APPENDIX 2

A-2. TUPPER CREEK

A-2.1 Watershed Pre-TMDL Information

Tupper Creek is in the eastern portion of the Lower Kanawha River watershed and drains approximately 23.6 square miles (15,102 acres), as shown in Figure A-2-1. The dominant land use is forest, which covers 77.0 percent of the watershed. Other important land use types are urban/residential (9.7 percent) and pasture (8.4 percent). All other individual land cover types account for less than 5 percent of the total watershed area. There are five impaired streams in the watershed, including Tupper Creek. Figure A-2-2 shows the impaired segments and the causative pollutants for each.

Before establishing Total Maximum Daily Loads (TMDLs), WVDEP monitored each of the impaired streams in the Lower Kanawha River watershed to better characterize water quality and to refine impairment listings. Monthly samples were taken at 10 stations throughout the Tupper Creek watershed from July 1, 2002, through June 30, 2003. 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 total iron, dissolved iron, total aluminum, dissolved aluminum, total suspended solids, selenium, pH, sulfate, 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 that period.

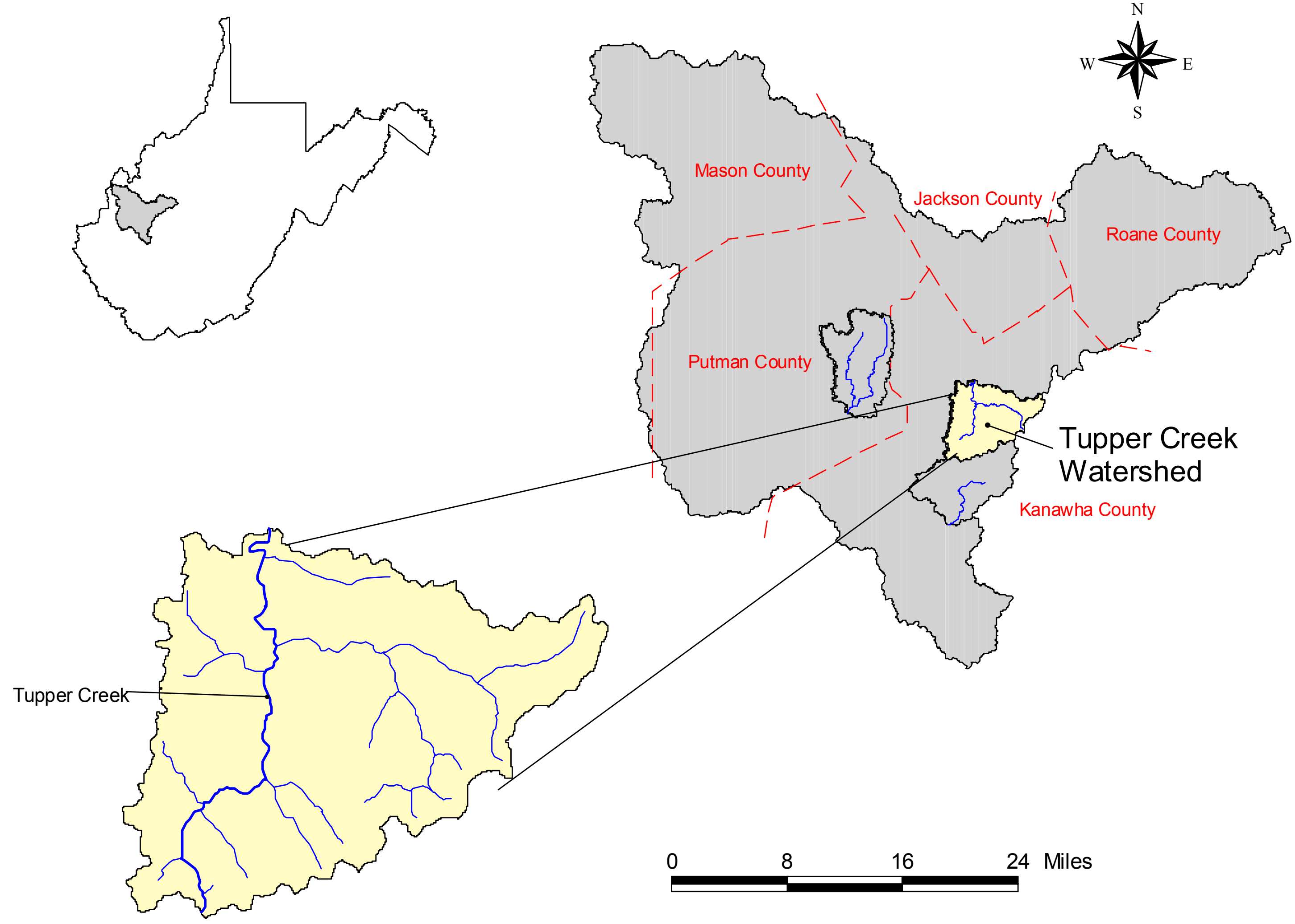
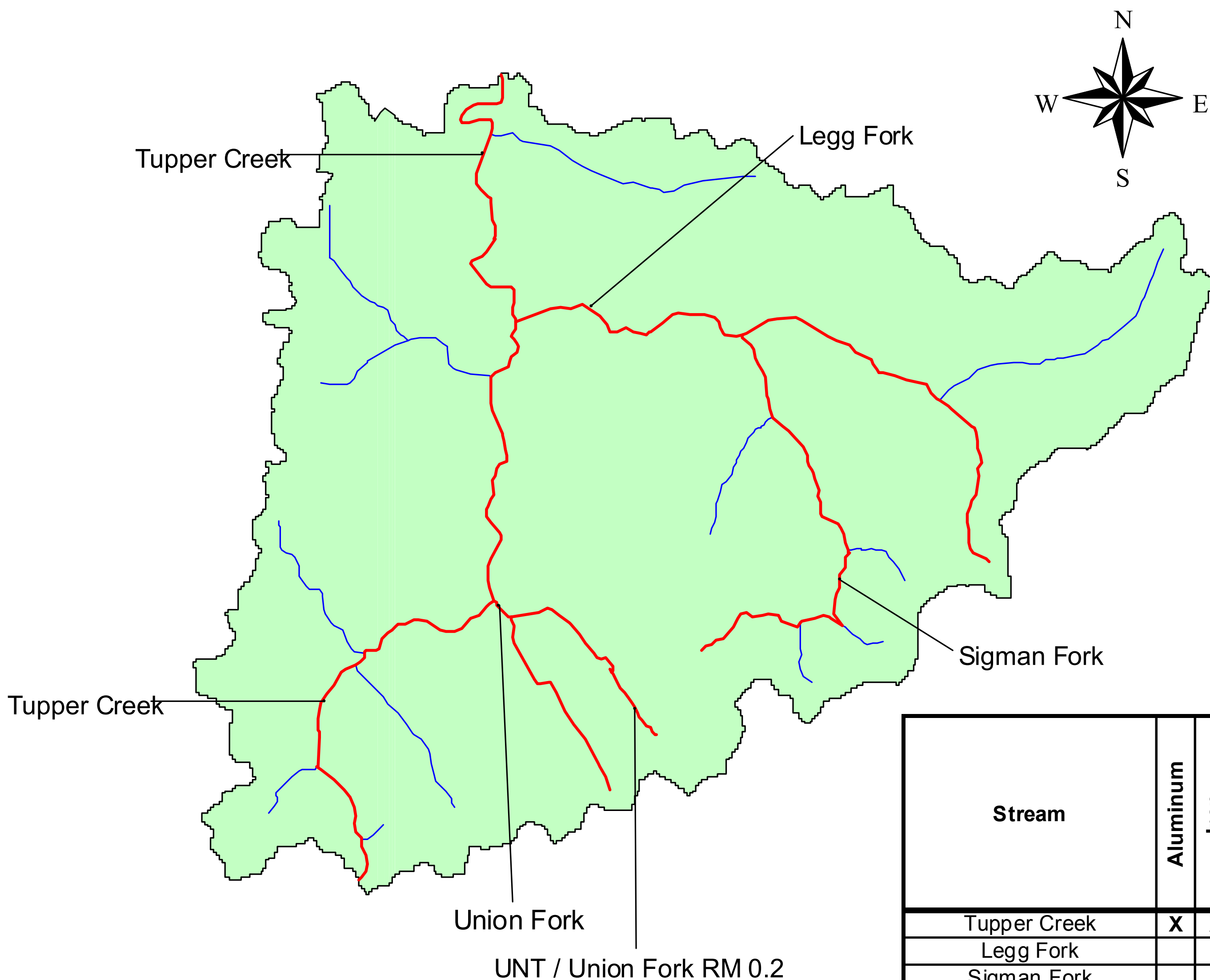


Figure A-2-1. Location of the Tupper Creek watershed.



Stream	Aluminum	Iron	pH	Biological	Fecal Coliforms
Tupper Creek	X	X	X	X	X
Legg Fork					X
Sigman Fork					X
Union Fork	X	X	X		X
UNT/Union Fork RM 0.2	X	X	X		X

Figure A-2-2. Impaired waterbodies in the Tupper Creek watershed.

A-2.2 Metals and pH Sources

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

Pollution 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 pollution source in detail, collecting Global Positioning System (GPS) 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. They compiled these records and electronically plotted them 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-2-3.

Based on 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 dissolved aluminum and total iron during critical high flow conditions. Although some of these sediment-producing sources are not displayed in Figure A-2-3 (e.g., harvested forest areas, agricultural areas, and unpaved roads), specific details relative to these sources are discussed in section A-2.2.2.

A-2.2.1 Metals Point Source Inventory

As described in the main 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.

No mining or non-mining metals related NPDES permits are present in the Tupper Creek watershed.

A-2.2.2 Metals Nonpoint Source Inventory

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

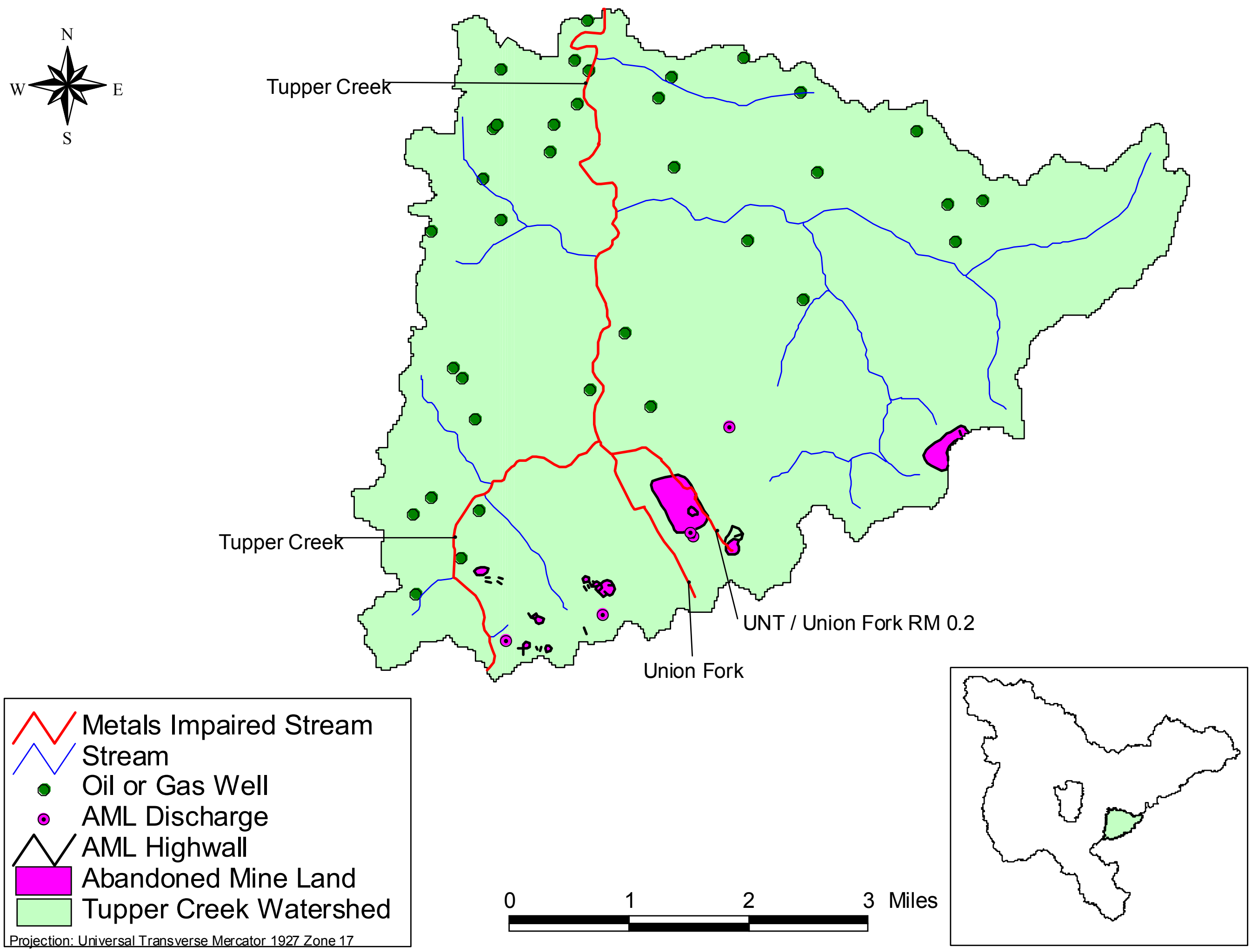
Abandoned Mine Lands and Bond Forfeiture Sites

Based on the identification of a number of abandoned mining activities in the Tupper 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 Tupper Creek watershed. In addition, source-tracking efforts by WVDEP’s Division of Water and Waste Management identified and characterized 24 abandoned mine sources (discharges, seeps, and streams).

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. No bond forfeiture sites exist in the Tupper Creek watershed.

Land-Disturbing Activities

Based on the GAP 2000 land use coverage, no agricultural areas are present in the Tupper Creek watershed. There are two active logging operations. The disturbed areas associated with these operations are estimated to cover 163 acres (1.1 percent) of the total watershed area. The watershed contains 35 active oil and gas wells, which, based on the survey by WVDEP’s Office of Oil and Gas, are estimated to comprise 182 acres (1.2 percent). 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 on topographic maps that were not included in the TIGER shapefile. There are 67.2 miles of paved roads and 200.8 miles of unpaved roads in the Tupper Creek watershed.



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

Figure A-2-3. Metals sources in the Tupper Creek watershed.

A-2.3 Fecal Coliform Bacteria Sources

This section identifies and examines the potential sources of fecal coliform bacteria in the Tupper Creek watershed. Sources can be classified as point sources (specific sources subject to a permit) or nonpoint sources (diffuse sources). Point sources of fecal coliform bacteria are classified by several different types of sewage permits and the point source discharges regulated therein. Nonpoint sources are diffuse, non-permitted sources.

A-2.3.1 Fecal Coliform Bacteria Point Sources

Permitted sources of fecal coliform bacteria that experience effluent overflows or do not comply with permit limits can cause occasional high loadings of fecal coliform bacteria in receiving streams. In the Tupper Creek watershed there are 23 general sewage permits for home aeration units that serve private residences and a church. There are two additional general sewage permits for the Edens Mobile Home Park (WVG550192) and the Stone Mobile Home Trailer Park (WVG551242).

A-2.3.2 Nonpoint (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 Tupper 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). The West Virginia Bureau for Public Health estimates the septic tank failure rate in this area to be 70 percent in the first 10 years (WV Bureau for Public Health 2003). An analysis of census data from the 1990 Census combined with WVDEP source-tracking information yielded an estimate of 2,270 people living in the unsewered homes in the Tupper Creek watershed. Figure A-2-4 shows the estimated distribution of the unsewered population 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. 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 Lower Kanawha River watershed that consists of agricultural areas, as well as the low fecal coliform bacteria accumulation rates for forested areas, stormwater runoff from these areas is not considered to be a significant nonpoint source of fecal coliform bacteria except in localized areas. However, stormwater runoff from residential areas contributes to the fecal coliform impairments in the Tupper Creek watershed.

A certain “natural background” contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forested areas. Accumulation rates for fecal coliform bacteria in forested areas were developed using reference numbers from past TMDLs, incorporating wildlife estimates obtained from WVDEP’s Division of Natural Resources. Although wildlife contributions of fecal coliform bacteria were considered in modeling, they were not found to be a significant source.

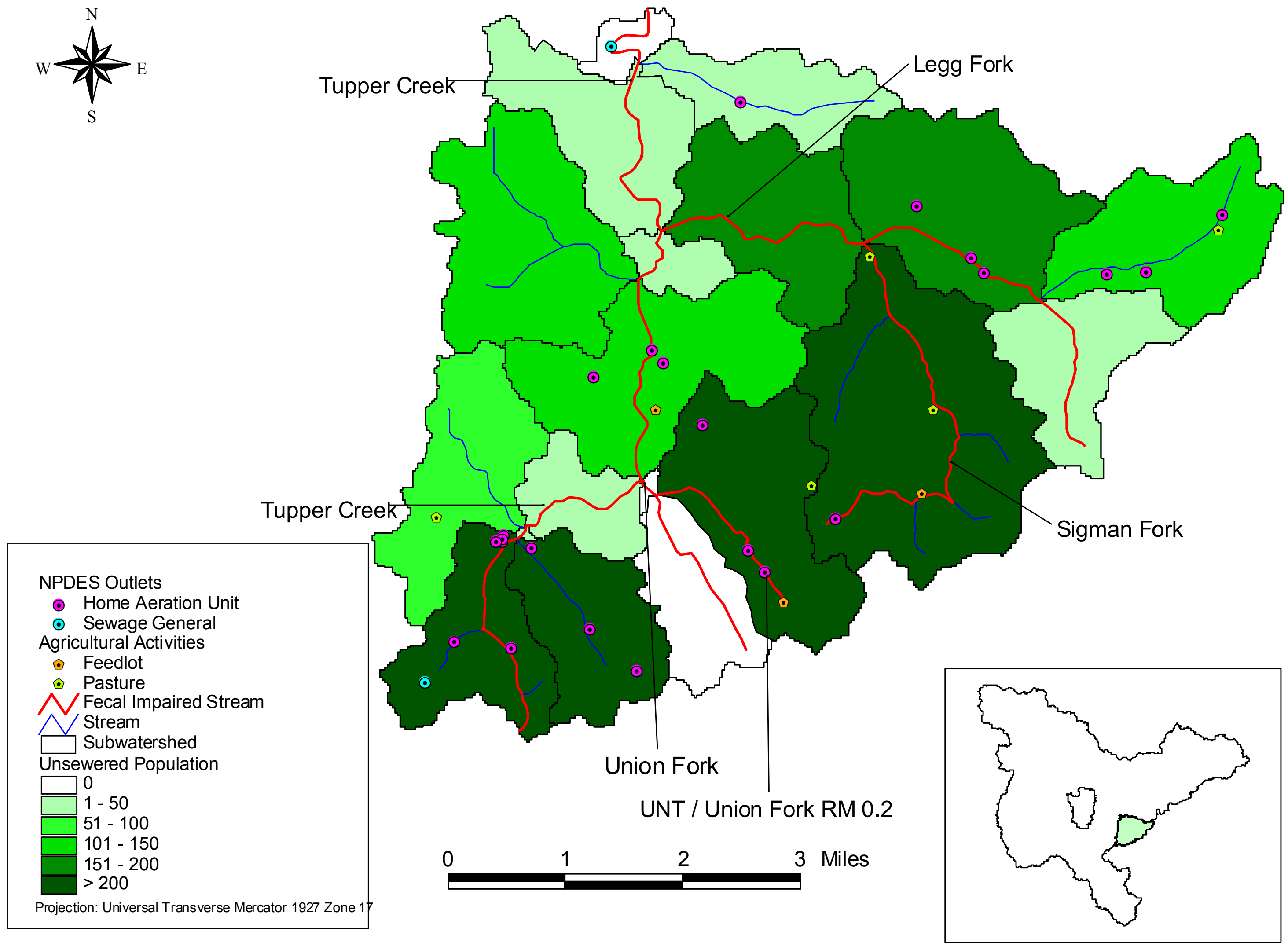


Figure A-2-4. Fecal coliform sources in the Tupper Creek watershed.

A-2.4 Stressors of Biologically Impaired Streams

The Tupper Creek watershed has one biologically impaired stream for which TMDLs have been developed. This stream is identified in Table A-2-1 along with the biological stressors of the stream's benthic communities and the TMDLs required to address these impairments. A stressor identification process was used to evaluate and identify the primary stressors of impaired benthic communities. Refer to the main report for a detailed description of the stressor identification process.

Table A-2-1. Primary stressors of biologically impaired streams in the Tupper Creek watershed

Stream	Biological Stressors	TMDLs Required
Tupper Creek	Metals toxicity (aluminum, iron)	Aluminum Iron
	pH toxicity (acidity)	pH
	Organic enrichment	Fecal coliform
	Sedimentation	Sediment

TMDLs for each specific biological stressor are shown in Table A-2-6. Sediment TMDLs are required only when the stressor identification process indicates that a sedimentation problem is impairing the biological community. A sediment TMDL has been developed for Tupper Creek.

A-2.5 TMDLs for the Tupper Creek Watershed

A-2.5.1 TMDL Development

TMDLs and source allocations were developed for impaired streams in the Tupper Creek watershed. 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 Section 7.4 of the main report for a detailed description of the allocation methodologies used in developing the pollutant-specific TMDLs.

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

As stated in Section 7.3, a surrogate approach was used to develop pH TMDLs. It was assumed that reducing 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-2-4, 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.

A-2.6 TMDL Tables: Metals and pH

Table A-2-2. Iron TMDLs for the Tupper Creek watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lb/yr)	Wasteload Allocation (lb/yr)	Margin of Safety (lb/yr)	TMDL (lb/yr)
Tupper Creek	WVKP-13	Tupper Creek	Iron	8,785	NA	462	9,247
Tupper Creek	WVKP-13-C.5	Union Fork	Iron	991	NA	52	1,044
Tupper Creek	WVKP-13-C.5-1	UNT/Union Fork RM 0.2	Iron	667	NA	35	702

NA = not applicable; UNT = unnamed tributary.

Table A-2-3. Aluminum TMDLs for the Tupper Creek watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lb/yr)	Wasteload Allocation (lb/yr)	Margin of Safety (lb/yr)	TMDL (lb/yr)
Tupper Creek	WVKP-13	Tupper Creek	Aluminum	6,820	NA	359	7,179
Tupper Creek	WVKP-13-C.5	Union Fork	Aluminum	775	NA	41	815
Tupper Creek	WVKP-13-C.5-1	UNT/Union Fork RM 0.2	Aluminum	532	NA	28	560

NA = not applicable; UNT = unnamed tributary.

Table A-2-4. pH TMDLs for the Tupper Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
Tupper Creek	WVKP-13	Tupper Creek	pH	8.64
Tupper Creek	WVKP-13-C.5	Union Fork	pH	8.65
Tupper Creek	WVKP-13-C.5-1	UNT/Union Fork RM 0.2	pH	8.67

UNT = unnamed tributary.
*Predicted pH assumes that all metals (aluminum and iron) meet TMDL endpoints.

A-2.7 TMDL Tables: Fecal Coliform Bacteria

Table A-2-5. Fecal coliform bacteria TMDLs for the Tupper Creek watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/yr)	Wasteload Allocation (counts/yr)	Margin of Safety (counts /yr)	TMDL (counts /yr)
Tupper Creek	WVKP-13	Tupper Creek	Fecal coliform	2.68E+13	6.39E+05	1.41E+12	2.82E+13
Tupper Creek	WVKP-13-A	Legg Fork	Fecal coliform	4.25E+12	1.79E+05	2.24E+11	4.47E+12
Tupper Creek	WVKP-13-A-1	Sigman Fork	Fecal coliform	2.75E+12	2.56E+04	1.45E+11	2.89E+12
Tupper Creek	WVKP-13-C.5	Union Fork	Fecal coliform	2.03E+12	7.67E+04	1.07E+11	2.13E+12
Tupper Creek	WVKP-13-C.5-1	UNT/Union Fork RM 0.2	Fecal coliform	1.43E+12	7.67E+04	7.53E+10	1.51E+12

NA = not applicable; UNT = unnamed tributary.

A-2.8 TMDL Tables: Biological

Table A-2-6. Biological TMDLs for the Tupper Creek watershed

Stream	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
Tupper Creek WVKP-13	Metals Toxicity	Aluminum	6,820	NA	359	7,179	lb/yr
		Iron	8,785	NA	462	9,247	lb/yr
	pH Toxicity	pH	Not Applicable			8.64	Standard Units
	Organic Enrichment	Fecal Coliform	2.68E+13	6.39E+05	1.41E+12	2.82E+13	counts/yr
	Sedimentation	Sediment	2,822	2	149	2,972	tonnes/yr