Chapter 6: Strategy for Success

6.1 Introduction

Best Management Practices (BMPs) were presented in Chapter 5 to address the specific pollution and biological issues outlined in Chapter 4. This chapter plans out the BMPs selected by the Red River Watershed Team as feasible for their communities. Other BMPs discussed in Chapter 5 may become possibilities at some time in the future.

In this chapter, you will:

- see which BMPs were selected by the watershed team
- learn about the estimated pollutant load reductions expected from these BMPs in the specific sub-watershed where they are assigned, and
- understand the planning of implementing the BMPs with Action Item Tables.

This chapter is first organized by sub-watershed area and related water quality issues and BMPs. Then, in Table 6.5, the BMPs are organized by objective. The expected pollutant load reductions and more specific Action Items are then presented in subsequent tables.

6.2 Feasibility

There are multiple solutions to many of the pollution issues discussed in this watershed plan. However, not all of them are feasible at this time. Factors to consider in feasibility are cost, available funding, cost-benefit analysis, existing priority status, areas of local concern, political will, other local projects like sewer line extension, stakeholder cooperation, and regulatory matters. These factors have been considered by the watershed team, and the following tables, broken down by sub-watershed, display the BMPs that are considered feasible at this time.

In the following BMP planning, some projects are already slated for implementation while others will need to be explored by the watershed team and Watershed Coordinator. Other factors, such as future sewer line extension in Campton, should also be considered. Which are implemented will depend on the watershed community and other local factors.

A note on pollutant load reductions

Many of the BMPs discussed in this chapter may have greater impacts than the pollutant load tables indicate. It is not possible to calculate the pollutant loads for a community education campaign, for example, but such a BMP may have an enormous impact.

Similarly, other BMPs may have more far reaching impacts on pollutant loads than illustrated in the planning tables. Repairing or replacing a septic system, for example, can have many benefits for water quality, not just removing *E. coli*. A new septic system may also reduce total suspended solids, total phosphorus, conductivity, and nitrogen. Although there are issues with conductivity and nitrogen in some parts of the project area, the BMP planning does not specifically address these pollutants. Many of the other prescribed BMPs will likely reduce conductivity and nitrogen levels, but actual reductions are difficult to calculate.

6.3 Sub-watersheds and recommended BMPs

Swift Camp Creek

Swift Camp Creek and Unnamed Tributary (UT) to Swift Camp Creek are both impaired waters. As discussed in Chapter 4, Swift Camp Creek needs improvement in many water quality parameters, habitat, and biology (see Table 6.1). Pollutant load reductions are needed for *E. coli*, total suspended solids, and total phosphorus. Conductivity issues were reported for all Swift Camp Creek sites.

Because water quality and habitat protection are vital to each of the four sub-watershed areas, it has been included as a BMP for all areas.

Table 6.1: Water quality issues in Swift Camp Creek sub-watershed and selected BMPs to address them.

Water Quality Issue	Suspected Source(s)	Best Management Practice
E. coli	Failing septic systems	Education about wastewater issues
		Septic system repair and replacement program
Total Suspended Solids	Stormwater runoff	Education on stormwater pollution in the watershed
	Urbanization	Riparian buffer establishment or improvement
Total Phosphorus	Septic systems	Education about septic systems and phosphates
		Septic system repair and replacement program
Watershed Protection	Urbanization	Riparian buffer establishment or improvement
	Recreation	Trail & campsite erosion work

Gladie Creek

Gladie Creek appears to be in relatively good condition. This is evident by the "excellent" MBI score. Total phosphorus is an issue at the downstream site. BMPs to address total phosphorus and continuing the erosion work related to dispersed recreation lower in the sub-watershed may be beneficial for the area. No conductivity issues were reported.

Table 6.2: Water quality issues in the Gladie Creek sub-watershed and selected BMPs to address them.

Water Quality Issue	Suspected Source(s)	Best Management Practice
Total Phosphorus	Wastewater systems	Education about wastewater and phosphates
	Urbanization	Riparian buffer establishment or improvement
Watershed Protection	Urbanization	Riparian buffer establishment or improvement
	Recreation	Trail & campsite erosion work

Septic system BMPs are not being recommended for Gladie Creek at this time. Education on wastewater, in general, is being advised to reduce the amount of phosphates from detergents or soaps entering the waterways.

Indian Creek

Total phosphorus and conductivity are issues for Indian Creek. This may be due to development near the headwaters including homes, businesses, and failing septic systems in the area. Both of these elevated parameters could be contributed to the natural limestone geology and/or the limestone quarry located near the headwaters (see Table 5.2).

Indian Creek had the lowest MBI score outside of the Swift Camp Creek sub-watershed. It was determined to be "fair." This may be due to development activities in the headwaters area.

Table 6.3: Water quality issues in the Indian Creek sub-watershed and selected BMPs to address them.

Water Quality Issue	Suspected Source(s)	Best Management Practice
Total Phosphorus	Wastewater systems	Education about septic issues
	Urbanization	Riparian buffer establishment or improvement
Watershed Protection	Urbanization	Riparian buffer establishment or improvement
	Recreation	Trail & campsite erosion work

Clifty Creek

Clifty Creek had the lowest prioritization score of the four sub-watersheds studied. This means that, overall, it has the best water quality. However, there was only one site in the Clifty Creek sub-watershed, and it was only sampled for biology – no water quality parameters were collected at this site. Practices to help protect the water quality and habitat are recommended.

Table 6.4: Water quality issues in the Clifty Creek sub-watershed and selected BMPs to address them.

Water Quality Issue	Suspected Source(s)	Best Management Practice
Watershed Protection	Urbanization	Riparian buffer establishment or improvement
	Recreation	Trail & campsite erosion work

Table 6.5: BMPs organized by objective.

Objective	BMP	Action Items
#1: Reduce bacteria loads from failing residential septic systems	Community education about onsite wastewater issues and responsibilities	1. Work with local agencies and organizations on public awareness measures. 2. Create or update outreach materials
	Financial incentives for septic system repair and replacement.	3. Work with local health departments to identify areas of need. 4. Create BMP implementation plan and application including educational materials.
#2: Reduce sediment loads	Trail and recreation site improvements	1. Install water bars and rolling grade dips to reduce water damage.
		2. Close or rehabilitate eroded trails and recreation sites.
	Create or improve riparian buffers	3. Plant native vegetation along streams. 4. Reach out to community and user groups about the importance of riparian areas.
#3: Reduce total phosphorus loads	Community education about onsite wastewater issues and responsibilities	1. Work with local agencies and organizations on public awareness measures. 2. Create or update outreach materials
	Financial incentives for septic system repair and replacement.	3. Work with local health departments to identify areas of need. 4. Create BMP implementation plan and application including educational materials.
	Community awareness campaign on phosphates in detergents and soaps and water quality impacts	5. Work with local agencies and organizations on public awareness measures
	Create or improve riparian buffers	6. Plant native vegetation along streams. 7. Reach out to community and user groups about the importance of riparian areas.
#4: Protect and improve water quality and habitat	Create or improve riparian area buffers	1. Create or adapt outreach materials on benefits of good water quality and healthy riparian areas. 2. Collaborate with local agencies or organizations on public outreach on tree planting and no mow zones. 3. Conduct planning and zoning review to facilitate the wider use and acceptance of protected areas and riparian buffers.
#5: Community Outreach and Education	Creek cleanups	1. Work with local agencies and organizations on awareness of garbage issues and host cleanups.

6.4 Action Item Planning

Objective #1: Reduce E. coli pollutant loads from failing residential septic systems

Primary Target Area: Swift Camp Creek

Septic system repair or replacement will be implemented on a case-by-case basis to mitigate pollution loads. Before any work is done, many factors will be considered such as surrounding land uses, soils, proximity to creek, and site location within sub-watershed. Project watershed coordinator will conduct a site visit.

For septic system education and septic system repair and replacement BMPs, there is an additional table depicting the expected pollutant load reductions expected at each of the four Swift Camp Creek sites. Before any BMP work begins, it will be important to determine the future plans of the town of Campton in regards to sewer line extensions. Other sub-watersheds of the project do not have significant *E. coli* pollutant loading, thus septic system BMPs are not recommended at this time for those areas.

The load calculations presented here (Table 6.6) are based on literature values and best estimates of current conditions in the sub-watershed. Repairing or replacing septic systems will likely have the added benefit of reducing total suspended solids, total phosphorus, conductivity, and total nitrogen loads even though those loads will not be calculated in this plan.

Septic systems and E. coli loading

There are no sewer lines in parts of the Swift Camp Creek Watershed, so all human sources of bacteria are assumed to be due to failing septic systems or straight pipes. A conservative estimate of daily wastewater flow for a single home with 2.5 occupants is 150 gallons per day (US EPA "Onsite Wastewater Treatment Systems Manual"). An estimate of fecal coliform in raw wastewater reaching the stream (Mayer et al., 1999) is 10,000,000 colony-forming units (cfu) per 100 milliliters (ml). Removing a straight pipe or failing system that flows into surface water by replacing it with a working system will remove 56,781,176,700 fecal coliform colonies per day per home. This equates to 13,056,831,582,165 *E. coli* cfu/year for each septic system remediated. The pollutant load reductions provided in Table 6.6 are rough estimates as many variables affect the rates including household habits, distance from stream, soil type and depth, groundwater interaction, and *E. coli* concentration.

The exact number of septic systems, or how many of those are failing, in the watershed is not known. Also, the exact percentage of human source bacteria (versus animal) is not known, so estimated load reduction are based on the entire *E. coli* load being of human origin. There are sewer lines in part of Campton, but not all of Campton is on sewer. According to a study published by the Kentucky River Area Development District (2000) and data gathered from the KY Gazetteer:

- 7,502 people live in Wolfe County
- 8% of them are on sewer lines (about 600 people)
- 2,700 County residents use onsite wastewater systems, most of which are septic systems
- Population of Campton is 441
- Wolfe County is made up of 142,188 acres total
- Campton is 704 acres

There are 13,693 total acres in the watershed which means that there are 12,989 acres in the watershed excluding Campton. The county population excluding Campton is 7,062. So there are 141,484 acres in Wolfe County excluding Campton, therefore, there are 0.05 people per acre (this assumes an even population distribution outside of Campton).

Approximately 649 people live in the watershed outside of Campton. The total number of people that live in the watershed equals 1,090 (649 plus 441 people in Campton) = 1090. If there are 600 people on sewer lines, that leaves 490 people in the watershed not on sewer. If 37% of the county uses onsite septic systems, then 181.3 people in the watershed use onsite systems. That leaves 308.7 people in the watershed area not using onsite septic systems or sewer. With an estimated 2.5 people per household, there are 124 homes without sewer or onsite septic systems. This number is an estimate. The exact number is unknown.

Tables 6.6 and 6.7 present the pollutant loads and pollutant load reductions needed to meet water quality standards (discussed in Chapter 4) and the recommended septic system BMPs per sub-watershed site.

Table 6.6: Estimated *E. coli* Load Reductions for septic system BMPs for Swift Camp Creek.

BMP	Indicator	Sub-watershed - Site	*E. coli* load*	Load Reduction Needed*	# of septic systems recommended	Estimated Load Reduction Expected**
Education on residential septic system function and maintenance.	n/a	All of Swift Camp Creek	n/a	n/a	n/a	Not measureable
Financial incentive program for septic system tank repair or replacement	Bacteria Count	Unnamed Trib	13.4	10.6	1	13 trillion/97.0%
		Below Hirams	27.0	16.7	2	26 trillion/96.2%
		Off KY 15	11.2	6.6	1	13 trillion/116.0%
		Above WWTP	42.9	34.0	4	52 trillion/121.2%

*units of trillion *E. coli* cfu/100 mL/yr

**based on 13 trillion *E. coli* cfu/100 mL/yr reduction for each corrected failing septic system. Literature values from U.S. EPA, National Environmental Services Center, and AWWA Research Foundation.

Table 6.7: Action Item details for septic system BMPs for Swift Camp Creek sub-watersheds.

BMP	Site/sub-watershed	Responsible Party	Technical assistance	Cost	Funding Mechanism
Education on residential septic system function and maintenance.	Unnamed Trib Below Hirams Off KY 15 Above WWTP	Project Watershed Coordinator and Watershed Team	Eastern KY PRIDE, Health Department of Wolfe County, KOWA, and KDOW	Fees for facility rental, printed materials, and other supplies.	319 grant
Financial incentive program for septic system tank repair or replacement	Unnamed Trib Below Hirams Off KY 15 Above WWTP	Homeowner	Eastern KY PRIDE, Health Department of Wolfe County, KOWA, and KDOW	$2,000 to $7,000 per septic system	319 grant Matching funds from homeowners

Objective #2: Reduce total suspended solids pollutant loads from trails and recreation site improvements and create or improve riparian buffers.

Primary Target Area: Swift Camp Creek, Gladie Creek, Indian Creek, and Clifty Creek

In all of the watershed study areas, there are some total suspended solid issues, though only Swift Camp Creek required pollutant load reductions. A portion of the total suspended solids in these areas come from the erosion of sediment from hiking trails, campsites, and other recreational features. Because all of these areas are adjacent to the Red River Gorge Geological Area in the Daniel Boone National Forest and host to millions of hiking and camping guests each year, directly addressing these recreational sources of sediment may be a beneficial BMP.

Table 6.8: Estimated reductions in total suspended solids

	Swift Camp	Gladie	Clifty	Indian
# of campsites	25	25	10	20
Campsite erosion (tons/year)	12.5	12.5	5	10
Trail miles	1.8	1.8	0.75	1.5
Trail erosion (tons/year)	23	23	10	19
Total erosion (tons/year)	**35.5**	**35.5**	**15**	**29**

Based on the Water Erosion Prediction Project (WEPP) model (Elliott, et al., 2000).

Objective #3: Reduce Total Phosphorus pollutant loads

Target Areas: Swift Camp Creek, Indian Creek, and Gladie Creek

Swift Camp Creek, Indian Creek, and Gladie Creek all had issues with total phosphorus during the water quality sampling period. As noted in Chapter 4, total phosphorus can be contributed to a variety of sources, but one common culprit is wastewater.

Properly functioning septic systems will remove a percentage of total phosphorous, but are not typically thought to be cost effective treatments as BMPs (Toor et al., 2011). The septic system BMPs planned for Swift Camp Creek will undoubtedly help with total phosphorus issues in that sub-watershed. In the other areas where septic system BMPs are not planned, however, another source of total phosphorus can be targeted.

Reducing the amount of total phosphorus going into wastewater systems (failing or functional septic system or sewer system) has been shown to reduce total phosphorus pollutant loads reaching surface and ground waters. According the EPA, eliminating phosphates from detergent can reduce phosphorus loads to septic systems by 40 to 50 percent (USEPA, 1980). As of October 1993, 17 states had enacted phosphate detergent restrictions or bans – not including Kentucky (Soap and Detergent Association, 1993). Phosphate restrictions are most effective when used as part of a BMP system which involves other source reduction practices such as elimination of garbage disposals and use of low-volume plumbing fixtures, as well as mitigation BMPs such as upgrading and regular maintenance in areas served by septic systems (Osmond et al., 1995). Low-phosphate or phosphate-free detergents and/or soaps may be difficult to procure in rural locations. Community awareness and education on the matter may go a long way to treat the issue in a cost-efficient manner.

Objective #4: Protect and improve water quality and habitat

Location: Swift Camp Creek, Gladie Creek, Indian Creek, and Clifty Creek

Protecting habitat in all four sub-watersheds may be one of the best ways to improve overall water quality. Creating or improving existing riparian buffers is the BMP selected by community stakeholders to address habitat protection for the project area. Riparian buffers have many benefits for a creek. In some parts of the project area, there is an existing riparian buffer. Where there are existing buffers, a wider or denser swath of vegetation may be developed. In those places without a buffer, native grasses, trees, and/or shrubs may be planted. In places where a wide riparian buffer is not practical or desirable, a "no-mow" zone may also have a positive impact. Education about why a buffer is important will be critical to the long term success of the buffer.

Specifically, riparian buffers have been shown to act as physical barriers to pollutants that become mobile during a rain event or pollutants that are contained in runoff (see Chapter 5 for more information). Additionally, the shade and habitat resources of food and shelter that vegetation provides can greatly improve living conditions for aquatic communities.

Table 6.9: BMP and Action Item Planning Table.

Target Pollutant	BMP	Sub-watershed	Specific sites	Cost	Estimated Load Reduction*	Action Items	Responsible Parties	Technical Assistance	Funding Sources
E. coli	Wastewater Education	Swift Camp Creek	All 4 sites	n/a	Not measureable	Work with agencies and organizations on public awareness measures. Create or update outreach materials	Watershed Coordinator and USFS	Wolfe County Health Depart. and PRIDE	319 grant (secured)
E. coli	Septic System Repair or Replacement	Swift Camp Creek	All 4 sites	Repair cost depends on issue; $2500-7000 per new system.	See Table 6.4	Work with local health depart to id areas of need. Create BMP plan and application including educational materials.	Watershed Coordinator and USFS	Wolfe County Health Depart. and PRIDE	319 grant (secured) and participant match
Total Suspended Solids	Create or improve riparian buffers	Swift Camp Creek	Unnamed Tributary 50 foot buffer for 500 feet	90 lbs/yr/dollar 10 per linear foot of stream	50% removal of sediment and nutrients	Plant native trees, shrubs, and/or grasses along streams. Reach out to community and user groups about riparian areas importance	Watershed Coordinator and USFS	USFS	319 grant (secured)
Total Suspended Solids	Trail and recreation site improvements	All sub-watersheds	Lower watershed sections on USFS	$870/ton	115 tons	Install water bars and rolling grade dips and close or rehab eroded trails and recreation sites	USFS	USFS	319 grant (secured)
Total Phosphorus	Septic System Repair or Replacement	Swift Camp Creek	All 4 sites	Repair cost depends on issue; $2500-7000 per new system.	30-40% reduction per systems	Work with local health depart to id areas of need. Create BMP plan and application including educational materials.	Watershed Coordinator and USFS	Wolfe County Health Depart. and PRIDE	319 grant (secured) and participant match
Total Phosphorus	Education on phosphate sources and impacts	Swift Camp Creek, Indian Creek, Gladie Creek	All sites	$1000 per year	Up to 50%	Work with local agencies and organizations on public awareness measures.	Watershed Coordinator and USFS	Wolfe County Health Depart. and PRIDE	319 grant (secured)

Table 6.9: BMP and Action Item Planning Table (continued).

Target Pollutant or Protection Object	BMP	Sub-watershed	Specific sites	Cost	Estimated Load Reduction	Action Items	Responsible Parties	Technical Assistance	Funding Sources
Total Phosphorus	Create or improve riparian buffers	Swift Camp Creek	Unnamed Tributary 50 foot buffer for 500 feet	90 lbs/yr/dollar 10 per linear foot of stream	50% removal of sediment and nutrients	Plant native trees, shrubs, and/or grasses along streams. Reach out to community and user groups about riparian areas importance	Watershed Coordinator and USFS	USFS	319 grant (secured)
Habitat Protection	Create or improve riparian buffers	All sub-watersheds	All sites	90 lbs/yr/dollar 10 per linear foot of stream	50% removal of sediment and nutrients	Plant native trees, shrubs, and/or grasses along streams. Reach out to community and user groups about riparian areas importance	Watershed Coordinator and USFS and Watershed Team	USFS	319 grant (secured)
Community Outreach and Education	Creek cleanups	All sub-watersheds	All sites	$300 per cleanup	Not measurable	Work with local agencies and organizations on community awareness of garbage issues Host cleanups	Watershed Coordinator and USFS and Watershed Team	USFS and PRIDE	319 grant (secured) and community partners

*based on literature values.