APPENDIX 1

A-1. CLEAR FORK

A-1.1 Watershed Information

Clear Fork is in the southeastern portion of the Coal River watershed and drains approximately 63.3 square miles (40,516 acres), as shown in Figure A-1-1. The dominant landuse in the watershed is forest, which covers 76.3 percent of the watershed. Other important landuse types include burned forest (4.4 percent) and active mine land (15.0 percent). All other individual land cover types account for less than 4.5 percent of the total watershed area. There are 12 impaired streams in the watershed, including Clear Fork, that are addressed in this TMDL development effort. Figure A-1-2 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 Coal River watershed to better characterize water quality and refine impairment listings. Monthly samples were taken at 42 stations (station locations can be viewed using the ArcExplorer project) throughout the Clear Fork 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 acidity, alkalinity, total iron, dissolved iron, total aluminum, dissolved aluminum, total suspended solids, pH, sulfate, total selenium, total manganese, 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.

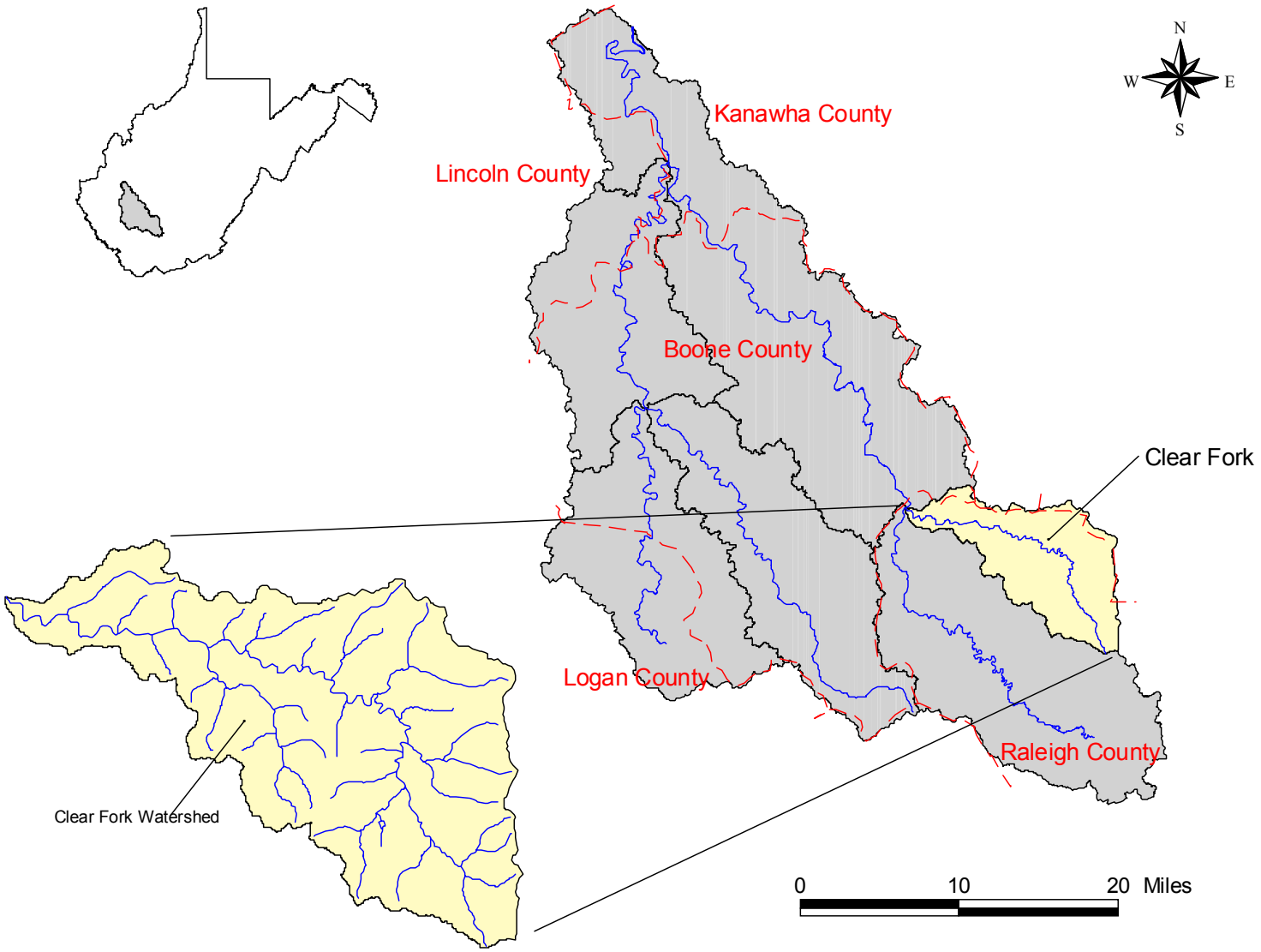
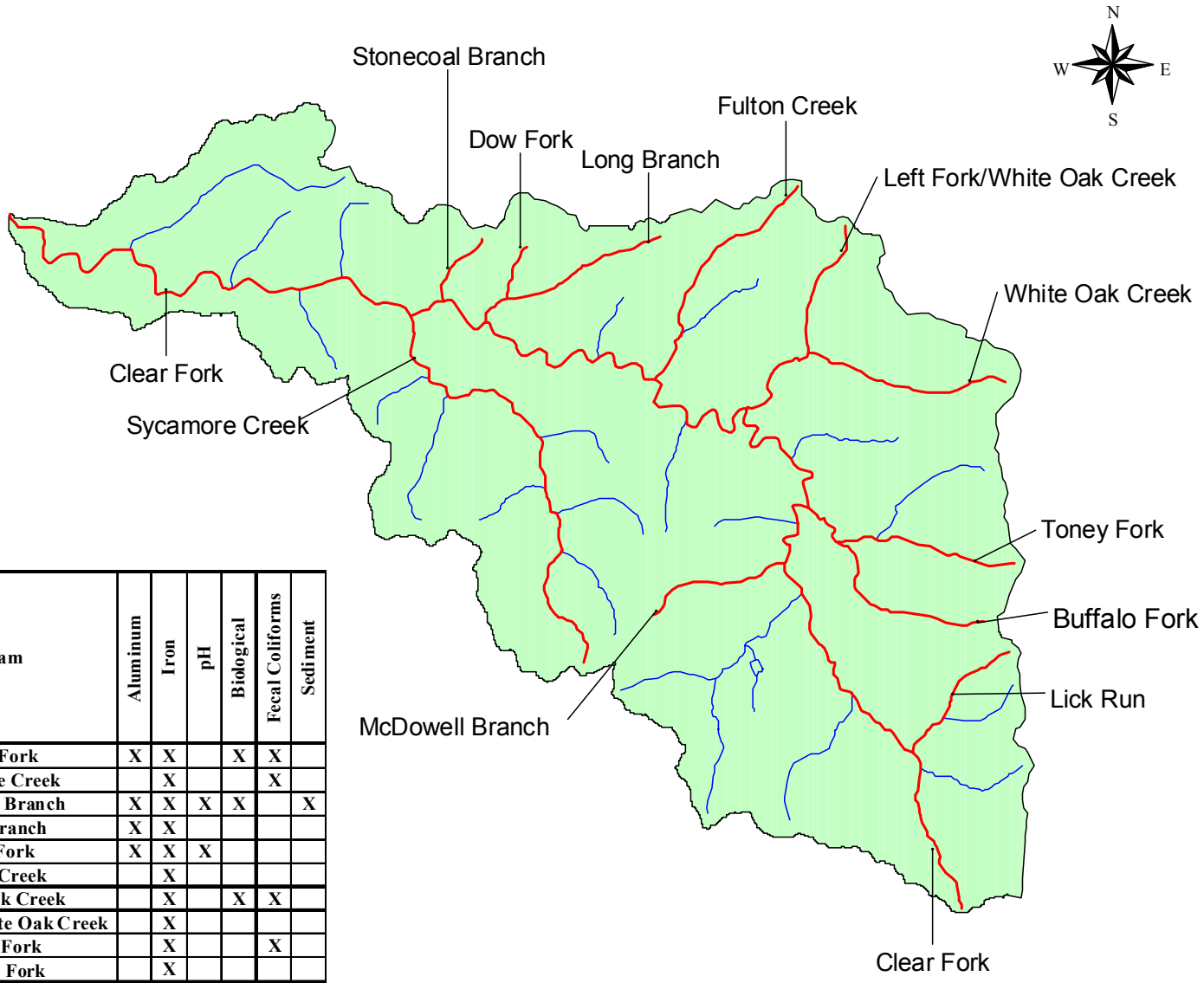


Figure A-1-1. Location of the Clear Fork watershed.



Stream	Aluminum	Iron	pH	Biological	Fecal Coliforms	Sediment
Clear Fork	X	X		X	X	
Sycamore Creek		X			X	
Stonecoal Branch	X	X	X	X		X
Long Branch	X	X				
Dow Fork	X	X	X			
Fulton Creek		X				
White Oak Creek		X		X	X	
Left Fork/White Oak Creek		X				
Toney Fork		X			X	
Buffalo Fork		X				
McDowell Branch		X			X	
Lick Run		X		X	X	X

Figure A-1-2. Waterbodies and impairments under TMDL development in the Clear Fork watershed.

A-1.2 Metals and pH Sources

This section identifies and examines the potential sources of aluminum, iron, and pH impairment in the Clear Fork 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 diffuse, non-permitted sources such as abandoned or forfeited mine sites.

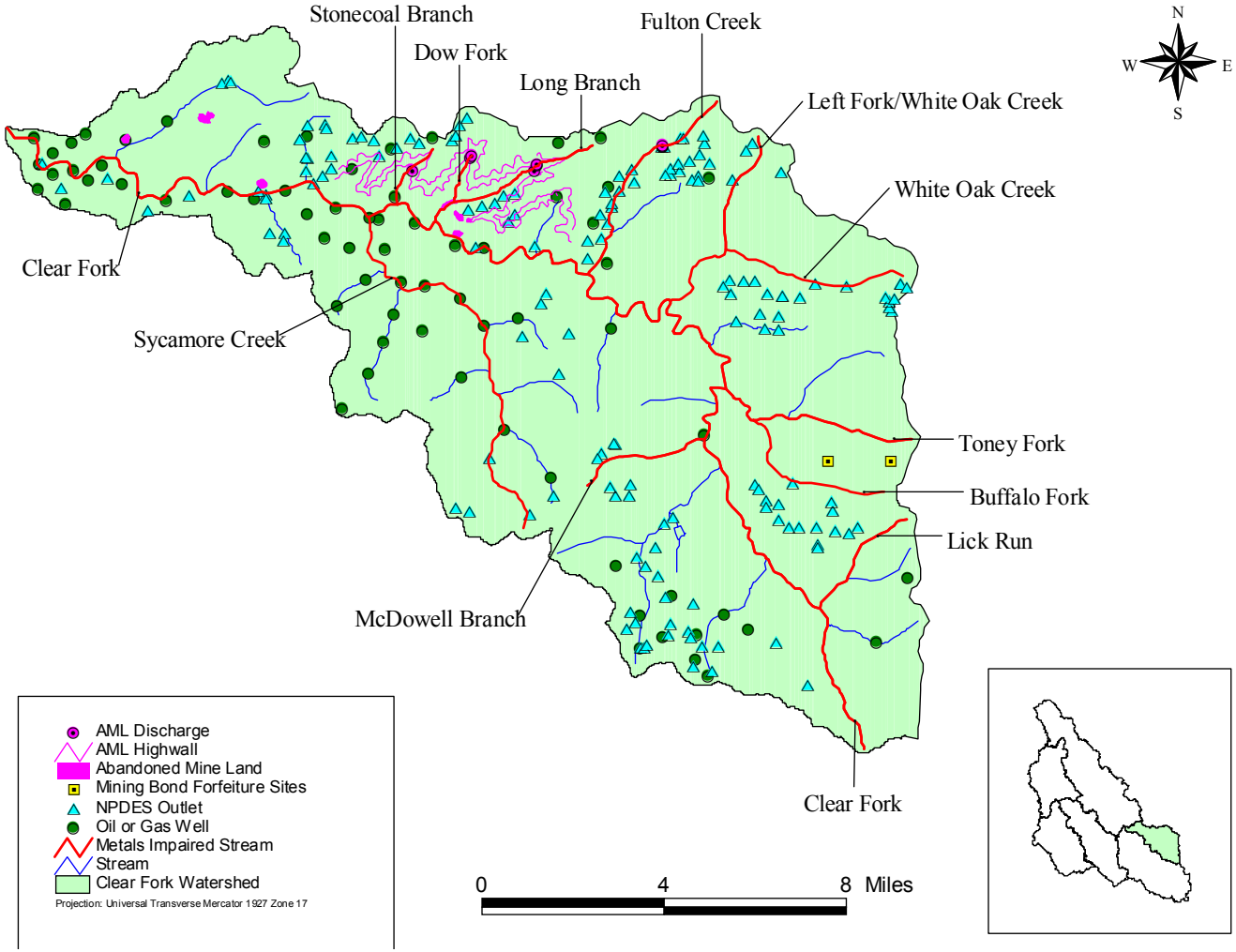
Pollutant sources were identified using statewide geographic information system (GIS) coverages of point and non-point sources, and through field reconnaissance. As part of the TMDL process, WVDEP documented pollution sources by describing the pollutant source in detail, collecting Global Positioning 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-1-3.

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 dissolved aluminum and total iron during critical high-flow conditions. Although some of these sediment-producing sources are not shown in Figure A-1-3 (e.g., burned forest areas, agriculture, and unpaved roads), specific details relative to these sources are discussed in section A-1.2.2.

A-1.2.1 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.

In the Clear Fork watershed, all NPDES permits for metals effluents are related to mining. 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. There are 173 mining-related NPDES outlets in the Clear Fork watershed. 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 Clear Fork 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.



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

Figure A-1-3. Metals sources in the Clear Fork watershed.

A-1.2.2 Metals Non-point Source Inventory

In addition to point sources, non-point sources also contribute to metals-related water quality impairments in the Clear Fork 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 Clear Fork watershed are discussed below.

Abandoned Mine Lands and Bond Forfeiture Sites

Based on the identification of a number of abandoned mining activities in the Clear Fork 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 Clear Fork watershed. In addition, source-tracking efforts by WVDEP's Division of Water and Waste Management identified and characterized nine abandoned mine sources (i.e. discharges, seeps, portals, refuse piles, streams, and ponds).

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 two bond forfeiture sites in the Clear Fork watershed that encompass approximately 311 acres.

Land-Disturbing Activities

Based on the GAP 2000 landuse coverage, there are 53 acres of row crop agriculture in the Clear Fork watershed, representing approximately 0.1 percent of the total area. There are no active logging operations in the watershed. However, there is significant acreage of burned forest. Burned forest areas are estimated to cover 1776 acres (4.4 percent) of the total watershed area. The watershed contains 48 active oil and gas wells, which, based on the survey by WVDEP's Office of Oil and Gas, are estimated to comprise 66 acres (0.1 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 shown on topographic maps that were not included in the TIGER shapefile. There are 54.3 miles of paved roads and 350.2 miles of unpaved roads in the Clear Fork watershed.

A-1.3 Fecal Coliform Bacteria Sources

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

A-1.3.1 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 Clear Fork watershed, there is one discharge permit (WVG551137), which is a general sewage permit for the Clear Fork Elementary School.

A-1.3.2 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 Clear Fork 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 after installation (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 1,117 people living in the unsewered homes in the Clear Fork watershed. Figure A-1-4 shows the estimated distribution of the unsewered population 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 Clear Fork watershed that consists of residential and agricultural areas, and the low fecal coliform bacteria accumulation rates for forested areas, stormwater runoff from these areas is not considered a significant non-point source of fecal coliform bacteria, except in localized areas.

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 the Division of Natural Resources. Although wildlife contributions of fecal coliform bacteria were considered in modeling, they were not found to be a significant source.

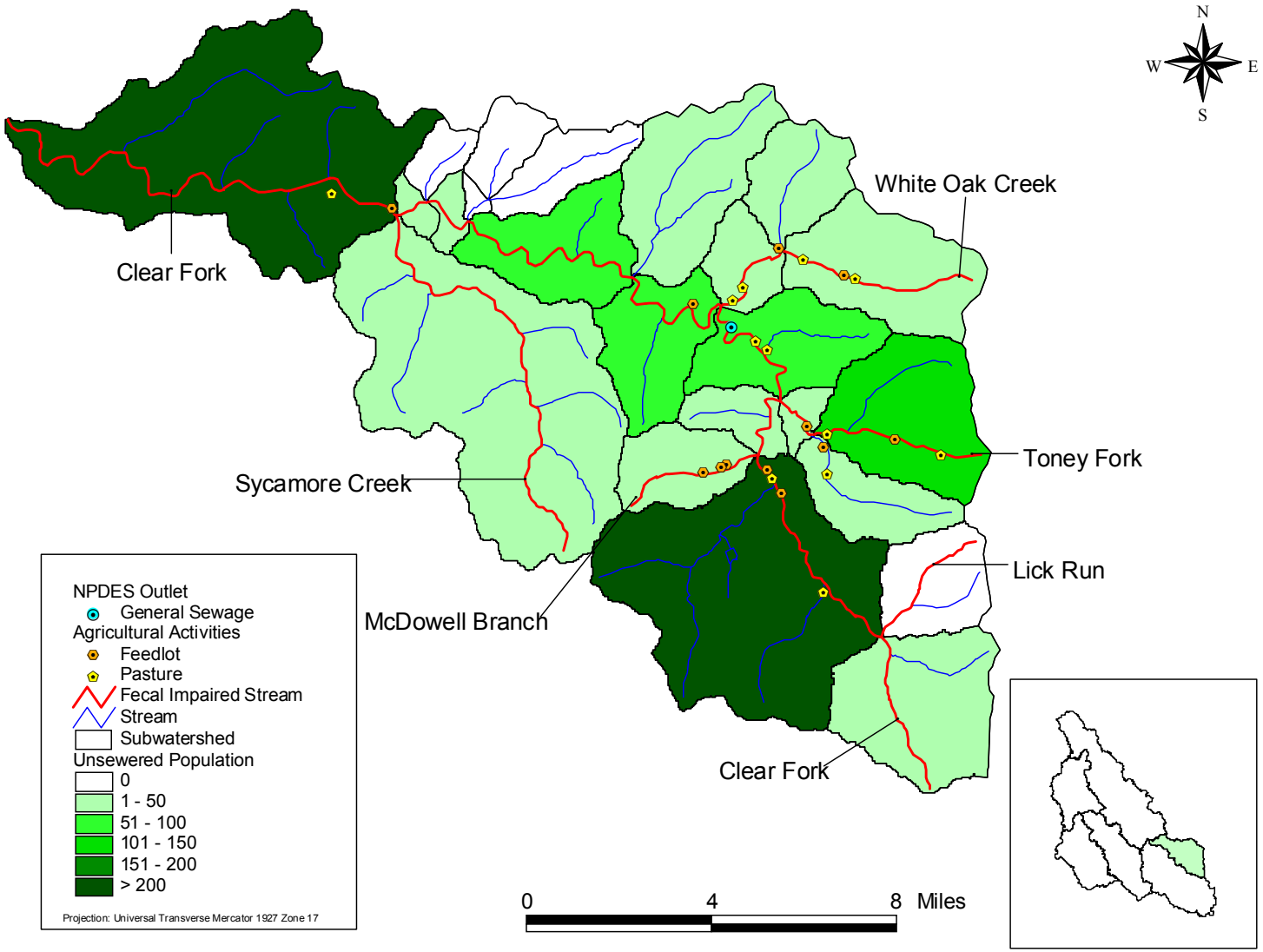


Figure A-1-4. Fecal coliform sources in the Clear Fork watershed.

A-1.4 Stressors of Biologically Impaired Streams

The Clear Fork watershed has four biologically impaired streams for which TMDLs have been developed. These streams are identified in Table A-1-1 along with the biological stressors of the streams' 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. WVDEP is deferring biological TMDL development for Toney Fork and Buffalo Fork. The information available on the causative pollutants and associated impairment thresholds is insufficient to support TMDL development at this time.

Table A-1-1. Primary stressors of biologically impaired streams in the Clear Fork watershed

Stream	Biological Stressors	TMDLs Required
Clear Fork	Organic enrichment	Fecal coliform
Stonecoal Branch	Metals toxicity (iron) pH toxicity (acidity) Sedimentation	Iron pH Sediment
White Oak Creek	Organic enrichment	Fecal coliform
Lick Run	Metal toxicity (iron) Sedimentation	Iron Sediment

TMDLs for each specific biological stressor are shown in Table A-1-6. Sediment TMDLs are required only when the stressor identification process indicates that a sedimentation problem is impairing the biological community. Sediment TMDLs are presented for Stonecoal Branch and Lick Run. Refer to section A-1.2.2 for additional sediment source information.

A-1.5 TMDLs for the Clear Fork Watershed

A-1.5.1 TMDL Development

TMDLs and source allocations were developed for impaired streams in the Clear Fork 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 7.5 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-1-2 through A-1-6. The TMDLs for iron and aluminum are presented as annual average loads, in pounds per year. The TMDLs for sediment are presented in tonnes per year. The TMDLs for fecal coliform bacteria are presented in 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.

The Fecal Coliform TMDL for Lick Run (WVKC-47-P.5) shows no pollutant reductions. Pre-TMDL monitoring results indicate 2 out of 12 samples exceed 400 colonies/100ml and therefore Lick Run was identified as impaired. Pre-TMDL monitoring utilizes grab sampling techniques that provide water quality information at distinct points in time, whereas fecal coliform water quality criteria are prescribed in daily maximum and monthly geometric mean terms. Specifically, the monthly geometric mean of fecal coliform concentration is not to exceed 200 colonies/100 mL and no more than 10 percent of daily values are to exceed 400 colonies/100 mL in any month.

Resource constraints preclude a fecal coliform monitoring frequency that allows direct comparison of water quality to criteria, and a simplified approach is used to assess impairment prior to TMDL development (10 percent frequency of exceedance of 400 colonies/100mL). Conversely, TMDL modeling is configured to the specific terms of the water quality criteria. Under baseline conditions, the model predicts that the fecal coliform concentration in Lick Run does not exceed a monthly geometric mean of 200 colonies/100mL and less than 10 percent of the daily values exceed 400 colonies/100mL in any month. As such, fecal coliform reductions from existing sources in the Lick Run watershed are not needed.

As stated in Section 7.4.1, 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 in which 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-1-4, 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-1.6 TMDL Tables: Metals and pH

Table A-1-2. Iron TMDLs for the Clear Fork watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/yr)	Wasteload Allocation (lbs/yr)	Margin of Safety (lbs/yr)	TMDL (lbs/yr)
Clear Fork	WVKC-47	Clear Fork	Iron	69,555	41,154	6,759	117,468
Clear Fork	WVKC-47-E	Sycamore Creek	Iron	9,164	741	521	10,427
Clear Fork	WVKC-47-F	Stonecoal Branch	Iron	586	408	52	1,047
Clear Fork	WVKC-47-G	Long Branch	Iron	3,894	1,557	287	5,783
Clear Fork	WVKC-47-G-1	Dow Fork	Iron	710	296	53	1,059
Clear Fork	WVKC-47-I	Fulton Creek	Iron	2,099	2,709	253	5,060
Clear Fork	WVKC-47-K	White Oak Creek	Iron	4,671	1,725	337	6,733
Clear Fork	WVKC-47-K-1	Left Fork/White Oak Creek	Iron	1,133	821	103	2,057
Clear Fork	WVKC-47-L	Toney Fork	Iron	4,374	540	259	5,173
Clear Fork	WVKC-47-L-1	Buffalo Fork	Iron	895	540	76	1,510
Clear Fork	WVKC-47-N	McDowell Branch	Iron	1,396	73	77	1,547
Clear Fork	WVKC-47-P.5	Lick Run	Iron	1,587	229	96	1,912

Table A-1-3. Aluminum TMDLs for the Clear Fork watershed

Major Watershed	Stream Code	Stream Name	Metal	Load Allocation (lbs/yr)	Wasteload Allocation (lbs/yr)	Margin of Safety (lbs/yr)	TMDL (lbs/yr)
Clear Fork	WVKC-47	Clear Fork	Aluminum	9,163	9,873	1,002	20,037
Clear Fork	WVKC-47-F	Stonecoal Branch	Aluminum	92	72	9	173
Clear Fork	WVKC-47-G	Long Branch	Aluminum	921	465	73	1,459
Clear Fork	WVKC-47-G-1	Dow Fork	Aluminum	160	278	23	461

Table A-1-4. pH TMDLs for the Clear Fork watershed

Major Watershed	Stream Code	Stream Name	Parameter	pH* (Under TMDL conditions)
Clear Fork	WVKC-47-F	Stonecoal Branch	pH	7.55
Clear Fork	WVKC-47-G-1	Dow Fork	pH	7.53

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

A-1.7 TMDL Tables: Fecal Coliform Bacteria

Table A-1-5. Fecal coliform bacteria TMDLs for the Clear Fork watershed

Major Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/yr)	Wasteload Allocation (counts/yr)	Margin of Safety (counts/yr)	TMDL (counts/yr)
Clear Fork	WVKC-47	Clear Fork	Fecal coliform	4.26E+13	8.85E+09	2.24E+12	4.48E+13
Clear Fork	WVKC-47-E	Sycamore Creek	Fecal coliform	6.31E+12	NA	3.32E+11	6.64E+12
Clear Fork	WVKC-47-K	White Oak Creek	Fecal coliform	3.30E+12	NA	1.74E+11	3.48E+12
Clear Fork	WVKC-47-L	Toney Fork	Fecal coliform	3.22E+12	NA	1.69E+11	3.39E+12
Clear Fork	WVKC-47-N	McDowell Branch	Fecal coliform	9.74E+11	NA	5.13E+10	1.03E+12
Clear Fork	WVKC-47-P.5	Lick Run	Fecal coliform	9.55E+11	NA	5.02E+10	1.00E+12

NA = not applicable.

A-1.8 TMDL Tables: Biological

Table A-1-6. Biological TMDLs for the Clear Fork watershed

Stream	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
Clear Fork WVKC-47	Organic enrichment	Fecal coliform	4.26E+13	8.85E+09	2.24E+12	4.48E+13	counts/yr
Stonecoal Branch WVKC-47-F	Metals toxicity	Iron	586	408	52	1,047	lbs/yr
	pH toxicity	pH	Not Applicable			7.55	SU
	Sedimentation	Sediment	62.1	26.5	4.7	93.3	tonnes/yr
White Oak Creek WVKC-47-K	Organic enrichment	Fecal coliform	3.30E+12	NA	1.74E+11	3.48E+12	counts/yr
Lick Run WVKC-47-P.5	Metals toxicity	Iron	1,587	229	96	1,912	lbs/yr
	Sedimentation	Sediment	216.8	63.7	14.8	295.3	tonnes/yr