This will prevent livestock form defecating in or close to the stream, and reduce stream bank erosion.

Heavy Use Area Protection: Practices that restore or put into proper use, areas that are or have been used by large numbers of areas for feeding, walking, loafing.

Conservation Easements: These easements compensate landowners for voluntarily restricting their activities in sensitive areas.

Riparian Buffer practices: Areas of vegetation (herbaceous or woody) that are tolerant of intermittent flooding or saturated soils and that are established or managed in the transitional zone between terrestrial and aquatic habitats.

Filter Strip: A strip or area of herbaceous vegetation situated between cropland, grazingland, or disturbed land (including forestland) and environmentally sensitive areas.

Manure Transfer: A complete removal of manure or litter from the watershed to be used as fertilizer somewhere else.

Miscellaneous BMPs

- *Conservation tillage* practices to improve crop residue management and increase soil tilth and organic matter. Such practices may include no-till and minimum tillage practices.
- *Crop rotation* to utilize legume nitrogen credits and nutrient residuals in the soil.
- Use of *cover crops* for fallow land or over-wintering of crop land.
- *Vegetative buffer zones and grassed filter strips* for stream and sink hole protection. This should be a 35 foot minimum.
- *Grassed waterway* is a natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff.
- *Strip cropping and contour farming* to slow surface water runoff.
- *Diversion systems* to route storm water away from facilities and storage sites.
- *Constructed wetlands* are typically engineered complexes of saturated substrates, emergent and submergent vegetation and water. They are used to slow runoff to the stream and use natural processes to reduce fecal coliform and nutrients.

Estimated load reductions will be based on the number of animal units affected by the BMP and its efficiency.

Table 25: BMP Efficiencies

BMP	Efficiency Rate
Filter Strip	70%
Single Stage Waste Stabilization Lagoon	85%
Sediment Pond/Swale in Combination with Filter Strip	85%
Fencing (complete removal of livestock from waterway)	90%
Buffer	80%
Off Watering System Without fencing	50%
Off Site Watering System With Flash Rotational Grazing In the Riparian Zone	90%

On-site wastewater treatment:

Two categories of failing septic systems have been identified: completely and periodically failing systems. Experience has shown that completely failing systems usually indicates a lack of any system or one that is so antiquated or poorly maintained it fails on a year round basis. Periodically failing systems are usually septic systems that are not being properly maintained so that the drain fields are not functioning as they should and fail during the wet season. To determine the specific needs a field survey must be conducted first to identify problem sites. This will require the participation of the county Health Department (HD). Once a problem site has been identified a specific project plan can be developed and must be approved by the HD.

Completely failing systems usually require the installation of a new or upgraded system. New or upgraded systems will be installed in compliance with Health Department regulations based on home size and soil porosity and must be approved by the PCHD Sanitarian. The average cost for such a project is about $7500 but can range widely due to specific circumstances. Similar efforts in other watersheds throughout the state have used a combination of Section 319 grants administered through DEP and low interest loans from the On-Site Loan Program (OSLP) to fund these system replacements.

Periodically failing systems are usually systems where pumping the system combined with proper maintenance will solve the problem. One potential solution that has been used successfully in some Potomac watersheds is to offer residents partial payment coupons for septic tank pumping in combination with an educational effort to inform homeowners how to maintain their system in the future. In most cases this has cost less than $500 per home. Due to the sparse population density in the watershed cluster systems would not be cost effective. However if the survey shows a grouping of failures in one location such a system could be an option.

Mining

Land reclamation

Removing acid-forming material: This method has the potential to eliminate the acid load completely if all of the acid-forming material can be removed. 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: Can involve moving refuse from a drainage area or using surface water management techniques (see below).

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.

Isolating from below: Interactions between water and acid-forming materials can be minimized by separating the refuse from impermeable bedrock below and providing drainage below the pile. 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.

Passive AMD treatment

Successive Alkalinity Producing Systems (SAPS): Also known as "vertical flow ponds," water encounters two or more treatment cells in series. First, water passes through organic material to deplete dissolved oxygen. In a second cell, the anoxic solution passes through limestone and is neutralized. Finally, Water then runs through an aeration process and settling pond, in which ferrous iron oxidizes and then precipitates out of solution.

Open limestone channels (OLC): Open channels filled with limestone that AMD passes through and is neutralized.

Limestone leach beds (LLB): Limestone leachbeds are most effective when water has a pH of 3 or less, and when water retention times are short. The AMD passes through a pit filled with limestone.

Compost wetlands (CW): Cause precipitates to fall out of suspension and 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.

Active Treatment

Active treatment involves the dosing of an acid flow with alkaline materials to neutralize the acid. It can, and should, include a settling pond to allow metals to precipitate out of the water. However, some treatments may dose the stream itself allowing the metals to precipitate out in the stream. This is less expensive and does not require periodic cleaning of the pond and landfilling the precipitates.

Erosion

In most cases barren land has been disturbed and possibly damaged in a way that has prevented the natural process of succession of vegetation. Depending on the damage, soil or soil enhancements may be needed to allow successful planting of vegetation. It might also be necessary to do runoff management by directing drainage away from vulnerable areas and/or protecting drainage ditches with stone.

Reducing erosion from dirt roads can involve runoff management and protecting the road surface. Drainage is the key especially on roads with steep slopes. Drainage ditches should be sufficiently below road grade with sufficient drainage outlets. Roads can be sloped to allow dispersed sheet flow off the road by removing berms. A sufficient number of drainage outlets including culverts, cross drains and swales are needed with steeper slopes requiring more. Adding limestone gravel to the road surface protects that surface and reduces gullies.

Natural Stream Channel Design (NSCD) is the acceptable method of stabilizing stream banks, unlike rip-rap it does not destroy the hydrological function of the stream. It relies on a geomorphic approach using natural stability concepts. The objectives are to restore a stable, self maintaining channel form, reestablish interactions between stream and adjacent riparian areas and restore the natural functions of floodplains. Each problem area is assessed and the projects are designed to accomplish the objectives. Some of the techniques used in these projects include: root wad and boulder revetment, cross vanes, rock vanes, boulder structures such as J hooks and weirs and toe benches. Critical to the success of any NSCD is the establishment of a protected riparian area.

Priorities

In order to effectively implement the TMDL, priorities for projects should be set using the following criteria:

- Significance of pollutant contribution
- Public and landowner support or participation
- Opportunity to use additional resources or volunteers
- Cost vs. Benefit

Using these criteria the best choice for selecting a priority watershed to start becomes Sewell Creek, including Little Sewell Creek. The town of Rainell has been the focus of citizen involvement in bringing attention to the Meadow River and the problems affecting it. The city government has expressed an interest in an education program to reduce stormwater and residential impacts. Sewell Creek is also the area of greatest pollution contribution. Little Sewell is less so but is a contributor to Sewell Creek impairment in the lower section. Cost vs. benefit and the availability of a watershed association and a cooperative town government in Sewell Creek add to its priority status.

This TMDL offers some special challenges to implementation if it is strictly followed. For one, the load allocations for iron are spread through a wide variety of source categories and subwatersheds. If followed strictly, these load allocations require a load reduction to be made in that category and subwatershed. In several cases the reductions are insignificant to the impairment of the stream while the costs for such projects could be high. It is clear that this TMDL was not developed with any consideration of cost vs. benefit for implementation. Some of these categories such as forest harvest and barren land naturally heal over time and may not be contributing pollutants today or in the near future.

Secondly, an agricultural contribution for sediment (iron) was not considered. It may be that livestock destabilization of stream banks is included in the stream bank erosion category. However, that is not certain and other contributions from agriculture were not included. In order to stabilize and restore stream banks on agricultural land the livestock must be excluded from stream access. This requires additional BMPs to provide water and land protection for the farm. This could lead to the necessity of agricultural BMPs in subwatersheds not listed for any agricultural impacts but having stream bank erosion load allocations in the TMDL. Monitoring after projects may show that strictly adhering to the TMDL subwatershed and source categories load reductions isn’t necessary if sufficient load reductions from other categories are achieved.

TECHNICAL AND FINANCIAL RESOURCES

Technical Resources:

West Virginia Conservation Agency (WVCA) – The WVCA will be the applicant for CWA Section 319 grants on this effort and will provide the technical assistance needed for implementation. The WVCA coordinates statewide conservation efforts to conserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, conserve wildlife and assist farmers with conservation practices. The WVCA Environmental Specialists (ES) will coordinate with other agencies and work directly with landowners to implement the practices called for in this watershed based plan. The WVCA ES will also conduct monitoring to determine the environmental results for the three impaired streams. They will also produce grant proposals and status reports.

The Natural Resources Conservation Service (NRCS) – The NRCS is the federal agency that works directly with farmers for designing and installing practices. In West Virginia they work closely with the WVCA for installing BMPs. The NRCS also implements the Wildlife Habitat Improvement Program (WHIP) and the Conservation Reserve Enhancement Program (CREP).

The West Virginia Department of Environmental Protection (DEP)

Division of Water and Waste Management (DWWM): The DWWM is the agency with primary responsibility for protecting the environment including stream water quality. The Nonpoint Source Program (NPS) within the DEP administers the Section 319 grants and the Basin Coordinators in the program work closely with project managers to accomplish the approved watershed based plans including assistance, if needed, with monitoring. The NPS also has experience and materials for outreach, education and volunteer monitoring. The Watershed Assessment Branch (WAB) includes the programs that develop the integrated watershed report with the 303(d) list of impaired streams, the TMDL and conduct water quality monitoring around the state. After completion of the installation of practices it will be WAB that makes the final determination if the TMDL has been fully implemented.

Abandoned Mine Lands and Reclamation (AML&R): The AML&R is the part of DEP that manages the reclamation of lands and waters affected by mining prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. Funded by a fee placed on coal AML&R implements projects on a priority system with emergencies first, human health and safety second and water quality third.

Office of Special Reclamation (OSR): The OSR manages the reclamation of abandoned mine lands and the treatment of AMD from coal mining that occurred after 1977 (SMCRA). Part of its funding comes from the forfeiture of bonds companies must supply prior to receiving a permit to establish a mine.

WV Division of Forestry (DOF): The DOF oversees all logging in West Virginia and is responsible for enforcing the LSCA. The DOF heads the state's logging BMP committee that establishes the standards that logging operations must conform to.

County Health Departments (HD): The county sanitarians are responsible for ensuring that the installation of all on-site wastewater systems comply with health department regulations. The Meadow River watershed contains parts of three counties: Fayette, Nicholas and Greenbrier. Most of the project area is in Greenbrier county but the county lines cross through some of the affected subwatersheds.

Meadow River Watershed Association (MRWA): The MRWA is a volunteer citizen organization that focuses primarily on water related outreach and education along with an occasional community based projects.

Town of Rainell: Rainell is where most of the urban and residential load reductions are called for and would be a partner in any stormwater runoff projects.

Financial Resources

Clean Water Act Section 319 Grants – 319 funds are provided to the state by the US Environmental Protection Agency (EPA). In West Virginia these funds are distributed by the DEP for agencies or organizations who are conducting projects related to nonpoint source pollution.

The WVCA – provides up to 15% cost share for agricultural practices associated with an approved Section 319 grant proposal.

Conservation Reserve Enhancement Program (CREP) – CREP is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. CREP addresses high-priority conservation issues in priority watersheds as designated by the NRCS State Conservationist.

Wildlife Habitat Incentive Program (WHIP) - WHIP is a voluntary program for landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land.

Environmental Quality Incentive Program (EQIP) – EQIP is a voluntary conservation program that provides assistance to farmers who face threats to soil, water, air, and related natural resources on their land. The NRCS through EQIP offers financial and technical assistance to eligible participants to install or implement structural and management practices to promote agricultural production and optimize environmental benefits to help farmers meet environmental requirements on eligible agricultural land.

The WV Onsite State Revolving Fund Program (OSLP)- is administered through the DEP. This program can be used to provide loan funding for individual onsite systems as well as homeowner-owned components of decentralized systems

WV Infrastructure and Jobs Development Council (IJDC) - Most sources of public funding for wastewater infrastructure are administered by the IJDC.

Landowners – Farmers will provide 25% matching funds for practices developed on their property. Much of these funds will be in kind for labor, equipment use, and materials. Homeowners who participate in any septic project will provide 40% of the funding.

Estimated Financial Needs

Table 26: Cost Estimates for BMPs *

BMP	**Unit cost**	**Unit**
Agriculture		
Livestock fencing	$2	linear foot
Riparian buffer establishment	$1,000	acre
Armored stream crossing	$1,200	18” culvert, 20’ length
	$2,800	30” culvert, 30’ length
	$5,900	48” culvert, 40’ length
Alternative watering source	$3,000	unit
Conservation plans	$150	plan
Critical area planting	$720	acre
Armored, roofed feeding area	$75,000	unit
Stream Banks		
Stream channel stabilization	$185	linear foot
On-site Wastewater Systems		
Septic system replacement	$7,500	unit
Septic system pumping	$500	unit action
Mining		
Land Reclamation	$10,000	acre
OLC	$40	linear foot
LLB	$2	cubic foot
Residential and Urban		
Stormwater Retention	$10,000	unit
Road Restoration		
BMP Combination w/ limestone	$5,000	Mile
Barren Land Restoration		
Revegetation/tree planting	$1500	acre

* The cost estimates per BMP are based on research, average costs from other projects and AMD Treat. Cost could vary considerably based on accessibility, fuel costs, labor cost and engineering and design costs.

Table 27: Estimated Costs of Watershed Based Plan

BMP or System	Units	Cost/Unit	Total Costs	Load Reductions	
WVCA				FC (cfu/yr)	Fe (lbs/yr)
Conservation Plans	26	$150.00	$3,900.00	6.47E+13	
Fencing	5000	$2.00	$10,000.00		
Riparian Buffers	10	$1,000.00	$10,000.00		
Alternative water source	26	$3,000.00	$78,000.00		
Roofed Feeding Area	1	$75,000.00	$75,000.00		
Stream Bank Stabilization	46,548	$185.00	$8,611,380.00		162,919.50
Septic System Replacements	42	$7,000.00	$294,000.00	6.74E+15	
Septic System Pumping	29	$500.00	$14,500.00	2.33E+15	
HD Support	1	$5,000.00	$5,000.00	NA	NA
Road Stabilization	6.1	$5,000.00	$30,500.00		3523.9
Stormwater Retention	10	$10,000	$100,000		
Barren Land Restoration	1648	$1500	$2,472,000.00		
Environmental Specialist	0.25	$30,000.00	$7,500.00	NA	NA
Monitoring	1	$5,000.00	$5,000.00	NA	NA
AML&R or OSR					
Land Reclamation	981	$10,000.00	$9,810,000.00		27,511.90
OLC	100	$40.00	$4,000.00		982.1
LLB	8000	$2.00	$16,000.00		2,834.8 (Al)
Total Plan Cost			$21,546,780.00		

Al = Aluminum. All other metal reductions are for iron.

Volunteers from the American Chestnut Foundation, Meadow River Watershed Association, Glenville State College, Virginia Tech, MeadWestvaco and other volunteers planted 660 disease resistant American chestnut trees on barren land.

Source: Meadow River Watershed Association website: http://meadowriver.org/

IMPLEMENTATION SCHEDULE

Date	Activity	Major Stream
June 2013	Submit Watershed Base Plan	All
Sept 2014	Revise Watershed Based Plan	All
June 2014	Submit 1st 319 Proposal	Sewell, Little Sewell
Aug 2014	Conduct septic survey	Sewell, Little Sewell, Little, Sturgeon, Boggs
	Project discussions with AML&R, OSR	Sewell, Little Sewell, Little Clear, Briery, Kuhn, Cutlip
Sept 2014	Monitoring	All
June 2015	Submit 2rd 319 proposal	All
	Sign contracts for 4 farms	Sewell
	Monitoring	All
	Begin septic pumping program	Sewell, Little Sewell
March 2016	Pump out 14 seasonally failing septic systems	Sewell, Little Sewell
	Install BMPs on 4 farms	Sewell
	Replace 8 septic systems	Sewell
	AML&R project design phase	Briery
	Stream bank project design phase	Sewell
June 2016	1st Stream bank stabilization project begins	Sewell, Little Sewell
	Begin sign-ups for next 10 farms	Sewell, Little Sewell
	Briery Creek project begins	Briery
	Pump out 14 seasonally failing septic systems	Sewell, Little Sewell
	Start replacement 10 fully failing septic systems	Sewell

IMPLEMENTATION SCHEDULE

Date	Activity	Major Stream
July 2016	Submit 3rd 319 proposal	All
	Monitoring	All
	Planning for next stream bank project	Sewell, Little Sewell
March 2017	Complete BMPs on 14 farms	Sewell, Little Sewell
	Complete 10 septic replacements	Sewell
	1st Stream bank stabilization completed	Sewell
March 2018	New TMDL	Meadow River
	Review TMDL and WBP, revise WBP if necessary	Meadow River
	Pump out 8 seasonally failing septic systems, project complete	Sewell, Little Sewell, Little, Sturgeon, Boggs
	Start replacement 10 fully failing septic systems	Sewell, Little Sewell
	Start BMPs on 18 farms	Sewell, Little Sewell
	2nd & 3rd stream bank projects started	Sewell, Little Sewell
	Sign-ups on last 8 farms	Sewell, Little Sewell
June 2018	Monitoring	All
	4th & 5th stream bank projects planning	Sewell, Little Sewell, Sturgeon, Boggs, Briery
	Survey dirt roads, locate demo project	All
	After review of WBP, draft revisions or submit 5th 319 proposal	All
Oct 2018	Complete BMPs on 18 farms	Sewell, Little Sewell
	Submit revised WBP if needed	All
	Select road restoration project	All
	Complete 10 septic replacements	Sewell, Little Sewell
	Complete 2nd & 3rd stream bank projects	Sewell, Little Sewell

IMPLEMENTATION SCHEDULE

Date	Activity	Stream
March 2019	Start BMPS on 8 farms	Sewell, Little Sewell
	Start planning for stream bank projects	Little Sewell, Little Clear, Briery
	Start 4th & 5th Stream bank projects	Little Sewell
	Start replacement 6 fully failing septic systems	Sewell, Little Sewell
	Start road restoration project	Little Sewell, Little Clear
	Locate Forest project	Little Clear
	Conduct survey to locate possible barren land project	Little Sewell, Little Clear
June 2019	Monitoring	All
	Submit 319 proposal for any barren land and final stream bank projects	All
Oct 2019	Complete BMPs on 8 farms	Sewell, Little Sewell
	Complete road restoration project	Little Sewell, Little Clear
	Complete 4th & 5th stream bank projects	Little Sewell
	Complete Forest project	Little Clear
	Complete barren land project	Little Sewell, Little Clear
	Complete 6 septic replacements	Sewell, Little Sewell
March 2020	Start replacement 9 fully failing septic systems	Sewell, Little Sewell
	Start stream bank projects	Little Sewell
	Review farm conservation plans, start installing any uninstalled BMPs	Sewell, Little Sewell,
	Plan road restoration projects	Little Clear
	Plan any barren land project	Little Clear

IMPLEMENTATION SCHEDULE

Date	Activity	Stream
June 2020	Monitoring	All
	Review all projects determine any outstanding needs	All
Oct 2020	Complete 9 septic replacements	Sewell, Little Sewell,
	Complete any needed farm BMPs	Sewell, Little Sewell
	Complete stream bank projects	Little Sewell
	Complete road restoration project	Little Clear
	Complete barren land project	Little Clear
March 2021	Replace 6 fully failing septic systems	Little Sewell
	Plan road restoration projects	Little Clear
	Plan barren land projects	Little Clear
	Plan stream bank projects, determine if more are needed	Little Clear, Briery
June 2021	Monitoring	All
Oct 2021	Complete 6 septic replacements	Little Sewell
	Complete barren land projects	Little Clear
	Complete stream bank projects	Little Clear, Briery
	Complete road restoration projects	Little Clear
March 2022	Monitoring and review of WBP	All
	This WBP is complete, if not revised, submit success story.	All

* *The stream designation "All" indicates that the activity can occur in any or all of the 13 TMDL streams.*

This implementation schedule is intended for this version of the WBP any amendments or revisions will require changes to the schedule.

For a break out of the implementation milestones by subwatershed see the Appendix.

WATERSHED BASED PLAN MILESTONES

Year	Implementation Milestone	Environmental Milestone	TMDL Milestone
2013	BEHI surveys		
	WBP		
2014	Projects start		
	Septic surveys		
	Monitoring begins		
2015	Limestone fines program begins - pH	4.38 tons/yr - AC	***Annual treatments to complete pH TMDL***
	CPs on 4 farms	1.05E+13cfu/yr - FC	1.79E+15 - FC in Sewell, 26.21% Sewell TMDL FC reductions
	Rainell stormwater program	7.27E+10cfu/yr - FC	
	8 septic system replacements	1.10E+15cfu/yr - FC	
	10 septic systems pumped -	6.84E+14cfu/yr - FC	
2016	14 septic systems pumped	9.58E+14cfu/yr - FC	2.21E+15 - FC 80.9% in Sewell, 1.49E+14 – FC 6.84% in Little Sewell, ***TMDL FC total reduction of 46.05%***
	10 septic systems replaced	1.37E+15cfu/yr - FC	
	CPs on 14 farms	3.57E+13cfu/yr - FC	
	1 OSR projects installed	117 lbs/yr - Fe	Sewell Creek Bond forfeiture project complete. 80.92% of Sewell Creek TMDL reduction, ***TMDL Fe total reduction of 24.95%***
	15,000 ft of stream bank stabilized	52,675 lbs/yr - Fe	
2017	29 septic systems pumped	1.98E+15cfu/yr - FC	1.72E+15 – FC 20.86% in Sewell,2.11E+14 – FC 55.94% in Little Sewell, ***TMDL FC total reduction of 67.49%***
	12 septic systems replaced	1.64E+15 cfu/yr- FC	
	8 CPs on farms, Total 26, Ag complete	2.09E+13 cfu/yr- FC	
	17967 ft of stream bank stabilized	74,380 lbs/yr - Fe	28.72% of TMDL reduction in Sewell, 55.94% in Little Sewell, ***TMDL Fe total reduction of 60.10%***

WATERSHED BASED PLAN MILESTONES

Year	Implementation Milestone	Environmental Milestone	TMDL Milestone
2018	1.53 miles road restoration	883 lbs/yr - Fe	50,544 lbs/yr of Fe reduced, 28.89% TMDL reduction ***TMDL Fe total reduction 83.98%***
	4 acres logging areas restored	2310 lbs/yr - Fe	
	23 acres barren land restored	164 lbs/yr - Fe	
	12694 ft stream bank stabilized - SB	44,430 lbs/yr - Fe	
	3 septic systems pumped - OSWW	2.05E+14 cfu/yr- FC	4.11E+15 cfu/yr reduced, 6.02% in Sewell, 6.16E+14 cfu/yr, 28.22% in Little Sewell, ***TMDL FC total reduction 78.89%***
	6 septic systems replaced - OSWW	8.21E+15cfu/yr - FC	
2019	9 septic systems replaced	1.23E+15cfu/yr - FC	8.21E+14, 12.03%, FC in Sewell, 4.11E+14, 18.81% in Little Sewell, ***TMDL FC total reduction of 92.56%***
	494 acres of barren land restored	3523.3 lbs/yr - Fe	2835 lbs/yr Al reduced, ***TMDL total Al 100%*** 24,986.5 lbs/yr Fe, 11.81% of TMDL reduction, ***TMDL Fe total reduction of 95.79%***
	Briery AML project completed	2835 lbs/yr - Al	
	3.1 miles road restoration	1788 lbs/yr -Fe	
	1078 acres bond forfeiture land restored	14,016 lbs/yr - Fe	
	77 acres AML land restored	2937.2 lbs/yr - Fe	
	775 ft stream bank stabilized	2731 lbs/yr - FC	
2020	6 septic systems replaced - OSWW	8.21E+14cfu/yr - FC	8.21E+14 FC in Little Sewell, 9.11% TMDL reduction, ***TMDL FC total reduction of 101.68%, FC TMDL completed***
	1.5 miles road restored	838lbs/yr - Fe	10,335 lbs/yr reduced in Little Clear, 4.88% of TMDL, ***TMDL Fe total reduction 100.68%, Fe TMDL complete***
	1120.4 acres barren land restored	7988 lbs/yr - Fe	
	430 ft stream bank stabilized	1509 lbs/yr - Fe	
			FC TMDL in Sewell, Little Sewell accomplished ***Fe & Al TMDL in all 13 Streams accomplished***

INFORMATION AND EDUCATION

In any watershed restoration effort informing and educating the residents of the watershed and all other stakeholders is vital. In watersheds that are as small as these with such a small population the most important form of that communication is done face to face. The WVCA Environmental Specialist has already started that process by contacting local farmers. It will be their responsibility to directly inform each farmer about the water quality issues as well as productivity issues. They will work closely with each farmer to design and customize each conservation plan to meet the TMDL while helping the farm improve his operation.

For the onsite wastewater issue the WVCA and DEP will assist the HDs in passing out information packets and brochures to the residents. Face to face contacts between the involved agencies and homeowners will be made to explain the problems and solutions.

The DOF routinely conducts training and certification sessions for loggers. The Foresters also make direct contact with operators on site.

Informational signs will be posted at major project areas such as stream bank stabilization projects. Public educational sessions will be held on nonpoint issues such as reducing storm water runoff.

The WVCA will also contact local organizations such as the 4-H to set up educational efforts. Field visits and farm tours especially after BMP installation will be conducted. Finally an attempt will be made to use the WV Save Our Streams (WVSOS) volunteer monitoring program as both an educational tool and to promote citizen involvement in protecting their watershed.

The MRWA also conducts educational and outreach sessions open to the public. They often apply for Stream Partners Program grants to conduct their outreach activities.

MONITORING

The responsibility for monitoring will fall primarily on the WVCA who will enlist the assistance of DEP and any other state or federal agency as well as volunteers. The parameters to be monitored will have to fulfill the requirements of this plan and the reporting requirements of Section 319 grants reports. The parameters will include: temperature, flow, fecal coliform, total nitrogen, total phosphorus and total suspended solids and any others that may be considered important. In addition sampling for iron will occur in conjunction with sediment reducing projects.

The timing of sampling will be up to the local project managers but should include three samples within a year during different flow regimes for establishing the baseline. Afterward, two a year during different seasons and only after practices have been installed should provide adequate data for progress assessment. To determine if stream or stream segments have been returned to water quality standards WVCA will conduct fecal coliform sampling of at least ten samples in a one month period. The methods and location will correspond to DEP quality assurance standards and the data will be submitted to DEP.

In 2013 the DEP has begun to hold public meetings to inform the public of their upcoming monitoring for a new TMDL. Monitoring should take place in 2014 and the TMDL should be finished by 2016 – 17. The DEP monitoring covers biological, bacteriological, physical and chemical parameters. It may be too soon to show improvements from the few projects that have been completed or are underway when they are in the Meadow River. The monitoring may cause new streams to be added to the 303(d) list which will then be included into the new TMDL. It is likely that the new TMDL will create a need to revise this WBP.

The AML&R and the OSR monitor their projects routinely. Their focus is primarily on pH, acidity, alkalinity and metals.

The WVSOS program is promoted statewide by the Nonpoint Source Program (NPS) in DWWM. It provides citizens a non-professional method to assess the quality of their streams. It relies on sampling benthic macroinvertebrates with some basic physical assessments. The coordinator of the program with the assistance of the WVCA Environmental Specialists will hold a training and educational workshop in the Rainell vicinity.

The data collected from this monitoring will be incorporated into reports submitted to the NPS coordinator to be part of the state's report to EPA. Any stream found to be in compliance with water quality standards will be submitted to the WAP for verification. Should WAP decide the stream is restored a success story for that stream will be produced and submitted to EPA.

In order to assure the data being collected is of good quality and usable for determining progress, a Quality Assurance Project Plan (QAPP) will be developed for this effort. The QAPP will be submitted to the DEP Nonpoint Source Program Coordinator for review and approval. The Coordinator will then be responsible for submitting the QAPP to EPA for review, comment and approval.

MRWA volunteers monitoring Big Clear Creek in Meadow River watershed.

Source MRWA website: http://meadowriver.org/

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APPENDIX

Common Acronyms

Sewell Creek Tracking Module

Little Sewell Creek Tracking Module

Little Clear and Briery Creeks Tracking Module

Subwatersheds' Year of TMDL Completion

Meadow River Watershed's Location in West Virginia

Meadow River Watershed and Counties

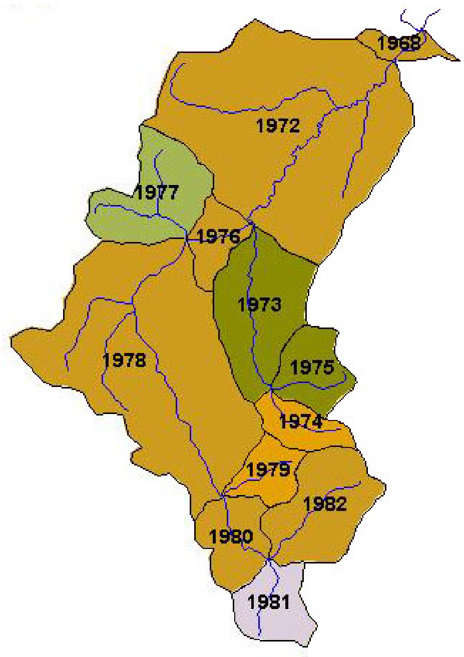
DOF Harvest Notifications Meadow River Subwatershed

COMMON ACRONYMS

TMDL	Total Maximum Daily Load
WLA	Waste load allocation
LA	Load allocation
LR	Load reduction
MOS	Margin of safety
BL	Baseline
SI	Stressor identification
USEPA or EPA	US Environmental Protection Agency
DEP	WV Department of Environmental Protection
WVCA	WV Conservation Agency
NRCS	Natural Resources Conservation Service
HD	Health Department
BPH	Bureau of Public Health
WAB	Watershed Assessment Branch
OSLP	On-site Loan Program
BMP	Best management practice
WQ	Water quality
ES	Environmental Specialist
AU	Animal unit
MRWA	Meadow River Watershed Association
DOF	WV Division of Forestry

Note: This does not include the abbreviations used on pages 39 and 40 as shown on page 40.

SEWELL CREEK TRACKING MODULE



Sewell Creek (WVKG-19-Q) enters the Meadow River at the town of Rainell. This watershed holds the most fecal coliform impaired subwatersheds in the Meadow River watershed. Along with its major tributary, Little Sewell Creek, they are the only subwatersheds with fecal coliform load allocations in the TMDL. These watersheds also contain the largest amount of urban land use, 878.3 acres, in the Meadow River watershed.

The following tables will breakdown the load reduction targets from the TMDL, expected load reductions if they are different from the targets, BMPs to be used and costs all by subwatershed. The milestone timeline will be estimated by priority but landowners and their willingness to sign on as a cooperator is a determining factor in setting the timeline.

Table A-1: Overview of Load Reduction Targets as Determined by the TMDL

SWS	Stream	Code	Fecal coliform (cfu/yr)	Iron (lbs/yr)
1968	Sewell Creek	WVKG-19-Q	7.27E+10	33930.4
1972	Sewell Creek	WVKG-19-Q	4.81E+14	12925
1973	Little Creek	WVKG-19-Q-3	7.80E+14	198.7
1974	UNT	WVKG-19-Q-3-A	4.51E+13	0
1975	Little Creek	WVKG-19-Q-3	2.62E+14	0
1976	Sewell Creek	WVKG-19-Q	4.81E+14	4506.3
1977	Sturgeon Branch	WVKG-19-Q-4	2.25E+14	229.8
1978	Sewell Creek	WVKG-19-Q	3.60E+15	12614.2
1980	Sewell Creek	WVKG-19-Q	3.94E+14	693.3
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	4.67E+13	139.4
1982	Sewell Creek	WVKG-19-Q	5.08E+14	0
Totals			**6.83E+15**	**65,237.10**

Table A – 2: Fecal coliform Load Reduction Targets by Subwatershed

SWS	Stream	Code	Agriculture	On-Site Wastewater	Residential
1968	Sewell Creek	WVKG-19-Q	0.00E+00	0.00E+00	7.27E+10
1972	Sewell Creek	WVKG-19-Q	1.25E+12	4.76E+14	3.13E+12
1973	Little Creek	WVKG-19-Q-3	0.00E+00	7.79E+14	3.00E+11
1974	UNT	WVKG-19-Q-3-A	1.84E+12	4.33E+13	0.00E+00
1975	Little Creek	WVKG-19-Q-3	2.31E+12	2.60E+14	0.00E+00
1976	Sewell Creek	WVKG-19-Q	0.00E+00	4.81E+14	0.00E+00
1977	Sturgeon Branch	WVKG-19-Q-4	8.25E+12	2.16E+14	0.00E+00
1978	Sewell Creek	WVKG-19-Q	1.65E+13	3.59E+15	0.00E+00
1980	Sewell Creek	WVKG-19-Q	4.03E+12	3.90E+14	0.00E+00
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	3.46E+12	4.33E+13	0.00E+00
1982	Sewell Creek	WVKG-19-Q	1.03E+13	4.98E+14	0.00E+00
Sewell Creek Totals (cfu/yr)			**4.79E+13**	**6.78E+15**	**3.50E+12**
Source percentage of Sewell Creek total			**0.70%**	**99.25%**	**0.05%**

On-site wastewater, or failing septic systems, is by far the predominant source for fecal coliforms in Sewell Creek. The residential source is insignificant but educational programs will be developed by the WVCA, MRWA and the town of Rainell to address this source. Agriculture is only slightly more significant but an added benefit of installing agriculture BMPS is a reduction in sediment (iron) which the TMDL does not consider.

Table A – 3: On-site Wastewater Systems BMPs, Load Reductions and Costs

SWS	Stream	Code	Septic Replace	Septic Repair	LR Expected	Cost
1972	Sewell Creek	WVKG-19-Q	3	2	6.42E+14	$22,000.00
1973	Little Creek	WVKG-19-Q-3	4	3	8.82E+14	$29,500.00
1974	UNT	WVKG-19-Q-3-A	1	1	2.41E+14	$7,500.00
1975	Little Creek	WVKG-19-Q-3	2	1	4.01E+14	$14,500.00
1976	Sewell Creek	WVKG-19-Q	3	2	6.42E+14	$22,000.00
1977	Sturgeon Branch	WVKG-19-Q-4	1	1	2.41E+14	$7,500.00
1978	Sewell Creek	WVKG-19-Q	17	10	3.53E+15	$124,000.00
1980	Sewell Creek	WVKG-19-Q	2	2	4.81E+14	$15,000.00
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	1	1	2.41E+14	$7,500.00
1982	Sewell Creek	WVKG-19-Q	3	2	6.42E+14	$22,000.00
Totals			**37**	**25**	**7.94E+15**	**$271,500.00**

Table A – 4: Agriculture BMPs, Load Reductions and Costs

SWS	Stream	Code	LR Target	Conservation Plans	LR Expected	Cost
1972	Sewell Creek	WVKG-19-Q	1.25E+12	4	1.05E+13	$29,483.33
1974	UNT	WVKG-19-Q-3-A	1.84E+12	2	1.25E+12	$14,741.67
1975	Little Creek	WVKG-19-Q-3	2.31E+12	1	1.84E+12	$7,370.83
1976	Sewell Creek	WVKG-19-Q	0.00E+00	1	2.31E+12	$7,370.83
1977	Sturgeon Branch	WVKG-19-Q-4	8.25E+12	3	8.25E+12	$22,112.50
1978	Sewell Creek	WVKG-19-Q	1.65E+13	6	1.65E+13	$44,225.00
1980	Sewell Creek	WVKG-19-Q	4.03E+12	2	4.03E+12	$14,741.67
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	3.46E+12	1	3.46E+12	$7,370.83
1982	Sewell Creek	WVKG-19-Q	1.03E+13	4	1.02E+13	$29,483.33
Totals			4.79E+13	24	5.83E+13	$176,900.00

For the WBP the conservation plan is the BMP unit for agriculture. A custom design action plan for each farm its goals are to remove livestock access from the stream or near the stream and filter the runoff from the pastures and feeding areas. Individually many BMPs have a limited efficiency put used together in a well designed plan the efficiency is increased. This increased efficiency is the number used to calculate load reductions.

Table A – 5: Iron Load Reduction Targets by Subwatershed

SWS	Stream	Code	AML	Bond ForfeitureF	Forest Harvest	Roads	Barren Land	Streambank Erosion
1968	Sewell Creek	WVKG-19-Q	15.5	0.0	0.0	5.6	0.0	33909.3
1972	Sewell Creek	WVKG-19-Q	0.0	0.0	53.7	92.0	0.0	12779.3
1973	Little Creek	WVKG-19-Q-3	0.0	0.0	0.0	0.0	0.0	198.7
1976	Sewell Creek	WVKG-19-Q	0.0	0.0	0.0	0.0	0.0	4506.3
1977	Sturgeon Branch	WVKG-19-Q-4	0.0	0.0	0.0	0.0	0.0	229.8
1978	Sewell Creek	WVKG-19-Q	11309.8	116.9	0.0	0.0	0.0	1187.5
1980	Sewell Creek	WVKG-19-Q	0.0	0.0	0.0	0.0	0.0	693.3
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	0.0	0.0	0.0	0.0	0.0	139.4
Sewell Creek Totals (lbs/yr)			11325.3	116.9	53.7	97.6	0.0	53643.7
Source percentage of Sewell Creek total			17.36%	0.18%	0.08%	0.15%	0.00%	82.23%

Stream bank erosion accounts for the greatest amount of iron entering Sewell Creek. The mining related sources are adding a much smaller but still significant amount of iron. The other sources are insignificant in this watershed. The agriculture BMPs installed has the double benefit of reducing fecal coliform and sediment that carries the iron into the stream. The sediment reductions from these projects, not accounted for in the TMDL, will exceed forestry and roads.

Table A – 6: Costs of Reducing Significant Sources of Iron

SWS	Stream	Code	AML (lbs/yr)	Cost	Bond Forfeiture (lbs/yr)	Cost	Streambank Erosion (lbs/yr)	Cost
1968	Sewell Creek	WVKG-19-Q	15.5	$8,829.00	0.0		33909.3	$1,792,332.60
1972	Sewell Creek	WVKG-19-Q	0.0		0.0		12779.3	$675,473.33
1973	Little Creek	WVKG-19-Q-3	0.0		0.0		198.7	$10,501.14
1976	Sewell Creek	WVKG-19-Q	0.0		0.0		4506.3	$238,190.12
1977	Sturgeon Branch	WVKG-19-Q-4	0.0		0.0		229.8	$12,146.73
1978	Sewell Creek	WVKG-19-Q	11309.8	$6,504,030.00	116.9	$80,442.00	1187.5	$62,768.19
1980	Sewell Creek	WVKG-19-Q	0.0		0.0		693.3	$36,643.78
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	0.0		0.0		139.4	$7,369.91
Sewell Creek Totals			**11325.3**	**$6,512,859.00**	**116.9**	**$80,442.00**	**53643.7**	**$2,835,425.80**
Source percentage of Sewell Creek LR total			**17.36%**		**0.18%**		**82.23%**	

Table A-7: Implementation Milestones for Fecal Coliform

	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Reductions	Agriculture Reductions	Total Reductions Expected	Total Reductins Needed
SWS	Needed BMPs			2015			2016			2017			2018			2019						
1972	3	2	2				3	2	2										5.48E+14	1.25E+12	5.49E+14	4.81E+14
1973	4	3	0		3		3			1									7.53E+14		7.53E+14	7.80E+14
1974	1	1	1						1	1	1								2.05E+14	1.84E+12	2.07E+14	4.51E+13
1975	2	1	1							2	1	1							3.42E+14	2.31E+12	3.44E+14	2.62E+14
1976	3	2	0							3	2								5.48E+14		5.48E+14	4.81E+14
1977	1	1	3	1		1		1				2							2.05E+14	8.25E+12	2.14E+14	2.25E+14
1978	17	12	6	7	6	1	4	6	4	3		1	3						3.15E+15	1.65E+13	3.16E+15	3.60E+15
1980	2	2	2			1		2	1							2			4.11E+14	4.03E+12	4.15E+14	3.94E+14
1981	1	1	1						1		1					1			2.05E+14	3.46E+12	2.09E+14	4.67E+13
1982	3	2	4		1	1		1	1			2				3			5.48E+14	1.03E+13	5.58E+14	5.08E+14
Totals	**37**	**27**	**20**	**8**	**10**	**4**	**10**	**12**	**10**	**10**	**5**	**6**	**3**	**0**	**0**	**6**	**0**	**0**	**6.91E+15**	**4.79E+13**	**6.96E+15**	**6.83E+15**
Anticipated component completion date:							Septic Replacement															
							Septic Repair															
							Conservation Plans															

The increase in the number of on-site wastewater systems repaired or replaced above the fractional number from the TMDL model accounts for the higher than required load reductions.

Table A – 8: Implementation Milestones for Iron

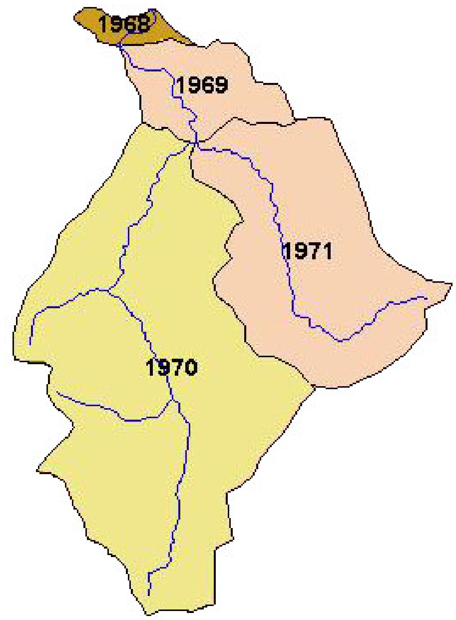
SWS	AML	Bond Forfeiture	Stream Bank Erosion	AML	Bond Forfeiture	Stream Bank Erosion	AML	Bond Forfeiture	Stream Bank Erosion	AML Reductions	Bond Forfeiture Reductions	Stream Bank Erosion Reductions	Total Reductions Expected	Total Reductins Needed
SWS	Needed Restored			2016			2017							
	acres	acres	linear ft	acres	acres	linear ft	acres	acres	linear ft					
1968	0.41		9688.4			9700	0.41			15.6		33950	33965.6	33924.8
1972			3651.2			4000						14000	14000.0	12779.3
1973			56.8			60						210	210.0	198.7
1976			1287.5			1290						4515	4515.0	4506.3
1977			65.7						66			231	231.0	229.8
1978	296.5	9	339.3		9		297		340	11330.1	117	1190	12637.1	12614.3
1980			198.1						200			700	700.0	693.3
1981			39.8						40			140	140.0	139.4
Totals	**296.9**	**9.00**	**15326.8**	**0.0**	**9.0**	**15050.0**	**297.4**	**0.0**	**646.0**	**11345.8**	**117.0**	**54936.0**	**66398.8**	**65085.9**

Some restoration unit numbers were rounded up to a more realistic construction number than the TMDL modeled number.

Table A – 9: Environmental Milestones (Reductions by year and SWS)

SWS	Pollutant	2015	2016	2017	2018	2019	Total Reductions		TMDL Reductions	
1968	FC	7.27E+10					7.27E+10	cfu/yr	7.27E+10	cfu/yr
	Fe		33950	15.64			33965.64	lbs/yr	33930.40	lbs/yr
1972	FC		5.49E+14				5.49E+14	cfu/yr	4.81E+14	cfu/yr
	Fe		14000				14000.00	lbs/yr	12925.03	lbs/yr
1973	FC	2.05E+14	4.11E+14	1.37E+14			7.53E+14	cfu/yr	7.80E+14	cfu/yr
	Fe		210				210.00	lbs/yr	198.67	lbs/yr
1974	FC		1.84E+12	2.05E+14			2.07E+14	cfu/yr	4.51E+13	cfu/yr
	Fe							lbs/yr	0.00	lbs/yr
1975	FC			3.42E+14			3.42E+14	cfu/yr	2.62E+14	cfu/yr
	Fe							lbs/yr	0.00	lbs/yr
1976	FC			5.48E+14			5.48E+14	cfu/yr	4.81E+14	cfu/yr
	Fe		4515				4515.00	lbs/yr	4506.34	lbs/yr
1977	FC	1.40E+14	6.84E+13	5.50E+12			2.14E+14	cfu/yr	2.25E+14	cfu/yr
	Fe			231			231.00	lbs/yr	229.81	lbs/yr
1978	FC	1.37E+15	9.69E+14	4.13E+14	4.11E+14		3.16E+15	cfu/yr	3.60E+15	cfu/yr
	Fe		117	12520.14			12637.14	lbs/yr	12614.31	lbs/yr
1980	FC	2.02E+12	1.39E+14			2.7375E+14	4.15E+14	cfu/yr	3.94E+14	cfu/yr
	Fe			700			700.00	lbs/yr	693.27	lbs/yr
1981	FC		3.46E+12	6.84E+13		1.36875E+14	2.09E+14	cfu/yr	4.67E+13	cfu/yr
	Fe			140			140.00	lbs/yr	139.43	lbs/yr
1982	FC	7.10E+13	7.10E+13	5.10E+12		4.10625E+14	5.58E+14	cfu/yr	5.08E+14	cfu/yr
	Fe							lbs/yr	0.0	lbs/yr

LITTLE SEWELL CREEK TRACKING MODULE



Little Sewell Creek (WVKG-19-Q-1) joins Sewell Creek at the town of Rainell near where Sewell Creek enters Meadow River. Like Sewell Creek it is impaired for fecal coliform and iron.

The following tables will breakdown the load reduction targets from the TMDL, expected load reductions if they are different from the targets, BMPs to be used and costs all by subwatershed. The milestone timeline will be estimated by priority but landowners and their willingness to sign on as a cooperator is a determining factor in setting the timeline.

Table B-1: Overview of Load Reduction Targets as Determined by the TMDL

Subwatershed	Stream Name	Stream Code	Fecal Coliform (cfu/yr)	Iron (lbs/yr)
1969	Little Sewell Creek	WVKG-19-Q-1	9.00E+11	60739.1
1970	Boggs Creek	WVKG-19-Q-1-A	5.52E+14	44793.2
1971	Little Sewell Creek	WVKG-19-Q-1	1.63E+15	3100.7
	Totals		**2.18E+15**	**108632.9**

Table B – 2: Fecal coliform Load Reduction Targets by Subwatershed

Subwatershed	Stream Name	Stream Code	Agriculture Reductions	On-site Wastewater Reductions	Residential
1969	Little Sewell Creek	WVKG-19-Q-1	0.00E+00	0.00E+00	9.00E+11
1970	Boggs Creek	WVKG-19-Q-1-A	1.05E+13	5.41E+14	0.00E+00
1971	Little Sewell Creek	WVKG-19-Q-1	6.33E+12	1.62E+15	2.88E+11
	Totals		**1.68E+13**	**2.16E+15**	**1.19E+12**

Table B – 3: On-site Wastewater Systems BMPs, Load Reductions and Costs

Subwatershed	Stream Name	Stream Code	Septic Replace	Septic Repair	LR Expected	Costs
1970	Boggs Creek	WVKG-19-Q-1-A	3	2	5.48E+14	$22,000
1971	Little Sewell	WVKG-19-Q-1	8	6	1.51E+15	$59,000
	Totals		**11**	**8**	**2.058E+15**	**$81,000**

Table B – 4: Agriculture BMPs, Load Reductions and Costs

Subwatershed	Stream	Code	Conservation Plans	LR Expected	Cost
1970	Boggs Creek	WVKG-19-Q-1-A	4	1.05E+13	$27,215
1971	Little Sewell	WVKG-19-Q-1-A	2	6.33E+12	$13,608
	Totals		**6**	**1.683E+13**	**$40,823**

Table B – 5: Iron Load Reduction Targets by Subwatershed

Subwatershed	Stream Name	Stream Code	Bond Forfeiture	Roads	Barren Land	Stream Bank Erosion
1969	Little Sewell Creek	WVKG-19-Q-1	0.0	114.3	0.0	60624.77
1970	Boggs Creek	WVKG-19-Q-1-A	0.0	208.5	154.3	44430.43
1971	Little Sewell Creek	WVKG-19-Q-1	148.1	154.2	85.6	2712.69
	Totals		**148.1**	**477.0**	**239.9**	**107767.9**
Source percentage of Little Sewell Creek total			0.14%	0.44%	0.22%	99.20%

Table B – 6: Costs of Reducing Significant Sources of Iron

Subwatershed	Stream Name	Stream Code	Bond Forfeiture	Costs	Roads	Costs	Barren Land	Costs	Stream Bank Erosion	Costs
1969	Little Sewell Creek	WVKG-19-Q-1	0.0		114.3	$1,000	0.0		60624.8	$3,204,423
1970	Boggs Creek	WVKG-19-Q-1-A	0.0		208.5	$1,800	154.3	$32,458	44430.4	$2,348,444
1971	Little Sewell Creek	WVKG-19-Q-1	148.1	$190,000	154.2	$1,300	85.6	$18,015	2712.7	$143,384
	Totals		**148.1**	$190,000	**477.0**	**$4,100**	**239.9**	**$50,473**	**107767.9**	**$5,696,250**
Source percentage of Little Sewell Creek total			0.14%		0.44%		0.22%		99.20%	

Table B-7: Implementation Milestones for Fecal Coliform

	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Replacement	Septic Repair	Conservation Plans	Septic Reductions	Agriculture Reductions	ResidentialReductions	Total Reductions Expected	Total Reductins Needed
SWS	Needed BMPs			2016			2017			2018			2019			2020							
1969	0	0	0																		9.00E+11	9.00E+11	9.00E+11
1970	3	2	4			2		1	2	1	1		1			1			5.48E+14	1.05E+13		5.58E+14	5.52E+14
1971	9	6	2		2	2		2		2	2		2			5			1.64E+15	6.33E+12	2.88E+11	1.65E+15	1.63E+15
Totals	**12**	**8**	**6**	**0**	**2**	**4**	**0**	**3**	**2**	**3**	**3**	**0**	**3**	**0**	**0**	**6**	**0**	**0**	**2.19E+15**	**1.68E+13**	**1.19E+12**	**2.21E+15**	**2.18E+15**

Anticipated component completion date: Septic Replacement; Septic Repair; Conservation Plans

Residential reductions will be accomplised in 2015 by working with the town of Rainell.

Table B – 8: Implementation Milestones for Iron

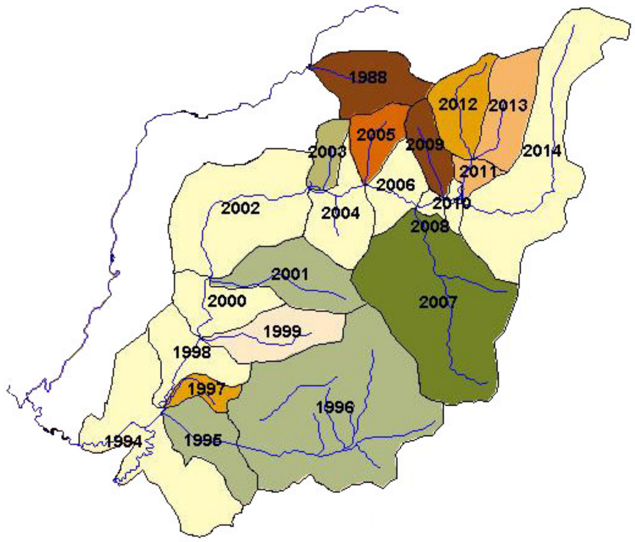
	Bond Forfeiture	Roads	Barren Land	Stream Bank Erosion	Bond Forfeiture	Roads	Barren Land	Stream Bank Erosion	Bond Forfeiture	Roads	Barren Land	Stream Bank Erosion	Bond Forfeiture	Roads	Barren Land	Stream Bank Erosion	Bond Forfeiture	Roads	Barren Land	Stream Bank Erosion	Total Reductions Expected	Total Reductins Needed
SWS	Needed Restored				2017				2018				2019									
	acres	miles	acres	linear ft	acres	miles	acres	linear ft	acres	miles	acres	linear ft	acres	miles	acres	linear ft						
1969		0.20	0	17321				17321		0.20							0	114.3	0	60625	60739.1	60739.1
1970		0.36	1100	12694						0.36	22	12694					0	208.5	154.3	44430	44793.2	44793.2
1971	11.4	0.27	611	775	11.4					0.27	12					775	148.1	154.2	85.6	2713	3100.7	3100.7
Totals	**11.4**	**0.83**	**1710.6**	**30790.8**	**11.4**	**0.0**	**0.0**	**17321.0**	**0.0**	**0.83**	**34.0**	**12694.0**	**0.0**	**0.0**	**0.0**	**775.0**	**148.1**	**477.0**	**239.9**	**107767.9**	**108632.9**	**108632.9**

Estimate TMDL completion for source and SWS:

Table B – 9: Environmental Milestones (Reductions by year and SWS)

SWS	Pollutant	2016	2017	2018	2019	2020	Total Reductions		TMDL Reductions	
1969	FC	9.00E+11					9.00E+11	cfu/yr	9.00E+11	cfu/yr
	Fe		60625	114			60739	lbs/yr	60739	lbs/yr
1970	FC	5.25E+12	7.37E+13	2.05E+14	1.37E+14	1.37E+14	5.58E+14	cfu/yr	5.52E+14	cfu/yr
	Fe			47493			47493	lbs/yr	44793	lbs/yr
1971	FC	1.43E+14	1.37E+14	4.11E+14	2.74E+14	6.84E+14	1.65E+15	cfu/yr	1.63E+15	cfu/yr
	Fe		148	239	2731		3118	lbs/yr	3101	lbs/yr

LITTLE CLEAR AND BRIERY CREEKS TRACKING MODULE



Briery Creek (WVKG-19-U-2-A) is a small tributary of Big Clear Creek with a significant source of AMD. It is adjacent to the Little Clear Creek watershed. Little Clear Creek (WVKG-19-V) joins the Meadow River at the town of Rupert.

The following tables will breakdown the load reduction targets from the TMDL, expected load reductions if they are different from the targets, BMPs to be used and costs all by subwatershed. The milestone timeline will be estimated by priority but landowners and their willingness to sign on as a cooperator is a determining factor in setting the timeline.

Table C-1: Overview of Load Reduction Targets as Determined by the TMDL

Stream Code	Stream Name	Subwatershed	Aluminum	Iron
WVKG-19-U-2-A	Briery Creek	1988	2,834.7	1,303.2
WVKG-19-V	Little Clear Creek	1994		3,189.7
WVKG-19-V-1	Beaver Creek	1995		263.6
WVKG-19-V-1	Beaver Creek	1996		579.6
WVKG-19-V-1.2	UNT	1997		63.8
WVKG-19-V	Little Clear Creek	1998		325.4
WVKG-19-V-2	Stoney Run	1999		62.6
WVKG-19-V	Little Clear Creek	2000		189.9
WVKG-19-V-3	Rader Run	2001		248.6
WVKG-19-V	Little Clear Creek	2002		312.1
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	2003		7,490.2
WVKG-19-V	Little Clear Creek	2004		52.4
WVKG-19-V-4	Cutlip Branch	2005		1,649.1
WVKG-19-V	Little Clear Creek	2006		58.9
WVKG-19-V-5	Laurel Creek	2007		1,020.7
WVKG-19-V	Little Clear Creek	2008		32.9
WVKG-19-V-6	Wallace Branch	2009		492.2
WVKG-19-V	Little Clear Creek	2010		24.7
WVKG-19-V-7	Kuhn Branch	2011		103.4
WVKG-19-V-7-A	Joe Knob Branch	2012		3,764.7
WVKG-19-V-7	Kuhn Branch	2013		4,657.4
WVKG-19-V	Little Clear Creek	2014		9,017.1
	Total Reductions		**2,834.7**	**34,902.3**

Table C – 2: Metals Load Reduction Targets by Subwatershed and Source

Stream Code	Stream Name	Metal	SWS	AML Reductions	Bond Forfeiture Reductions	Forestry Reductions	Roads Reductions	Barren Lands Reductions	Stream Bank Erosion Reductions	Total Reductions	% of Total
WVKG-19-U-2-A	Briery Creek	Aluminum	1988	2,834.7	0	0	0	0	0	2,834.7	7.51%
WVKG-19-U-2-A	Briery Creek	Iron	1988	0	0	0	0	0	1303.2	1,303.2	3.45%
WVKG-19-V	Little Clear Creek	Iron	1994	0	0	0	217.6	2972.1	0	3,189.7	8.45%
WVKG-19-V-1	Beaver Creek	Iron	1995	0	0	0	61.9	201.7	0	263.6	0.70%
WVKG-19-V-1	Beaver Creek	Iron	1996	0	0	0	569.1	10.5	0	579.6	1.54%
WVKG-19-V-1.2	UNT	Iron	1997	0	0	0	26.3	37.5	0	63.8	0.17%
WVKG-19-V	Little Clear Creek	Iron	1998	0	0	0	99.0	226.4	0	325.4	0.86%
WVKG-19-V-2	Stoney Run	Iron	1999	0	0	0	60.6	2.0	0	62.6	0.17%
WVKG-19-V	Little Clear Creek	Iron	2000	0	0	43.2	92.4	54.3	0	189.9	0.50%
WVKG-19-V-3	Rader Run	Iron	2001	0	0	0	245.6	3.0	0	248.6	0.66%
WVKG-19-V	Little Clear Creek	Iron	2002	0	0	0	305.8	6.3	0	312.1	0.83%
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	Iron	2003	0	7440	0	49.8	0.3	0	7,490.2	19.85%
WVKG-19-V	Little Clear Creek	Iron	2004	0	0	0	50.0	2.3	0	52.4	0.14%
WVKG-19-V-4	Cutlip Branch	Iron	2005	0	636.7	941.3	70.1	1.0	0	1,649.1	4.37%
WVKG-19-V	Little Clear Creek	Iron	2006	0	0	0	39.5	19.4	0	58.9	0.16%
WVKG-19-V-5	Laurel Creek	Iron	2007	0	0	0	356.1	664.6	0	1,020.7	2.70%
WVKG-19-V	Little Clear Creek	Iron	2008	0	0	0	32.9	0.0	0	32.9	0.09%
WVKG-19-V-6	Wallace Branch	Iron	2009	0	0	468.8	22.5	1.0	0	492.2	1.30%
WVKG-19-V	Little Clear Creek	Iron	2010	0	0	0	24.4	0.3	0	24.7	0.07%
WVKG-19-V-7	Kuhn Branch	Iron	2011	0	0	0	53.0	50.4	0	103.4	0.27%
WVKG-19-V-7-A	Joe Knob Branch	Iron	2012	0	0	0	49.6	3715.1	0	3,764.7	9.98%
WVKG-19-V-7	Kuhn Branch	Iron	2013	982.1	0	0	140.3	3535.0	0	4,657.4	12.34%
WVKG-19-V	Little Clear Creek	Iron	2014	1918.5	5926.4	578.0	382.5	6.9	204.7	9,017.1	23.89%
	Total Reductions			5,735.4	14,003.1	2,031.3	2,949.1	11,510.2	1,507.9	**37,737.1**	
	% of Total Reductions			15.20%	37.11%	5.38%	7.81%	30.50%	4.00%		

Table C – 3: Costs of Reducing Significant Sources of Metals

Stream Code	Stream Name	Subwatershed	AML Reductions (lbs/yr)	Costs	Bond Forfeiture Reductions (lbs/yr)	Costs	Forestry Reductions (lbs/yr)	Costs	Roads Reductions (lbs/yr)	Costs	Barren Lands Reductions (lbs/yr)	Costs	Stream Bank Erosion Reductions (lbs/yr)	Costs
WVKG-19-U-2-A	Briery Creek	1988	2,834.7	$20,000	0		0		0		0		1303.2	$68,884
WVKG-19-V	Little Clear Creek	1994	0		0		0		217.6	$1,164	2972.1	$10,649	0	
WVKG-19-V-1	Beaver Creek	1995	0		0		0		61.9	$331	201.7	$723	0	
WVKG-19-V-1	Beaver Creek	1996	0		0		0		569.1	$3,044	10.5	$38	0	
WVKG-19-V-1.2	UNT	1997	0		0		0		26.3	$141	37.5	$134	0	
WVKG-19-V	Little Clear Creek	1998	0		0		0		99.0	$530	226.4	$811	0	
WVKG-19-V-2	Stoney Run	1999	0		0		0		60.6	$324	2.0	$7	0	
WVKG-19-V	Little Clear Creek	2000	0		0		43.2	$231	92.4	$494	54.3	$194	0	
WVKG-19-V-3	Rader Run	2001	0		0		0		245.6	$1,314	3.0	$11	0	
WVKG-19-V	Little Clear Creek	2002	0		0		0		305.8	$1,636	6.3	$22	0	
WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	2003	0		7440	$2,329,684	0		49.8	$267	0.3	$1	0	
WVKG-19-V	Little Clear Creek	2004	0		0		0		50.0	$268	2.3	$8	0	
WVKG-19-V-4	Cutlip Branch	2005	0		636.7	$199,376	941.3	$5,035	70.1	$375	1.0	$4	0	
WVKG-19-V	Little Clear Creek	2006	0		0		0		39.5	$211	19.4	$70	0	
WVKG-19-V-5	Laurel Creek	2007	0		0		0		356.1	$1,905	664.6	$2,381	0	
WVKG-19-V	Little Clear Creek	2008	0		0		0		32.9	$176	0.0	$0	0	
WVKG-19-V-6	Wallace Branch	2009	0		0		468.8	$2,507	22.5	$120	1.0	$4	0	
WVKG-19-V	Little Clear Creek	2010	0		0		0		24.4	$130	0.3	$1	0	
WVKG-19-V-7	Kuhn Branch	2011	0		0		0		53.0	$284	50.4	$181	0	
WVKG-19-V-7-A	Joe Knob Branch	2012	0		0		0		49.6	$265	3715.1	$13,311	0	
WVKG-19-V-7	Kuhn Branch	2013	982.1	$307,528	0		0		140.3	$750	3535.0	$12,666	0	
WVKG-19-V	Little Clear Creek	2014	1918.5	$600,746	5926.4	$1,855,725	578.0	$3,092	382.5	$2,046	6.9	$25	204.7	$10,819
	Totals		**5,735**	**$928,274**	**14,003**	**$4,384,786**	**2,031**	**$10,865**	**2,949**	**$15,774**	**11,510**	**$41,241**	**1,508**	**$79,703**
Little Clear & Briery Sources Percentage of Total Metals			6.19%		15.12%		2.19%		3.18%		12.43%		1.63%	

Table C – 4: Implementation Milestones for Little Clear and Briery Creeks

	AML	Bond Forfeiture	Forest Harvest	Roads	Barren Land	Stream Bank Erosion	AML	Bond Forfeiture	Forest Harvest	Roads	Barren Land	Stream Bank Erosion	AML	Bond Forfeiture	Forest Harvest	Roads	Barren Land	Stream Bank Erosion	AML	Bond Forfeiture	Forest Harvest	Roads	Barren Land	Stream Bank Erosion	AML	Bond Forfeiture	Forest Harvest	Roads	Barren Land	Stream Bank Erosion	Total Reductions Expected	Total Reductins Needed
SWS	Needed Restored						2018						2019						2020													
	acres	acres	miles	miles	acres	linear ft	acres	acres	miles	miles	acres	linear ft	acres	acres	miles	miles	acres	linear ft	acres	acres	miles	miles	acres	linear ft								
1988	*					372							*											372	2835					1304	4139.0	4138.0
1994				0.38	416.84											0.38	417											217.6	2973.2		3190.8	3189.7
1995				0.11	28.30											0.11	29											61.9	206.8		268.6	263.6
1996				0.99	1.48											0.99	1.5											569.1	10.7		579.8	579.6
1997				0.05	5.26											0.05	5.25											26.3	37.4		63.8	63.8
1998				0.17	31.75											0.17	31.75											99.0	226.4		325.4	325.4
1999				0.11	0.28											0.11	0.3											60.6	2.1		62.7	62.6
2000				0.16	7.61											0.16	7.6											92.4	54.2		146.6	189.9
2001				0.43	0.42											0.43	0.5											245.6	3.6		249.2	248.6
2002				0.53	0.88											0.53	0.9											305.8	6.4		312.2	312.1
2003		572		0.09	0.05									572		0.09										7440		49.8	0.0		7489.8	7490.2
2004				0.09	0.32											0.09	0.35											50.0	2.5		52.5	52.4
2005		49	1.6	0.12	0.14				2					50								0.20	0.2			650	1154.2	115.4	1.4		1921.1	1649.1
2006				0.07	2.72																	0.07	2.75					39.5	19.6		59.1	58.9
2007				0.62	93.21																	0.62	93.2					356.3	664.5		1020.8	1020.7
2008				0.06	0.00																	0.06						32.9	0.0		32.9	32.9
2009			0.8	0.04	0.14				1													0.04	0.2				578.0	22.5	1.4		601.9	492.2
2010				0.04	0.05																	0.04						24.4	0.0		24.4	24.7
2011				0.09	7.07																	0.09	7					53.0	49.9		102.9	103.4
2012				0.09	521.05																	0.09	521					49.6	3714.7		3764.4	3764.7
2013	25.7			0.24	495.80								26									0.25	496		992			144.3	3536.5		4672.8	4657.4
2014	50.3	456.0	1.0	0.66	0.97	58			1	0.66	1		51	456										58	1945.6	5926.4	578.0	380.9	7.1	205	9043.0	9017.1
Totals	**76.0**	**1077.0**	**3.4**	**5.1**	**1614.3**	**430.8**	**0.0**	**0.0**	**4.0**	**0.7**	**1.0**	**0.0**	**77.0**	**1078.0**	**0.0**	**3.1**	**494.2**	**0.0**	**0.0**	**0.0**	**0.0**	**1.5**	**1120.4**	**430.0**	**5772.6**	**14016.4**	**2310.2**	**2997.1**	**11518.5**	**1509.0**	**38123.8**	**37737.1**

Estimate TMDL completion for source and SWS:

* Briery Creek Aluminum is due to an AMD discharge not refuse piles

Table C – 5: Environmental Milestones (Reductions by year and SWS)

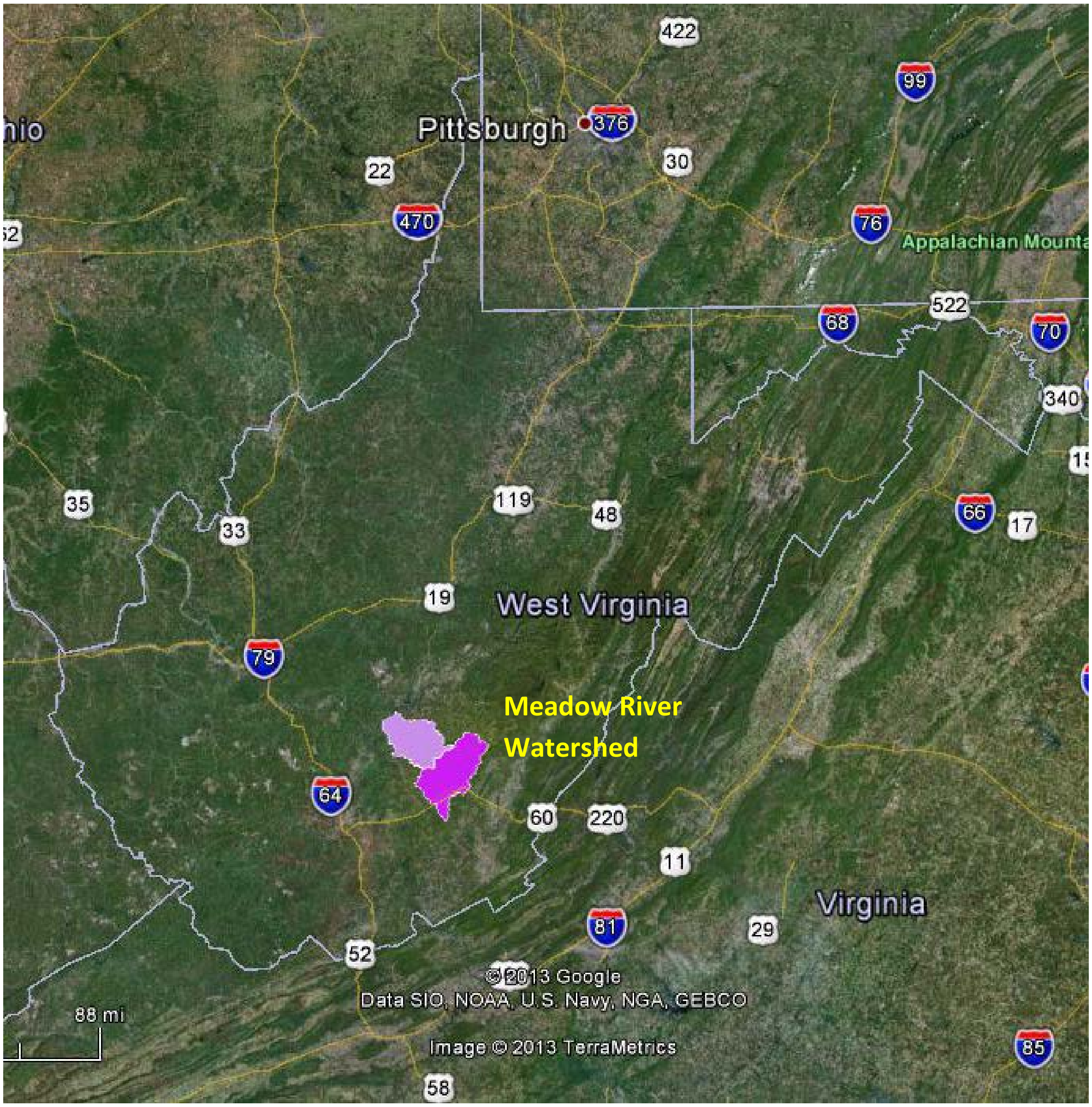
SWS	Pollutant	2018	2019	2020	Total Reductions (lbs/yr)	TMDL Reductions (lbs/yr
1988	Al		2835.0		2835.0	2834.7
1988	Fe			1304.0	1304.0	1303.2
1994	Fe		3190.8		3190.8	3189.7
1995	Fe		268.6		268.6	263.6
1996	Fe		579.8		579.8	579.6
1997	Fe		63.8		63.8	63.8
1998	Fe		325.4		325.4	325.4
1999	Fe		62.7		62.7	62.6
2000	Fe		146.6		146.6	189.9
2001	Fe		249.2		249.2	248.6
2002	Fe		312.2		312.2	312.1
2003	Fe		7489.8		7489.8	7490.2
2004	Fe		52.5		52.5	52.4
2005	Fe	1154.2	650.0	116.8	1921.0	1649.1
2006	Fe			59.1	59.1	58.9
2007	Fe			1020.8	1020.8	1020.7
2008	Fe			32.9	32.9	32.9
2009	Fe	578.0		23.9	601.9	492.2
2010	Fe			24.4	24.4	24.7
2011	Fe			102.9	102.9	103.4
2012	Fe			3764.4	3764.4	3764.7
2013	Fe		992.0	3680.8	4672.8	4657.4
2014	Fe	966.0	7872.0	205.0	9043.0	9017.1

Subwatersheds' Year of TMDL Completion

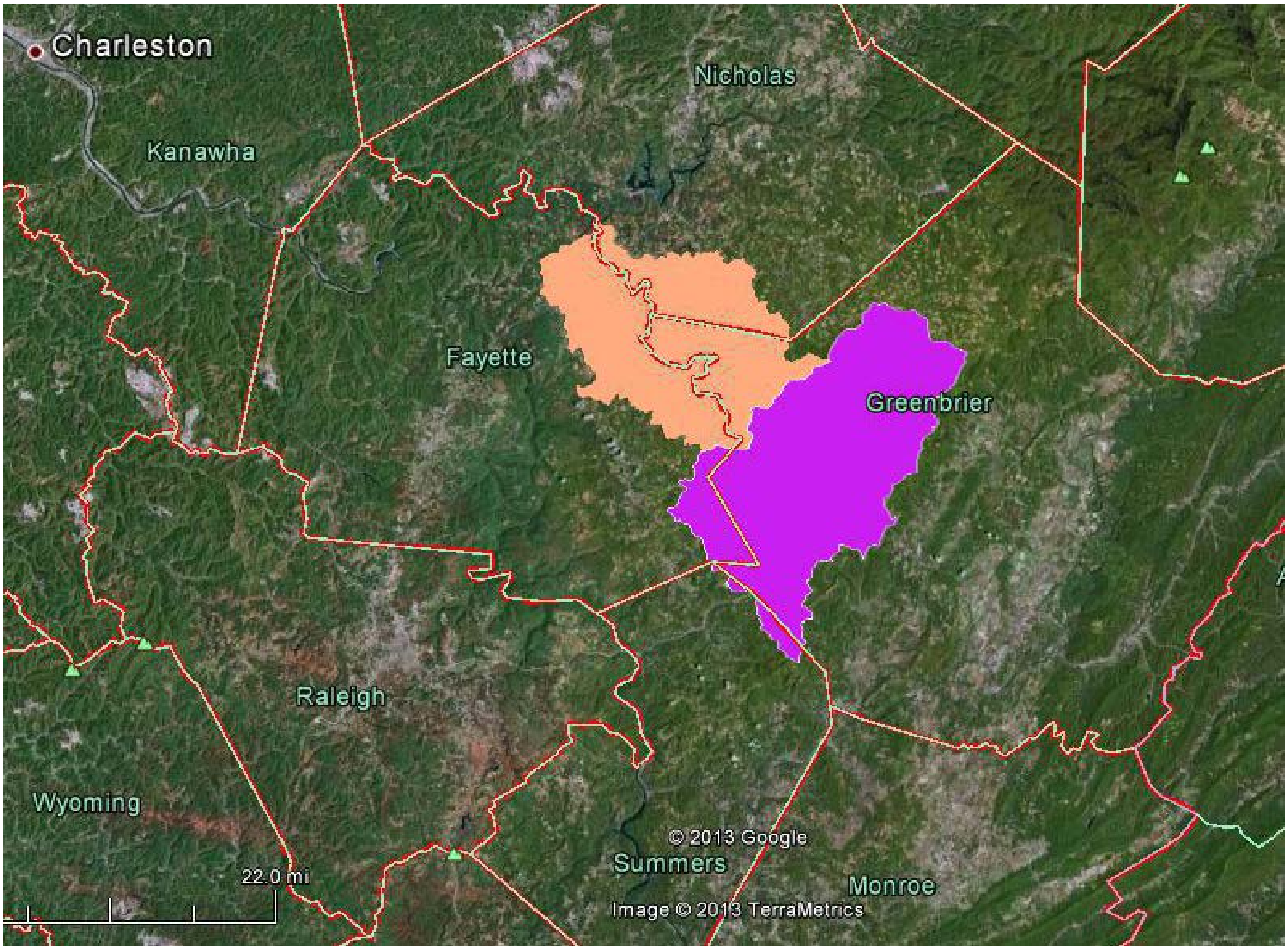
			Expected Year of TMDL Target			
SWS	Stream Name	Stream Code	FC	Fe	Al	Acid
1968	Sewell Creek	WVKG-19-Q	2020	2019	2019	
1969	Little Sewell Creek	WVKG-19-Q-1	2020	2019	2019	
1970	Boggs Creek	WVKG-19-Q-1-A	2020	2019	2019	
1971	Little Sewell Creek	WVKG-19-Q-1	2020	2019	2019	
1972	Sewell Creek	WVKG-19-Q	2020	2019	2019	
1973	Little Creek	WVKG-19-Q-3	2020	2019	2019	
1974	UNT	WVKG-19-Q-3-A	2020			
1975	Little Creek	WVKG-19-Q-3	2020			
1976	Sewell Creek	WVKG-19-Q	2020	2019	2019	
1977	Sturgeon Branch	WVKG-19-Q-4	2020	2019	2019	
1978	Sewell Creek	WVKG-19-Q	2020	2019	2019	
1980	Sewell Creek	WVKG-19-Q	2020	2019	2019	
1981	UNT/Sewell Creek RM 11.04	WVKG-19-Q-17	2020	2019	2019	
1982	Sewell Creek	WVKG-19-Q	2020			
1988	Briery Creek	WVKG-19-U-2-A		2016	2016	
1994	Little Clear Creek	WVKG-19-V		2019	2019	
1995	Beaver Creek	WVKG-19-V-1		2019	2019	
1996	Beaver Creek	WVKG-19-V-1		2019	2019	
1997	UNT	WVKG-19-V-1.2		2019	2019	
1998	Little Clear Creek	WVKG-19-V		2019	2019	
1999	Stoney Run	WVKG-19-V-2		2019	2019	
2000	Little Clear Creek	WVKG-19-V		2019	2019	
2001	Rader Run	WVKG-19-V-3		2019	2019	
2002	Little Clear Creek	WVKG-19-V		2019 *	2019 *	
2003	UNT/Little Clear Creek RM 7.5	WVKG-19-V-3.8		2019	2019	
2004	Little Clear Creek	WVKG-19-V		2019 *	2019 *	
2005	Cutlip Branch	WVKG-19-V-4		2019	2019	
2006	Little Clear Creek	WVKG-19-V		2019 *	2019*	
2007	Laurel Creek	WVKG-19-V-5		2019	2019	2014
2008	Little Clear Creek	WVKG-19-V		2019 *	2019 *	
2009	Wallace Branch	WVKG-19-V-6		2019	2019	
2010	Little Clear Creek	WVKG-19-V		2019 *	2019*	
2011	Kuhn Branch	WVKG-19-V-7		2019 *	2019 *	
2012	Joe Knob Branch	WVKG-19-V-7-A		2019	2019	
2013	Kuhn Branch	WVKG-19-V-7		2019	2019	
2014	Little Clear Creek	WVKG-19-V		2019	2019	2014

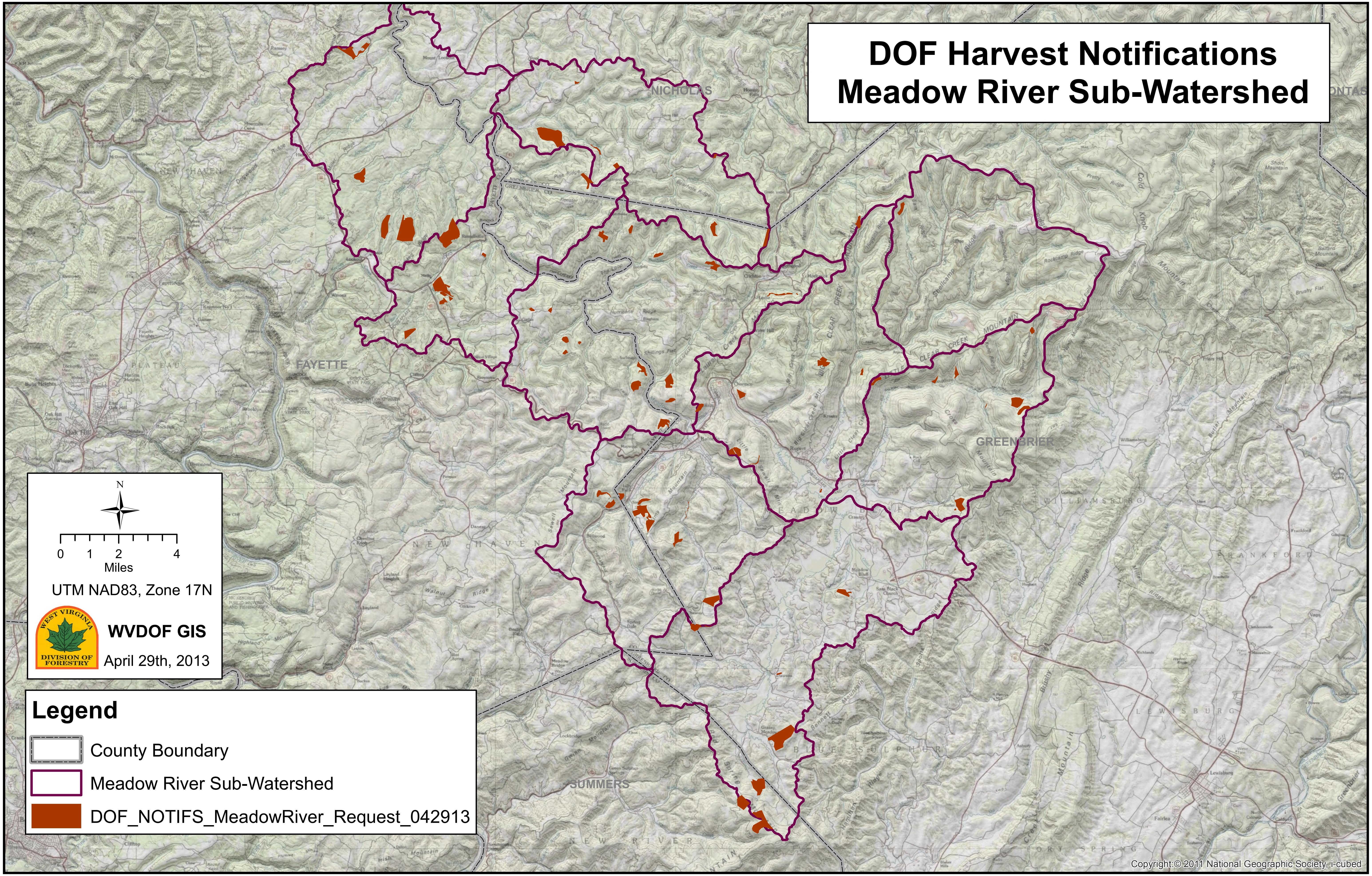
* These subwatersheds were assigned insignificant load reductions from roads and barren lands.

Meadow River Watershed's Location in West Virginia



Meadow River Watershed and Counties




DOF Harvest Notifications
Meadow River Sub-Watershed
NICHOLAS
FAYETTE
GREENBRIER
SUMMERS
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Miles
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WEST VIRGINIA DIVISION OF FORESTRY
WVDOF GIS
April 29th, 2013
Legend
County Boundary
Meadow River Sub-Watershed
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