APPENDIX 5

A-5 BIG BEAVER CREEK

A-5.1 Watershed Information

Big Beaver Creek is in the southeastern portion of the Gauley River watershed and drains approximately 38.2 square miles (24,500 acres), as shown in Figure A-5-1. The dominant landuse in the watershed is forest, which covers 68.4 percent of the watershed. Other important landuse types include grassland (16.9 percent), AML (6.6 percent), urban/residential (3.3 percent), and wetland (2.9 percent). All other individual land cover types account for less than 2 percent of the total watershed area. There are eight impaired streams in the watershed, including Big Beaver Creek, which are addressed in this TMDL development effort. Figure A-5-2 shows the impaired segments and the pollutants for which each is listed as impaired.

Before establishing Total Maximum Daily Loads (TMDLs), WVDEP performed monitoring in each of the impaired streams in the Gauley River watershed to better characterize water quality and refine impairment listings. Monthly samples were taken at 34 stations (station locations can be viewed using the ArcExplorer project) throughout the Big Beaver Creek 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.

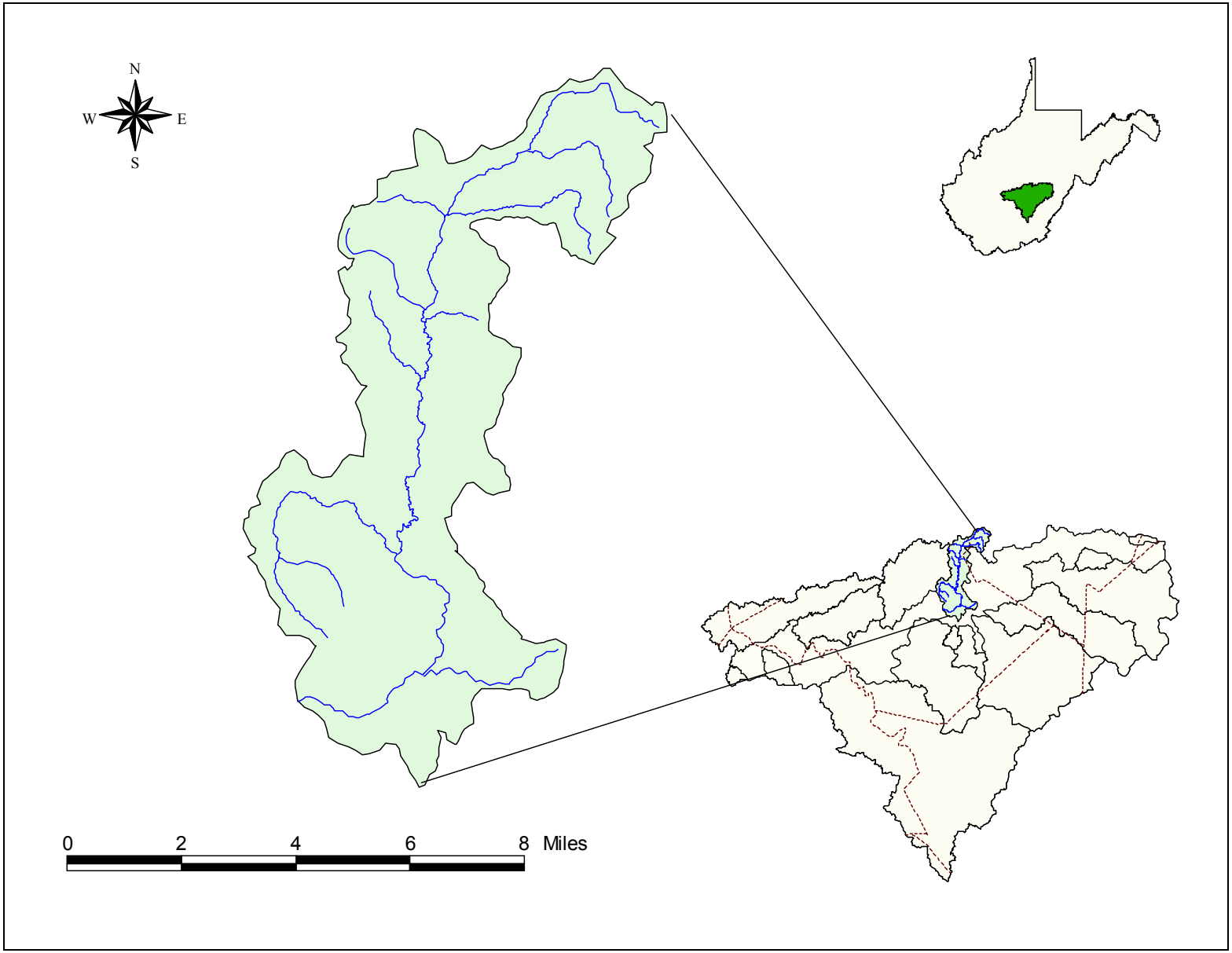
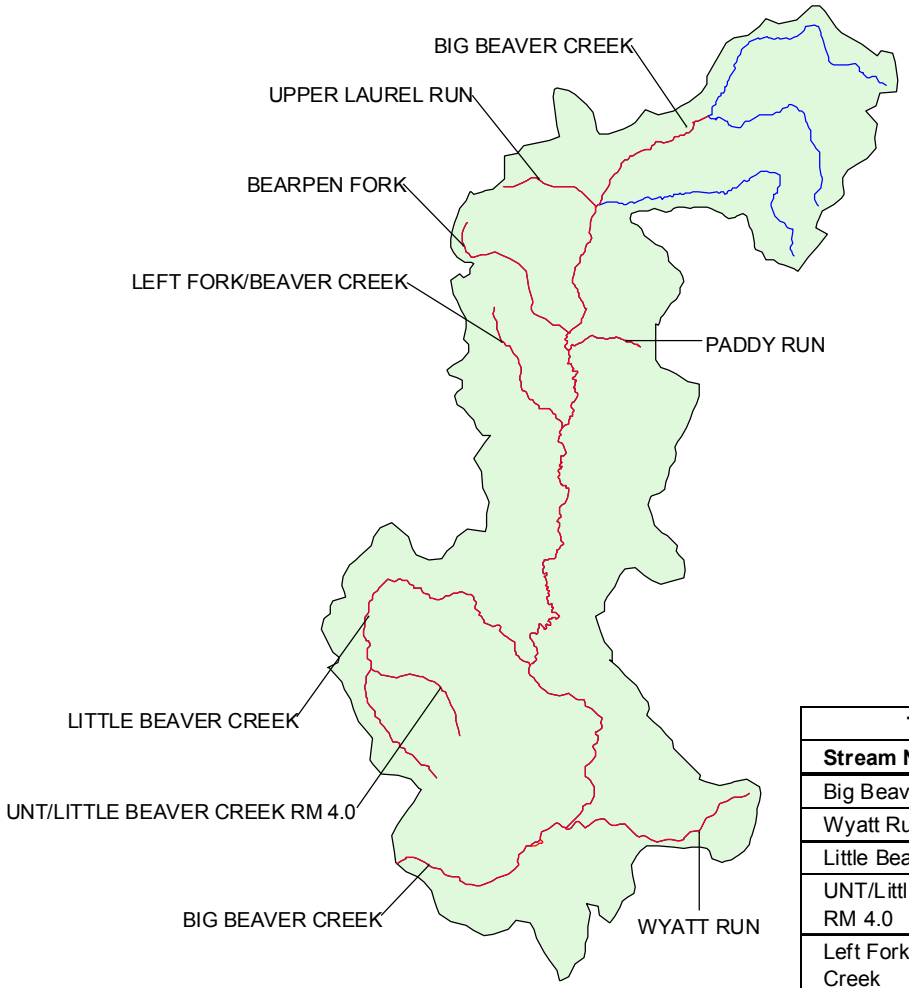


Figure A-5-1. Location of the Big Beaver Creek watershed



TMDL	Impairment					
Stream Name	**Fe**	**Al**	**pH**	**Se**	**FC**	**BIO**
Big Beaver Creek					x	
Wyatt Run					x	
Little Beaver Creek					x	
UNT/Little Beaver Creek RM 4.0	x				x	
Left Fork/Big Beaver Creek					x	
Paddy Run	x					
Bearpen Fork	x					x
Upper Laurel Run		x	x			

Figure A-5-2. Waterbodies and impairments under TMDL development in the Big Beaver Creek watershed

A-5.2 Metals and pH Sources

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

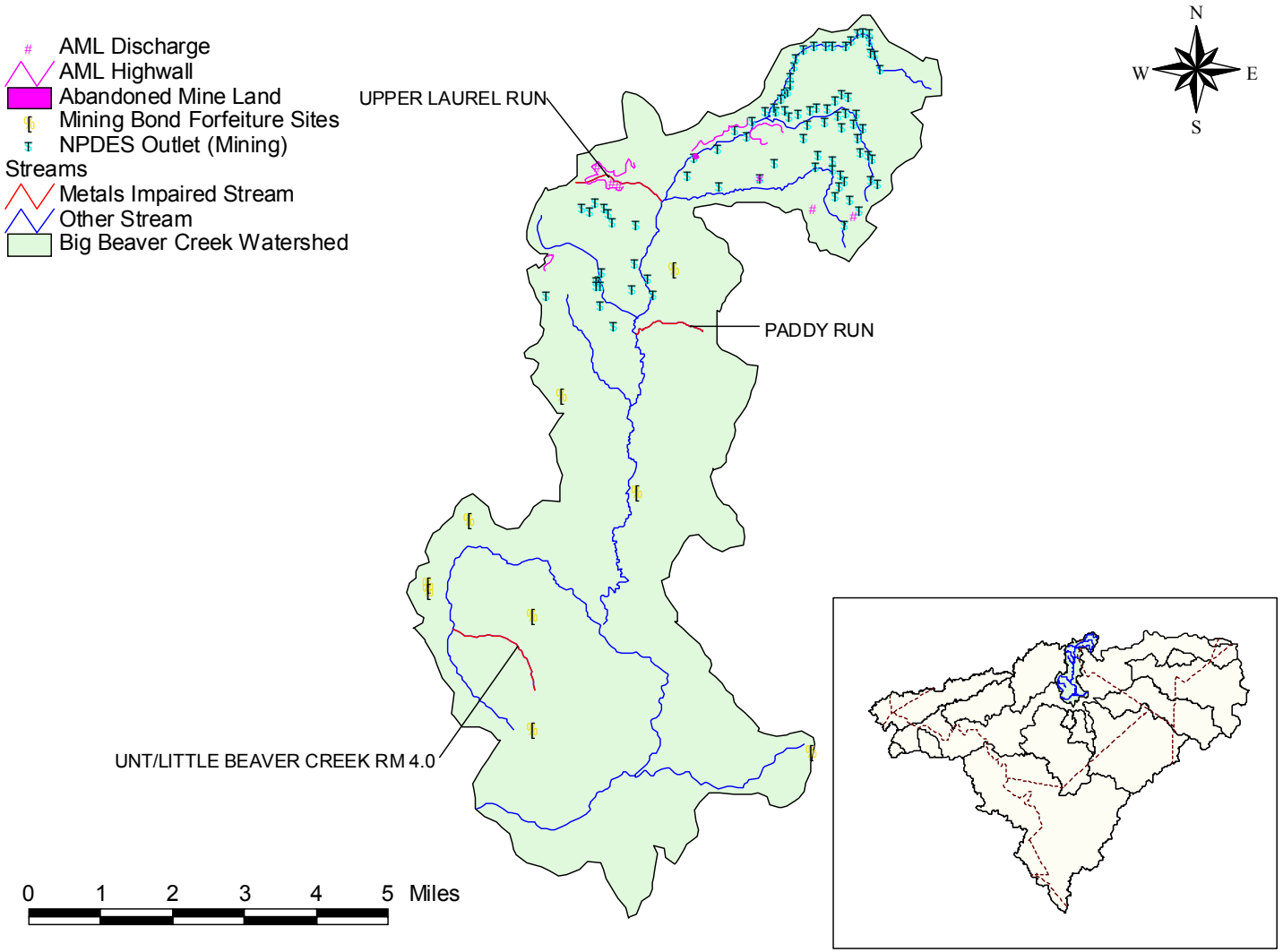
Pollutant sources were identified using statewide geographic information system (GIS) coverages of point and non-point sources, and through field reconnaissance. As part of the TMDL process, WVDEP documented pollution sources by describing the pollutant source in detail, collecting Global Positioning 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-5-3.

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 might be 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-5-3 (e.g., agricultural areas and unpaved roads), specific details relative to these sources are discussed in section A-5.2.2.

A-5.2.1 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.

In the Big Beaver Creek watershed there are 6 mining-related NPDES metals effluent outlets. 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 that discharge to the Big Beaver Creek watershed. 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 no existing non-mining point sources of iron or aluminum in the watershed.



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

Figure A-5-3. Metals sources in the Big Beaver Creek watershed

A-5.2.2 Metals Non-point Source Inventory

In addition to point sources, non-point sources also contribute to metals-related water quality impairments in the Big Beaver Creek watershed. Non-point 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 non-point 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 Big Beaver Creek watershed are discussed below.

Abandoned Mine Lands and Bond Forfeiture Sites
Based on the identification of a number of abandoned mining activities in the Big Beaver Creek 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 Big Beaver Creek watershed. In addition, source-tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized six abandoned mine sources (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 no bond forfeiture sites represented in the model in the Big Beaver Creek watershed.

Land-Disturbing Activities
Based on the GAP 2000 landuse coverage, there are only 0.3 acres of row crop agriculture in the Big Beaver Creek watershed, representing a small fraction of the total watershed area. During the pre-TMDL sampling period there were 120 acres of active timber harvest in the watershed. The watershed does not have 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 74.8 miles of paved roads and 53.5 miles of unpaved roads in the Big Beaver Creek watershed.

A-5.3 Fecal Coliform Bacteria Sources

This section identifies and examines the potential sources of fecal coliform bacteria in the Big Beaver Creek watershed. Sources can be classified as either point sources or non-point sources. Potential point sources include effluent discharges of sewage treatment facilities and collection system overflows. Potential non-point 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-5.3.1 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. In the Big Beaver Creek watershed there is one general sewage discharge permit for a package plant-type treatment system.

A-5.3.2 Non-point (Non-permitted) Fecal Coliform Bacteria Sources

Pollutant source-tracking by WVDEP personnel identified scattered areas of high population density without access to public sewers in the Big Beaver Creek 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 479 unsewered homes in the Big Beaver Creek watershed. A septic system failure rate derived from geology and soil type was applied to the number of unsewered homes to calculate non-point source fecal coliform loading from failing septic systems. Figure A-5-4 shows the geographic distribution of estimated failing septic system non-point sources in the watershed.

Stormwater runoff is another potential non-point 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. Given the small portion of total land area in the Big Beaver Creek watershed that consists of agricultural areas, stormwater runoff from these areas is not considered a significant non-point source of fecal coliform bacteria, except in localized areas. Therefore, fecal coliform bacteria reductions from agricultural landuses are prescribed in only seven of the 17 subwatersheds in the Big Beaver Creek drainage. Fecal coliform bacteria reductions in stormwater runoff form residential/urban areas are prescribed in six of the 17 subwatersheds that compose the Big Beaver Creek drainage area. WVDEP source tracking determined that failing septic systems and/or straight pipe discharges were sources of fecal coliform in the Big Beaver Creek watershed. As a result, 12 subwatersheds were prescribed reductions to failing onsite septic systems.

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. In addition, WVDEP conducted storm sampling on a 100 percent forested subwatershed (Shrewsbury Hollow) within the Kanawha State Forest, Kanawha County, West Virginia to determine wildlife contributions of fecal coliform. 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.

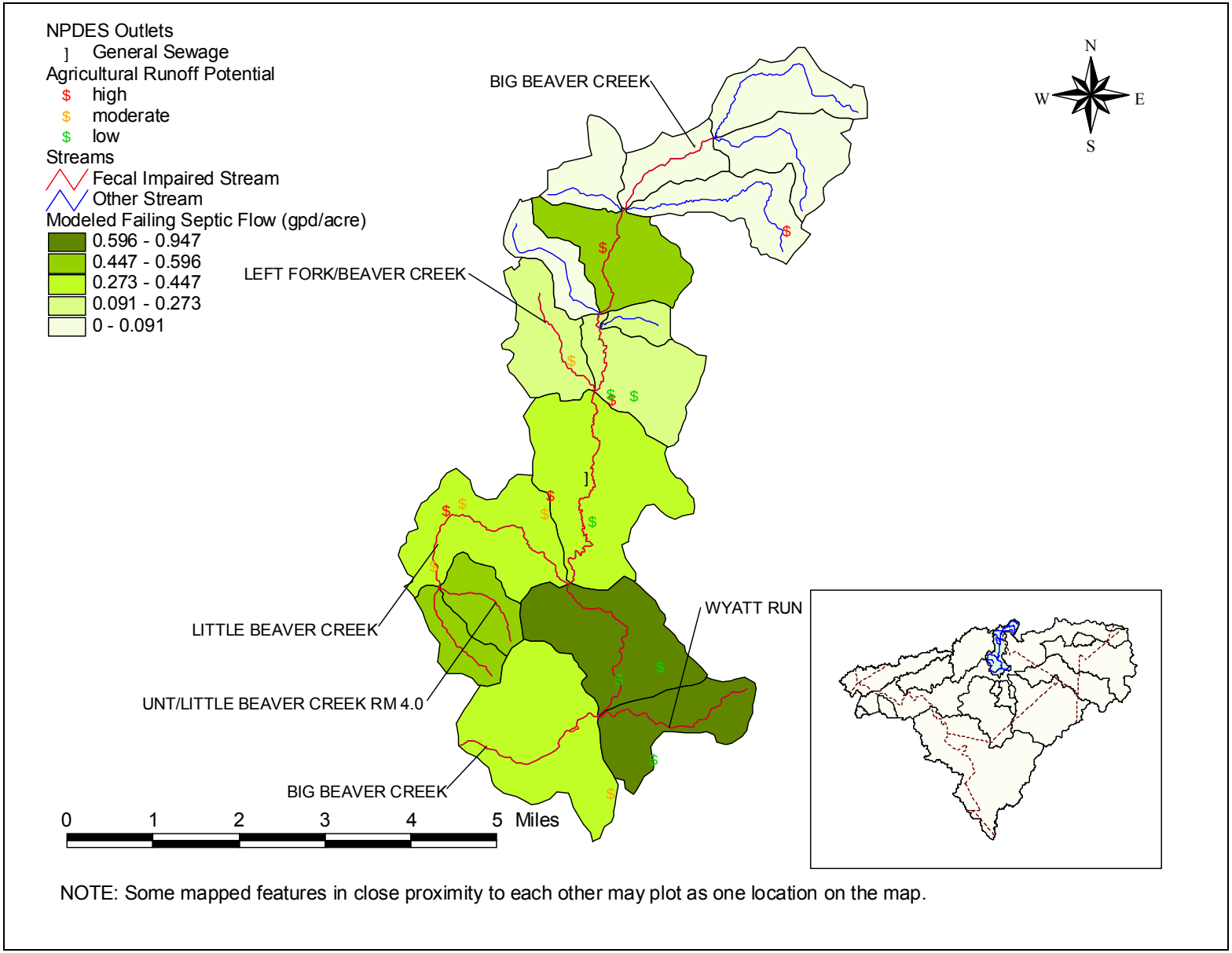


Figure A-5-4. Fecal coliform sources in the Big Beaver Creek watershed

A-5.4 Stressors of Biologically Impaired Streams

The Big Beaver Creek watershed has one biologically impaired stream, Bearpen Fork, for which TMDLs have been developed. Biological stressors of the stream's benthic communities and the TMDLs required to address these impairments are identified in Table A-5-1. A stressor identification process was used to evaluate and identify the significant stressors of impaired benthic communities. The stressor identification process is detailed in the TMDL Report with additional information provided in the Technical Report.

Table A-5-1. Significant stressors of Bearpen Fork in the Big Beaver Creek watershed

Stream	Biological Stressors	TMDLs Required
Bearpen Fork	Sedimentation	Total iron (surrogate)

The stressor identification process indicated sedimentation as the causative stressor for the biological impairment of Bearpen Fork, which also exhibited impairment pursuant to total iron water quality criteria. WVDEP determined that the sediment reductions that are necessary to ensure compliance with iron criteria exceed those necessary to resolve biological impairments. As such, the iron TMDL presented for Bearpen Fork is a surrogate for the necessary sediment TMDL.

A-5.5 TMDLs for the Big Beaver Creek Watershed

A-5.5.1 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 to 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-5-2 through A-5-5. The TMDLs for iron and aluminum are presented as daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in number of colonies per day. The biological TMDL for sedimentation is presented in Table A-5-6 in pounds 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-5-3, 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.

A-5.6 TMDL Tables: Metals and pH

Table A-5-2. Iron TMDLs for the Big Beaver Creek watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)
Big Beaver Creek	WVKG-30-E-4	UNT/Little Beaver Creek RM 4.0	Iron	8.0	0.1	0.4	8.6
Big Beaver Creek	WVKG-30-K	Paddy Run	Iron	2.2	0.1	0.1	2.3
Big Beaver Creek	WVKG-30-L	Bearpen Fork	Iron	5.8	3.2	0.5	9.5
UNT = unnamed tributary; RM = river mile							

Table A-5-3. Aluminum TMDLs for the Big Beaver Creek watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)
Big Beaver Creek	WVKG-30-P	Upper Laurel Run	Aluminum	10.3	NA	0.5	10.9
NA = Not Applicable							

Table A-5-4. pH TMDLs for the Big Beaver Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
Big Beaver Creek	WVKG-30-P	Upper Laurel Run	pH	6.99

UNT = unnamed tributary; RM = river mile

*Predicted pH assumes that all metals (aluminum, iron) meet TMDL endpoints.

A-5.7 TMDL Tables: Fecal Coliform Bacteria

Table A-5-5. Fecal coliform bacteria TMDLs for the Big Beaver Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
Big Beaver Creek	WVKG-30	Big Beaver Creek	Fecal coliform	1.41E+11	1.51E+08	7.42E+09	1.48E+11
Big Beaver Creek	WVKG-30-D	Wyatt Run	Fecal coliform	1.03E+10	NA	5.41E+08	1.08E+10
Big Beaver Creek	WVKG-30-E	Little Beaver Creek	Fecal coliform	2.09E+10	NA	1.10E+09	2.20E+10
Big Beaver Creek	WVKG-30-E-4	UNT/Little Beaver Creek RM 4.0	Fecal coliform	4.55E+09	NA	2.39E+08	4.79E+09
Big Beaver Creek	WVKG-30-H	Left Fork/Beaver Creek	Fecal coliform	7.84E+09	NA	4.12E+08	8.25E+09

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

"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.

A-5.8 TMDL Tables: Biological

Table A-5-6. Biological TMDLs for the Big Beaver Creek watershed

Stream	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
Bearpen Fork	Sedimentation	Total iron (surrogate)	5.8	3.2	0.5	9.5	lbs/day