APPENDIX 8

A-8 MEADOW RIVER

A-8.1 Watershed Information

Meadow River forms the southern portion of the Gauley River watershed and drains approximately 364.6 square miles (233,388 acres), as shown in Figure A-8-1. Thirteen impaired streams are addressed in this TMDL development effort. The impaired streams are primarily located in the Little Clear Creek and Sewell Creek drainages. Figure A-8-2 shows the impaired segments and the pollutants for which each is listed as impaired. Of those streams, WVDEP has identified Little Clear Creek and Kuhn Branch as troutwaters.

The dominant landuse in the modeled drainages is forest, which covers 81.3 percent of the watershed. Other important landuse types include grassland (11.4 percent), ALM land (2.3 percent), and wetland (2.5 percent). All other individual land cover types account for less than 3 percent of the total watershed area.

Before establishing Total Maximum Daily Loads (TMDLs), WVDEP performed monitoring in each of the impaired streams in the Meadow River watershed to better characterize water quality and refine impairment listings. Monthly samples were taken at 23 stations (station locations can be viewed using the ArcExplorer project) throughout the Meadow River watershed from July 1, 2003, through June 30, 2004. Monitoring suites at each site were determined based on the types of impairments observed in each stream. 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. In addition, benthic macroinvertebrate assessments were performed at specific locations on the biologically impaired streams during the pre-TMDL monitoring period. Instantaneous flow measurements were also taken at strategic locations during pre-TMDL monitoring.

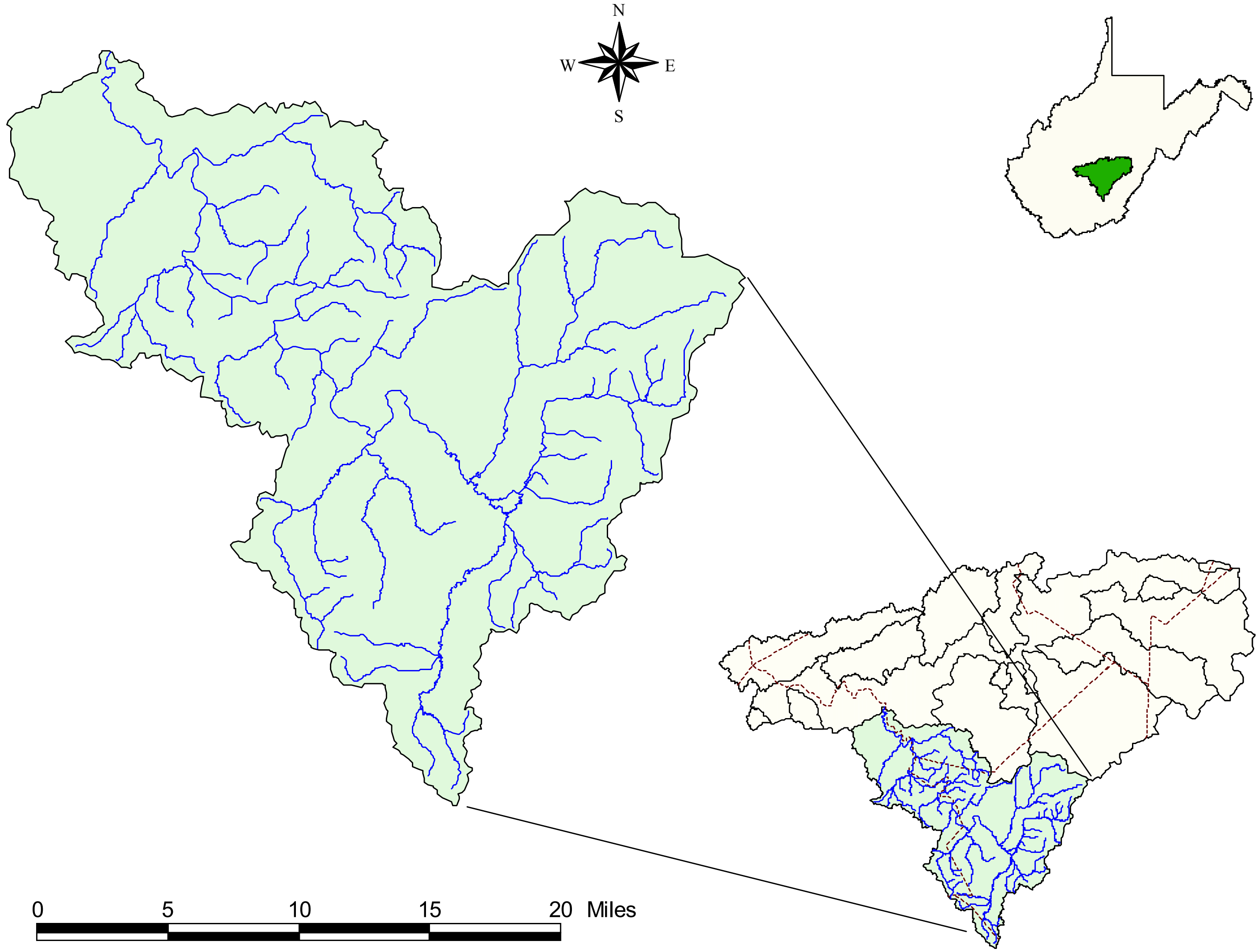


Figure A-8-1. Location of the Meadow River watershed

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					

Figure A-8-2. Waterbodies and impairments under TMDL development in the Meadow River watershed

A-8.2 Metals and pH Sources

This section identifies and examines the potential sources of aluminum, iron, and pH impairment in the Sewell Creek and Little Clear Creek drainages. Sources can be classified as point sources (specific sources subject to a permit) or nonpoint sources (diffuse sources). Mining and non-mining-related permitted discharges are potential metals and pH point sources. Metals and pH nonpoint sources are non-permitted sources such as abandoned or forfeited mine sites.

Pollutant sources were identified using statewide geographic information system (GIS) coverages of point and nonpoint sources, and through field reconnaissance. As part of the TMDL process, WVDEP documented pollution sources by describing the pollutant source in detail, collecting Global Positioning System data, and if necessary, collecting a water quality sample for laboratory analysis. WVDEP personnel recorded physical descriptions of the pollutant sources, such as the number of outfalls, the source of the outfalls, and the general condition of the stream in the vicinity of each outfall. These records were compiled and electronically plotted on maps using GIS software. This information was used in conjunction with other information to characterize pollutant sources. Significant metals sources in the watershed are shown in Figure A-8-3.

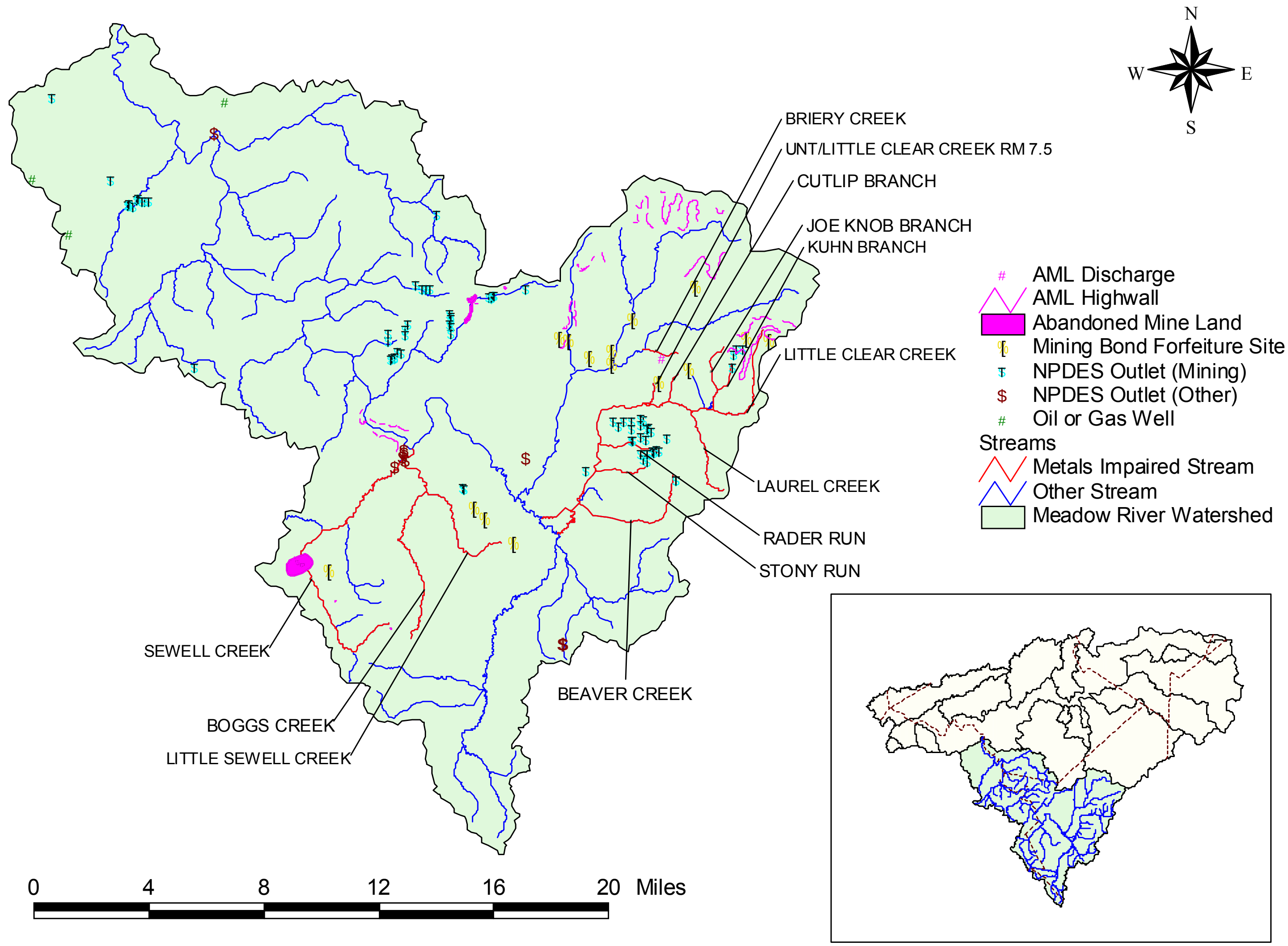
On the basis of scientific knowledge of sediment/metals interaction and knowledge of West Virginia's soils, it is reasonable to conclude that sediments contain high levels of aluminum and iron. Control of sediment-producing sources were determined necessary to meet water quality criteria for total iron during critical high-flow conditions. Although some of these sediment-producing sources are not shown in Figure A-8-3 (e.g., agricultural areas and unpaved roads), specific details relative to these sources are discussed in section A-8.2.2.

A-8.2.1 Metals Point Source Inventory

As described in the TMDL Report, the National Pollutant Discharge Elimination System (NPDES) program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. Metals and pH point sources can be classified into two major categories: permitted non-mining point sources and permitted mining point sources.

There are 35 mining-related NPDES outlets in the TMDL development areas. WVDEP's HPU GIS coverage was used to determine the locations of the mining permits; the detailed permit information came from WVDEP's ERIS database system. The permits related to these outlets are listed in the Technical Report, which shows the name of each responsible party and the total number of outlets modeled. The Technical Report also contains specific data for each permitted outlet (including effluent type, drainage areas, and pump capacities) and permit limits for each of the mining-related NPDES outlets. Because NPDES permits contain effluent limitations and/or monitoring requirements, the discharges from mining activities were determined to be contributing point sources of iron and aluminum

There are four non-mining point sources present in TMDL development areas. The Multi-Sector Stormwater General Permit regulates discharges from two facilities that are subject to a benchmark value for iron. The other non-mining point source is a discharge from a water treatment facility that includes discharge limitations for iron.



NOTE: Some mapped features in close proximity to each other may plot as one location on the map.

Figure A-8-3. Metals sources in the Meadow River watershed

A-8.2.2 Metals Nonpoint Source Inventory

In addition to point sources, nonpoint sources also contribute to metals-related water quality impairments. Nonpoint sources are diffuse, non-permitted sources. Abandoned mine lands and facilities that were subject to the Surface Mining Control and Reclamation Act of 1977, and forfeited their bonds or abandoned operations can be a significant non-permitted source of metals. Non-mining land disturbance activities can also be a nonpoint source of metals, causing metals to enter waterbodies as a component of sediment. Examples of such land disturbance activities are agriculture, forestry, oil and gas wells, and the construction and use of roads. The applicable land-disturbing activities in the Sewell Creek and Little Clear Creek drainages are discussed below.

Abandoned Mine Lands and Bond Forfeiture Sites

Based on the identification of a number of abandoned mining activities in the Meadow River watershed, abandoned mine lands are a significant non-permitted source of metals and pH impairment in the watershed. WVDEP's Office of Abandoned Mine Lands identified the locations of abandoned mine lands in the Meadow River watershed. In addition, source tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized 2 abandoned mine sources (AML seeps).

WVDEP's Division of Land Restoration, Office of Special Reclamation, provided bond forfeiture information and data. 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 modeling of Sewell Creek and Little Clear Creek of the Meadow River watershed.

Land-Disturbing Activities

Based on the GAP 2000 landuse coverage, there are only 113 acres of row crop agriculture in the Sewell Creek and Little Clear Creek drainages, representing 0.04 percent of the total area. During the pre-TMDL sampling period there were 10 registered sites that encompass 1,384 acres of active timber harvest in the two drainages. The watershed does not contain any active oil and gas wells. The length and area of paved roads were calculated using the Census 2000 TIGER/Line files roads coverage for West Virginia. Information on unpaved roads from TIGER was supplemented by digitizing any unpaved roads shown on topographic maps that were not included in the TIGER shapefile. There are 551.4 miles of paved roads and 464.3 miles of unpaved roads represented in the model.

A-8.3 Fecal Coliform Bacteria Sources

This section identifies and examines the potential sources of fecal coliform bacteria in the watersheds of bacteria impaired streams. Sources can be classified as either point sources or nonpoint sources. Potential point sources include effluent discharges of sewage treatment facilities and collection system overflows. Potential nonpoint sources of fecal coliform bacteria include failing or nonexistent on-site sewage disposal systems, stormwater runoff from pasture and cropland, direct deposition of wastes from livestock, and stormwater runoff from residential and urban areas.

A-8.3.1 Fecal Coliform Bacteria Point Sources

Permitted sources of fecal coliform bacteria that experience effluent overflows or that do not comply with permit limits can cause occasional high loadings of fecal coliform bacteria in receiving streams. 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. As discussed in the main report, 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.

A-8.3.2 Fecal Coliform Bacteria Nonpoint Sources

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). WVDEP source tracking information yielded an estimate of 186 unsewered homes in the modeled watershed. 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. Figure A-8-4 shows the geographic distribution of estimated failing septic system nonpoint sources in the watershed.

Stormwater runoff is another potential nonpoint source of fecal coliform bacteria in both residential/urban and rural areas. Runoff from residential areas can deliver the waste of pets and wildlife to the waterbody. In addition, rural stormwater runoff can transport significant loads of bacteria from livestock pastures, livestock and poultry feeding facilities, and manure storage and application.

Fecal coliform bacteria loadings from agricultural landuses are significant in the Sewell Creek watershed and reductions are prescribed for most model subwatersheds. Fecal coliform loading associated with stormwater runoff from residential and urban areas is less significant, with reductions prescribed only in the more densely populated areas near the Town of Rainelle.

A certain “natural background” contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forest and grassland areas. Accumulation rates for fecal coliform bacteria in those areas were developed using reference numbers from past TMDLs, incorporating wildlife estimates obtained from the Division of Natural Resources, and WVDEP fecal coliform sampling in Shrewsbury Hollow in the Kanawha State Forest. Although wildlife contributions of fecal coliform bacteria were considered in modeling, they were not found to be a significant source, and reductions were not prescribed.

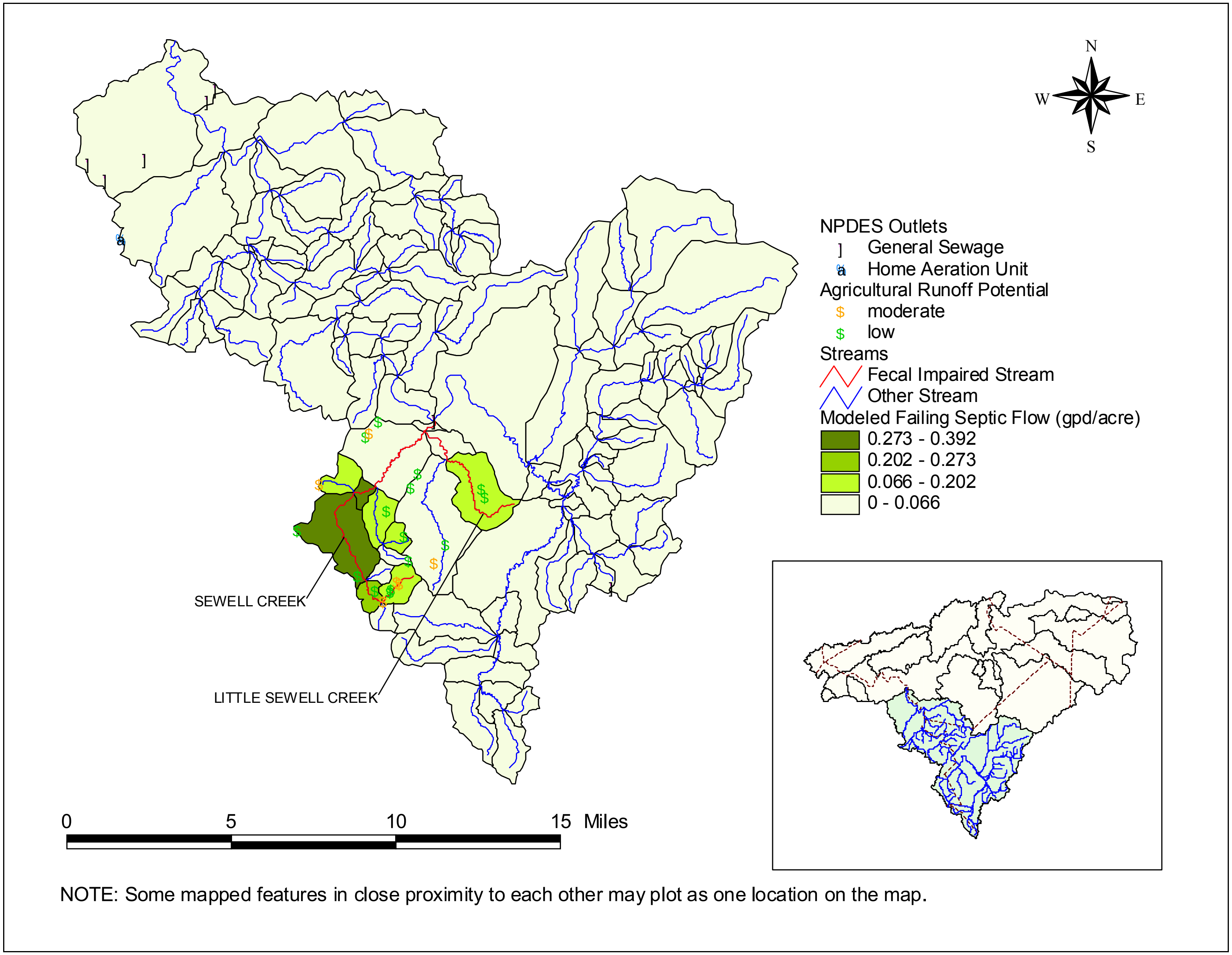


Figure A-8-4. Fecal coliform sources in the Meadow River watershed

A-8.5 TMDLs for the Meadow River Watershed

A-8.5.1 TMDL Development

A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were analyzed first because they have a profound effect on downstream water quality. Loading contributions were reduced from applicable sources for these waterbodies, and TMDLs were developed. Refer the TMDL Report for a detailed description of the allocation methodologies used in developing the pollutant-specific TMDLs.

The TMDLs for iron, aluminum, pH, and fecal coliform bacteria are shown in Tables A-8-2 through A-8-6. The TMDLs for iron and aluminum are presented as annual daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in number of colonies per day. All TMDLs were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

As stated in the TMDL Report, a surrogate approach was used to develop pH TMDLs. It was assumed that reductions in metals concentrations to TMDL endpoints would result in compliance with the pH water quality standard. To verify this assumption, the Dynamic Equilibrium In-stream Chemical Reactions model (DESC-R) was run for an extended period under TMDL conditions—conditions where TMDL endpoints for metals were met. A median equilibrium pH was calculated based on the daily equilibrium pH output from DESC-R. The results, shown in Table A-8-4, are the TMDLs for the pH-impaired streams in the watershed. Refer to the Technical Report for a detailed description of the pH modeling approach.

For pH impairments associated with atmospheric deposition, TMDLs are presented as the annual net acidity load associated with maintenance of the pH TMDL endpoint. Because the source of impairment is limited to atmospheric deposition, these TMDLs incorporate only a gross load allocation. The TMDLs represent the annual net acidity loads that can be present at the downstream extent of impaired streams while maintaining the pH TMDL endpoint. Table A-8-5 shows the TMDLs for acid deposition.

A-8.6 TMDL Tables: Metals and pH

Table A-8-2. Iron TMDLs for the Meadow River watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day	TMDL (lbs/day)
Meadow River	WVKG-19-Q	Sewell Creek	Iron	173.9	4.3	9.4	187.5
Meadow River	WVKG-19-Q-1	Little Sewell Creek	Iron	80.6	2.5	4.4	87.5
Meadow River	WVKG-19-Q-1-A	Boggs Creek	Iron	45.2	1.2	2.4	48.9
Meadow River	WVKG-19-V	Little Clear Creek	Iron	269.6	27.4	15.6	312.6
Meadow River	WVKG-19-V-1	Beaver Creek	Iron	50.8	11.5	3.3	65.6
Meadow River	WVKG-19-V-2	Stoney Run	Iron	9.5	0.7	0.5	10.8
Meadow River	WVKG-19-V-3	Rader Run	Iron	7.8	5.2	0.7	13.7
Meadow River	WVKG-19-V-3.8	UNT/Little Clear Creek RM 7.5	Iron	3.9	NA	0.2	4.1
Meadow River	WVKG-19-V-4	Cutlip Branch	Iron	5.8	0.1	0.3	6.3
Meadow River	WVKG-19-V-5	Laurel Creek	Iron	39.5	1.3	2.1	42.9
Meadow River	WVKG-19-V-7	Kuhn Branch	Iron	20.5	2.5	1.2	24.2
Meadow River	WVKG-19-V-7-A	Joe Knob Branch	Iron	8.5	0.2	0.5	9.2

UNT = unnamed tributary; RM = river mile; NA = not applicable

Table A-8-3. Aluminum TMDLs for the Meadow River watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)
Meadow River	WVKG-19-U-2-A	Briery Creek	Aluminum	14.1	NA	0.7	14.9

Table A-8-4. pH TMDLs for the Meadow River watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
Meadow River	WVKG-19-U-2-A	Briery Creek	pH	7.87

UNT = unnamed tributary; RM = river mile
*Predicted pH assumes that all metals (aluminum, iron) meet TMDL endpoints.

Table A-8-5. Acid deposition TMDLs for the Meadow River watershed

Major Watershed	Stream Name	Stream Code	Baseline Average Annual Net Acidity Load (ton/yr)	Allocated Average Annual Net Acidity Load (ton/yr)
Meadow River	Laurel Creek	WVKG-19-V-5	3.49	2.39
Meadow River	Little Clear Creek upstream of Kuhn Branch	WVKG-19-V	3.33	1.99

A-8.5 TMDL Tables: Fecal Coliform Bacteria

Table A-8-6. Fecal coliform bacteria TMDLs for the Meadow River watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
Meadow River	WVKG-19-Q	Sewell Creek	Fecal coliform	1.06E+11	2.95E+10	7.14E+09	1.43E+11
Meadow River	WVKG-19-Q-1	Little Sewell Creek	Fecal coliform	3.79E+10	NA	2.00E+09	3.99E+10

NA = not applicable; UNT = unnamed tributary

"Scientific notation" is a method of writing or displaying numbers in terms of a decimal number between 1 and 10 multiplied by a power of 10. The scientific notation of 10,492, for example, is 1.0492×10^4.