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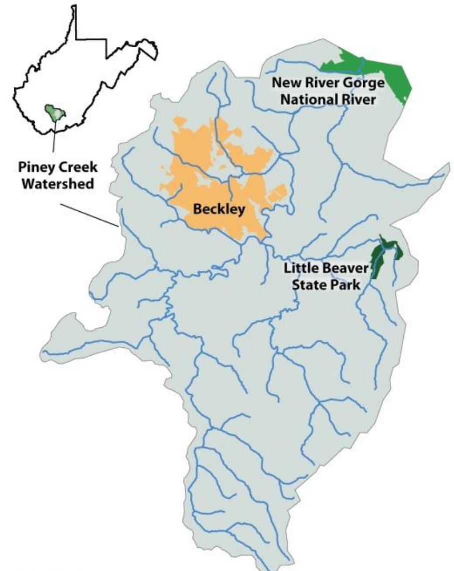

Piney Creek Watershed Plan

West Virginia Department of Environmental Protection
Nonpoint Source Program
601 – 57th Street
Charleston, WV 25304-2345

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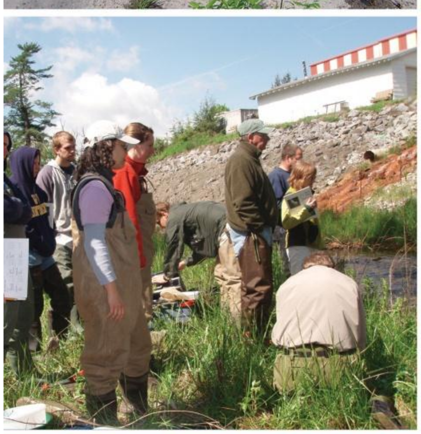

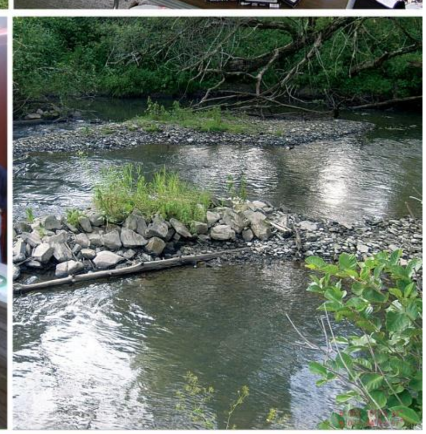

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Acronyms and Abbreviations List

µg/L	micrograms per liter
AMD	acid mine drainage
AML	abandoned mine land
AML&R	[WVDEP] Office of Abandoned Mine Lands & Reclamation
BMP	best management practice
BOD	biochemical oxygen demand
BPH	[West Virginia] Bureau for Public Health
BRCCC	Beckley – Raleigh County Chamber of Commerce
CSO	combined sewer overflow
DMR	[WVDEP] Division of Mining and Reclamation
DO	dissolved oxygen
DWWM	[WVDEP] Division of Water and Waste Management
ERIS	Environmental Resources Information System
GIS	geographic information system
GPD	gallons per day
GPS	global positioning system
HAU	home aeration unit
I & I	inflow and infiltration
IJDC	Infrastructure and Jobs Development Council
LA	load allocation
mg/L	milligrams per liter
mL	milliliter
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OOG	[WVDEP] Office of Oil and Gas
PCWA	Piney Creek Watershed Association
POTW	publicly owned treatment works
PSD	Public Service District
SMCRA	Surface Mining Control and Reclamation Act
SRF	State Revolving Fund
SSO	sanitary sewer overflow
TMDL	Total Maximum Daily Load
TSS	total suspended solids
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
WLA	wasteload allocation
WVDEP	West Virginia Department of Environmental Protection
WVDHHR	West Virginia Department of Health and Human Services
WVDNR	West Virginia Division of Natural Resources
WVDOH	West Virginia Division of Highways

WVSCI	West Virginia Stream Condition Index
WVU	West Virginia University

Acknowledgments

The West Virginia Department of Environmental Protection (WVDEP) and the Piney Creek Watershed Association (PCWA) and would like to express thanks for everyone's participation and contributions throughout the course of creating this plan. The steering committee especially thanks Dave Sibray for authoring the history section and David Matchen and Joseph Allen for authoring the geology section. The information in this plan has been a collaborative effort between many contributing parties listed below:

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1.0 Introduction

Tetra Tech was selected by West Virginia Department of Environmental Protection (WVDEP), Division of Water and Waste Management (DWWM), Nonpoint Source Program and awarded Purchase Order Number DEP 14798 to complete a Watershed Implementation Plan for the Piney Creek Watershed. The general scope of work for this project was established in the tasks outlined below:

- Project Meetings
- Public Participation
- Watershed Characterization
- Watershed Plan Development
- Best Management Practices (BMP) Decision Support Tool Development

1.1 Purpose

According to water quality sampling conducted by WVDEP, Piney Creek and various tributaries have been determined to be impaired by various pollutants (aluminum, iron, fecal coliform and sediment) because they do not meet the applicable state water quality standards. The streams have been placed on the state's impairment list, known as the 303(d) List. The U.S. Environmental Protection Agency (USEPA) requires that pollution budgets, or total maximum daily loads (TMDLs) be completed for impaired streams on the 303(d) List. WVDEP has completed the TMDL process that prescribes the amount of pollution that is permissible in streams without adversely affecting human health or the environment.

The purpose of this watershed implementation plan is to begin the planning and implementation process to achieve the required reductions to iron, aluminum and fecal coliform bacteria. The TMDL documents established the required reductions to the surface waters within the Piney Creek Watershed Area. It is necessary to reduce the concentrations of these pollutants throughout the watershed in order to meet the applicable state water quality standards and to ensure that human health and the environment are protected.

The challenging goal of implementing projects to reduce different pollutants from various types of sources makes this plan more intricate in detail. This comprehensive watershed plan incorporates projects that will reduce iron, aluminum and fecal coliform bacteria from various nonpoint (residential, urban and barren landuse areas) and point sources (National Pollution Discharge Elimination System (NPDES)), such as construction stormwater permits by implementing BMPs throughout the watershed. The City of Beckley, which is the county seat of Raleigh County, is entirely contained within the Piney Creek

Watershed and is subject to a Municipal Separate Storm Sewer System (MS4s) NPDES permit. This plan incorporates projects within the MS4 area as well as projects throughout the remainder of the watershed.

In addition, the National Park Service (NPS) has been committed to this project from the beginning and is dedicated to improving overall water quality in the New River Gorge National River. The NPS recognizes the importance of improving water quality and that upstream watershed management and implementation is critical to achieve this goal. The New River Gorge National River is a popular tourist and recreation destination that helps to support the white water rafting industry and the newly established high adventure facility of the Boy Scouts of America: The Summit: Bechtel Family National Scout Reserve. Improvements to water quality are critical to promote the New River as a tourist destination point and high adventure recreation area.

1.2 Background

Piney Creek is in the northwestern portion of the New River watershed in Raleigh County West Virginia and drains approximately 136 square miles as shown in **Table 1-1**. The Piney Creek watershed is broken into three 12 digit Hydrologic Unit Codes:

- 050500040103 Outlet Piney Creek
- 050500040102 Headwaters Piney Creek
- 050500040101 Beaver Creek

The towns of Beckley, Crab Orchard, Sophia, Mabscott and portions of Coal City are within the watershed boundary as well as Little Beaver State Park and a small portion of the New River Gorge National River (**Figure 1-1**). The City of Beckley, the West Virginia Department of Transportation, West Virginia Division of Highways (WVDOH), and the West Virginia Parkways, Economic Development and Tourism Authority (WV Parkways) are designated as an MS4s and subject to stormwater permitting.

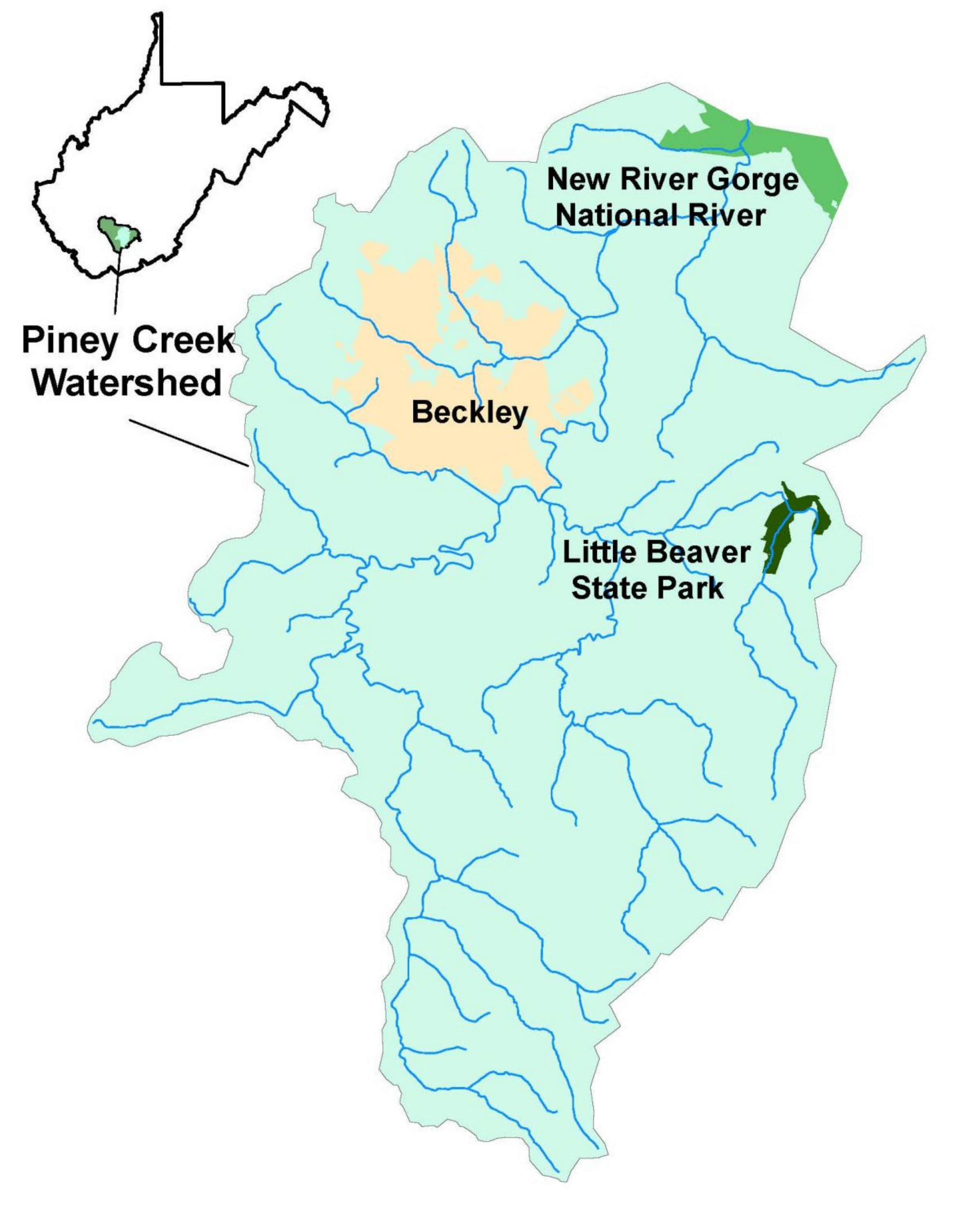


Figure 1-1. Piney Creek Watershed Location Map

1.2.1 History

The history of the drainage area of the Piney Creek is largely one of transition from wilderness to habitation and from habitation to mixed rural, suburban, and urban habitation. These patterns have been influenced largely by the relatively gentle relief of the watershed when compared to adjacent mountainous areas, to its position along a natural east-west passage across the local Appalachian Mountains, and to the presence of coal-bearing strata throughout the region.

Prior to the late 1800s, the drainage of the Piney Creek was a virtual wilderness, opened here and there by a few industrious farmers. The area was shaded almost entirely by a vast forest of Eastern White Pine, for which the Piney Creek was named. According to archeological evidence, small Native American communities existed throughout the region, though no habitations were present at the time of European exploration and settlement.

A handful of bridle paths, formerly Native American trails, traversed the watershed area before and during its early settlement. Foremost among these was the Bluestone Road, which circumvented the rugged New River Gorge to the north and east. By his own admission, the Bluestone and other lesser trails led Alfred Beckley to establish present-day Beckley, then Beckleyville, in the 1830s in an attempt to develop the region. Beckley wrote on many occasions that increasing commerce would route through the region over the mountain passage formed by the drainage of the New and Kanawha rivers. He established Beckleyville on the Bluestone Road at its junction with the Logan Road, a trail branching westward toward the Coal River.

By the 1860s, Beckley's attempt to develop the region had attracted many settlers, and a cluster of stores, taverns, and homesteads collected along the road at Beckleyville. Over the next five years, however, the Civil War decimated the region. The passage of Union and Confederate troops virtually annihilated the roads, and many residents, including Beckley, relocated, at least temporarily, to more settled regions. Only 3,673 residents were counted within the territory of Raleigh County in 1870, and the larger part resided in the valley areas to the west, rather than in the forested tablelands of the Piney territory. Still, Beckleyville had survived the war and showed much promise. In 1872, a minister described the community in the Pittsburgh Christian Advocate as "a pretty little village of thirty houses nestled amid tall pines on a plot of table land..."

Within a matter of a handful of years, however, the region's isolation and pastoral character would begin to erode. In 1873 the Chesapeake & Ohio (C&O) Railway was completed through the New River Gorge, and the forest that once shaded its drainage was quickly harvested and hauled to the rail line. Small, narrow-gauge railroads were built in the tablelands of the Piney drainage. The timber industry attracted new residents, and the cleared lands were opened to agricultural development.

Beginning with the completion of the Piney Creek Branch of the C&O in 1901, life along the Piney and its tributaries was wholly transformed. Railways allowed for the efficient transportation of coal, and dozens of mines sprang into operation throughout the region. Thousands of new residents, including many recently emigrated Europeans, arrived to help mine and work in supportive industries. By the 1940s the population of Raleigh County swelled to more than 91,000 residents, according to estimates provided by the Beckley-Raleigh County Chamber of Commerce (BRCCC). Many residents had located in the drainage of the Piney Creek at Beckley and in the mining communities to its southwest, notably Raleigh, Mabscott, MacArthur, Crab Orchard, and Sophia. Smaller, unincorporated mining communities sprang up wherever mine operators found it useful to house residents.

In the 1950s, the mechanization of the mining process led to a slow-but-unrelenting decline in mining employment. Many small mining communities located along the Piney and its tributaries were vacated or abandoned, and their inhabitants willingly or unwillingly moved out of the area and off properties owned by the coal-mining companies. Many sparsely populated unincorporated towns survive along Piney Creek, such as Sullivan, Whitby, Jonben, and Fireco. Beckley and land areas outside the mineable coal areas, notably at Beaver, Shady Spring, and Coal City, quickly began to swell with displaced residents, and by 1980 Beckley had reached its peak population at 20,492, according to the US Census Bureau.

The passage of commerce that Alfred Beckley predicted would lead to the region's prosperity has continued to prove itself through the last century, despite the fluctuation in population across the watershed. By way of example, the C&O was followed in the 1920s by state and federal highways and in the 1980s by interstate highways such as I-77 and I-64. Despite such interstate-commerce access, the area population continues to dwindle and many populated areas beyond Beckley have been reforested. Beckley's 2008 population was estimated at 16,832, significantly lower than its population of 19,397 in 1950.

1.2.2 Geology

Overview

The Piney Creek watershed is underlain by sedimentary rocks that were deposited during the latter part of the Mississippian Period and the early part of the Pennsylvanian Period (approximately 335 to 300 million years ago). These rocks were initially deposited as sediment in coastal lowlands and near-shore marine environments in an elongate northeast-southwest trending trough known as the Appalachian foreland basin. The eastern limit of the basin was in central and western Virginia, where mountains were uplifted during a collision between North America and Africa, before the modern-day Atlantic Ocean formed. These mountains formed an extensive highland that was eroded down to produce the sediment deposited in the Appalachian basin in Mississippian and Pennsylvanian time.

The Piney Creek watershed is part of the greater New River watershed. This drainage system is a vast series of forested canyons cut down into flat-lying sedimentary rocks in southern West Virginia. Young gravel deposits found along the New River canyon system suggest that the course of the river was established in the late Tertiary Period (~3 to 7 million years ago) (Bartholomew, 1991). Thus, the river has eroded down through ~300 meters of existing bedrock only within the last few million years.

Hinton Formation

Rocks of the Hinton Formation of Mississippian age are the oldest sedimentary strata in the Piney Creek watershed, and can be found cropping out along the lower reaches of Piney Creek near the confluence with the New River. The dominant lithology is red mudstone. The mudstone is poorly bedded and fractured, individual beds are 0.5 – 1 meter thick. Interbedded within the mudstone are 3-5 m thick grayish brown sandstones. The sandstones are fine grained, well-sorted, and cross bedded. The upper portions of the Hinton feature a few sandstones that can be up to 10 meters thick, and produce locally prominent cliffs. Several fossil-rich limestone beds are found within the upper portion of the Hinton Formation. The most prominent of these, the Avis Limestone, occurs in the middle of the Hinton Formation and may be exposed near the confluence of Piney Creek and the New River. The Avis is 8-10 meters thick, and often forms cliffs and ledges. Other limestones are commonly thin and rarely exposed along the walls of the gorge except where roads are cut into the valley walls.

Princeton Sandstone

The Princeton Sandstone of Mississippian age lies over top of the Hinton Formation, and is comprised of coarse-grained, well-sorted sandstone. Across southern West Virginia, the Princeton is as much as 30 meters thick and forms prominent cliffs and ledges. Some of the thickest outcrops are found along Batoff Creek in the northern portion of the Piney Creek watershed. The Princeton Sandstone includes beds of conglomerate with white to gray quartz pebbles that range in size from 1 to 5 cm. Trough-shaped cross bedding is apparent in many outcrops.

Bluestone Formation

The Bluestone Formation of Mississippian age is thin and poorly exposed in the Piney Creek region. Little is currently known about this formation, which lies over top of the Princeton Sandstone and beneath Pennsylvanian strata of the Pocahontas Formation. Stratigraphic intervals that are most likely found within the Piney Creek watershed include the Pride Shale and red mudstones of the middle Bluestone. The Pride Shale is a black shale and siltstone with very thin laminations. If it is present, it is highly unlikely that many outcrops could be found. There may be some thin sandstone beds present above the Pride Shale, which may form some small ledges and cliffs. Above the sandstone beds are a series of red mudstone beds that are similar to those seen in the upper Hinton Formation. The distribution of these rocks is poorly understood north of Interstate 64. It is most likely that this formation is obscured by coarse sandstone debris shed from the cliffs of Pennsylvanian sandstones that form the rim of New River Gorge.

Pocahontas and New River Formations

Mississippian-age sedimentary rocks of the Bluestone Formation are overlain by Pennsylvanian-age rocks of the Pocahontas Formation. The Pocahontas Formation is approximately 200 m thick and is overlain by the New River Formation. Both of these formations consist of thick sandstones, with interbedded coal, siltstone, and shale. They form the prominent cliffs along the New River Gorge and the Piney Creek watershed. Rocks of the New River Formation are the youngest rocks present in southern West Virginia and form most of the bedrock within the Beckley city limits. It can be difficult to distinguish between these two formations at a distance, but sandstones in the New River Formation are generally found to be more quartz-rich when examined closely. Both formations were originally deposited as sediment in coastal lowland areas where thick accumulations of organic peat allowed coal beds to form when the sediments were slowly buried and lithified into rock.

1.2.3 Landuse

The dominant landuse in the watershed is forest, which covers 68.4 percent of the watershed. Other significant landuse types include urban/residential (15.2 percent) and grassland (12.7 percent). All other individual land cover types together account for 3.7 percent of the total watershed area (WVDEP, 2008a).

Table 1-1. Landuse Types in the Piney Creek Watershed

Landuse Type	Area of Watershed		Percentage
	Acres	Square Miles	
Water	211.6	0.3	0.2%
Wetland	124.2	0.2	0.1%
Barren	366.3	0.6	0.4%
Forest	59,755.9	93.4	68.4%
Grassland	11,079.0	17.3	12.7%
Cropland	0.00	0.00	0.00%
Pasture	1,079.2	1.7	1.2%
Urban/Residential	13,267.8	20.7	15.2%
Mining	285.8	0.5	0.3%
AML	1,166.1	1.8	1.3%
Total Area	**87,335.9**	**136.5**	**100.00%**

The Raleigh County Tax Parcel Map was obtained and landowners with over 400 acres within the Piney Creek Watershed boundary were identified and are presented in **Table 1-2** below. The intent of identifying the larger landowners within the watershed is to begin a dialog with them and to identify mutually beneficial projects that would improve water quality within the watershed. Identification of these landowners does not limit other landowners from volunteering their land for improvement projects.

Table 1-2. Landowners with over 400 Acres in the Piney Creek Watershed

Company	Acres
Beaver Coal Co Ltd	17050.01
Raleigh County*	3376.45
Piney Land Co	3337.19
White Oak Land Company	2011.83
Grandview Investment Co	1883.41
T & M LLC	1821.85
Caldwell Trailblazer LLC	1807.09
Stretcher Neck Properties Ltd	1777.69
Kirby Land Company Inc	1342.98
Federal Government**	1234.08
Hylton, Tracy Warren II	1015.75
Copper, Thomas F.	732.74
Glade Springs***	593.73
Meadow Creek Coal	586.09
Hedrick G C Heirs	490.12
Pocahontas Land Corp	436.37
American East Explosives Inc	402.70

*Raleigh County includes: the County Court of Raleigh, County Commission of Raleigh County, Raleigh County Solid Waste, Raleigh County Public Service District, Raleigh County Shelter, Raleigh County Housing Authority, Raleigh County Public Library Board, Raleigh County Emergency Services Authority, Raleigh County Building Commission, Raleigh County Board of Education, and Raleigh County Airport Authority

**Federal Government includes: Department of the Interior, Department of Agriculture, Department of Justice, and the Bureau of Mines

*** Glade Springs Includes: The Glade Springs Partnership, Glade Springs Resort Limited, Glade Spring Utilities LLC, Glade Springs Village and Glade Springs Village Property.

1.3 Plan Development

Establishing the steering committee was a critical first step in the beginning phase of this project. The main focus of the implementation plan is to gain community acceptance and willingness to move forward with implementation strategies. Key stakeholders and potential steering committee members representing diverse interests within the watershed were identified and contacted at the beginning of the project. Stakeholders and Steering Committee members were compiled from the following general categories:

- Chamber of Commerce members,

- Conservation groups,
- Federal , state and local government agency representatives,
- Landowners and developers,
- Piney Creek Recreational Users Groups
- Public Service Districts (PSDs).

Monthly meetings were held with the steering committee members during critical information gathering stages of the project. Active members of the steering committee are presented in **Table 1-3**.

Table 1-3. Piney Creek Implementation Plan Steering Committee Members

Organization	Affiliation	Contact Name
Piney Creek Watershed Association	Non-Profit	Tara Shleser Phyllis Farley Sabrina Sears
Appalachian Coal Country Team	Non-Profit	April Trent
National Committee for the New River	Non-Profit	Courtney Wait George Santucci
National Parks Conservation Association	Non-Profit	Erin Haddix St. John Heather Lukacs
WVDEP, Nonpoint Source Program	State Agency	Jennifer Liddle Teresa Koon
West Virginia Conservation Agency	State Agency	Adam Merritt
Crab Orchard-MacArthur PSD	Public Service District	Barry Milam
Beckley Sanitary Board	Beckley City Government	Jeremiah Johnson
National Park Service	Federal Agency	Don Striker Scott Stonum Jesse Purvis
Beckley-Raleigh County Chamber of Commerce (BRCCC)	Local Business Community	Ellen Taylor
United Coal	Private Business	Frank Rose
The Bright Group	Private Business/Landowner	Stephen Keen
Beaver Coal Company Limited	Private Business/Landowner	Woody Duba Lon Jones

Selected steering committee members were asked to lead a focus group during the public meeting that encompassed their area of concern. Numerous steering committee meetings, focus group meetings and a public meeting were held to gather information and general watershed concerns from a vast group of stakeholders in the Piney Creek Watershed. The focus groups were organized into five segments:

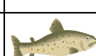
- Commercial Interests
- Education, Outreach, and Monitoring
- Future Development
- Stormwater and Wastewater
- Tourism and Recreation

Through a combination of focus group and steering committee meetings, a list was compiled of possible projects based on need and public support. This list of projects developed into the implementation projects suggested later in this plan. The proposed projects were evaluated to determine anticipated pollutant reductions, preliminary estimated construction cost and prioritization.

2.0 Pollutant Impairments

WVDEP performed monitoring in each of the impaired streams in the Piney Creek watershed to better characterize water quality and refine impairment listings. Monthly samples were taken at 25 stations throughout the Piney Creek watershed from July 1, 2004, through June 30, 2005 (**Figure 2-1**). Monitoring suites at each site were determined based on past water quality data, field reconnaissance, and the use of statewide geographic information system (GIS) shape files to locate point and nonpoint sources that could cause stream impairments. Streams potentially 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 (TSS), pH, sulfate, and specific conductance. Monthly samples from streams potentially 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 monitoring period. Instantaneous flow measurements were also taken at strategic locations during monitoring. **Table 2-1** lists the parameters causing impairments in each stream, while **Figure 2-1** shows the impaired streams in a watershed map with the WVDEP sampling station locations.

Table 2-1. Streams and Impairments in the Piney Creek Watershed

TMDL Watershed	WV Code	Trout	Stream Name	Fe	Al	pH	FC	BIO	SED
Piney Creek	WVKN-26		Piney Creek	X			X		
Piney Creek	WVKN-26-A		Batoff Creek	X	X	X			
Piney Creek	WVKN-26-E		Cranberry Creek	X			X	X	X
Piney Creek	WVKN-26-E-1		Little Whitestick Creek				X		
Piney Creek	WVKN-26-F		Beaver Creek	X			X	X	
Piney Creek	WVKN-26-F-2		Little Beaver Creek				X	X	
Piney Creek	WVKN-26-G		Whitestick Creek				X	X	
Piney Creek	WVKN-26-K		Soak Creek				X		
Piney Creek	WVKN-26-N		Laurel Creek	X			X		
Piney Creek	WVKN-26-M		Bowyer Creek	X			X		

Notes: Fe is total iron impairment; Al is dissolved aluminum impairment; FC is fecal coliform bacteria impairment; BIO is a biological impairment; SED is sediment impairment

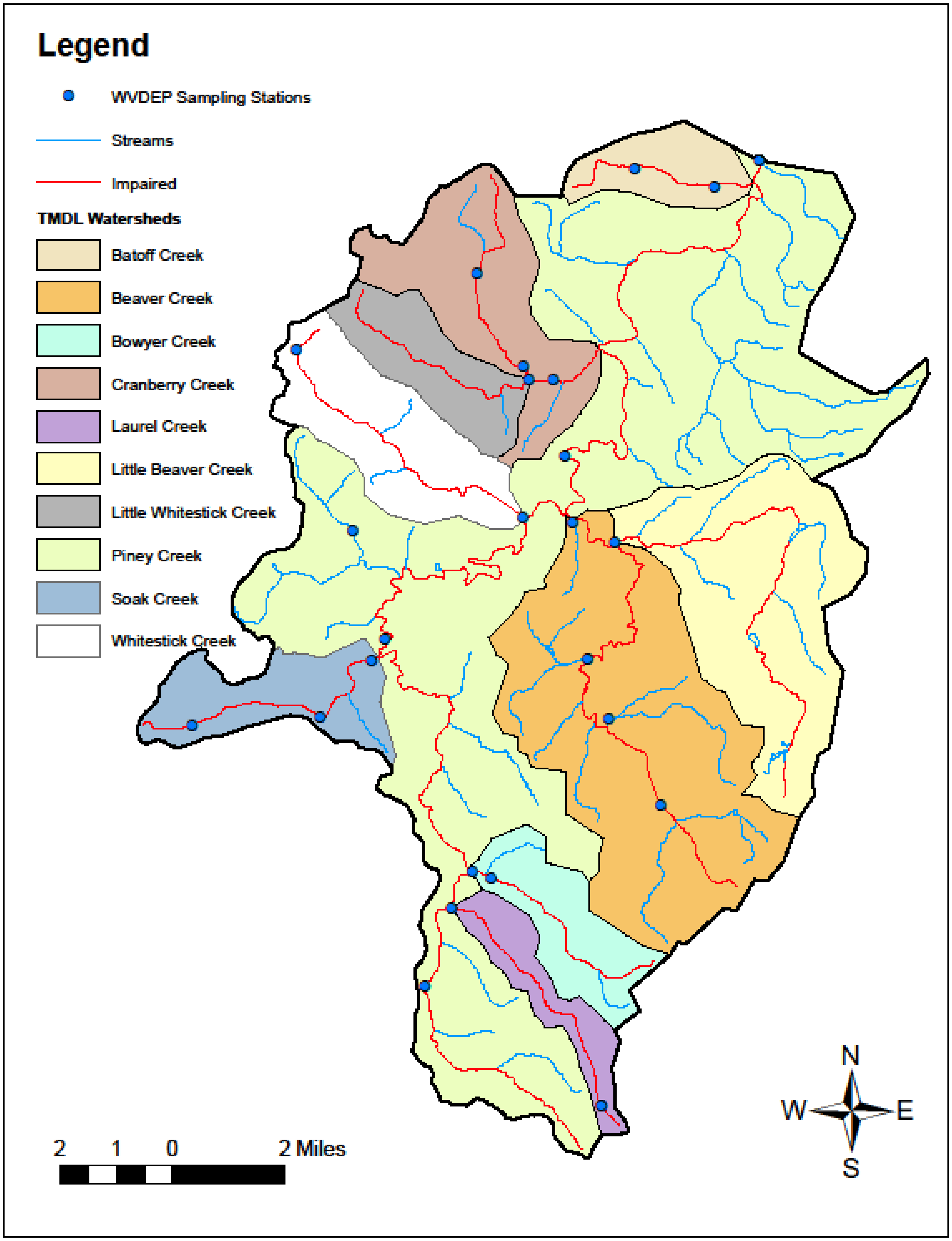


Figure 2-1. Impaired Streams and Sampling Locations in the Piney Creek Watershed

3.0 Pollutant Sources

There are two general categories of pollution sources, nonpoint and point sources. Nonpoint pollution is from non-discrete sources. Some examples of nonpoint pollution include over fertilization, leaking or malfunctioning individual septic systems, pet waste runoff, and erosion from heavy rain events. Point sources are considered to be discrete outlets such as pipes from industrial facilities, mining locations, larger construction sites, or stormwater runoff in more populated towns, such as Beckley. These types of sources are described in the following sections.

3.1 Fecal Coliform Nonpoint Sources

3.1.1 On-Site Treatment Systems

Pollutant source tracking by WVDEP personnel identified scattered areas of high population density without access to public sewers in the Piney 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 10,311 unsewered homes in the Piney Creek watershed during the TMDL development. 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 3-1** shows the geographic distribution of estimated failing septic system nonpoint sources in the watershed. Failing septic systems and/or straight pipe discharges are a significant fecal coliform bacteria source in the Piney Creek watershed with pollutant reductions prescribed in 73 of the 84 subwatersheds. **Photo 3-1** is an example of a straight pipe directly into a stream.

Recent public sewer expansion projects have converted approximately 2,000 dwellings in some of the more dense residential areas from individual onsite septic systems. There are another 774 homes that will be incorporated into the public wastewater system in the near future and approximately 750 more homes would be included in future suggested implementation projects for the watershed.

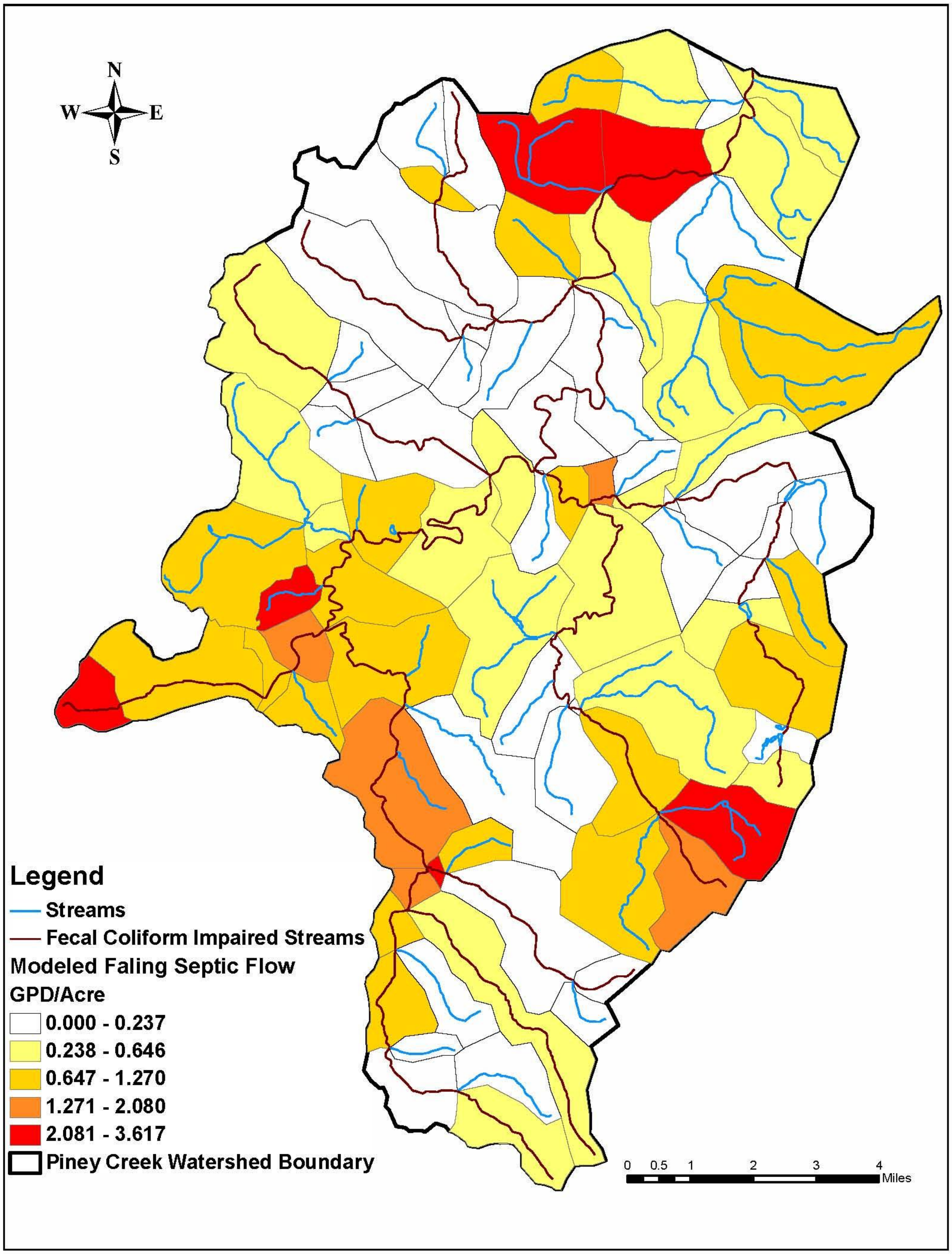


Figure 3-1. Failing Septic System Flows in the Piney Creek Watershed

Photo 3-1. Example Straight Pipe

Current Events Information

A Developer in WV Threatens to Sue State over Failing Septic Systems and what one WV Watershed Group is doing to Correct this Problem

A developer has stated that they intend to sue the State of West Virginia over the state's alleged neglect of its high number of illicit sewage discharges from failing or nonexistent septic systems into its streams and rivers. The lawyers for the developer have sent out intent to sue letter to the WVDEP, the West Virginia Department of Health and Human Resources (WVDHHR) Bureau for Public Health (BPH) and 55 county governments. The intent to sue states that there are around 160,000 or more failing septic systems within West Virginia as stated in the State's TMDLs and that all of these are in violation of the federal Clean Water Act.

There are a lot of groups within the state of West Virginia that are trying to do something about the failing septic issue; one of these groups is the Sleepy Creek Project Team. Since being awarded $487,576.00 in 2008 to reduce fecal coliform levels by using BMPs, the Sleepy Creek Project Team has repaired or upgraded 23 out of 25 identified failing septic systems within the watershed. The last two systems that were identified are to be repaired in the near future. Among the types of systems installed, were new tanks, new drain fields, curtain drains, composting toilets, and low pressure pipe systems. In addition to the septic system construction, the Project team is also providing septic system pumping assistance to homeowners that need it. Since the inception of this project, the Morgan County WV Health Department has created a waiting list for failing septic systems for possible future grant opportunities.

Sources:

Elliot, Barbara. WVCA, Foulds, Gale. Sleepy Creek Watershed Association Spring 2010 News Letter. *Status of Sleepy Creek Watershed Clean Up Project. 2*010
http://www.wvca.us/wvwn/wvwn_waternet.cfm
Associated Press. Smith, Vicki. *Developer Threatens to Sue WV Over Pollution.* 2010
http://blogs.wvgazette.com/watchdog/2010/05/14/ap-reports-on-threatened-suit-over-inaction-to-stop-sewage-discharges-into-w-va-streams/

3.1.2 Urban/Residential Runoff

Stormwater runoff from residential and urbanized areas that are not subject to Municipal Separate Storm Sewer Systems (MS4) permitting requirements can be a significant source of fecal coliform bacteria. These landuses are considered to be nonpoint sources and load allocations are prescribed. The modified GAP 2000 landuse data were used to determine the extent of residential and urban areas not subject to MS4 permitting requirements and source representation was based upon precipitation and runoff. Stormwater runoff from non-MS4 residential areas was generally not significant, with pollutant reductions prescribed in only 14 of 84 Piney Creek subwatersheds. **Photo 3-2** shows an example of a strip mall parking lot adjacent to a stream.

Photo 3-2. Impervious Surface Adjacent to the Stream

3.1.3 Agriculture

Agricultural activities can contribute fecal coliform bacteria to receiving streams through surface runoff or direct deposition. Grazing livestock and land application of manure result in the deposition and accumulation of bacteria on land surfaces. These bacteria are then available for wash-off and transport during rain events. In addition, livestock with unrestricted access can deposit feces directly into streams. Pastures and feedlots are typically located near streams and can have localized impacts on instream bacteria levels. Given the small portion of total land area in the Piney Creek watershed that consists of agricultural areas, bacteria loadings in stormwater runoff from these areas were found to be problematic only in limited areas. The existing loadings during TMDL development from this nonpoint source category were reduced in only 3 of 84 Piney Creek subwatersheds.

3.1.4 Natural Background (Wildlife)

A certain "natural background" contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forested and grassland areas. Accumulation rates for fecal coliform bacteria in these areas were developed using reference numbers from past TMDLs and by incorporating wildlife estimates obtained from West Virginia's Division of Natural Resources (WVDNR). 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. On the basis of the low fecal coliform accumulation rates for forested and grassland areas, the storm water sampling results, and model simulations, wildlife is not considered to be a significant nonpoint source of fecal coliform bacteria in the Piney Creek watershed.

3.2 Metals Nonpoint Sources

Nonpoint sources also contribute to metals-related water quality impairments in the Piney Creek watershed. Nonpoint sources are diffuse, non-permitted sources. Abandoned mine lands (AML), as well as facilities that were subject to the Surface Mining Control and Reclamation Act (SMCRA) of 1977 but 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, streambank erosion, roads, and urban and residential lands outside MS4 areas. The applicable land-disturbing activities in the Piney Creek watershed are discussed below.

3.2.1 Abandoned Mine Lands (AML)

The Office of Abandoned Mine Land & Reclamation (AML&R) data identified approximately 1,166 acres of AML in the Piney Creek watershed. In addition, source tracking efforts by WVDEP identified seven additional AML sources (acid mine drainage seeps and refuse piles). Field data, such as global positioning system (GPS) locations, water samples, and flow measurements, were collected from the seeps to represent these sources and characterize their impact on water quality (**Table 3-1**). **Photos 3-3 and 3-4** are representative pictures from AML seeps in the Piney Creek Watershed. Based on this work, AMLs represent a significant source of metals in certain metals impaired streams. In addition, acid mine drainage seeps are the predominant source of acidic conditions in Batoff Creek, however acid precipitation is also a common problem in areas where the soil is not able to buffer acid rain.

Table 3-1. 7 AML Seeps Identified in the Piney Creek Watershed

Seep #	Stream	Code	Flow (GPM)	Field PH	Total AL	Total FE	Total MN	Units
S12	Batoff Creek	WVKN-26-A	25.00	3.78	2.00	3.20	0.18	mg/L
S13	Cranberry Creek	WVKN-26-E	4.00		0.02	1.72	2.32	mg/L
S15	Cranberry Creek	WVKN-26-E	34.00		0.02	19.20	6.57	mg/L
S16	Cranberry Creek	WVKN-26-E	8.00	3.41	33.20	9.27	8.57	mg/L
S17	Cranberry Creek	WVKN-26-E	10.00	3.45	21.40	13.30	7.51	mg/L
S18	Bowyer Creek	WVKN-26-M	2.00	3.01	49.20	26.00	5.54	mg/L
S19	Piney Creek	WVKN-26	14.00	6.68	0.35	0.65	0.24	mg/L

Photo 3-3. Cranberry Creek Acid Mine Drainage

Photo 3-4. Acid Mine Drainage in Beckley

3.2.2 Bond Forfeiture Sites

Mining permittee's are required to post a performance bond to ensure the completion of reclamation requirements. When a bond is forfeited, WVDEP assumes the responsibility for the reclamation requirements. The Office of Special Reclamation in WVDEP's Division of Land Restoration provided bond forfeiture site locations and information regarding the status of land reclamation and water treatment activities. Sites with un-reclaimed land disturbance and unresolved water quality impacts were represented, as were sites with ongoing water treatment activities. There are seven bond forfeiture sites modeled as metals sources in the Piney Creek watershed. Acid mine drainage from a bond forfeiture site may be contributing to the pH impairment to Batoff Creek. A recent Northern District Federal Court ruling (Civil Action No. 07-cv-87) ordered WVDEP to begin issuing NPDES permit limits for bond forfeiture sites. Depending on the appeal process, all bond forfeiture sites with water discharges may become permitted point sources in West Virginia in the near future. **Figure 3-2** shows the bond forfeiture sites, AML land and AML seeps in the Piney Creek watershed.

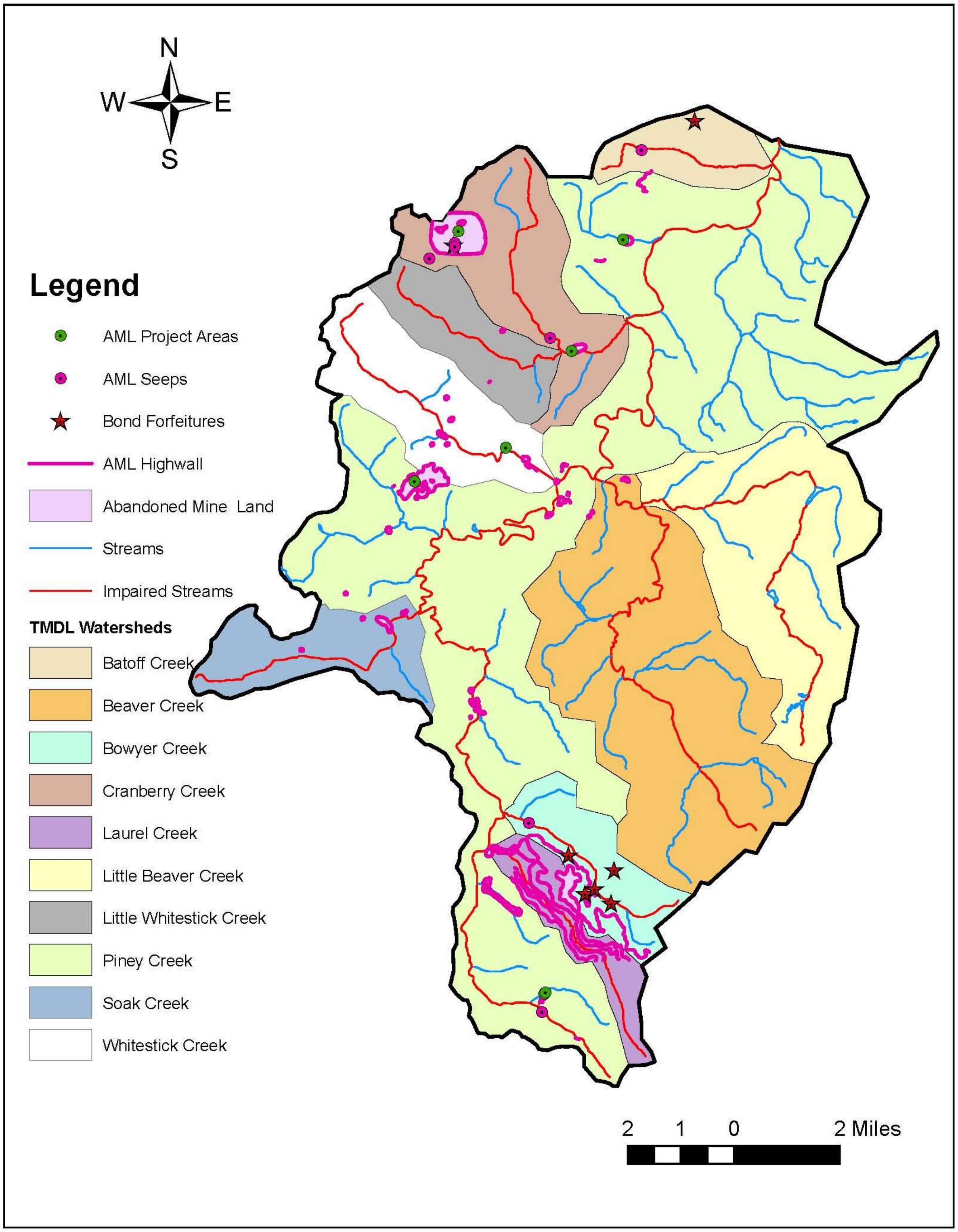


Figure 3-2. Iron Nonpoint Sources in the Piney Creek Watershed

3.3 Iron and Sediment Nonpoint Sources

3.3.1 Forestry

West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992, the West Virginia Legislature passed the Logging Sediment Control Act. The act requires the use of best management practices (BMPs) to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and associated access roads can increase sediment loading to streams. According to the Division of Forestry, illicit logging operations represent approximately 2.5 percent of the total harvested forest area (registered logging sites) throughout West Virginia. These illicit operations do not have properly installed BMPs and can contribute sediment to streams.

3.3.2 Oil and Gas

The WVDEP Office of Oil and Gas (OOG) is responsible for monitoring and regulating all actions related to the exploration, drilling, storage, and production of oil and natural gas in West Virginia. The OOG is the enforcement agency to ensure that surface water and groundwater are protected from oil and gas activities. Runoff from unpaved access roads to these wells and the disturbed areas around the wells can contribute sediment to adjacent streams if proper BMPs are not properly installed and maintained.

3.3.3 Roads

Heightened stormwater runoff from paved roads (impervious surface) can increase erosion potential. Unpaved roads can contribute sediment through precipitation-driven runoff. 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.

3.3.4 Agriculture

Agricultural activities can contribute sediment loads to nearby streams. However, there is minimal agricultural activity in Piney Creek watershed and agricultural land (pasture and cropland) was not reduced for iron or sediment in the Piney Creek watershed.

3.3.5 Streambank Erosion

Streambank erosion is a significant source of sediment and iron throughout the watershed. The baseline and allocated loads associated with bank erosion are included in both the MS4 waste load allocations (WLAs) in subwatersheds or portions of subwatersheds where MS4 entities have areas of responsibility and as load allocations (LAs) for the streambank erosion nonpoint source category in non-MS4 areas. The subdivision of the bank erosion component between point and nonpoint sources, and where applicable, between multiple MS4 entities is proportional to their respective drainage areas within each subwatershed. Reductions were required to streambank erosion in 74 of 84 subwatersheds in the Piney

Creek watershed. **Photo 3-5** shows an example where streambank erosion is a prominent source of pollution to the stream.

Photo 3-5. Example of Streambank Erosion Due to Increased Storm Water Runoff

3.3.6 Other Land-Disturbance Activities

Land disturbance causes soil erosion, which, if not carefully controlled, will increase sediment loading to streams. The control of sediment-producing sources has been determined to be necessary to meet water quality criteria for total iron during high-flow conditions. Stormwater runoff from residential and urban landuses in non-MS4 areas is a significant source of sediment in parts of the watershed. The modified GAP 2000 landuse data were used to determine the extent of barren, residential and urban areas. These landuses are considered to be nonpoint sources and load allocations are prescribed. **Photos 3-6 and 3-7** show disturbed land with sparse or no vegetative cover from within the Piney Creek watershed.

Photo 3-6. Sparsely Vegetated Area Subject to Erosion

Photo 3-7. Barren Land with Large Eroded Gullies

3.3.7 Background Iron Conditions

The sediment loadings from non-pasture grasslands and forested areas are not considered to be significant sediment or iron sources. Iron loadings from those landuses are categorized as "background" and are not reduced from existing conditions. Agricultural landuses (pasture and cropland) are not prevalent and are also included in the unreduced background metal loadings.

3.4 Fecal Coliform Bacteria Point Sources

At the time of TMDL development there were 21 permitted sewage treatment facilities with a total of 26 outlets discharging in the Piney Creek watershed (**Appendix A**). During the information gathering phase of this implementation plan, several meetings were held with the PSDs within the Piney Creek watershed. Eleven of the fecal coliform permits identified in the TMDL effort have been absorbed by public sewer expansion projects in recent years. There are currently 10 sewage permits with a total of 14 outlets within the watershed. Only 2 of the 10 permits are home aeration units (HAUs) held by private individuals and 1 permit with 4 outlets is a package plant run by the Stanaford Acres Sewage System, Incorporated. In the future, it is possible that one of the PSDs could take over the package plant, but mutually agreeable terms would need to be worked out and ultimately approved by the Public Service Commission. The remainder of the permits are held by various PSDs. **Table 3-2** and **Figure 3-3** show the fecal coliform permits in the Piney Creek watershed.

Table 3-2. Fecal Coliform Permits in the Piney Creek Watershed

Stream Name	Subwatershed	Stream Code	Permit	Outlet	Permit Type
Cranberry Creek	1188	WVKN-26-E	WV0027740	001	North Beckley PSD
UNT Cranberry Creek	1184	Not Coded	WV0027740	004	North Beckley PSD
Little Whitestick Creek	1187	WVKN-26-E-1	WV0027740	007	North Beckley PSD
Fat Creek	1116	WVKN-26-B	WV0080403	002	Shady Spring-PSD
Griffith Branch	1192	WVKN-26-D	WV0084824	001	Individual STP (Stanaford Acres Sewage System, INC)
Griffith Branch	1192	WVKN-26-D	WV0084824	003	Individual STP (Stanaford Acres Sewage System, INC)
Griffith Branch	1192	WVKN-26-D	WV0084824	004	Individual STP (Stanaford Acres Sewage System, INC)
Griffith Branch	1192	WVKN-26-D	WV0084824	002	Individual STP (Stanaford Acres Sewage System, INC)

Stream Name	Subwatershed	Stream Code	Permit	Outlet	Permit Type
Laurel Creek	1162	WVKN-26-N	WV0105759	001	Shady Spring-PSD (Cool Ridge/Flat Top Wastewater Treatment Plant)
Little Whitestick Creek	1185	WVKN-26-E-1	WV0023183	C002	City of Beckley
Piney Creek	1121	WVKN-26	WV0023183	001	City of Beckley
Piney Creek	1149	WVKN-26	WV0080403	001	Shady Spring-PSD
Piney Creek	1151	WVKN-26	WV0082309	001	Crab Orchard/Macarthur PSD
Soak Creek	1173	WVKN-26-K	WV0024422	001	Town of Sophia
Soak Creek	1174	WVKN-26-K	WVG413530	001	Home Aeration Unit (General Permit WV0107000)
Stanaford Branch	1193	WVKN-26-C	WVG410650	001	Home Aeration Unit (General Permit WV0107000)

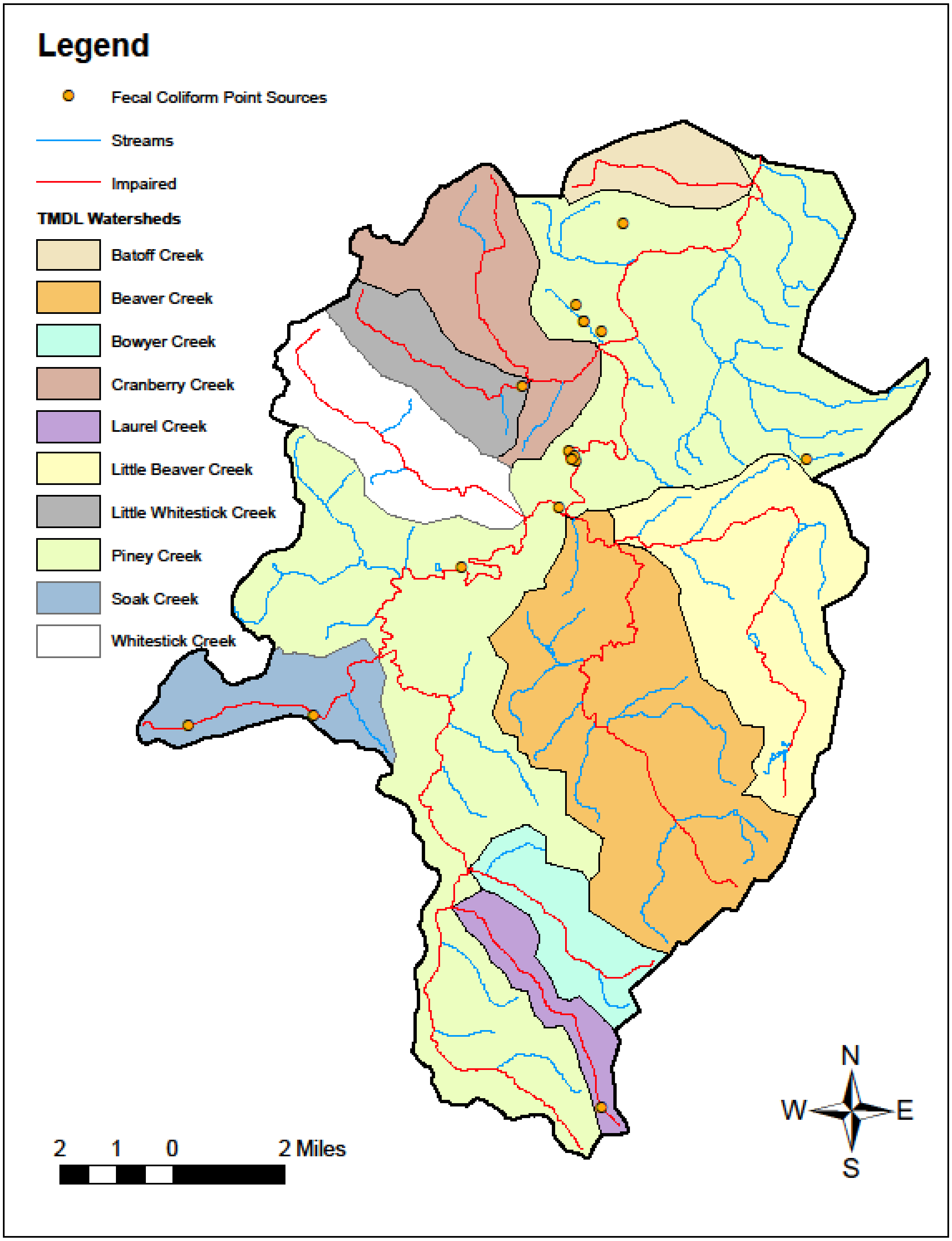


Figure 3-3. Fecal Coliform Point Source Locations

3.4.1 Individual NPDES Permits

WVDEP issues individual NPDES permits to both publicly owned and privately owned wastewater treatment facilities. Publicly owned treatment works (POTWs) are relatively large facilities with extensive wastewater collection systems, whereas private facilities are usually used in smaller applications such as subdivisions and shopping centers. Five POTWs discharge treated effluent from 8 outlets in the watershed. One additional permit exists for Stanaford Acres, which is a privately owned sewage treatment facility that discharges into Griffith Branch. Normally, treated effluents of individually permitted facilities are not expected to be significant sources of fecal coliform bacteria because of disinfection system and permit limits more stringent than water quality criteria. However, if treatment systems are not operated or designed properly, process upsets or overloading can lead to lack of treatment and potentially high loads of fecal coliform. Local knowledge gathered for this implementation plan has indicated that the Stanaford Acres system does have problems that may be leading to process upsets and/or overloading. North Beckley PSD has expressed interest in taking over the system in the future.

3.4.2 Sewer Leaks and Overflows

Sewer systems can release untreated sewage to streams and groundwater through overflows on the surface and through underground leakage. These releases carry extremely high concentrations and volumes of fecal coliform. Sewers overflow or leak when overloaded from infiltration and inflow of runoff water, or when sewers are damaged from breakage or blockage. Some overflows are actually designed into the sewer systems that are older, combined pipes that mix stormwater and sewage. These systems have combined sewer overflows (CSOs) that are constructed discharge outfalls that are permitted to discharge only during precipitation events, within limits. Outlet number C002 of NPDES Permit WV0023183 is a CSO for the City of Beckley's POTW collection system that discharges into Little Whitestick Creek (**Photo 3-8 and 3-9**). Overflows from this outlet are currently disinfected and the City has made significant improvements to performance to achieve fecal coliform criteria (200 counts/100 milliliters (mL)) in the discharge. The more common, modern sanitary sewers are designed to convey only sewage, but they can overflow when stormwater leaks or is improperly connected into the system. These overflows are called sanitary sewer overflows (SSOs) and are not allowed by the system permits. Sometimes overflows can occur when a wastewater pipe is crushed by nearby construction or soil movement, when grease accumulates and causes blockage, or when roots intrude into and break or block the pipe. Two potential overflows have been identified as outlet 004 (**Photo 3-10**) and outlet 007 (**Photos 3-11 and 3 -12**) of North Beckley PSDs permit. It is recommended that more research and information about these outlets should be gathered by the steering committee and the watershed association. This will provide valuable information to begin working with North Beckley PSD in order to understand when these outlets flow and what can be done to minimize and ultimately eliminate them in the future.

Photo 3-8. Photo of the Beckley Combined Sewer Overflow, Permit WV0023183 Outlet C002

Photo 3-9. Beckley Combined Sewer Overflow into Little Whitestick Creek

Photo 3-10. **North Beckley PSD Permit WV0027740 Outlet 004 into Stream**

Photo 3-11. **North Beckley PSD Permit WV0027740 Outlet 007**

Photo 3-12. North Beckley PSD Permit WV0027740 Outlet 007 into Stream

3.4.3 General Sewage Permits

General sewage permits are designed to cover like discharges from numerous individual owners and facilities throughout the state. General Permit WV0103110 regulates small, privately owned sewage treatment plants ("package plants") that have a design flow of less than 50,000 gallons per day (gpd). General Permit WV0107000 regulates home aeration units (HAUs). HAUs are small sewage treatment plants primarily used by individual residences where site considerations preclude typical septic tank and leach field installation. Both general permits contain fecal coliform effluent limitations identical to those in individual NPDES permits for sewage treatment facilities.

3.5 Metals Point Sources

This section identifies and examines the potential sources of iron impairments in the Piney Creek watershed. The NPDES program, established under Clean Water Act Sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. Metals point sources can be classified into two major categories: permitted non-mining point sources and permitted mining point sources. Permit and outlet information is provided in **Appendix A**, which shows the name of each responsible party and the total number of outlets that discharge to the Piney Creek watershed. **Appendix A** also contains specific data for each permitted outlet including permit limits for each of the mining-related NPDES outlets. Industrial stormwater permits in **Appendix A** show the permit number, and the concentration limits for aluminum, iron and total suspended solids (TSS). Mining and non-mining-related permitted discharges are shown in **Figure 3-4**. The permit reductions required in the TMDL are also included in Appendix B Piney Metals Allocations.

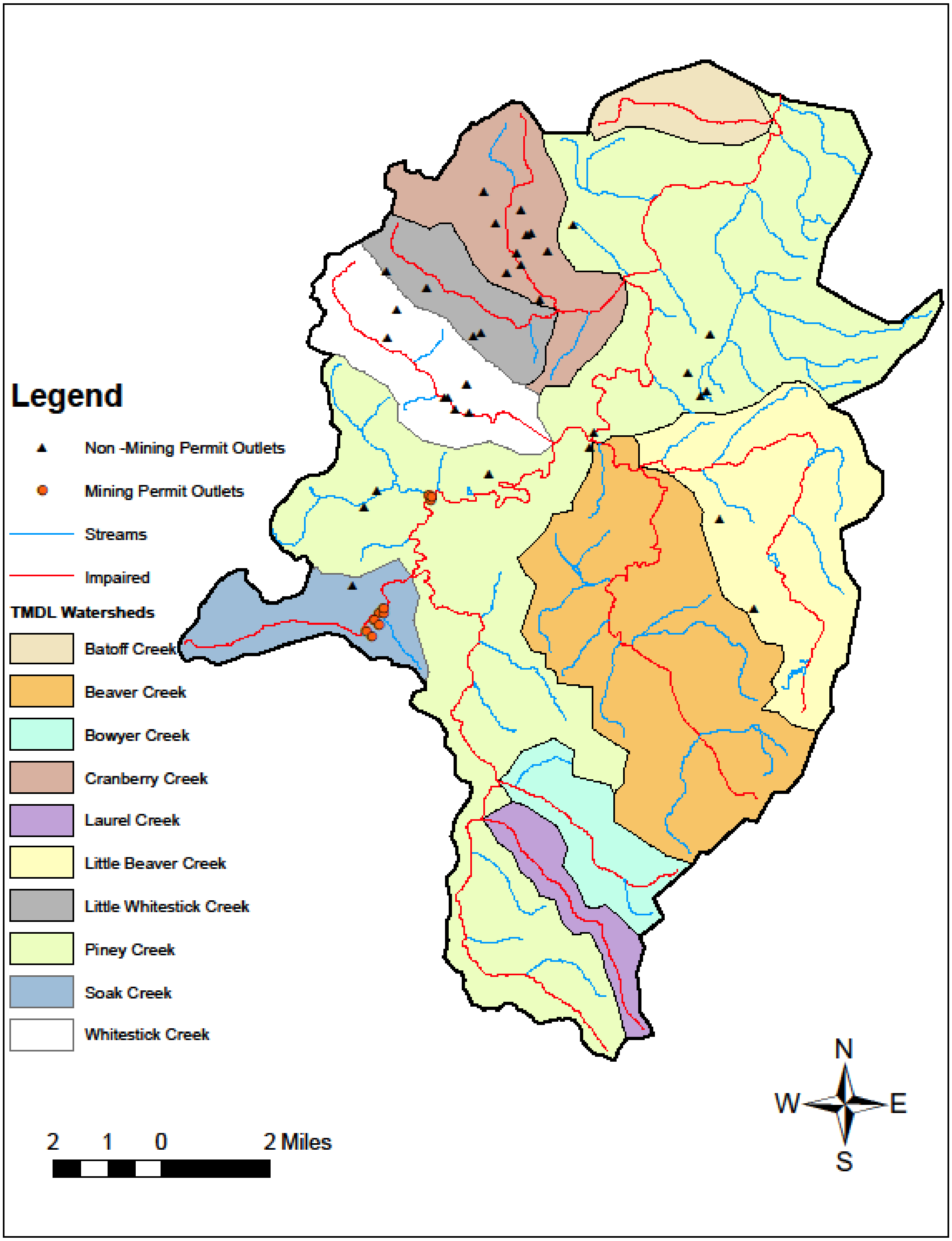


Figure 3-4. Mining and Non-Mining Point Sources in Piney Creek Watershed

3.5.1 Mining Point Sources

In the Piney Creek watershed during TMDL development, there were two mining-related NPDES permits with ten outlets. Because those NPDES permits contain effluent limitations and/or monitoring requirements, the regulated discharges were determined to be contributing point sources of iron and aluminum. In the TMDL, all the mining permits are assumed to be in compliance with the proper iron permit limit for trout water (0.5 mg/L iron), warm water (1.5 mg/L iron) or technology based permit limit (between 1.5 and 3.0 mg/L iron). The goal of an NPDES permit limit is to ensure that water quality targets are met throughout the watershed. As a result of the TMDL wasteload allocations, when NPDES permits are up for renewal, WVDEP will assign effluent concentration limits consistent with the TMDL wasteloads to renewed permits. By adjusting permit limits, WVDEP will be implementing a portion of the TMDL. Effluent concentrations exceeding these permit requirements would constitute a NPDES permit violation and the permit holder could be subject to enforcement actions by WVDEP and potential civil litigation by citizens and/or citizen groups. As recent EPA and environmental organization lawsuits have shown, strict permit compliance by permittee's and enforcement by WVDEP does not always happen.

3.5.2 Industrial Stormwater (Non-Mining) Point Sources

During TMDL development, there were 34 sites in the watershed registered under the Multi-Sector Stormwater General Permit. That permit regulates stormwater associated with non-mining industrial activity, such as junk yards or metal fabricators. All regulated outlets are subject to benchmark values for total iron and/or total suspended solids. Those general permit registrations were determined to be contributing point sources of iron. In the TMDL, all industrial stormwater permits are assumed to be in compliance with the benchmark iron concentration of 1.0 mg/L. Again, it is important to note that strict compliance with permit limits may not always be occurring. Additional monitoring during critical wet weather periods would be beneficial to determine if this assumption does in fact hold true.

3.5.3 Construction Stormwater Permits

The discharges from construction activities that disturb more than one acre of land are legally defined as point sources and the sediment introduced from such discharges can contribute iron and aluminum. WVDEP issues a General NPDES Permit (permit WV0115924) to regulate stormwater discharges associated with construction activities with a land disturbance greater than one acre. These permits require that the site have properly installed BMPs), such as silt fences, sediment traps, seeding/mulching, and riprap, to prevent or reduce erosion and sediment runoff. The BMPs will remain intact until the construction is complete and the site has been stabilized. Individual registration under the General Permit is usually limited to less than one year.

Under the existing TMDL, construction sites registered under the Construction Stormwater General Permit are required to follow the area-based allocation for site registrations provided for each Piney Creek subwatershed. Traditionally, the construction stormwater permit program has been under-funded and under-staffed at the state level. Therefore, the program struggles with conducting site inspections to determine compliance with permit terms, and to implement consistent and meaningful enforcement throughout the state. In addition, the current permit has no mechanism to mitigate increased runoff volumes (peak flow) from new developments. Peak runoff flows from heavy rains are one of the primary sources contributing to streambank erosion that has been identified as a significant source of iron loading in the TMDL. **Photo 3-13** shows a recent construction site in the Piney Creek watershed with no visible best management practices to control erosion to the stream below.

Photo 3-13. Recent Construction Site in Piney Creek Watershed

The current events article below documents an example of how private property developers can be subjected to stormwater permit enforcement actions by failing to comply with NPDES permit regulations.

Current Events Information

Delaware Based Corporation Settles in Federal Court After Multiple Stormwater Violations Discovered

After numerous stormwater permit violations, USEPA sued Hovnanian Enterprises, Inc. in federal court and has since come to a settlement. Hovnanian is a Delaware based corporation that designs, constructs, and sells various types of residential properties. It is one of the top ten home building operations within the US. It was found that Hovnanian had 580 violations in 18 states and the District of Columbia; 161 violations were in the Chesapeake Bay Watershed, and 10 were in the state of West Virginia.

The violations fell into 3 different categories: the discharge of pollutants into stormwater without a permit, failure to provide information in the form of permit applications, and failure to comply with the conditions of permits issued. The amount of pollutant reduction stemming from the settlement would be a total of 366,208,399 lbs, of which 81,706,940 lbs would be within the Chesapeake Bay watershed.
The consent Decree required Hovnanian to implement the following:

- Implement a program that will ensure adequate management oversight of construction sites and compliance with NPDES stormwater permits.
- Appoint a national stormwater compliance program manager
- Appoint site and division level stormwater compliance managers.
- Employ a stormwater training program for all employees which include annual refresher training for managers.
- Conduct a stormwater orientation program for contractors
- Have site-specific Stormwater Pollution Prevention Plans in place.
- Conduct and document a pre-construction inspection and review at every site before starting construction.
- Conduct routine site inspections that include the use of USEPA approved standardized forms. All actions taken to achieve or maintain compliance at each site must be documented on the forms.

The company must also pay out a total of 1 million dollars for the violations, $8,500 of which goes to the state of West Virginia.

Environmental Protection Agency. Hovnanian Enterprises, Inc. Settlement Information Sheet.
www.epa.gov/compliance/resources/cases/civil/cwa/hovnanian.html

3.6 Municipal Separate Storm Sewer Systems (MS4s)

The Clean Water Act (CWA) has evolved over the past few decades. First, the most obvious and worst sources were regulated, such as untreated industrial wastes and sewage treatment plants that did not remove organic wastes. These early efforts resulted in great improvements to the quality of our waterways. However, water studies continue to find rivers, lakes, and streams that do not meet water quality standards. Polluted runoff was identified as a leading source of these impairments. In 1990, Phase I stormwater regulations set up a new category of National Pollutant Discharge Elimination System (NPDES) permit coverage to address stormwater runoff from medium and large MS4s, construction activity disturbing 5 acres of land or greater, and ten categories of industrial activity. In 2003, additional operators of MS4s in urbanized areas and operators of small construction sites (1-5 acre sites) were included in the permitting requirements in Phase II stormwater rules. (EPA 2005 http://www.epa.gov/npdes/pubs/fact1-0.pdf)

Runoff from residential and urbanized areas during storm events can be a significant fecal coliform, iron and sediment source. Unmitigated impervious areas, such as parking lots, can also increase runoff volume and velocity and magnify in-stream erosion processes. Because of those factors, stormwater runoff from residential and urban lands is a source of iron and sediment. The City of Beckley, WVDOH, and WV Parkways are designated MS4 entities within the City of Beckley. Each entity is registered under, and subject to, the requirements of General Permit Number WV0110625. **Figure 1-2** displays the MS4 areas of responsibility for each entity.

The Beckley Sanitary Board is the operator of the MS4 for the City of Beckley that is subject to the Phase II rules and regulated under WV/NPDES Discharge Permit Number WV0116025, registration number WVR030009. The MS4 area includes the City of Beckley and surrounding areas in Raleigh County that drain to the City area in the subwatersheds of Whitestick Creek, Little Whitestick Creek, and Cranberry Creek (shown on **Figure 3-5**). The total urban watershed area in this MS4 is 19 square miles, 9 square miles in the City and 10 square miles in the adjacent county areas.

The permit requires Beckley Sanitary Board to develop and implement stormwater management programs with minimum control measures that help to protect and restore water quality from polluted runoff. These measures include the following categories.

- Public education and outreach;
- Public participation/involvement;
- Illicit discharge detection and elimination;
- Construction site runoff control;
- Post-construction runoff control; and pollution prevention/good housekeeping.

The Beckley Sanitary Board (BSB) has developed a Stormwater Management Plan that guides the ongoing efforts to implement specific BMPs that are applicable to the local area and specific water quality concerns. (Beckley Sanitary Board 2007 MS4 report http://www.beckleysanitaryboard.org/DocumentsCenter/MS4_WVDEP_Report2007.pdf)

To fund the implementation of the stormwater management plan, the Beckley Stormwater Ordinance established a stormwater utility on June 26, 2007 and it became operational on July 1, 2007.

Because the City of Beckley has formed a stormwater utility to comprehensively control stormwater within its jurisdiction and to facilitate implementation of the requirements of the MS4 General Permit, the bacteria, iron and sediment loadings associated with precipitation and runoff from most land within the Beckley corporate boundary were aggregated to represent the City's baseline MS4 condition and WLAs. The BSB has been mapping storm and sanitary sewer systems to better identify potential issues. Sanitary sewer illicit discharges to the storm sewer system have been found and corrected. These corrections have reduced fecal coliform loadings to streams and the continuing program will make future reductions. The BSB Operations and Maintenance (O&M) program regularly respond to customer complaints and internal work orders. Activities include cleaning storm drain inlets, flushing storm sewer pipes and locating storm sewers for MISS Utility requests. The MS4 program is also assessing and documenting the condition of the storm sewer system to plan for catch basin cleaning, line flushing, new line installations, etc. These activities will capture and avoid discharge of sediment and metals pollutants; fecal coliform discharges may also be corrected through better system knowledge.

Under the TMDL MS4 approach,(WVDEP, 2008a), the fecal coliform bacteria and iron loading associated with precipitation and runoff from approximately 14 percent of the land area of the Piney Creek watershed is subject to MS4 wasteload allocations (WLAs). The fecal coliform bacteria and iron loading associated with precipitation and runoff from the remaining 86 percent is addressed by load allocations (LAs) for nonpoint sources.

State-administered roadways in the watershed are subject to MS4 regulation as well. Stormwater management is regulated on and near the roadways under WV/NPDES Discharge Permit Number WV0116025, registration number WVR030004, issued to the, WVDOH. The WV Parkways roads and associated facilities, including the Tamarack Center, are regulated under WV/NPDES Discharge Permit Number WV0116025, registration number WVR030041**.** The roadway areas subject to this permit and prescribed fecal coliform and iron reductions in the TMDL are shown on **Figure 3-5**. The WVDOH and WV Parkways were invited to be a part of the steering committee but have not participated in the process of creating this implementation plan. At this time, it is not known how WVDOH and WV Parkways are implementing required TMDL reductions for fecal coliform and iron/sediment within the MS4 area of Beckley.

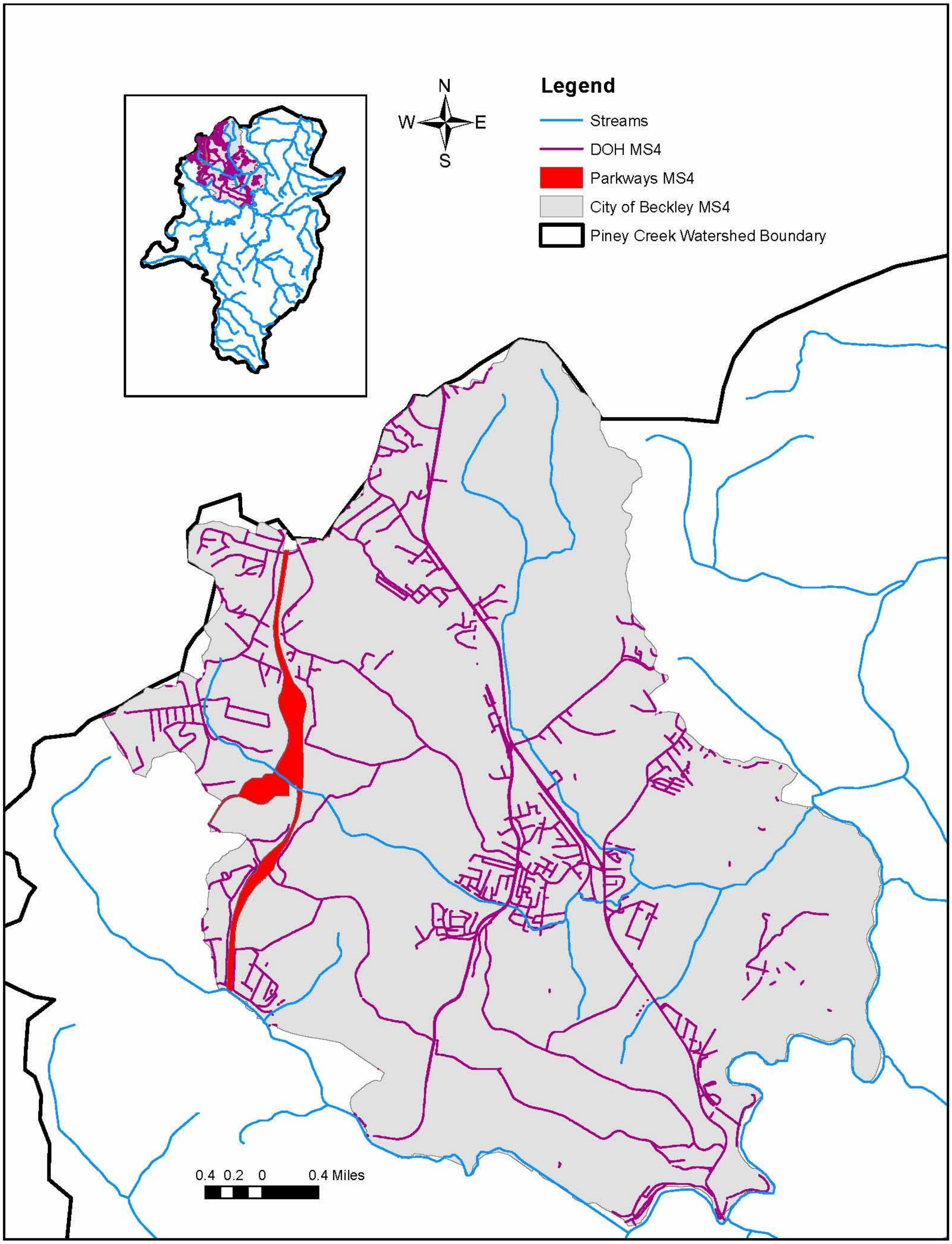


Figure 3-5. Spatial Distribution of MS4 Areas

Current Events Information

Compost BMP on State Highways

With funding provided by a USEPA cooperative agreement, The Composting Council Research and Education Foundation (CCREF), in conjunction with the United States Composting Council (USCC) has developed the guidance document COMPOST USE ON STATE HIGHWAY APPLICATIONS.
A very promising, and rapidly expanding, application for compost is as an erosion and sediment control material. Various research, as well as, field trials, has shown that compost can often outperform conventional slope stabilization methods, such as hydro-seeding, hay/straw mulching, geotextile blankets, etc. Compost, composted mulches and compost blends are used as a soil 'blanket' or 'cover', and typically placed on up to a 2:1 slopes at an application rate of 2 to 4 inches. Lesser application rates are possible in areas of lower flow and on less severe slopes. This compost layer not only absorbs the energy of the rainfall, which causes the movement of soil particles, but can also absorb a substantial volume of moisture, as well as reduce its flow velocity, improving moisture percolation into the soil.

Compost has been used extensively in re-vegetation and reclamation of marginal and low quality soils. These problem sites benefit through improving soil quality, reducing erosion, enhancing plant establishment, immobilizing toxic metals and supplying microbes. In research performed by Dr. William Sopper of Penn State University, compost (and biosolids) were applied to a gravely site, possessing a low pH and organic matter content, and contaminated with zinc. Within fifteen months of the application, the hillside was covered by a combination of orchard grass, tall fescue and crown vetch. Newly planted trees showed a survival rate of over 70%. In this example, the compost not only supplied plant nutrition and moderated soil pH, but also established a nitrogen and organic matter cycle in the soil and immobilized heavy metals, by both reducing their leachability and absorption by plants. By establishing vegetation on soils contaminated with heavy metals, water erosion can be minimized, thus reducing the transfer of pollutants. The physical structure of the compost amended soil is also improved, increasing soil porosity and moisture infiltration, thus reducing run-off.

In addition to helping to assure healthy plant growth and reduced plant loss, the use of compost in roadside applications, can also reduce the production of greenhouse gases by promoting the use of composting as an alternative waste management strategy for organic by-products, known sources of methane production, and secondly, through the increased carbon sequestration in the soil that results from compost use.

The report was developed through surveying transportation agencies in all 50 states. Case studies include:

- Connecticut DOT – Landscape Plantings
- Connecticut DOT – Wetlands Creation
- Florida DOT – Turf Establishment
- Idaho Transportation Department – Vegetation Establishment
- New Hampshire DOT – Wildflower & Roadside Plantings
- Oregon DOT – Erosion Control
- Texas DOT – On Site Topsoil Manufacturing
- Texas DOT – Re-vegetating Difficult Slopes
- Virginia DOT – Wildflower Plantings
- Washington State DOT – Soil Bioengineering

Source:
http://www.epa.gov/epawaste/conserve/rrr/composting/highway/index.htm

4.0 Required Load Reductions

The baseline pollutant loads have been calculated for metals and fecal coliform in the TMDL allocation spreadsheets (**Appendix B**). The baseline load is the amount of pollution in the stream during current conditions given contributions from existing pollution sources. The prescribed reductions or allocations for metals and fecal coliform have also been calculated in the TMDL allocation spreadsheets. The allocated condition is simply a scenario where pollution sources contributing to the water quality have been reduced so that the stream can meet water quality criteria. The following sections will show the required reductions for fecal coliform, iron and aluminum from various streams in the Piney Creek Watershed.

4.1 Fecal Coliform TMDL Load Reductions

To better facilitate implementation, a Microsoft Excel spreadsheet tool contains the detailed fecal coliform sources and associated load allocations and waste load allocations in each subwatershed. This tool is presented as **Appendix_B_Piney_Fecal_Allocations_02_16_2011**. **Figure 4-1** below summarizes the necessary reductions to fecal coliform by impaired stream. Streams that are surrounded by a greater population density require the most reductions. This may be explained, in part, by a greater number of pets, therefore a higher wash off of pet waste to the stream during rain events. This may also be an indication of an aging waste water infrastructure system that is beginning to have a significant amount of leakage. Another possibility is that there could be unknown breaks in the waste water lines or straight pipes that are not connected to the sanitary sewer collection lines at all. Another possible contributor could be Outlets 004 and 007 of North Beckley PSD. These undocumented outlets may be contributing pollution during heavy storm events. It is recommended that the steering committee and the Piney Creek Watershed Association conduct further research and information gathering on these outlets and work directly with the North Beckley PSD to reduce or eliminate these outlets. **Figure 4-2** summarizes the different types of source categories used in the TMDL that produce fecal coliform loading to the surface waters. The predominant sources of fecal coliform bacteria to surface waters within the Piney Creek watershed are MS4 area, urban/residential lands, agricultural areas and failing on-site septic systems. The background category identified in **Figure 4-2** shows the yearly fecal coliform load originating from all the background landuses (mainly forest and grassland areas). WVDEP has chosen not to reduce fecal coliform loading from natural wildlife because it is impractical. For specific subwatershed or individual stream information with the associated detailed pollutant source contributions to fecal coliform impairments, refer the electronic Microsoft Excel file **Appendix_B_Piney_Fecal_Allocations_02_16_2011**.

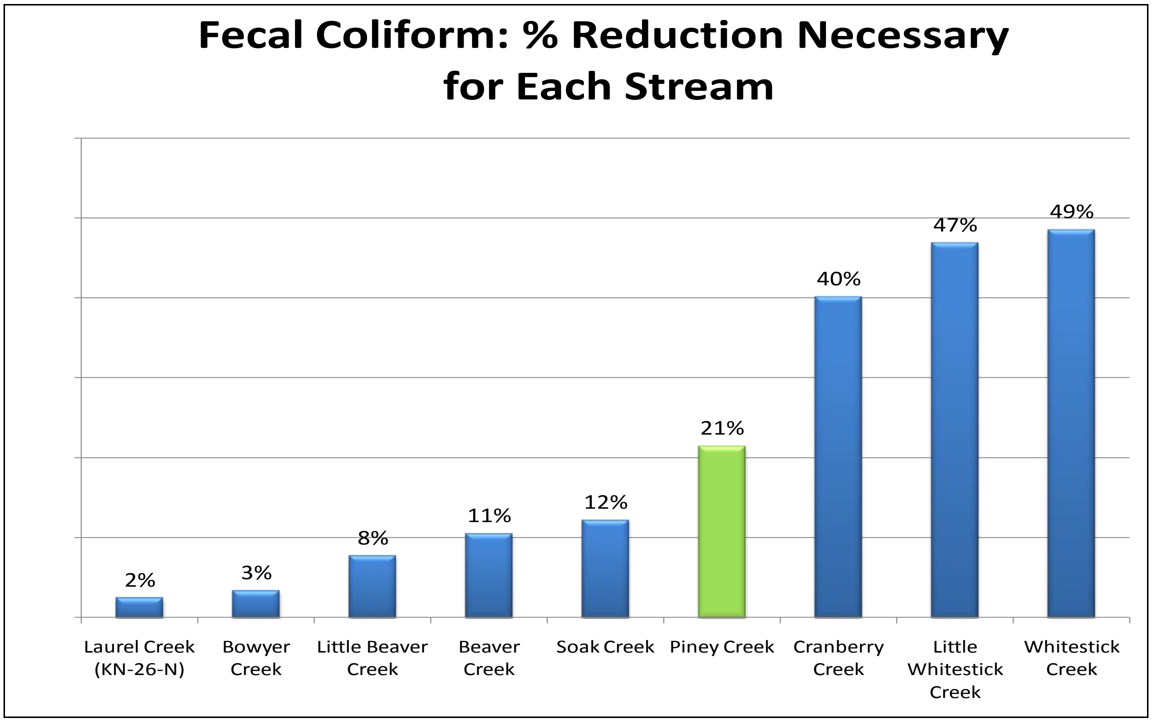


Figure 4-1. Necessary Fecal Coliform Reductions in Piney Creek and Tributaries

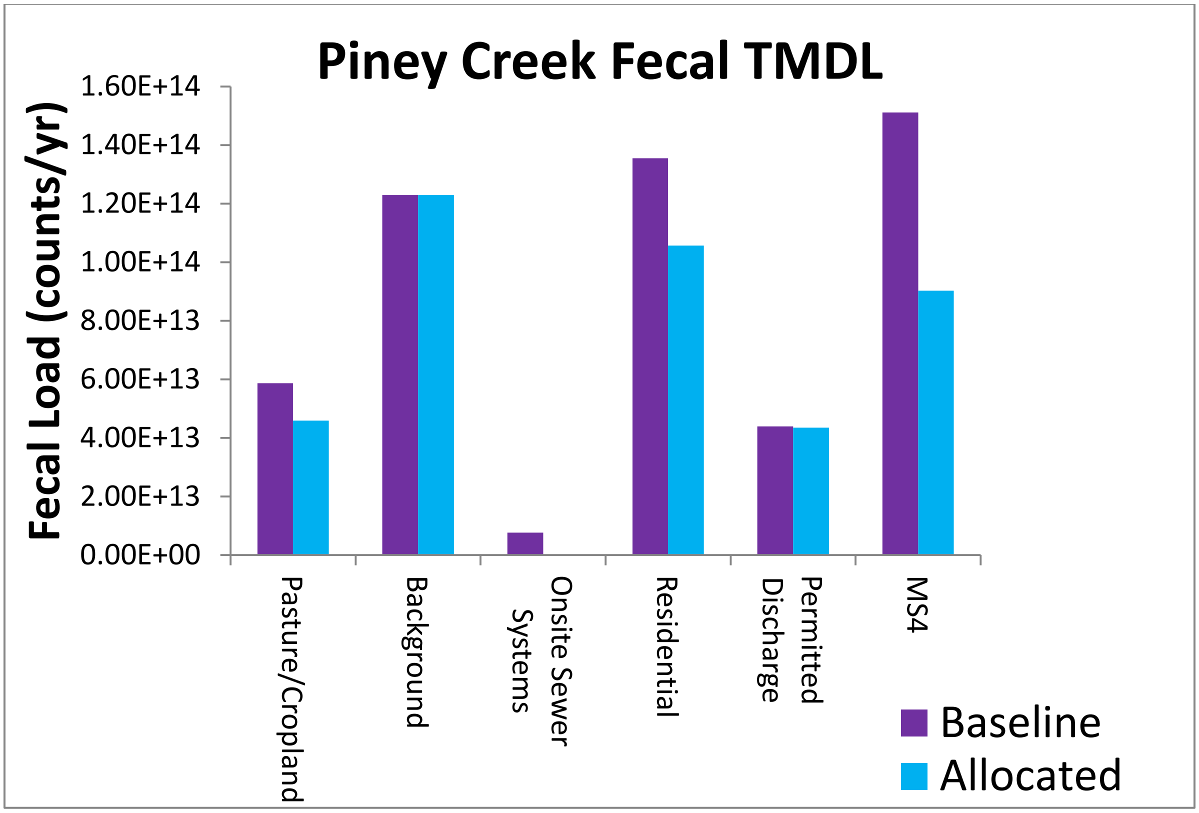


Figure 4-2. Necessary Fecal Coliform Reductions by Source Category

4.1.1 Pasture/Cropland Load Reductions

In the entire Piney Creek Watershed there are only three subwatersheds that require reductions to the pasture/cropland category. **Table 4-1** shows the agriculture related reductions.

Table 4-1. Pasture/Cropland Fecal Coliform Load Reductions

Sub water shed	Stream Name	Stream Code	Pasture/ Cropland Baseline Load (counts/yr)	Pasture/ Cropland Allocated Load (counts/yr)	Pasture/ Cropland Reduction (base - allocated)	Pasture/ Cropland Percent Reduction
1116	Fat Creek	WVKN-26-B	1.98E+13	1.29E+13	6.90E+12	34.8
1145	UNT/Beaver Creek RM 10.11	WVKN-26-F-8	9.43E+12	3.77E+12	5.66E+12	60.0
1158	Bowyer Creek	WVKN-26-M	3.84E+11	2.31E+11	1.53E+11	39.8

4.1.2 Failing Septic Load Reductions

Failing individual septic system require a 100% reduction because the discharge of untreated sewage to surface waters is illegal in West Virginia. Many of the subwatersheds within the Piney Creek watershed require reductions to failing septic systems as shown in **Table 4-2**.

Table 4-2. Failing Septic Fecal Coliform Load Reductions

Sub Water shed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Onsite Sewer Systems Allocated Load (counts/yr)	Onsite Sewer Systems Percent Reduction
1113	Piney Creek	WVKN-26	3.53E+10	0.00E+00	100
1114	Piney Creek	WVKN-26	1.23E+11	0.00E+00	100
1115	Fat Creek	WVKN-26-B	6.26E+10	0.00E+00	100
1116	Fat Creek	WVKN-26-B	4.36E+11	0.00E+00	100
1117	Brammer Branch	WVKN-26-B-2	8.31E+10	0.00E+00	100
1118	Piney Creek	WVKN-26	5.13E+11	0.00E+00	100
1119	Piney Creek	WVKN-26	8.20E+10	0.00E+00	100
1120	Piney Creek	WVKN-26	7.97E+09	0.00E+00	100
1121	Piney Creek	WVKN-26	3.42E+09	0.00E+00	100
1122	Beaver Creek	WVKN-26-F	5.12E+10	0.00E+00	100
1123	Little Beaver Creek	WVKN-26-F-2	4.44E+10	0.00E+00	100
1124	UNT/Little Beaver Creek RM 0.25	WVKN-26-F-2-0.4A	9.11E+09	0.00E+00	100
1125	Little Beaver Creek	WVKN-26-F-2	2.05E+10	0.00E+00	100

Sub Water shed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Onsite Sewer Systems Allocated Load (counts/yr)	Onsite Sewer Systems Percent Reduction
1127	UNT/Little Beaver Creek RM 0.25	WVKN-26-F-2-A.1	4.21E+10	0.00E+00	100
1128	Little Beaver Creek	WVKN-26-F-2	1.14E+09	0.00E+00	100
1129	Laurel Run	WVKN-26-F-2-B	2.16E+10	0.00E+00	100
1130	Little Beaver Creek	WVKN-26-F-2	1.14E+09	0.00E+00	100
1131	Sims Branch	WVKN-26-F-2-C	1.01E+11	0.00E+00	100
1132	Little Beaver Creek	WVKN-26-F-2	1.02E+10	0.00E+00	100
1133	Lake	WVKN-26-F-2-(L2)	3.19E+10	0.00E+00	100
1134	Little Beaver Creek	WVKN-26-F-2	1.87E+11	0.00E+00	100
1135	Lake	WVKN-26-F-2-(L3)	4.55E+09	0.00E+00	100
1136	Little Beaver Creek	WVKN-26-F-2	2.16E+10	0.00E+00	100
1137	Sand Branch	WVKN-26-F-2-A	1.14E+09	0.00E+00	100
1138	Beaver Creek	WVKN-26-F	8.31E+10	0.00E+00	100
1139	Beaver Creek	WVKN-26-F	2.16E+10	0.00E+00	100
1141	Left Fork/Beaver Creek	WVKN-26-F-6	1.92E+11	0.00E+00	100
1142	Beaver Creek	WVKN-26-F	1.64E+11	0.00E+00	100
1143	Cherry Creek	WVKN-26-F-7	5.57E+11	0.00E+00	100
1144	Beaver Creek	WVKN-26-F	2.66E+11	0.00E+00	100
1145	UNT/Beaver Creek RM 10.11	WVKN-26-F-8	2.37E+11	0.00E+00	100
1146	Rocky Branch	WVKN-26-F-5	2.39E+10	0.00E+00	100
1147	Glade Fork	WVKN-26-F-3	8.88E+10	0.00E+00	100
1148	Tank Branch	WVKN-26-F-1	6.83E+09	0.00E+00	100
1149	Piney Creek	WVKN-26	2.85E+10	0.00E+00	100
1150	Piney Creek	WVKN-26	5.35E+10	0.00E+00	100
1151	Piney Creek	WVKN-26	1.80E+11	0.00E+00	100
1152	Piney Creek	WVKN-26	1.10E+11	0.00E+00	100
1153	Piney Creek	WVKN-26	1.76E+11	0.00E+00	100
1154	Take-In Creek	WVKN-26-L	1.70E+10	0.00E+00	100
1155	Piney Creek	WVKN-26	4.49E+11	0.00E+00	100
1156	Bowyer Creek	WVKN-26-M	1.54E+10	0.00E+00	100
1157	Spencer Branch	WVKN-26-M-1	5.27E+10	0.00E+00	100
1158	Bowyer Creek	WVKN-26-M	5.69E+09	0.00E+00	100
1161	Piney Creek	WVKN-26	6.32E+10	0.00E+00	100
1162	Laurel Creek (KN-26-N)	WVKN-26-N	1.29E+11	0.00E+00	100
1163	Piney Creek	WVKN-26	5.29E+10	0.00E+00	100

Sub Water shed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Onsite Sewer Systems Allocated Load (counts/yr)	Onsite Sewer Systems Percent Reduction
1164	Lampkin Branch	WVKN-26-O	1.68E+10	0.00E+00	100
1165	Piney Creek	WVKN-26	8.49E+10	0.00E+00	100
1167	Piney Creek	WVKN-26	1.14E+09	0.00E+00	100
1168	Keaton Branch	WVKN-26-P	2.28E+09	0.00E+00	100
1169	Piney Creek	WVKN-26	7.63E+10	0.00E+00	100
1170	Soak Creek	WVKN-26-K	1.12E+11	0.00E+00	100
1171	Laurel Branch	WVKN-26-K-1	7.63E+10	0.00E+00	100
1172	Soak Creek	WVKN-26-K	2.85E+10	0.00E+00	100
1173	Soak Creek	WVKN-26-K	1.96E+11	0.00E+00	100
1174	Soak Creek	WVKN-26-K	2.13E+11	0.00E+00	100
1175	Turkey Branch	WVKN-26-J	1.39E+11	0.00E+00	100
1176	Crab Orchard Creek	WVKN-26-I	2.39E+10	0.00E+00	100
1177	Crab Orchard Creek	WVKN-26-I	2.44E+11	0.00E+00	100
1178	Stover Fork	WVKN-26-I-1	1.33E+11	0.00E+00	100
1179	Whitestick Creek	WVKN-26-G	2.50E+10	0.00E+00	100
1180	UNT/Whitestick Creek RM 2.83	WVKN-26-G-1	1.59E+10	0.00E+00	100
1182	Whitestick Creek	WVKN-26-G	1.80E+11	0.00E+00	100
1187	Little Whitestick Creek	WVKN-26-E-1	3.42E+10	0.00E+00	100
1188	Cranberry Creek	WVKN-26-E	7.63E+10	0.00E+00	100
1189	Cranberry Creek	WVKN-26-E	3.87E+10	0.00E+00	100
1190	UNT/Cranberry Creek RM 4.51	WVKN-26-E-2	1.71E+10	0.00E+00	100
1191	Cranberry Creek	WVKN-26-E	1.48E+10	0.00E+00	100
1192	Griffith Branch	WVKN-26-D	1.28E+11	0.00E+00	100
1193	Stanaford Branch	WVKN-26-C	8.21E+11	0.00E+00	100
1195	Batoff Creek	WVKN-26-A	7.09E+10	0.00E+00	100
1196	Batoff Creek	WVKN-26-A	7.80E+10	0.00E+00	100

4.1.3 Residential Fecal Coliform Load Reductions

The residential fecal coliform load reductions presented in **Table 4-3** originate from pet waste in residential areas and can signify leaking public wastewater lines in heavily populated areas with public sewage service.

Table 4-3. Residential Fecal Coliform Load Reductions

Subwatershed	Stream Name	Stream Code	Residential Baseline Load (counts/yr)	Residential Allocated Load (counts/yr)	Residential Percent Reduction
1134	Little Beaver Creek	WVKN-26-F-2	3.99E+12	3.00E+12	24.9
1137	Sand Branch	WVKN-26-F-2-A	2.69E+12	2.02E+12	25.0
1172	Soak Creek	WVKN-26-K	1.10E+12	8.80E+11	20.0
1173	Soak Creek	WVKN-26-K	7.86E+12	6.29E+12	19.9
1177	Crab Orchard Creek	WVKN-26-I	8.05E+12	6.03E+12	25.1
1178	Stover Fork	WVKN-26-I-1	6.80E+12	5.10E+12	25.1
1179	Whitestick Creek	WVKN-26-G	1.01E+13	4.03E+12	60.0
1180	UNT/Whitestick Creek RM 2.83	WVKN-26-G-1	8.51E+12	5.54E+12	34.9
1181	Whitestick Creek	WVKN-26-G	4.60E+12	2.75E+12	40.1
1182	Whitestick Creek	WVKN-26-G	1.80E+13	7.20E+12	59.9
1184	Cranberry Creek	WVKN-26-E	1.23E+11	7.99E+10	35.2
1187	Little Whitestick Creek	WVKN-26-E-1	1.11E+12	5.56E+11	49.9
1188	Cranberry Creek	WVKN-26-E	6.61E+11	3.29E+11	50.2
1190	UNT/Cranberry Creek RM 4.51	WVKN-26-E-2	8.41E+10	5.49E+10	34.8

4.1.4 MS4 Residential Fecal Coliform Load Reductions

The MS4 residential fecal coliform loads presented in **Table 4-4** represent runoff from impervious surfaces and pet waste. In some areas with public sewer lines, some of the fecal coliform load may be originating from leaking wastewater infrastructure and/or residential laterals.

Table 4-4. MS4 Residential Fecal Coliform Load Reductions

Sub Water shed	Stream Name	Stream Code	Sum MS4 Residential Baseline Load (counts/yr)	Sum MS4 Residential Allocated Load (counts/yr)	Sum MS4 Residential Reduction (base - allocated) (counts/yr)	MS4 Residential Percent Reduction
1179	Whitestick Creek	WVKN-26-G	1.12E+13	4.48E+12	6.71E+12	60.0
1181	Whitestick Creek	WVKN-26-G	5.81E+12	3.49E+12	2.33E+12	40.1
1182	Whitestick Creek	WVKN-26-G	3.77E+12	1.51E+12	2.26E+12	59.9
1183	UNT/Whitestick Creek RM 3.66	WVKN-26-G-2	9.08E+12	5.45E+12	3.63E+12	40.0

Sub Water shed	Stream Name	Stream Code	Sum MS4 Residential Baseline Load (counts/yr)	Sum MS4 Residential Allocated Load (counts/yr)	Sum MS4 Residential Reduction (base - allocated) (counts/yr)	MS4 Residential Percent Reduction
1184	Cranberry Creek	WVKN-26-E	1.26E+13	8.18E+12	4.44E+12	35.2
1185	Little Whitestick Creek	WVKN-26-E-1	4.90E+12	2.20E+12	2.69E+12	55.0
1186	UNT/Little Whitestick Creek RM 0.84	WVKN-26-E-1-A	1.05E+13	6.31E+12	4.20E+12	40.0
1187	Little Whitestick Creek	WVKN-26-E-1	3.57E+13	1.79E+13	1.78E+13	49.9
1188	Cranberry Creek	WVKN-26-E	3.04E+13	1.52E+13	1.53E+13	50.2
1189	Cranberry Creek	WVKN-26-E	1.63E+12	1.06E+12	5.66E+11	34.8
1190	UNT/Cranberry Creek RM 4.51	WVKN-26-E-2	2.75E+12	1.80E+12	9.59E+11	34.8

Note: the sum of the load from all three MS4 entities in the TMDL is presented and the overall percent reduction was recalculated.

4.2 Metals TMDL Load Reductions

To better facilitate implementation, a Microsoft Excel spreadsheet tool contains the detailed aluminum and iron sources and associated load allocations and waste load allocations in each subwatershed. This tool is presented as **Appendix_B_Piney_Metal_TMDL_Allocations_02_14_2011**. Aluminum and iron reductions to impaired streams are summarized in **Figure 4-3**. The main source of pH, aluminum and iron in the Batoff Creek drainage is abandoned mine land and acid mine drainage seeps. The assumption in the TMDL is that implementing aluminum and iron reduction strategies will also require meeting the pH standard (between 6.0-9.0 pH). Therefore this implementation plan will not specifically address the pH impairment in Batoff Creek. AML sources are also present in certain areas of the watershed and do require significant iron reductions. Other significant sources of metals are streambank erosion, MS4 landuse, urban/residential land and construction sites with barren non-vegetated areas (**Figure 4-4**). The other nonpoint sources category identified in **Figure 4-4** shows the yearly iron load originating from all the background landuses (mainly forest and grassland areas). WVDEP has chosen not to reduce metals loading from normal background landuses because it is impractical. For specific subwatershed or individual stream information with the associated detailed pollutant source contributions to metals impairments, refer the electronic Microsoft Excel file **Appendix_B_Piney_Metal TMDL_Allocations_02_14_2011**.

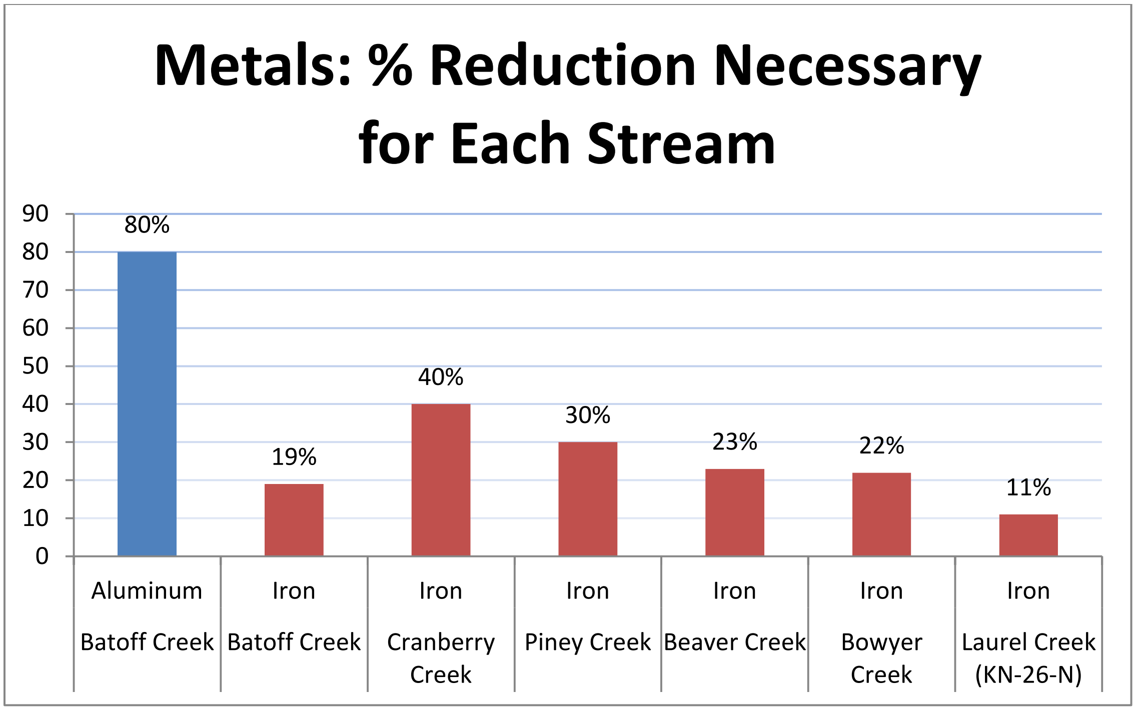


Figure 4-3. Necessary Metals Reductions in Piney Creek and Tributaries

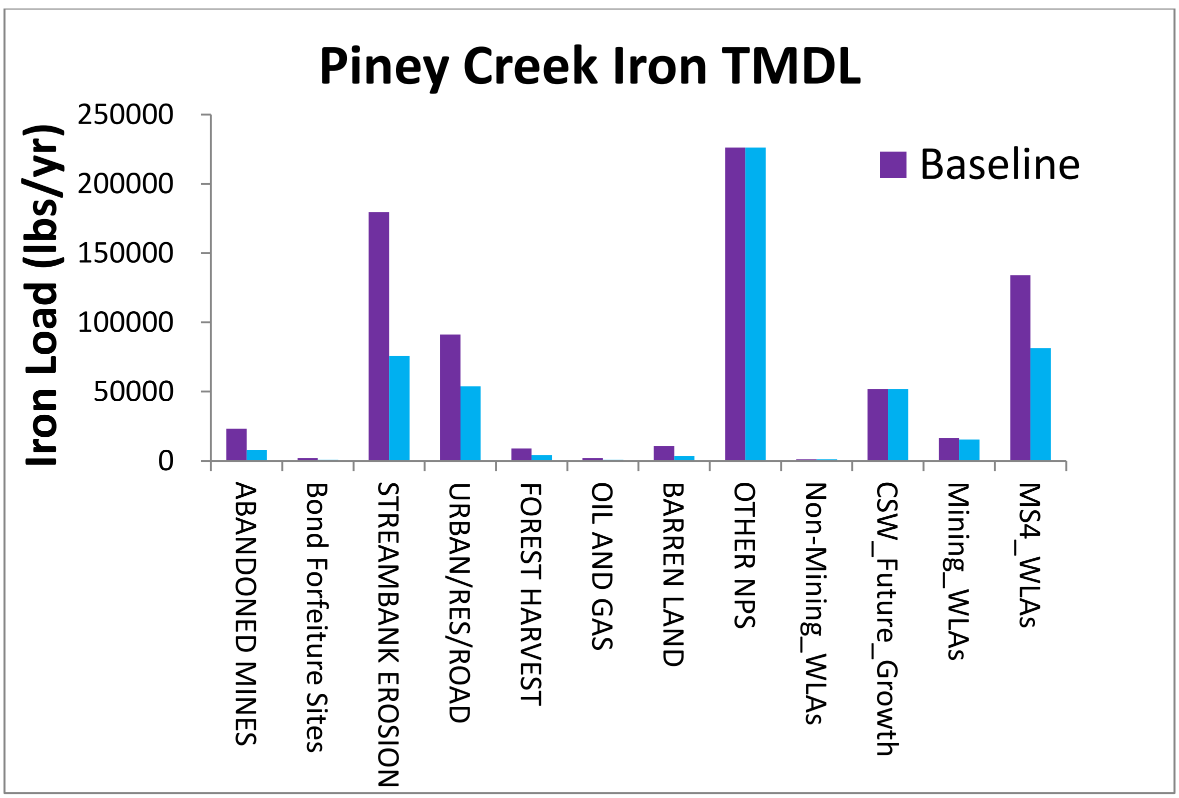


Figure 4-4. Necessary Iron Reductions by Source Category

4.2.1 Aluminum Load Reductions

The aluminum loads originate from two sources, abandoned mine seeps and bond forfeiture seeps. **Table 4-5** shows the required aluminum reductions.

Table 4-5. Aluminum Load Reductions

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-A	Batoff Creek	1194	0	0	0	0	0	0
WVKN-26-A	Batoff Creek	1195	0	0	0	74	5	93
WVKN-26-A	Batoff Creek	1196	2637	115	96	0	0	0

4.2.2 Iron Load Reductions

The iron loads originate from numerous sources, such as: abandoned mine lands, bond forfeiture sites, forest harvest locations, oil and gas well sites, barren land and urban areas. **Table 4-6** shows the required iron reductions from the various landuses.

Table 4-6. Iron Load Reductions

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES			FOREST HARVEST			OIL AND GAS			BARREN LAND			URBAN/RES/ROAD		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26	Piney Creek	1113	0	0	0	0	0	0	0	0	0	0	0	0	3	1	66	500	186	63
WVKN-26	Piney Creek	1114	0	0	0	0	0	0	0	0	0	0	0	0	548	186	66	986	416	58
WVKN-26-B	Fat Creek	1115	0	0	0	0	0	0	0	0	0	0	0	0	437	149	66	1045	452	57
WVKN-26-B	Fat Creek	1116	0	0	0	0	0	0	1720	796	54	0	0	0	7	3	66	2708	1308	52
WVKN-26-B-2	Brammer Branch	1117	0	0	0	0	0	0	3	3	0	0	0	0	1189	405	66	2593	1315	49
WVKN-26	Piney Creek	1118	0	0	0	0	0	0	0	0	0	0	0	0	438	149	66	905	530	41
WVKN-26	Piney Creek	1119	0	0	0	0	0	0	0	0	0	0	0	0	1551	528	66	2191	1120	49
WVKN-26	Piney Creek	1120	0	0	0	0	0	0	954	446	53	0	0	0	4	1	66	1155	601	48
WVKN-26	Piney Creek	1121	0	0	0	0	0	0	215	100	53	0	0	0	1	1	0	1639	983	40
WVKN-26-F	Beaver Creek	1122	39	13	68	0	0	0	7	3	52	0	0	0	1	1	0	991	634	36
WVKN-26-F-2	Little Beaver Creek	1123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	498	264	47
WVKN-26-F-2-0.4A	UNT/Little Beaver Creek RM 0.25	1124	0	0	0	0	0	0	3	3	0	0	0	0	128	44	66	140	73	47
WVKN-26-F-2	Little Beaver Creek	1125	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	323	198	39
WVKN-26-F-2	Little Beaver Creek	1126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES			FOREST HARVEST			OIL AND GAS			BARREN LAND			URBAN/RES/ROAD		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-F-2-A.1	UNT/Little Beaver Creek RM 0.25	1127	0	0	0	0	0	0	0	0	0	0	0	0	78	27	66	166	88	47
WVKN-26-F-2	Little Beaver Creek	1128	0	0	0	0	0	0	7	3	52	0	0	0	138	47	66	629	360	43
WVKN-26-F-2-B	Laurel Run	1129	0	0	0	0	0	0	2271	1049	54	0	0	0	2	2	0	476	246	48
WVKN-26-F-2	Little Beaver Creek	1130	0	0	0	0	0	0	0	0	0	0	0	0	50	17	66	45	26	43
WVKN-26-F-2-C	Sims Branch	1131	0	0	0	0	0	0	27	13	52	0	0	0	50	17	66	210	111	47
WVKN-26-F-2	Little Beaver Creek	1132	0	0	0	0	0	0	3	3	0	23	11	53	6	2	66	220	127	42
WVKN-26-F-2-(L2)	Lake	1133	0	0	0	0	0	0	1	1	0	0	0	0	188	64	66	462	222	52
WVKN-26-F-2	Little Beaver Creek	1134	0	0	0	0	0	0	27	13	52	0	0	0	254	86	66	1881	1230	35
WVKN-26-F-2-(L3)	Lake	1135	0	0	0	0	0	0	4	2	52	0	0	0	76	26	66	210	125	41
WVKN-26-F-2	Little Beaver Creek	1136	0	0	0	0	0	0	1	1	0	0	0	0	2	2	0	159	54	66
WVKN-26-F-2-A	Sand Branch	1137	0	0	0	0	0	0	85	41	52	0	0	0	265	90	66	1418	892	37
WVKN-26-F	Beaver Creek	1138	0	0	0	0	0	0	1	1	0	0	0	0	7	2	66	1840	1265	31
WVKN-26-F	Beaver Creek	1139	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	701	351	50
WVKN-26-F	Beaver Creek	1140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	22	39
WVKN-26-F-6	Left Fork/Beaver Creek	1141	0	0	0	0	0	0	47	22	52	0	0	0	5	2	66	1408	720	49

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES			FOREST HARVEST			OIL AND GAS			BARREN LAND			URBAN/RES/ROAD		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-F	Beaver Creek	1142	0	0	0	0	0	0	69	33	52	23	11	53	3	1	66	1431	800	44
WVKN-26-F-7	Cherry Creek	1143	0	0	0	0	0	0	5	3	52	0	0	0	287	98	66	475	309	35
WVKN-26-F	Beaver Creek	1144	0	0	0	0	0	0	0	0	0	0	0	0	451	154	66	1201	699	42
WVKN-26-F-8	UNT/Beaver Creek RM 10.11	1145	0	0	0	0	0	0	0	0	0	0	0	0	408	139	66	232	98	58
WVKN-26-F-5	Rocky Branch	1146	0	0	0	0	0	0	41	20	52	68	32	53	4	1	66	301	158	47
WVKN-26-F-3	Glade Fork	1147	0	0	0	0	0	0	253	122	52	0	0	0	7	2	66	1865	941	50
WVKN-26-F-1	Tank Branch	1148	20	6	68	0	0	0	0	0	0	0	0	0	26	9	66	410	258	37
WVKN-26	Piney Creek	1149	38	17	57	0	0	0	18	9	52	0	0	0	57	19	66	1398	932	33
WVKN-26	Piney Creek	1150	101	34	66	0	0	0	0	0	0	0	0	0	253	86	66	1322	712	46
WVKN-26	Piney Creek	1151	136	44	68	0	0	0	32	15	52	159	75	53	3	3	0	1200	671	44
WVKN-26	Piney Creek	1152	0	0	0	0	0	0	0	0	0	68	32	53	3	3	0	1252	630	50
WVKN-26	Piney Creek	1153	0	0	0	0	0	0	37	18	52	68	32	53	247	84	66	739	375	49
WVKN-26-L	Take-In Creek	1154	0	0	0	0	0	0	0	0	0	45	21	53	575	196	66	338	126	63
WVKN-26	Piney Creek	1155	155	52	66	0	0	0	721	337	53	136	64	53	8	3	66	601	314	48
WVKN-26-M	Bowyer Creek	1156	0	0	0	0	0	0	0	0	0	0	0	0	90	31	66	150	75	50
WVKN-26-M-1	Spencer Branch	1157	0	0	0	0	0	0	0	0	0	0	0	0	249	84	66	455	231	49

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES			FOREST HARVEST			OIL AND GAS			BARREN LAND			URBAN/RES/ROAD		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-M	Bowyer Creek	1158	1344	535	60	1108	520	53	427	204	52	0	0	0	10	3	66	1350	587	57
WVKN-26-M	Bowyer Creek	1159	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	97	33	66
WVKN-26-M-2	UNT/Bowyer Creek RM 3.34	1160	98	89	10	0	0	0	0	0	0	0	0	0	2	2	0	194	66	66
WVKN-26	Piney Creek	1161	5	2	67	0	0	0	0	0	0	0	0	0	275	93	66	146	82	44
WVKN-26-N	Laurel Creek	1162	2061	1206	41	0	0	0	0	0	0	37	17	53	11	4	66	881	403	54
WVKN-26	Piney Creek	1163	58	19	67	0	0	0	7	3	52	0	0	0	2	2	0	206	103	50
WVKN-26-O	Lampkin Branch	1164	668	224	66	0	0	0	45	21	52	0	0	0	4	1	66	379	143	62
WVKN-26	Piney Creek	1165	0	0	0	0	0	0	0	0	0	37	17	53	286	97	66	326	195	40
WVKN-26-0.5	UNT/Piney Creek RM 31.33	1166	0	0	0	0	0	0	0	0	0	37	17	53	150	51	66	0	0	0
WVKN-26	Piney Creek	1167	0	0	0	0	0	0	0	0	0	37	17	53	59	20	66	47	18	61
WVKN-26-P	Keaton Branch	1168	27	25	10	0	0	0	0	0	0	0	0	0	5	2	66	180	81	55
WVKN-26	Piney Creek	1169	61	59	2	0	0	0	0	0	0	0	0	0	6	2	66	15	6	59
WVKN-26-K	Soak Creek	1170	362	119	67	0	0	0	31	15	52	0	0	0	2	2	0	1488	810	46
WVKN-26-K-1	Laurel Branch	1171	0	0	0	0	0	0	0	0	0	74	35	53	2	2	0	878	466	47
WVKN-26-K	Soak Creek	1172	21	7	67	0	0	0	0	0	0	111	52	53	0	0	0	1013	620	39
WVKN-26-K	Soak Creek	1173	21	7	67	0	0	0	25	12	52	37	17	53	94	32	66	6026	3907	35

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES			FOREST HARVEST			OIL AND GAS			BARREN LAND			URBAN/RES/ROAD		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-K	Soak Creek	1174	0	0	0	0	0	0	0	0	0	74	35	53	15	5	66	227	166	27
WVKN-26-J	Turkey Branch	1175	0	0	0	0	0	0	1179	545	54	111	52	53	2	2	0	473	290	39
WVKN-26-I	Crab Orchard Creek	1176	0	0	0	0	0	0	0	0	0	74	35	53	1	1	0	730	499	32
WVKN-26-I	Crab Orchard Creek	1177	84	28	67	0	0	0	162	77	52	37	17	53	353	120	66	6419	4105	36
WVKN-26-I-1	Stover Fork	1178	1686	558	67	0	0	0	25	12	52	37	17	53	4	1	66	4757	3175	33
WVKN-26-G	Whitestick Creek	1179	185	64	66	0	0	0	22	11	52	186	87	53	2	2	0	3921	2712	31
WVKN-26-G-1	UNT/Whitestick Creek RM 2.83	1180	934	308	67	0	0	0	0	0	0	37	17	53	0	0	0	4246	2642	38
WVKN-26-G	Whitestick Creek	1181	70	23	67	0	0	0	0	0	0	0	0	0	0	0	0	1912	1282	33
WVKN-26-G	Whitestick Creek	1182	0	0	0	0	0	0	40	19	52	0	0	0	727	246	66	8151	5264	35
WVKN-26-G-2	UNT/Whitestick Creek RM 3.66	1183	26	8	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WVKN-26-E	Cranberry Creek	1184	308	102	67	0	0	0	0	0	0	0	0	0	0	0	0	50	35	31
WVKN-26-E-1	Little Whitestick Creek	1185	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
WVKN-26-E-1-A	UNT/Little Whitestick Creek RM 0.84	1186	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WVKN-26-E-1	Little Whitestick Creek	1187	27	10	62	0	0	0	9	4	52	0	0	0	67	23	66	517	331	36
WVKN-26-E	Cranberry Creek	1188	10220	2306	77	688	323	53	303	145	52	186	87	53	0	0	0	401	232	42

Stream Code	Stream Name	SWS	ABANDONED MINES			BOND FOREFITURE SITES			FOREST HARVEST			OIL AND GAS			BARREN LAND			URBAN/RES/ROAD		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-E	Cranberry Creek	1189	34	11	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WVKN-26-E-2	UNT/Cranberry Creek RM 4.51	1190	92	30	67	0	0	0	0	0	0	0	0	0	0	0	0	51	31	39
WVKN-26-E	Cranberry Creek	1191	0	0	0	0	0	0	0	0	0	37	17	53	1	1	0	108	54	50
WVKN-26-D	Griffith Branch	1192	12	11	10	0	0	0	22	11	52	0	0	0	363	123	66	2845	1732	39
WVKN-26-C	Stanaford Branch	1193	275	117	58	0	0	0	29	14	52	111	52	53	7	2	66	3414	2040	40
WVKN-26-A	Batoff Creek	1194	0	0	0	0	0	0	0	0	0	0	0	0	135	46	66	1	1	0
WVKN-26-A	Batoff Creek	1195	0	0	0	199	93	53	16	7	52	0	0	0	6	2	66	699	352	50
WVKN-26-A	Batoff Creek	1196	4219	1979	53	0	0	0	45	21	52	148	69	53	138	47	66	301	151	50

4.2.3 Stream Bank Erosion Reductions

Stream bank erosion is a significant source of iron in the Piney Creek watershed. Significant stream bank erosion reductions are required throughout the entire watershed and are presented in **Table 4-7**.

Table 4-7. Iron Reductions for Stream Bank Erosion Sediment

Stream Code	Stream Name	SWS	STREAMBANK EROSION		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26	Piney Creek	1113	38850	17205	56
WVKN-26	Piney Creek	1114	20183	8938	56
WVKN-26-B	Fat Creek	1115	260	260	0
WVKN-26-B	Fat Creek	1116	73	73	0
WVKN-26-B-2	Brammer Branch	1117	74	73	2
WVKN-26	Piney Creek	1118	7376	7230	2
WVKN-26	Piney Creek	1119	6880	6744	2
WVKN-26	Piney Creek	1120	3023	2963	2
WVKN-26	Piney Creek	1121	2707	2653	2
WVKN-26-F	Beaver Creek	1122	1806	1806	0
WVKN-26-F-2	Little Beaver Creek	1123	1846	1105	40
WVKN-26-F-2-0.4A	UNT/Little Beaver Creek RM 0.25	1124	25	15	40
WVKN-26-F-2	Little Beaver Creek	1125	1271	761	40
WVKN-26-F-2	Little Beaver Creek	1126	1849	1107	40
WVKN-26-F-2-A.1	UNT/Little Beaver Creek RM 0.25	1127	51	31	40
WVKN-26-F-2	Little Beaver Creek	1128	766	459	40
WVKN-26-F-2-B	Laurel Run	1129	87	52	40
WVKN-26-F-2	Little Beaver Creek	1130	486	387	20
WVKN-26-F-2-C	Sims Branch	1131	37	29	20
WVKN-26-F-2	Little Beaver Creek	1132	381	303	20
WVKN-26-F-2-(L2)	Lake	1133	464	370	20
WVKN-26-F-2	Little Beaver Creek	1134	192	153	20
WVKN-26-F-2-(L3)	Lake	1135	86	69	20
WVKN-26-F-2	Little Beaver Creek	1136	30	24	20
WVKN-26-F-2-A	Sand Branch	1137	107	64	40
WVKN-26-F	Beaver Creek	1138	6006	897	85
WVKN-26-F	Beaver Creek	1139	5249	784	85

Stream Code	Stream Name	SWS	STREAMBANK EROSION		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-F	Beaver Creek	1140	7872	1176	85
WVKN-26-F-6	Left Fork/Beaver Creek	1141	135	110	19
WVKN-26-F	Beaver Creek	1142	508	302	41
WVKN-26-F-7	Cherry Creek	1143	107	64	41
WVKN-26-F	Beaver Creek	1144	103	61	41
WVKN-26-F-8	UNT/Beaver Creek RM 10.11	1145	121	72	41
WVKN-26-F-5	Rocky Branch	1146	65	39	41
WVKN-26-F-3	Glade Fork	1147	154	91	41
WVKN-26-F-1	Tank Branch	1148	28	22	20
WVKN-26	Piney Creek	1149	11352	2523	78
WVKN-26	Piney Creek	1150	8734	1941	78
WVKN-26	Piney Creek	1151	9565	2126	78
WVKN-26	Piney Creek	1152	7310	1624	78
WVKN-26	Piney Creek	1153	5095	1132	78
WVKN-26-L	Take-In Creek	1154	370	82	78
WVKN-26	Piney Creek	1155	3906	868	78
WVKN-26-M	Bowyer Creek	1156	2350	522	78
WVKN-26-M-1	Spencer Branch	1157	126	28	78
WVKN-26-M	Bowyer Creek	1158	368	174	53
WVKN-26-M	Bowyer Creek	1159	43	21	53
WVKN-26-M-2	UNT/Bowyer Creek RM 3.34	1160	48	23	53
WVKN-26	Piney Creek	1161	2467	1165	53
WVKN-26-N	Laurel Creek	1162	268	105	61
WVKN-26	Piney Creek	1163	1013	590	42
WVKN-26-O	Lampkin Branch	1164	72	42	42
WVKN-26	Piney Creek	1165	601	350	42
WVKN-26-0.5	UNT/Piney Creek RM 31.33	1166	23	13	42
WVKN-26	Piney Creek	1167	182	182	0
WVKN-26-P	Keaton Branch	1168	37	37	0
WVKN-26	Piney Creek	1169	46	46	0
WVKN-26-K	Soak Creek	1170	1483	643	57
WVKN-26-K-1	Laurel Branch	1171	136	59	57
WVKN-26-K	Soak Creek	1172	1161	504	57

Stream Code	Stream Name	SWS	STREAMBANK EROSION		
			Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	% Reduction
WVKN-26-K	Soak Creek	1173	1143	411	64
WVKN-26-K	Soak Creek	1174	131	44	66
WVKN-26-J	Turkey Branch	1175	86	35	59
WVKN-26-I	Crab Orchard Creek	1176	2143	872	59
WVKN-26-I	Crab Orchard Creek	1177	678	276	59
WVKN-26-I-1	Stover Fork	1178	682	277	59
WVKN-26-G	Whitestick Creek	1179	1775	722	59
WVKN-26-G-1	UNT/Whitestick Creek RM 2.83	1180	463	188	59
WVKN-26-G	Whitestick Creek	1181	2745	527	81
WVKN-26-G	Whitestick Creek	1182	2174	417	81
WVKN-26-G-2	UNT/Whitestick Creek RM 3.66	1183	0	0	0
WVKN-26-E	Cranberry Creek	1184	91	20	78
WVKN-26-E-1	Little Whitestick Creek	1185	0	0	0
WVKN-26-E-1-A	UNT/Little Whitestick Creek RM 0.84	1186	0	0	0
WVKN-26-E-1	Little Whitestick Creek	1187	80	22	72
WVKN-26-E	Cranberry Creek	1188	55	17	68
WVKN-26-E	Cranberry Creek	1189	0	0	0
WVKN-26-E-2	UNT/Cranberry Creek RM 4.51	1190	7	2	69
WVKN-26-E	Cranberry Creek	1191	25	8	69
WVKN-26-D	Griffith Branch	1192	315	98	69
WVKN-26-C	Stanaford Branch	1193	402	125	69
WVKN-26-A	Batoff Creek	1194	355	225	37
WVKN-26-A	Batoff Creek	1195	190	120	37
WVKN-26-A	Batoff Creek	1196	86	45	47

5.0 Proposed Management Measures

The Piney Creek watershed has a variety of fecal coliform and metals sources for which pollution reductions are required. In order to address these pollutants, wide arrays of projects have been selected for implementation throughout the watershed. Many of the suggested projects will make significant reductions to both fecal coliform bacteria and iron pollution in the surface water. The different types of proposed activities and projects are described below.

5.1 Public Outreach and Education

The Piney Creek Watershed Association, in cooperation with various state and local agencies, can hold public meetings, training sessions, and create fact sheets on important topics to increase public awareness. Some of the public outreach campaign could include: pet waste education programs, proper operations and maintenance of individual septic systems, proper development practices on steep slopes, and proper sediment control for construction sites.

5.2 Permit Enforcement

Due to staffing shortages, personnel turnover and budgetary constraints, permit inspection and enforcement throughout the state has not been consistent and does not always act as a significant deterrent to prohibit permittee's from willfully violating permit limits. All agencies with regulatory authority need to provide consistent and thorough inspections statewide. Violators should be subject to significant penalties that would act as deterrents. It is suggested that a percentage of the monetary penalties collected be used to implement water quality improvement projects in the watershed where the violations occurred. In addition, regulatory agencies can hold yearly training seminars to demonstrate the proper ways to install and use specific BMPs and other pollution reduction methods. These classes can be mandatory for any violators during the previous year.

5.3 Green Design Projects: Rain Gardens and Porous Pavement

Green design projects are specifically designed to treat stormwater runoff as close to the source as possible. These strategies typically entail routing water with grassed swales to a bio-retention pond or rain garden where the water has the opportunity to filter into the ground instead of being routed directly to a stream. Porous pavement allows rain water to penetrate the surface where it can also seep into the ground instead of running off into streams.

5.4 Public Sewer Line Extensions

Expansion of existing sanitary sewer lines from established PSD to areas that currently have individual treatment systems or straight pipes are the best option for higher density developments in close proximity to existing wastewater infrastructure.

5.5 Decentralized/Cluster Sewer Systems

In many rural areas where it is not feasible to extend public wastewater service, other alternatives such as decentralized or cluster systems may be more cost effective. A cluster system may be appropriate in circumstances where a small number of homes are located in close proximity to each other. Cluster systems typically link homes together to share a septic tank and an effluent treatment field. Decentralized systems use a combination of individual septic tanks and clustered septic tanks and share a common subsurface effluent treatment field. More information about these types of systems can be found in a guidance document prepared by the WV Rivers Coalition in 2005 entitled *Helping Solve Local Wastewater Problems: A Guide for WV Watershed Organizations*.

5.6 Acid Mine Drainage (AMD) Treatment Systems

There have been a number of designs; both active and passive in treating acid mine drainage. Each situation needs to be evaluated, and the most appropriate treatment options determined on a case by case basis. Some of the more common treatment technologies available include:

- Land reclamation (including re-contouring, capping and re-vegetating) of barren areas
- Wet seals of draining mine portals or adits
- Constructed treatment wetlands
- Oxic limestone drains
- Bio-Reactor treatment options
- Lime or other appropriate alkaline chemical dosing systems

Additional information can be obtained from the Office of Surface Mining and by using AMD Treat (http://amd.osmre.gov/) to predict treatment costs.

5.7 Constructed Treatment Wetlands

Correctly constructed treatment wetlands have demonstrated high efficiency rates in removing nutrients, fecal coliform and metals pollution from aquatic systems. Additional information about constructed treatment wetlands is available at: http://www.itrcweb.org/Documents/WTLND-1.pdf

5.8 Stream Restoration

Much of the Piney Creek watershed has significant iron/sediment contributions from streambank erosion. Stabilizing and restoring streambanks to a more natural condition has numerous benefits, such as aquatic habitat enhancement and pollution buffering of stormwater runoff. Flood mitigation measures and natural stream restoration often contradict each other. More progressive ideas for flood mitigation and more thoughtfully designed stream restoration projects can ultimately benefit both goals. More communication between the regulatory agencies and watershed group’s needs to be done to arrive at mutually agreed upon methods that achieve both agendas for flood control and stream restoration.

5.9 Best Management Practices

The most cost effective and efficient solution to reducing nonpoint source pollution is to prevent stormwater runoff from reaching the stream. There are numerous BMPs options available depending on specific site circumstances. For further information and examples of BMPs, please refer to the following guidance documents:

- West Virginia Silviculture, Best Management Practices for Controlling Soil Erosion and Sedimentation from Logging Operations (http://www.wvforestry.com/BMP%20Book%202009.pdf)
- West Virginia Erosion and Sediment Control Best Management Practice Manual for Construction Sites (http://www.dep.wv.gov/WWE/Programs/stormwater/csw/Pages/ESC_BMP.aspx)

The Steering Committee, established as part of this implementation plan, will continue to meet regularly and discuss future implementation projects, funding, status of ongoing projects, and implementation milestones. Continued interaction with stakeholders and focus groups are imperative to further development of relationships for implementing large scale projects. Involvement by PCWA is also critical for continuing momentum, generating public support, education, and encouraging volunteers to be active in watershed activities. **Table 5-1** shows the total iron and fecal coliform load reductions required in Piney Creek along with a yearly reduction goal for each proposed management measure. The total TMDL implementation time frame shown in the table extends out to 45 years to allow for 15 year time periods to implement high, medium and low priority projects respectively.

Table 5-1. Load Reduction from each Management Strategy

		Proposed Management Measure Goals							
Priority	**Year**	**Permit Enforcement[2]**	**Green Design Projects: Rain Gardens and Porous Pavement[6]**	**Public Sewer Line Extensions[3]**	**Decentralized/Cluster Sewer Systems[3]**	**Acid Mine Drainage (AMD) Treatment Systems[4]**	**Constructed Treatment Wetlands[6]**	**Stream Restoration[5]**	**Best Management Practices[6]**
Iron reduction required Lbs/year[1]	**224,699**	**53,932**	**19,243**			**9,146**	**19,243**	**103,892**	**19,243**
Fecal Coliform TMDL counts/year[1]	**1.12E+14**	**6.14E+13**	**1.14E+13**	**3.87E+12**	**3.87E+12**		**1.14E+13**		**1.14E+13**

		Proposed Management Measure Goals							
Priority	Year	Permit Enforcement[2]	Green Design Projects: Rain Gardens and Porous Pavement[6]	Public Sewer Line Extensions[3]	Decentralized/Cluster Sewer Systems[3]	Acid Mine Drainage (AMD) Treatment Systems[4]	Constructed Treatment Wetlands[6]	Stream Restoration[5]	Best Management Practices[6]
High 15 years maximum to implement permit enforcement 10 years maximum to implement AMD Treatment and Restoration	1	3,595 Fe 4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	2	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	3	4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	4	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	5	4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	6	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	7	4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	8	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	9	4.09E+12 FC	428 Fe	8.6E+10	8.6E+10	915	428 Fe	2,309	428 Fe

		Proposed Management Measure Goals							
Priority	Year	Permit Enforcement[2]	Green Design Projects: Rain Gardens and Porous Pavement[6]	Public Sewer Line Extensions[3]	Decentralized/Cluster Sewer Systems[3]	Acid Mine Drainage (AMD) Treatment Systems[4]	Constructed Treatment Wetlands[6]	Stream Restoration[5]	Best Management Practices[6]
			2.5E+11				2.5E+11		2.5E+11
	10	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10	915	428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	11	4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	12	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	13	4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	14	3,595 Fe	428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	15	4.09E+12 FC	428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
Medium	16		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	17		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	18		428 Fe	8.6E+10	8.6E+10		428 Fe	2,309	428 Fe

		Proposed Management Measure Goals							
Priority	**Year**	**Permit Enforcement[2]**	**Green Design Projects: Rain Gardens and Porous Pavement[6]**	**Public Sewer Line Extensions[3]**	**Decentralized/Cluster Sewer Systems[3]**	**Acid Mine Drainage (AMD) Treatment Systems[4]**	**Constructed Treatment Wetlands[6]**	**Stream Restoration[5]**	**Best Management Practices[6]**
			2.5E+11				2.5E+11		2.5E+11
	19		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	20		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	21		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	22		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	23		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	24		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	25		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	26		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	27		428 Fe	8.6E+10	8.6E+10		428 Fe	2,309	428 Fe

		Proposed Management Measure Goals							
Priority	**Year**	**Permit Enforcement[2]**	**Green Design Projects: Rain Gardens and Porous Pavement[6]**	**Public Sewer Line Extensions[3]**	**Decentralized/Cluster Sewer Systems[3]**	**Acid Mine Drainage (AMD) Treatment Systems[4]**	**Constructed Treatment Wetlands[6]**	**Stream Restoration[5]**	**Best Management Practices[6]**
			2.5E+11				2.5E+11		2.5E+11
	28		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	29		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	30		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
Low	31		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	32		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	33		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	34		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	35		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	36		428 Fe	8.6E+10	8.6E+10		428 Fe	2,309	428 Fe

		Proposed Management Measure Goals							
Priority	**Year**	**Permit Enforcement[2]**	**Green Design Projects: Rain Gardens and Porous Pavement[6]**	**Public Sewer Line Extensions[3]**	**Decentralized/Cluster Sewer Systems[3]**	**Acid Mine Drainage (AMD) Treatment Systems[4]**	**Constructed Treatment Wetlands[6]**	**Stream Restoration[5]**	**Best Management Practices[6]**
			2.5E+11				2.5E+11		2.5E+11
	37		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	38		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	39		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	40		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	41		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	42		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	43		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	44		428 Fe 2.5E+11	8.6E+10	8.6E+10		428 Fe 2.5E+11	2,309	428 Fe 2.5E+11
	45		428 Fe	8.6E+10	8.6E+10		428 Fe	2,309	428 Fe

		Proposed Management Measure Goals							
Priority	Year	Permit Enforcement[2]	Green Design Projects: Rain Gardens and Porous Pavement[6]	Public Sewer Line Extensions[3]	Decentralized/Cluster Sewer Systems[3]	Acid Mine Drainage (AMD) Treatment Systems[4]	Constructed Treatment Wetlands[6]	Stream Restoration[5]	Best Management Practices[6]
			2.5E+11				2.5E+11		2.5E+11

Notes:
1: Iron and fecal coliform required reductions were calculated from Appendix B annual TMDL for Piney Creek (Baseline LA+Baseline WLA)-(Allocated LA+Allocated WLA)
2: Calculated from the iron and fecal coliform annual tab in Appendix B for Piney Creek (Baseline WLA – Allocated WLA
3: Calculated from the total sum of failing onsite sewer systems from the LA fecal tab of Appendix B then divided evenly between the two categories.
4: (Sum of all Baseline AMD Loads – Sum of all Allocated AMD Load) from the AML Discharges tab in Appendix B.
5: Total sum of the stream restoration load from the metals LA tab in Appendix B.
6: Calculated remaining loads and equally distributed among the three categories.

6.0 Estimated Load Reductions and Cost

The Steering Committee developed a list of potential implementation projects to address fecal coliform and metals sources throughout the watershed. There are a total of 38 projects ranging from small footprint rain gardens to large scale extensions of the public sewer lines. **Table 6-1** shows all the potential projects, estimated project costs, stream miles affected and the calculated yearly load reductions from metals and fecal coliform anticipated from implementing the project. The pollutant load reductions are based on various assumptions described in the sections below and the cost estimates are preliminary cost estimates for initial budgeting purposes. Project specific cost estimates should be recalculated when a decision has been made to move forward with a specific project. Construction costs can be better estimated during the preliminary design and construction scoping phase for each project.

Table 6-1. Proposed Implementation Projects

SWS	Project Area	Project Description	Total Project Cost	Stream Miles to Downstream Confluence	Required Fe TMDL Reduction (lbs/year)	Total Fe Load Reduction (lbs/year)	Required FC TMDL Reduction (counts/year)	FC Project Reduction (counts/year)	Priority Rank (Number)	Project Priority	Project Type
1120	YMCA	Soil Erosion	$135,760	2.57	1384	11.50	7.97E+09	4.99E+11	20	Medium	Fecal Coliform/Metals
1120	YMCA	Stormwater Management	$272,250	2.57	1384	1.96	7.97E+09	5.50E+10	37	Low	Fecal Coliform/Metals
1149	Stratton Elementary Retrofit/ Environmental Education	Stormwater Management	$571,725	6.91	15447	6.00	2.85E+10	6.56E+10	27	Low	Fecal Coliform/Metals
1152	Town of Cedar Sewer Extension	Wastewater extension	$119,000	4.02			1.10E+11	1.48E+10	12	High	Fecal Coliform
1153	Town of Sullivan Sewer Project	Decentralized/cluster system	$425,000	3.18			1.76E+11	5.82E+10	35	Low	Fecal Coliform
1155	Abney Refuse Pile	AML restoration	$5,643,764	6.18	3888	224.6			16	Medium	Metals
1155	Coal City/Abney Sewer Extension	Wastewater extension	$1,989,000	6.18			4.49E+11	2.78E+11	24	Medium	Fecal Coliform
1158	Whitby Area Seep	Iron AMD Seep	$839,080	1.8	2585	305.64			32	Low	Metals
1162	Jonben Refuse Pile	AML restoration	$168,869	4.95	1523	48.56			5	High	Metals
1162	Laurel Creek Mouth	Stormwater Management	$3,541,834	4.95	1524	113.93			24	Medium	Metals
1169	Piney Creek Headwaters Seep	Iron AMD Seep	$126,900	1.71	14	43.17			26	Medium	Metals
1179	Beckley Junction	Stream Restoration and Constructed Wetland	$1,489,920	3.01	4961	488.32	1.28E+13	1.06E+13	11	High	Fecal Coliform/Metals
1179	Downtown Fayette Street Daylighting /stormwater management facility	Stormwater Management	$161,113	2.34	4961	99.59	1.28E+13	5.55E+11	20	Medium	Fecal Coliform/Metals
1179	ACCWT Environmental Education/Office retrofit	Stormwater Management	$6,250	2.34	4961	0.39	1.28E+13	8.68E+09	33	Low	Fecal Coliform/Metals

SWS	Project Area	Project Description	Total Project Cost	Stream Miles to Downstream Confluence	Required Fe TMDL Reduction (lbs/year)	Total Fe Load Reduction (lbs/year)	Required FC TMDL Reduction (counts/year)	FC Project Reduction (counts/year)	Priority Rank (Number)	Project Priority	Project Type
1183	Crescent Elementary Retrofit/Environmental Education	Stormwater Management	$484,605	3.95	1907	27.68	3.63E+12	4.57E+11	19	Medium	Fecal Coliform/Metals
1184	Little Whitestick Creek Refuse Pile	AML Restoration	$1,198,470	3.75	9087	44.00			30	Low	Metals
1184	Beckley- Stratton Middle School/ Retrofit/ Environmental Education	Stormwater Management	$980,100	0.9	9087	36.17	4.48E+12	6.64E+11	31	Low	Fecal Coliform/Metals
1184	Beckley Elementary Retrofit /Environmental Education	Stormwater Management	$313,088	0.9	9087	7.39	4.48E+12	1.36E+11	37	Low	Fecal Coliform/Metals
1187	New River Drive	Soil Erosion	$32,594	4.17	8879	57.60	1.84E+13	1.22E+12	1	High	Fecal Coliform/Metals
1187	Maxwell Hill/Tolley Drive triangle retrofit	Stormwater Management	$313,088	4.17	8879	80.39	1.84E+13	1.32E+12	3	High	Fecal Coliform/Metals
1187	Ewart Street	Constructed Wetland	$361,250	3.19	8879	144.00	1.84E+13	4.06E+12	7	High	Metals
1187	Barren Land off of Harper Road by Pizza Hut	Soil Erosion	$53,763	4.17	8879	14.40	1.84E+13	3.79E+11	8	High	Fecal Coliform/Metals
1187	Pine Hills Stormwater retrofit	Stormwater Management	$375,000	5.07	8879	8.10	1.84E+13	1.33E+11	23	Medium	Fecal Coliform/Metals
1188	Dry Hill Area Seep	Iron AMD Seep	$133,150	3.87	17982	3096.98			2	High	Metals
1188	Cranberry Creek Seeps	Iron AMD Seep	$231,300	3.87	17982	982.80			6	High	Fecal Coliform/Metals
1188	Barren Land behind BBT Building	Soil Erosion	$70,700	2.7	17982	37.39	1.57E+13	9.51E+11	8	High	Fecal Coliform/Metals
1188	Maxwell Hill Elementary School Retrofit/ Environmental Education	Stormwater Management	$149,738	2.7	17982	37.80	1.57E+13	5.98E+11	10	High	Fecal Coliform/Metals
1188	Cranberry Creek Seep	Iron AMD Seep	$123,150	2.09	17982	32.64			28	Low	Metals
1188	Cranberry-Prosperity School/Retrofit/Environmental Education	Stormwater Management	$571,725	3.93	17982	6.11	1.57E+13	9.67E+10	33	Low	Fecal Coliform/Metals

SWS	Project Area	Project Description	Total Project Cost	Stream Miles to Downstream Confluence	Required Fe TMDL Reduction (lbs/year)	Total Fe Load Reduction (lbs/year)	Required FC TMDL Reduction (counts/year)	FC Project Reduction (counts/year)	Priority Rank (Number)	Project Priority	Project Type
1188	Woodrow Wilson High School Retrofit/Environmental Education	Stormwater Management	$1,361,250	2.12	17982	28.80	1.57E+13	4.56E+11	36	Low	Fecal Coliform/Metals
1193	Stanaford Branch Complex	AML Restoration	$202,020	2.68	1888	33.60			29	Low	Metals
1196	Batoff Area Iron Seep	Iron AMD Seep	$133,150	2.92	2240	3795.32			4	High	Metals
1196	Batoff Area Aluminum Seep	Aluminum AMD Seep			2521	2372.08				High	Metals
1113, 1114, 1115, 1116	Grandview Sewer Project	Decentralized/cluster system	$1,360,000	8.68			7.56E+12	1.69E+11	14	Medium	Fecal Coliform
1118,1193, 1195, 1196	Piney View Sewer Project	Decentralized/cluster system	$3,468,000	8.08			1.48E+12	5.11E+11	12	High	Fecal Coliform
1150, 1151,1179	Town of Fitzpatrick Sewer Extension	Wastewater extension	$850,000	6.89			1.30E+13	1.05E+11	17	Medium	Fecal Coliform
1157, 1155,1156	Whitby/Mt Olive Sewer Project	Decentralized/cluster system	$986,000	5.34			5.17E+11	1.39E+11	22	Medium	Fecal Coliform
1161,1162, 1163,1164, 1165	Jonben/Fireco Sewer Project	Decentralized/cluster system	$1,326,000	6.38			3.46E+11	1.98E+11	17	Medium	Fecal Coliform
1170, 1172, 1175, 1152, 1153, 1155	Pemberton Sewer Extension	Wastewater extension	$2,108,000	8.7			1.23E+12	2.83E+11	14	Medium	Fecal Coliform

[1] MS4 indicates that these projects are physically located within the MS4 boundary for the City of Beckley, but are not specific MS4 permit requirements.

[*] Batoff Creek aluminum load was excluded from rank; this project was ranked on the iron reduction only. However, constructing the project will have benefits to reducing the iron and aluminum loads as shown the above table.

6.1 Fecal Coliform

The load reductions estimated for the fecal coliform projects are calculated differently for two different categories of projects;

- Failing on-site septic that are incorporated into public wastewater extensions
- Projects that receive and treat stormwater runoff from various land uses

The public wastewater extension project reductions are based on the number of new customers brought online, thus reducing the failing on-site septic source category documented in the TMDL. The numbers of customers for completed and pending projects are based on information received directly from the PSD entity responsible for the project or the Infrastructure and Jobs Development Council (IJDC) website. The future extension projects customer numbers are based on the Raleigh County habitable structures GIS layer and the calculations used in the TMDL methodology (WVDEP, 2008b). Failing septic and straight pipe load reductions can generally be calculated by using the following equation. However, WVDEP calculated failing septic contributions based on a complex formula of complete and seasonal failure in four different septic failure zones based on soil composition. Detailed fecal coliform load reduction calculations are located in **Appendix C** fecal coliform reduction database.

$$\text{Failing Septic Load} = \frac{75\ \cancel{\text{gal}}}{1\ \cancel{\text{Day}}} * \frac{365\ \cancel{\text{days}}}{1\ \text{year}} * \frac{10{,}000\ \text{counts}}{100\ \cancel{\text{mL}}} * \frac{3785.412\ \cancel{\text{mL}}}{1\ \cancel{\text{gal}}} = \frac{1.04E10^{10}\ \text{counts}}{\text{year}}$$

Assumptions:

- Concentration of failing septic or straight pipe discharge is 10,000 counts/100 mL
- Flow of failing septic or straight pipe discharge is 75 gallons/day

The landuse based fecal coliform project reductions are based on the following assumptions:

- Project efficiency rates from various literature sources
- Estimated contributing stormwater drainage area
- Area weighted fecal coliform contributing subwatershed landuse by the estimated contributing stormwater drainage area
- Source loads for projects within the MS4 area were calculated from the Beckley urban/residential source category only
- Source loads for projects outside the MS4 area were calculated from the urban/residential nonpoint source category

Many of the fecal coliform impaired streams did not have public wastewater infrastructure at the time the Lower New River TMDLs were developed. These areas were subject to high failing septic flow rates at the time of the TMDL; however, many of these areas now have public sewer line extensions. The areas that still do not have public wastewater access contain exposed bedrock, very rocky soil, or are far away from the current wastewater infrastructure and contain smaller numbers of homes. These areas may benefit from alternative treatment systems, like package plants, cluster systems, or decentralized treatment systems.

Education programs about failing onsite septic systems can help to inform the public about the human health and environmental consequences of failing individual septic systems. Information is available to determine if your individual septic system is failing, one such resource pamphlet is available at: (http://www.nesc.wvu.edu/smart/training/toolkit/page2/onsite/WhyDoSepticSystemsFail.pdf). WVDEP and PCWA can provide information to the public about the benefits of following an onsite sewer maintenance program. WVDEP does have a low interest loan program for homeowners to fix failing septics or straight pipe discharges (http://www.dep.wv.gov/WWE/Programs/SRF/Pages/default.aspx).

There are two North Beckley PSD outlets (Outlets 004 and 007) described in the fecal coliform point source section of the report. Direct sampling data for these outlets was not provided during TMDL or watershed implementation plan development, therefore any future monitoring data from these outlets would be helpful in determining how often they discharge, the volume discharged and the fecal coliform concentration during discharge. Once this information is obtained, an accurate estimate of the fecal coliform loads could be made and credits given once these discharges are eliminated.

The fecal coliform bacteria reductions needed within the various PSD sewered areas will need to be managed mainly by controlling inflow and infiltration (I&I) and illicit discharges. For example, the Crab Orchard MacArthur PSD has an I&I plan in place that includes inspecting at least 5,000 feet of lines and manholes every month, and also conducting a smoke test every summer. The City of Beckley has completed many projects that would have a measurable impact to the WLAs prescribed in the TMDL. For example, Beckley has replaced 2,800 linear feet of failing infrastructure, upgraded a CSO chlorination system to Whitestick Creek, and eliminated a SSO on Whitestick Creek in Mabscott. In the near future, they plan to replace some of their oldest sewer lines in the Fayette Street area that have been identified to be a large source of I&I. The City of Beckley is also working to locate and eliminate illicit discharges within their system, and have implemented an illicit discharge elimination program.

A similar calculation used in determining loading from failing on-site septic systems can be used to calculate the fecal coliform load reduction from an illicit discharge. This calculation assumes data is available or can be estimated for flow and fecal coliform concentration. The Piney Creek Watershed TMDL assumes a fecal coliform concentration of 10,000 counts/mL for failing on-site septic systems.

Example calculation:

$$\text{Illicit Discharge Load} = \frac{200\ \cancel{gal}}{1\ \cancel{Day}} * \frac{365\ \cancel{days}}{1\ year} * \frac{10{,}000\ counts}{100\ \cancel{mL}} * \frac{3785.412\ \cancel{mL}}{1\ \cancel{gal}} = \frac{2.76E10^{10}\ counts}{year}$$

Calculation Assumptions:

- Concentration of illicit discharge is 10,000 counts/100 mL
- Flow of illicit discharge is 200 gallons/day

6.1.1 Failing Septic Reductions and Cost

Failing residential septic systems are present in almost every subwatershed of Piney Creek. **Table 6-2** below shows the estimated number of homes with failing septic systems from the TMDL and the estimated cost to construct decentralized systems based on the average of $17,000 per home calculated from existing decentralized projects in West Virginia (**Appendix D**).

Table 6-2. Failing Septic Reduction and Estimated Costs

Sub Water shed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Estimated Homes with Failing Septic from TMDL	Estimated Cost for Decentralized @ $17,000/home
1113	Piney Creek	WVKN-26	3.53E+10	17	$289,000
1114	Piney Creek	WVKN-26	1.23E+11	59	$1,003,000
1115	Fat Creek	WVKN-26-B	6.26E+10	30	$510,000
1116	Fat Creek	WVKN-26-B	4.36E+11	207	$3,519,000
1117	Brammer Branch	WVKN-26-B-2	8.31E+10	40	$680,000
1118	Piney Creek	WVKN-26	5.13E+11	215	$3,655,000
1119	Piney Creek	WVKN-26	8.20E+10	39	$663,000
1120	Piney Creek	WVKN-26	7.97E+09	4	$68,000
1121	Piney Creek	WVKN-26	3.42E+09	2	$34,000
1122	Beaver Creek	WVKN-26-F	5.12E+10	25	$425,000
1123	Little Beaver Creek	WVKN-26-F-2	4.44E+10	22	$374,000
1124	UNT/Little Beaver Creek RM 0.25	WVKN-26-F-2-0.4A	9.11E+09	5	$85,000
1125	Little Beaver Creek	WVKN-26-F-2	2.05E+10	10	$170,000
1127	UNT/Little Beaver Creek RM 0.25	WVKN-26-F-2-A.1	4.21E+10	20	$340,000
1128	Little Beaver Creek	WVKN-26-F-2	1.14E+09	1	$17,000
1129	Laurel Run	WVKN-26-F-2-B	2.16E+10	11	$187,000
1130	Little Beaver Creek	WVKN-26-F-2	1.14E+09	1	$17,000
1131	Sims Branch	WVKN-26-F-2-C	1.01E+11	49	$833,000

Sub Water shed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Estimated Homes with Failing Septic from TMDL	Estimated Cost for Decentralized @ $17,000/home
1132	Little Beaver Creek	WVKN-26-F-2	1.02E+10	5	$85,000
1133	Lake	WVKN-26-F-2-(L2)	3.19E+10	16	$272,000
1134	Little Beaver Creek	WVKN-26-F-2	1.87E+11	89	$1,513,000
1135	Lake	WVKN-26-F-2-(L3)	4.55E+09	3	$51,000
1136	Little Beaver Creek	WVKN-26-F-2	2.16E+10	11	$187,000
1137	Sand Branch	WVKN-26-F-2-A	1.14E+09	1	$17,000
1138	Beaver Creek	WVKN-26-F	8.31E+10	40	$680,000
1139	Beaver Creek	WVKN-26-F	2.16E+10	11	$187,000
1141	Left Fork/Beaver Creek	WVKN-26-F-6	1.92E+11	92	$1,564,000
1142	Beaver Creek	WVKN-26-F	1.64E+11	78	$1,326,000
1143	Cherry Creek	WVKN-26-F-7	5.57E+11	265	$4,505,000
1144	Beaver Creek	WVKN-26-F	2.66E+11	127	$2,159,000
1145	UNT/Beaver Creek RM 10.11	WVKN-26-F-8	2.37E+11	113	$1,921,000
1146	Rocky Branch	WVKN-26-F-5	2.39E+10	12	$204,000
1147	Glade Fork	WVKN-26-F-3	8.88E+10	43	$731,000
1148	Tank Branch	WVKN-26-F-1	6.83E+09	4	$68,000
1149	Piney Creek	WVKN-26	2.85E+10	14	$238,000
1150	Piney Creek	WVKN-26	5.35E+10	26	$442,000
1151	Piney Creek	WVKN-26	1.80E+11	86	$1,462,000
1152	Piney Creek	WVKN-26	1.10E+11	53	$901,000
1153	Piney Creek	WVKN-26	1.76E+11	76	$1,292,000
1154	Take-In Creek	WVKN-26-L	1.70E+10	8	$136,000
1155	Piney Creek	WVKN-26	4.49E+11	189	$3,213,000
1156	Bowyer Creek	WVKN-26-M	1.54E+10	6	$102,000
1157	Spencer Branch	WVKN-26-M-1	5.27E+10	21	$357,000
1158	Bowyer Creek	WVKN-26-M	5.69E+09	3	$51,000
1161	Piney Creek	WVKN-26	6.32E+10	26	$442,000
1162	Laurel Creek (KN-26-N)	WVKN-26-N	1.29E+11	52	$884,000
1163	Piney Creek	WVKN-26	5.29E+10	21	$357,000
1164	Lampkin Branch	WVKN-26-O	1.68E+10	7	$119,000
1165	Piney Creek	WVKN-26	8.49E+10	33	$561,000
1167	Piney Creek	WVKN-26	1.14E+09	1	$17,000

Sub Water shed	Stream Name	Stream Code	Onsite Sewer Systems Baseline Load (counts/yr)	Estimated Homes with Failing Septic from TMDL	Estimated Cost for Decentralized @ $17,000/home
1168	Keaton Branch	WVKN-26-P	2.28E+09	2	$34,000
1169	Piney Creek	WVKN-26	7.63E+10	37	$629,000
1170	Soak Creek	WVKN-26-K	1.12E+11	49	$833,000
1171	Laurel Branch	WVKN-26-K-1	7.63E+10	37	$629,000
1172	Soak Creek	WVKN-26-K	2.85E+10	14	$238,000
1173	Soak Creek	WVKN-26-K	1.96E+11	93	$1,581,000
1174	Soak Creek	WVKN-26-K	2.13E+11	101	$1,717,000
1175	Turkey Branch	WVKN-26-J	1.39E+11	66	$1,122,000
1176	Crab Orchard Creek	WVKN-26-I	2.39E+10	12	$204,000
1177	Crab Orchard Creek	WVKN-26-I	2.44E+11	116	$1,972,000
1178	Stover Fork	WVKN-26-I-1	1.33E+11	64	$1,088,000
1179	Whitestick Creek	WVKN-26-G	2.50E+10	12	$204,000
1180	UNT/Whitestick Creek RM 2.83	WVKN-26-G-1	1.59E+10	8	$136,000
1182	Whitestick Creek	WVKN-26-G	1.80E+11	86	$1,462,000
1187	Little Whitestick Creek	WVKN-26-E-1	3.42E+10	17	$289,000
1188	Cranberry Creek	WVKN-26-E	7.63E+10	37	$629,000
1189	Cranberry Creek	WVKN-26-E	3.87E+10	19	$323,000
1190	UNT/Cranberry Creek RM 4.51	WVKN-26-E-2	1.71E+10	9	$153,000
1191	Cranberry Creek	WVKN-26-E	1.48E+10	8	$136,000
1192	Griffith Branch	WVKN-26-D	1.28E+11	61	$1,037,000
1193	Stanaford Branch	WVKN-26-C	8.21E+11	319	$5,423,000
1195	Batoff Creek	WVKN-26-A	7.09E+10	28	$476,000
1196	Batoff Creek	WVKN-26-A	7.80E+10	33	$561,000
		Total	**7.72E+12**	**3517**	**$59,789,000**

6.1.2 Pasture/Cropland Reductions and Cost

In the Piney Creek Watershed, there are only three subwatersheds that contain agricultural pasture lands that require fecal coliform reductions. The best management practices to achieve the reductions would be to fence livestock away from the stream channel in these subwatersheds. In addition, riparian stream buffers can be established to achieve even greater reductions. Hardy (2007) indicates a conservative 70% reduction efficiency to fecal coliform using fencing or riparian buffers. The estimated cost for constructing barbed wire fencing is $1.23 per linear foot (Mayer, 2005). The estimated cost for constructing riparian buffers is approximately $1,000 per acre and establishing alternate watering sources for livestock is estimated at $3,000 (Hardy, 2007). **Table 6-3** shows the associated costs with the pasture reductions.

Table 6-3. Pasture Reduction and Cost from Fencing and Alternative Water Source

Sub water shed	Stream Name	Stream Code	Pasture/ Cropland Baseline Load (counts/yr)	Required Pasture/ Cropland Reduction (base - allocated)	Reduction from Fencing 70% Efficiency	Linear Feet of Stream per SWS	Area Weighted Pasture in Watershed (%)	Weighted Stream Length in Pasture[1] (feet)	Cost Calculation[2] (fence + water structure)
1116	Fat Creek	WVKN-26-B	1.98E+13	6.90E+12	1.39E+13	20806.56	11.75	2444.77	$12,014
1145	UNT/Beaver Creek RM 10.11	WVKN-26-F-8	9.43E+12	5.66E+12	6.60E+12	14729.06	8.11	1194.53	$8,939
1158	Bowyer Creek	WVKN-26-M	3.84E+11	1.53E+11	2.69E+11	15447.23	0.04	500.00	$7,230
			Total	**1.27E+13**	**2.07E+13**			**4139.30**	**$28,183**

Notes:
1 Assumed 500 feet of stream for fencing in SWS 1158
2 Weighted Stream Length * 2 * $1.23 + $6000 (cost for 2 water sources)

6.1.3 MS4 Fecal Coliform Reduction and Cost

Reductions required from the three MS4 entities present in the Piney Creek watershed have been totaled by subwatershed and presented in **Table 6-4** below. Actual rain garden construction costs were obtained from the Beckley Sanitary Board and averaged together from 4 recent rain garden projects. The average cost from the four projects was $43.07 per square foot.

Table 6-4. MS4 Reductions and Cost associated with Fecal Coliform

Sub water shed	Stream Name	Stream Code	Sum MS4 Residential Baseline Load (counts/yr)	Sum MS4 Residential Allocated Load (counts/yr)	Sum MS4 Residential Reduction (base - allocated) (counts/yr)	MS4 Residential Percent Reduction	Required Acres to Treat FC Load Reduction	Constructed Rain Garden Cost @ $1,876,136/acre
1179	Whitestick Creek	WVKN-26-G	1.12E+13	4.48E+12	6.71E+12	60	9.82	$18,431,731
1181	Whitestick Creek	WVKN-26-G	5.81E+12	3.49E+12	2.33E+12	40.1	3.41	$6,400,288
1182	Whitestick Creek	WVKN-26-G	3.77E+12	1.51E+12	2.26E+12	59.9	3.31	$6,208,005
1183	UNT/Whitestick Creek RM 3.66	WVKN-26-G-2	9.08E+12	5.45E+12	3.63E+12	40	5.31	$9,971,265
1184	Cranberry Creek	WVKN-26-E	1.26E+13	8.18E+12	4.44E+12	35.2	6.50	$12,196,257
1185	Little Whitestick Creek	WVKN-26-E-1	4.90E+12	2.20E+12	2.69E+12	55	3.94	$7,389,174

Sub watershed	Stream Name	Stream Code	Sum MS4 Residential Baseline Load (counts/yr)	Sum MS4 Residental Allocated Load (counts/yr)	Sum MS4 Residential Reduction (base - allocated) (counts/yr)	MS4 Residential Percent Reduction	Required Acres to Treat FC Load Reduction	Constructed Rain Garden Cost @ $1,876,136/acre
1186	UNT/Little Whitestick Creek RM 0.84	WVKN-26-E-1-A	1.05E+13	6.31E+12	4.20E+12	40	6.15	$11,537,000
1187	Little Whitestick Creek	WVKN-26-E-1	3.57E+13	1.79E+13	1.78E+13	49.9	26.06	$48,894,906
1188	Cranberry Creek	WVKN-26-E	3.04E+13	1.52E+13	1.53E+13	50.2	22.40	$42,027,644
1189	Cranberry Creek	WVKN-26-E	1.63E+12	1.06E+12	5.66E+11	34.8	0.83	$1,554,748
1190	UNT/Cranberry Creek RM 4.51	WVKN-26-E-2	2.75E+12	1.80E+12	9.59E+11	34.8	1.40	$2,634,282
						Total	**89.14**	**$167,245,301**

6.2 Metals

The general process for calculating the metals reductions for the proposed projects is described in this section. There are 3 different types of metals implementation projects:

- Landuse based projects to collect and infiltrate/detain stormwater
- Treatment of AMD seeps and AML restoration
- Stream restoration.

Landuse based projects include rain gardens, constructed wetlands, stormwater detention impoundments, and other green design strategies to treat stormwater runoff. The calculations for determining the iron reduction for these types of projects are complicated and depend on specific landuses contributing to the drainage area the project is located in the MS4 area. The reductions for each project were calculated in a database which can be found in **Appendix C**. The calculations consisted of the following steps below:

- Determine the location of the project (TMDL subwatershed and is the project within the MS4 boundary) and calculate the estimated drainage area for stormwater that will be collected by the project
- Area weight the contributing iron source loading by the project drainage area and the relevant source contribution
- Calculate the project reduction by multiplying the area weighted contribution by the anticipated project efficiency rate.

Reductions from proposed treatment of AMD seeps at AML sites were calculated by multiplying the Batoff Creek aluminum baseline load of 2,635 lbs/year by the project efficiency rate of 90% for each of the seeps.

$$\text{Batoff Creek Al Seep S12} = \frac{2{,}635 \text{ lbs Al}}{\text{year}} * 90\% \text{ efficiency} = \frac{2{,}372 \text{ lbs Al reduction}}{\text{year}}$$

The aluminum reductions required in the TMDL are associated with mining related seeps in the Batoff Creek watershed. The best management practices applicable to mining related seeps include passive treatment, such as constructed wetlands. In addition, site implementation may include diverting and re-routing stormwater, re-grading and re-vegetating land with sparse or no existing vegetation. It may be necessary to implement stream restoration and stream diversion on some sites. It is assumed that the same implementation strategies used to reduce iron originating from AML seeps and abandoned mine lands would be sufficient to reduce aluminum in the two subwatersheds where aluminum reductions (subwatersheds 1195 and 1196) are needed. The iron implementation methods are shown in **Table 6-6**.

Stream restoration project reductions were calculated by length weighting the overall streambank sediment/iron load for the specific TMDL subwatershed in which the project is located by the proposed restoration stream length. The following calculation is for the Whitby Stream restoration project.

$$\text{Whitby Stream Restoration Load Reduction} = \frac{2{,}473\ \text{feet}}{15{,}447\ \text{feet}} * \frac{368.197\ \text{lbs Fe}}{\text{year}} = \frac{58.95\ \text{lbs Fe reduction}}{\text{year}}$$

Assumptions

- Whitby Stream Restoration project contains 2,473 feet of stream
- TMDL subwatershed 1158 contains 15,447 feet of stream channel
- Baseline streambank erosion Load Allocation for subwatershed 1158 is 368.197 lbs Fe/year

The level of detail for specific stream bank conditions in each subwatershed was not evaluated during the TMDL process. Therefore, a detailed assessment would be required to evaluate and determine streambank conditions in specific subwatersheds. A practical approach to reducing streambank erosion is to reduce runoff from impervious surfaces. Retaining stormwater runoff and distributing it over time will help to keep the streams from reaching bank full conditions when the majority of stream bank erosion occurs.

6.2.1 Estimates for Stream Bank Erosion

The watershed estimates for implementing stream bank erosion in **Table 6-5** below are to be used as guidelines and are considered worst case conditions. A general assumption used was that 100% of a restored stream contributes negligible sediment to the stream; therefore the percent reduction is directly applicable to restoring the same percent of stream length. The cost of $290 per linear foot (AMEC, 2005) is used in the estimated cost calculations. The stream bank erosion reductions and costs were calculated in the following manner:

- The stream length restoration required for each watershed was calculated by multiplying the total stream length by the required reduction percentage for stream bank erosion.
- The estimated cost was calculated by first doubling the stream length restoration length to account for both right and left stream banks. The total linear feet of stream bank restoration was then multiplied by the estimate costs of $290 per linear foot.

Table 6-5. Stream Bank Erosion Iron Reduction and Costs

Stream Code	Stream Name	SWS	Stream Length (ft)	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	Total Reduction (base-allocated) (lbs/yr)	% Reduction	Stream Length Restoration Required (Ft) (Assume 100% Reduction from Restoration)	Estimated Cost [1]
WVKN-26	Piney Creek	1113	2720.83	38850	17205	21645	56	1524	$883,726
WVKN-26	Piney Creek	1114	8823	20183	8938	11245	56	4941	$2,865,710
WVKN-26-B	Fat Creek	1115	13486.54	260	260	0	0	0	$0
WVKN-26-B	Fat Creek	1116	20806.56	73	73	0	0	0	$0
WVKN-26-B-2	Brammer Branch	1117	12749.34	74	73	1	2	255	$147,892
WVKN-26	Piney Creek	1118	10694.03	7376	7230	146	2	214	$124,051
WVKN-26	Piney Creek	1119	11707.22	6880	6744	136	2	234	$135,804
WVKN-26	Piney Creek	1120	15468.03	3023	2963	60	2	309	$179,429
WVKN-26	Piney Creek	1121	13262.62	2707	2653	54	2	265	$153,846
WVKN-26-F	Beaver Creek	1122	6231.12	1806	1806	0	0	0	$0
WVKN-26-F-2	Little Beaver Creek	1123	2515.64	1846	1105	741	40	1006	$583,628
WVKN-26-F-2-0.4A	UNT/Little Beaver Creek RM 0.25	1124	6677.97	25	15	10	40	2671	$1,549,289
WVKN-26-F-2	Little Beaver Creek	1125	4710.06	1271	761	510	40	1884	$1,092,734
WVKN-26-F-2	Little Beaver Creek	1126	1294.12	1849	1107	742	40	518	$300,236
WVKN-26-F-2-A.1	UNT/Little Beaver Creek RM 0.25	1127	13183	51	31	20	40	5273	$3,058,456
WVKN-26-F-2	Little Beaver Creek	1128	12494.25	766	459	307	40	4998	$2,898,666

Stream Code	Stream Name	SWS	Stream Length (ft)	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	Total Reduction (base-allocated) (lbs/yr)	% Reduction	Stream Length Restoration Required (Ft) (Assume 100% Reduction from Restoration)	Estimated Cost [1]
WVKN-26-F-2-B	Laurel Run	1129	11730.87	87	52	35	40	4692	$2,721,562
WVKN-26-F-2	Little Beaver Creek	1130	5430.53	486	387	99	20	1086	$629,941
WVKN-26-F-2-C	Sims Branch	1131	9564.37	37	29	8	20	1913	$1,109,467
WVKN-26-F-2	Little Beaver Creek	1132	4566.32	381	303	78	20	913	$529,693
WVKN-26-F-2-(L2)	Lake	1133	1844.02	464	370	94	20	369	$213,906
WVKN-26-F-2	Little Beaver Creek	1134	12125.82	192	153	39	20	2425	$1,406,595
WVKN-26-F-2-(L3)	Lake	1135	2112.59	86	69	17	20	423	$245,060
WVKN-26-F-2	Little Beaver Creek	1136	3403.47	30	24	6	20	681	$394,803
WVKN-26-F-2-A	Sand Branch	1137	7790.4	107	64	43	40	3116	$1,807,373
WVKN-26-F	Beaver Creek	1138	20452.6	6006	897	5109	85	17385	$10,083,132
WVKN-26-F	Beaver Creek	1139	8937.7	5249	784	4465	85	7597	$4,406,286
WVKN-26-F	Beaver Creek	1140	1323.62	7872	1176	6696	85	1125	$652,545
WVKN-26-F-6	Left Fork/Beaver Creek	1141	20193.31	135	110	25	19	3837	$2,225,303
WVKN-26-F	Beaver Creek	1142	11605.02	508	302	206	41	4758	$2,759,674
WVKN-26-F-7	Cherry Creek	1143	9948.33	107	64	43	41	4079	$2,365,713
WVKN-26-F	Beaver Creek	1144	9232.42	103	61	42	41	3785	$2,195,469
WVKN-26-F-8	UNT/Beaver Creek RM 10.11	1145	14729.06	121	72	49	41	6039	$3,502,570
WVKN-26-F-5	Rocky Branch	1146	10996.49	65	39	26	41	4509	$2,614,965
WVKN-26-F-3	Glade Fork	1147	12510.89	154	91	63	41	5129	$2,975,090

Stream Code	Stream Name	SWS	Stream Length (ft)	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	Total Reduction (base-allocated) (lbs/yr)	% Reduction	Stream Length Restoration Required (Ft) (Assume 100% Reduction from Restoration)	Estimated Cost [1]
WVKN-26-F-1	Tank Branch	1148	9058.37	28	22	6	20	1812	$1,050,771
WVKN-26	Piney Creek	1149	5243.16	11352	2523	8829	78	4090	$2,372,006
WVKN-26	Piney Creek	1150	19418.22	8734	1941	6793	78	15146	$8,784,803
WVKN-26	Piney Creek	1151	8225.01	9565	2126	7439	78	6416	$3,720,995
WVKN-26	Piney Creek	1152	12972.83	7310	1624	5686	78	10119	$5,868,908
WVKN-26	Piney Creek	1153	15189.88	5095	1132	3963	78	11848	$6,871,902
WVKN-26-L	Take-In Creek	1154	12379.1	370	82	288	78	9656	$5,600,305
WVKN-26	Piney Creek	1155	17426.88	3906	868	3038	78	13593	$7,883,921
WVKN-26-M	Bowyer Creek	1156	1765.81	2350	522	1828	78	1377	$798,852
WVKN-26-M-1	Spencer Branch	1157	6849.36	126	28	98	78	5343	$3,098,650
WVKN-26-M	Bowyer Creek	1158	15447.23	368	174	194	53	8187	$4,748,479
WVKN-26-M	Bowyer Creek	1159	5851.75	43	21	22	53	3101	$1,798,828
WVKN-26-M-2	UNT/Bowyer Creek RM 3.34	1160	5367.73	48	23	25	53	2845	$1,650,040
WVKN-26	Piney Creek	1161	4580.53	2467	1165	1302	53	2428	$1,408,055
WVKN-26-N	Laurel Creek	1162	28724.03	268	105	163	61	17522	$10,162,562
WVKN-26	Piney Creek	1163	4464.75	1013	590	423	42	1875	$1,087,613
WVKN-26-O	Lampkin Branch	1164	10509.48	72	42	30	42	4414	$2,560,109
WVKN-26	Piney Creek	1165	9310.47	601	350	251	42	3910	$2,268,030
WVKN-26-0.5	UNT/Piney Creek RM 31.33	1166	5746.41	23	13	10	42	2413	$1,399,825
WVKN-26	Piney Creek	1167	8573.92	182	182	0	0	0	$0
WVKN-26-P	Keaton Branch	1168	10081.73	37	37	0	0	0	$0
WVKN-26	Piney Creek	1169	11646.29	46	46	0	0	0	$0
WVKN-26-K	Soak Creek	1170	6191.65	1483	643	840	57	3529	$2,046,959
WVKN-26-K-1	Laurel Branch	1171	6923.37	136	59	77	57	3946	$2,288,866

Stream Code	Stream Name	SWS	Stream Length (ft)	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	Total Reduction (base-allocated) (lbs/yr)	% Reduction	Stream Length Restoration Required (Ft) (Assume 100% Reduction from Restoration)	Estimated Cost [1]
WVKN-26-K	Soak Creek	1172	3570.79	1161	504	657	57	2035	$1,180,503
WVKN-26-K	Soak Creek	1173	13021.06	1143	411	732	64	8333	$4,833,417
WVKN-26-K	Soak Creek	1174	5564.55	131	44	87	66	3673	$2,130,110
WVKN-26-J	Turkey Branch	1175	6229.02	86	35	51	59	3675	$2,131,571
WVKN-26-I	Crab Orchard Creek	1176	4898.57	2143	872	1271	59	2890	$1,676,291
WVKN-26-I	Crab Orchard Creek	1177	16844.21	678	276	402	59	9938	$5,764,089
WVKN-26-I-1	Stover Fork	1178	13679.91	682	277	405	59	8071	$4,681,265
WVKN-26-G	Whitestick Creek	1179	14218.07	1775	722	1053	59	8389	$4,865,424
WVKN-26-G-1	UNT/Whitestick Creek RM 2.83	1180	4196.9	463	188	275	59	2476	$1,436,179
WVKN-26-G	Whitestick Creek	1181	4252.38	2745	527	2218	81	3444	$1,997,768
WVKN-26-G	Whitestick Creek	1182	15176.96	2174	417	1757	81	12293	$7,130,136
WVKN-26-G-2	UNT/Whitestick Creek RM 3.66	1183	4764.09	0	0	0	0	0	$0
WVKN-26-E	Cranberry Creek	1184	8092.82	91	20	71	78	6312	$3,661,192
WVKN-26-E-1	Little Whitestick Creek	1185	4371.71	0	0	0	0	0	$0
WVKN-26-E-1-A	UNT/Little Whitestick Creek RM 0.84	1186	3945.99	0	0	0	0	0	$0
WVKN-26-E-1	Little Whitestick Creek	1187	19092.72	80	22	58	72	13747	$7,973,120
WVKN-26-E	Cranberry Creek	1188	12376.01	55	17	38	68	8416	$4,881,098
WVKN-26-E	Cranberry Creek	1189	2440.38	0	0	0	0	0	$0
WVKN-26-E-2	UNT/Cranberry Creek RM 4.51	1190	7951.12	7	2	5	69	5486	$3,182,038

Stream Code	Stream Name	SWS	Stream Length (ft)	Baseline Load (lbs/yr)	Allocated Load (lbs/yr)	Total Reduction (base-allocated) (lbs/yr)	% Reduction	Stream Length Restoration Required (Ft) (Assume 100% Reduction from Restoration)	Estimated Cost [1]
WVKN-26-E	Cranberry Creek	1191	9169.76	25	8	17	69	6327	$3,669,738
WVKN-26-D	Griffith Branch	1192	7623.6	315	98	217	69	5260	$3,050,965
WVKN-26-C	Stanaford Branch	1193	13689.26	402	125	277	69	9446	$5,478,442
WVKN-26-A	Batoff Creek	1194	2921.55	355	225	130	37	1081	$626,965
WVKN-26-A	Batoff Creek	1195	8205.36	190	120	70	37	3036	$1,760,870
WVKN-26-A	Batoff Creek	1196	8674.88	86	45	41	47	4077	$2,364,772
	Total					**103897**		**359929**	**$208,759,047**

Notes:
1 ($290/linear foot) (Stream Length Restoration Length * 2 stream banks (Left and Right Streambank) *$290)

6.2.2 Estimates for AML, Bond Forfeitures and Barren Land

Table 6-6 shows the estimated re-vegetation costs and anticipated iron load reduction using a 70% removal efficiency. The land reclamation cost and iron reductions associated with abandoned mine land, bond forfeiture sites and barren landuse were all calculated using the same assumptions. The total area for each landuse category per subwatershed was multiplied by $13,796.26 per acre in addition to assuming that 1000 linear feet of silt fence was needed for an additional cost of $3,060. The individual components of the cost estimate are listed in **Appendix D** and the calculation spreadsheet is in **Appendix D1**.

Table 6-6. Iron Reductions and Estimated Costs for AML, Forfeitures and Barren Land

Stream Code	Stream Name	SWS	ABANDONED MINES				BOND FOREFITURE SITES				BARREN LAND			
			Required Reduction (lbs/yr)	Total AML (acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Revoked Bond (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Barren (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)
WVKN-26	Piney Creek	1113	0	0	$0	0	0	0	$0	0	2	0.08	$4,117	2.1
WVKN-26	Piney Creek	1114	0	0	$0	0	0	0	$0	0	362	13.67	$191,687	383.6
WVKN-26-B	Fat Creek	1115	0	0	$0	0	0	0	$0	0	288	10.90	$153,458	305.9
WVKN-26-B	Fat Creek	1116	0	0	$0	0	0	0	$0	0	4	0.18	$5,597	4.9
WVKN-26-B-2	Brammer Branch	1117	0	0	$0	0	0	0	$0	0	784	29.60	$411,448	832.3
WVKN-26	Piney Creek	1118	0	0	$0	0	0	0	$0	0	289	10.95	$154,178	306.6
WVKN-26	Piney Creek	1119	0	0	$0	0	0	0	$0	0	1023	38.73	$537,422	1085.7
WVKN-26	Piney Creek	1120	0	0	$0	0	0	0	$0	0	3	0.13	$4,826	2.8
WVKN-26	Piney Creek	1121	0	0	$0	0	0	0	$0	0	0	0.06	$0	0
WVKN-26-F	Beaver Creek	1122	26	4.59	$66,447	27.3	0	0	$0	0	0	0.02	$0	0
WVKN-26-F-2	Little Beaver Creek	1123	0	0	$0	0	0	0	$0	0	0	0.01	$0	0
WVKN-26-F-2-0.4A	UNT/Little Beaver Creek RM 0.25	1124	0	0	$0	0	0	0	$0	0	84	3.19	$47,040	89.6
WVKN-26-F-2	Little Beaver Creek	1125	0	0	$0	0	0	0	$0	0	0	0.01	$0	0
WVKN-26-F-2	Little Beaver Creek	1126	0	0	$0	0	0	0	$0	0	0	0.00	$0	0
WVKN-26-F-	UNT/Little	1127	0	0	$0	0	0	0	$0	0	51	1.95	$29,943	54.6

Stream Code	Stream Name	SWS	ABANDONED MINES				BOND FOREFITURE SITES				BARREN LAND			
			Required Reduction (lbs/yr)	Total AML (acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Revoked Bond (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Barren (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)
2-A.1	Beaver Creek RM 0.25													
WVKN-26-F-2	Little Beaver Creek	1128	0	0	$0	0	0	0	$0	0	91	3.45	$50,673	96.6
WVKN-26-F-2-B	Laurel Run	1129	0	0	$0	0	0	0	$0	0	0	0.06	$0	0
WVKN-26-F-2	Little Beaver Creek	1130	0	0	$0	0	0	0	$0	0	33	1.25	$20,261	35
WVKN-26-F-2-C	Sims Branch	1131	0	0	$0	0	0	0	$0	0	33	1.25	$20,337	35
WVKN-26-F-2	Little Beaver Creek	1132	0	0	$0	0	0	0	$0	0	4	0.15	$5,137	4.2
WVKN-26-F-2-(L2)	Lake	1133	0	0	$0	0	0	0	$0	0	124	4.69	$67,746	131.6
WVKN-26-F-2	Little Beaver Creek	1134	0	0	$0	0	0	0	$0	0	168	6.31	$90,181	177.8
WVKN-26-F-2-(L3)	Lake	1135	0	0	$0	0	0	0	$0	0	50	1.88	$28,994	53.2
WVKN-26-F-2	Little Beaver Creek	1136	0	0	$0	0	0	0	$0	0	0	0.04	$0	0
WVKN-26-F-2-A	Sand Branch	1137	0	0	$0	0	0	0	$0	0	175	6.59	$94,020	185.5
WVKN-26-F	Beaver Creek	1138	0	0	$0	0	0	0	$0	0	5	0.16	$5,326	4.9
WVKN-26-F	Beaver Creek	1139	0	0	$0	0	0	0	$0	0	0	0.07	$0	0
WVKN-26-F	Beaver Creek	1140	0	0	$0	0	0	0	$0	0	0	0.00	$0	0

Stream Code	Stream Name	SWS	ABANDONED MINES				BOND FOREFITURE SITES				BARREN LAND			
			Required Reduction (lbs/yr)	Total AML (acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Revoked Bond (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Barren (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)
WVKN-26-F-6	Left Fork/Beaver Creek	1141	0	0	$0	0	0	0	$0	0	3	0.12	$4,719	3.5
WVKN-26-F	Beaver Creek	1142	0	0	$0	0	0	0	$0	0	2	0.08	$4,131	2.1
WVKN-26-F-7	Cherry Creek	1143	0	0	$0	0	0	0	$0	0	189	7.15	$101,716	200.9
WVKN-26-F	Beaver Creek	1144	0	0	$0	0	0	0	$0	0	297	11.23	$158,006	315.7
WVKN-26-F-8	UNT/Beaver Creek RM 10.11	1145	0	0	$0	0	0	0	$0	0	269	10.15	$143,046	285.6
WVKN-26-F-5	Rocky Branch	1146	0	0	$0	0	0	0	$0	0	3	0.09	$4,337	2.8
WVKN-26-F-3	Glade Fork	1147	0	0	$0	0	0	0	$0	0	5	0.17	$5,357	4.9
WVKN-26-F-1	Tank Branch	1148	14	2.33	$35,141	14	0	0	$0	0	17	0.65	$12,027	18.2
WVKN-26	Piney Creek	1149	21	4.99	$71,893	26.6	0	0	$0	0	38	2.37	$35,764	39.9
WVKN-26	Piney Creek	1150	67	12.07	$169,555	70.7	0	0	$0	0	167	6.32	$90,202	177.1
WVKN-26	Piney Creek	1151	92	16.20	$226,520	95.2	0	0	$0	0	0	0.06	$0	0
WVKN-26	Piney Creek	1152	0	0	$0	0	0	0	$0	0	0	0.07	$0	0
WVKN-26	Piney Creek	1153	0	0	$0	0	0	0	$0	0	163	6.15	$87,973	172.9
WVKN-26-L	Take-In Creek	1154	0	0	$0	0	0	0	$0	0	379	14.30	$200,415	402.5
WVKN-26	Piney Creek	1155	103	18.60	$259,737	108.5	0	0	$0	0	5	0.19	$5,667	5.6
WVKN-26-M	Bowyer Creek	1156	0	0	$0	0	0	0	$0	0	59	1.37	$21,945	63
WVKN-26-M-1	Spencer Branch	1157	0	0	$0	0	0	0	$0	0	165	3.77	$55,061	174.3

Stream Code	Stream Name	SWS	ABANDONED MINES				BOND FOREFITURE SITES				BARREN LAND			
			Required Reduction (lbs/yr)	Total AML (acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Revoked Bond (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Barren (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)
WVKN-26-M	Bowyer Creek	1158	809	92.30	$1,276,515	940.8	588	61	$844,632	775.6	7	0.15	$5,161	7
WVKN-26-M	Bowyer Creek	1159	0	0	$0	0	0	0	$0	0	0	0.03	$0	0
WVKN-26-M-2	UNT/Bowyer Creek RM 3.34	1160	9	11.12	$156,455	68.6	0	0	$0	0	0	0.03	$0	0
WVKN-26	Piney Creek	1161	3	0.36	$7,975	3.5	0	0	$0	0	182	4.17	$60,628	192.5
WVKN-26-N	Laurel Creek	1162	855	191.00	$2,638,146	1442.7	0	0	$0	0	7	0.17	$5,422	7.7
WVKN-26	Piney Creek	1163	39	4.46	$64,655	40.6	0	0	$0	0	0	0.02	$0	0
WVKN-26-O	Lampkin Branch	1164	444	51.23	$709,851	467.6	0	0	$0	0	3	0.06	$3,890	2.8
WVKN-26	Piney Creek	1165	0	0	$0	0	0	0	$0	0	189	4.33	$62,862	200.2
WVKN-26-0.5	UNT/Piney Creek RM 31.33	1166	0	0	$0	0	0	0	$0	0	99	2.27	$34,400	105
WVKN-26	Piney Creek	1167	0	0	$0	0	0	0	$0	0	39	0.90	$15,420	41.3
WVKN-26-P	Keaton Branch	1168	2	3.08	$45,500	18.9	0	0	$0	0	3	0.07	$4,054	3.5
WVKN-26	Piney Creek	1169	2	1.43	$22,751	42.7	0	0	$0	0	4	0.09	$4,244	4.2
WVKN-26-K	Soak Creek	1170	243	27.70	$385,168	253.4	0	0	$0	0	0	0.03	$0	0
WVKN-26-K-1	Laurel Branch	1171	0	0	$0	0	0	0	$0	0	0	0.03	$0	0
WVKN-26-K	Soak Creek	1172	14	1.62	$25,346	14.7	0	0	$0	0	0	0.01	$0	0
WVKN-26-K	Soak Creek	1173	14	1.60	$25,079	14.7	0	0	$0	0	62	1.42	$22,703	65.8
WVKN-26-K	Soak Creek	1174	0	0	$0	0	0	0	$0	0	10	0.22	$6,126	10.5
WVKN-26-J	Turkey Branch	1175	0	0	$0	0	0	0	$0	0	0	0.02	$0	0

Stream Code	Stream Name	SWS	ABANDONED MINES				BOND FOREFITURE SITES				BARREN LAND			
			Required Reduction (lbs/yr)	Total AML (acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Revoked Bond (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Barren (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)
WVKN-26-I	Crab Orchard Creek	1176	0	0	$0	0	0	0	$0	0	0	0.01	$0	0
WVKN-26-I	Crab Orchard Creek	1177	56	6.45	$92,085	58.8	0	0	$0	0	233	5.35	$76,908	247.1
WVKN-26-I-1	Stover Fork	1178	1128	129.18	$1,785,260	1180.2	0	0	$0	0	3	0.06	$3,887	2.8
WVKN-26-G	Whitestick Creek	1179	121	14.38	$201,435	129.5	0	0	$0	0	0	0.05	$0	0
WVKN-26-G-1	UNT/Whitestick Creek RM 2.83	1180	626	71.52	$989,818	653.8	0	0	$0	0	0	0.01	$0	0
WVKN-26-G	Whitestick Creek	1181	47	5.39	$77,359	49	0	0	$0	0	0	0.01	$0	0
WVKN-26-G	Whitestick Creek	1182	0	0	$0	0	0	0	$0	0	481	13.34	$187,108	508.9
WVKN-26-G-2	UNT/Whitestick Creek RM 3.66	1183	18	1.96	$30,066	18.2	0	0	$0	0	0	0.00	$0	0
WVKN-26-E	Cranberry Creek	1184	206	23.60	$328,715	215.6	0	0	$0	0	0	0.05	$0	0
WVKN-26-E-1	Little Whitestick Creek	1185	0	0	$0	0	0	0	$0	0	0	0.00	$0	0
WVKN-26-E-1-A	UNT/Little Whitestick Creek RM 0.84	1186	0	0	$0	0	0	0	$0	0	0	0.00	$0	0
WVKN-26-E-1	Little Whitestick Creek	1187	17	2.17	$32,931	18.9	0	0	$0	0	44	33.89	$470,580	46.9
WVKN-26-E	Cranberry Creek	1188	7914	432.81	$5,974,194	7154	365	38	$527,318	481.6	0	0.07	$0	0
WVKN-26-E	Cranberry Creek	1189	23	2.58	$38,671	23.8	0	0	$0	0	0	0.02	$0	0
WVKN-26-E-2	UNT/Cranberry	1190	62	7.03	$100,009	64.4	0	0	$0	0	0	0.05	$0	0

Stream Code	Stream Name	SWS	ABANDONED MINES				BOND FOREFITURE SITES				BARREN LAND			
			Required Reduction (lbs/yr)	Total AML (acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Revoked Bond (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Barren (Acres)	Revegetation cost	Estimated Reduction Load (70% efficiency)
	Creek RM 4.51													
WVKN-26-E	Cranberry Creek	1191	0	0	$0	0	0	0	$0	0	0	0.06	$0	0
WVKN-26-D	Griffith Branch	1192	1	1.38	$22,161	8.4	0	0	$0	0	240	6.96	$99,028	254.1
WVKN-26-C	Stanaford Branch	1193	158	22.74	$316,820	192.5	0	0	$0	0	5	0.11	$4,514	4.9
WVKN-26-A	Batoff Creek	1194	0	0	$0	0	0	0	$0	0	89	2.06	$31,474	94.5
WVKN-26-A	Batoff Creek	1195	0	0	$0	0	106	11	$154,819	139.3	4	0.09	$4,340	4.2
WVKN-26-A	Batoff Creek	1196	2240	0.25	$6,562	2953.3	0	0	$0	0	91	2.09	$31,940	96.6
TOTAL	**$21,697,036**		**15374**		**$16,182,822**	**16370.9**	**1059**		**$1,526,769**	**1396.5**	**7129**		**$3,987,445**	**7561.4**

6.2.3 Estimates for Forest Harvest and Oil and Gas Land

Table 6-7 shows the estimated re-vegetation costs and anticipated iron load reduction using a 70% removal efficiency. The reductions and costs associated with re-vegetating forest and oil and gas sites were calculated using the same method as AML and bond forfeitures. The total area for each landuse category per subwatershed was multiplied by $4,949 per acre. This represented the costs associated with fertilizer and seeding barren areas that were not anticipated to require any earthmoving. The load reduction was calculated by multiplying the baseline load by the 70% efficiency rate for re-vegetating barren land. The individual components of the cost estimate are listed in **Appendix D** and the load reduction and calculation spreadsheet is presented in **Appendix D1**.

Table 6-7. Iron Reductions and Implementation Costs for Forest Harvest and Oil and Gas

Stream Code	Stream Name	SWS	FOREST HARVEST				OIL AND GAS			
			Required Reduction (lbs/yr)	Total Forest Harvest (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Oil and Gas (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)
WVKN-26	Piney Creek	1113	0	0.0	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1114	0	0.0	$0	0	0	0	$0	0
WVKN-26-B	Fat Creek	1115	0	0.0	$0	0	0	0	$0	0
WVKN-26-B	Fat Creek	1116	924	123.0	$235,469	1204	0	0	$0	0
WVKN-26-B-2	Brammer Branch	1117	0	0.2	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1118	0	0.0	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1119	0	0.0	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1120	508	70.1	$135,555	667.8	0	0	$0	0
WVKN-26	Piney Creek	1121	115	15.7	$32,808	150.5	0	0	$0	0
WVKN-26-F	Beaver Creek	1122	4	0.5	$4,004	4.9	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1123	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-2-0.4A	UNT/Little Beaver Creek RM 0.25	1124	0	0.2	$0	0	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1125	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1126	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-2-A.1	UNT/Little Beaver Creek RM 0.25	1127	0	0.0	$0	0	0	0	$0	0

Stream Code	Stream Name	SWS	FOREST HARVEST				OIL AND GAS			
			Required Reduction (lbs/yr)	Total Forest Harvest (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Oil and Gas (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)
WVKN-26-F-2	Little Beaver Creek	1128	4	0.5	$4,004	4.9	0	0	$0	0
WVKN-26-F-2-B	Laurel Run	1129	1222	162.2	$309,508	1589.7	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1130	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-2-C	Sims Branch	1131	14	2.0	$6,837	18.9	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1132	0	0.2	$0	0	12	1	$5,666	16.1
WVKN-26-F-2-(L2)	Lake	1133	0	0.1	$0	0	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1134	14	2.0	$6,837	18.9	0	0	$0	0
WVKN-26-F-2-(L3)	Lake	1135	2	0.3	$3,627	2.8	0	0	$0	0
WVKN-26-F-2	Little Beaver Creek	1136	0	0.1	$0	0	0	0	$0	0
WVKN-26-F-2-A	Sand Branch	1137	44	6.2	$14,770	59.5	0	0	$0	0
WVKN-26-F	Beaver Creek	1138	0	0.1	$0	0	0	0	$0	0
WVKN-26-F	Beaver Creek	1139	0	0.0	$0	0	0	0	$0	0
WVKN-26-F	Beaver Creek	1140	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-6	Left Fork/Beaver Creek	1141	25	3.4	$9,482	32.9	0	0	$0	0
WVKN-26-F	Beaver Creek	1142	36	5.0	$12,504	48.3	12	1	$5,666	16.1
WVKN-26-F-7	Cherry Creek	1143	2	0.4	$3,815	3.5	0	0	$0	0
WVKN-26-F	Beaver Creek	1144	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-8	UNT/Beaver Creek RM 10.11	1145	0	0.0	$0	0	0	0	$0	0
WVKN-26-F-5	Rocky Branch	1146	21	3.0	$8,726	28.7	36	4	$10,879	47.6
WVKN-26-F-3	Glade Fork	1147	131	18.4	$37,813	177.1	0	0	$0	0
WVKN-26-F-1	Tank Branch	1148	0	0.0	$0	0	0	0	$0	0

Stream Code	Stream Name	SWS	FOREST HARVEST				OIL AND GAS			
			Required Reduction (lbs/yr)	Total Forest Harvest (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Oil and Gas (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)
WVKN-26	Piney Creek	1149	9	1.3	$5,515	12.6	0	0	$0	0
WVKN-26	Piney Creek	1150	0	0.0	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1151	17	2.3	$7,404	22.4	84	10	$21,305	111.3
WVKN-26	Piney Creek	1152	0	0.0	$0	0	36	4	$10,879	47.6
WVKN-26	Piney Creek	1153	19	2.7	$8,160	25.9	36	4	$10,879	47.6
WVKN-26-L	Take-In Creek	1154	0	0.0	$0	0	24	3	$8,273	31.5
WVKN-26	Piney Creek	1155	384	52.6	$102,408	504.7	72	8	$18,699	95.2
WVKN-26-M	Bowyer Creek	1156	0	0.0	$0	0	0	0	$0	0
WVKN-26-M-1	Spencer Branch	1157	0	0.0	$0	0	0	0	$0	0
WVKN-26-M	Bowyer Creek	1158	223	19.0	$38,946	298.9	0	0	$0	0
WVKN-26-M	Bowyer Creek	1159	0	0.0	$0	0	0	0	$0	0
WVKN-26-M-2	UNT/Bowyer Creek RM 3.34	1160	0	0.0	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1161	0	0.0	$0	0	0	0	$0	0
WVKN-26-N	Laurel Creek	1162	0	0.0	$0	0	20	1	$5,666	25.9
WVKN-26	Piney Creek	1163	4	0.3	$3,627	4.9	0	0	$0	0
WVKN-26-O	Lampkin Branch	1164	24	2.0	$6,837	31.5	0	0	$0	0
WVKN-26	Piney Creek	1165	0	0.0	$0	0	20	1	$5,666	25.9
WVKN-26-0.5	UNT/Piney Creek RM 31.33	1166	0	0.0	$0	0	20	1	$5,666	25.9
WVKN-26	Piney Creek	1167	0	0.0	$0	0	20	1	$5,666	25.9
WVKN-26-P	Keaton Branch	1168	0	0.0	$0	0	0	0	$0	0
WVKN-26	Piney Creek	1169	0	0.0	$0	0	0	0	$0	0
WVKN-26-K	Soak Creek	1170	16	1.4	$5,704	21.7	0	0	$0	0
WVKN-26-K-1	Laurel Branch	1171	0	0.0	$0	0	39	3	$8,273	51.8
WVKN-26-K	Soak Creek	1172	0	0.0	$0	0	59	4	$10,879	77.7
WVKN-26-K	Soak Creek	1173	13	1.1	$5,138	17.5	20	1	$5,666	25.9

Stream Code	Stream Name	SWS	FOREST HARVEST				OIL AND GAS			
			Required Reduction (lbs/yr)	Total Forest Harvest (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Oil and Gas (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)
WVKN-26-K	Soak Creek	1174	0	0.0	$0	0	39	3	$8,273	51.8
WVKN-26-J	Turkey Branch	1175	634	52.6	$102,408	825.3	59	4	$10,879	77.7
WVKN-26-I	Crab Orchard Creek	1176	0	0.0	$0	0	39	3	$8,273	51.8
WVKN-26-I	Crab Orchard Creek	1177	85	7.2	$16,659	113.4	20	1	$5,666	25.9
WVKN-26-I-1	Stover Fork	1178	13	1.1	$5,138	17.5	20	1	$5,666	25.9
WVKN-26-G	Whitestick Creek	1179	11	1.0	$4,949	15.4	99	7	$16,092	130.2
WVKN-26-G-1	UNT/Whitestick Creek RM 2.83	1180	0	0.0	$0	0	20	1	$5,666	25.9
WVKN-26-G	Whitestick Creek	1181	0	0.0	$0	0	0	0	$0	0
WVKN-26-G	Whitestick Creek	1182	21	1.8	$6,460	28	0	0	$0	0
WVKN-26-G-2	UNT/Whitestick Creek RM 3.66	1183	0	0.0	$0	0	0	0	$0	0
WVKN-26-E	Cranberry Creek	1184	0	0.0	$0	0	0	0	$0	0
WVKN-26-E-1	Little Whitestick Creek	1185	0	0.1	$0	0	0	0	$0	0
WVKN-26-E-1-A	UNT/Little Whitestick Creek RM 0.84	1186	0	0.0	$0	0	0	0	$0	0
WVKN-26-E-1	Little Whitestick Creek	1187	5	0.4	$3,815	6.3	0	0	$0	0
WVKN-26-E	Cranberry Creek	1188	158	13.5	$28,558	212.1	99	7	$16,092	130.2
WVKN-26-E	Cranberry Creek	1189	0	0.0	$0	0	0	0	$0	0
WVKN-26-E-2	UNT/Cranberry Creek RM 4.51	1190	0	0.0	$0	0	0	0	$0	0
WVKN-26-E	Cranberry Creek	1191	0	0.0	$0	0	20	1	$5,666	25.9
WVKN-26-D	Griffith Branch	1192	11	1.0	$4,949	15.4	0	0	$0	0
WVKN-26-C	Stanaford Branch	1193	15	1.3	$5,515	20.3	59	4	$10,879	77.7
WVKN-26-A	Batoff Creek	1194	0	0.0	$0	0	0	0	$0	0

Stream Code	Stream Name	SWS	FOREST HARVEST				OIL AND GAS			
			Required Reduction (lbs/yr)	Total Forest Harvest (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)	Required Reduction (lbs/yr)	Oil and Gas (Acres)	Re-vegetation Cost ($4949/acre)	Estimated Reduction Load (70% efficiency)
WVKN-26-A	Batoff Creek	1195	9	0.7	$4,382	11.2	0	0	$0	0
WVKN-26-A	Batoff Creek	1196	24	2.0	$6,837	31.5	79	6	$13,486	103.6
	TOTAL	**$1,445,542**			**$1,199,168**				**$246,373**	

6.2.4 Estimates for Urban Land

The iron reductions and costs from urban landuse presented in **Table 6-8** were calculated in the following manner (calculations are presented in spreadsheet **Appendix D1**):

- To determine the reduction loads the baseline load was first multiplied by the removal efficiency of the proposed management method. The remaining load was then evenly divided between the three most viable management methods: rain gardens, constructed wetlands, and riparian buffers.
- Rain garden costs were calculated by first assuming that 50% of the urban landuse requiring reductions was available for constructing rain gardens. The available area was multiplied by $25 per square foot. The $25 cost was reduced from the current average rain garden costs ($43 per square foot) incurred by Beckley Sanitary Board. The $25 cost assumes that as more rain gardens are constructed the overall costs will lower.
- Constructed wetlands costs were calculated by first assuming that 10% of the urban landuse requiring reductions was available for wetland construction. The available area was multiplied by $10,146 per acre of constructed wetlands.
- Riparian buffer costs were calculated by assuming that 10% of the total subwatershed stream length was available for constructing buffers. The available stream length was doubled to account for right and left stream banks. Then the area was multiplied by 35 feet, which is the assumed width of the riparian stream buffer. The resulting acreage was multiplied by $1,000 per acre, the estimated cost to properly vegetate a stream buffer.

Table 6-8 Iron Reductions and Cost Estimates for Urban Landuse

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26	Piney Creek	1113	314	2720.83	18.37	1.84	149	$1,000,116	149	$9,318	19,046	116	$437	413
WVKN-26	Piney Creek	1114	570	8823	52.71	5.27	293	$2,869,879	293	$26,738	61,761	228	$1,418	813
WVKN-26-B	Fat Creek	1115	593	13486.54	56.04	5.60	310	$3,051,493	310	$28,430	94,406	241	$2,167	862
WVKN-26-B	Fat Creek	1116	1400	20806.56	189.72	18.97	804	$10,330,097	804	$96,243	145,646	626	$3,344	2,234
WVKN-26-B-2	Brammer Branch	1117	1278	12749.34	202.71	20.27	770	$11,037,483	770	$102,834	89,245	599	$2,049	2,139
WVKN-26	Piney Creek	1118	375	10694.03	99.85	9.99	269	$5,436,859	269	$50,654	74,858	209	$1,719	747
WVKN-26	Piney Creek	1119	1071	11707.22	175.75	17.57	651	$9,569,601	651	$89,158	81,951	506	$1,881	1,808
WVKN-26	Piney Creek	1120	554	15468.03	138.99	13.90	343	$7,567,818	343	$70,508	108,276	267	$2,486	953
WVKN-26	Piney Creek	1121	656	13262.62	383.33	38.33	487	$20,872,240	487	$194,462	92,838	379	$2,131	1,352
WVKN-26-F	Beaver Creek	1122	357	6231.12	130.64	13.06	294	$7,113,641	294	$66,276	43,618	229	$1,001	818

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-F-2	Little Beaver Creek	1123	234	2515.64	42.74	4.27	148	$2,327,370	148	$21,684	17,609	115	$404	411
WVKN-26-F-2-0.4A	UNT/Little Beaver Creek RM 0.25	1124	67	6677.97	12.52	1.25	42	$681,840	42	$6,353	46,746	32	$1,073	116
WVKN-26-F-2	Little Beaver Creek	1125	125	4710.06	39.96	4.00	96	$2,176,099	96	$20,274	32,970	75	$757	266
WVKN-26-F-2	Little Beaver Creek	1126	0	1294.12	0.38	0.04	0	$0	0	$0	0	0	$0	0
WVKN-26-F-2-A.1	UNT/Little Beaver Creek RM 0.25	1127	78	13183	15.49	1.55	49	$843,214	49	$7,856	92,281	38	$2,118	137
WVKN-26-F-2	Little Beaver Creek	1128	269	12494.25	66.71	6.67	187	$3,632,474	187	$33,843	87,460	145	$2,008	519
WVKN-26-F-2-B	Laurel Run	1129	230	11730.87	39.72	3.97	141	$2,162,828	141	$20,151	82,116	110	$1,885	393

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-F-2	Little Beaver Creek	1130	19	5430.53	4.87	0.49	13	$265,078	13	$2,470	38,014	10	$873	37
WVKN-26-F-2-C	Sims Branch	1131	99	9564.37	19.05	1.91	62	$1,037,372	62	$9,665	66,951	49	$1,537	173
WVKN-26-F-2	Little Beaver Creek	1132	93	4566.32	23.53	2.35	65	$1,281,020	65	$11,935	31,964	51	$734	182
WVKN-26-F-2-(L2)	Lake	1133	240	1844.02	32.09	3.21	137	$1,747,051	137	$16,277	12,908	107	$296	381
WVKN-26-F-2	Little Beaver Creek	1134	651	12125.82	259.65	25.96	559	$14,137,743	559	$131,718	84,881	435	$1,949	1,552
WVKN-26-F-2-(L3)	Lake	1135	85	2112.59	24.32	2.43	62	$1,324,245	62	$12,338	14,788	49	$339	173
WVKN-26-F-2	Little Beaver Creek	1136	105	3403.47	4.31	0.43	47	$234,540	47	$2,185	23,824	37	$547	131
WVKN-26-F-2-A	Sand Branch	1137	526	7790.4	181.52	18.15	421	$9,884,012	421	$92,087	54,533	328	$1,252	1,170

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-F	Beaver Creek	1138	575	20452.6	279.45	27.95	546	$15,216,238	546	$141,766	143,168	425	$3,287	1,518
WVKN-26-F	Beaver Creek	1139	350	8937.7	53.55	5.35	208	$2,915,647	208	$27,164	62,564	162	$1,436	578
WVKN-26-F	Beaver Creek	1140	14	1323.62	4.30	0.43	11	$234,136	11	$2,181	9,265	8	$213	30
WVKN-26-F-6	Left Fork/Beaver Creek	1141	688	20193.31	116.51	11.65	418	$6,343,999	418	$59,106	141,353	325	$3,245	1,162
WVKN-26-F	Beaver Creek	1142	631	11605.02	142.19	14.22	425	$7,742,222	425	$72,132	81,235	331	$1,865	1,181
WVKN-26-F-7	Cherry Creek	1143	166	9948.33	65.84	6.58	141	$3,584,974	141	$33,400	69,638	110	$1,599	392
WVKN-26-F	Beaver Creek	1144	502	9232.42	130.41	13.04	357	$7,100,676	357	$66,155	64,627	277	$1,484	991
WVKN-26-F-8	UNT/Beaver Creek RM 10.11	1145	134	14729.06	11.88	1.19	69	$646,833	69	$6,026	103,103	54	$2,367	191
WVKN-26-F-5	Rocky Branch	1146	143	10996.49	25.80	2.58	89	$1,404,633	89	$13,087	76,975	70	$1,767	248
WVKN-26-F-3	Glade Fork	1147	924	12510.89	142.45	14.25	554	$7,756,589	554	$72,266	87,576	431	$2,010	1,539

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-F-1	Tank Branch	1148	152	9058.37	52.34	5.23	122	$2,849,724	122	$26,550	63,409	95	$1,456	338
WVKN-26	Piney Creek	1149	466	5243.16	334.07	33.41	415	$18,190,232	415	$169,474	36,702	323	$843	1,153
WVKN-26	Piney Creek	1150	610	19418.22	120.18	12.02	393	$6,543,699	393	$60,966	135,928	305	$3,120	1,091
WVKN-26	Piney Creek	1151	529	8225.01	118.67	11.87	356	$6,461,377	356	$60,199	57,575	277	$1,322	990
WVKN-26	Piney Creek	1152	622	12972.83	95.44	9.54	372	$5,196,675	372	$48,416	90,810	289	$2,085	1,033
WVKN-26	Piney Creek	1153	364	15189.88	58.52	5.85	219	$3,186,562	219	$29,688	106,329	171	$2,441	610
WVKN-26-L	Take-In Creek	1154	212	12379.1	12.46	1.25	100	$678,194	100	$6,319	86,654	78	$1,989	279
WVKN-26	Piney Creek	1155	287	17426.88	53.05	5.30	178	$2,888,530	178	$26,912	121,988	139	$2,800	496
WVKN-26-M	Bowyer Creek	1156	75	1765.81	6.59	0.66	45	$359,098	45	$3,346	12,361	35	$284	124
WVKN-26-M-1	Spencer Branch	1157	224	6849.36	24.62	2.46	135	$1,340,441	135	$12,489	47,946	105	$1,101	375
WVKN-26-M	Bowyer Creek	1158	763	15447.23	46.20	4.62	401	$2,515,780	401	$23,439	108,131	312	$2,482	1,114

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-M	Bowyer Creek	1159	64	5851.75	1.58	0.16	29	$85,854	29	$800	40,962	22	$940	80
WVKN-26-M-2	UNT/Bowyer Creek RM 3.34	1160	128	5367.73	3.13	0.31	58	$170,546	58	$1,589	37,574	45	$863	160
WVKN-26	Piney Creek	1161	64	4580.53	9.62	0.96	43	$523,809	43	$4,880	32,064	34	$736	120
WVKN-26-N	Laurel Creek	1162	478	28724.03	37.70	3.77	262	$2,052,510	262	$19,123	201,068	204	$4,616	727
WVKN-26	Piney Creek	1163	103	4464.75	10.36	1.04	61	$564,247	61	$5,257	31,253	48	$717	170
WVKN-26-O	Lampkin Branch	1164	236	10509.48	9.07	0.91	113	$494,133	113	$4,604	73,566	88	$1,689	313
WVKN-26	Piney Creek	1165	131	9310.47	23.93	2.39	97	$1,303,070	97	$12,140	65,173	75	$1,496	269
WVKN-26-0.5	UNT/Piney Creek RM 31.33	1166	0	5746.41	0.00	0.00	0	$0	0	$0	0	0	$0	0
WVKN-26	Piney Creek	1167	29	8573.92	1.34	0.13	14	$73,149	14	$682	60,017	11	$1,378	39
WVKN-26-P	Keaton Branch	1168	99	10081.73	6.74	0.67	53	$366,757	53	$3,417	70,572	42	$1,620	149

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26	Piney Creek	1169	9	11646.29	0.50	0.05	4	$27,247	4	$254	81,524	3	$1,872	12
WVKN-26-K	Soak Creek	1170	678	6191.65	87.59	8.76	442	$4,769,042	442	$44,432	43,342	344	$995	1,228
WVKN-26-K-1	Laurel Branch	1171	412	6923.37	48.18	4.82	261	$2,623,514	261	$24,443	48,464	203	$1,113	724
WVKN-26-K	Soak Creek	1172	393	3570.79	76.69	7.67	301	$4,175,738	301	$38,904	24,996	234	$574	836
WVKN-26-K	Soak Creek	1173	2119	13021.06	513.70	51.37	1790	$27,970,997	1790	$260,599	91,147	1,392	$2,092	4,971
WVKN-26-K	Soak Creek	1174	61	5564.55	24.21	2.42	67	$1,318,452	67	$12,284	38,952	52	$894	187
WVKN-26-J	Turkey Branch	1175	183	6229.02	35.88	3.59	140	$1,953,811	140	$18,203	43,603	109	$1,001	390
WVKN-26-I	Crab Orchard Creek	1176	231	4898.57	68.74	6.87	217	$3,742,767	217	$34,870	34,290	169	$787	602
WVKN-26-I	Crab Orchard Creek	1177	2314	16844.21	532.69	53.27	1906	$29,005,075	1906	$270,234	117,909	1,483	$2,707	5,296
WVKN-26-I-1	Stover Fork	1178	1582	13679.91	430.57	43.06	1413	$23,444,463	1413	$218,427	95,759	1,099	$2,198	3,925

Stream Code	Stream Name	SWS	URBAN/RES/ROAD												
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-G	Whitestick Creek	1179	1209	14218.07	798.35	79.84	1165	$43,470,453	1165	$405,004	99,526	906	$2,285	3,235
WVKN-26-G-1	UNT/White stick Creek RM 2.83	1180	1604	4196.9	332.91	33.29	1261	$18,127,063	1261	$168,886	29,378	981	$674	3,503
WVKN-26-G	Whitestick Creek	1181	630	4252.38	394.18	39.42	568	$21,463,148	568	$199,967	29,767	442	$683	1,577
WVKN-26-G	Whitestick Creek	1182	2887	15176.96	837.30	83.73	2421	$45,591,050	2421	$424,761	106,239	1,883	$2,439	6,725
WVKN-26-G-2	UNT/White stick Creek RM 3.66	1183	0	4764.09	337.55	33.76	0	$0	0	$0	0	0	$0	0
WVKN-26-E	Cranberry Creek	1184	15	8092.82	479.93	47.99	15	$26,132,065	15	$243,466	56,650	12	$1,300	41
WVKN-26-E-1	Little Whitestick Creek	1185	0	4371.71	184.79	18.48	0	$0	0	$0	0	0	$0	0
WVKN-26-E-1-A	UNT/Little Whitestick Creek RM 0.84	1186	0	3945.99	386.41	38.64	0	$0	0	$0	0	0	$0	0

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
WVKN-26-E-1	Little Whitestick Creek	1187	186	19092.72	1422.96	142.30	154	$77,480,276	154	$721,866	133,649	119	$3,068	427
WVKN-26-E	Cranberry Creek	1188	169	12376.01	1265.35	126.54	119	$68,898,688	119	$641,913	86,632	93	$1,989	331
WVKN-26-E	Cranberry Creek	1189	0	2440.38	67.41	6.74	0	$0	0	$0	0	0	$0	0
WVKN-26-E-2	UNT/Cranberry Creek RM 4.51	1190	20	7951.12	115.98	11.60	15	$6,315,325	15	$58,838	55,658	12	$1,278	42
WVKN-26-E	Cranberry Creek	1191	54	9169.76	40.19	4.02	32	$2,188,405	32	$20,389	64,188	25	$1,474	89
WVKN-26-D	Griffith Branch	1192	1113	7623.6	270.49	27.05	845	$14,728,390	845	$137,221	53,365	657	$1,225	2,347
WVKN-26-C	Stanaford Branch	1193	1374	13689.26	253.22	25.32	1014	$13,787,848	1014	$128,458	95,825	789	$2,200	2,817
WVKN-26-A	Batoff Creek	1194	0	2921.55	0.02	0.00	0	$0	0	$0	0	0	$0	0
WVKN-26-A	Batoff Creek	1195	347	8205.36	34.70	3.47	208	$1,889,684	208	$17,606	57,438	161	$1,319	577
WVKN-26-A	Batoff Creek	1196	150	8674.88	14.37	1.44	89	$782,520	89	$7,291	60,724	70	$1,394	248

Stream Code	Stream Name	SWS	URBAN/RES/ROAD											
			Required Reduction (lbs/yr)	Stream Reach Length (Feet)	Total Urban/Res/Roads (Acres)	Available Landuse Area [1] (acres)	Rain garden Reduction [2] (lbs/yr)	Rain garden Costs (50% applicable landuse area * $25/sq ft)	Constructed Wetland Reduction [2] (lbs/yr)	Constructed Wetland Cost [3]	Riparian Stream Area [4] (ft2)	Riparian Buffer Reduction [5] (lbs/yr)	Riparian Stream Buffers ($1000/acre)	Total Anticipated Reduction from implementation (lbs/yr)
TOTAL		**$675,619,027**						**$669,260,466**		**$6,235,345**			**$123,216**	

Notes:

1 (assumes 10% of the urban landuse available for implementation)
2 (90% removal Efficiency*(1/3) of the Fe load)
3 (50% applicable landuse area*$10146 constructed wetland cost per acre)
4 (assumes 10% of the stream channel is available for 35 foot buffer on both sides)
5 (70% removal Efficiency)

6.3 Cost Estimations

The cost estimates provided in this report are not meant to represent actual design and construction costs for the proposed projects. Project specific cost estimates should be recalculated when a decision has been made to move forward with a specific project. Construction costs can be more accurately estimated during the preliminary design and construction scoping phase for each project.

Proposed project costs were calculated using general assumptions, general construction costs from various sources, as well as average West Virginia-specific construction costs from public request for quotation solicitations by WVDEP to obtain cost estimates for various construction projects. Specific methods for calculating cost can be found in **Appendix** D and the calculation spreadsheet in **Appendix D1**.

The entire Piney Creek Watershed implementation costs as calculated in Appendix D1 are summarized in **Table 6-9** below. The anticipated costs for the 38 proposed implementation projects and the already completed projects are also shown.

Table 6-9. Fecal Coliform and Iron Reductions and Cost Estimate Summary

Fecal Coliform	
Implementation Method	Estimated Implementation Cost
Agricultural	$28,183
Failing Septic	$59,789,000
Residential	$442,952
MS4 Residential	$167,245,301
Total	**$227,505,436**
Iron	
Implementation Method	Estimated Implementation Cost
Stream Bank Erosion Restoration	$208,759,047
AML, Forfeiture, Barren Land Restoration	$21,697,036
Forest Harvest and Oil and Gas Restoration	$1,445,542
Urban Land Restoration	$675,619,027
Total	**$907,520,651**
Total Estimated Watershed Implementation Costs	**$1,135,026,087**
38 Proposed Project Estimate	$32,676,605
Completed Sewer Line Extensions	$48,924,718
Completed Rain Gardens and Wetland	$171,000

Current Events Information

Conservation Easement in Raleigh County West Virginia

Over one thousand acres of land will now be protected in Raleigh County, including land along 6 miles of tributaries to the New River. This 1,324 acre area is the largest easement the National Committee for the New River (NCNR) has received, and the first in West Virginia. The NCNR has 37 other easements in North Carolina and Virginia. With the recent addition of the West Virginia easement, the NCNR has 6,900 total acres under protection. With such a large easement now in the region, it is hoped that other landowners in the New River Watershed, including Piney Creek will be encouraged to investigate the benefits of placing conservation easements on their land.

There are other conservation groups working in West Virginia to establish protective easements. Different groups focus on a diverse array of conservation priorities specific to each group's goals when establishing easements. Some of the organizations are as follows:

- West Virginia Land Trust
- Ducks Unlimited
- Pheasants Forever
- The National Wild Turkey Federation
- Southern Conservation District
- Natural Resources Conservation Service (NRCS)
- The Nature Conservancy

Reference: Associated Press, WHSVC Channel 3 ABC. First WV Easement to Protect Land in New River Watershed. (http://www.whsv.com/home/headlines/88467262.html) March 19, 2010

7.0 Implementation Prioritization Schedule and Milestones

The Piney Creek Steering Committee that was established as part of this implementation plan will continue to meet regularly and discuss future implementation projects, funding, status of ongoing projects, and implementation milestones. At a minimum, the project implementation schedule (**Table 7-1**) will be reviewed and revised as necessary every five years by PCWA and the Steering Committee. An action item list will be used to ensure forward momentum and progress. A summary of each Steering Committee meeting will be written up and circulated to the group and presented at the regular monthly PCWA meeting. Continued interaction with stakeholders and focus groups are imperative to further develop relationships for implementing large scale projects. The implementation timeframe presented in **Table 7-1** incorporates the 2006 AML funding reauthorization for a 15 year time period (2007-2021). The federal AML program will need to be reevaluated and approved by Congress at that time to continue additional funding of AML projects. Currently funded sewer line extensions projects should be completed no later than the end of 2013. The implementation timeframe is provided as a guide and should be flexible to accommodate new or higher priority projects and/or projects that can secure funding in a timelier fashion.

The Steering Committee designed the following project prioritization ranking methodology for each of the projects.

- Rank each project according to estimated cost. Lowest cost = rank 1
- Rank stream miles improved by each project. Highest miles improved = rank 1
- Rank each projects calculated iron reduction. Highest iron load reduction = rank 1
- Rank each projects calculated fecal coliform reduction. Highest fecal coliform load reduction = rank 1
- Average the ranks of each project for the four categories above.
- Rank each of the calculated averages for each project.
- The overall Priority Rank (Table 6-1) for each project is the implementation order in which projects should be undertaken
- The 38 projects were assigned a high, medium, and low priority according to the overall Priority Rank resulting in 13 High, 13 Medium, and 12 Low priority projects

The implementation schedule starts with the high priority projects to be completed within the first five years; medium priority projects have a completion goal of 10 years; and low priority projects within 15 years. The schedule is built to be flexible and can be modified based on specific circumstances such as landowner consent, pubic involvement, funding opportunities, or other unforeseen events. This implementation schedule also allows for additional projects to be added at any time that are deemed to significant in reducing pollution and improving water quality. The prioritization and suggested order of implementation is shown in **Table 7-1**; however, projects may be implemented based on community need, available funding and willing landowner participation. The prioritization schedule was calculated by ranking estimated project costs, stream miles affected, and fecal coliform and iron load reductions. It is difficult to judge and assess more qualitative, but none the less important, parameters such as community acceptance, political support, and property owner willingness to cooperate. These local intangible parameters certainly can play a role; therefore the proposed implementation schedule needs to be flexible and adjusted based on these uncertainties.

Table 7-1. Project Implementation Schedule

SWS	Project Area	Project Description	Priority Rank (Number)	Project Priority	Point or Nonpoint	Implementation Timeframe
1187	New River Drive	Soil Erosion	1	High	Nonpoint (MS4)	2013
1188	Dry Hill Area Seep	Iron AMD Seep	2	High	Nonpoint (MS4)	2015
1187	Maxwell Hill/Tolley Drive triangle retrofit	Stormwater Management	3	High	Nonpoint (MS4)	2014
1196	Batoff Area Iron Seep	**Iron AMD Seep**	4	High	Nonpoint	2016

SWS	Project Area	Project Description	Priority Rank (Number)	Project Priority	Point or Nonpoint	Implementation Timeframe
1162	Jonben Refuse Pile	AML restoration	5	High	Nonpoint	2017
1188	Cranberry Creek Seeps	Iron AMD Seep	6	High	Nonpoint (MS4)	2018
1187	Ewart Street	Constructed Wetland	7	High	Nonpoint (MS4)	2019
1187	Barren Land off of Harper Road by Pizza Hut	Soil Erosion	8	High	Nonpoint (MS4)	2020
1188	Barren Land behind BBT Building	Soil Erosion	8	High	Nonpoint (MS4)	2021
1188	Maxwell Hill Elementary School Retrofit/ Environmental Education	Stormwater Management	10	High	Nonpoint (MS4)	2022
1179	Beckley Junction	Stream Restoration and Constructed Wetland	11	High	Nonpoint	2023
1152	Town of Cedar Sewer Extension	Wastewater extension	12	High	Point	2013
1118, 1193, 1195, 1196	Piney View Sewer Project	Decentralized/cluster system	12	High	Nonpoint/Point	2024
1113, 1114, 1115, 1116	Pemberton Sewer Extension	Wastewater extension	14	Medium	Point	2013
1170, 1172, 1175, 1152, 1153, 1155	Grandview Sewer Project	Decentralized/cluster system	14	Medium	Nonpoint/Point	2025
1155	Abney Refuse Pile	AML restoration	16	Medium	Nonpoint	2019
1150, 1151,1179	Town of Fitzpatrick Sewer Extension	Wastewater extension	17	Medium	Point	2013
1161,1162 1163,1164 1165	Jonben/Fireco Sewer Project	Decentralized/cluster system	17	Medium	Nonpoint/Point	2026
1183	Crescent Elementary Retrofit/Environmental Education	Stormwater Management	19	Medium	Nonpoint (MS4)	2027
1120	YMCA	Soil Erosion	20	Medium	Nonpoint (MS4)	2021
1179	Downtown Fayette Street Daylighting /stormwater management facility	Stormwater Management	20	Medium	Nonpoint (MS4)	2021
1157, 1155, 1156	Whitby/Mt Olive Sewer Project	Decentralized/cluster system	22	Medium	Nonpoint/Point	2022

SWS	Project Area	Project Description	Priority Rank (Number)	Project Priority	Point or Nonpoint	Implementation Timeframe
1187	Pine Hills Stormwater retrofit	Stormwater Management	23	Medium	Nonpoint (MS4)	2022
1162	Coal City/Abney Sewer Extension	Wastewater extension	24	Medium	Point	2013
1155	Laurel Creek Mouth	Stormwater Management	24	Medium	Nonpoint (MS4)	2023
1169	Piney Creek Headwaters Seep	Iron AMD Seep	26	Medium	Nonpoint	2019
1149	Stratton Elementary Retrofit/ Environmental Education	Stormwater Management	27	Low	Nonpoint (MS4)	2023
1188	Cranberry Creek Seep	Iron AMD Seep	28	Low	Nonpoint (MS4)	2020
1193	Stanaford Branch Complex	AML Restoration	29	Low	Nonpoint	2020
1184	Little Whitestick Creek Refuse Pile	AML Restoration	30	Low	Nonpoint	2021
1184	Beckley- Stratton Middle School/ Retrofit/ Environmental Education	Stormwater Management	31	Low	Nonpoint (MS4)	2024
1158	Whitby Area Seep	Iron AMD Seep	32	Low	Nonpoint	2021
1179	ACCWT Environmental Education/Office retrofit	Stormwater Management	33	Low	Nonpoint (MS4)	2024
1188	Cranberry-Prosperity School/Retrofit/Environmental Education	Stormwater Management	33	Low	Nonpoint (MS4)	2025
1153	Town of Sullivan Sewer Project	Decentralized/cluster system	35	Low	Nonpoint/Point	2025
1188	Woodrow Wilson High School Retrofit/Environmental Education	Stormwater Management	36	Low	Nonpoint (MS4)	2026
1120	YMCA	Stormwater Management	37	Low	Nonpoint (MS4)	2027
1184	Beckley Elementary Retrofit /Environmental Education	Stormwater Management	37	Low	Nonpoint (MS4)	2028
1196	**Batoff Area Aluminum Seep**	**Aluminum AMD Seep**		**High**	**Nonpoint**	**2016**

7.1 Fecal Coliform

The Beckley Junction project has begun preliminary planning meetings between Raleigh County, BSB and the landowner's representative. All parties are interested in participating in this project, although there are differing ideas of the specific treatment options and project goals. Continued coordination and planning with the stakeholders for this project could result in a highly visible and successful beginning to this much needed community project. The reductions from this project, combined with other suggested projects upstream would have a significant impact to improving water quality on Whitestick Creek. Large constructed wetlands and rain gardens to treat stormwater runoff from large drainage areas in conjunction with public sewer extensions, decentralized sewage treatment systems, and repairing leaking or damaged wastewater collection pipes are the most practical for making large steps toward meeting the required fecal coliform bacteria reductions.

7.2 Metals

The Beckley Sanitary Board has started to add rain gardens into their overall stormwater management philosophy. Four have completed construction and one more is in the design phase currently. The main purposes of rain gardens are water retention and infiltration. However, they also provide an efficient removal rate for fecal coliform bacteria, metals and sediment. These added benefits make them an extremely cost effective treatment option in urban areas. In the near future, BSB will begin to sample influent and effluent from these structures to determine specific efficiency rates for various parameters.

Three AMD seeps projects ranked in the top 10, Dry Hill, Batoff Creek and Cranberry Creek. All efforts should be made to coordinate with WVDEP, AML&R to check on the status of these projects and impress upon them the importance for completing these projects in a timely fashion. Although stream restoration projects are costly, they enhance aquatic habitat while providing significant reduction to streambank erosion. Stabilizing streambanks using green restoration techniques can have a tremendous impact toward meeting the streambank erosion reduction goals.

8.0 Implemented Project Reductions

Significant effort has been made since the TMDL development process for the Piney Creek watershed began in 2006, and completed with USEPA approval in November 2008. To date, more than 49 million dollars has been spent on wastewater infrastructure improvement and expansion projects throughout the watershed. **Table 8-1** shows the public sewer extensions and the load reductions attributed to those projects. **Table 8-2** displays completed wetland and rain garden projects that have reduced storm water contributions of both iron and fecal coliform pollution.

Taking into account the load reductions from projects already implemented and the 38 proposed implementation projects, the remaining necessary load reductions for each impaired stream can be predicted. **Tables 8-3 and 8-4** show the iron and fecal coliform loads reduced from already implemented projects and proposed implementation projects, as well as the remaining loads required to be reduced to meet the TMDL condition. **Figures 8-1 and 8-2** show the same information in a graphical format. Further calculations were made assuming that the remaining loads will be targeted for green projects such as created wetland and rain gardens. Using the already constructed projects in Table 8-2 as a guide, approximately 1 acre of constructed rain garden or wetland can reduce the iron load by 743 pounds per year and fecal coliform load by approximately $6.83E10^{+11}$ counts per year. By using these assumptions, the required acres for green projects was calculated for each impaired stream and is shown in the last column in **Tables 8-3 and 8-4** below. The required green project acres can be reduced significantly by vegetating barren areas and by incorporating stream bank stabilization and restoration projects for additional iron reductions. By continuing to locate and repair failing septic tanks, eliminating illicit discharges to the stormwater system, extending wastewater infrastructure, constructing decentralized or cluster wastewater systems, repairing leaking wastewater lines, and reducing inflow and infiltration will all help to achieve additional fecal coliform reductions.

Table 8-1. Completed Sewer Extension Projects

Sponsor	TMDL Sub Watershed	Impaired Stream	Customers	Description	Total Cost	Sewer Extension Reductions (counts/yr)	Year Completed
Shady Spring PSD	1145 1142 1144	Beaver Creek	716	Design: Upgrade seven existing pump stations to accommodate increased flows, slipline of existing interceptor sewer to correct infiltration, and design expansion to the existing sewage treatment plant.	$247,000		May 2011
Shady Spring PSD		Beaver Creek		Upgrade Capacity of Wastewater Treatment facility from 0.8 to 1.2 mgd, aeration basin., sludge basin, sludge holding, clarifier, chorine contact chamber and related items	$1,011,800		2002
Shady Spring PSD	1129 to 1134	Little Beaver	409	Wastewater collection system project including purchase of the Glade Springs system and construction of new collection system to serve Mont Philips	$1,591,000	1.44E+11	April 1999
North Beckley	1193	Piney Creek	532	Sewer extension areas within the district of Stanaford, Oakley Road, and Maxwell Hill	$7,707,741	7.36E+11	2005
North Beckley PSD	1193	Piney Creek	300	Extend sanitary sewer lines to serve the unincorporated community of Lanark along State Route 41 and Stanaford Branch	$4,831,042		2011
Crab Orchard MacArthur PSD	1176, 1151, 1178, 1177, 1175	Piney Creek	200	Miscellaneous Extensions Throughout the PSDs area	NA	1.22E+12	80% Jan' 2012 100% June 2012
City of Beckley Sanitary Board		Piney Creek Whitestick	10	Replaced approximately 6 miles of Piney Creek Interceptor Sewer to reduce Inflow & Infiltration (I&I) & relieve hydraulic overloading.	$9,039,000		2006
North Beckley PSD		Piney Creek		Constructed 2.5 MGD wastewater treatment plant and upgraded Sprague lift station and force main	$8,090,898		2001
Town of Sophia PSD	1171	Soak Creek	170	Sewer extensions to Soak Creek area, Independence Junior and Senior High Schools, Coal City Elementary School	$2,407,031	1.62E+10	2009

Sponsor	TMDL Sub Watershed	Impaired Stream	Customers	Description	Total Cost	Sewer Extension Reductions (counts/yr)	Year Completed
Town of Sophia PSD	1171	Soak Creek	35	Extension to the Coal City Mobile Home Park. Project has been put on hold the Crab Orchard MacArthur PSD is running the lagoon system located there for now.	NA		Not done
Crab Orchard MacArthur PSD	1182	Whitestick Creek	150	Extension of the line to include 150 new customers	$2,814,606	1.02E+11	100% October 2012
City of Beckley Sanitary Board	1179	Whitestick Creek	23	Replacement of existing sanitary sewers to reduce I & I and extend service to the Redbrush area	$4,212,100	1.20E+10	2012
Beckley Sanitary Board		Whitestick Creek		Replace sanitary sewers, extend sanitary sewer service, install a new effluent flow meter at WWTP, improve Whitestick CSO, construct a new maintenance garage, rehab primary clarifiers at the WWTP	$6,972,500		January 2011
Beckley Sanitary Board	1181	Whitestick Creek		Eliminated a SSO in Mabscott on Whitestick Creek		1.08E+13*	2006

* Baseline load is an average of the Fayetteville and Hinton CSO baseline loads.

Table 8-2. Completed Iron and Fecal Coliform Projects

Sponsor	Type of Project	Location	SWS	Drainage Area (acres)	Project Area Footprint (acres)	Total Project Costs	Fe Reduction Calculation (lbs/year)	FC Reduction (counts/yr)	Year Completed
PCWA	Wetland	Shady Spring Library	1141	5.00	0.0698	$6,000	59.07	3.45E+10	2010
Beckley Sanitary Board	Rain garden	320 City Ave, Beckley	1179	0.50	0.0275	$25,000	2.42	3.80E+09	2010
Beckley Sanitary Board	Rain garden	Robert Street, Beckley	1183	2.26	0.0349	$100,000	30.78	3.33E+10	2010

Sponsor	Type of Project	Location	SWS	Drainage Area (acres)	Project Area Footprint (acres)	Total Project Costs	Fe Reduction Calculation (lbs/year)	FC Reduction (counts/yr)	Year Completed
Beckley Sanitary Board	Rain garden	Howe Street, Beckley	1187	0.45	0.0078	$30,000	4.39	6.07E+09	2009
Beckley Sanitary Board	Rain garden	Exhibition Coal Mine	1187	2.50	0.0230	$10,000	24.38	3.37E+10	2008

Table 8-3. Iron Reductions for Impaired Streams

Stream Name	Required Reduction (Baseline-TMDL) (lbs/yr)	Fe Completed Reduction (lbs/year)	Fe Proposed Reduction (lbs/year)	Fe Sum of Completed + Proposed Reduction (lbs/yr)	Fe Remaining Reduction Necessary (lbs/year)	% Reduction Required in TMDL	% Implementation Achieved	Acres Required to Treat Remaining Load
Batoff Creek WVKN-26-A	3,379		3,795	3,795	-416	18.88	21.21	-0.56
Beaver Creek WVKN-26-F	29,968	59		59	29,909	23.43	0.05	40.28
Bowyer Creek WVKN-26-M	5,284	306		306	4,978	21.99	1.27	6.70
Cranberry Creek WVKN-26-E	45,471	29	4,266	4,295	41,176	39.78	3.76	55.45
Laurel Creek WVKN-26-N	1,524		162	162	1,361	11.20	1.19	1.83
Piney Creek WVKN-26	224,700	121	1,285	10,024	206,059	30.06	1.34	277.49

Notes: Required Reduction is calculated from the TMDL by (Baseline LA + Baseline WLA) - (TMDL LA + TMDL WLA)
Acres required to treat remaining load is calculated by dividing the remaining load column by 743 pounds/year

Table 8-4. Fecal Coliform Reductions for Impaired Streams

Stream Name	Required Reduction (Baseline-TMDL) (counts/yr)	FC Completed Reduction (counts/yr)	FC Proposed Reduction (counts/yr)	FC Sum of Completed + Proposed Reduction (counts/yr)	FC Remaining Reduction Necessary (counts/yr)	% Reduction Required in TMDL	% Implementation Achieved	Acres Required to Treat Remaining Load
Beaver Creek WVKN-26-F	9.51E+12	3.45E+10		1.79E+11	9.33E+12	10.50	0.20	13.66
Bowyer Creek WVKN-26-M	2.27E+11		1.39E+11	1.39E+11	8.78E+10	3.35	2.05	0.13

Stream Name	Required Reduction (Baseline-TMDL) (counts/yr)	FC Completed Reduction (counts/yr)	FC Proposed Reduction (counts/yr)	FC Sum of Completed + Proposed Reduction (counts/yr)	FC Remaining Reduction Necessary (counts/yr)	% Reduction Required in TMDL	% Implementation Achieved	Acres Required to Treat Remaining Load
Cranberry Creek WVKN-26-E	4.76E+13		2.90E+12	1.00E+13	3.04E+13	40.11	8.47	44.48
Laurel Creek WVKN-26-N	1.29E+11		1.98E+11	1.98E+11	-6.95E+10	2.42	3.73	-0.10
Little Beaver Creek WVKN-26-F-2	2.16E+12	1.44E+11		1.44E+11	2.02E+12	7.69	0.51	2.95
Little Whitestick Creek WVKN-26-E-1	2.58E+13	3.98E+10	7.10E+12	7.14E+12	1.86E+13	46.86	12.98	27.28
Piney Creek WVKN-26	1.12E+14	1.31E+13		4.66E+13	2.43E+13	21.44	8.95	35.51
Soak Creek WVKN-26-K	2.41E+12	1.62E+10	2.83E+11	2.99E+11	2.11E+12	12.17	1.51	3.10
Whitestick Creek WVKN-26-G	3.68E+13	1.09E+13	1.17E+13	2.26E+13	1.42E+13	48.53	29.81	20.76

Notes: Required Reduction is calculated from the TMDL by (Baseline LA + Baseline WLA) - (TMDL LA + TMDL WLA)
Acres required to treat remaining load is calculated by dividing the remaining load column by $6.83E^{+11}$ counts/year

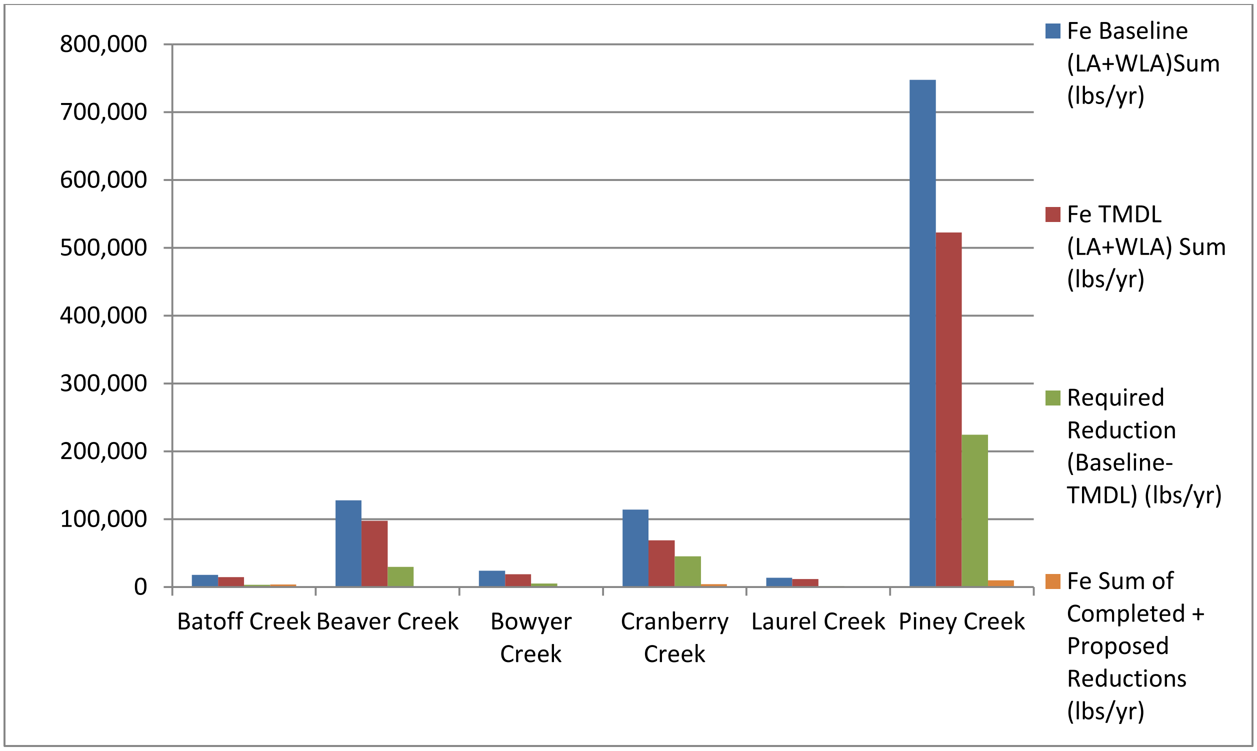


Figure 8-1. Iron Impaired Stream Loads

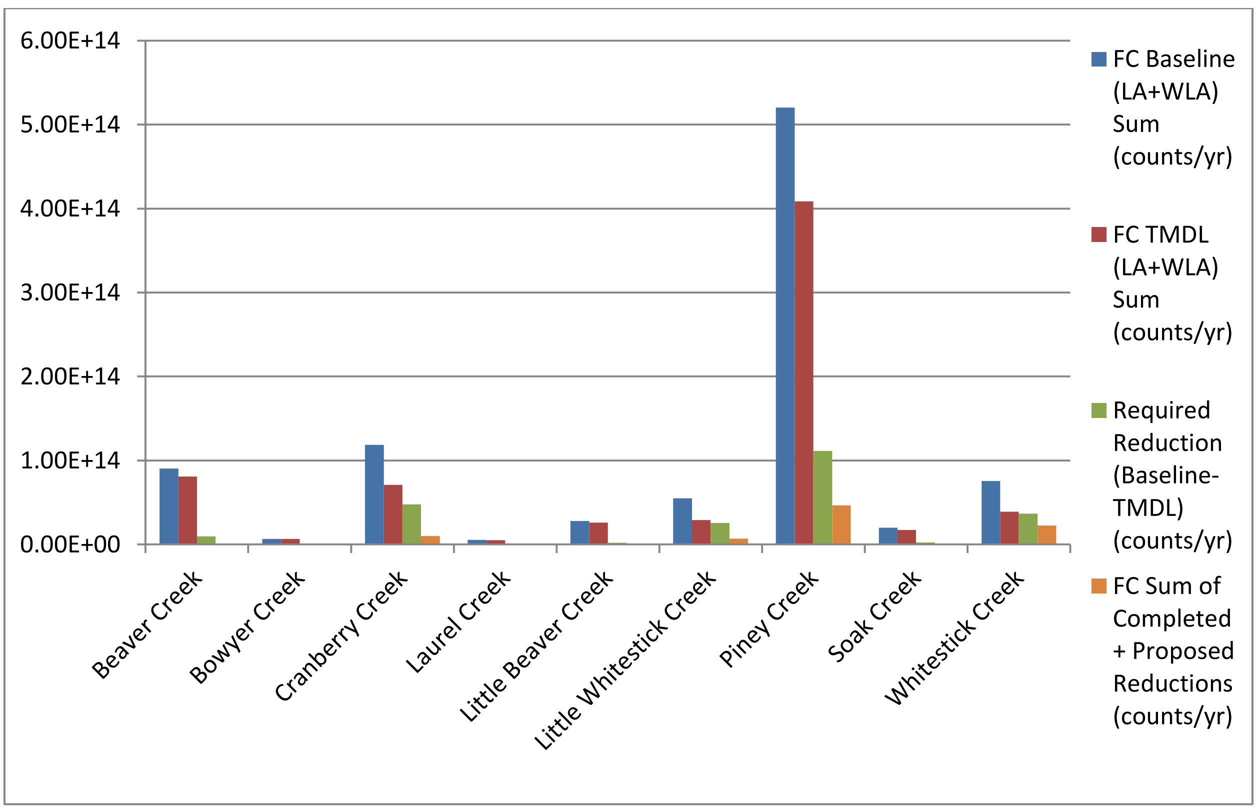


Figure 8-2. Fecal Coliform Impaired Stream Loads

9.0 Monitoring Implementation Projects

A few different approaches can be used to monitor and document progress during the implementation of the watershed plan. Both quantitative and qualitative approaches can work in tandem with each other. Qualitative observations can be made to be easily obtained and do not require elaborate or time consuming methods. Quantitative measures can be more involved and require more effort to gather information.

The watershed association can keep track of the public outreach events in which the watershed organization takes part, document the attendance with a sign in sheet, and document activities that occur at each event. An annual report of these events can be complied and qualitatively tracked year by year. The watershed association should begin to establishing water quality monitoring stations to determine where implementation projects would maximize pollutant load reductions. Sample stations should target suspected source areas to definitively identify and quantify pollution. If specific sources are not readily identified, pollutant tracking upstream may be necessary to isolate individual sources. This can be done by conducting stream surveys and collecting samples at intervals or when new inflows to the stream are discovered.

A basic sampling plan would be needed to ensure proper documentation and methodologies are being used based on the specific implementation project. If a large scale stream restoration or wetland creation project were constructed in the watershed, a specific monitoring plan could be developed to track water quality and document pollutant concentrations over time. Concentration trends of individual parameters could be evaluated to determine if the implementation project is indeed functioning to reduce pollutant parameters and document the projects specific removal rate over time. Trend analysis will also be used to establish performance benchmarks to measure implementation progress. In general, a sampling strategy may consist of the following:

- Evaluate which parameters should be collected, the sample collection methods to be used, laboratory analytical methods, and method detection limits appropriate to compare to water quality criteria.
- Prior to any construction conduct at least two (high and low flow), and more if possible, sampling events to establish baseline chemistry conditions above and below the proposed site.
- Consider sampling for macroinvertebrate to document baseline ecological conditions above and below the site.
- After construction of the project, conduct monthly or at a minimum, quarterly sampling above and below the site. Efforts should be made to capture high flow and low flow conditions on a yearly basis.
- Consider sampling for macroinvertebrates to document post construction ecological conditions above and below the site on a yearly basis

- Produce an annual report summarizing the collected data and general trends of the data. As additional years of data are collected, long term trends should become apparent. Most wetland and stream restoration projects have a 5 year minimum monitoring requirement.
- If long term trends do not show improvement, reevaluation of design specifications will be conducted to determine why load reductions are not as anticipated.

Qualitative measures of overall program success will also be measured at yearly intervals. Annual implementation status reports will be conducted by PCWA to show the number of projects undertaken throughout the watershed during the year, total project acres and/or total stream miles restored. The Executive Director of PCWA can also work closely with the various Public Service Districts and Beckley Sanitary Board to obtain summary information about PSD and MS4 implementation projects that reduce pollutant loading in the watershed. Every five years the implementation goals will be reviewed and reassessed as necessary by the PCWA and the Steering Committee.

9.1 Collecting Sampling Data

Chemical, biological and physical data collection in the watershed is an essential component to track the effectiveness of implementation projects toward reaching the load reductions stated in the TMDLs. Sampling results can also provide a baseline for pre-implementation activity within the watershed. The pre-implementation data gathered from sites can help determine the best type of treatment for site specific circumstances and design of specific treatment systems. Post implementation data can assist in determining if the treatment system is functioning properly, help to make modifications to the treatment process, if necessary, and determine the efficiency of the treatment system in removing targeted pollutants. This documentation is critical in showing progress toward improving water quality throughout the watershed and achieving the required TMDL load reductions for various pollutants.

PCWA will work with BSB to develop a routine to also randomly sample a portion of the 35 subwatersheds contained with the Cranberry Creek and Whitestick Creek subwatersheds. During this random sampling, the monitors will complete urban subwatershed assessments to attempt to document land use characteristics that may be contributing to the water quality impairments. The study period will allow the initiation of targeted monitoring at potential project sites for water quality projects. The list of potential study sites include the Fayette Street stream day lighting/constructed wetland area, the Stanaford Mine Road Cranberry Mine AML mitigation site, the Little League stream corridor enhancement/stormwater retrofit area, the Soccer Complex barren land mitigation area, private barren land properties within the Cranberry Creek headwaters. At minimum two of these study sites will be characterized and wet weather sampling completed to provide the first in the field ground truthing of estimated pollutant loads during the study period.

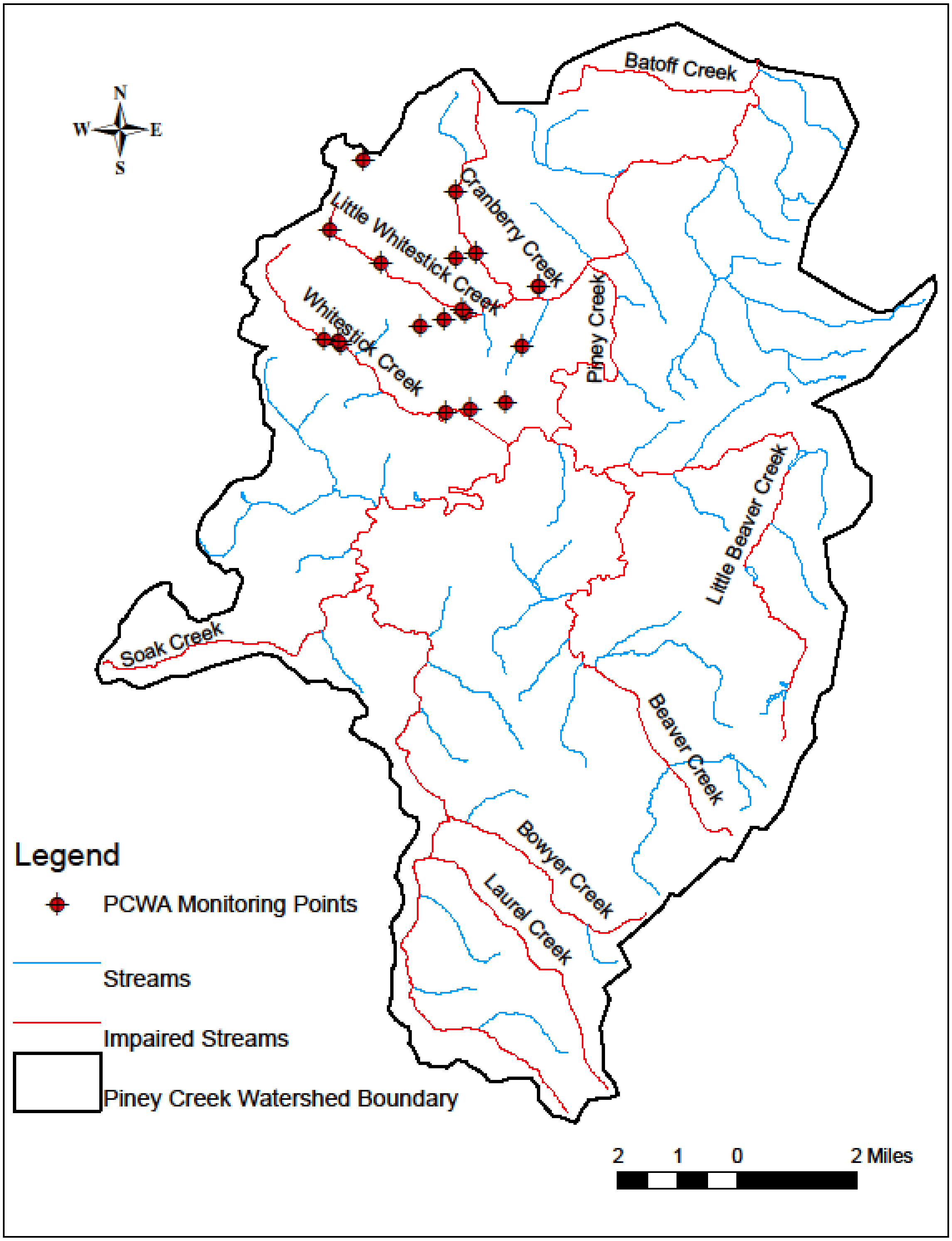


Figure 9-1 Proposed Piney Creek Sampling Stations

The volunteers will also be taking temperature, DO and pH readings at each site using a handheld multimeter. All of the volunteers have participated in a WV Save Our Streams Workshop where they learned how to accurately take biological samples and grab samples. The PCWA will work with the WVDEP to develop and obtain approval on a QAPP which is required if federal funding is used to support any sampling activities. The New River Clean Water Alliance has also offered assistance to the PCWA with creating a QAPP and other issues that watershed groups typically encounter when starting up their monitoring programs.

Although the PCWA does not have a Quality Assurance Project Plan (QAPP) in place at this time, they are committed to completing one in the near future. They are currently following a Field Sampling Plan (FSP) to ensure the quality of their sampling data. All of the sampling sites will be marked with paint or flagging and GPS coordinates will be taken to ensure that the site sampling history will be precise. Each sample bottle will be marked with site information, time, and date. A field form will be filled out that will record temperature, weather conditions, sample time, date, and the names of the volunteers performing the monitoring. After water samples are collected, they will stored on ice in a cooler and transported to the Beckley Sanitary Board's laboratory so they will be analyzed within the analytical hold time as required by the analytical methods. As the PCWA builds up their membership base and sampling experience, additional sites will be added.

In the future, PCWA will also add metals analysis to the current suite of pollutants, appropriately based on the type of impairment identified at each sampling location. As the PCWA secures more funding for sampling, additional sites throughout the watershed can be added to the sampling plan.

In general, the PCWA will establish sampling locations above and below the highest priority implementation projects identified in the implementation plan. The intention is to begin sampling before any construction begins to establish a baseline condition. Sampling should continue through construction and for a minimum of five years after construction ends. This period of record will ensure enough data for statistical analysis and identification of trends, both above and below the implementation project. This data can then be used to evaluate and determine if water quality is being improved and to make any necessary adjustments to improve the efficiency of the implementation project. As implementation progresses throughout the watershed it will also become necessary to add iron as an additional analytical parameter. To ensure that this sampling plan is carried out by PCWA, additional volunteers are needed as well as financial or teaming partners to assist in funding laboratory analysis.

The National Park Service (NPS) has historical data for fecal coliform bacteria on the New River and various tributaries and has recently established a sampling station located at the mouth of Piney Creek near the confluence with the New River. The NPS plans to continue to collect sample data on Piney Creek on a yearly basis.

Additionally, the WVDEP WAB program will continue their regularly scheduled monitoring regime, as determined by the Watershed Management Framework. The WAB team will continue to collect quarterly ambient water quality samples. WVDEP WAB follows a 5 year rotating basin sampling schedule. Hydrologic Group D, which contains the Upper and Lower New River Watersheds, is scheduled to be sampled in the following years: 2012, 2017 and 2022.

As implementation projects are designed and constructed, the management entity for each implementation project will be responsible for ensuring that project specific monitoring requirements are followed as outlined in required permits.

10.0 Education and Outreach Component

The watershed association has interested members who are capable of conducting public education and outreach. The association has been conducting outreach at local events and sponsoring activities for the general public. Example activities that the watershed association is willing to organize and seek funding include:

- Pet waste education
- Proper septic system maintenance/cleanouts
- Private sanitary sewer line replacement
- Stop Mud – Volunteer construction site reporting
- Training and education to private landowners to implement erosion control.

Outreach is anticipated to be a major factor in the implementation process. PCWA hosted the public meetings regarding this plan to incorporate stakeholders’ input into this process. As the watershed association gains experience with project implementation, the need for additional members and volunteers will increase. The PCWA should make every effort to obtain additional contact information for potential new members and volunteers at all watershed association events. It is suggested that a database or spreadsheet of contact information be maintained by the association. Periodic notification by email can be sent to new member prospects, such as the quarterly newsletter and special events notifications. The sections that follow have been identified by the PCWA as important areas for the watershed association to continue to concentrate outreach and educational efforts.

10.1 Events

Watershed Meetings

The PCWA holds monthly general members and board meetings. The general membership meetings are open to the public and a good opportunity for new people to become involved. Committees for specific projects meet as needed. The monthly meetings are held at the BRCCC meeting room.

Watershed Festival

The PCWA puts together a watershed festival every year that informs the public of various issues within the watershed. Many local stakeholders get involved with the festival, including local businesses, other conservation organizations, local, state and federal government agencies, private citizens, and local schools. This is an excellent opportunity for the association to solicit additional members and volunteers for upcoming projects. This is another opportunity for the association to make the public aware of information such as the Citizens Guide created by the WVDEP's Office of Environmental Advocate. This document contains information for the general citizen on how to protect the environment (http://www.dep.wv.gov/environmental-advocate/Documents/DEP2008CitizensGuide.pdf). The Ohio River Valley Water Sanitation Commission's pamphlet, *How to Properly Dispose of Unwanted Medication* (http://orsanco.org/images/stories/files/publications/biological/orsanco%20pharmaceutical%20pamphlet.pdf) is another internet reference that can help the general public contribute to cleaner surface water.

Partners Include

- WVDEP- Nonpoint Source Program and Public Information Office
- WVDNR- Parks and Wildlife
- National Park Service
- ACCT
- Beckley-Raleigh County Chamber of Commerce
- Local businesses donations of food, funding and supplies
- City of Beckley Recreation Department
- Southern Conservation District
- Master Gardeners

Moving into the future, the PCWA will need to expand and update various components of their association. Such as expanding upon the events in which they become involved will be important. Setting up a booth, sponsoring an event with in-kind services, and speaking with other organizations and groups within different demographics are all ways to get new members and volunteers to participate with the association.

Rainbarrel Workshops

Water conservation education is a priority to PCWA. Rainbarrel workshops are a tool to promote household water conservation practices. Annually, PCWA provides workshops that include the barrels, plumbing components and demonstrates how to set up and use a rainbarrel at a reasonable cost to the resident.

10.2 Media

An effective way to encourage more public involvement is to use traditional media outlets such as newspapers, TV and radio to publicize events and solicit volunteers to assist with special projects. Distributing occasional press releases, and making personal visits or calls to these sources can help keep them informed as to what is happening in the community.

Publications

The association's tri-annual newsletter is another way the members and volunteers can get involved within the watershed. The newsletter is put together solely by volunteers and contains educational and informational articles to show the public how to become involved in the watershed and the importance of their participation. The newsletter is currently provided both by mail or email to over 100 interested people in the Piney Creek area. It is suggested that the association encourage the distribution of the newsletter by email in order to reach a greater number of people without any additional cost.

Website

The internet is another way the PCWA is working to encourage more volunteers to become involved with association events. The web links are: http://www.pineycreekwatershed.org/ or http://myplace.frontier.com/~vzeyjhu1/pcwa/index.html. The PCWA also uses Facebook (*www.facebook.com/group.php?gid=38551473441*) as a way to get information out to their membership about upcoming events in a hurry. PCWA is working on upgrading the website to include this report, events, newsletters, watershed concerns and future monitoring data.

10.3 Recreation

PCWA holds stream walks to get outside and explore new areas of the watershed and involve more members. The association could expand on this form of outreach by advertising their walks in the newspaper, through email notifications and by inviting the local news media to cover local current events or at least notify the public of the events.


10.4 Projects

The Shady Spring Library Wetland and Trail

The Straley Walker Memorial Branch Library wetland, located in Shady Spring, was designed by volunteers with the idea of treating runoff from the library's parking lot and providing hands-on teaching tool. The project works at a site level to reduce polluntant load, which is necessary to achieve PCWA's goal of removing Piney Creek from West Virginia's list of impaired streams. As a demonstration project, the project educates library patrons, parents, teachers and school children from the two adjacent community schools. Local youth can learn about the process of how wetlands work and help to filter water. The wetland captures 18,000 gallons of water during a 1 inch rainfall event and provides wildlife habitat in its 1,500 square foot area. The Shady Cattail Trail connects the library to the local middle school by providing easy access to the wetland for study within their classes.

Partner's involved:

- WVDEP Nonpoint Source Program
- ACCT
- Shady Spring Middle School
- Straley Walker Memorial Branch Library
- Shady Spring FLOW Students

Rain garden at the Exhibition Coal Mine in Beckley

The most well known PCWA volunteer project is the rain garden at the exhibition coal mine in Beckley. The rain garden was designed, built and planted by the association's volunteers. The location for this project is highly visible to the public, because it is located on City of Beckley property near the City pool, the local youth museum, and the exhibition mine, which gives daily tours of the mine to the general public. The rain garden treats runoff from 4000 square feet of impervious parking area.

Partner's included:

- City of Beckley (Public Works and Sanitary Board)
- Beckley Area Foundation
- Local chapter of Master's Gardeners
- WVDEP Nonpoint Source Program

Rain garden at a Private Residence in Beckley

- ACCT
- Private Citizens

Pet Waste Stations

PCWA started a pet waste disposal education initiative in 2009. This includes the placement of pet waste stations in public places throughout the watershed, distribution of pet waste leash bags to dog owners at community events and public presentations, and creation of a public education/outreach campaign through print and media advertisement. Pet waste stations are placed in community spaces in Beckley, parks and recreational facilities in the county, as well as at private establishments such as veterinary clinics and hotels that cater to pets. By preventing improper pet waste disposal, PCWA will be targeting a source of bacteria that is contributing to fecal coliform impairments of most of the streams within Piney Creek watershed and New River mainstem.

Partners Included

- State and City Parks
- Beckley Area Foundation
- WVDEP Nonpoint Source Program
- City of Beckley

Stream Clean ups

The volunteers from the organization have assisted with stream cleanups along Little Beaver and Beaver Creeks. PCWA worked together with other local non-profit organizations to help clean debris out of the streams after heavy floods affected the watershed. The Beaver Creek Clean Up has been one of PCWA's larger events with over 100 volunteers coming out to help clean up the streams.

Partners Included

- Raleigh County Make it Shine
- Southern Conservation District
- Raleigh County Solid Waste Authority
- WVDEP Pollution and Prevention of Open Dumping
- Sherriff of Raleigh County
- Raleigh County Commission
- Jan Care Ambulance
- Local businesses donations of food and water

Environmental Education

PCWA has worked with the WVDEP Save Our Streams Volunteer Water Monitoring Program to coordinate several stream monitoring training events and worked with students and adults to implement water related educational events such as the Grandview Water Festival and educational classroom activities.

PCWA received a Future Leaders of Watersheds (FLOW) Grant from 2007-2009 to conduct educational programs with hands-on in the field learning activities related to water quality and water management. Each student completed 32 hours of learning activities and service learning hours. This included marking storm drains, stream monitoring and community clean ups.

Storm Drain Marking Project

While driving through the Beckley City limits, the public will notice small round markers on all of the storm drains telling them not to dump trash into the drains because it leads to a stream. This was another successful volunteer project that was accomplished by the PCWA membership and youth volunteers under the FLOW program. They marked over 600 drains within the MS4 area over a short period of time.

Partners Included:

- WVDEP Public Information and Nonpoint Source Program
- Future Leaders of Watersheds (FLOW) Program
- City of Beckley
- WVDNR

Artist Rainbarrel Project 2010

PCWA coordinated an artistic Rainbarrel Project with local artisans. PCWA provided the barrels and the painting materials to the artist. Painted barrels were displayed and sold by silent auction at the annual Arts and Crafts Festival in Beckley.

Partners Included:

- Beckley Area Foundation

Outreach Evaluation

Outreach to stakeholders in the watershed for events such as the annual water festival, stream clean ups, stream walks or monitoring could be evaluated by the number of attendees and new memberships. One way to evaluate the effectiveness of PCWA's outreach campaign is to use a method where you estimate the outcome you think will happen for a planned event and then compare it to the true outcome. The slope of people who are exposed to a request for action and who actual do it is rather steep and steeper for different avenues of outreach. The chart below is an evaluation on the effectiveness of using a newspaper ad to inform the public about the water shed festival.

Table 10-1. Piney Creek Water Festival 2011 Outreach Communication Effort Evaluation

	Exposed		Noticed		Contemplate		Baby Step		Big Step	
Technique	**Newspaper Ad**		**Reads Ad**		**Call for Details**		**Attends Festival**		**New Paid Memberships**	
	%	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**
Projected	100	16000	10	160	30	32	20	8	80	6
Actual	100	16000	5	80	30	20	40	8	100	6

Note: The ad was only published for two days, thus response was less than hoped. Attendance was reduced as several local churches were holding Vacation Bible School on the same day which reduced youth audience.
Method taught by Eric Eckl of Water Words that Work

The PCWA's Executive Director Position's success can be evaluated quantitatively by comparing each year's progress toward established goals such as number of grant proposals prepared/funded, donations received, and number of community service projects created or facilitated. Evaluations conducted annually from calendar year to calendar year.

Table 10-2. Goals for the Piney Creek Watershed Association Executive Director Position

Goal	***Description***	***2011 Annual Total***	***2012 Annual Target***	***2017 Annual Target***
Core Goal #1: Build the capacity of Piney Creek to enable the long-term stability and success of the Association.				
1.1	# of paid staffers serving at end of reporting period	1	2	3
1.2	Dollar value of in-kind resources developed	$450	$500	
1.3	Dollar value of cash resources developed	$1,500	$2,000	$20,000
1.4	Total # of Hours worked by Community Volunteers	74	100	
1.5	Total # of Community Volunteers giving time and/or money to organization and projects	60	100	
1.6	# of Community Volunteers in attendance per meeting (on average)	10	20	25
1.7	# of Community Residents attending your organization's events (estimate if necessary) ***does not include # of Community Volunteers in your organization that worked on those events	110	500	600

Goal	***Description***	***2011 Annual Total***	***2012 Annual Target***	***2017 Annual Target***
1.8	# of grant proposals prepared and submitted	2	4	5
1.9	# of grant proposals funded	2	4	5
1.1	# of press releases submitted	10	20	
1.11	# of times the Director's work or related programs were mentioned in the media	15	20	
1.12	# of community service projects created/facilitated	1	1	4
1.13	# of funding proposals that include staffing salaries	0	1	2
1.14	% of funding received to cover staffing costs	75%	90%	100%
1.15	Overall % increase in annual organizational budget, if any, *since beginning of year*	10%	10%	20%
Core Goal #2: Assist with conducting watershed research and water quality monitoring critical to future funding.				
2.1	# of new AMD sites identified for future monitoring	3	4	6
2.2	# of AMD sites monitored	10	10	15
2.3	Overall # of sites monitored for water quality (bacterial, chemistry and flow, biological etc.)	15	20	25
2.4	# of volunteers trained in monitoring (through state Clean Streams Coordinator, SOS, etc.)	0	2	5
2.5	# of volunteers participating in monitoring	1	5	10
2.6	# of AMD remediation projects started within the watershed	0	0	3
Core Goal #3: Assist organization in enhancing community awareness and involvement through education and outreach.				
3.1	Number of students and youth receiving education or training in environmentally-conscious practices, promoting improvement and protection of water quality issues (Count of each individual student/youth participating in the training. Some students/youth may attend multiple trainings but they should only be counted once. If providing the training through the classroom training, should count the students/youth present not just those enrolled.)	50	200	500
3.1 a	# of presentations, classes, trainings, etc. held in schools or with classes (this number should count only different presentations, classes, trainings, etc. Some presentations, classes, trainings, etc may be held multiple times to different audiences but they should only be counted once.)	0	6	15
3.1 b	Total hours of presentations, classes, trainings, etc. held in schools or with classes (total should count ALL presentations, classes, trainings, etc. Count multiple presentations, classes, trainings, etc held in the same format. Number of presentations, classes, trainings, etc held multiplied by the length of each)	0	0	100
3.2 a	# of presentations, classes, trainings, etc. held apart from school or classes (this number should count only different presentations, classes, trainings, etc. Some presentations, classes, trainings, etc may be held multiple times to different audiences but they should only be counted once.)	2	6	10
3.2 b	Total hours of presentations, classes, trainings, etc. apart from schools or classes (total should count ALL presentations, classes, trainings, etc. Count multiple presentations, classes, trainings, etc held in the same format. Number of presentations, classes, trainings, etc held multiplied by the length of each)	7	40	25

Goal	Description	2011 Annual Total	2012 Annual Target	2017 Annual Target
3.2	# of schools, community groups, etc. utilizing information produced and/or provided (i.e. if you provided educ. materials that are being used but you did not conduct a presentation there)	0	2	30
Core Goal #4: The Director's skills enhancement through training, conferences, and work experiences, broadening his or her ability to engage with watershed development issues				
4.1	# of Regional or larger scale training events or conferences attended	2	2	4
4.2	# of presentations made at professional conferences	1	2	4
4.3	% of time spent on regional activities (activities outside the immediate watershed or organizational service area)	0%	0%	5%
Core Goal # 5: Funding and Implementation of Watershed Based Plan				
5.1	# of projects applied for funding	0	3	5
5.2	# of proposals funded	0	3	5
5.3	# of projects funded by grants	0	1	3
5.4	# of monitoring sites at the Whitbey/Jonben site	0	2	5
5.5	# of completed projects identified in Plan	0	1	3

Future Projects

The association is now in the process of starting to work with educators at various schools within the watershed to bring the classroom outdoors. Volunteers will have the opportunity to work with the teachers to get students learning in an outdoor environment and teaching various topics related to the environment surrounding them. There are many teachers and PCWA volunteers that are interested in getting involved with these projects in the future.

As the implementation process progresses, the need for volunteers will increase and education outreach will be an important factor in the success of the projects. The PCWA has a great relationship with many of the other organizations in the area, and continuing and building on this organizational strength will also be beneficial for successful implementation. The more support achieved and partnerships created, the greater backing the association have in the future. The PCWA is also very involved with the New River Clean Water Alliance which is a collaboration of many different groups within the Lower New River Watershed. The purpose of this organization is to come together in a collaborative effort to improve water quality within the Lower New River Watershed.

11.0 Technical and Financial Assistance Needs

11.1 Technical Assistance

The Steering Committee and various focus groups that were formed during the implementation plan process will continue to meet on a regular basis to share pertinent information, evaluate the implementation schedule, and decide if updates or modifications need to be addressed. At a minimum, this plan will be reviewed and project schedules updated and revised every five years. The Steering Committee and PCWA will need to search for appropriate funding sources and set up appropriate project goals. Additional tasks that will be needed for each project may consist of the following:

- Establishing and carrying out pre implementation sampling activities
- Finding engineering firms to analyze technical data
- Conduct preliminary project engineering designs
- Draft detailed construction specifications
- Calculate construction costs based on the engineering designs
- Soliciting bids for construction services
- Hiring construction companies
- Providing construction oversight
- Establishing and carrying out post implementation sampling activities

Some of these tasks may be handled by in-kind agreements between some of the entities and agencies listed below. The Steering Committee should continue to reach out and incorporate other entities into the committee that can offer additional technical assistance to ensure future success of this implementation plan.

The WVDEP Southern Basin Coordinator can assist with finding the appropriate technical assistance required for the implementation projects. A valuable source for technical assistance in metals treatment projects can be found with the WVDEP’s Oak Hill Office of Abandoned Mine Land & Reclamation (AML&R) and with the Charleston office of the OSM. The AML reclamation and AMD seeps projects proposed in this plan can be presented to AML&R personnel and a request can be made to have those sites reevaluated and elevated in priority. The benefits to water quality can easily be demonstrated using the TMDL and implementation plan documents as justification.

Below is a list of current and suggested future members of the Piney Creek Steering Committee:

- Appalachian Coal Country Team
- Beckley Sanitary Board
- Beckley-Raleigh County Health Department
- Bradley Public Service District
- City of Beckley
- Crab Orchard MacArthur PSD

- Eastern Coal Regional Round Table
- Environmental Protection Agency
- Local Industry/Business
- National Park Service
- National Parks Conservation Association
- North Beckley PSD
- WV Parkways Authority
- PCWA
- Raleigh County Government
- Region 1 Planning and Development Council
- Rural Appalachian Improvement League
- Shady Spring PSD
- Sophia PSD
- Southern Conservation District
- U.S. Department of Agriculture (USDA)
- US Army Corps of Engineers, Huntington Office
- US Office of Surface Mining, Reclamation and Enforcement
- USDA NRCS
- West Virginia BPH (Rick Hertges)
- West Virginia Conservation Agency
- West Virginia University (WVU), National Mine Land Reclamation Center
- WV Brownfield Assistance Center
- WV Public Service Commission
- WV Sewage Advisory Board
- WV Water Research Institute
- WVDEP Nonpoint Source Program
- WVDEP Office of AML&R
- WVDEP TMDL Section
- WVDEP Watershed Assessment Branch
- WVDOH

11.2 Financial Assistance

The total implementation cost for all 38 fecal coliform and metals projects is $32.6 million dollars. Fecal coliform projects are just over $20.2 million dollars and metals implementation projects total $20.0 million dollars. Many of the implementation projects are achieving reductions to both fecal coliform and metals pollutants by treating stormwater runoff.

The fecal coliform project costs can be further divided into public sewer projects ($12.6 million dollars) that would be extended to areas with individual on-site treatment systems and landuse based projects that would capture stormwater runoff from impervious and residential areas ($7.5 million dollars). Metals project costs can be further divided into subcategories; AML restoration projects ($7.2 million dollars), AMD seep treatment projects ($1.5 million dollars), stream restoration projects ($3.7 million dollars) and stormwater runoff projects ($7.5 million dollars). The preliminary cost estimates calculated in this implementation plan for all projects is contained in **Table 11-1**. Individual project costs are for project planning/engineering design and construction only. Project sampling, education and outreach costs should be incorporated into PCWA general operating costs or added to individual projects as an additional line item by project sponsors when applying for specific grant funding, if applicable.

Table 11-1. Estimated Project Costs

Priority Rank	Priority	Project Area	Project Description	Project Type	Total Project Cost
1	High	New River Drive	Soil Erosion	Fecal Coliform/Metals	$32,594
2	High	Dry Hill Area Seep	Iron AMD Seep	Metals	$133,150
3	High	Maxwell Hill/Tolley Drive triangle retrofit	Stormwater Management	Fecal Coliform/Metals	$313,088
4	High	Batoff Area Iron Seep	Iron AMD Seep	Metals	$133,150
5	High	Jonben Refuse Pile	AML restoration	Metals	$168,869
6	High	Cranberry Creek Seeps	Iron AMD Seep	Fecal Coliform/Metals	$231,300
7	High	Ewart Street	Constructed Wetland	Metals	$361,250
8	High	Barren Land off of Harper Road by Pizza Hut	Soil Erosion	Fecal Coliform/Metals	$53,763
8	High	Barren Land behind BBT Building	Soil Erosion	Fecal Coliform/Metals	$70,700
10	High	Maxwell Hill Elementary School Retrofit/ Environmental Education	Stormwater Management	Fecal Coliform/Metals	$149,738
11	High	Beckley Junction	Stream Restoration & Constructed Wetland	Fecal Coliform/Metals	$1,489,920
12	High	Town of Cedar Sewer Extension	Wastewater Extension	Fecal Coliform	$119,000
12	High	Piney View Sewer Project	Decentralized/ Cluster System	Fecal Coliform	$3,468,000
14	Medium	Grandview Sewer Project	Decentralized/ Cluster System	Fecal Coliform	$1,360,000
14	Medium	Pemberton Sewer Extension	Wastewater Extension	Fecal Coliform	$2,108,000
16	Medium	Abney Refuse Pile	AML Restoration	Metals	$5,643,764
17	Medium	Town of Fitzpatrick Sewer Extension	Wastewater extension	Fecal Coliform	$850,000
17	Medium	Jonben/Fireco Sewer Project	Decentralized/ Cluster System	Fecal Coliform	$1,326,000
19	Medium	Crescent Elementary Retrofit/Environmental Education	Stormwater Management	Fecal Coliform/Metals	$484,605
20	Medium	YMCA	Soil Erosion	Fecal Coliform/Metals	$135,760

Priority Rank	Priority	Project Area	Project Description	Project Type	Total Project Cost
20	Medium	Downtown Fayette Street Daylighting /stormwater management facility	Stormwater Management	Fecal Coliform/Metals	$161,113
22	Medium	Whitby/Mt Olive Sewer Project	Decentralized/ Cluster System	Fecal Coliform	$986,000
23	Medium	Pine Hills Stormwater retrofit	Stormwater Management	Fecal Coliform/Metals	$375,000
24	Medium	Laurel Creek Mouth	Stormwater Management	Metals	$3,541,834
24	Medium	Coal City/Abney Sewer Extension	Wastewater Extension	Fecal Coliform	$1,989,000
26	Medium	Piney Creek Headwaters Seep	Iron AMD Seep	Metals	$126,900
27	Low	Stratton Elementary Retrofit/ Environmental Education	Stormwater Management	Fecal Coliform/Metals	$571,725
28	Low	Cranberry Creek Seep	Iron AMD Seep	Metals	$123,150
29	Low	Stanaford Branch Complex	AML Restoration	Metals	$202,020
30	Low	Little Whitestick Creek Refuse Pile	AML Restoration	Metals	$1,198,470
31	Low	Beckley- Stratton Middle School/ Retrofit/ Environmental Education	Stormwater Management	Fecal Coliform/Metals	$980,100
32	Low	Whitby Area Seep	Iron AMD Seep	Metals	$839,080
33	Low	ACCT Environmental Education/Office retrofit	Stormwater Management	Fecal Coliform/Metals	$6,250
33	Low	Cranberry-Prosperity School/Retrofit/Environmental Education	Stormwater Management	Fecal Coliform/Metals	$571,725
35	Low	Town of Sullivan Sewer Project	Decentralized/ Cluster System	Fecal Coliform	$425,000
36	Low	Woodrow Wilson High School Retrofit/Environmental Education	Stormwater Management	Fecal Coliform/Metals	$1,361,250
37	Low	YMCA	Stormwater Management	Fecal Coliform/Metals	$272,250
37	Low	Beckley Elementary Retrofit /Environmental Education	Stormwater Management	Fecal Coliform/Metals	$313,088
				Fecal Coliform Only	**12,631,000**
				Metals Only	**12,471,637**
				Fecal Coliform/Metals Only	**7,573,968**
				Total Projects	**32,676,605**

Most public wastewater treatment projects in the state of West Virginia are funded through the Infrastructure Jobs Development Council (IJDC). The IJDC is a governmental council established by the

Legislature to oversee and administer both public wastewater and drinking water State Revolving Funds (SRF).

Metals implementation projects can have a wide array of funding sources available to them. Some of the most common sources of funding for these types of projects include the following:

- City of Beckley
- Local landowners, industry and other private investments
- OSM's Watershed Cooperative Agreement Program
- Private Foundations
- Raleigh County Government
- Stream Partners Grant
- US Army Corps of Engineers
- USEPA Brownfield Program
- WVDEP AML&R up to 30% of the AML Fund can be used for water quality projects
- WVDEP Section 319 funds

The 30% AMD Set Aside from the AML Fund is part of the state's AML Program that is funded through fees placed on the coal industry. The fee is set at 31.5 cents per ton for surface mined coal and 13.5 cents per ton for coal that is mined underground. The state is required to focus on eliminating high priority sites which includes the protection of public health, safety, and property.

Stream restoration projects can also have wide options of funding available. For example, the WVDEP Stream Restoration Fund obtains its funding from settlements with private industry (mainly coal companies) in lieu of enforcement penalties from environmental violations. The most common sources include:

- US Army Corps of Engineers,
- Natural Resources Conservation Service,
- West Virginia Conservation Agency,
- WVDEP Section 319 funds.
- WVDEP Stream Restoration Fund

The landuse based stormwater projects are more unique, because they may be designed for treating a primary pollutant of concern; there are additional ancillary benefits to these projects. Many of these projects would be constructed primarily to reduce the sediment and iron loads from stormwater; however, the added benefit is that any fecal coliform transported in the stormwater would also be treated in the process. Therefore, a wider range of funding may be available to these sorts of projects. One source of public funds for these types of projects is through the WVDEP's 319 program, which is for nonpoint source reduction projects. In addition, the onsite septic loan program can be used to help homeowners with straight pipes or failing on-site septics establish, replace or repair an individual on-site treatment system on their property. The USDA and the WVDEP in conjunction with the WV Housing Development Fund have low interest loan programs that help homeowners fund on-site septic systems. **Appendix E** contains relevant contact information for these programs. Some examples of other funding sources for fecal coliform implementation projects are:

- Small cities block grants
- US Army Corps of Engineers
- USDA 504 program

Because much of the area in Piney Creek contains public sewer, a potential problem exists involving failing private sanitary sewer laterals that connect to the public sewer system. In many situations the homeowner may not be aware that their sewer lateral is leaking and in need of repair. Currently, laterals for homeowners connecting to a public sewer system could be paid for from the Onsite Loan Program if it is a new hook up and the existing septic tank will no longer be in service. However, according to WVDEP's Nonpoint Source Program, it does not appear that there are any funding sources to help people with leaking or damaged existing laterals that are already hooked to the public wastewater system. If it is a significant problem in a certain area, then the Nonpoint Source Program would be willing to enter into discussions to help identify funding mechanisms. The State Revolving Fund (SRF) Program position is that the Nonpoint 319 Program funding is for failing on-site septic systems and that funding for permitted wastewater systems can only go to municipalities or PSDs. If a municipality or PSD would be interested and willing to take a low interest SRF loan then re-loaning it out to its customers, WVDEP Nonpoint Source Program would be willing to work with the SRF Program to see if they would be open to that idea.

Additionally, some PSDs offer customers insurance through a private insurance program to cover water and sewer laterals between a home and the public lines. It is suggested that PSDs look into this option and provide information to customers in monthly billing statements. Customers can also check with their carrier of homeowner's insurance if their policy contains this type of coverage or if an additional rider can be added to the existing policy for such coverage. Otherwise, this burden entirely becomes the homeowner's responsibility.

There are numerous financial and technical assistance options available for the Piney Creek Steering Committee and PCWA. There are funds available from state, federal, non-profits, and private foundations that will fund implementation projects. A list of potential grant sources with their contact information can be found in **Appendix E.** There are a significant number of businesses and industries in the Piney Creek Watershed that could be potential sources of funding or in-kind services for the watershed association. In the future, the PCWA will need to establish a rapport with more of these businesses to gain their support, and to promote the message of improving the quality of streams throughout the watershed.

The PCWA and the Piney Creek Steering Committee must be committed to following through with proposed projects for this implementation plan to succeed. Part of that commitment will be to meet regularly and continue to make progress toward implementing projects. To accomplish this goal, it will be necessary to apply for numerous high dollar grants and begin to forge relationships with community businesses that can assist in accomplishing these goals.

12.0 Piney Creek Watershed Association Capacity Building

The Piney Creek Steering Committee that was established as part of this implementation plan will continue to meet regularly and discuss future implementation projects, funding, status of ongoing projects, and implementation milestones. An action item list will be used to ensure forward momentum and progress. A summary of each Steering Committee meeting will be written up and circulated to the group and presented at the monthly PCWA meetings. Continued ongoing interaction with stakeholders and focus groups are imperative to further development of relationships for implementing large scale projects.

The association should continue to be encouraged to utilize the implementation plan to build knowledge, experience, members, volunteers and momentum. It is imperative for the association to continue to conduct community events and take advantage of all opportunities to spread the word about the association's goals and the projects in the implementation plan.

Below are some suggestions for the association to assist and better prepare for future implementation of projects.

Create internal subcommittees or groups of interested members to reach out to the community in the following areas:

- Commercial Interests and Future Development
- Education, Outreach, and Monitoring
- Grants
    - Research and Writing
    - Review
- Stormwater and Wastewater
- Tourism and Recreation

Employ a staff member to oversee the plan's implementation. The staff member would need to manage the following:

- Implementation subcommittees.

- Implementation grants
- Implementation projects

Continuity of staff is an essential part of this plan, as there will be much to accomplish to get many of these projects funded, designed, constructed and monitored. There has also been a constant concern at the Steering Committee meeting that the implementation phase is too much work to ask any current volunteers within the association to take on. A staff member whose sole purpose is to oversee implementation would alleviate this concern and get the process moving at a much quicker pace. Association members that have particular expertise or interest in various projects can then be interspersed into specific oversight or management aspects of projects.

For the Piney Creek Watershed Plan to succeed, the PCWA must build internal capacity and forge external relationships within the community in order to administer grants and oversee multiple implementation projects. The PCWA would require regular yearly funding to staff a part time position, with the intention of the position becoming full time in the future. Once this plan is approved by the USEPA, it will become the responsibility of Piney Creek Steering Committee and the PCWA with assistance from the WVDEP Southern Basin Coordinator to continue to follow through with implementing the watershed plan.

Another suggestion is for the PCWA and Steering Committee to reach out and forge relationships with other successful and active watershed groups throughout the state. Group representatives could be invited to speak at a monthly meeting to share some of their most prominent implementation strategies and success stories. Some of these groups may be able to provide helpful suggestions and methods that have worked for them in the past. A partial list of possible mentor associations is shown in **Table 12-1**.

Table 12-1. Potential Mentor Watershed Associations

Watershed Association Contact Person	Watershed Association Contact Information
Coal River Group Bill Curry - president	PO Box 363 St. Albans, WV 25177 coalrivergroup.com 304-727-3112
Coal River Mountain Watch Randy Sprouse	PO Box 18 Whitesville, WV 25209 (304) 854-2182
Friends of Deckers Creek Evan Hansen	ehansen@downstreamstrategies.com
Friends of the Cheat Amanda Pitzer	119 S Price St, Suite 206 Kingwood, WV 26537 (304) 329-3621

Opequon Creek Project Team George Snider	PO Box 4248 Martinsburg, WV 25402 http://www.opequoncreek.org/
Opequon Watershed Steve Bauserman	609 S. Braddock St. Winchester, VA 22601 (540) 667-4272
Sleepy Creek Watershed Association Susan Taylor	PO Box 991, Berkley Springs, WV 25411 (304) 258-6611
Upper Guyandotte Watershed Association Val Page	PO Box 196 Mullens, WV 25882 (304) 250-7661

12.1 PCWA Executive Director Position

The PCWA has hired a part time Executive Director during the Piney Creek watershed based plan process. This position is expected to provide and expand upon the association's capacity for implementing this watershed plan. The position has been funded with $9,000 from WVDEP's nonpoint source program funding, along with $5,000 that the PCWA was awarded for being selected Watershed of the Year in 2010. Also available is office space provided in-kind by the Raleigh County Solid Waste Authority. Jennifer Liddle, the WVDEP Southern Basin Coordinator, is the point of contact for this position, although direct supervision is provided by PCWA's Board.

Hiring staff is an important milestone for the PCWA and a terrific beginning step toward carrying out the tasks in this implementation plan. Unfortunately, the existing funding is only temporary and lasts for one year. Over the course of the next year a more permanent funding source will need to be secured in order to continue building capacity to implement this plan and meet the 15 year timeframe for completing the projects suggested in this plan.

12.2 Collaboration of Funding Partners

The most viable option to fund a long-term staff position is to receive funding from multiple sources. The local significant landowners, various government agencies, and developers would all need to be approached about the amount of funding that is needed and how that money will be put to use within the Piney Creek Watershed. The Piney Creek Steering Committee is currently working on a plan to approach landowners, businesses, and developers in the near future to ask for contributions and obtain ideas for future funding opportunities. Some of the options being investigated include funding from the National Park Service, WVDEP, Raleigh County, Beckley Sanitary Board, National Parks Conservation Association, State 106b grant funds, state 319 grant funds, stream partners, commercial interest groups such as coal companies and various landholders and business within the Piney Creek Watershed. For example, if the PCWA wanted to pay a watershed coordinator $20,000 a year, the association could ask for $2,000 donations from 10 different entities. This also would not be a long term solution, but it would be an excellent way to begin the capacity building process for the organization. As the organization gets more grants, they can fund the position in part by grant administrative fees. Part of the Executive Director Position should entail enrolling corporate memberships to the association and ensuring that a minimum number of grants are submitted. The association may wish to also have an associated minimum grant dollar amount associated with the minimum number of grants that must be submitted during a calendar or fiscal year.

12.3 Industrial and Commercial Memberships

One way the PCWA could try to become financially stable would be to solicit tiered membership fees from commercial and industrial enterprises in the watershed. The PCWA could add more tiers to the membership dues such as, gold, silver, bronze etc. At each level the association could include different in-kind advertising for the membership fees. As an example, at the gold level of $1000 the member would have their logo printed on all newsletters, tee-shirts, and banners; bronze members of $250 would entitle the member to have their logo in the newsletter only. These memberships will not be easy to acquire, so the PCWA should be prepared to have to convince business of the advantages of becoming a member, and should calculate precise numbers for newsletter distribution, tee shirts printed every year, number of outreach events attended, and other important public display activities planned. Most likely, face to face meetings with each potential member would be beneficial in order to tell them why they should become a member, what benefits are associated with each membership level, and most importantly, how membership fees will be used to fund association staff positions, events and projects. The organization would benefit from having an established business plan in place to account for membership dues spending. A prepared, detailed, concise presentation can be used for all meetings, but slightly tailored for each specific business would be a great way of approaching this task initially.

12.4 Permit Violations Fees/Settlements within the Watershed

Over the past year, permittees and non-permittees have both expressed a preference that permit violation fees be used locally within the watershed. This approach could be a long-term funding mechanism for an executive director position for the PCWA. To start the process, the association would need to meet and negotiate with the various point source departments within WVDEP. Ideally, a Memorandum of Agreement between WVDEP and the PCWA could be drafted to ensure that some percentage of permit violation fees and/or settlements be directly routed back to the watershed. The PCWA would agree that the funds will be used partially for staffing capacity to ensure that water quality improvement projects are implemented in the watershed with the remainder of the permit violation fees.

12.5 Long-Term Government Funding

Another long term option for the state as a whole would be to lobby the state government to find ways to fund a watershed coordinator for all or most of the states watersheds. Below you will find examples from other states; however much of the funding comes from sources such as: recreation tax, landfill tipping fees, conservation license plates, lottery revenue, etc. This option might be the hardest one to accomplish, but by looking at the examples from other states, it is evident that this option would be the most stable way to fund a long term position. Follow the links listed below to read more of what these states have achieved through their efforts.

12.6 Examples from Other States

The following examples of programs in other states are concepts that all conservation groups in the state of West Virginia should take into consideration when thinking of longer term solutions to staffing and accomplishing watershed based cleanups. These are not an immediate solution but longer term more stable answers to this growing problem.

All of the following states have realized that in order to have successful watershed plan implementation, they must have capable staff members to undertake the appropriate tasks. Common reoccurring themes observed during this information review revealed the important contribution of stakeholder involvement during the creation of watershed monitoring plans and implementation project suggestions. However, it is very difficult for watershed groups to actually implement the plans without paid staff or extremely dedicated and experienced members and volunteers.

The following information has been developed with support from Levi Rose, Watershed Coordinator for Wolf Creek Watershed in Fayette County.

12.6.1 Pennsylvania

In Pennsylvania, every county in the state has a Watershed Coordinator that works at the County Conservation District. These positions are largely funded by Pennsylvania’s Growing Greener Grant Program. The watershed coordinators help the groups in their county in most aspects, such as writing grants, securing grants for projects, and running field activities such as retrofitting and maintaining stormwater basins. These individuals also help design watershed plans, coordinate partnerships for new groups and help provide educational activities in the area.

The watershed coordinator’s job is to attend every meeting, help with every project and grant, and provide support for all the conservation groups in their area. West Virginia has a similar program with the regional basin coordinators, but the WV coordinators cover a much larger area and have to communicate with more groups with fewer resources.

The growing greener funds in Pennsylvania are the largest investment of the states funds to address environmental issues in the state's history. The PA DEP's portion of these funds started out in 1999 with $240 million dollars and doubled in 2002 to $547.7 million dollars. In 2005, PA voters approved an additional $625 million dollars over six years. The total amount that the state has committed is in excess of $1.4 billion dollars. Some of the financial support for this program comes from a $4 dollar per ton landfill tipping fee throughout the state.

Reference: www.depweb.state.pa.us/portal/server.pt/community/growing_greener/13958

12.6.2 Oregon

The Oregon Watershed Enhancement Board (OWEB) is a state agency that helps clean up and maintain natural areas by administering various grant programs. The OWEB has three different grant categories, regular grants, small grants, and watershed council support grants. The last category will pay for salaries and benefits for council coordinators (watershed coordinators). The funding for these grants is supplied by the Oregon State Lottery, federal dollars, and revenues from the states salmon license plate.

Reference: WWW.oregon.gov/OWEB

12.6.3 Ohio

In Ohio there are four groups working together to fund Ohio's Watershed Coordinator Program

- Ohio Environmental Protection Agency;
- Ohio Department of Natural Resources, Division of Soil and Water Conservation;
- Ohio Department of Natural Resources, Division of Mineral Resources Management; and
- Ohio State University Extension.

This collaboration came to fruition after the program went to the state legislature in 1999 to ask for funding to support watershed organizations in hiring much needed watershed coordinators. The responsibilities of these coordinators include working with the TMDL process, working on watershed plans and implementing projects. Under this program the assistance recipient has a total of 6 years to become totally self-sufficient. Every year the local organization will have to pay 10 % more of the coordinators' salary from the year before. For example, the first year the state pays 100%, the second year 90%, the third 80% and so on. As coordinators become more engrained in the community and vested in individual project implementation; they are also working to generate sources of funding to make the position self-sustaining.

Reference: www.dnr.state.oh.us/H_Nav2/Water/WatershedCoordinator/tabid/9192/Default.aspx

12.6.4 California

California has a statewide program that provides funding for watershed coordinator positions. In 2000 it started as a $2 million dollar pilot program that funded the watershed coordinators through the Resource Conservation Districts in the bay area (similar to the Pennsylvania program). After a few years, the California Legislature realized just how important these watershed coordinator positions were and added another $7 million dollars to fund the program on a statewide basis.

Reference: www.conservation.ca.gov/dlrp/wp/pages/index.aspx /

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