

# Eden Area Watershed Restoration Plan





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Prepared By



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## INTRODUCTION

The Eden Area watershed focuses on the Dan and Smith Rivers of the Roanoke River Basin headwaters and covers approximately 225 square miles in central North Carolina and Virginia just east of the foothills of the Blue Ridge Mountains (Figures 3 & 4). The landscape is hilly, but resides entirely within the Piedmont, and presents challenges found throughout the ecoregion due to its soils, history, and local weather. It includes all of the waters draining to the Smith River downstream of the City of Martinsville, VA; to Matrimony Creek, a significant tributary to the Dan River; and to the Dan River between Stoneville and the exit of the river to Virginia in Caswell County, NC. It is bisected by the Virginia-North Carolina state boundary and a US EPA regional boundary (Mid-Atlantic (Region 3) & Southeastern (Region 4)).

The Dan River has been listed as impaired by the NC Department of Environment and Natural Resources (DENR), Division of Water Quality (NC DWQ, now titled the Division of Water Resources (DWR)) for aquatic life due to high turbidity levels since 2002 and high fecal coliform bacteria levels since 2008. Similarly, the Smith River has been listed by the NC DWR as impaired for biological habitat conditions due to high fecal coliform bacteria and copper levels since 2008 (NC DWQ 2013). The NC DWQ completed a Total Maximum Daily Load assessment (TMDL, aka “pollution diet”) for turbidity on the entire Dan River in 2005, concluding that the dominant sources of sediment are rural erosion sites (NC DWQ, 2012).

The Virginia Division of Environmental Quality (VA DEQ) lists the Smith River and many of its tributaries within this watershed as violating their water quality standard for *E. coli*, a measurement of fecal material. It conducted a TMDL for *E. coli* in 2007, and determined that its sources of pollution were non-point sources, primarily from rural areas in Virginia and North Carolina, though stormwater runoff from Martinsville was also attributed as a source (NC DWQ, 2009). The VA DEQ and the Division of Conservation and Recreation (VA DCR) completed a



**Figure 1: Turbidity in Matrimony Creek Tributary**

TMDL Implementation Plan for the Smith and Mayo River’s *E. coli* bacteria water quality standard violations. Within these two subbasins are two watersheds addressed in this study. Based upon their findings, the majority of inputs to these two watersheds are agricultural or from ill-maintained septic tanks (VA DCR, 2013).

The Upper Dan River Subbasin has been prioritized as an area of focus by the NC Watershed Restoration Improvement Team

(WRIT). The WRIT is comprised of representatives from different DENR and NC Department of Agriculture and Consumer Services (DACCS) divisions and programs who are working to better coordinate watershed efforts across the state. WRIT has specifically selected the following 12-digit HUCs within this subbasin as part of those few watersheds across the state to focus efforts:

- Elk Creek (030101030104);
- Peters Creek (030101030105);
- Matrimony Creek (030101030505);
- Smith River (030101030807);
- Town Creek (030101030901); and
- Cascade Creek (030101030902) (NC DWQ, 2012).

## HISTORY

The Dan River is the headwaters of the Roanoke River and is largely undeveloped. Historically, the Dan River Basin economy was largely based upon forestry and agriculture, with tobacco being the largest cash crop. Tobacco, which is a significant sediment source without stream buffering, continues to be a major economic engine for Rockingham County (NC DA&CS, 2013). Tobacco is still a primary economic driver in Rockingham County, which was the top North Carolina county in the production of burley tobacco in 2010 and 2011. These economic sectors directly used the Dan River to transport goods to coastal communities and ports via bateaus.

The City of Eden was technically founded in 1967, but that belies its much longer history as the Towns of Leaksville (est. 1796), Spray (est. 1813), and Draper (est. 1906). By the early 20th century, tobacco production began to wane due to the consolidation of small, privately owned farms and factories by companies such as R.J. Reynolds in Winston-Salem, NC. Workers took advantage of jobs in textiles and manufacturing that were more profitable than farming. In North Carolina, industrial mills sprang up in the towns and cities of Eden, Reidsville, and Roxboro (Figure 5; *personal communication with NC & VA Soil & Water Conservation Districts*, 2012).



**Figure 2: Spray Cotton Mill, Eden, NC**

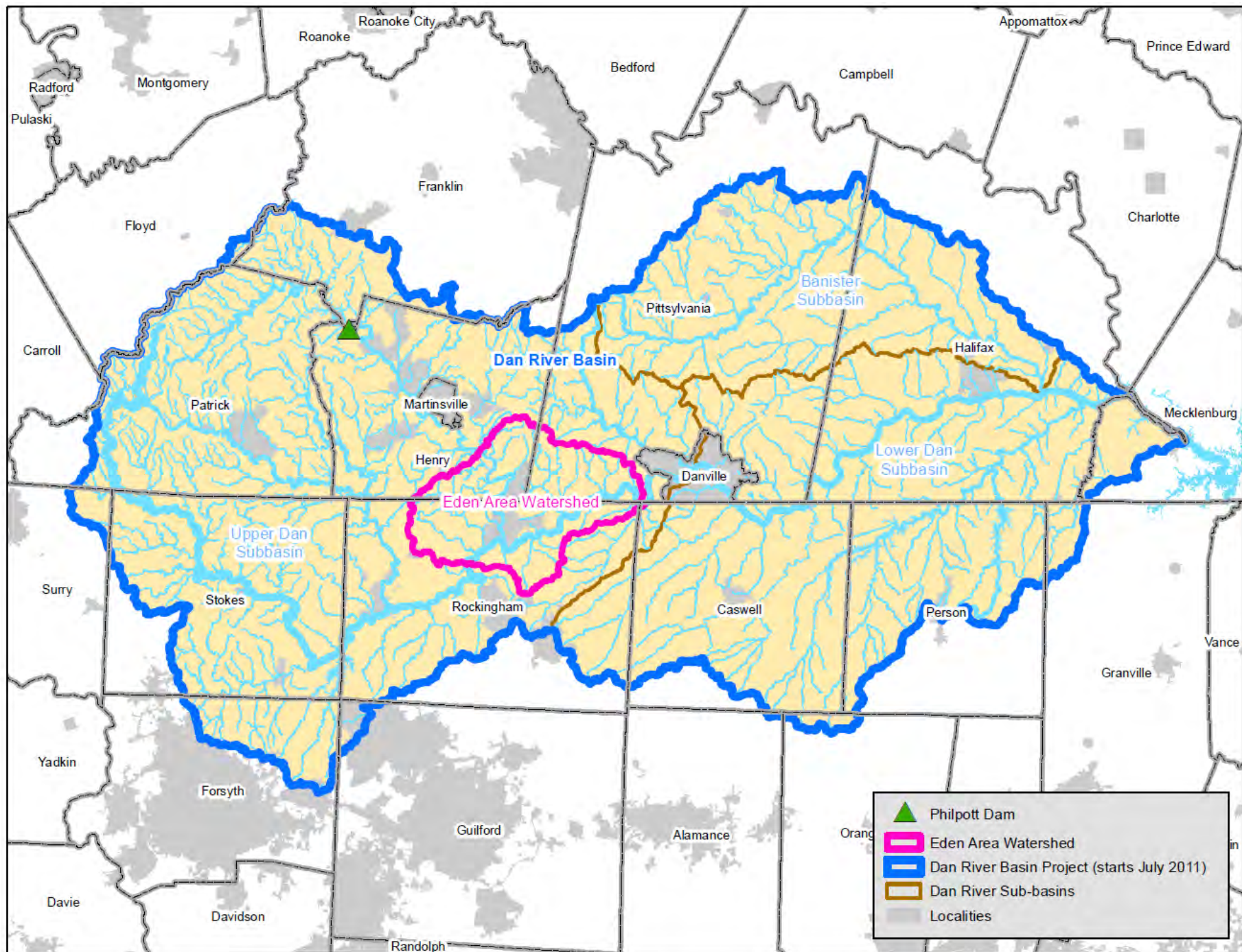


Figure 3: The Project Area in the Upper Dan River Subbasin

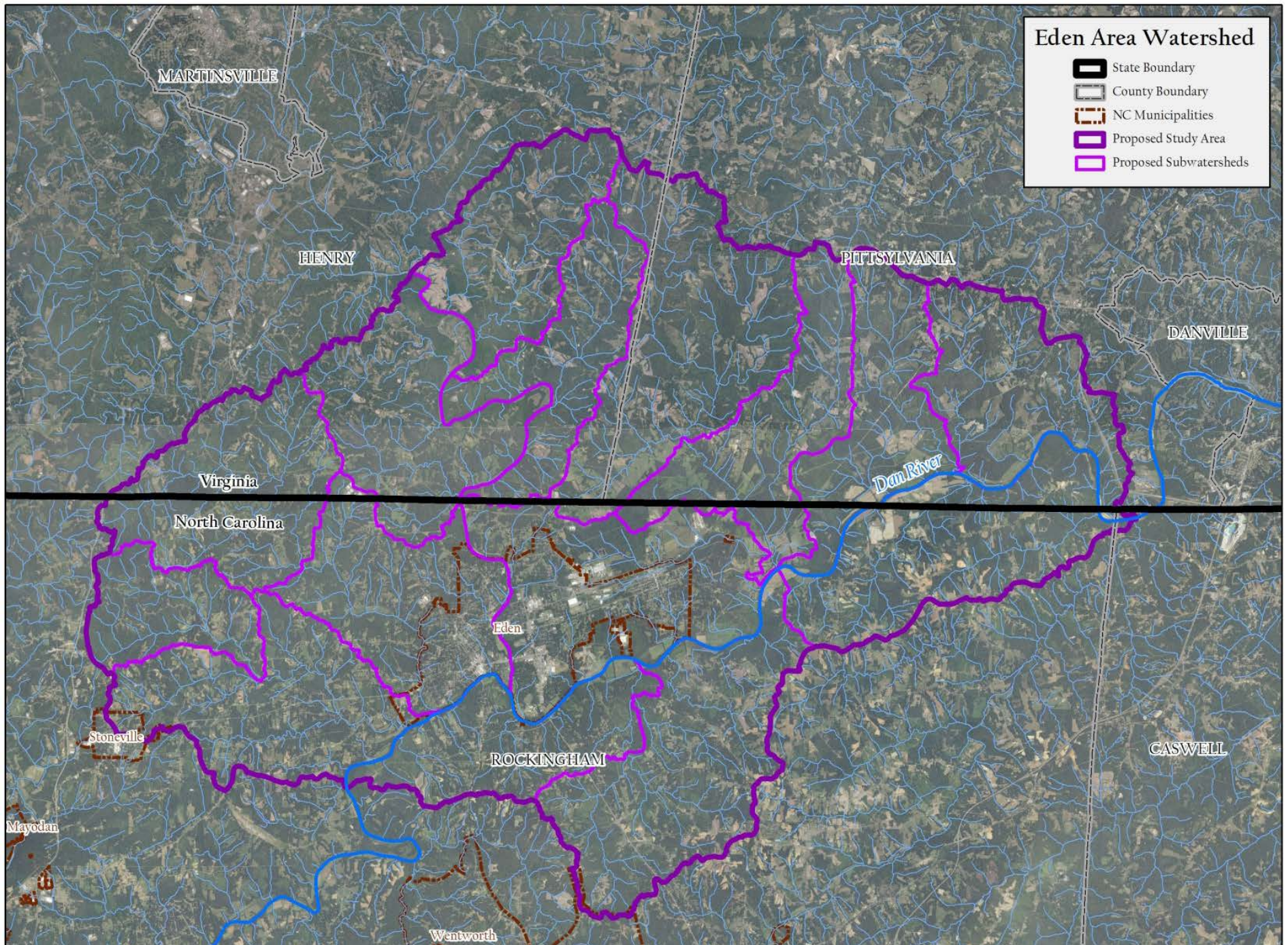


Figure 4: Eden Area Watershed Satellite Image

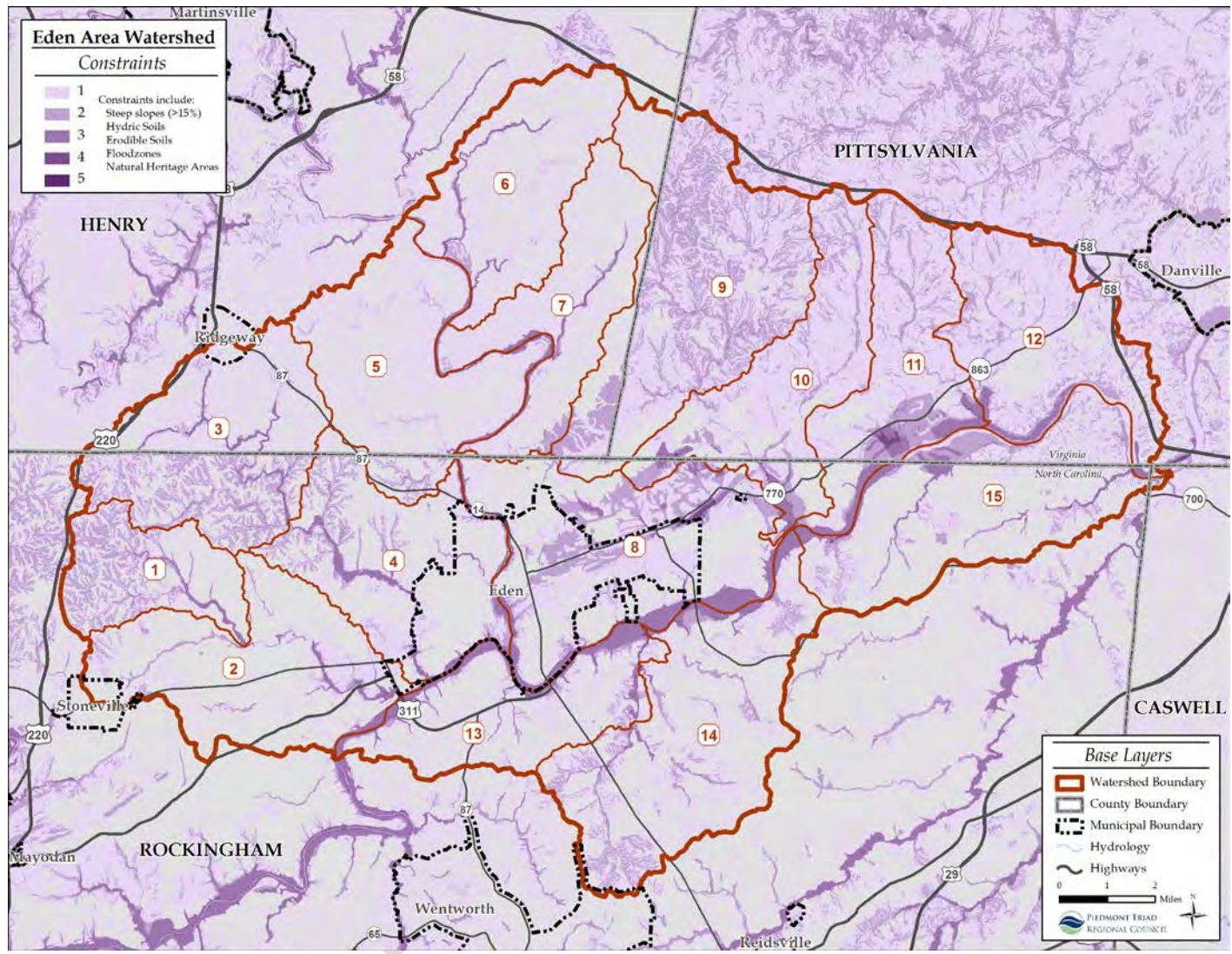


Figure 5: Eden Area Watershed Constraints

The value of water for manufacturing and public health was recognized in this watershed in 1906 with the establishment of the Spray Water Power and Land Company, which was a utility serving all three towns. The three adjacent towns consolidated their services and governments under the title of “Eden” in 1967, partly in an effort to minimize water and sewer maintenance costs (City of Eden, 2007). Beginning in the 1970’s textile and manufacturing facilities throughout the basin started outsourcing jobs globally. Rockingham County is a NC Department of Commerce Tier 1 county, meaning that it is among the most economically-distressed in the state (NC Department of Commerce [NC DOC], 2013). The City currently has a population of 15,488 people (US Census Bureau, 2012).

## **BACKGROUND**

In 2009, the Piedmont Triad Regional Council (PTRC) was awarded a restoration planning grant from the NC Clean Water Management Trust Fund to develop a plan to restore healthy water quality conditions to the Dan and Smith Rivers through the reduction of sediment and fecal inputs to the rivers, as well as the causes of impaired biological habitat conditions on the Smith River. The first phase of this planning effort yielded the *Eden Area Watershed Assessment* in 2012. This watershed assessment analyzed watershed conditions and identified sources contributing to impaired conditions which must be addressed if watershed functions are to improve. This included assessments of current and past land use, local policies related to land use and development, water quality data, and field conditions recorded directly in the watershed.

The *Eden Area Watershed Assessment* determined that long-term programmatic and policy-based solutions would achieve greater water quality improvements than most – but not all – structural improvements made to the watershed at this time. The need for action is immediate as the Dan and Smith are home to federally-endangered and –threatened fish and mussel species (Table 1). The species are vulnerable to different types of pollution impacts, and, therefore, require actions that will reduce the loadings of both sediment and fecal material in the main to both rivers. However, a more comprehensive watershed-scale restoration effort could restore healthy habitat conditions for these species and perhaps others to a much greater extent of the rivers and their tributaries.

**Table 1: Federally- and State-Listed Species known to reside within the Eden Area Watershed, NC WRC 2014**

Federal	State	Common Name	Species Name
<b>Endangered</b>	Endangered	Roanoke logperch	<i>Percina rex</i>
<b>Species of Concern</b>	Endangered	Green floater	<i>Lasmigona subviridis</i>
<b>Species of Concern</b>	Significantly Rare	Roanoke bass	<i>Ambloplites cavifrons</i>
<b>None</b>	Threatened	Bigeye jumprock	<i>Moxostoma ariommum</i>
<b>None</b>	Special Concern	Riverweed darter	<i>Etheostoma podostemone</i>
<b>None</b>	Significantly Rare	Roanoke hogsucker	<i>Hypentelium roanokese</i>
<b>None</b>	Significantly Rare	Quillback	<i>Carpoides cyprinus</i>

Due to landscape and soil constraints, the cost of retrofitting most sites was determined to be a less beneficial than agricultural practices and new policies could be to address sources of sedimentation and fecal input (Figure 5). However, the need to manage runoff from new developments and using innovative stormwater controls on redevelopment sites is paramount. This *Assessment* was also determined that there is simply not enough water quality data to determine if actions taken would improve local subwatershed health and function. There are only four NC Division of Water Resources (NC DWR) ambient monitoring stations in the entire Upper Dan River Subbasin.

The *Assessment* also determined that the Dan and Smith Rivers have an untapped wealth. This wealth could be seen in the reclamation of the river systems for healthier ecological habitat conditions; in the growth of businesses and the residential sector, especially in the City of Eden, which has an underutilized infrastructure; in the ecotourism potential of the rivers paddling, hiking, and biking trails; and in its potential to be a state leader in balancing economic resiliency with environmental restoration.

Lastly, the watershed’s water quality priorities have shifted very recently. On February 2, 2014, a 850-foot, 14-inch stormwater pipe at Duke Energy’s retired Dan River power plant discharged 82,000 tons of coal ash residue to the Dan River, 1 mile downstream of the City of Eden’s water intake and 20 miles upstream of the City of Danville, VA’s, water intake. Danville’s water treatment facility appears to be able to ensure the health and safety of the water for consumptive purposes, but the Dan River itself has arsenic concentrations deemed unsafe for

primary contact such as swimming or drinking untreated. Coal ash contains a variety of potentially toxic metals including arsenic and lead. As of February 9, 2014, the stormwater pipe leaking the coal ash from the 27-acre holding pond had been plugged by Duke Energy. Another stormwater pipe draining the runoff from the land surrounding this pond has not been a focus of the response efforts so far (Charlotte.Observer 02/09/14; Associated Press 02/02/14). The impacts of the coal ash spill to the Dan River's wildlife, including its federally-threatened mussel, the green floater, are, as yet, unknown. However, the addition of 82,000 tons of sediment to the river exacerbates existing impaired water quality conditions, and will require remediation investments by Duke Energy and others that could otherwise be dedicated to addressing the pre-existing fecal and sediment inputs in the river.

This *Restoration Plan* features a Project Atlas, seven Policy Initiatives, and an Implementation Timeline for watershed stakeholders to use to aggressively improve water quality conditions in the next twenty years. Restoration of the Eden Area watershed needs to be approached through both projects and policy initiatives. Projects address obvious impacts to current watershed health, such as eroding streambanks and agricultural best management practices (BMPs). Policy initiatives provide a more long-term strategy for sustainable watershed stewardship and public awareness necessary for a shift in land use and development practices. In the Eden Area watershed, where a major cause of water quality pollution appears to be a number of small, dispersed impacts, this is especially important.

The ultimate goal of the *Eden Area Watershed Restoration Plan* is to comprehensively address the sources of sediment and fecal coliform pollution that currently impair the aquatic life needs of the Dan and Smith Rivers, and to be a useful tool in improving and then sustaining watershed conditions for both its ecological and human populations. It is intended to be used both directly and as guidance in drafting and adopting new policies, reaching out to the public through diverse stewardship programs, and planning for restoration and conservation projects. The *Eden Area Watershed Restoration Plan* must be a living document that is periodically revisited so that it is used for maximum cost-effectiveness and environmental benefit.

## PROJECT PRIORITIZATION

The 2012 *Eden Area Watershed Assessment* determined that the sources of sediment and fecal pollution in the Dan and Smith Rivers are small and dispersed throughout the 225-square mile watershed. The water quality data, field data, and land use assessments show a watershed in which a lack of stewardship, some significant poorly-maintained sites, and a history of intense land uses have added up to impair water quality conditions for aquatic habitat today. However, this large dataset also did not provide any insights on simple solutions to these concerns. The PTRC recognized the need for technical assistance in determining what investments on the ground could provide significant benefits toward restoring healthy water quality conditions to these rivers and their tributaries. It contracted with the NC State University Biological and Agricultural Engineering (NCSU BAE) Department to develop a model that would use all of this data and more to provide all watershed stakeholders with guidance.

## APPROACH DEVELOPMENT

The NCSU BAE team was tasked by the PTRC with developing an approach that would help prioritize potential project implementation efforts. The approach must identify projects that can help reduce problems with sediment and bacteria, and also factor in potential costs and feasibility into the prioritization scheme. The first step in developing the approach was to become involved with the stakeholder team. Participation in discussions helped target the approach with an end product in mind. A few primary points that were taken/interpreted from stakeholder meetings included:

- Drinking water is a focal point for the area. Current water source is the Dan River, but the future may involve drawing from the Smith River.
- Boating and recreational use of rivers is important to the local economy and way of life. Wildlife and preservation areas are an important part of this.
- The area has a history in agricultural and forestry land use. Freedom of land management by owners is important. Area policy makers want to balance initiatives accordingly.
- Eden and Rockingham County are future minded in both policy and planning. They have already committed significant resources to infrastructure improvements and agricultural BMP initiatives.
- With limited resources, final recommendations should be as specific as possible and focused on feasibility.

The complexity of decision making for this watershed led the BAE team to a watershed modeling approach. A watershed model allows a quantitative analysis that combines all the contributing factors into the final result. A model also allows users to quickly estimate the effect of changing land uses, implementing projects, or other scenarios to track potential

benefits. There are a large number of watershed models available for use, but each has its own requirements and application benefits. Research into available GIS based watershed models led to the choice of a model called GWLF (Generalized Watershed Loading Function). The use of this model maximized the benefit of data already available to the project team with the goal of project prioritization in mind. The latest version of this model runs in an environment called Mapshed, developed by Penn State University. A further benefit of this model is a built-in routine called PRedICT, which allows the incorporation of BMP projects and estimates of water quality benefits and costs at a watershed level. These models are in the public domain and are free of charge. Watershed modeling was used with other analysis as the basis for the rest of the study. A simplified approach process is provided below and a flowchart is provided in Figure 6. Further detail on each of these steps and the results are provided in the following sections

Eden Watershed Modeling Targeting Analysis  
Flow Schematics

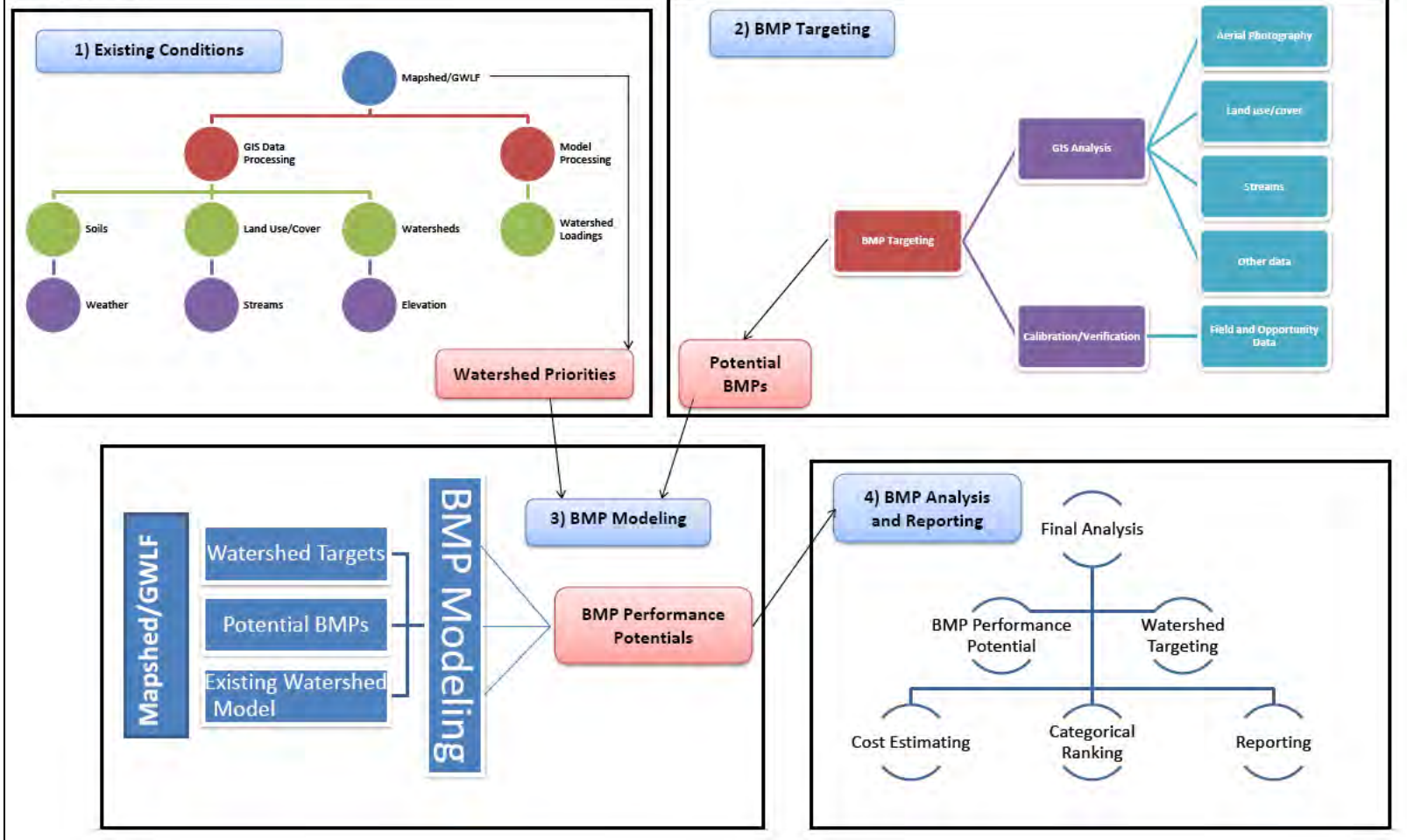


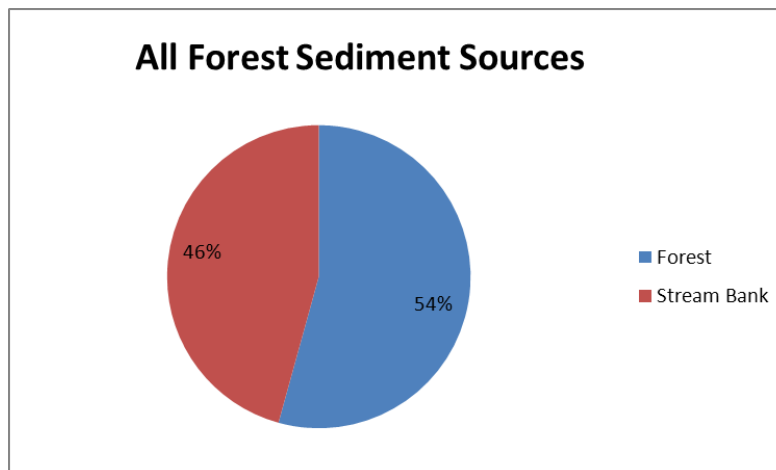
Figure 6

## INITIAL WATERSHED MODELING

Details on the modeling effort can be found in Appendix B. The first step was to create a modeling analysis of the watershed in both forested and existing land use conditions. The forested analysis provides insight into baseline conditions as if the entire watershed were forested. This isolates the effect of terrain, soils, and stream processes and allows a comparison of the watershed to existing land uses. This approach has been popularized in the Chesapeake Bay area and used for developing TMDL studies in Virginia. As a point of reference, a recent analysis of a watershed in Virginia predicted existing loadings to be 10 times than in forested conditions (VA DEQ 2013).

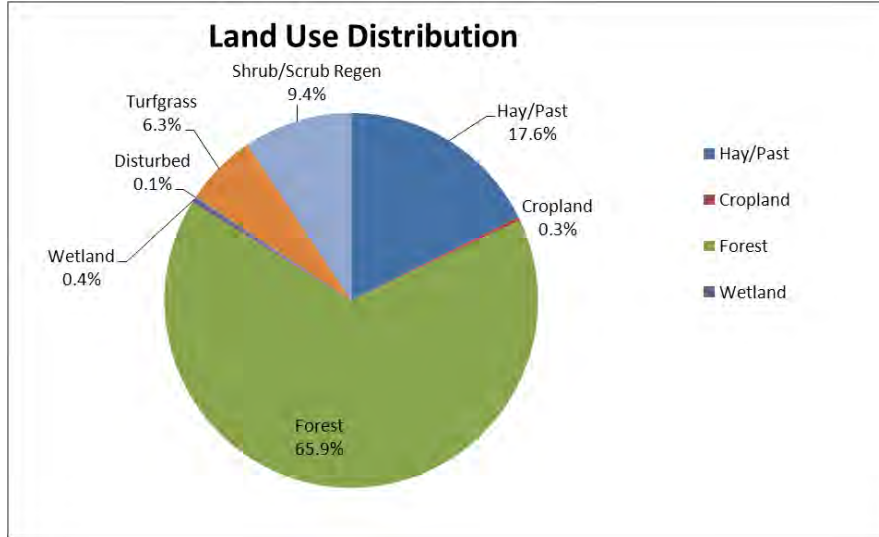
### Sediment Analysis

In the forested analysis, this watershed can be pictured as an evolving landscape. Sediment is generated by water moving across the terrain (landscape erosion) and water flowing through channels (streambank erosion). It is important to note that eroded material moves through the landscape over time and only contributes to the sediment load once it reaches a waterbody. Under forested conditions, the relative amount of sediment transport is evenly sourced between upland erosion and streambank loss (Figure 7).



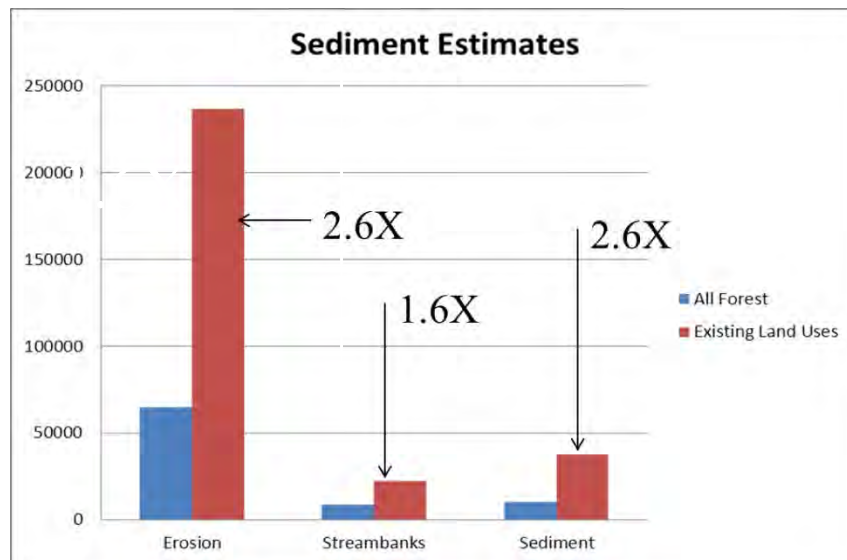
**Figure 7: Sources of sediment within completely forested watershed**

The distribution of existing land cover is shown in Figure 8. Nearly 66% of the watershed remains in forested land uses. 18% was found to be in hay/pastures and 10% in shrub/ scrub. The shrub/scrub land use represents areas that have been logged or cleared in recent years and is in a state of mixed regeneration. These areas could be replanted and have small trees, or be relatively unmanaged regrowth. Lawns, crops, and urban areas comprise very small portions of existing land uses in the watershed.



**Figure 8: Existing land use distributions calculated by the BAE team**

The modeling results for existing conditions show a substantial increase in the predicted transport of sediment, nutrients, and bacteria as compared to forested conditions. The current land uses are predicted to generate more than double (2.6 times) the amount of erosion and 1.6 times the amount of streambank erosion than in forested conditions. This leads to a 2.6 times increase in overall sediment load from the watershed.

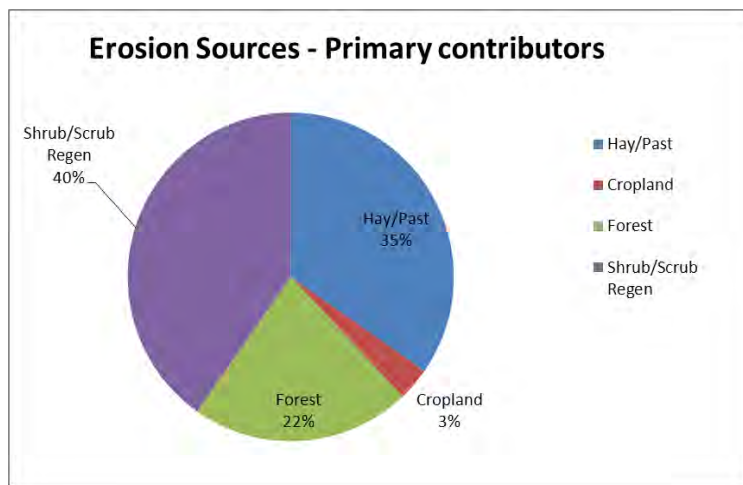


**Figure 9: Predicted sediment load comparison**

Figure 9 shows that the rate of increase in erosion from land use is much greater than the rate of increase in streambank sediment loss. Streambank erosion increases are largely due to

increases in runoff and streamflow. In the current conditions, with less than 2% total impervious cover and only 9% impervious cover in the subwatershed with the densest development, the watershed has not yet reached a point of development where the problems from runoff volume have outpaced the problems from land erosion. This points to a priority for projects addressing land erosion (agricultural BMPs) over projects that might control runoff (stormwater BMPs). A closer look at the increased rate of erosion points to the sensitivity of this watershed to land use changes. Even in a condition where most of the watershed remains forested or in rural land uses, large changes in erosion have already taken place.

A closer look at the data reveals that the overall sediment load from the watershed is not at alarmingly high rates. Figure 10 shows the predicted sources of erosion in current conditions.



**Figure 10: Predicted total sediment load contributed from erosion of major land uses**

Although shrub/scrub land use only comprises 10% of the watershed, it is responsible for 40% of the erosion. This reveals the effect of logging and unmanaged clearing on sediment loads. An additional 35% of erosion is attributed to hay and pasture areas. Crops and urban land uses are so small that they are not significant contributors to sediment. Table 1 provides a more detailed look at sediment loading rates from the various land uses.

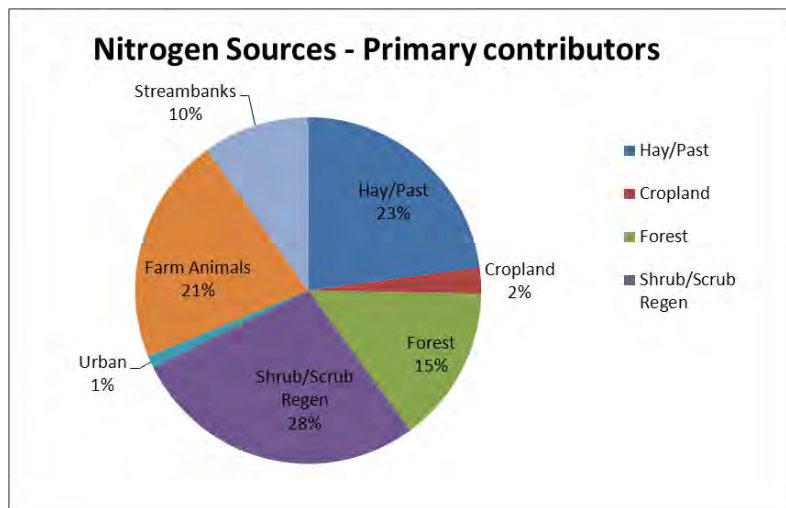
**Table 2: Predicted sediment loading rates**

Land Use	Sediment (tons/acre)
Forest	0.09
Hay/Past	0.51
Shrub/Scrub Regen	1.11
Cropland	2.78
Overall Average	0.40

The predicted overall loading rate is consistent with measurements from largely forested watersheds. The predicted loading rate from pastures is not much higher than the overall rate. However, the rate from regenerating areas is over 10 times the rate of forest land. This is a primary indicator of the potential damage that can be caused by improperly managed logging and clearing operations.

### Nutrient Sources

Predictions of nitrogen and phosphorus loads are also produced during model analysis. Overall, nutrient loads are 1.7-2.5 times higher in existing versus forested conditions. This is consistent with the predictions for sediment loading and within the realm of expectation. One difference in this analysis is the sources for nutrient loads. Figure 11 shows the distribution of predicted loading sources.



**Figure 11: Predicted nutrient loading sources**

Common contributors to nutrients are seen, including shrub/scrub (logged sites) and pastures. Farm animals are shown as a significant contributor to nutrient loads. The primary animal operations in the watershed are grazing cattle. Streambanks are not seen as a major source of nutrient loads. Although nutrients are not one of the major problems or focus areas in this

watershed, it is valuable to view planning efforts for multiple benefits in mind. A general view of nutrients loads would add an emphasis on BMPs for grazing/cattle operations in addition to logging sites.

### **Bacteria Analysis**

A final area of focus is the analysis of potential sources of bacteria impairment. Particular emphasis is placed on fecal coliform as it has been identified as a water quality problem. The GWLF model makes predictions of loadings of fecal coliform bacteria. This model was chosen primarily for this functionality. The model uses land uses to predict loading rates of bacteria from wildlife and urban areas (pets and other sources). The data used is based on a database of published research. In addition, the model uses similar data on the bacteria loads generated from farm animals. The BAE team generated estimates of the number of farm animals in the watershed using information from a USDA database and by contacting the Rockingham County extension agent. This data was used to distribute numbers of cattle to various pasture land uses throughout the watershed.

The overall results predict high concentrations of fecal coliform bacteria regularly from the watershed. Averages routinely exceed water quality thresholds. Although bacteria loading can be very dependent on storm events and timing that cannot be fully captured in our modeling, the overall average indicates issues that are supported by observations already made in the watershed. The model further indicates farm animals as the source of about 99% of all bacteria loading. Wildlife and urban sources combine for the remaining bacteria sources. In this analysis, the impact of wastewater treatment plants and septic system could not be included. These results put a strong emphasis on targeting grazing cattle for BMPs that reduce potential pathways for bacteria.

### **INITIAL WATERSHED MODELING SUMMARY**

The initial modeling results are summarized below. Some interpretation of the data has been made to provide the summary. The results have been simplified to identify primary watershed stressors, sources of sediment and bacteria, and to develop a strategy for further targeting.

- This watershed is sensitive to any changes in land use.
  - Even small changes in area from forest to logged or cleared land have caused substantial increases in sediment loads.
  - Further logging or clearing will increase these changes.
  - Additional urbanization may shift primary sources from land uses to streambanks.
- Predictions show increases in landscape erosion, streambank erosion, and overall sediment loads.
  - Overall loads are not alarmingly high.

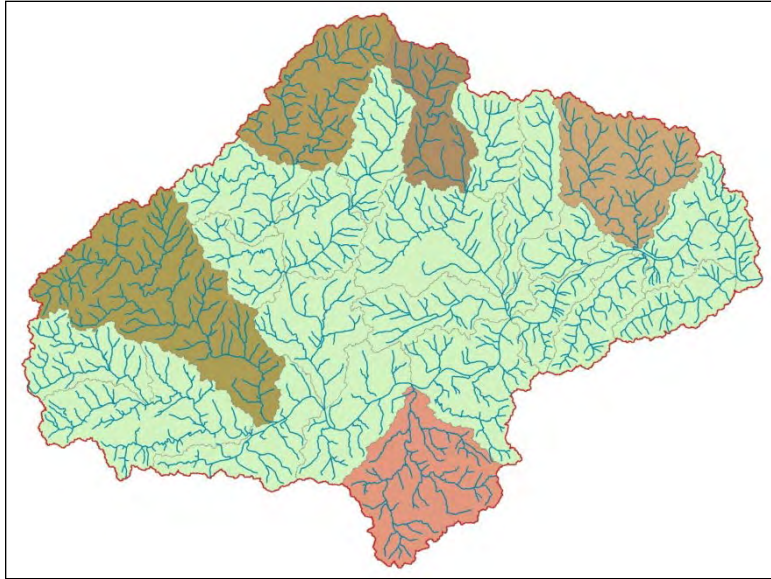
- A good watershed plan would target predicted sources of sediment such as clearing operations and streambanks.
- Predictions show significant bacterial concentrations.
  - 99% of bacteria predictions are generated from grazing cattle.
  - A strong emphasis should be placed on BMPs for cattle operations.

Analysis of these results was used to create some guidelines for planning and targeting of practices to address water quality problems. A summary list of targeting areas is provided below.

- Sediment Targeting
  1. Focus on headwater streams and logging practices.
  2. Pastures with animal operations
  3. Streambank stabilization using bioengineering practices
- Bacteria
  1. Focus on grazing cattle operations with regulations and BMPs.
  2. Focus in small watersheds where ratio of cattle to drainage area is high.
- Urban Sources
  1. Urban sources of runoff and pollutants are not substantial at the watershed scale.
  2. Future protection against the impacts of developed should be strategized carefully.

## **STRATEGIC PRIORITIZATION**

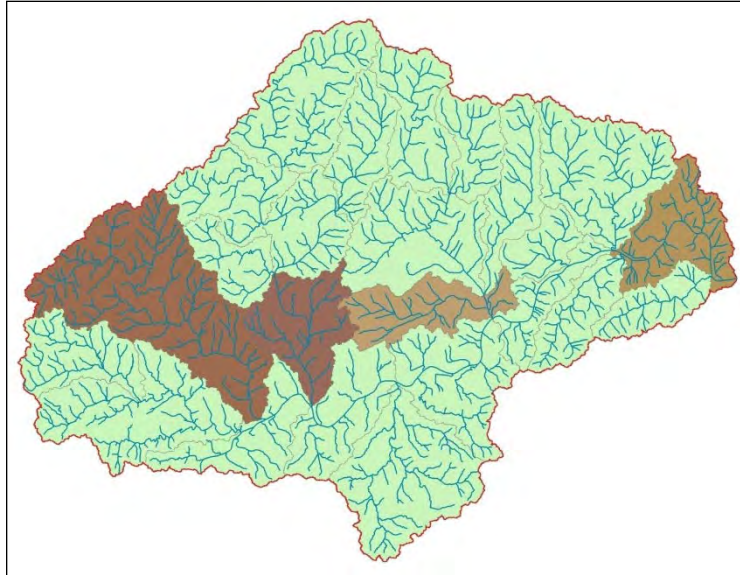
The next phase of this approach involves using the initial results to identify potential target areas for further study. One of the advantages of the modeling approach is that it provides values of relative contribution from various locations. This mapping is useful for targeting practices not just based on perceived benefit, but also based on the strategic location where they may provide the most benefit. An example of this is shown in Figure 12, which shows the top subwatersheds that are contributing the most to erosion loadings.



**Figure 12: Map of major subwatershed contributors to erosion loads**

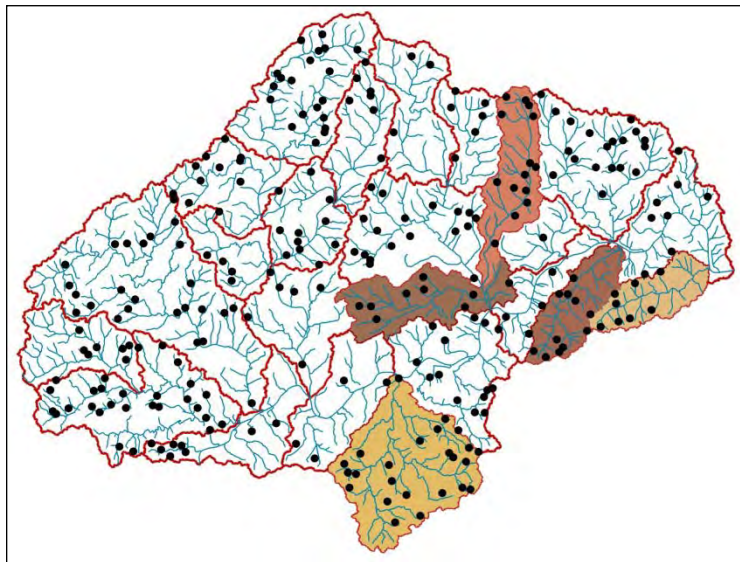
These watersheds represent a unique combination of topography and soils that have led to land use changes that are generating the highest sediment loads. A visual analysis shows that these are headwater type watersheds that have somewhat steep topography, but are not so steep that they have prevented access for logging and pastures. BMPs and management practices that can reduce erosion loss from land uses should be focused in these subwatersheds.

A similar map that shows streambank erosion identifies other subwatersheds of concern (Figure 13). The subwatersheds shown tend to have large contributing areas that are providing significant volumes of streamflow. This adds up to cause greater potential for streambank erosion. One of the watersheds identified includes urban areas, which is a contributing factor to its ranking here. Streambank stabilization efforts should be focused on these watersheds for maximum benefit.



**Figure 13: Map of subwatershed streambank contributors**

A separate map shows the top sources of bacteria loads in the watershed (Figure 14).

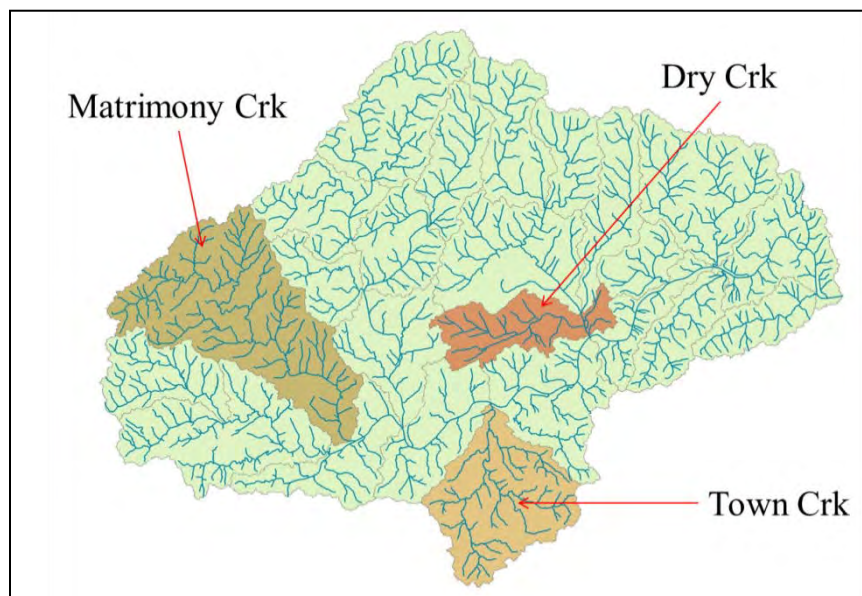


**Figure 14: Top bacteria contributors**

The black dots on the map are locations of pastures that may have animal operations. In comparison to other subwatershed rankings, the difference in bacteria loadings between watersheds is less evident. The reasons for the differences are even less easily identified. For example, it appears that the top sources are in smaller subwatersheds where streamflows are not substantial enough to dilute concentrations of bacteria. There also may be a higher ratio of animal density in these watersheds that is also contributing to the impairments. In any case,

strategic implementation of BMPs that can reduce bacterial loading should be focused in these subwatersheds.

The overlay of all three of these maps generates some interesting results. Although these maps can be used by themselves for targeting purposes, the combined map can be used to further simplify and target specific subwatersheds. This is an indicator that multiple problems exist in these basins and that an emphasis should be placed on additional analysis. Figure 15 shows three subwatersheds that are in NC and that appear on multiple maps: Matrimony Creek, Dry Creek and Town Creek.



**Figure 15: Priority subwatersheds based on being major contributors of multiple pollutants**

Matrimony Creek subwatershed falls on both the erosion and streambank sediment maps. This finding duplicates observations in this watershed that have identified it as a source of excess sediment and turbidity problems. The Town Creek subbasin is seen on the erosion and bacteria source maps. Dry Creek is seen on the streambank erosion and bacteria source maps. This analysis helps add focus to potential projects that can be applied in each watershed.

### **POTENTIAL BMP IDENTIFICATION**

The results of this modeling and analysis were used to develop a GIS approach for identifying potential water quality projects. In order to find potential projects at a watershed scale, a number of decisions had to be made regarding the size and scope of what could be identified. Some details of this process for each of the targeted BMPs are provided in the companion report (Eden Watershed Modeling Details; Appendix A) for this project. In addition, the number of potential BMP types that exist is far beyond the scope of what can be considered for this

study. Some aggregation of BMP types was used to maximize the efficiency of this step in the process.

BMP types were identified based on the types of practices that can provide the most benefit to the found problems and land uses in the watershed. Some of the BMP types can be identified using GIS data, while others are more general in nature. Table 2 includes a list of the BMP types chosen and how they were targeted.

**Table 3: Targeted BMP types**

<b>BMP Type</b>	<b>Targeting</b>	<b>Implementation scale</b>
Logging management practices	General – Management	Watershed
Agricultural BMPs	General – Management	
Preservation	General/GIS	Subwatershed
Improved pasture management	General/GIS	
Cattle exclusion/fencing	GIS – Implementation	Field Level
Wetland restoration	GIS – Implementation	
Stream restoration and buffers	GIS – Implementation	
Stormwater BMPs	GIS – Implementation	Parcel or Regional

The table distinguishes between strategies that should be implemented using a policy or management approach and those that can be specifically identified using GIS methods. The table also provides information on the expected level that these types of BMPs can be implemented. In general, policy/management level practices can be implemented in the entire watershed for maximum effect. As logging sites are somewhat of a moving target, a policy based method of improvement may have the best effect. Potential preservation and pasture sites can be simply identified using GIS data. However, the scale of these practices probably needs a more general approach to implementation. Other BMP types have been identified at a field scale and can be considered for application at a very specific level.

The GIS site identification has been applied throughout the entire watershed to find more than 500 potential specific BMP sites. It is anticipated that these sites are locations where multiple

BMP projects can be implemented. Approximately 30 miles of fencing opportunities and stream buffers were found, 2,000 acres of potential wetland restoration sites, and 100 potential stormwater projects. It should be expected that many streambank stabilization sites are available that could not be identified using remote sensing. In addition to field level sites, over 200 pasture sites and over 30 recent logging sites were found. Many older logging sites were also found that would benefit from stabilization or improved management.

## **MODELING POTENTIAL BENEFITS**

Identified BMP sites were compiled for further modeling analysis. The PRedICT modeling tool was used to analyze the potential benefits of implementing BMPs at a watershed scale. This tool is an add-on to the Mapshed and GWLF system and can provide predictions of load reductions and costs. The model allows the implementation of a range of BMP types targeted for the project.

Initial modeling of this type was focused on the Matrimony Creek subwatershed. BMPs were implemented in various stages to predict benefits and costs. Eventually, the full extent of BMPs was included to predict the maximum effect of potential BMP implementation. Full implementation of BMPs in this watershed can provide only modest reductions in sediment and nutrient loads. With full BMP implementation, an estimated reduction of up to 8% of sediment load and 10% of nutrients can be achieved for a total cost of \$2.5-\$3 million. Although an 8-10% reduction in loads does not appear substantial, this equates to thousands of pounds of pollutant removals. More encouraging is the potential for bacteria reductions. The implementation of improved pasture management and cattle exclusion systems can provide an estimated reduction of over 50% of bacteria loading.

This initial analysis provides insight on the capability of BMP implementation to address specific water quality problems. In general, the cost:benefit ratio of implementing BMPs to address erosion is not acceptable. Even with significant expenditures in this area and implementation of almost every possible site, substantial changes to resulting sediment loads cannot be achieved. However, a weakness of this modeling is that it cannot simulate the effect of implementing forestry BMPs and the re-establishment of forests on logged sites over time. As logging sites have already been identified as a primary source of watershed sediment loads, it is expected that better forestry management practices could have an effect that is not properly captured with this analysis.

The effect of BMP practices on bacteria loads does show substantial promise. Cattle exclusion, fencing, and established buffers show an excellent potential for reducing bacteria loadings. The incorporation of rotational grazing schemes and other pasture management practices can be

implemented for additional benefit. Out of the total cost estimate, only \$270,000 is attributed to these BMP types, providing by far the most benefit for implementation resources.

PRedICT model runs for both Town Creek and Dry Creek create similar cost:benefit results. Town Creek predicts a 10% sediment reduction for a total of \$2 million. Bacteria loads can be reduced by over 50% for an estimated cost of \$61,000. Dry Creek is slightly different as costs are dominated by stormwater BMPs. As a result, there is a higher benefit to sediment and nutrients, of 12% reduction. Bacteria benefit in this watershed also exceeds 50%. This load reduction is also achieved primarily through the use of fencing and buffers, for an estimated cost of \$125,000. This is a small portion of the total cost of \$1.7 million. Table 3 shows the estimated performance and costs for full implementation of all three subwatersheds.

**Table 4: PRedICT subwatershed results**

<b>Subwatershed</b>	<b>Sediment reduction</b>	<b>Estimated Cost</b>	<b>Bacteria reduction</b>	<b>Estimated Cost</b>
Matrimony Creek	8%	\$2.75M	>50%	\$270,000
Town Creek	10%	\$2M	>50%	\$61,000
Dry Creek	12%	\$1.7M	>50%	\$125,000

### **BMP Modeling Summary**

It is clear that the most efficient practice for implementation in this watershed is cattle exclusion fencing and buffer establishment. This practice has an excellent projection for reducing bacteria loadings. The addition of pasture management or rotational grazing can be a value added practice to increase results. Other BMP types in these watersheds can provide reductions to sediment loads. However, benefit of these BMPs at a watershed scale appears limited. The cost of implementing these practices appears high relative to the potential results. Particularly when compared to fencing and buffers. Based on the initial results of this modeling, recommendations should focus on maximum implementation of cattle exclusion fencing and buffer establishment.

The lower reductions shown for other BMP types may be more of a function of sources than a limitation of the BMPs themselves. As logging sites tend to be viewed as a temporary type of impact, they are difficult to target for BMP implementation. These practices cannot be accurately included in model results and predictions, as assumptions are that logging is a rare

occurrence and that eventual stability will happen. For these reasons, BMPs that are focused on logging sites are more of a policy and management objective rather than a target BMP type.

## RECOMMENDATIONS

A series of recommendations has been compiled based on the results of this study. The recommendations fall into three categories. The categories are separated based on the potential actions that might be needed to implement the recommendations. The first category of recommendations is Management Actions. These ideas are strategies that are directed toward focus areas of reducing sediment and bacteria loads, but that are most efficiently improved through either policy directives or planning. A second category falls under the description of BMP Implementation. Items in this area are specific BMP types and locations that will provide the most efficient gains toward reducing sediment and bacteria. Priority projects in this category include maps of example projects and projected costs and benefits. A final section of recommendations includes ideas that have appeared useful in other watersheds in NC. The ideas are focused on the specific issues that have been found in the Eden Watershed and may provide strategic notes for future planning.

### MANAGEMENT ACTIONS:

#### General

- Continue developing policy and strategies for watershed protection.
- Many rules and planning currently in place are not as effective as they could be (ie: erosion control, animal operations).
- Develop/plan sources of funding for enforcement and inspectors.

It is clear from the modeling efforts of this study that the Eden Area Watershed is and will be particularly sensitive to unmanaged development activity. The further development of county and local ordinances, zoning, and planning will play a significant role in the future protection of water quality resources.

#### Forestry Practices

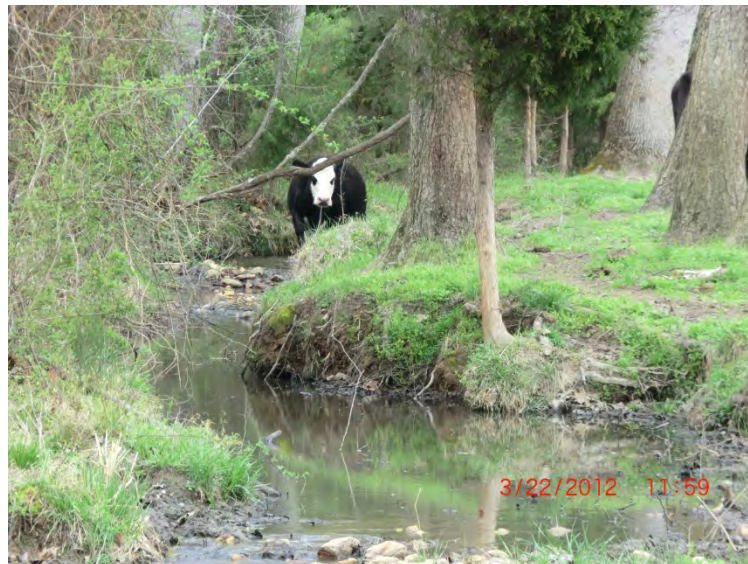
- Improve the standard of practice for forestry operations.
- Expand rules and expectations for sustainable practices.
- Education on sensitivity of water resources to logging.
- Enforcement.

Problems with excess sediment can be largely linked to logging and clearing practices. It is recommended that existing rules be strengthened and resources be allocated to better enforcement and management of potential logging sites.

## Animal Operations

- Improve the standard of practice for animal operations.
- Almost every site is exempt from existing rules for managing animal operations.
- Every program available is voluntary/cost-share.
- Perennial buffers are ineffective when short circuits exist.

Problems with excessive bacterial loadings have been strongly linked to grazing animal operations. The size of these operations allows them to operate independently of most rules. It is recommended to consider whether additional requirements for buffers, density of livestock, or management of feedlots and pastures can be developed. It is recommended that a strong emphasis be placed on supporting and implementing cost share programs that can lead to BMP implementation.



**Figure 16: Cattle Access to Matrimony Creek, PTRC 2012**

## BMP IMPLEMENTATION

### Priority Practices for Matrimony Creek

- Cattle exclusion fencing.
- Combine with buffer establishment.
- Combine with improved pasture management.

Matrimony Creek is a top contributing watershed of sediment. It also ranks high in potential sites for fencing and buffers. Implementation of these practices can be combined with improved management to maximize benefit (Figure 17; Table 5).

### **Priority Practices for Town Creek**

- Cattle exclusion fencing.
- Agricultural BMPs.
- Combine with improved pasture management.

Town Creek is a top contributor to both erosion and bacteria. However, this subwatershed does not rank highly in numbers of potential fencing sites. Modeling predictions indicate an excellent benefit to installing fencing for bacteria reduction. Agricultural BMPs may be of added benefit in this subwatershed (Figure 18; Table 5).

### **Priority Practices for Dry Creek**

- Cattle exclusion and buffers.
- Stream restoration
- Stormwater BMPs

Dry Creek is a top contributor of both streambank erosion and bacteria. This subwatershed ranks in high opportunities for both fencing and stream restoration. The upper reaches of this subwatershed are some of the more dense urban areas in Eden. A number of stormwater BMP opportunities were identified (Figure 19; Table 5).

### **Priority Practice – Overall Watershed**

- Preservation opportunities

**Table 5: Priority Subwatershed Recommended BMP Totals**

Subwatershed	Watershed Area	Buffer Establishment		Cattle Exclusion		Wetland Restoration		Urban BMP Sites		# Farm Ponds	
	(sq miles)	(Length/miles)	Estimated Costs	(Length/miles)	Estimated Costs	(acres)	Estimated Costs	(count)	Estimated Costs	(count)	Estimated Costs
Dry Cr	7.7	3.3	\$33,000	2.3	\$36,401	299	\$3,980,000	42	\$1,730,000	3	\$130,000
East Branch Cascade Creek	5.4	0.4	\$3,865	0.6	\$14,418	0	-	0	-	2	\$60,000
Home Cr	6.8	0.7	\$7,118	0.5	\$12,119	0	-	0	-	3	\$130,000
Lower Buffalo Cr	14.5	2.4	\$24,000	2.7	\$67,440	26	\$520,000	0	-	21	\$630,000
Lower Cascade Creek	13.1	1.6	\$16,000	1.7	\$43,313	260	\$3,200,000	2	\$90,000	14	\$420,000
Lower Dan R. Childress Cr	9.5	1.0	\$10,000	0.9	\$22,907	29	\$380,000	0	-	1	\$30,000
Lower Smith	9.3	0.8	\$8,282	0.2	\$6,237	110	\$2,200,000	8	\$930,000	7	\$210,000
Matrimony Creek	26.0	2.8	\$28,000	1.9	\$46,648	77	\$1,340,000	3	\$101,900	14	\$420,000
Middle Dan River 3	5.0	0.9	\$8,680	1.0	\$25,836	184	\$3,680,000	0	-	9	\$270,000
Middle Dan River1 Fishing Cr	9.0	0.7	\$7,160	0.3	\$8,122	168	\$3,360,000	23	\$1,010,000	4	\$120,000
Middle Dan River2 Rock Cr	11.1	1.6	\$16,000	1.1	\$28,065	513	\$10,260,000	7	\$232,000	16	\$480,000
Middle Smith1 Turkeycock Cr	7.9	1.7	\$16,701	1.6	\$40,324	0	-	0	-	2	\$60,000
Middle Smith2	7.1	1.0	\$9,940	0.9	\$22,713	123	\$2,460,000	0	-	2	\$60,000
Mountain Run	7.2	1.1	\$11,215	1.1	\$27,899	0	-	0	-	2	\$60,000
Stuart and Martin Cr	4.9	0.3	\$3,279	0.3	\$8,079	0	-	0	-	1	\$30,000
Town Cr	15.4	0.6	\$5,776	0.9	\$22,712	34	\$680,000	0	-	18	\$340,000
Trotters Cr	13.9	3.1	\$31,000	3.0	\$74,220	0	-	0	-	9	\$270,000
Upper Buffalo Cr	7.4	1.0	\$10,000	0.7	\$16,572	11	\$220,000	0	-	2	\$60,000
Upper Dan River	7.7	0.7	\$7,168	0.3	\$8,647	117	\$2,340,000	10	\$370,000	10	\$300,000
UpperSmith Fall Cr	13.1	3.3	\$33,000	2.3	\$26,881	26	\$520,000	0	-	6	\$180,000
UT Dan River	3.9	0.1	\$701	0.1	\$2,752	28	\$560,000	0	-	1	\$30,000
West Branch Cascade Cr	8.7	1.3	\$12,573	1.0	\$26,164	0	-	0	-	3	\$90,000
White Oak Cr	5.8	0.7	\$7,008	0.6	\$13,792	134	\$2,680,000	0	-	21	\$630,000
Williamson Cr	5.0	0.5	\$4,672	0.8	\$21,135	1	\$20,000	0	-	11	\$330,000
<b>TOTALS</b>	<b>225.4</b>	<b>31.5</b>	<b>\$315,137</b>	<b>26.9</b>	<b>\$673,496</b>	<b>2,140</b>	<b>\$42,800,000</b>	<b>95</b>	<b>\$4,063,900</b>	<b>186</b>	<b>\$5,580,000</b>

**Notes:**

In general, the cost estimates should be considered suitable for construction implementation.

The costs for buffer establishment and cattle exclusion provide moderate resources for design, administration, or other additional costs.

Wetland restoration and Urban BMP Sites require substantial engineering or administration costs. The cost estimates for these items includes resources for these costs.

Farm Pond projects may or may not require additional resources for engineering analysis. A broad price of \$30,000 per/site was used.

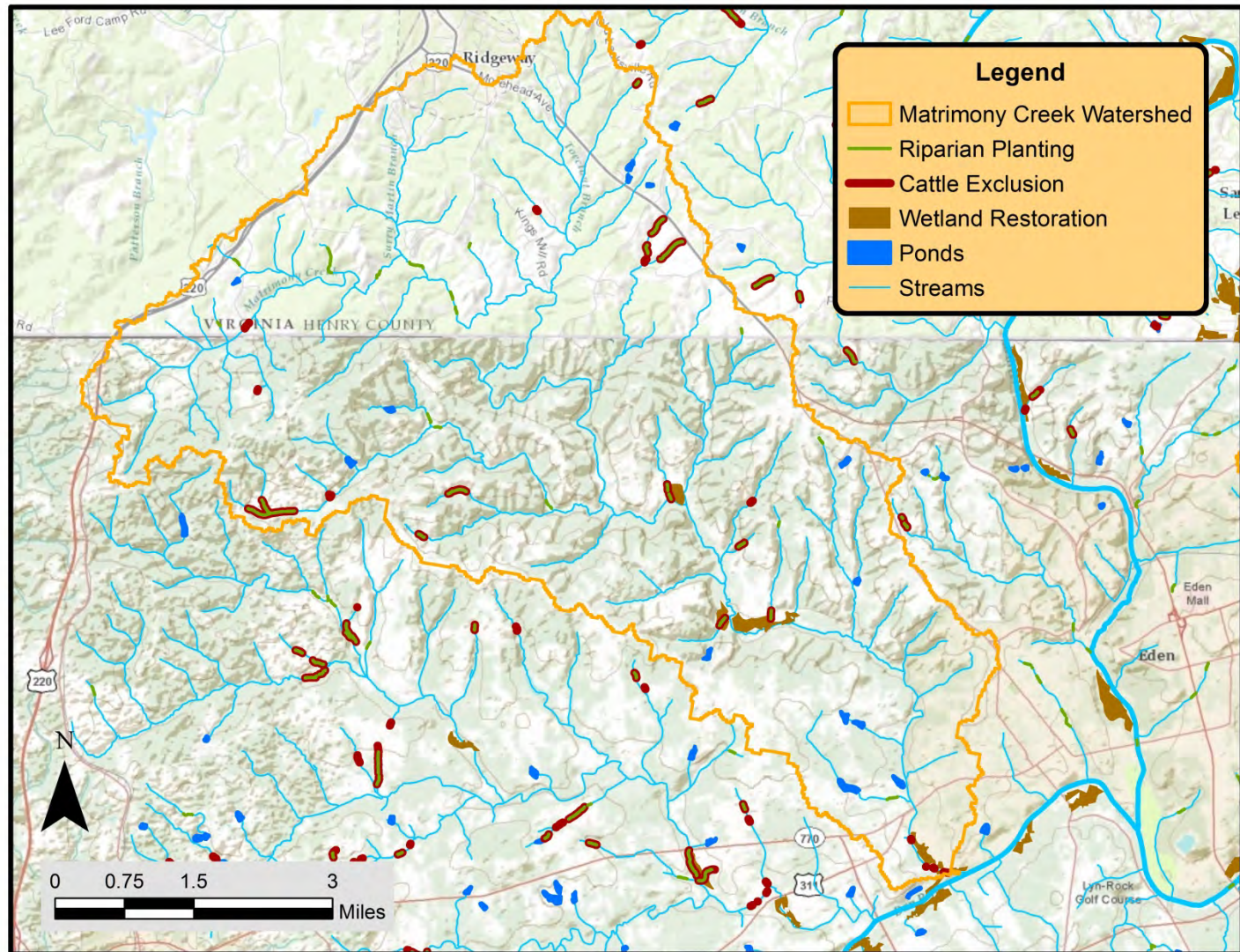


Figure 17: Matrimony Creek Subwatershed BMP Opportunities, NCSU 2014

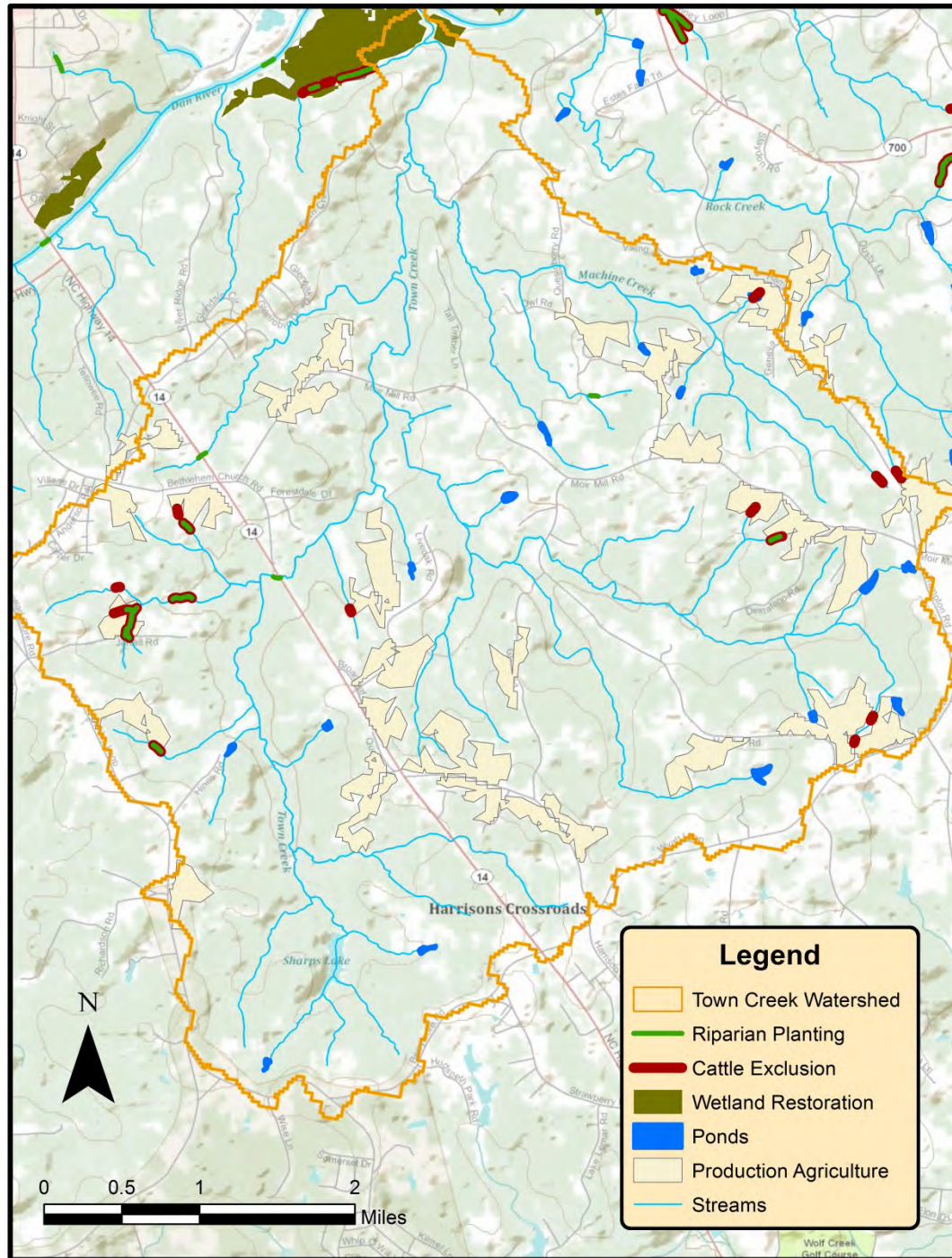


Figure 18: Town Creek Subwatershed BMP Opportunities, NCSU 2014

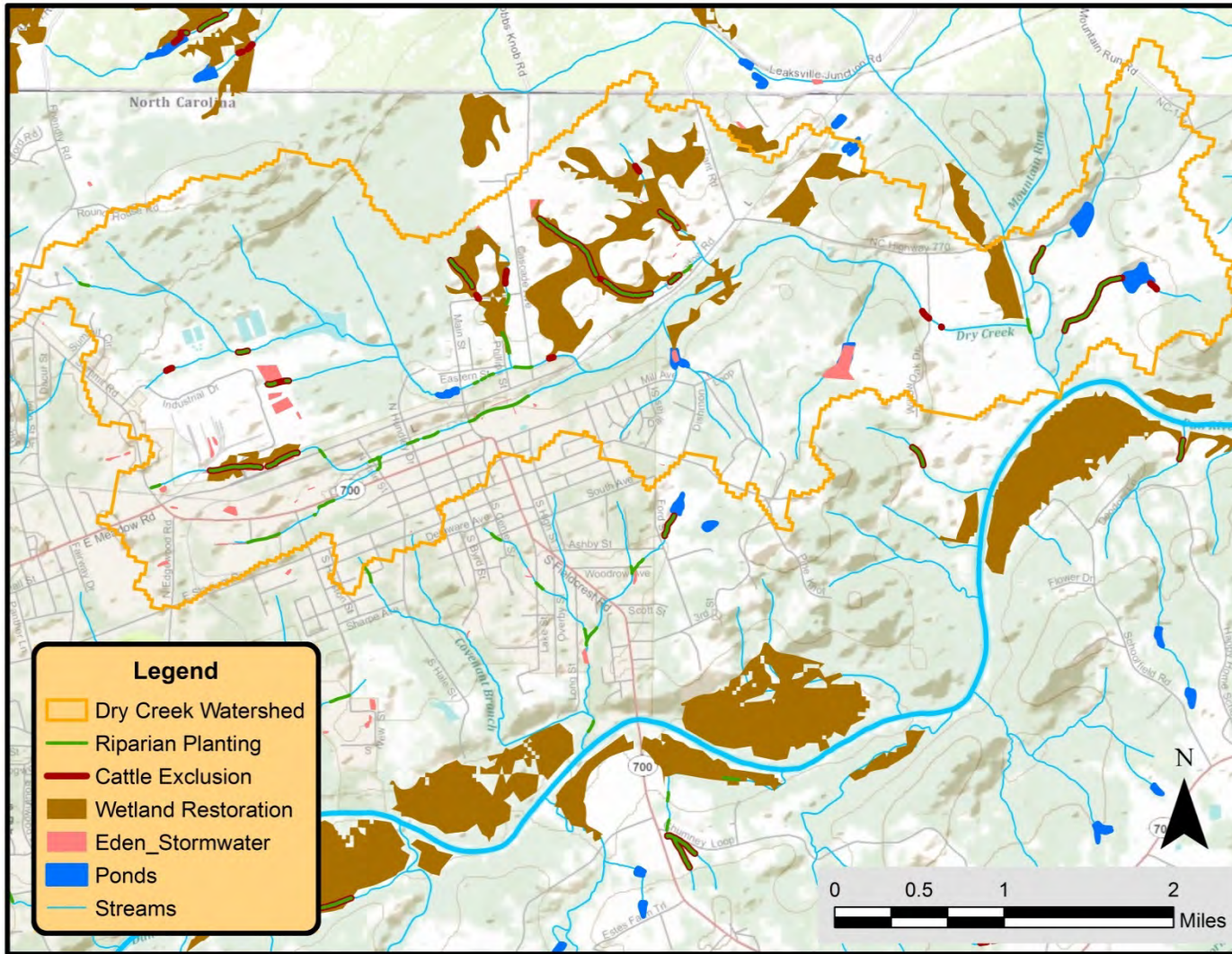
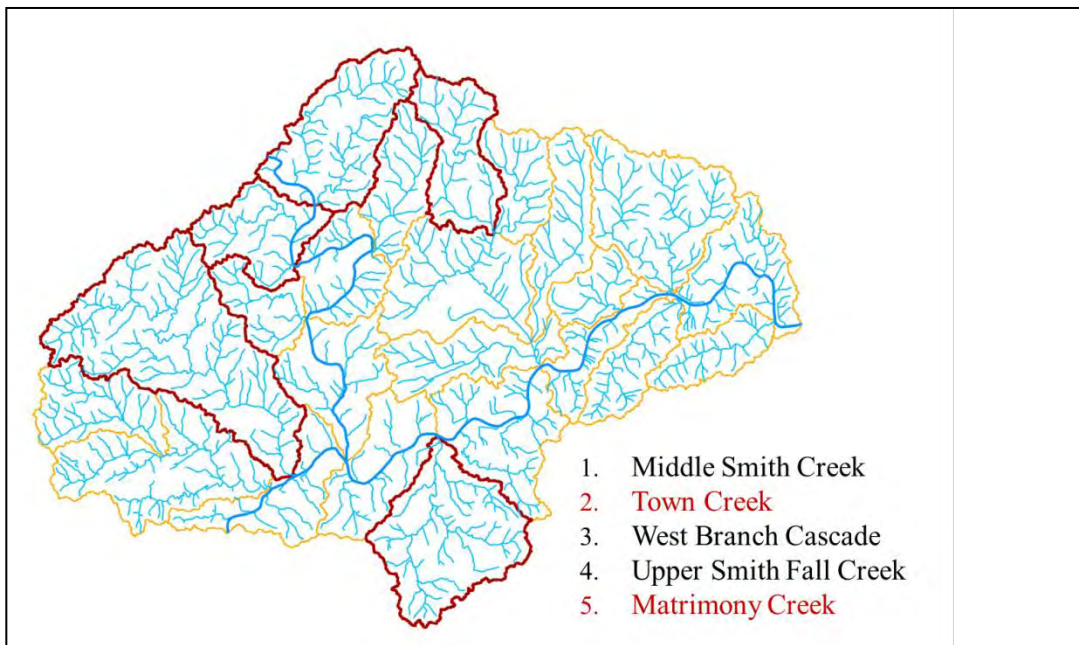


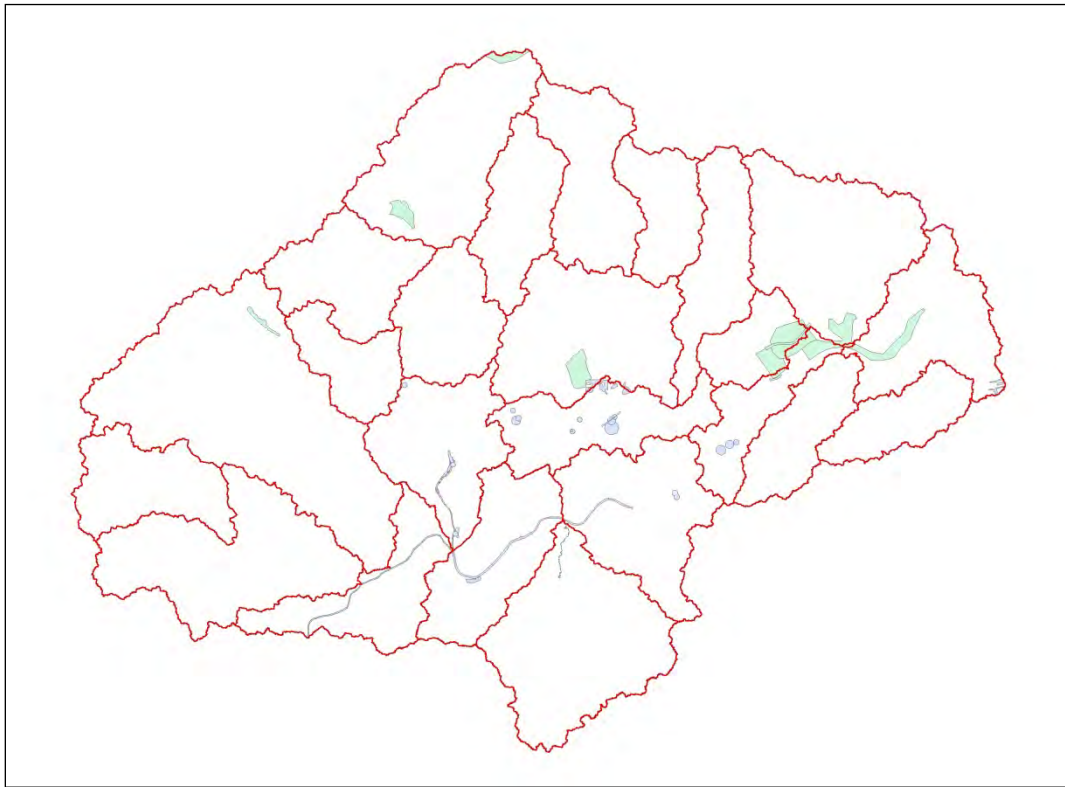
Figure 19: Dry Creek Subwatershed BMP Opportunities, NCSU 2014

The sensitivity of this watershed to changing land uses has been shown to be very high. This creates a high value of preservation of forest and other natural areas. A separate analysis was completed to help prioritize subwatersheds for preservation efforts. Modeling results were used to identify subwatersheds that are most sensitive to a change from forest to other land use types. These subwatersheds were then overlaid with land use change data and logging to data to eliminate areas that have been previously logged. Figure 20 shows the subwatersheds identified for focused preservation efforts. These watersheds have a combination of sensitivity to logging and large areas of unlogged hardwood trees. 10 subwatersheds have at least 20% of the total land area in unlogged hardwood forest.



**Figure 20: Preservation site focus subwatersheds**

Natural Heritage Areas are unique habitats that should be considered for preservation efforts. An overlay of these areas is shown in Figure 21. A number of these sites exist in the Dry Creek subwatershed, which has also been identified as a priority area. A large concentration of these areas is also seen in the lower sections of the watershed and along the Dan River. These priorities complement those already identified by the Piedmont Land Conservancy in their 2006 *Dan River Watershed Protection Plan* (Figure 22; PLC 2006).



**Figure 21: Natural Heritage Site**

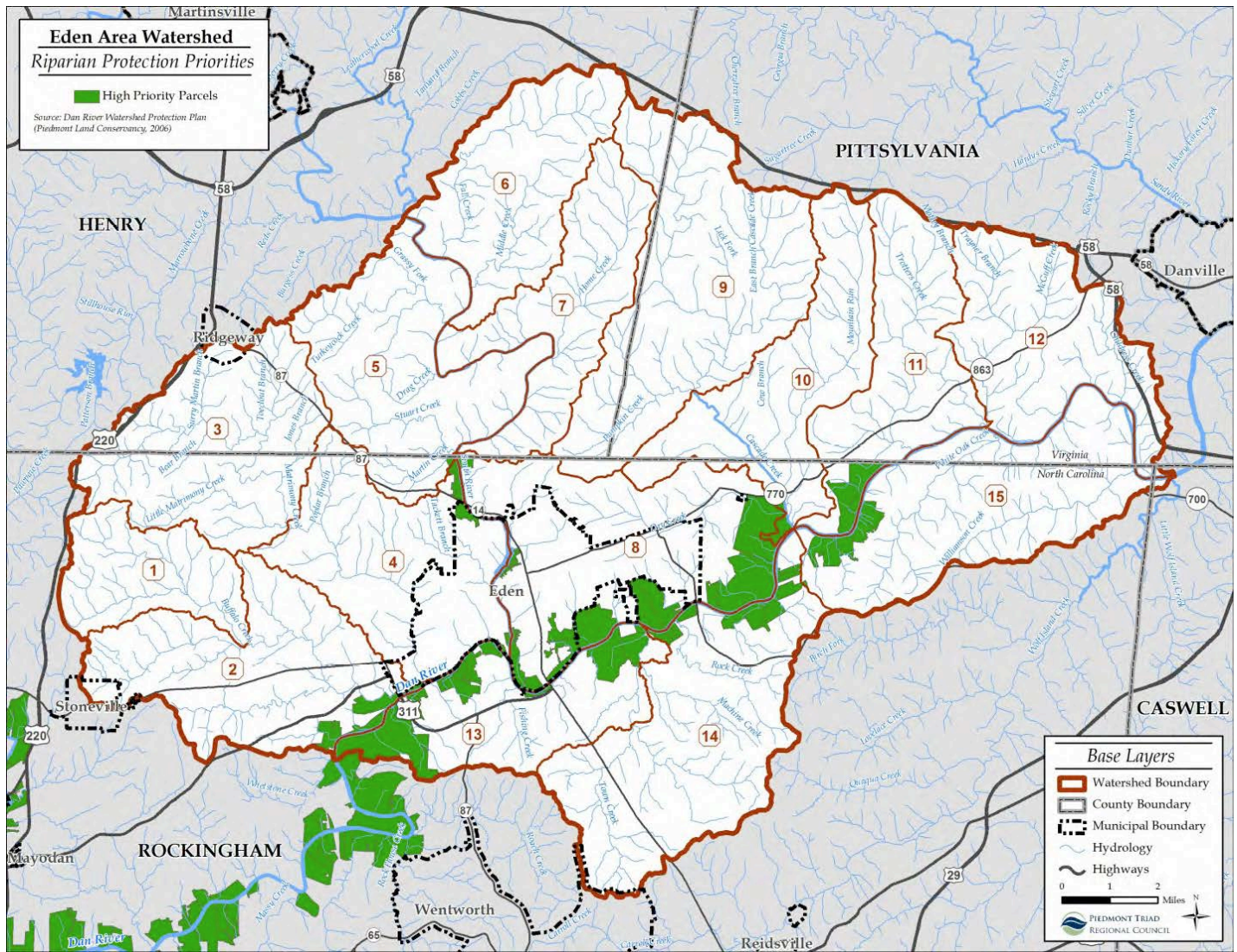
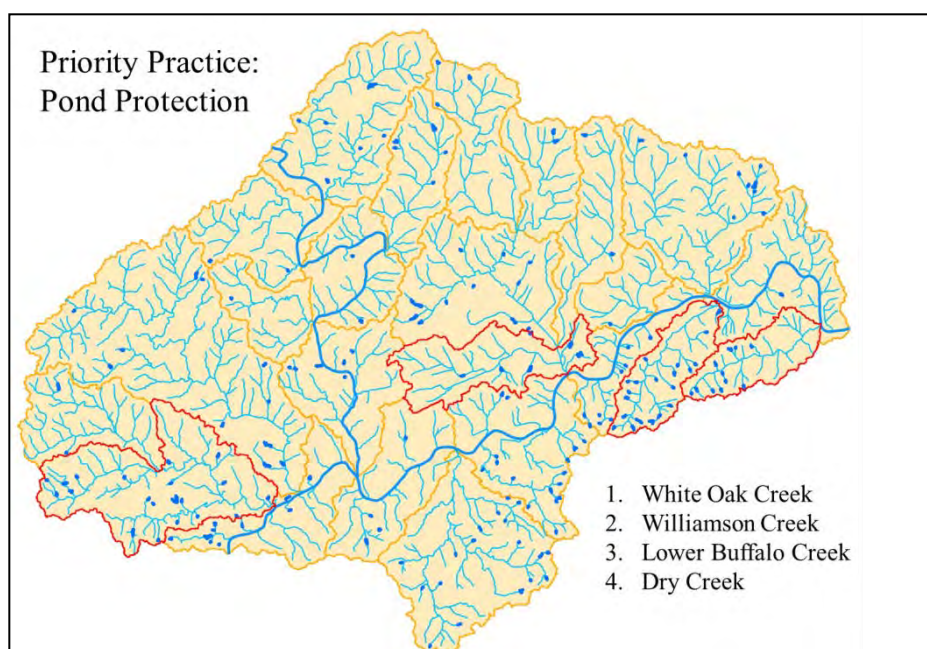


Figure 22: Piedmont Land Conservancy Conservation Priorities in the Eden Area Watershed, PLC 2006

## Priority Practice – Overall Watershed

- Pond Protection

The number of farm ponds in this watershed is substantial. The age of ponds and status of dams has created a growing concern over dramatic sediment loss that may result if a breach occurs. Over 400 farm ponds were found in a GIS analysis. Approximately 186 of those ponds are over 0.75 acres in size. The subwatersheds with the highest ratio of farm ponds to drainage area were identified. These subwatersheds should be targeted first for pond protection efforts. A map of these subwatershed is shown in Figure 23.



**Figure 23: Subwatersheds with the highest density of farm ponds**

## OTHER IDEAS

This section focuses on other ideas that may fall outside the original scope of this plan, but may be worth additional consideration.

As BMP implementation sites identified as Priorities were limited to NC subwatersheds, areas in Virginia received less attention. A large portion of the Smith River watershed lies primarily in Virginia and will require special cooperation if protection efforts are desired. One potential idea is the formation of a watershed group dedicated to the implementation of this plan, perhaps a non-profit organization. While the Dan River Basin Association has a well-established presence on the watershed, it has largely

focused its efforts on restoring river conditions through citizen education and outreach, with several marquee projects focused on stream restoration and trail establishment. They are an excellent candidate to take on plan implementation, but to do so may require an advocacy position their board of directors may feel outside the organization's mission.

Non-profits focused on rivers and watersheds have been very effective at educational campaigns and gathering support for water quality initiatives in NC. Small groups have been successful at obtaining grant money and leverage support to pursue and implement protection programs and implementation projects. The educational value gained from improved exposure and attention to stewardship cannot be underestimated.

Several of the management actions recommended will require local involvement and enforcement. The full implementation of this plan will require resources to hire technical personnel that may provide assistance to landowners and participate in implementation of practices. The cost of hiring technical personnel can potentially be spread among counties or the watershed if creative planning takes place. The potential cost:benefit ratio of this type of resource is outstanding compared to the cost of implementing specific BMPs.

## **CONCLUSIONS**

The Eden Area Watershed is at a critical stage for future planning, and water quality protection efforts. The watershed topography, soils, and geologic setting make it particularly sensitive to changes in land use. This study indicates both the sensitivity of water resources to land use changes and to the management of those land uses. Our analysis shows that logging sites and practices are a major contributor to potential sediment loss in the watershed. Hay and pasture sites, particular those with grazing cattle, are also potential sources of sediment impairments. Grazing cattle was identified as the primary source of bacterial concentrations in the watershed.

The primary recommendation for future water quality protection is to further develop policy that will improve the standards of land use practices. Many of the common land uses that can be sources of sediment operate under the thresholds of existing rules. Stronger standards for logging and clearing sites were identified as having the highest potential benefit to watershed protection. Similar standards or incentives for improved management of grazing cattle and pastures were also identified for potential benefits. The amount of urban development in this watershed is not high enough to cause significant impairments on a watershed scale. However, this watershed will be sensitive

to future development. The protection of the watershed from development impacts should be an important part of future planning.

The subwatersheds of Matrimony Creek, Town Creek, and Dry Creek were identified as priority implementation areas. These subbasins were shown to be among the highest contributors of sediment and bacteria to streams. Matrimony Creek would most benefit from fencing and buffers. The Town Creek watershed would appear to benefit from the implementation of common agricultural BMPs. The Dry Creek watershed would benefit from stream restoration and stormwater management. Many areas in these watersheds would benefit from BMP installations. However, the cost of widespread application is high compared to the expected benefit. Cattle exclusion fencing and the establishment of stream buffers was found to have the highest potential benefit to water quality. Widespread implementation of this practice was shown to provide substantial improvements in bacteria transport to streams. In addition, this practice was low in cost relative to other types of BMPs identified.

## POLICY INITIATIVES

### AGRICULTURE

In North Carolina, agriculture remains a major economic sector, contributing \$70 billion to the state's economy (NC DACS 2013). North Carolina ranks as the eighth largest agricultural state in the United States, and the food sector and processing of local, value-added foods (such as jams, sauces, and deli meats) continues to grow (CEFS 2013). The Eden Area watershed is able to benefit from this important cultural and economic sector with just over 44% of the land (102 square miles) categorized as being used for agricultural and forestry purposes. Resident farmers also benefit from Rockingham County having a Community Kitchen that is certified to enable farmers to process their crops into value added foods that can then be legally sold to the public (RCLFC 2014).

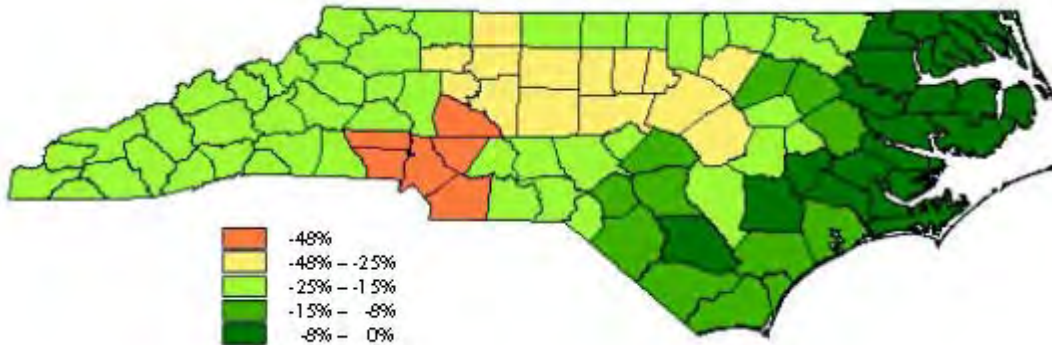


Figure 24: Photo – Rockingham SWCD

However, most of Rockingham County's lands are dedicated to growing tobacco, which is a crop with a notoriously negative relationship with healthy waters. Rockingham County has been the state's top producer of burley tobacco throughout recent years (NCDACS 2012, 2013). Significantly, for the water quality conditions in this watershed, most of the agricultural production lies in the Matrimony Creek watershed and on the southern bank of the Dan River. As seen in the water quality model conducted for this planning effort, these lands are having a significant effect upon local water quality conditions, attributed with over 90% of the fecal material inputs to the Dan and Smith Rivers. Immediate action at these sites could reduce the fecal loadings by over 50% to the receiving waters, and have an immediate benefit for all watershed residents.

Agricultural land can be an important tool to improving water quality. Many agricultural BMPs can reduce pollution entering the water. When agricultural land is transformed into residential uses the amount of impervious surfaces increases and often stormwater runoff can greatly increase which has the potential to negatively impact the water. According to the 2007 Census of Agriculture, North Carolina is among the leading states in farmland acreage loss at an estimated rate of 10.3% over a 10 year period. North Carolina lost more than 970,000 acres of farmland from 1997 to 2007 or approximately 100,000 acres annually (NCDACS 2013). The Triad's consumption of land outpaces the rest of the state during this time period, if accounted for at a *per capita* scale (Figure 25;

ENC 2007). The Dan River Basin Association (DRBA) lists the loss of farmland as the top risk to forest and water health in Rockingham County (DRBA 2013).



**Figure 25: Projected Percentage Decrease in Total Forest and Cropland, 2002 – 2022, ENC 2007**

A number of studies in NC counties indicate that residential properties can cost counties more in needed services than they provide in revenue, while farms and forestlands pay more taxes than the services they require. For example, for every dollar of revenue that Alamance County gained in 2006, the cost of providing services to various types of properties were as follows: residential (\$1.47), commercial/ industrial (\$.23) and farm/forestland (\$.59/\$.25) (CEFS 2013). Therefore, encouraging agriculture can have significant economic benefit while maintaining healthy natural resources and reducing sediment inputs.

When BMPs are used in agriculture, the land provides infiltration and filtering capacity to reduce pollution and provide important ecosystem services for the community. If the land is not managed correctly, agricultural impacts to the Dan River are caused by soil erosion, excessive fertilizer use, animal waste contamination, improper use of chemicals and sewage overflows. As seen in the supporting analysis for the *Mayo and Smith River TMDL Implementation Plan* and the water quality model for this planning project, the need for agricultural BMPs is immediate and could be extremely valuable to all watershed residents.

There are many programs offered to help landowners receive financial benefits from implementing BMPs on



**Figure 26: Alternative water source, Joy Fields 2013**

their land that protect water quality (See Appendix B). Landowners can voluntarily participate in these financial and management programs to address their objectives on agricultural lands, urban lands or other land uses. Because these programs are entirely voluntary, landowners need to define their intentions or objectives for their land. Some objectives may include: maximizing tax credit, creating bird habitat, protecting riparian buffers, increasing hunting opportunities, creating a healthy forest to ensure high timber yield, optimizing agricultural practices to improve profit, protecting soil and water quality, or simply having land for descendants.

Once agricultural landowners begin to think about their primary objectives they can work with the Natural Resource Conservation Service (NRCS) or the NC Wildlife Resource Commission (WRC) to create a Conservation Plan. The NC WRC can develop a habitat management plan that is integrated into a Conservation Plan at the request of the landowner. Alternatively, the NRCS can seek technical guidance from the NC WRC in the development of a Conservation Plan. According to NRCS “Conservation planning helps clients, conservationists, and others view the environment as a living system of which humans are an integral part.” and conservation planning “is based on a desired future condition that is developed by the client for an individual conservation plan”(NRCS 2013).

There are no natural lakes in the Piedmont but there are many man made reservoirs and farm ponds. These sources of water are very important for livestock and human use. These areas are also important areas for many bird species (nesting, roosting, and feeding sites) and provide habitat for fish, reptiles, amphibians, and aquatic mammals. In addition, these water bodies are popular destinations for human recreation (WRC 2005). Through the Eden Area Assessment, field teams found 72 ponds that were in need of maintenance. The maintenance needs ranged from removing trees that could potentially compromise the integrity of the dam to needing a replacement for a failing overflow pipe. While ponds are an important water feature for the County attention needs to be paid to keeping the pond dams intact to reduce the sediment load to downstream waters. Pond removal with the support, guidance, and oversight of the NCSU Department of Biological and Agricultural Engineering, NC Division of Water Resources, and the US Army Corps of Engineers is in the best interest of the watershed, though their guidance and support should also be sought for pond stabilization, which may be more appealing to landowners.

## Programs

### Farmland Protection Plan

Rockingham County has a farmland protection plan within the *Land Use Plan* that identifies and strives to maintain the agricultural heritage and economy of the County. The Rockingham County Agricultural Advisory Board has also been appointed by the Board of Commissioners to implement the provisions of the voluntary farmland protection ordinance. Caswell County has also recently developed a Farmland Protection Plan written by the Piedmont Conservation Council which is intended to coordinate future efforts to sustain local agriculture in Caswell County by building on the county's rich natural resources, strong farming tradition, and proximity to urban areas (Dorsett & Cohn, 2013).

### Present Use Value Program

The Present use value program allows reduced county tax assessments for individually owned property used for agriculture, horticulture, or forestry. To qualify, a property must be at least 10 acres in size, horticultural land must be 5 acres, forestland must be at least 20 acres in size and the land needs to be managed soundly following a management plan. To receive the tax reduction the farmland or horticultural land must also generate at least \$1,000 annually. The North Carolina Department of Revenue offers a Present-Use Value Program Guide:

[http://www.dor.state.nc.us/publications/puv\\_guide.pdf](http://www.dor.state.nc.us/publications/puv_guide.pdf) and an example of an application for the present-use value program:

<http://www.dornc.com/downloads/av5.pdf>.

### Wildlife Conservation Lands Program

Similar to the Present Use Value program, but with an emphasis on ecological rather than agricultural value, this program is administered by the NC WRC. Lands must satisfy two criteria: the land must have more one or more protected species and the land is managed to support that species; and that the landowner must conserve at least one of the following NC WRC priority wildlife habitats:

- longleaf pine forest;
- early-successional habitat;
- small wetland community;
- stream and riparian zone;
- rock outcrop; or
- bat cave.

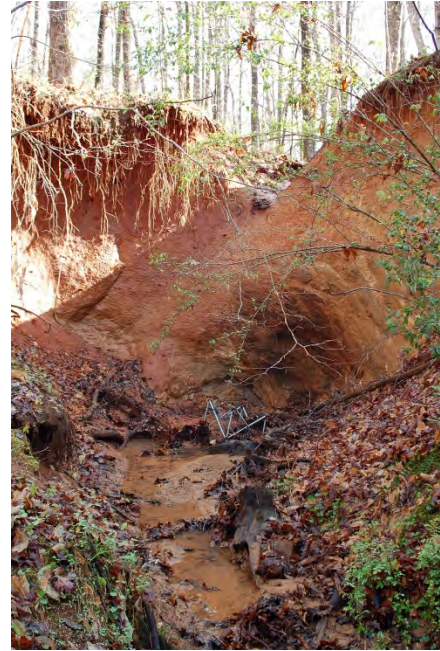
The lands and waters of this watershed can satisfy all but two of these habitat needs. Landowners can contact the NC WRC directly to pursue this credit program.

### NC Cost Share Programs

Rockingham County supports the Soil and Water Conservation District staff who provide valuable technical expertise in using the North Carolina Agriculture Cost Share Programs (See Appendix B) and installing BMPs on agricultural and residential land. The Rockingham County Soil and Water Conservation District staff were able to receive funds from two EPA 319 grants to install many BMPs in the County. BMPs commonly installed through incentive programs include cattle exclusion fencing, buffer enhancement, sediment removal etc., which are needed immediately, as evidenced in this project's water quality model (Appendix B). Participation in any incentive program requires a site specific conservation plan to preserve land and water quality.

AgWRAP is an example of an incentive program that has the potential to significantly reduce the amount of sediment entering the

rivers though voluntary landowner participation. AgWRAP provides limited funding to farmers who need to remove sediment from farm ponds, build a pond, or maintain a farm pond dam. According to Soil and Water Conservation District, most of the dams in Rockingham County that were built fifty years ago used steel pipes from locomotives for the primary spillway (*personal communication with Grady Wise, 2012*). These primary spillways are now rusted out and water is using the emergency spillway, which is leading to intense erosion of the dam. AgWRAP can help in addressing failing pond dams by providing financial assistance to farmers to address this issue.



**Figure 27: Failing Farm Pond & Spillway, Matrimony Creek, PTRC 2012**

### Agritourism

Agritourism is an additional tool that farmers can use to increase revenue and ensure that agriculture remains beneficial for the community. Agritourism can include hay rides, pick-your-own fruits and vegetables, bird watching, fishing, hunting, camping, pumpkin patches, and flowers (NC DACS 2013a). Farmers interested in increasing the public's awareness of their operation can participate in Piedmont Local Food, Piedmont Grown or Carolina Grown to increase their online exposure.

### NC Cooperative Extension

North Carolina Cooperative Extension provides a bridge between the expertise of NC State University and NC A&T State University and the landowner. Through educational programs, publications, and events, Cooperative Extension field faculty deliver unbiased, research-based information to North Carolina citizens. Cooperative Extension provides technical assistance through many programs including 4-H Youth Development; Agriculture & Food; Animal Agriculture; Commercial Horticulture; and, Soil, Water & Air.

### Local Food Coalition

Rockingham County's Local Food Coalition strives to market and distribute locally grown products to preserve the environmentally friendly sustainable agriculture in Rockingham County. Members of this coalition included representatives from the Cooperative Extension, the Soil and Water Conservation District, the Opportunity Center, the Rockingham County Business and Technology Center and the Upper Piedmont Research Station. The Coalition was instrumental in creating Piedmont Local Food, which then merged with Carolina Grown to provide farmers and consumers with valuable resources such as a website for ordering food from local farmers who are using the best practices available to them.

### **Partnerships**

Because the Eden Area watershed lies within both Virginia and North Carolina, a bi-state initiative between the Soil and Water Conservation Districts in both states and the regulatory bodies in both States is greatly needed. A bi-state initiative will ensure that messages about BMPs for farmland and tools available for farmers are unified. A bi-state initiative also has the potential to increase the funding that is available to install BMPs around the watershed.

The VA Department of Conservation and Recreation (VA DCR) and the VA DEQ have spent the past several years supporting the *Mayo and Smith Rivers TMDL*

*Implementation Plan*, an analytical and planning effort to address the reduction of fecal inputs in these watersheds that are causing impairments for *E. coli* in these rivers. There are several subwatersheds in the Smith River watershed that overlap with the Eden area watershed studied in this assessment and planning effort. The *Implementation Plan* determined that there is an immediate need to address two primary sources of fecal material inputs: rural household septic tanks and livestock operations. The Commonwealth is already supporting stakeholders on the ground – namely the DRBA, the Western Piedmont Planning District Commission, and the local Soil and Water Conservation Districts, to address these sources of impairments, establishing a programmatic foothold in the watersheds for long-term recovery. These actions will directly benefit residents of the Eden area watershed.

Partnerships between the Piedmont Land Conservancy (PLC), the Soil and Water Conservation District and the Dan River Basin Association (DRBA), has the potential to increase the amount of agricultural land that is held in conservation easements, or protected for ecosystem services. PLC is an entity that is legally able to hold conservation easements in North Carolina in perpetuity, which complements the Soil and Water Conservation District and DRBA’s relationships with local landowners and active presence in the watershed. Working together will increase the awareness of using conservation easements to protect agricultural land and improve water quality. The work that PLC conducted for the *Dan River Watershed Protection Plan* in 2006 also greatly complements the work that DRBA is doing with buffer inventories and volunteer monitoring (DRBA 2006).



**Figure 28: Farm along the Dan River, PTRC 2012**

The Center for Environmental Farming Systems (CEFS) (<http://www.cefs.ncsu.edu/>) develops and promotes food and farming systems that protect the environment, strengthen local communities, and provide economic opportunities in North Carolina and beyond. It was established in 1994 by North Carolina State University (NCSU) and North Carolina A&T State University (NCA&TSU) along with the NC DACS. A partnership

between CEFS and the local representatives of the Cooperative Extension and the Soil and Water Conservation districts may lead to productive projects implemented on the ground that can improve water quality. Assisting small farmers in gaining access to better technology, which would enable them to make a profit and thereby preserve working farms (Rockingham County 2006).

## **Policies**

### *Voluntary Agricultural Districts*

Landowners of agricultural land (including forest management, livestock, and crops) can participate in the voluntary agriculture district (VAD) program authorized under the Agricultural Development and Farmland Preservation Enabling Act (N.C.G.S. §§ 106-735 through 106-749) and adopted by Rockingham County. Land with this designation is dedicated to the management of the land for rural uses. These voluntary districts give farmers who enroll the benefit of letting new neighbors know that agricultural operations will be occurring within a short distance of their property and protect the farmers from nuisance suits due to normal agricultural operations. Although Voluntary Agricultural Districts or VADs are implemented Rockingham County, Eden also has the ability to promote or create their own VAD programs to preserve the rural heritage of the City and to support the agricultural economy. The increased pressure of housing developments in rural areas often prompts the creation of these district programs (CEFS 2013).

### *Adequate Public Facility Ordinance*

Adequate Public Facility Ordinance (APFO) is an option that Rockingham County and Eden may consider in mitigating uncontrolled growth and protecting important rural characteristics of the community. An APFO is primarily designed to require proof that adequate public facilities (e.g., schools, water mains, sanitary sewer mains, etc.) will be available concurrently with a development proposal. If an adequate public facility is not in place, a development permit can be denied until a reasonable, set date specified in a Capital Improvements Plan (CIP) for the provision of the facility (Rockingham County 2006).

## FORESTRY

Forests cover approximately 66% of the land in the Eden Area watershed. When managed responsibly, these forests help keep sediment and debris out of the water. The trees also produce oxygen, reduce greenhouse gasses in the atmosphere and provide shade to cool streams and people. A forested buffer along waterways are important for water quality and provide habitat for songbirds, deer, frogs and other wildlife people enjoy viewing or hunting (WRC 2007).

However, the field assessment and water quality model for this project determined that forestry operations are the most significant source of the Dan River's turbidity impairment. Many sites were determined to not be using required forestry practice guidelines (FPGs), allowing thousands of tons of sediment to run into small tributaries and destabilizing local streams. The lack of good stewardship at these sites will require millions of rehabilitation dollars to successfully reduce sediment loads to the watershed by even 10%. Through the field work for the Eden Area Assessment, field teams found 253 areas throughout the watershed that need enhanced buffers to reduce the non-point sources of pollution and 43 sites that were in need of buffer restoration (PTRC 2012). Through conserving natural forests and enhancing vegetated buffers, high-costing stormwater treatment, flood damage, and environmental mitigation can be minimized.



**Figure 29: Stream Restoration Need, Little Matrimony Creek, PTRC 2012**

### Programs

#### Forestry Practices Guidelines

The State of North Carolina encourages forestry operations to abide by Forestry Practices Guidelines (FPGs). The FPGs are designed to manage runoff from forestry sites to minimize water quality degradation through the use of stream management zones (riparian buffers), perpendicular and minimal stream crossings, soil and erosion control management, chemical application management, access roads that run up the slope of the hill rather than along it, and rehabilitating the site. The NC Forest Service (NCFS) inspects all forestry sites it is aware of, but landowners are not obligated to notify them

that a timber harvest is going to occur. However, upon inspection, the NCFS has limited enforcement capacity and must report violations to the NC DENR Division of Land Quality regional office in Winston-Salem, which is under-resourced and often is unable to observe the reported violation (NCFS 2014). This enforcement approach is consequently only nominally effective.

In Rockingham County there is one NC Forester who monitors logging operations to determine if the forestry practices guidelines and forestry BMPs are being followed as is required by law. Abiding by the Forestry Practices Guidelines can greatly reduce the amount of sediment that results from forestry practices. Currently in the Eden Area watershed approximately 10% of the land in various states of regeneration after a timber harvest contributes 40% of the erosion in the watershed. Using the forestry practices guidelines has the potential to reduce the resulting sediment by half.

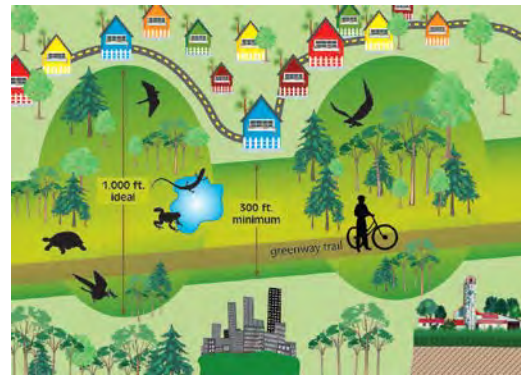
Virginia has the Virginia Forest Landowner Education Program (VFLEP), which “...offers a wide variety of science-based educational opportunities for new and experienced forest landowners. VFLEP also offers continuing education opportunities for natural resource and real estate professionals.” It is designed to educate landowners on best practices so that they can both minimize environmental impacts of their forestry operations and optimize the yield(s) of their harvest(s). The program focuses on both structural and non-structural practices to accomplish these goals. More information can be found at <http://forestupdate.frec.vt.edu/>.

#### Reforestation Cost Share Programs

There are many cost share programs designed to help landowners conserve soil and water resources. Landowners with a forest management plan can work with the NC Forest Service to through the Forest Development Program to partially re-coup the cost of re-planting after timbering. Landowners who are interested in participating in an easement program may elect to work with NRCS through the Healthy Forests Reserve Program, which helps to enhance or restore healthy forests. Landowners may also work with the Soil and Water Conservation District (SWCD) through CREP to convert crop land on steep slopes or in riparian areas into forested cover. If schools or businesses have large expanses of lawn area and wish to improve water quality by converting those areas to forest, they can also utilize a Soil and Water Conservation District cost share program called CCAP which is designed for the protection of soil and water resources from pollution coming off non-agricultural land. For more information on cost share programs see Appendix B.

### Riparian Buffer Enhancement

There is broad scientifically-based consensus that contiguous, intact riparian areas are essential for the healthy functioning of streams (McNaught, et al., 2003). In the Eden area watershed, streambank root systems provided by riparian buffers may be the only line of defense for preventing further stream channel erosion and sedimentation. Furthermore, buffering zones provide the service of filtering debris, nutrients, and sediment from surface flow before it reaches catchment waters. Perhaps most importantly, riparian buffers have the ability to attenuate the velocity and disperse the volume of stormwater runoff before it reaches streams and erodes their banks and beds. Armored streambanks in urban subwatersheds not only see increased risks of flash flooding and poor surface water filtration, but also have more degraded aquatic habitat due to more intense stormflow velocity downstream. The stream assessment field teams discovered 314 instances of needed riparian buffer improvements, ranging from mild enhancements (i.e. stop mowing) to full restoration of vegetation (i.e. restructuring of a degraded stream buffer) (PTRC 2012). Stream buffers also benefit priority species of terrestrial wildlife; buffers of at least 200-feet protect the habitat for federally-listed aquatic species; wider buffers of at least 300–feet provide habitat for many terrestrial species (WRC 2012).



**Figure 30: NCWRC recommendations for wildlife protection**

### **Partnerships**

Through a grant DRBA provided a targeted outreach effort in VA about the benefit of riparian buffers. Such an effort is greatly needed in the North Carolina part of the Dan River Basin. An intense education effort for the Eden Area watershed can assist in maintaining and improving riparian buffers. There also needs to be greater awareness by the public that they can report poor forestry practices to improve their drinking water and recreational resources.

### **Policies**

#### Increased notification

Currently Rockingham County requires a notification of any planned logging in the County. Through the notification process landowners can be asked if they have a

forestry plan. This has the potential to make landowners aware that a forestry plan drawn up by a consulting forester is an option that can increase the financial benefits of the logging and reduce the environmental impact of the timber operation. The *City of Eden Land Use Ordinance* can also require notification of logging operations so the County's NC Forest Service forester has access to important information about current or planned logging operations in the City and the County.

#### Increased enforcement

There needs to be increased enforcement of the FPGs in Rockingham County and the City of Eden. Currently, nearly all enforcement responsibilities lie with the NC DENR Division of Land Quality at the NC DENR Regional Office in Winston-Salem, NC. It is unclear if localities are permitted by state statute to assume this responsibility. Under the current system, effective enforcement requires there to be a link between the County that is being notified of the logging and the forester who is monitoring forest practices to ensure that every guideline is followed. If used, the FPGs are designed to effectively ensure healthy water quality conditions even in steep-sloped landscapes. This is an important path for information to transfer from the County to the NCFS Forester. Poor practices from timbering also need to be referred to the Division of Land Quality for proper enforcement.

#### Incentivize Regeneration

Regeneration following logging is a great way to reduce sedimentation. Currently there is a 50% cost share program for replanting after timbering. Incentivizing replanting through expedited re-zoning, or grant programs to increase the amount of financial incentives available to landowners, is important to keep sediment from entering the waterways.

#### Conserve Large Areas of Forest

In the Piedmont region of NC the Wildlife Resources Commission recommends protecting 75 acres or more of upland forest blocks to provide habitat for priority species that include the Worm-eating Warbler, Black-throated Green Warbler, Yellow-billed Cuckoo, and Eastern Fox Squirrel. Using clustered development, a bond referendum, or fee-in-lieu systems may enable the City and the County to conserve forest land for recreation potential as well as wildlife habitat, which ultimately ensures water quality by protecting forested land use.

Both the City of Eden and Rockingham County require 50-foot stream buffers for any land disturbance activities. State-certified farms, which include many forested

properties, are often exempt from these regulations. The NC WRC also recommends the use of 200-foot buffers for watersheds where aquatic endangered species reside, such as the Dan and Smith rivers. 300-foot buffers can provide valuable habitat for some terrestrial species.



## WATER QUALITY MONITORING NETWORK

In the 225-square mile Eden Area Watershed, the VA DEQ has three ambient water quality monitoring stations and the NC DWQ has two. The City of Eden has to monitor and report upstream and downstream of its wastewater treatment plant (WWTP) to satisfy its NPDES permit. To support this planning effort and better understand the urban contributions to water quality impairments, the City of Eden Department of Environmental Services has also monitored water quality conditions in the City at two locations on the Smith River: just downstream of the Spray Cotton Mill dam, and the other at the confluence with the Dan River (Figure 31). Furthermore, it has invested significant staff resources in monitoring the chemical conditions of the Dan River upstream of the City to identify the source(s) of bromine in its drinking water supply. There is only one benthic macroinvertebrate and one fish community monitoring station throughout the Eden Area watershed, but there are many throughout the larger Upper Dan River Subbasin. Many of these benthic macroinvertebrate monitoring stations are not yet rated due to monitoring just beginning recently.

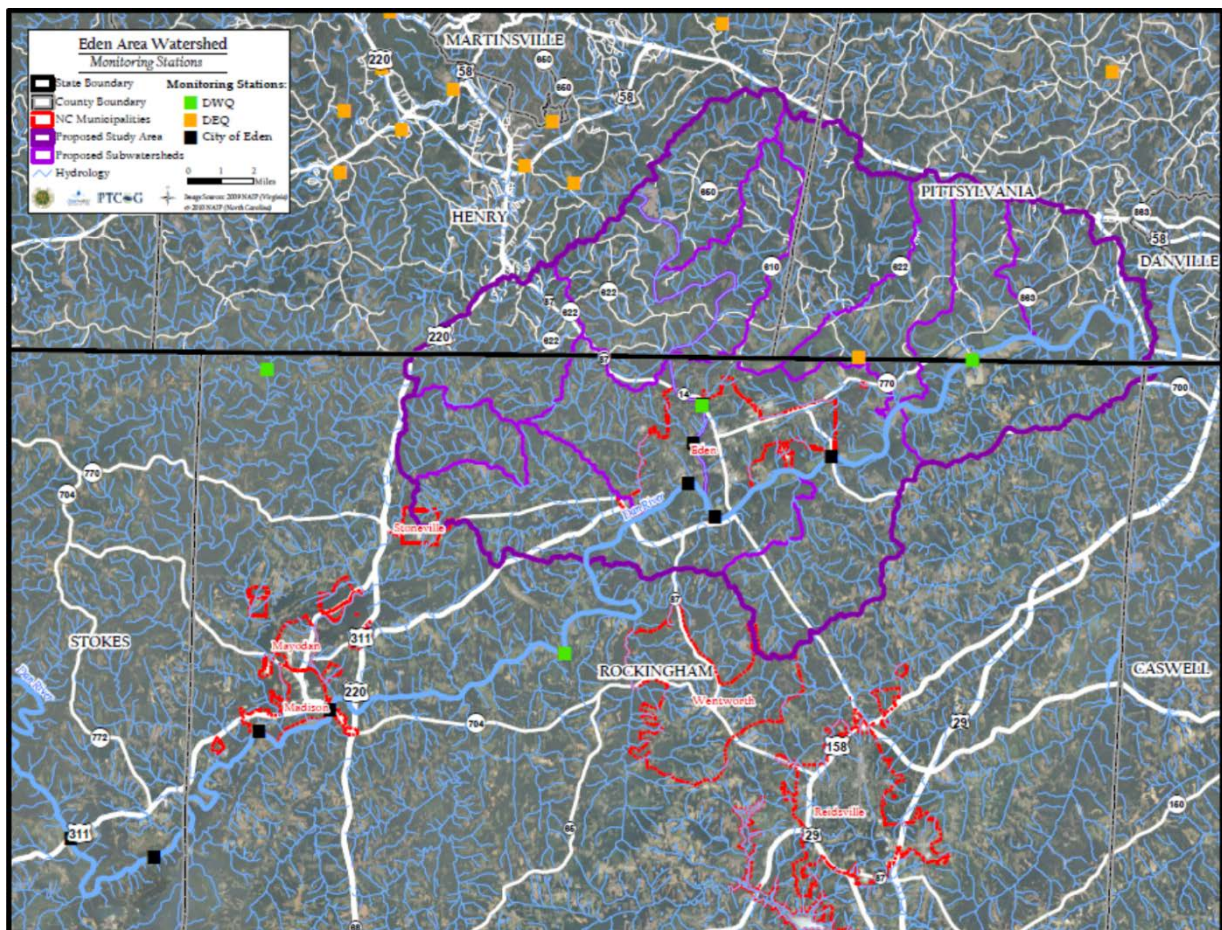


Figure 31: Eden Area Watershed Ambient Water Quality Monitoring Stations, PTRC 2012

### *A More Robust Water Quality Monitoring Network*

The VA DEQ ambient monitoring stations are located at the Smith River at Route 636 Bridge in a rural area of Henry County; the Smith River at the Morgan Ford Bridge; and the Dan River at the state border on Route 880. The NC DWQ stations are located in Rockingham County on the Smith River upstream of the Spray Cotton Mill dam and on the Dan River downstream of Eden at the state border (and downstream of the VA DEQ station). However, both states have other water quality monitoring data that provides some upstream and downstream context of water quality conditions throughout the Dan River Basin. The NC DWQ has established a headwaters monitoring station in Stokes County and another just upstream of this watershed near the Town of Wentworth, in Rockingham County. Immediately upstream of the Eden Area Watershed and downstream of the City of Martinsville, VA DEQ has established seven water quality monitoring stations that have data from the past fifteen years.

As discussed in the *Eden Area Watershed Assessment*, the water quality data for this particular watershed are inadequate to accurately guide restoration efforts. The monitoring sites are dispersed throughout this fairly large watershed to the point where the pollutant contributions of fairly large tributaries like Matrimony Creek are unaccountable. Consequently, the entire lengths of these rivers (11 miles on the Dan River and 5 miles on the Smith River in North Carolina) are generically impaired due to sedimentation and fecal inputs from agricultural, natural, urban, and development impacts. No area of the watershed can be determined to load more pollution to the watershed than another, creating a scenario in which restoration investments made literally anywhere in the watershed can be claimed to have equivalent value. The watershed model used for this planning effort shows that this assumption is false, but there is no real data to support any other conclusion.

### **Programs**

There is an immediate need to augment the existing water quality monitoring network within this watershed with more ambient and biological monitoring stations. At a minimum, in the North Carolina sector of the watershed, there is a need for new and permanent water quality monitoring stations at the confluence of Matrimony Creek with the Dan River; of Town Creek with the Dan River; and of Dry Creek with the Dan River. With the presence of federally- and state-endangered and several other listed species in the Dan and Smith rivers and the modeled pollutant loads coming from these three subwatersheds, it is essential to have biological monitoring stations at one or more of these sites so that chemical and biological conditions can be correlated. At least one biological monitoring station on the Dan River and the Smith River should also be

maintained within this watershed for similar purposes. The Duke Energy 82,000 ton coal ash spill in February 2014 only heightens the need for more and better monitoring in this watershed, particularly for biological health.

The support of this planning effort has come from the NC CWMTF, so the initial programmatic initiative for improved water quality monitoring is focused upon that state's needs. However, there is an identical urgent need for enhancement of the water quality monitoring network in the Commonwealth of Virginia. There are biological monitoring stations in the Virginia portions of the watershed, all of which drain to North Carolina. The Smith River is home to the federally-endangered Roanoke log perch and economically-valuable trout, reflecting the urgency to better understand water quality concerns in this watershed. The VA DEQ also has created a TMDL Implementation Plan for *E. coli* impairments in the Smith and Mayo rivers that is already being implemented. Without a more detailed monitoring network and/or reliable input from local stakeholders, it will not be possible to assess the highest needs in the watershed and/or document the improvements of the rivers following the implementation of restoration practices.

### **Partners**

The PTRC, the City of Eden, and the DRBA have met with the NC DWR to discuss how they can collaborate to better assess water quality conditions in this watershed. The City of Eden has invested significant resources to monitoring water quality conditions in and upstream of the City. They use a state-certified laboratory that is audited for performance and techniques annually by the NC DWR. It donated its services to this project to monitor two additional sites on the Smith and Dan rivers for basic parameters. It dedicated its Drinking Water Program staff to identifying the source of brominated trihalomethanes in the Dan River. It has expressed a willingness to more comprehensively assess water quality conditions in and upstream of the City, but is reluctant to do so if the NC DWR does not use data collected with an approved Quality Assurance Project Plan for Use Support Decision Making.

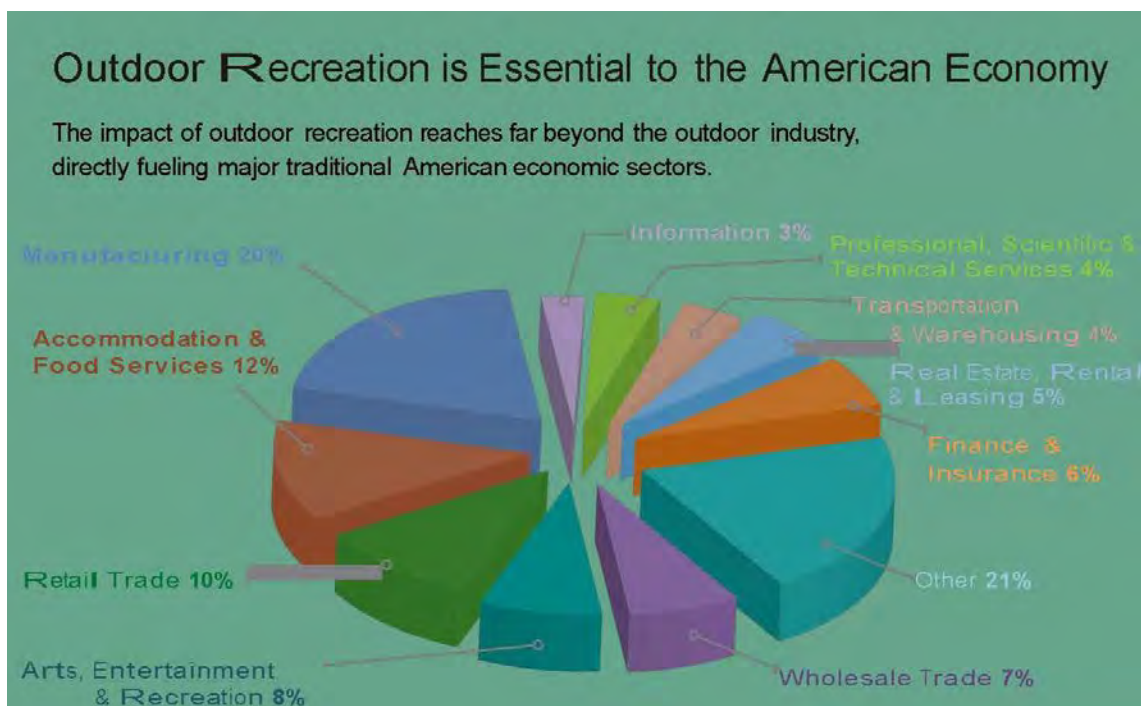
Similarly, the Dan River Basin Association (DRBA) has expressed an interest in finding funding to better characterize and monitor rural watershed conditions as it has in Virginia. Efforts by the NC DWR to better support and partner with the City need to be taken in order to develop local and regional monitoring strategies that utilize appropriate quality control measures to ensure data fidelity and more comprehensive data to work with all stakeholders in the Dan River Basin to best restore healthy water quality conditions to the river and its tributaries. These stakeholders need to know that if they are investing resources and time into assessing water quality conditions –

especially the value of any restoration projects used to directly address the impaired water quality conditions – will be used by the NC DWR and US EPA to determine the health of these waters, including that if conditions improved so they satisfy water quality standards more than ninety percent of the time, they will be removed from the Us EPA’s 303(d) Impaired Waters list.

The PTRC will draft a Water Quality Monitoring Plan for the Eden area watershed to the NC DWR on behalf of the City of Eden, Rockingham County, and the DRBA, which will feature staff and resources investments from all three entities as well as NC DWR. Upon DWR approval, the coalition will seek 2014 CWMTF funds to put this more robust network of water quality monitoring stations on the ground. Duke Energy also now has a direct interest in the chemical and biological conditions of the river downstream of the City of Eden, and needs to be invited to both participate in and fund the more robust monitoring effort. If success can be reached among these potential partners within North Carolina, the next logical step will be to align monitoring efforts across the state and EPA regional boundary and work with partners in Virginia – especially the VA DEQ – to mirror these investments for the Smith River watershed.

## RECREATION AND TOURISM

The natural environment in the Eden area can draw many tourists to see the natural beauty of North Carolina while having outdoor recreation opportunities. Despite the economic downturn, a 2012 national report found that 140 million Americans make outdoor recreation a priority in their lives and spend \$646 billion in outdoor recreation. The recreation economy currently supports 6.1 million direct jobs and \$39.7 billion in state and local tax revenue (Outdoor Industry Association 2012). The Triad's regional outdoor recreation revenues totaled \$52 million in 2006 (Piedmont Together 2013). Improving water quality in the Eden Area watershed can add to the recreation potential and bring additional economic resources to the area.



**Figure 32: Outdoor Industry Association report Take it Outside for American Jobs and a Strong Economy**

The Dan and Smith rivers are great outdoor recreation assets within the Eden Area watershed, but their use could be further enhanced. Blueways are managed systems of access points and facilities that allow trail users to plan trips along the water. The Dan, Smith and Mayo rivers provide blueway trail access locations across Rockingham County. Within the Eden Area watershed there are two important access points for boaters who wish to paddle on the Dan River:

- Eden Boat Landing Access: From NC 14 at the Dan River turn west on Harrington Highway (toward NC 87, 135, & 770) Go 1/2 mile. Turn right on Bethlehem Church Road (SR 2039). The NC Wildlife Access is 1/2 mile on right.
- Hamilton St. Access: Open summer of 2005 - North on Highway 87 (SR2282). Cross 87 bridge and turn right into access parking lot.

The *Rockingham County Rivers Guide* (2012) identified the following points of interest along the blueway trail that crosses the Eden Area watershed:

- Batteau port Leaksville Landing (c. 1820s)
- Massive stone pier of the Leaksville Covered Bridge (1852)
- Mebane's Bridge (1924)
- Triassic conglomerate formations nearly 200 million years old.
- Shoals and rapids with picturesque names-- Widemouth, Beasley's Gallows, Tanyard, and Devil's Jump.
- Hamilton St. bridge.



**Figure 33: Family outing near Triassic Basin conglomerate formations. Photo courtesy of Wayne Kirkpatrick**

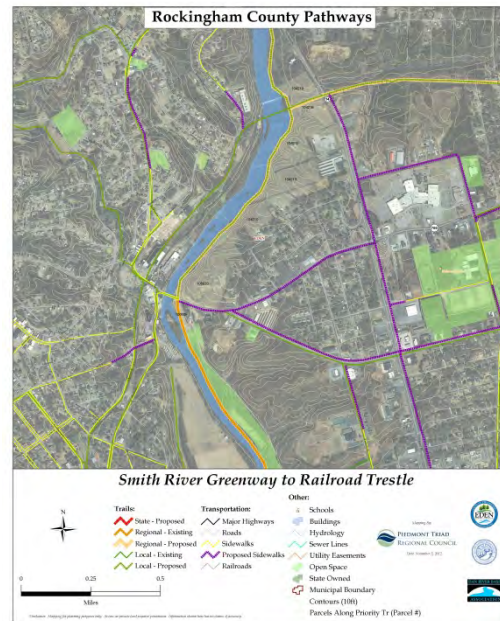
Additional fishing and boating access points would be a valuable tourism resource for the Dan River and Smith River. Facilities such as parking lots, bathrooms, and boat ramps at the access points increase the attractiveness of a blueway to less seasoned paddlers, and should be a capital investment for any enhancements on the rivers. Eden has provided a model for such investments at Island Ford Landing off the Smith River Greenway. Providing increased access points along the rivers will supply additional adventures for visitors looking for longer or shorter river trips, or less crowded fishing access.

Rockingham County has a growing network of trails, parks and recreational areas. The *Eden Greenway Master Plan* provides a framework for connecting parks, rivers, schools, historic sites and other resources through a network of proposed greenways and trails (WK Dickson 2007). Building off of the existing *Greenway Master Plan* completed in 2007, the *Eden Comprehensive Pedestrian Transportation Plan* identifies programs and

projects that support pedestrian transportation and provides an action plan for connecting sidewalks and greenways for the City of Eden through 2030. The City has already invested \$2 million in greenway developments on its publicly-owned sewer easements that run alongside the Smith River. These paved walking and cycling paths have proven to be enormously popular. The Piedmont Triad Rural Planning Organization and its Rockingham County municipalities have also adopted the *Rockingham County Comprehensive Transportation Plan* in 2010, which identifies several trail projects in this watershed. The

*Rockingham County Pathways Plan* also identified potential opportunities for the City of Eden to connect with other recreational resources in the County. One of the priority projects in the *Plan* is extending the Smith Greenway northward to lengthen the recreational potential and draw additional. Another of the projects links Eden with Stoneville following a utility easement crossing through subwatersheds 2 and 4 users (PTRC 2013).

Through GIS and field assessments for the Eden Area watershed Assessment, several priority wildlife habitats were identified (NCWRC 2005; PTRC 2012). These habitats include large parcels with contiguous forest habitats, small wetland communities (particularly upland depression swamps), floodplain forest, early successional habitat, rock outcrops and key aquatic habitats (NCWRC 2005). These environments are home to a number of economically-valuable game species (turkeys, deer, etc.) and ecologically-valuable species, including the state-endangered freshwater mussel (the Green Floater), and four fish species of concern (the federally endangered Roanoke Logperch, the Roanoke Bass, the Roanoke Hog Sucker, and Riverweed Darter). Immediately upstream of this watershed, the James Spiny mussel can be found in the Mayo River. Maintaining these important wildlife habitats ensures the rural culture of Rockingham County is sustained and protected, while also encouraging visitors to enjoy these resources for hunting or other recreational opportunities.

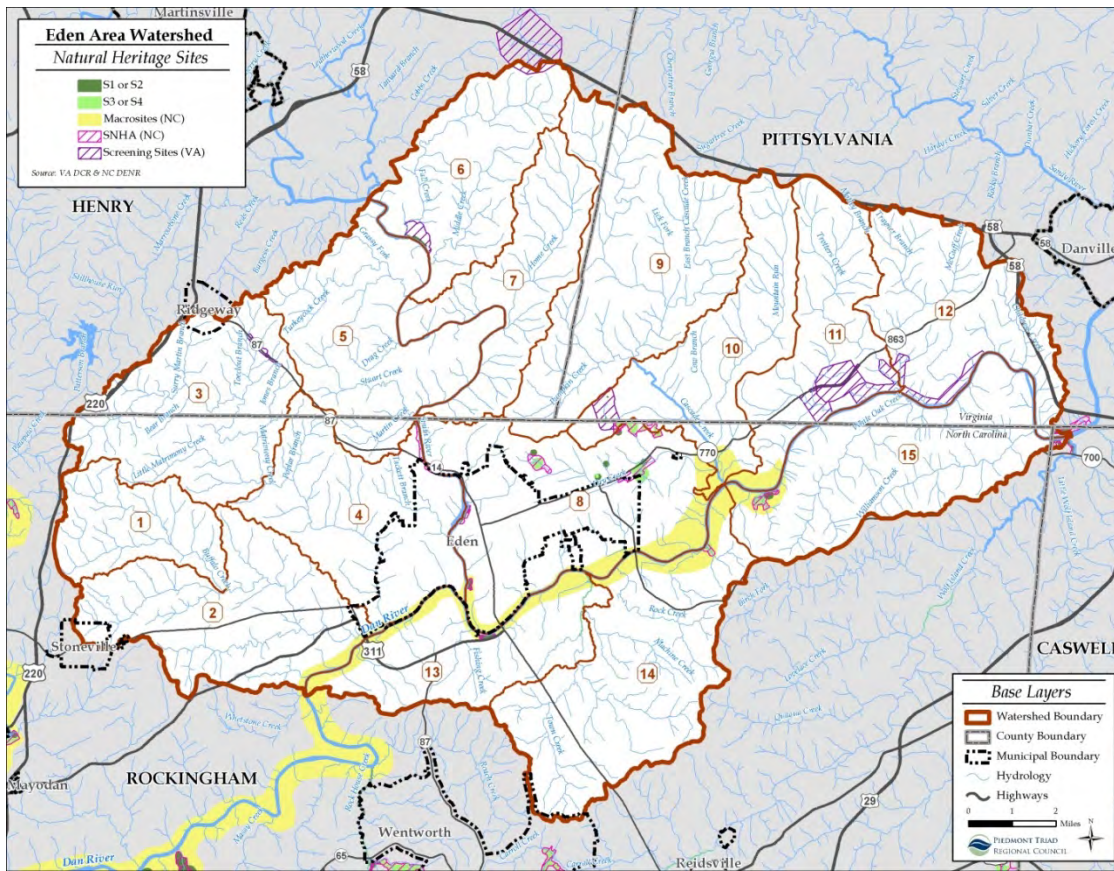


**Figure 34: Smith River Greenway Northward in Eden**

The Piedmont Land Conservancy conducted an inventory of the natural resources along the Dan and Smith rivers and found many areas that could be protected through land conservation techniques to maintain the ecological services from those lands (PLC 2006). The Natural Heritage Program (NHP) has also identified a total of just over 2,938 acres of land in the Eden Area watershed with significant value for 44 special species of plants, animals or the natural communities that support unique assemblages of species (Figure 37). Remediation of the rivers to ecological function and supporting status may ensure the success of these species while also keeping the rivers clean enough for increased tourism and recreational opportunities.



**Figure 35: Unmarked tributary in the Little Matrimony Creek subwatershed north of Stoneville, NC, PTRC 2012**



**Figure 36: Eden Area Watershed's Natural Heritage Habitats and Species Occurrences, NC DENR, VA DCR 2013**

## Programs

### Marketing Ecotourism for Economic Growth

Ecotourism is a form of tourism that involves visiting destinations with rich ecological and cultural resources, including outdoor experiences as simple as hiking. The Eden Area watershed can capitalize on ecotourism by preserving its valuable ecosystems and cultural history to ensure that Eden draws tourists and increases economic growth. Ecotourism has been successfully embraced by areas such as nearby Hanging Rock State Park and Asheville, North Carolina, both of which have spent significant amounts of money to brand themselves as a destination for those seeking an authentic experience outdoors in areas with rich natural resources and cultural histories. The City of Eden and Rockingham County have all of the ingredients to be the next ecotourism destination in North Carolina, but will need to make investments in outreach and marketing to attract visitors and document value for local residents of the valuable natural assets.

### Implement Recreational Trail Plans



**Figure 37: Golf Course & Walking Trail on the Smith River, PTRC 2012**

Implementing the City of Eden’s *Greenway Master Plan* and the *Eden Comprehensive Pedestrian Transportation Plan* is an important part of increasing the recreational opportunities within the Eden Area watershed for residents and visitors. Creating trails 5 miles or more in length can encourage visitors to spend an afternoon or a full day exploring trail systems, and can provide the infrastructure for races or other types of competitions. Instead of just an activity, the trip to the trail can

become an experience that encourages longer visits, more meals purchased and possibly overnight stays (Cocburn 2013). A local example of a trail that brings visitors is the Virginia Creeper trail, which is 33.4 miles long and has 100,000 visitors annually. Leveraging staff and financial resources to maximize trail development is critical for the entire County to draw trail users who are traveling to southside Virginia, other parts of the Piedmont Triad or elsewhere (Cockburn 2013).

In early 2014, Dan River Basin Association, each municipality in Rockingham County (including the County), and the Reidsville Area Foundation (RAF) pooled resources to support the development of recreational trails (and possibly blue-ways) throughout the County. By linking recreational trails within the Eden Watershed to a larger trail system throughout the County, this partnership will help increase tourism, economic development and overall health of citizens. A staff person will be dedicated to manage projects and write grant proposals in order to develop outdoor recreational and stewardship opportunities (*personal communication with DRBA, 2014*).

With these commitments and investments, the area can be much more competitive in seeking out Parks And Recreation Trust Fund support for recreational development. The US EPA, US Housing and Urban Development, and the Department of Health and Human Services all have funding dedicated to improving the health and livability of economically- and socially-disadvantaged communities which would also be ideal for

enhancing the area recreational resources, as they will assist in combating obesity, improving cardiac and respiratory health, and improve the quality of life for watershed residents. Creating passive recreation opportunities, such as trails, along the waterways of the Eden Area watershed connects residents to the water resources of their community and ensures that those sensitive areas are protected from more intense development.

### *Increase Responsible Hunting*

Increasing the opportunities for hunting to support ecologically stable populations of game species can be a valuable method of bringing visitors to the County while also protecting the habitats of more sensitive species. Rooting by wild hogs, which have been found in the Eden Area watershed around Ruffin, can destroy pasture, crops, and native plants, and can cause increased soil erosion (Chairman of the Hunting and Wildlife Advisory Committee, 2012). To protect the water from the erosion caused by an invasive wild hog, hunting and education awareness need to be investments for the future of the watershed.

### *Increase wetland and stream protection programs*

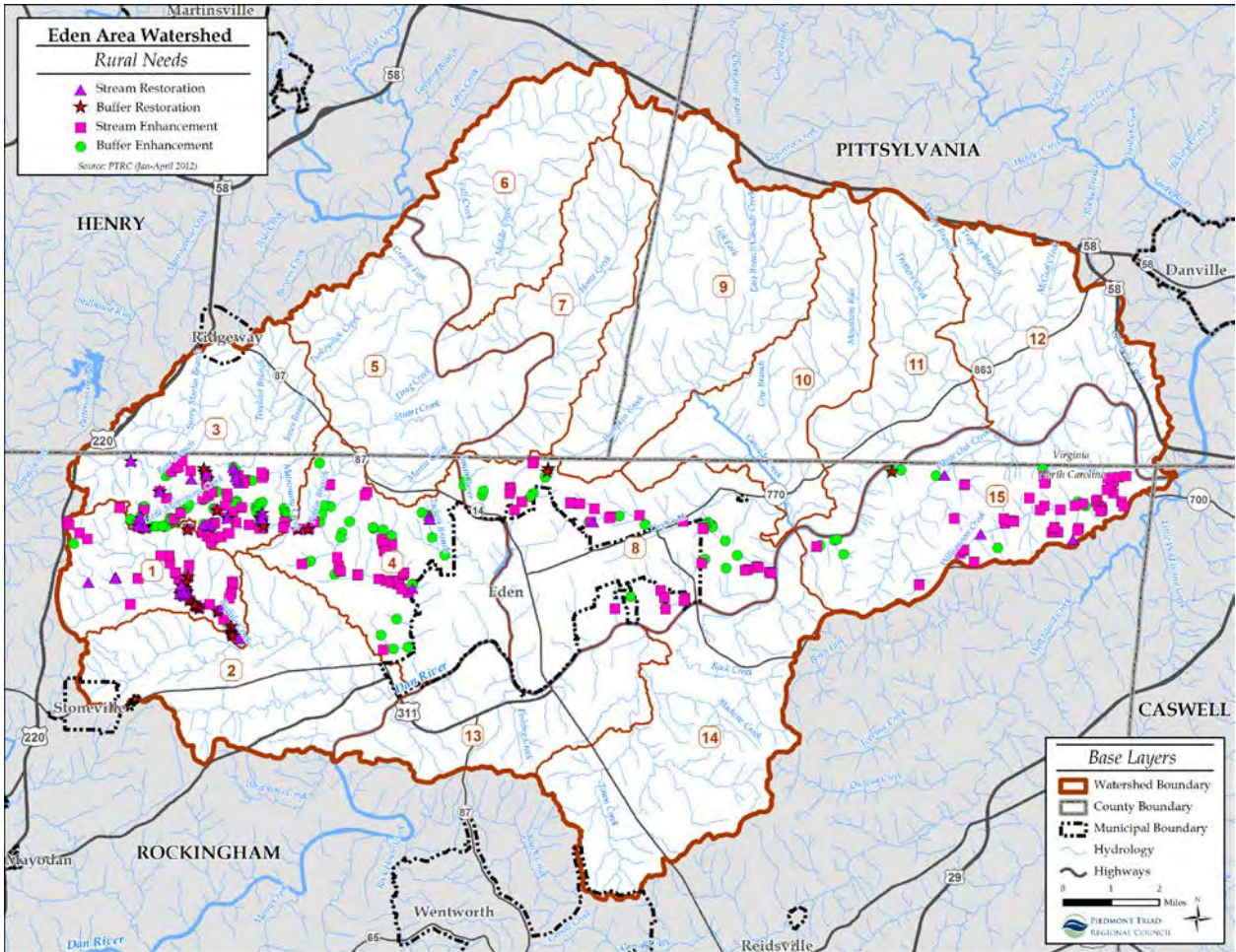
To increase the number and or quality of the wetland and stream assets that are available in the Eden Area Watershed, Rockingham County and the City of Eden could consider identifying and actively participating in stream buffer or wetland restoration in the context of mitigation banking. Under the Clean Water Act of 1990, there can be no net loss of streams or



**Figure 38: Wetland just east of Eden. PTRC 2012**

wetlands. This requires all developers who disturb any of these water features to enhance, restore, or protect streams or wetlands within the same watershed. Private mitigation banks are common in NC, as is the NC Ecosystem Enhancement Program, which is run jointly by NC DENR and the DOT to mitigate the impacts to streams and wetlands from transportation projects. The field work for the Eden Area watershed characterization found 263 sites requiring stream enhancements or total restoration; 21 potential sites for wetland enhancement and wetland restoration; and 60 sites that

would benefit water quality if protected in their current state (Figure 40; PTRC 2012). Rockingham County and the City of Eden can both work with these sectors to restore impaired areas of the watershed and invest in untouched streams, which all have mitigation value.



**Figure 39: Stream & Stream Buffer Needs, PTRC 2013**

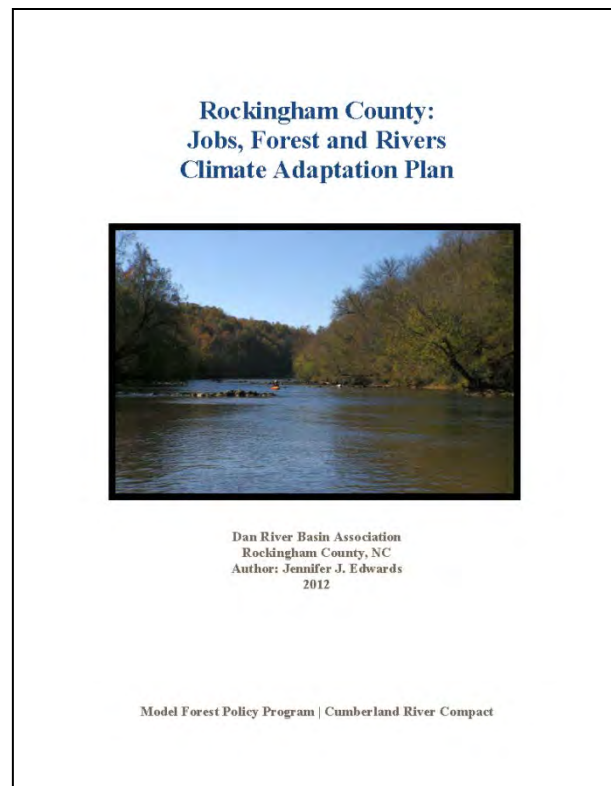
*Use Green Growth Toolbox & Piedmont Together to guide future decision making*

The NC Wildlife Resources Commission (WRC) is the state agency in charge of conserving and sustaining the state’s fish and wildlife resources. The Green Growth Toolbox is a comprehensive set of resources that provides communities with tools to identify its natural assets and develop protections for them. The toolbox includes a technical assistance tool, a handbook on developing ordinances for protecting the environment, a GIS dataset and a website developed by the NC WRC to assist communities in growing in ways that conserve the most valuable natural resources including streams, and habitat. These resources were developed by the NC WRC to assist communities in directing growth in ways that conserve the most valuable natural

resources, including streams and habitat. Organized, carefully planned, thoughtful development can coexist with a healthy environment and functional wildlife habitat (NCWRC 2007.) The NC WRC provides municipal staff training on the tool that can be used to encourage the enhancement of recreation and tourism opportunities while attracting businesses and residents who are looking for healthy communities and understand how healthy environments increase quality of life (NCWRC 2013).

The PTRC is partnering with the Piedmont Authority for Regional Transportation (PART) on a 2011 US HUD Sustainable Communities planning and outreach grant called Piedmont Together. The project features seven work groups, including Green Infrastructure and Climate Adaptability. These work groups recommend using policies of open space and natural resources protection, restoring urban tree canopies, protecting farmlands, providing transportation options, and stabilizing hydrology throughout the region to protect existing land, water, and resources to ensure local and regional economic, social, and environmental resiliency. The final planning documents will provide Rockingham County and its municipalities with guidance on policies and ordinances it can use to optimize economic, social, and environmental resiliency. Furthermore, a green infrastructure network will be provided at regional and county scales so that stakeholders can prioritize open space and habitat protection efforts as well planning out their trails and blueways to highlight the ecological assets they possess.

Concurrently with the Piedmont Together project, the DRBA was awarded a Model Forestry Planning Project grant and received financial support from the Reidsville Area Foundation and DRBA members to assess the climate resiliency of Rockingham County. Meeting with a steering committee regularly over a one-year period the DRBA assessed the risks and vulnerabilities of the County's economy and water and forest resources, complementing this assessment with the identification of resiliency responses and strategies that can meet these challenges.



Specific to water resources, *Rockingham County: Jobs, Forest and Rivers Climate Adaptation Plan* identified “Electricity Production during Drought,” “Coal Fly Ash Disposal Ponds, Dams, and Contamination,” “Depression-era Farm Ponds,” “Stream Bank Erosion,” “Agriculture and Timbering,” and several proposed (but still illegal) resource extraction initiatives as immediate water quality concerns. Many of its resiliency strategies are complementary with the recommendations of this watershed restoration plan, focusing on sediment and fecal material reductions for long-term water quality improvements, and improved stewardship of natural resources under warming climate conditions.

### **Partnerships**

The City of Eden Recreation Department is very active in providing recreational opportunities for Eden residents and is actively implementing priority projects in the City of Eden Greenway Master Plan. Adding additional recreational opportunities to the City’s facilities would promote community health while maintaining open space for improved infiltration and reduced sedimentation.

In addition to the City of Eden Parks and Recreation Department, Rockingham County is the home of the main office of the Dan River Basin Association (DRBA), a non-profit with a mission to preserve and promote the natural and cultural resources of the region. Rockingham County and Eden participate in a countywide Partnership for Economic and Tourism Development. This partnership actively recruits new businesses and industry while marketing Rockingham County as a tourist destination. The Partnership for Economic and Tourism Development showcases the natural resources, the heritage and the recreation potential through marketing venues including a website.

Two state parks have been opened in the last 10 years in Rockingham County. The Mayo River State Park and Haw River State Park both have plans for expanding activities and facilities offered at each location. These state parks can be a prime location to market other recreational opportunities to visitors who may be looking for additional adventures. A formal greenway to connect the two parks would connect the western and eastern areas of Rockingham County and could easily be integrated with the recreational infrastructure planned in the Rockingham County Pathways plan. The NC Department of Parks and Recreation will need to be involved in any efforts to tie these economic and recreational resources together within Rockingham County.

The NC WRC can provide technical assistance for river access points that increase recreational opportunities while protecting fragile wildlife habitat. Some aquatic programs where the NCWRC has partnered with local governments include the Community Fishing Program (<http://www.ncwildlife.org/Fishing/LearnResources/Programs/CommunityFishingProgram.aspx>) and the Tackle Loaner Program

(<http://www.ncwildlife.org/Fishing/LearnResources/Programs/TLP.aspx>), but these two programs are not directly related to special ecological resources. The NCWRC focuses on natural resource management more with their Green Growth Toolbox.

To ensure that the special ecological resources that draw tourists are conserved to ensure outdoor recreation as economic revenue, the NC WRC could partner with the City of Eden and Rockingham County to train staff on applying the Green Growth Toolbox to development permit reviews or planning additional City services. Partnerships between the City, the County, the Forest Service, Wildlife Resources Commission and DRBA can also increase funding opportunities to realize the potential for recreation in the Eden Area watershed. EEP could also be a very beneficial partner to involve to restore streamside or wetland resources along blueways and greenways or to protect important areas through easements.

## **Policies**

### *Recognize Important Open Spaces in Ordinances and Planning Documents*

While both communities state that urban-centric development and open space preservation are goals, no requirements have been imposed, nor have steps been taken to make them more attractive to developers or investors through procedural or financial incentives. Neither Eden nor Rockingham County uses a regulatory approach to environmental resource protection and sprawl management. Instead, they depend on the Eden and Rockingham County planning boards to make recommendations to City Council or County Commissioners on matters pertaining to land use and rezoning issues. To assure that the open spaces that provide ecological, recreational, community health and tourism value are serving these roles, these special places need to be recognized by all jurisdictions, and explicitly identified and protected by their land use ordinances and plans.

The NC WRC provides guidance on how the technical review and development permitting process can be expedited for those developers demonstrating a commitment to LID practices and/or open space and natural resources protection. At minimum, the NC WRC recommends 100-foot riparian buffers should be considered in the more ecologically sensitive areas of the watershed, and 200-foot buffers in those areas such as the Dan and Smith rivers that have federally-endangered species (NCWRC 2012). Both Rockingham County and Eden already have mandated 50-foot buffers, which are closer to satisfying these needs than many communities in the Piedmont.

### Open Space Preservation, Fee in Lieu Ordinances and Cluster Development

Many options are available for the City of Eden and Rockingham County to use to ensure that open space is maintained in their jurisdictions. The following options are appropriate to include in the subdivision ordinance and are examples that other communities in NC are following.

Open space preservation or dedication ordinances are being used by communities throughout the State of North Carolina to ensure that there are recreational sites for current and future residents. Randolph County, for example, requires that developments within its rural/agricultural zone set aside a portion of a development site as open space in order to preserve the rural, agrarian heritage of the county. To incorporate open space preservation, or dedication as part of the zoning/subdivision ordinance, all residential developments with more than a certain number of dwelling units could be required to dedicate open space. The amount of useable open space required for dedication shall be determined by the jurisdiction adopting these policies. To encourage development of residential units in the Downtown District or designated development districts, all such residential development could be exempt from these provisions. This strategy is already identified in the *Rockingham County Land Use Plan* and as part of the Eden Ordinance for PUDs but it needs to be clearly adopted and any barriers to implementation of this policy need to be removed.

As part of the power to regulate the subdivision of land, the City or County may determine an appropriate amount to be paid as a fee in lieu of parkland or open space dedication. The fee would not be greater than the fair market value of the land at the time of subdivision and can give the developer greater freedom in designing a subdivision. The fee in lieu allows the City or County to use those fees to create a larger park or open space opportunity for the community in an area that may not be suitable for development but may be perfect for blueway access, trails, birding or other recreational activities. In this way fee in lieu ordinances can be used to ensure that water quality is improved by allowing infiltration of stormwater into open areas in areas not optimal for development. While such regulations are illegal in North Carolina if done for solely environmental benefits, their value for economic development, property values, and community health allow for other uses by communities.

An equally effective approach might be to structure a system of incentives that encourage a developer to reserve open space by coupling clustering techniques with

density bonuses in the County's development regulations (Rockingham County Land Use Plan).

The NCWRC has the Wildlife Friendly Development Certification Program. This is a program that allows developments to be recognized as wildlife friendly after meeting sufficient criteria. Developers must meet a portion of these criteria throughout all phases of the development's planning and construction, and must maintain the criteria once the development is complete. More information on the program can be found at <http://www.ncwildcertify.org/Home.aspx>.



## URBAN WASTEWATER

One of the main motivations for the incorporation of the City of Eden from the Towns of Draper, Leaksville, and Spray was the need for better maintenance and management of the towns' wastewater systems. The Eden Wastewater Treatment Division now manages a collection system consisting of 145+ miles of gravity and force main sewer pipelines. The pipelines are composed of a mixture of clay and ductile iron pipe, ranging in size from 2 to 36 inches. Collection is accomplished by gravity from homes and businesses until it is necessary to pump from low elevations in force main sewer lines that transport the sewage to the treatment plants. There are 20 pump stations in the collection system. These range in size from pumping a few thousand gallons per day to more than five million gallons a day (MGD). All of the City sewer drains, collects or is pumped to the Mebane Bridge Wastewater Treatment Plant (MBWWTP), which can treat 13.5 million gallons per day (City of Eden, 2012).

The establishment of a City with regional authority over the three formerly independent systems added administrative efficiency to wastewater management in Eden, but it did not fully address the needs for systemic repairs and upgrades, which required unavailable political will and financing. The legacy of this approach has led to the need for significant expenses being applied to a failing wastewater infrastructure on a timeline that is nearly unaffordable for the City. The age of Eden's sewer pipelines currently ranges from new to more than 50 years old.



**Figure 40: Sewer Overflow in Eden**

Rockingham County has minimal wastewater infrastructure but coordinated construction on the Wentworth sewer system that serves the County's Governmental Center, Rockingham Community College, and various institutional, commercial, and residential customers in the central Wentworth area. This system has recently been expanded east to serve the area along NC 65 and NC 87 between the Rockingham County High School and Sandy Cross Road. Wastewater collected by this system is pumped to the City of Eden for treatment and disposal. The County's Wentworth

wastewater collection system has a maximum discharge capacity of 218,000 and is operating at an average daily flow of 61,500 gallons per day (Rockingham County 2006).

The Eden wastewater system is maintained and operated by the Environmental Services Department. The Department has water quality restoration goals set by a 2007 NC DENR Special Order of Consent (SOC) addressing inflow and infiltration (I&I) impacts causing sanitary sewer overflows (SSOs) at one of its older pump stations, and a 2012 US EPA Administrative Order (AO) requiring the City to address the over 150 SSOs it experienced between 2006 and 2011, violating clean water protections within its NPDES wastewater permit. The NC DENR was satisfied that the City had complied with its needs, and terminated the SOC in 2009. The US EPA AO is still standing, and guides all sewer maintenance and improvement projects by the City. Among other requirements, the US EPA AO requires Eden to develop a System Evaluation and Rehabilitation Plan that features a Capacity Assessment Plan and Report and a Sewer System Evaluation Survey. The City has less than a year to comply with the AO.

The City of Eden contracted with WK Dickson in 2003 to produce the *City of Eden Water and Wastewater Master Plan*, a two-year assessment effort to optimize current infrastructure needs with the expansion of the City's public utilities to meet anticipated demand beyond 2020 (WK Dickson, 2003). The *Plan* evaluated the City's collection system pump stations and treatment facilities based on age, material, and potential for inflow and infiltration (I&I) problems associated with the different drainage basins and sub-basins in the City (City of Eden, 2007). It determined that the City has \$93,963,000 in pressing water sewer repair and enhancement needs (WK Dickson, 2003).

Eden's 2012 Water and Sewer Fund totaled \$10,806,155; its 2012 General Fund for all municipal operations was \$24,429,384: Eden's Water and Sewer capital projects consume 44% of its entire 2012 budget, with the sewer fund alone representing 25% of all expenditures. The City of Eden has spent \$13,399,000 on sewer needs between 2002 and 2011. According to their Capital Improvements Plan, they intend to spend an additional \$32,249,700 in the next five years to address further outstanding water and sewer needs. Without accounting for inflation, the City will have addressed 49% of all known infrastructure needs and satisfied the US EPA AO by 2017. Yet, the Eden Comprehensive Water and Wastewater Master Plan identified an additional \$37 million in pressing infrastructure needs for the City.

In addition to wastewater infrastructure needs, the City is addressing Safe Drinking Water Act concerns for trihalomethanes (THMs) in the City's drinking water source. These concerns appear to be the result of improved mercury scrubbing at the Duke

Energy Belews Creek power plant in Stokes County upstream of the City. Duke Energy upgraded the mercury scrubbers to comply with air quality standards, a consequence of which has been the discharge of bromide. Duke Energy's wastewater discharge of bromide is not a violation of any surface water standard limits set by Federal or State regulations, but when combined with the chlorine the City uses to treat its drinking water, brominated THMs can be produced. These THMs are addressed by the Safe Drinking Water Act, and a priority concern for Eden. The City has elected to switch to chloramines as its residual disinfectant as surrounding municipalities such as Reidsville, Greensboro, Burlington, and High Point have done to control chlorinated or brominated THM formation. The City estimates that it will need to invest at least \$1.3 million immediately to build a chloramine treatment system (*personal communication with City of Eden Department of Environmental Services, 2013*).

## **Programs**

### *Improve Financial Stability for Eden's Infrastructure Improvements*

The City of Eden is investing significant resources in improving and repairing their wastewater infrastructure, largely due to external pressure from the NC DWR and the US EPA. However, its *Water and Wastewater Master Plan* details a total of nearly \$94 million worth of improvements that need to be made. While grants, loans, and, mostly, dedications of local public funds will have addressed 49% of these needs by 2017, a more financially-sustainable approach is necessary for future capital improvements and emergency repairs. The City needs to reconsider its water and sewer rates in order to have adequate reserves for addressing outstanding capital needs as well as supplies for new growth. The creation of a municipal bond to create such a reserve and remove potentially poor public response to hikes in utility rates is another approach to addressing this.

The UNC Environmental Finance Center (UNC EFC) maintains an interactive dashboard designed to “assist utility managers and local officials analyze residential water and wastewater rates against multiple characteristics, including utility finances, system characteristics, customer base socioeconomic conditions, geography and history” (UNC EFC 2014). As of January 2013, the residential wastewater rate in Eden was \$25.19 per 5,000 gallons and the business/commercial/industrial water rate was \$3,048.54 per 500,000 gallons. The municipal residential rate is significantly below the state residential median of \$34.95 per 5,000 gallons, but well above the business/commercial/industrial median of \$2,697.77 per 500,000 gallons (UNC EFC 2013).

These rates reflect the interests of the City to keep rates affordable for their significantly impoverished population as well as attracting new businesses. Both the residential and commercial sector water and wastewater billing rates have increased in recent years in order to maintain the financial stability of the utility (City of Eden 2012). In order to raise residential rates to a place where they could sustain utility operating costs, however, they would need to be raised by 40%, which would be a significant and unacceptable impact to Eden residents' budgets (UNC EFC 2013).

Similarly, the City of Eden has no current source of revenue to support stormwater infrastructure needs. Consequently, these funds must be drawn from the strained Water and Sewer Fund or the General Fund. Unregulated for stormwater management, Eden would gain meaningful new assets if a utility fund was created. It could better address its sanitary sewer overflows through the creation of an Illicit Discharge Detection and Elimination (IDDE) program. These programs regularly assess stormwater systems for discharges that in dry weather conditions indicate a connection to a greywater source (e.g. a washing machine), a water system, or a sewer or septic system. Such a program could also proactively address I&I concerns in which excess fluid from sewer systems is absorbed by stormwater systems, making them a sewer discharge point. In North Carolina's disconnected systems management of these utilities, I&I concerns almost always indicate an infrastructure failure.

#### *Strategically Invest in Future Utility Services*

It is recommended that the City identify potential future sewer service basins to help determine logical and cost-efficient ways to expand its sewer collection system over time and to coordinate the provision of sewer services with existing and future land development within each basin. These areas should be focused on areas where there is low shrink-swell potential in the soils, the bedrock is not too shallow, and stream crossings are minimized (Figure 5).

The City may consider making strategic investments in new gravity sewer lines, to encourage land development in the most appropriate locations, and to reduce the need for costly pump stations and force mains, as new development occurs. In addition, as the City acquires sewer easements for its future wastewater collection system expansions, it can simultaneously acquire rights for future greenway and recreational trail system development, providing safe and convenient pedestrian access among public uses, neighborhoods and businesses. If the new lines are not installed along existing rights of way, then care should be taken to minimize impacts to the rivers and their tributaries by maintaining 200-foot undisturbed buffers along perennial streams

and 100-foot riparian buffers along intermittent streams or the 100-year floodplain, whichever is greater. The NCWRC's *Guidance Memorandum to Address and Mitigate Secondary and Cumulative Impacts to Aquatic and Terrestrial Wildlife Resources and Water Quality* (August 2002) can provide further information and support for the City's Environmental Services Department in the issue of enhancing the existing infrastructure network.

### **Partnerships**

Though some water, sewer, and stormwater projects have been supported by federal and state grants, much of the funding for these efforts have come from local taxpayers in the City of Eden. With only a year left in the two-year compliance timeline for the US EPA AO, the City needs external sources of funding to reach its infrastructure improvement and water quality restoration goals. Many of these efforts are necessary, but could financially burden the City to a point where other water quality needs – especially in stormwater and education – are not supported. Matching efforts from public and non-profit partners including, but not limited to, the US EPA 319 Program, the NC Clean Water Management Trust Fund, and the USDA Community Conservation Assistance Program are needed to serve immediate needs. Funding by these external sources will allow municipal support of improvements in water quality in other ways – namely stormwater management, landowner education, and stream bank stabilization.

Less direct funding could also assist the City in addressing these infrastructure needs. With the completion of the regional Comprehensive Economic Development Strategy (CEDS) by the PTRC, the City will fall in a designated Economic Development District, making them eligible for greater Community Development Block Grant support. This will enable the City to focus on infrastructure, housing, and economic development needs in blighted urban areas and address water, wastewater, and stormwater infrastructure maintenance and improvements as part of these projects.

The UNC EFC offers affordable services that could work with the City's needs to raise water and wastewater rates simultaneously without making the rates unaffordable or discouraging business growth. They would also be a useful resource if and when a stormwater utility is established that can deal with IDDE and I&I issues, as well as the City's other stormwater needs. The UNC EFC specializes in the needs of smaller rural municipalities with aging infrastructure, and could create a long-term funding mechanism for the City.



## RURAL HERITAGE PROTECTION

The Eden Area watershed is largely composed of rural and undeveloped lands. According to the land use data for the watershed, 12% of the properties in the Eden Area watershed are listed as “Vacant,” 25.4% are dedicated as “Forest,” 0.2% designated as “Recreational” and an additional 18.8% is used as “Agriculture,” which can include raising livestock, crops, or timber. An additional 37% of the watershed is used for residential purposes, most of which are small properties within and just outside of the city, but 39% of which are rural. The watershed modeling done for this project identified subwatersheds that are conservation priorities for protecting the rural heritage of the Dan River as well as protecting water quality.

This primarily rural watershed boasts a rich cultural heritage. Rockingham County, and especially Eden, have heritage running through the fabric of the County and City. The County is still a leading producer of tobacco in North Carolina, and tobacco’s legacy in defining the current economy and culture cannot be overstated. Similarly, the municipalities of the Dan River Basin are defined by their role as economic engines in the textile and tobacco product economies. Their legacies can be seen in the factories and mill towns of Draper, Leaksville, and Spray but is largely unrecognized by the public. The City of Eden lays claims to the beginnings of country music, with Charlie Poole having called it home. The City celebrates this important history annually with the Charlie Poole music festival which brings musicians from all across the country. In addition to musical heritage there are Civil War trails crossing Eden, with signs posted at the junction of Henry and Moncure Streets and at the junction of Morgan and Meadow Streets.

The Museum and Archives of Rockingham County (MARC) hosted a traveling exhibit from the Smithsonian Institution in 2012 titled “Journey Stories” which highlighted Rockingham County’s role in the migration and transportation of the Moravians from Bethlehem, PA, to Winston Salem, NC. “Travel over trails, rails, rivers, roads, and in the sky shaped the American cultural and economic landscape” (Smithsonian Institution 2009). Also highlighted in the Smithsonian/MARC exhibit was the importance of the Smith and Dan rivers in the economy of Eden and the surrounding areas. “Beginning in 1792, batteaux were directly responsible for the economic development of the 200-mile-long Dan River and the founding of the river port cities and towns of Madison, Leaksville (now Eden), Danville, Milton, South Boston, and Clarksville,” (City of Eden 2007). Batteaux are long narrow boats that carried the early commerce up and down the shallow inland waters of the United States including the Dan and Smith rivers.

“Leaksville Landing is the only known existing port in the United States for bateaux,” (City of Eden 2007). While batteaux were the driving economic force in early American History, factories located on the rivers became the next important use of water for economic growth. The factories that built the City of Eden are still visible along the rivers.

In addition to identifying and conserving the cultural heritage of the Eden Area watershed, the agricultural heritage found surrounding Eden in Rockingham County and Caswell County also merits significant preservation. The Willow Oaks Plantation just east of the City of Eden brings economic benefits to the area as it draws on the agricultural history of the estate (<http://willowoaksplantation.com/history.html> 11/18/13). Additional camps and agritourism destinations would increase the visibility and value of the agricultural heritage of the Eden Area watershed.

In 2011, the non-profit American Rivers ranked the Roanoke River as the third most endangered river in America due to the possibility of uranium mining. Virginia is currently considering lifting a 30-year ban on uranium mining. The Coles Hill deposit in Pittsylvania County, VA, is believed to contain the largest undeveloped uranium deposit in the United States (Hammack, 2012). Coles Hill is at the headwaters of the Banister River, a major tributary of the Dan River, and less than 50 miles from Eden. If lifted, uranium mining has the potential to impact surface and ground water quality and quantity. Extracting uranium ore requires intensive use of water and chemicals, and leaves behind massive amounts of radioactive and contaminated waste. The mining, processing, and waste disposal have the possibility to leave a toxic, radioactive legacy in the watershed for centuries if not done in an environmentally sensitive manner (DRBA 2013).

## **Programs**

### *Voluntary Agriculture Districts*

Landowners of agricultural land (including forest management, livestock, and crops) can participate in the voluntary agriculture district (VAD) program authorized under the Agricultural Development and Farmland Preservation Enabling Act (N.C.G.S. §§ 106-735 through 106-749) and adopted by Rockingham County. Land with this designation is dedicated to the management of the land for rural uses. These voluntary districts give farmers who enroll the benefit of letting new neighbors know that agricultural operations will be occurring within a short distance of their property and protect the farmers from nuisance suits due to normal agricultural operations. VAD lands must be

certified by the County Tax Department in order to receive a property tax deferment or credit and are inspected regularly to ensure that they are meeting VAD requirements. Within the watershed, there are only two registered VADs. As Eden and the urbanized areas of Rockingham County grow, conserving open spaces and agricultural land will be necessary to preserving the County's agrarian heritage and maintaining high quality waters.

An approach that both protects agricultural lands and promotes development is that seen in Randolph County. There they have a rural/agricultural zone that can be developed, but only if at least 30% of its open space is protected. These areas can include the mandatory riparian buffer, and are encouraged to be contiguous. Randolph County also requires all new developments that adjoin agricultural or open space areas to preserve a viewshed buffer that preserves the rural aesthetic of the landscape. These ordinances reflect the investment commissioners have in preserving the county's agrarian heritage and ensuring that it is protected for future generations.

#### Ecotourism

Today the rivers still serve the local economy. By embracing the rich history of the rivers and highlighting the importance of the ecology in and along the rivers, the City of Eden and Rockingham County can capitalize on them as their ecotourism sector grows. The Partnership for Economic and Tourism Development in which the County and the City participate, serves an important role in marketing the ecotourism potential of the community.

#### Dan River Valley Heritage Initiative

The Dan River Valley Heritage Initiative (DRVHI) is an effort sponsored by DRBA which aims to collaborate with appropriate partners to market the region to tourists, new businesses and relocating families to enhance economic development in the region.

#### Conservation Easements

Protecting the rural landscape through the use of conservation easements is another strategy that can support local landowners by reducing the taxes on their land while ensuring undeveloped, agricultural or ecologically sensitive areas are managed to benefit the landowner and the natural resources. There is little protected land within the watershed, and all of those lands are primarily dedicated to public uses. Increasing the prevalence of protected land within the watershed will keep the rural heritage of the community alive while ensuring that residents are receiving the recreational, aesthetic and water quality benefits of open land.

## Partnerships

Locally the Dan River Basin Association and Three Rivers Outfitters capitalize on ecotourism by providing canoe, kayak and until 2008, batteau tours. While the batteau is no longer a viable recreation tool, the Dan River has many river access points and features suitable for boats including canoes and kayaks. In fact, the Dan River has been recognized by the National Register of Historical Places with “33 fascinating navigational structures including sluices, wing dams and landings designed to enable boats to maneuver the rapids”



(City of Eden 2012a). Encouraging partnerships between DRBA, Three Rivers Outfitters, the Wildlife Resources Commission, the City and County can increase the visibility, safety and accessibility of the historically important features found in the Eden Area Watershed along the rivers.

In North Carolina, local historic preservation commissions are appointed by local governing boards and have the power to study and recommend designation of local historic districts and landmarks (<http://www.hpo.ncdcr.gov/commhome.htm> 12/9/13). Involving the Eden historic preservation commission and the local Chamber of Commerce in the DRVHI can increase the local support and viability of any historical preservation efforts.

Piedmont Land Conservancy is a local resource for landowners interested in protecting the rural nature of their land and conserving the natural resources in perpetuity. Through Conservation easements and donations, Piedmont Land Conservancy strives to conserve the region’s rivers, streams, wildlife, farmland and scenic areas that provide the rural heritage that draws residents and visitors alike.

MillerCoors is another potential partner for improving environmental conditions and increasing ecotourism. Many large corporations invest in their local communities to ensure they maintain the support of community and have a location with high quality of life that will draw future employees. MillerCoors is poised to invest in maintaining or increasing the water quality in the Eden Area watershed since brewing beer requires copious amounts of clean water.

Due to the negative impact the coal ash spill from its holding pond has had upon the public’s perception of the City of Eden and the Dan River Basin in general, it seems

appropriate for Duke Energy to be a financial supporter of these recreation and tourism efforts. A robust campaign to improve and protect ecological health throughout the river basin as well as a marketing effort that highlights the value(s) of the river basin to broader public are needed. There is warranted concern about the safety and health of the rivers, their species, and the reasonability of public access that need to be directly and quickly addressed.

## **Policies**

### **Bond Referendums**

Many rural communities in Rockingham County were historically able to use trails and open space access that crossed private land (*personal communication with Kevin Moore, Rockingham County Soil and Water Conservation District*). As communities have become more fragmented, neighbors no longer know neighbors and the inherent understanding of respectful use in exchange for access has been replaced by distrust for “trespassers” and a misuse of private access points. As the culture changes in rural areas, residents will need official access points to benefit from the natural resources and passive recreation that draws them to reside in rural communities.

Bond referendums that are approved by voters are one way to pay for open space for nature preserves, open space next to schools to improve access to low-impact recreation for youth, and to preserve land along stream corridors to protect drinking water supplies. Voters in Rockingham and Caswell Counties may appreciate the opportunity to voice their support of increasing open space with public access through bond referendums.



## URBAN STORMWATER

The NC DWQ 2012 *Roanoke River Basinwide Assessment* identified stormwater runoff as a source of suspended solids which increases the turbidity of the water (NC DWQ, 2012). This conclusion has been verified by intensive streambank and ecological assessments conducted in support of this restoration planning effort, which found 94 sites that have issues with excessive stormwater runoff or have stormwater retrofit needs, almost all of them within the municipal boundaries (PTRC 2012). However, the impacts of this runoff appear to be focused upon the Dry Creek tributary to the Dan River. They are also undoubtedly having an impact upon habitat conditions in the Smith River due to the poor soils and intense channelization found in that watershed within the City of Eden. However, the majority of stormwater-associated sedimentation is occurring in Dry Creek in northern Eden.

Many characteristics of the Eden Area Watershed escalate the potential for stormwater to be a source of water pollution (Figure 5). These same characteristics make it a challenge to manage, especially in a retrofit capacity. A significant portion of the City lies in the Triassic Basin, which has Type D soils that can be almost as impervious as pavement, exacerbating runoff in highly urbanized subwatersheds (Figure 41). The topography of the Eden Area watershed tends to be flatter in the City and steeper in the rural areas. Most of the steep slopes (greater than 15% slope) are located adjacent to small waterways with more erodible soils.

The City of Eden is not regulated by the National Pollutant Discharge Elimination System (NPDES) Phase II program, which sets minimum requirements for qualifying municipalities to address that indicate a community is adequately addressing stormwater impacts. The six minimum requirements of the Phase II program are public education and outreach, public involvement, IDDE, construction site runoff control, post-construction site runoff control, and good housekeeping. The City has already put some of these regulations into practice, with a mapped stormwater system, ordinance language regarding construction and post-construction stormwater management, and codes regarding the good housekeeping of hazardous materials.

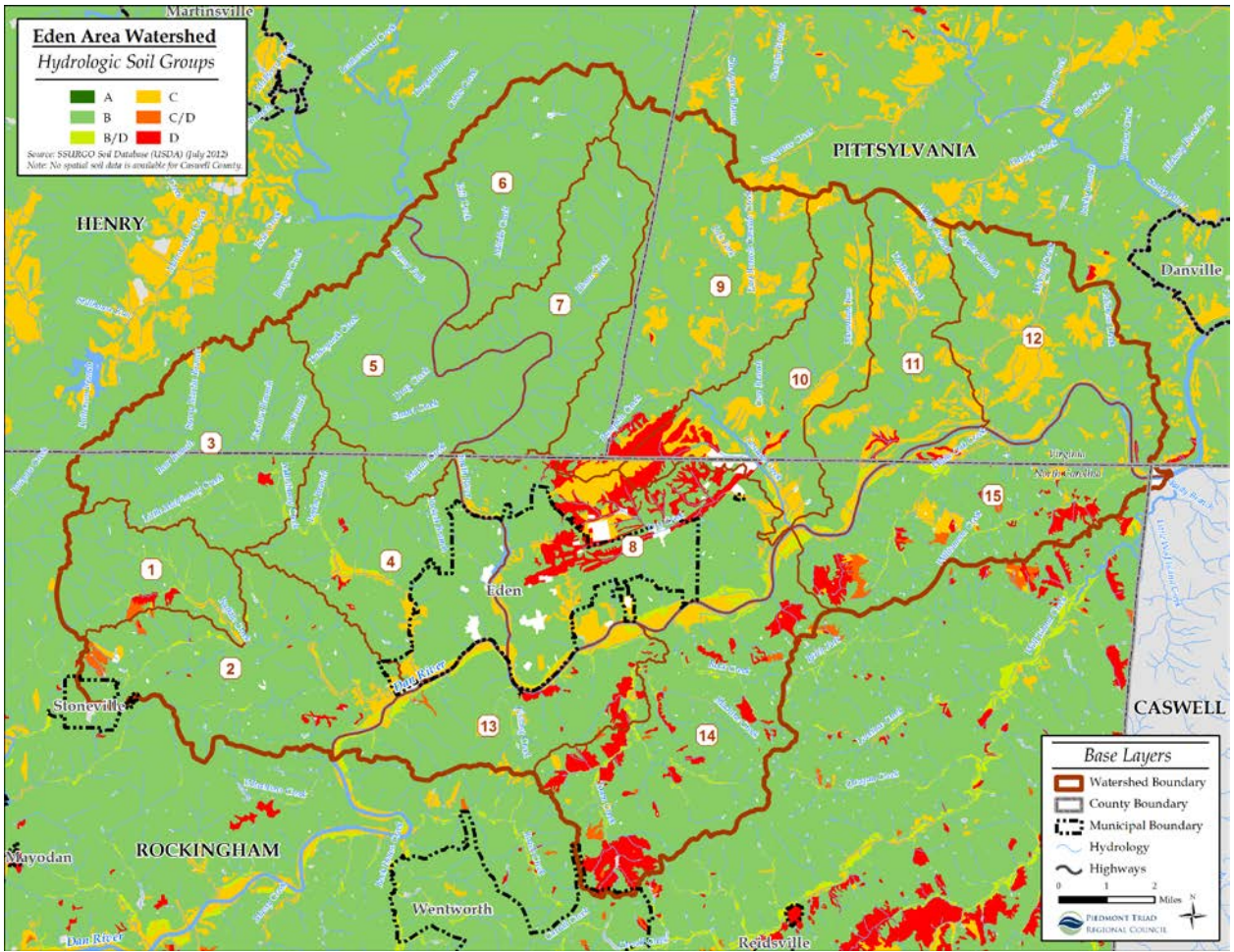


Figure 41: Eden Area Watershed Hydrologic Soils Groups - note Class D & C/D soils

## Programs

### Adopt NPDES Phase II Regulations for Stormwater Management

The City of Eden should adopt the regulations of the National Pollutant Discharge Elimination System (NPDES) Phase II program. It already practices most of the six minimum measures required by the NPDES Phase II program – only active IDDE, public involvement, and community outreach programs would need to be formally created and maintained to satisfy federal requirements. It would benefit the City for sewage management and public stewardship purposes to adopt practices required by the program. It would also place the City well for the (eventual) day it will fall under the regulatory authority of the NPDES program. Currently, the population threshold to qualify a community for required regulation is 20,000, but there is discussion of lowering the threshold and Eden is growing.

Such action would necessitate the establishment of a stormwater utility fee, which is likely to have a mixed reception from the public. However, if the application of revenue collected from the fees is visibly applied to municipal improvements, the value of this small, additional household charge might be more apparent. As discussed in the Urban Wastewater chapter, the establishment of a stormwater utility would aid in the management of illicit sewage discharges from the municipal system, empowering the City to proactively address IDDE and I&I issues before they necessitate emergency repairs.

### Utilize Low Impact Development Practices

The Triassic Basin which transects all of Eden presents extraordinarily challenging environmental conditions with which to contend in stormwater management: highly impervious soils, steep slopes, and limited retrofit potential. However, the surrounding soils in the city and in Rockingham County have their own challenges. The landscape is steeper, the soils more erodible, and the land use less predictable due to a more general zoning ordinance. The Eden area watershed's growth needs to be low-impact in design to minimize water quality impacts and stabilize local soils and direct development to the vacant urban centers in and around Eden that are extremely capable of absorbing residential and business growth.

Low Impact Development (LID) offers a menu of options on how to grow while minimizing environmental impacts, including features that can be utilized prior to, during, and following development. Many of these practices are applied to the development site itself, and can be implemented with little more than a change in

perspective. Their fundamental purpose though, is to minimize the environmental footprint of development, with a focus on minimizing stormwater runoff. One popular approach to incentivize the use of LID measures is a streamlined technical review process for developers willing to integrate such features into their sites. While this policy has environmental benefits, it also expedites economic development and acknowledges the efficient use of available public services and/or minimizing future remediation or infrastructure costs. For the eventual property owner, many of these features (i.e. minimizing tree removal) can have immediate cost savings.

### **Partnerships**

The DRBA has already begun addressing stormwater impacts in and around the City of Eden. Their established riparian buffer program has met with success in Virginia in securing landowner interest and cooperation in protection stream buffers, especially in rural areas. These efforts are especially needed in the headwater subwatersheds of Little Matrimony Creek and Matrimony Creek and will require the partnership of the Rockingham County Soil & Water Conservation District (RC SWCD).

The DRBA has also been actively distributing rain barrels in the Matrimony Creek subwatershed within the city limits of Eden, addressing long-standing concerns of flooding and stormwater runoff. Expansion of this program throughout the City, especially in the Dry Creek subwatershed, and coupling it with other programs that implement stormwater features in residential settings (e.g. rain gardens) is needed. Such efforts would be best served through a partnership between DRBA, the City, and the RC SWCD.

The PTRC administers a stormwater outreach and education program called Stormwater SMART that can address the long-term stewardship needs of the Eden area watershed. Working within its member communities, Stormwater SMART directly educates communities on the cumulative impacts of small individual actions that ultimately impact water quality (e.g. pet waste cleanup) as well as more comprehensive approaches to targeting neighborhoods for different types of campaigns. With the wealth of data from this planning effort, the Stormwater SMART staff already has a head start on how it could customize outreach efforts and public involvement projects for different area of the watershed.

The UNC EFC offers affordable services that could work with the City's needs to raise water and wastewater rates simultaneously with not making the rates unaffordable or

discouraging business growth. They would also be a useful resource if and when a stormwater utility is established that can deal with IDDE and I&I issues, as well as the City's other stormwater needs. The UNC EFC specializes in the needs of rural municipalities with aging infrastructure, and could create a long-term funding mechanism for the City.

The PTRC can assist Eden and Rockingham County with creating a permanent IDDE program. Their staff has the diversity of skill and experience needed to provide such services, and has already mapped the entire stormwater system. They can also initiate the City's IDDE program at the same time, training municipal staff on how to manage the program for the longer term. The PTRC is also experienced with ordinance drafting and development, but the UNC School of Government has provided many examples for local governments to assist with such actions as those recommended for Eden, including providing a model stormwater ordinance for the public.

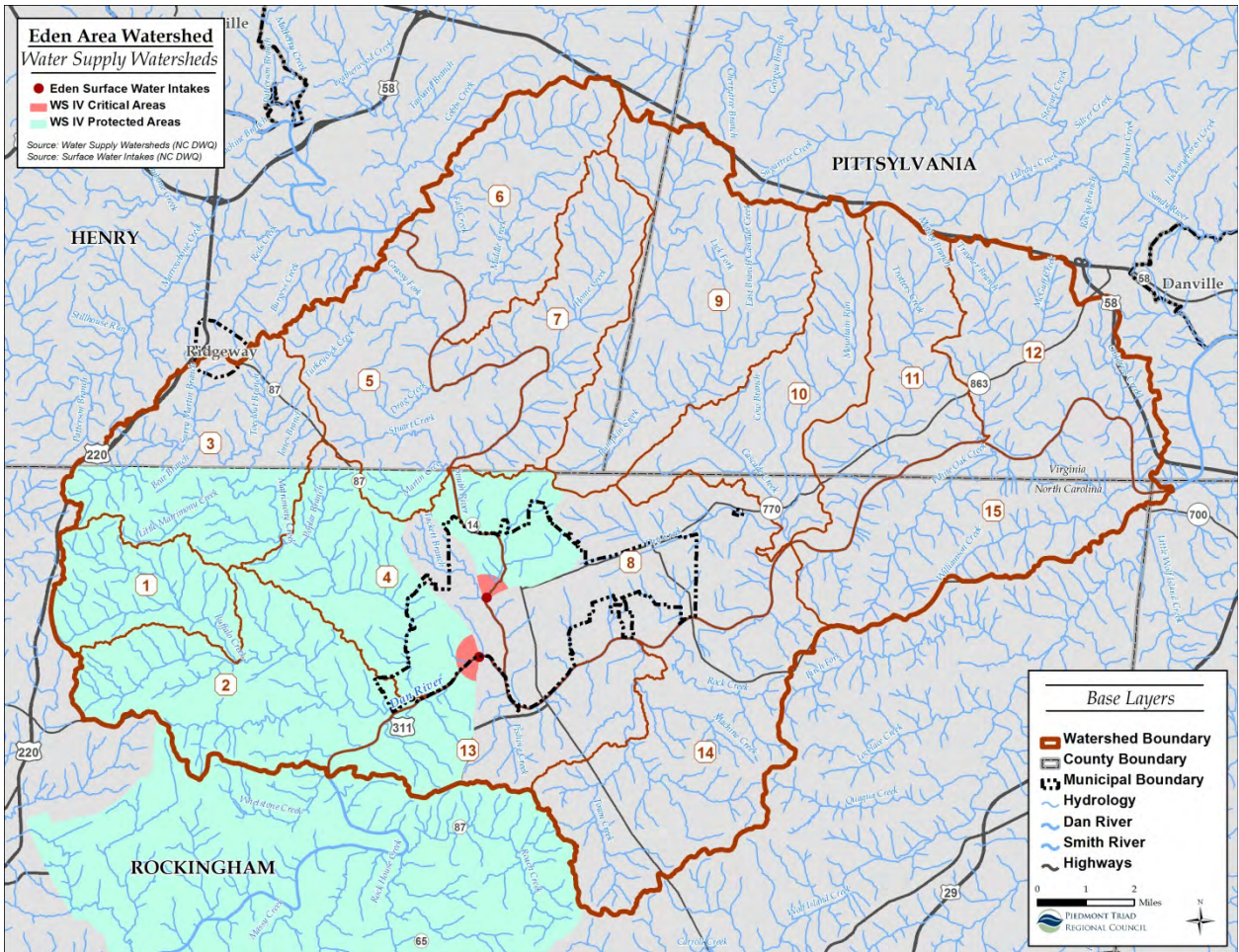
## **Policies**

### *Develop Local Policies to Minimize Development Impacts Using State Resources*

In the *Rockingham County Land Use Plan*, current zoning regulations designate every acre of land as residential, commercial, or industrial. Though a "permitted-by-right" system is clearly more efficient, it has the unintended consequence of segregating residential and commercial uses and further contributing to urban sprawl. While the Plan identifies 24% of the County as less favorable to high intensity development due to steep slopes, soil limitations, flood hazard areas and critical watershed areas, incentives that encourage development on less sensitive areas and discourage developers from building on sensitive sites need to be considered (Figure 5). Both Rockingham County and the City of Eden have a mandatory 50-foot stream buffer ordinance. The drafting of ordinances addressing development density and stormwater management by the Rockingham County Planning Department and the City of Eden Planning & Inspections staff is recommended. This could be done in coordination with the use and application of the NC WRC Green Growth Toolbox or separately.

While perhaps unreasonably burdensome as a whole, the NC DENR has developed two regulations regarding development that both Rockingham County and the City of Eden are familiar with, and which can provide guidance in managing stormwater runoff from new developments. The drinking water supply watershed protections mandate riparian buffers and density restrictions for development in areas where a public water supply lies, protecting its cleanliness for the greater public. They are already in place

throughout most of western Eden, protecting the City’s drinking water intake on the Dan River (Figure 42).



**Figure 42: City of Eden Water Supply Watershed areas, PTRC 2012**

The Jordan Lake Rules were adopted by the NC General Assembly in 2009 to attempt to comprehensively address nutrient impacts to a large Piedmont reservoir through the management of runoff from agriculture, new development, and existing development. Rockingham County must abide by these Rules throughout its southern extent, which drains to the Haw River. Both of these regulations protect water quality conditions by intensively managing runoff either with engineered solutions or by focusing developments away from water bodies.

While non-point source pollution management can be addressed through capital investments in restoration or retrofit projects that directly address sources of pollution

such as stormwater, new watershed policies are necessary to prevent further degradation of the Eden Area watershed conditions. An ordinance limiting development to the most appropriate areas, but especially in avoiding slopes greater than 15%, would have an impact upon potential development areas in the watershed, but a profound impact upon watershed health and stability, as it will prevent more erodible areas of the watershed from being developed and adding to the turbidity problems (Figure 5). This is only relevant to 28% of the watershed, and mostly within the more rural areas in the outskirts of Eden. If these policies are left unaddressed, future generations will have to invest much more to repair and remediate these problems. Limiting development to slopes of less than 15% will also reduce the cost of extending sewer and water infrastructure by encouraging more development within the existing urban core of Eden.

#### *Enhance the Eden Tree Ordinance for Improved Stormwater Management*

The City of Eden regulates the protection, removal and long-term management of trees within the City and its extraterritorial jurisdiction. Street trees intercept and slow stormwater runoff, reducing the pollution levels in the Dan and Smith rivers and their tributaries while also improving the aesthetics, shade cover, and property values of the community. However, some trees (e.g. oaks) have a greater stormwater mitigation value than others (e.g. crape myrtles) (USDA, *et. al* 2005). To enhance street tree and tree preservation found in Ordinance Section(s): Sub-division regulations (Article 10), tree protection ordinance (Section 11.33) and off-street parking and loading (Section 11.25), specific trees that have greater stormwater benefits and fit in with existing development could be identified for developers. This will simplify the selection of appropriate trees for development site plans and make it clear that the City values stormwater management, aesthetics, and shade cover in its community.

#### *Identify Development Centers to Guide High Density Growth*

The City and the County could also designate Development Centers through ordinances that support economic development using Zoning Districts (Section 11.24). Through special zoning districts Development Centers can be identified and encouraged in areas that have well-draining soil that can accommodate stormwater infiltration.

Development Centers can also be identified in areas that have reduced soil erosion and limited steep slopes to reduce the impact of stormwater leaving the site and reduce costs for the developers. Such an ordinance would be complementary to recommendations for the Eden Environmental Services Department to identify best future sewer service basins that will be most cost-effective to install and maintain.



## EDUCATION AND AWARENESS

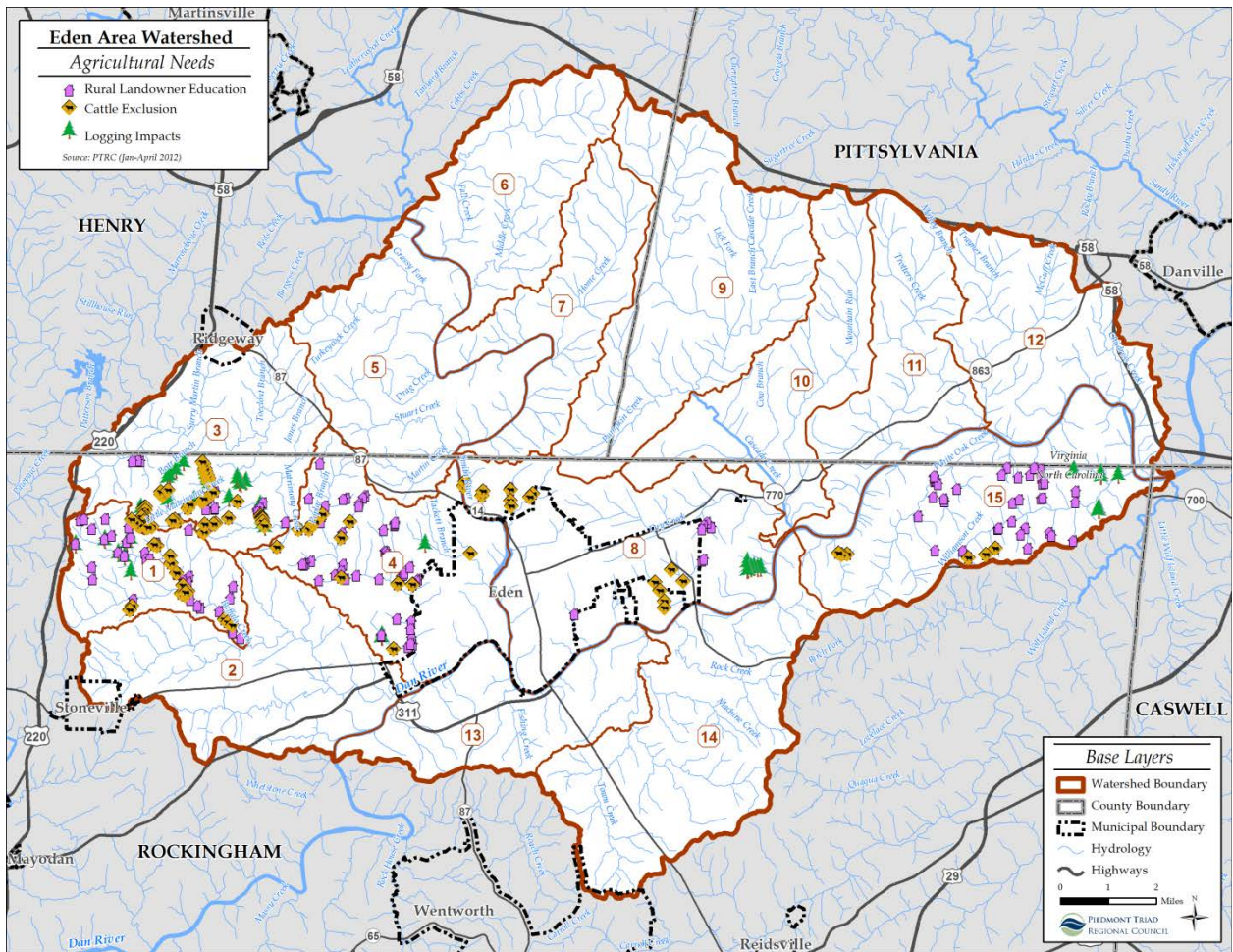
Most of the acreage in Rockingham County is privately owned; and collectively these individual landowners wield considerable influence over the health of forests, agricultural land and thus the water. The Eden Area watershed suffers from non-point sources of pollution, most of which can be addressed through more awareness, understanding, and involvement of the residents in the sustainability and stability of their watershed's health and function.



**Figure 43: Trash Dump on Matrimony Creek, PTRC 2012**

Through the field work for the *Eden Area Watershed Assessment*, 252 opportunities for landowner education were documented by stream assessment teams (Figure 44; PTRC 2012). These educational opportunities included information on the impact of 70 unpermitted trash dumps, 72 farm ponds in need of work, 65 stormwater pipes that may be a source of illicit discharges and opportunities to enhance riparian buffers.

Sources of nutrient, sediment, and litter pollution can be addressed and reduced quickly and cheaply through simple and direct outreach programs that target all watershed residents and uses resources that are readily available to both Rockingham County and the City of Eden. Educational projects must be invested in and protected by the communities they serve if they are to have long-term benefits to the watershed and its residents. “Local initiatives to protect water quality are essential to any community because local citizens make decisions that affect change in their own communities” (NC DWQ, 2012).



**Figure 44: Documented sites of landowner education opportunities and needs in the Eden Area Watershed, PTRC 2012**

Working the land in Rockingham County is rarely a sole occupation (personal communication Kevin Moore). So these landowners are farmers during evenings and weekends while holding down blue- or white-collar jobs. A 2006 survey of North Carolina landowners by the N.C. Forest Service revealed that the majority of landowners say that: “owning forest land for commercial timber production is ... *not* a primary reason for owning forest land [emphasis added].” Rather, the motivation for owning land and forests arises from a desire to pass that land on to their descendants, long term investment and aesthetic enjoyment. Because individual actions have such a significant impact, it has been suggested that in order to make significant and lasting strides in improving water quality, the culture surrounding land management in the Eden Area Watershed needs to highlight the necessity of stewardship.

## Programs

### Stormwater SMART

In response to the federal and state regulatory needs of member governments, the Piedmont Triad Regional Council (PTRC) created a regional stormwater outreach, education and public participation program. Nineteen communities in the Piedmont Triad participate in Stormwater SMART to meet NPDES Phase II, Jordan Lake Rules, and the Randleman Buffer Rules requirements, and to ensure recreational and drinking waters are protected for future generations. Stormwater SMART provides direct outreach and education to citizens in Stormwater SMART communities. Each program is customized to address specific water quality needs in the local community. Stormwater SMART attempts to eliminate any potential duplication of programs by making an effort to partner with other organizations to ensure the message is consistent and programs are filling a need in the community that is not already being met. Rockingham County is already a member of a Stormwater SMART, but the City of Eden has not yet become a member.



### Trout in the Classroom

The Dan River Basin Association (DRBA) has partnered with Trout Unlimited to provide a few schools in the Eden Area Watershed with Trout in the Classroom, which is an environmental education program that gives students the opportunity to raise trout from eggs to fingerlings. Raising trout in the classroom gives the students first-hand experience in the importance of clean water, water chemistry and aquatic ecosystems which addresses the NC Essential Standards for many grade levels. Since none of the water in the Eden Area Watershed is cold enough to support the trout raised in the classroom, students travel to the headwater region of the Smith River to release the trout. This trip provides them with additional learning experiences centered in the concepts of what a watershed is and how all runoff drains to a common point, as evidenced by the changes of the Smith River by the time it reaches the City of Eden.

### Local Technical Assistance and Outreach

County Soil and Water Conservation Districts and the Cooperative Extension also conduct significant education through programs, workshops and technical assistance to landowners. This education is very valuable for understanding BMPs for farmland and private yards.



### Improving the Land Ethic

Including the humanities and cultural work as part of the educational effort could build connections and provide support for policies and programs suggested in this restoration plan. The approach suggested here is a cooperative discovery, creation, and articulation of a land ethic. Some examples of programs and projects that are based in the humanities but have the ability to affect water quality are: faith-based initiatives, particularly Creation Care; reading and discussion groups in libraries; an oral history project on Rockingham County land ethics; "Sense of Place" public art projects; storytelling programs; creation of a speakers bureau, particularly targeting civic club meetings; a land ethic teachers' institute; and readers' theaters. Resources to support these programs are: North Carolina Humanities Council; Dan River Basin Association; Southern Oral History Program, University of North Carolina, Chapel Hill; Center for Documentary Studies, Duke University; and the North Carolina Arts Council.

### **Partnerships**

Partnerships between DRBA and Stormwater SMART will ensure additional audiences are receiving quality information about the importance of clean water and facilitate high quality programming. Partnerships between all agencies conducting education will also facilitate the leveraging of resources.

Due to the negative impact the coal ash spill from its holding pond has had upon the public's perception of the City of Eden and the Dan River Basin in general, it seems appropriate for Duke Energy to be a financial supporter of these education efforts. A robust campaign to acquaint both the local residents and the public at-large of the river basin's assets is needed. There is warranted concern about the safety and health of the rivers, their species, and the reasonability of public access that need to be directly and quickly addressed.

### **Policies**

The City of Eden should consider joining Stormwater SMART to increase local watershed stewardship and address non-point source pollution through direct education.

## IMPLEMENTATION TIMELINE

### REGULATORY BACKGROUND OF WATERSHED RESTORATION

The US EPA has developed a *Strategic Plan* for the period of 2011-2015. This Plan features five key goals that are guiding the US EPA in all respects, and includes one relevant to this *Restoration Plan*: Protecting America’s Waters, which has the two primary objectives of “Protect Human Health,” and “Protect and Restore Watersheds and Aquatic Ecosystems” (US EPA 2014). Once fully implemented, the *Eden Area Watershed Restoration Plan* will fulfill these objectives and the US EPA’s Strategic Plan, as well as the more basic requirements and needs of the National Environmental Protection Act of 1972 and the Clean Water Acts of 1973 and 1990.

The *Eden Area Watershed Restoration Plan* also addresses the US EPA Nine Key Elements of Watershed Planning:

- 1) Identify the causes and sources of pollution;
- 2) Recommend management solutions to improve water quality;
- 3) Estimate the load reductions from taking these measures;
- 4) Estimate the technical and financial assistance needed to improve water quality;
- 5) Employ an education and outreach effort to address sources of pollution;
- 6) Create an implementation timeline;
- 7) Define milestones of success in improving water quality;
- 8) Define how water quality success will be determined; and
- 9) Monitor water quality to determine if milestones are being met.

With the completion and implementation of this *Restoration Plan*, the stakeholders of the Eden Area watershed will have successfully served these nine key elements and restored healthy water quality conditions to the Dan River, the Smith River, and their tributaries, as defined within this planning effort. This recovery will not occur overnight, but will require dedication and commitment of resources, staff, and time over a twenty-year period in which the *Plan* may be adaptively managed to reflect changes in conditions on the ground and in policy that affect it.

This Eden Area Watershed Restoration Implementation Timeline is designed to serve all of the needs of the watershed and its stakeholders. It packages the findings of the *Eden Area Watershed Assessment* with the Policy Recommendations and the Project Atlas projects found in this document to comprehensively address the sources of impairments in the Dan River and Smith River: turbidity, fecal coliform bacteria, and ecological

habitat conditions. Due to the recent coal ash spill from Duke Energy's retired Dan River power plant, it is likely that finite resources for restoration and sustainability of the watershed will instead be focused on remediating potentially toxic sediments and improving ecological health in the watershed. There are opportunities, though, to address the watershed's pre-existing needs as well as respond to this new impact, and this strategy is strongly recommended to all involved in both efforts. This Implementation Timeline will focus on the needs identified through this restoration planning effort and not comment further upon the need to rehabilitate the river from the impacts of the coal ash spill. Its guidance is recommended for integration into all efforts associated with responding to the Duke Energy coal ash spill. The Implementation Timeline is supposed to be an easy-to-use summary of what needs to be done to remediate and finally restore health water quality conditions to the Eden area watershed.

The Eden Area Watershed Implementation Timeline attempts to coordinate policy and project needs for cost-effective and quick watershed recovery. The policies and the projects are only worth pursuing together; policy or project improvements will be futile without the other. The Implementation Timeline recommends the optimal coordination of these watershed stewardship measures, but is not final. Most steps taken to improve watershed conditions are steps in the right direction and are recommended and supported in the service of restoring a healthy, functioning watershed to both the Dan River and the Smith River.

## PHASE I (2014 – 2015)

*There are three primary sources of concern in the Eden area watershed that require immediate attention, none of them necessarily structural. The first is the need for programming and messaging on the need for improved agricultural practices in the watershed. Agriculture is the primary source of fecal material pollution in either river. It is estimated that the levels of fecal pollution could be reduced by over 50%, with several BMPs in the Matrimony Creek and Town Creek subwatersheds that would cost a total of \$300,000. These projects, however, will require the support of a local steward who can work with key landowners to put such projects in place, reassuring them that they will not lose the use of their lands and to administer the many parties involved in implementing agricultural BMPs.*

*The other immediate need is to develop better communication regarding high-impact forestry operations, which are the primary source of sedimentation in the watershed. This is due to both direct and indirect contributions in which the cleared sites are loading sediment to streams due a lack of FPGs and the downstream effect destabilizes streams, discharging sediment from erosion to the beds and banks. Many local residents (and County and City staff) do not know that these high-impact operations are not legal in North Carolina and must be inspected by the NC Forest Service. The creation of outreach materials and publicity on this issue, including a hotline or website for citizen reporting, could be extremely beneficial for local water quality conditions, requiring landowners to work within state law. Better yet, it will likely lead to greater use of consulting foresters, who can not only ensure that FPGs are used but that timber harvests are timed to minimize environmental impacts and optimize landowner profits.*

*However, before restoration activities begin in earnest, the watershed is in need of a more robust monitoring network. There are currently only six permanent ambient monitoring stations in this 225-square mile watershed, and all of them are on the main stems of the Dan and Smith Rivers. Without more monitoring stations representing significant tributaries, there is no way of establishing a baseline of water quality conditions on these tributaries, nor any way of documenting any improvements from investments in structural and non-structural solutions to these problems. The PTRC is working with many of the project stakeholders to develop a monitoring plan for the watershed that will address these needs.*

*These three primary steps must be supplemented with actions by stakeholders across the state boundary (which is also an US EPA regional boundary). These concerns are universal throughout the watershed, and action to address agricultural operation, the need for more and better water quality monitoring data, and better actions on high-impact logging sites is needed in both North Carolina and Virginia. Thanks to the Mayo River and Smith River TMDL Implementation Plan, Soil and Water Conservation Districts, the Western Piedmont Planning District Commission, and DRBA are addressing sources of agricultural pollution in the Smith River watershed in Virginia. These efforts need to be*

*mirrored in North Carolina not only in their intent but also in their form, using language and images that are consistent and recognizable across the state line. While it may be difficult due to the political boundary, any progress that creates such a stable and consistent message will be an enormous step forward for water quality in this watershed.*

*Finally, smaller significant steps that cost little to nothing should be taken in this initial phase of the watershed's restoration. The City of Eden should adopt all of the six minimum measures of the NPDES Phase II program. This could be fulfilled by the adoption of an illicit discharge detection and elimination ordinance and joining the PTRC's outreach and education program Stormwater SMART. All stormwater management efforts should be focused in the Dry Creek subwatershed, which includes much of Draper, and the Matrimony Creek subwatershed, which includes parts of Spray. Rockingham County should consider revising and strengthening its land suitability assessment using the approach included in this Plan, which would better protect the waters, while declaring more area suitable for standard development practices. Both the City and the County should draft and consider tree ordinances that protect "legacy trees" and require the planting of trees that have greater environmental service values. The NC Natural Heritage Program and/or the Piedmont Land Conservancy should be granted access to the MillerCoors property to assess and preserve the globally-significant habitat found there.*

#### Action Steps

- 1) Pursue state, federal, and private foundation funding to support a sustained presence in the watershed, with a primary goal of working with agricultural landowners to put agricultural BMPs – especially livestock exclusion fencing – on the ground. Focus efforts on the Matrimony Creek and Town Creek subwatersheds, and cultivate better communication with complementary efforts and programming in Virginia. Develop target goals for BMP implementation that funders can hold the steward(s) accountable to, and ensure that administrative support is validated with water quality improvements.
- 2) Pursue state, federal, and private foundation funding to develop and create outreach materials that educate the public about the do's and don't's of timber operations and make the contact information of the NCFS Forester better known. Create a hotline to report forestry operations and potential FPG violations.
- 3) PTRC will draft a water quality monitoring plan for the Eden area watershed that, at minimum, records the impacts of the Matrimony Creek and Town Creek subwatersheds on the Dan River and Smith River. New biological monitoring stations are needed on the Dan and Smith rivers as well to ensure that federally-endangered and –threatened species are not in danger and are being protected.

- 4) The City of Eden communicates and potentially contracts with the UNC Environmental Finance Center to develop an utility finance strategy that can address immediate and outstanding infrastructure needs, ensure fiscal sustainability, and provide residents with affordable rates.
- 5) The City of Eden adopts all six minimum measures of the NPDES Phase II program. This requires them to draft and adopt an illicit discharge detection and elimination ordinance and join Stormwater SMART.
  - o After Eden joins, Stormwater SMART will focus its outreach and education efforts regarding stormwater on the Dry Creek and Matrimony Creek subwatersheds within the city limits.
- 6) Rockingham County reconsiders its land suitability assessment, and integrates hydric soils, geology, and slopes into their considerations of where development is most desirable. May be accompanied by the identification of “Development Centers” in the county.
- 7) PTRC will work with the City and the County to draft tree ordinances that promote trees that can better mitigate stormwater runoff.
- 8) MillerCoors works with Piedmont Land Conservancy, the NC Natural Heritage Program, and DRBA to ensure the protection of its globally-significant upland hardpan forest.

## PHASE II (2015 – 2020)

*Phase I is dedicated to addressing immediate concerns in the Eden area watershed. Phase II is dedicated to establishing a programmatic base to sustain the restoration efforts and recovery of watershed health and function. It will both capitalize upon and complement the efforts of Phase I in a way that improves water quality conditions and ensures the presence of stewards within the watershed and its stakeholder parties who can shepherd the rest of the plan to fruition. The basic philosophy behind Phase II is that of accounting for the assets within the watershed and capitalizing upon them for growth.*

*The two most significant assets that the Eden area watershed has are land and water. These natural resources define the watershed's past and, if cared for, can define its future. The lands are primarily used for agriculture and rural residences, both of which are a reflection of deep pride residents have in the agrarian heritage of this area. Rockingham County, however, has done little to retain this landscape, which is vulnerable to development and resource extraction that can damage the water quality as well as the view and the feel of the rural landscape of Rockingham County. Better promoting and utilizing ordinances in the Rockingham County Land Use Plan's "Voluntary Farmland Preservation Ordinance" would effectively protect these land uses and ensure the health and longevity of these landscapes and waters for future generations. The NC WRC's Green Growth Toolbox provides staff and elected officials with the resources needed to document these values and protect these assets. The creation of a market that directly values these land uses – like Rockingham County's Local Food Coalition – can create direct, grass roots support for such policies.*

*The waters and lands have other, less obvious uses that can benefit area residents as well. Curating a marketing strategy that capitalizes upon the abundant waters, rare habitats, and significant recreational opportunities of the area could reap an economic windfall for entrepreneurs and residents of the City of Eden and Rockingham County, as well as the greater Upper Dan River Basin. Efforts are already being made to do so by many of the stakeholders – especially DRBA – but there are opportunities to advertise the Eden area as a destination for day trips and weekends to potential visitors throughout North Carolina and Virginia. The presence of endangered species, small whitewater rapids, hiking trails, and a rich cultural heritage could bring tourism dollars in from all over if marketed strategically.*

*To ensure that visitors are impressed, the lands and waters will need to be curated to*

*meet this public interest. With support from DRBA and PLC, the enhancement of open spaces and large riparian buffers that fulfill conservation and recreational strategies could create wildlife corridors and recreational paths for multiple constituencies. Rockingham County and its municipalities are already invested in this approach, funding DRBA in 2014 to ensure that wildlife corridors and the County's ecology are a priority that guides growth. Such features will also attract residential growth to the area, as young families see an opportunity to live, work, and play in one place.*

*However, to protect these natural assets continued diligence is needed throughout the watershed to address sources of sediment and fecal material, especially in the priority subwatersheds of Matrimony Creek, Town Creek, and Dry Creek. The Rockingham County Soil and Water Conservation District and DRBA need to have direct support from state and federal programs that can fund effective but expensive agricultural BMPs that prioritize the reduction of fecal material and sediment (in that order) into the rivers and their tributaries. Fundamental to these efforts is the creation of a program that can stabilize or remove farm ponds that are structurally failing due to age. These ponds, which number over 400, present an immediate threat to water quality health in both rivers. They were designed to last fifty years, and most of them are over seventy-five years old. Should they fail, thousands of tons of sediment could be released to endangered species habitat in these rivers. With the watershed located in a hurricane zone, this possibility is real and deserves attention. The solutions will be expensive, but are necessary.*

### Action Steps

All **Phase I** actions are priority concerns. Persist with their successful implementation first.

- 1) Rockingham County and the City of Eden work with the NC WRC to be trained on the use of the Green Growth Toolbox and how conservation planning can benefit their communities.
  - Rockingham County updates its Farmland Preservation Ordinance that prioritizes valuable open space and agricultural lands to ensure they will not be lost to development or neglect through added values (i.e. rural heritage) and incentive programs
  
- 2) Support Rockingham County and the City of Eden in their efforts to market the area as an ecotourism and recreational destination. Work with non-profit and economic development partners to determine what will best draw visitors from

- throughout North Carolina and Virginia.
- Develop multimedia campaign and determine long-term funding support for a visible and effective campaign manager. See Davidson County Tourism and Recreation Investment Partnership for an example.
- 3) Multiple partners support Piedmont Land Conservancy (PLC) and Rockingham County in open space and habitat preservation efforts.
    - Ensure that key public interest sites and access points are identified by consensus so that PLC can provide them to the community-at-large.
  - 4) Develop a pond rehabilitation and removal program through the Rockingham County Soil and Water Conservation District. Utilize AgWRAP funds as seed money and build a long-term funding solution for this potential problem.
  - 5) Track stormwater management efforts in Dry Creek through the implementation of structural and non-structural BMPs. The City of Eden and Stormwater SMART can work with the local community to ensure that any projects placed on the ground serve other community needs. Stormwater SMART and/or DRBA should customize messaging and campaigns for the different watersheds and their concerns.
  - 6) Track agricultural BMP implementation headed by the Rockingham County Soil and Water Conservation District. Estimate the value of spent cost-share and grant funds in the water quality data on all significant tributaries. Continue to cultivate bi-state working relationship to prioritize investments for the greater economic good of the river basin. Conversely, estimate the potential benefits lost without greater support from NRCS, CWMTF, 319, and cost-share assistance programs.

### PHASE III (2020 – 2030)

*After seven years of implementing the Eden Area Watershed Restoration Plan, significant changes in water quality and watershed conditions should be apparent and measurable. Water quality monitoring data should bear this evidence, and if a bi-state monitoring program has not been created yet, this is the phase in which it happens. Similarly, other programs that will be most effective at the bi-state scale (i.e. Soil and Water Conservation District actions) should be progressing towards a uniform model, even if it is directly managed by two entities in separate states.*

*At this point, agricultural BMPs should be in place that can account for 90% removal of fecal coliform bacteria in North Carolina's subwatersheds. The impact sites are largely known at the present, and the solutions are simple, if costly. However, their relative impact is much greater than many of the sediment BMPs that will be required to restore healthy water quality conditions to both the Dan and Smith Rivers. A feasible goal is to have established either BMPs or agreements with landowners to reduce the fecal inputs from their farms by 2020.*

*This is the phase in which hard work can be capitalized upon through the creation of long-term funding mechanisms. The support of open space and farmland protection through a public bond could be considered. Incentives for developers who use low impact development practices should be in place, so more complex measures such as density incentives and flexibility on parking restrictions can be considered as well as used to optimize density and minimize environmental impacts. The establishment of a county-level public penalty for failing to abide by FPGs could be considered. Without a change in programs or policies at the federal, state, and/or local scales, achieving healthy sediment levels within this watershed are likely to be impossible. As demonstrated in this report, simply reducing sediment inputs by 10% in the three watersheds with the greatest impact will require over \$5 million. The costs for similar actions in the Smith River watershed from the VA DEQ TMDL Implementation Plan show similar costs for Virginia inputs. Sediment reduction should be the overarching focus of all outreach activities in the watershed, with fecal input reductions being a short-termed campaign to launch restoration efforts in 2014. With most of the water and wastewater infrastructure needs provided for, the City of Eden can begin investing in capital stormwater needs, prioritizing projects in the Dry Creek and Matrimony Creek watersheds.*

*Lastly, the programs that are immediately necessary: agricultural BMP implementation, enforcement of FPGs, and the enhancement of the water quality monitoring network should be firmly in place and financially sustainable. The most sustainable strategy to addressing these needs is to prevent the degradations from occurring through education and stewardship. The technology and policies that can minimize degradation and financial investments in restoration are known and available – the responsibility lies with the watershed stakeholder to support organizations and staff to ensure that farmers,*

*foresters, and landowners are aware of their options and the impacts of their decisions. This will require organizational investments from the public sector as well as non-profit partners like DRBA, but ultimately the decisions lie with private property owners.*

## REFERENCES

- Associated Press. "NC Admits Mistake, Says Arsenic Topped Safe Level." Emery P. Dalesio. 02/09/14. <http://www.charlotteobserver.com/2014/02/09/4678375/nc-admits-mistake-says-arsenic.html#.Uv0YqUam3EO>.
- Charlotte Observer. "Duke Energy Permanently Plugs Ash Pond Pipe." Bruce Henderson. 02/09/14. <http://www.charlotteobserver.com/2014/02/09/4677984/duke-energy-permanently-plugs.html#.Uv0YRUam3EO>
- Blue Ridge Environmental Solutions, Inc. (2013). *South Mayo River, North Fork Mayo River, South Fork Mayo River, Blackberry Creek, Marrowbone Creek, Leatherwood Creek, and Smith River Watershed Implementation Plan*. Retrieved December 12, 2013, from <http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/smithmayoip.pdf>.
- Bryant, Shari L., (January 31, 2014). Piedmont Region Coordinator, NC Wildlife Resources Commission. Comment letter regarding "Eden Area Watershed Restoration Plan, December 2013, Rockingham County, North Carolina." NC Wildlife Resources Commission, Division of Inland Fisheries, Raleigh, NC.
- City of Eden. (2007, August). Land Development Plan. Eden, NC.
- City of Eden. (2012). *Wastewater Treatment Division*. Retrieved December 19, 2012, from Eden NC: <http://www.ci.eden.nc.us/wastewatertreatment.cfm>.
- City of Eden. (2012). "Explore Eden: Batteau!" Retrieved November 2013 from <http://www.exploreedennc.com/batteau.html>.
- Cockburn, H., et al. (May 2013). *Rockingham County Pathways: A Trail Plan for Rockingham County*. Prepared for the Reidsville Area Foundation. Retrieved December 2013 from the Rockingham County Trails: [http://www.rockinghamcountytrails.org/documents/RockPathwaysReportPublicComment5\\_8\\_13.pdf](http://www.rockinghamcountytrails.org/documents/RockPathwaysReportPublicComment5_8_13.pdf).
- Dan River Basin Association (DRBA). (2013). *Rockingham County: Jobs, Forest and Rivers Climate Adaptation Plan*. Rockingham County, NC. 2013.
- Dorsett, Jerry & Gerry Cohn. (2013). *Caswell County Farmland Protection Plan*. Prepared for the Piedmont Conservation Council, Durham, NC. Retrieved November 2013, from <http://www.piedmontconservation.org/library/library/documents/z-caswell-county-fpp-finalized-8-june-2013-.pdf>.

- Environment North Carolina, Research & Policy Center. (2007). *Losing Our Heritage: Development and Open Space Loss in North Carolina*. Retrieved from [http://www.environmentnorthcarolina.org/sites/environment/files/reports/Losing Our Natural Heritage.pdf](http://www.environmentnorthcarolina.org/sites/environment/files/reports/Losing%20Our%20Natural%20Heritage.pdf).
- McNaught, D., J. Rudek & E. Spalt. 2003. *Riparian Buffers: Common Sense Protection of North Carolina's Water*. Environmental Defense, Los Angeles, CA. Web site: [http://www.edf.org/documents/2758 NCbuffers.pdf](http://www.edf.org/documents/2758_NCbuffers.pdf).
- Mettam, Laurie, Brandon King, and Rebecca Dunning. (2013) *A Community and Local Government Guide to Developing Local Food Systems in North Carolina*. AG-744. Raleigh, NC: The Center for Environmental Farming Systems.
- NC Department of Agriculture & Consumer Services (DACS). (2012). *2011 Agricultural Statistics - Summary of Commodities by County*. Retrieved from North Carolina Department of Agriculture & Consumer Services, June 2012.
- NC DACS, Agritourism Office, Marketing Division. (2013). *So You Want to Start an Agritourism Farm?* Prepared by Martha Glass, Marketing Division Manager, NC DACS, Raleigh, NC. Retrieved November 2013, from <http://www.ncagr.gov/markets/agritourism/documents/StartingAgritourismBusiness.pdf>.
- NC DACS. (2013, January 22). *2012 Agricultural Statistics - Summary of Commodities by County*. Retrieved from North Carolina Department of Agriculture & Consumer Services: <http://www.ncagr.gov/stats/codata/index.htm>
- NC DACS, Forest Service (NCFS). (2014). "Forestry Leaflets." NC DACS, NCFS, Raleigh, NC. Retrieved February 2014 from <http://ncforestservice.gov/publications/Forestry%20Leaflets/WQ01.pdf>.
- NC Department of Commerce. (2014). "County Tier Designations." Retrieved from the NC Department of Commerce: <http://www.nccommerce.com/research-publications/incentive-reports/county-tier-designations>.
- NC Division of Water Quality (DWQ). (Jan. 11, 2005). *Total Maximum Daily Load for Turbidity and Fecal Coliform for Haw River, Deep River, Third Fork Creek, and Dan River in North Carolina*. NC Department of Environment and Natural Resources, DWQ, Raleigh, NC. Retrieved July 11, 2012, from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=0b76e1b5-34cc-45ed-a261-4a5b34a1676e&groupId=38364](http://portal.ncdenr.org/c/document_library/get_file?uuid=0b76e1b5-34cc-45ed-a261-4a5b34a1676e&groupId=38364).
- NC DWQ. (July 31, 2009). *North Carolina Addendum Total Maximum Daily Load (TMDL) for Impaired Segments in the Dan River Watershed to Virginia TMDLs Approved by*

*EPA Region 3: Assessment units (U) for the Dan River, 22-(31.5)a, 22-(31.5)b, 22-(38.5), 22-(39)a, 22-(39)b and for the Smith River, 22-+40-(2.5), 22-40-(3).* NC Department of Environment and Natural Resources, DWQ, Raleigh, NC. Retrieved July 11, 2012, from [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=e3122098-986e-4e72-9bac-02c084b3d8e2&groupId=38364](http://portal.ncdenr.org/c/document_library/get_file?uuid=e3122098-986e-4e72-9bac-02c084b3d8e2&groupId=38364).

NC Division of Water Quality. (2012). *Roanoke River Basinwide Water Quality Plan*. NC Department of Natural Resources, NC Division of Water Quality, Raleigh. Retrieved 12 05, 2012, from <http://portal.ncdenr.org/web/wq/ps/bpu/basin/roanoke/2012>

NC Division of Water Quality. (2013). *NC 2010 Integrated Report Categories 4 and 5 Impaired Waters*. Retrieved January 7, 2013, from North Carolina Division of Water Quality: [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=8ff0bb29-62c2-4b33-810c-2eee5afa75e9&groupId=38364](http://portal.ncdenr.org/c/document_library/get_file?uuid=8ff0bb29-62c2-4b33-810c-2eee5afa75e9&groupId=38364)

North Carolina Wildlife Resources Commission. (2005). *North Carolina Wildlife Action Plan*. NC Wildlife Resources Commission, Division of Inland Fisheries, Raleigh, NC.

North Carolina Wildlife Resources Commission. (2012). *Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina*. NC Wildlife Resources Commission, Division of Inland Fisheries, Raleigh, NC.

Outdoor Industry Association. (2012). *The Outdoor Recreation Economy*. Retrieved June 2012 from [http://www.outdoorindustry.org/pdf/OIA\\_OutdoorRecEconomyReport2012.pdf](http://www.outdoorindustry.org/pdf/OIA_OutdoorRecEconomyReport2012.pdf).

Piedmont Land Conservancy. (2006). *Dan River Watershed Protection Plan*. Piedmont Land Conservancy. North Carolina Clean Water Management Trust Fund.

Piedmont Triad Regional Council (PTRC). (December 2013). *Eden Area Watershed Assessment*. Prepared by Cy Stober, Water Resources Manager, PTRC, Kernersville, NC. Retrieved February 2014 from <http://www.ptrc.org/modules/showdocument.aspx?documentid=2876>.

Piedmont Together. (2013). "What Is Green Infrastructure?" Retrieved June 2013 from <http://piedmonttogether.org/sites/default/files/attachments/PublicForumHandoutGIJan12.pdf>.

The Roanoke Times. (December 12, 2011). "Uranium in Pittsylvania: Buried treasure or threat?" Laurence Hammack & Michael Sluss. Retrieved January 2012 from <http://hamptonroads.com/2011/12/uranium-pittsylvania-buried-treasure-or-threat>.

- Rockingham Community Local Food Coalition, Inc. (RCLFC). (2014.) "Rockingham Community Kitchen." Retrieved from [www.rockinghamkitchen.org](http://www.rockinghamkitchen.org).
- Rockingham County Planning Department et al. (September 2006). *A Land Use Plan for Managing Growth: Rockingham County, North Carolina*. (R. C. Department, R. C. Department, P. T. Governments, & D. L. Consulting, Eds.) Retrieved from Rockingham County:  
<http://www.co.rockingham.nc.us/pView.aspx?id=14918&catid=408>
- Smithsonian Institution Traveling Exhibition Service, Museum On Main Street. (2009). *Journey Stories Script*. Prepared by Ann C. Easterling. Retrieved September 2013 from  
[http://www.museumonmainstreet.org/exhibitors/journey\\_stories/JScript.pdf](http://www.museumonmainstreet.org/exhibitors/journey_stories/JScript.pdf).
- US Census Bureau, Population Estimates Division. (March 2013). "2012 Population Estimates, Piedmont Triad Region of NC." Retrieved January 10, 2013, from  
<http://www.ptrc.org/modules/showdocument.aspx?documentid=2147>.
- US Department of Agriculture (USDA), Forest Service (USFS). (2005.) *City of Charlotte, NC, Municipal Forest Resources Analysis*. USDA USFS Southwestern Station, Davis, CA. Retrieved February 2014 from [http://www.charlottetreefund.org/wp-content/uploads/2009/09/CLT\\_MFRA\\_2005.pdf](http://www.charlottetreefund.org/wp-content/uploads/2009/09/CLT_MFRA_2005.pdf)
- United States Department of Agriculture, Natural Resources Conservation Service (NRCS). (January 2013.) *National Planning Procedures Handbook (NPPH), Amendment 5*. (180-VI-NPPH, Amend. 5, p. 27, January 2013)
- United States Environmental Protection Agency (US EPA). (2014.) "An Introduction to the Water Elements of EPA's Strategic Plan." Retrieved January 2014 from  
[http://water.epa.gov/aboutow/goals\\_objectives/goals.cfm](http://water.epa.gov/aboutow/goals_objectives/goals.cfm).
- University of North Carolina, Environmental Finance Center (EFC). (January 2013). *Water and Wastewater Rates and Rate Structures in North Carolina*. Prepared by Shadi Eskaf, et al. Retrieved December 2014 from  
[http://www.efc.sog.unc.edu/sites/www.efc.sog.unc.edu/files/NCLM\\_EFC\\_AnnualW%26WWRatesReport-2013.pdf](http://www.efc.sog.unc.edu/sites/www.efc.sog.unc.edu/files/NCLM_EFC_AnnualW%26WWRatesReport-2013.pdf).
- University of North Carolina, EFC. (2014). "Publications – Publications, Tools, Presentations – Filter Results: North Carolina Water and Wastewater Rates Dashboard." Retrieved February 2014 from  
[http://www.efc.sog.unc.edu/reslib/filter/results?field\\_tags\\_tid=&field\\_lb\\_program\\_tid=All&field\\_lb\\_date\\_value%255Bvalue%255D%255Byear%255D=&field\\_lb\\_resource\\_type\\_tid=30](http://www.efc.sog.unc.edu/reslib/filter/results?field_tags_tid=&field_lb_program_tid=All&field_lb_date_value%255Bvalue%255D%255Byear%255D=&field_lb_resource_type_tid=30).

Virginia Department of Environmental Quality. (February 12, 2013). *Sediment TMDL Development Report for Benthic Impairments in Little Otter River, Johns Creek, Wells Creek, and Buffalo Creek, Bedford City, Bedford and Campbell Counties, Virginia*. Prepared by Virginia Tech Department of Biological Systems Engineering. Retrieved February 13, 2014, from <http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/drftmdls/littleotterbuffalo.pdf>.

WK Dickson. (2003). *Comprehensive Water and Wastewater Master Plan*. Raleigh: WK Dickson.

WK Dickson. (2007, February). *Eden Greenway Master Plan*. Eden, NC.



## APPENDIX A

### **Incentive programs that landowners have at their disposal include:**

Present Use Value (PUV) - Through this program the land is designated as agricultural or forest land and the taxes on the land are reduced to reflect that the property does not have the “value” that land in a subdivision may hold. To qualify for Present Use Value the landowner needs to have and follow a forestry plan or conservation plan. This program is voluntary, but if a landowner chooses to leave the PUV program back taxes for the previous three years have to be paid in full.

The NC Forest Service has a program aimed to aid in reforestation and active forest management:

Forest Development Program (FDP) – Property owners who have a forest management plan written by a consulting forester or NC Forest Service forester, are eligible for partial reimbursement for the cost of site preparation, seedling purchases, tree planting and the release of desirable seedlings by removing competing vegetation. These practices are aimed at increasing reforestation and providing a long term supply of timber.

[http://ncforestservice.gov/Managing\\_your\\_forest/fdp.htm](http://ncforestservice.gov/Managing_your_forest/fdp.htm) 1\_31\_14

The Wildlife Resources Commission has a program to help incentivize land management for wildlife.

Cooperative Upland habitat Restoration and Enhancement program (CURE) - Is a program developed by the North Carolina Wildlife Resources Commission (NCWRC) because wildlife that require early-successional habitats are among the most imperiled species in the United States, across the South, and within North Carolina. Bobwhite quail have become the “flagship species” among this group, but it also includes numerous declining songbirds, many species of mammals such as rabbits, pollinators such as butterflies, and many species of amphibians and reptiles.

#### Wildlife Conservation Lands Program

Similar to the Present Use Value program, but with an emphasis on ecological rather than agricultural value, this program is administered by the NC WRC. Lands must satisfy two criteria: the land must have more one or more protected species and the land is managed to support that species; and that the landowner must conserve at least one of the following NC WRC priority wildlife habitats:

- longleaf pine forest;

- early-successional habitat;
- small wetland community;
- stream and riparian zone;
- rock outcrop; or
- bat cave.

**NC Agriculture Cost Share Programs through the local Soil and Water Conservation District and the NRCS:**

Environmental Quality Incentives Program (EQIP) – EQIP offers financial and technical help to assist eligible participants in addressing resource concerns on eligible agricultural and forested land. Common concerns addressed by EQIP include livestock issues, soil quality and stabilization, forest health, and wildlife habitat quality.

Wildlife Habitat Incentive Program (WHIP) - Assists landowners who want to volunteer to develop and improve wildlife habitat on agricultural land and nonindustrial private forest land by providing up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP cost-share agreements between NRCS and the participant generally last from one year after the last conservation practice is implemented but not more than 10 years from the date the agreement is signed.

Community Conservation Assistance Program (CCAP) - Working to improve water quality for future generations by providing natural resource management through technical, educational, and financial assistance on urban, suburban, and rural lands for the benefit of all people. Approved community conservation BMPs that are eligible for CCAP include: Backyard rain gardens, cisterns, impervious surface conversion, riparian buffers, stream bank protection, pet waste receptacles, backyard wetlands, vegetation establishment and abandoned well closure.

Agricultural Resource Assistance Program (AgWrap) – Unlike the Ag Cost Share Program, AgWRAP will focus on the water quantity issues facing the NC agricultural producers. This practice will be continued to be offered for the aquaculture producers as a mechanism to eliminate discharges and recycle available water. AgWrap in 2013 will assist landowners with financial assistance (up to \$22,500) to cover the cost of construction and engineering services necessary for construction

of new pond construction and pond repair or retrofits. Funding is also being provided for sediment removal from ponds.

Conservation Reserve Enhancement Program (CREP) - is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pasture land. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. CREP encourages farmers to place environmentally sensitive land near streams or other approved water bodies into a vegetative cover for a period of time. In return, landowners receive annual payments and are reimbursed for establishing the conservation practices. Landowners choosing to enroll in a 30-year or permanent easement will also receive a one-time state incentive payment and may also be eligible to receive a tax incentive.

Conservation Stewardship Program (CSP) - Install new or help maintain existing conservation activities and systems. CSP participants will receive an annual land use payment for operation-level environmental benefits they produce. Under CSP, participants are paid for conservation performance: the higher the operational performance, the higher their payment. CSP is a voluntary conservation program that encourages producers to address resource concerns in a comprehensive manner by:

- Undertaking additional conservation activities; and
- Improving, maintaining, and managing existing conservation activities.

Emergency Watershed Protection (EWP) program – Through this program USDA’s NRCS can help communities address watershed impairments that pose imminent threats to lives and property. This program helps if your land has been damaged by floods, drought, windstorm or other natural occurrence. Through EWP 75-90% of the construction costs of the emergency measures that reduce threats to lives and property can be paid for by NRCS. The remaining 10-25% of the cost has to be made in cash or in-kind services from local sources.

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/> 8\_29\_13

USDA **Easements programs** are available to landowners who want to protect and enhance their lands to benefit agriculture and the environment. The enrollment authority for the Wetlands Reserve Program (WRP), Grassland Reserve Program (GRP), Farm and Ranch Lands Protection Program (FRPP) and the Healthy Forest Reserve Program (HFRP) expired on September 30, 2013. The new Farm Bill

passed by the House on January 29<sup>th</sup>, 2014 and headed to the Senate for a vote combines the Grassland Reserve Program and the Farm and Ranch Lands Protection Program into the Agricultural Lands Easement Program (ALEP). The USDA will continue to service prior-year enrollments in the programs listed below. In case NRCS is able to offer these programs in the future they are described below.

*The Wetlands Reserve Program (WRP)* - offers landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

*Farm and Ranch Lands Protection Program (FRPP)* - provides up to 50% in matching funds to acquire development rights to keep productive farmland in agricultural uses. Through this program the USDA works with an eligible entity with a proven record of acquiring and monitoring conservation and that have the ability to legally hold conservation easements

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/farmranch/> 8\_29\_13

*Grassland Reserve Program (GRP)* - through this program USDA will rent a 10-year, 15-year, or 20-year easement on the land which limits the use of that land to grazing operations, enhancement of plant and animal biodiversity or the protection of grassland under the threat of conversion. The annual financial benefit the landowner receives from this easement is up to 75 percent of the grazing value established by the Farm Service Agency. This program also authorizes compensation to a landowner for a permanent easement for the grazing land. Through this program landowners may also qualify for cost-share assistance up to 50 percent of the cost to re-establish grassland functions to the land that has been degraded or converted to other uses. This program was updated in the 2008 Farm Bill and may be subject to change from the 2013 Farm Bill.

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/> 8\_29\_13

*Healthy Forests Reserve Program (HFRP)* - assists landowners, on a voluntary basis, in restoring, enhancing and protecting forestland resources on private lands through easements, 30-year contracts and 10-year cost-share agreements.

## APPENDIX B: DETAILED GIS MODELING METHODOLOGY

### Data Development

All GIS analysis was conducted using ArcGIS Desktop 10.1. For consistency all spatial data was projected in North American Datum 1983, UTM Zone 17N to conform to MapShed Version 1.0 standards.

#### *Hydrography:*

The National Hydrography Dataset (NHD) was used to delineate subwatersheds within the study area. The data set includes a shapefile consisting of polygons representing the 16-digit hydrologic units and 12-digit hydrologic units. Using the 12-digit units would create five large subwatersheds each about 40 sq-miles. Conversely the 16-digit units produced many more watersheds than were feasible. To resolve this issue 24 subwatersheds were created by using the Merge Tool to combine multiple 16-digit units together. Watersheds were combined by merging areas based on land uses and stream/river junctions. Some merging was done using our experience to improve the modeling results and facilitate further analysis. The Dissolve Tool was then used on all subwatersheds to create a watershed boundary file for extracting and clipping data layers going forward.

Flowline and Waterbody feature classes from the National Hydrography Dataset Geodatabase were extracted and used to represent the location of streams and farm ponds for all modeling processes. Each feature class was converted to a shapefile and clipped to the extents of the watershed boundary.

#### *Soils and Land cover:*

Soils data from the SSURGO database was preprocessed for input into the BMP and MapShed models. Soil attributes including Hydrologic Soil Group, Hydric Classification, Available Water Capacity, and K-factor are joined to the soils data table using the NRCS Soil Data Viewer. Since the study area spanned over a three county area the soils shapefiles were first combined using the Merge Tool and then clipped using the watershed boundary resulting in a single shapefile. The file was then further simplified by using the Dissolve Tool to combine adjacent polygons with the same Hydrologic Soil Group, Available Water Capacity and K-factor. The resulting shapefile was used for input in further model routines.

The 2006 National Land Cover Database (NLCD) was used in both the Mapshed and BMP models. First, the Extract by Mask Tool was used to select raster cells within the watershed boundary. Next, the image was reclassified to meet the MapShed model specifications. Cell values were reclassified according to figure 1. The re-classification

is necessary to conform with the Mapshed modeling data requirements. In most cases, land use descriptions in the original land cover match with the descriptions used in the model. However, some land uses had to be combined or altered based on the most similar land uses that are a part of Mapshed. A duplicate of the reclassified file was further processed for input into the BMP model. The Raster to Polygon Tool, using the simplify polygons option, was used to generate a shapefile. This results in a series of polygons that represent the eleven land cover categories throughout the watershed.

Original NLCD Value	MapShed Classification	Reclassified Value
11	Water	1
81	Hay/Pasture	4
82	Cropland	5
41, 42, 43	Forest	7
90, 95	Wetland	10
31	Disturbed	12
21	Turf/Golf	16
22	Low-Density Residential	17
23	Medium-Density Residential	18
24	High-Density Residential	19
31, 51	Open Land	21

Fig.1

*Nutrient inputs:*

The MapShed model allows users to define areas where animals are concentrated to account for excess nutrient loading. The 2007 US Census of Agriculture was used to identify the number of cattle present in each of the three counties which comprise the watershed. The land area of each county was then used to generate a density of cattle per

acre for each county. Resulting in an estimate of the number of cattle within our watershed. The NLCD 'Hay/Pasture' land cover shapefile was used to identify where cattle are likely to be. Polygons less than ten acres were eliminated resulting in two hundred and seventy polygons. The area of each polygon was then multiplied by the calculated cattle density for its respective county and rounded to the nearest whole number. The Feature to Point tool was used to generate a point within each polygon. This results two hundred and seventy points each having an associated value representing the number of cattle. The resulting data table was further formatted with additional attributes to meet the input requirements of the MapShed model. For this analysis it was assumed that cattle could be present on lands that have a 'Hay/Pasture' designation in the NLCD. However, Rockingham County Cooperative Extension verified that many farmers in the watershed concentrate cattle and import hay from other farms. For this reason ten acre tracts were eliminated to increase the concentration on medium to large farm tracts.

### **BMP Site Identification**

#### *Wetland Restoration Sites:*

To identify potential wetland restoration areas it was determined that suitable sites should be in undeveloped or deforested areas greater than ten acres that have hydric soils. To locate areas with these attributes the preprocessed land cover and soils shapefiles were used. The reclassified land cover values of 4, 5, 10, 12, and 21 were selected to represent suitable land covers. This represented land uses of Wetland, Pasture, Row-Crop, Shrub land, and Barren land. The Dissolve Tool was then used to create one multipart polygon. After querying the soils shape file, a new file containing hydric soils was created and used to clip the new land cover file. The Multipart to Singlepart Tool was then used to create over 1,000 separate features. Areas for each polygon were then calculated and any polygons less than ten acres were discarded. This resulted in sixty polygons which meet the pre-determined criteria. The number and area of identified sites were finally totaled for each subwatershed for use in final modeling, reporting, and cost estimating.

#### *Validation:*

To validate our findings, the resulting wetland polygons were cross-referenced with the National Land Cover Database and GPS points collected during the field assessment. Investigators identified eleven wetland restoration sites, of these seven were deemed feasible. The above modeling procedure identified four of these seven wetlands. Visual investigation of aerial imagery suggests the three unidentified wetlands fall well below the ten acre threshold. The NLCD identifies twenty-one wetland areas with the watershed, of which eleven are larger than ten acres. The model identified five of these eleven sites. The unidentified sites were evaluated using aerial images. Five of the six

were found in forested areas. These sites would have been eliminated from consideration/identification using GIS. As a result, the wetland restoration site method was found to perform at a high accuracy level compared to field identification.

#### *Cattle Exclusion Fencing Sites:*

To identify locations where cattle could be excluded from streams the land cover data set was used again. It was assumed that cattle may be on any parcel with a land cover designation of Hay/Pasture. Polygons classified as 'Hay/Pasture' land cover were queried and a new layer created to represent areas cattle would be found. That file was then used to clip the NHD flow line shapefile. This resulted in a series of stream segments that intersect pastures. The length of each stream segment was then calculated and any length less than 100 feet was eliminated; resulting in 289 stream segments where cattle exclusion may be possible. The total length of potential fencing sites was totaled for each subwatershed. This information was used in the BMP modeling exercises. Totals and cost estimates for each subwatershed were estimated for reporting purposes.

#### *Riparian Buffer Planting Sites:*

To identify locations where riparian buffer could be restored or improved along stream corridors a workflow similar to the cattle exclusion analysis was used. Land cover polygons were queried to exclude the 'Forested' and 'Turf/Golf' land covers. The queried land cover file is then used to clip the NHD Flowlines shapefile; resulting in a series of stream segments. Many of these segments ran through inline farm ponds causing the results to be overestimated. To correct this issue the NHD Waterbody shapefile was used with the Erase Tool to eliminate those stream segments within ponds. The final result was 308 stream segments that may need riparian planting. Many of these segments were coincident with the cattle exclusion stream segments. Many riparian planting sites may be suitable for stream restoration work. Any sites that may receive a future field investigation for buffer work may also be evaluated for restoration work. The total length of sites identified were totaled and included in a cost estimate in the final report. It should be noted the 'Turf/Golf' land cover class was excluded to improve upon results from earlier trials. It was found that areas where a buffered stream, bordered on both sides by lawn, resulted in the buffer being underestimated and excessive stream segments being identified. By excluding this land cover from the analysis many potential sites with in urban areas were omitted.

#### *Validation:*

To evaluate how well the above method identifies where cattle exclusion and buffer enhancement opportunities the results were compared to field observations collected in a portion of the watershed. Investigators identified 74 GPS points along blue line streams

that were not in 'Forested' or 'Turf/Golf' land covers. These points were then cross-referenced with stream segments representing cattle exclusion and riparian buffer planting areas. Of the 74 points 48 were captured using the above method. The good correlation of remotely sensed sites to field findings helped verify the methodology used in this watershed.

#### *Stormwater BMP Sites:*

Stormwater BMP sites were identified using a manual/visual approach. This approach included a scan of urban areas using GIS and aerial photography. An overlay of streams helped identify general topography trends and aid in site identification. In general, potential stormwater sites were targeted for non-forested areas along natural drainageways. Sites were also located in proximity to large areas of impervious surface such as parking lots or buildings. At a reasonable zoom level, 95 stormwater BMP sites were identified. The sites are focused around the City of Eden area, but some are scattered around the outer limits of the City. In order to balance the effort of stormwater site identification, a reasonable zoom level was chosen that allowed for a good view of aerial photography. Additional smaller BMP sites could be identified in this watershed with a field level visit. The number of BMP sites identified in each subwatershed were totaled for reporting. As stormwater BMP implementation costs can be very field specific, a broad estimate of potential costs is provided.

#### **Other BMP Types**

##### *Agricultural Management and BMPs:*

The modeling analysis completed for the project indicated additional benefit to the implementation of Agricultural BMPs in this watershed. Potential BMPs include management practices for grazing animals and also BMPs targeted towards traditional crop systems. Practices that could be implemented in pastures such as rotational grazing, strategic location of feedlots, and other planning measures could provide added benefit to anyone cooperating with an exclusion fencing program. The Town Creek subwatershed, in particular, was identified as having a lot of more traditional farming areas. This area could benefit from many types of agricultural practices. These types of BMPs are challenging to target with a remote sensing approach used for this project. However, land use maps created as part of the project can be used to identify areas where traditional farming is most likely in place and where these types of practices may be pursued.

##### *Preservation Sites:*

Analysis shown in this report also indicates the importance of preserving sensitive forests in this watershed. The identification of specific sites for preservation was beyond the

grasp of this study. However, the most sensitive watersheds have been identified. In addition, the land use data prepared for the study can be used to identify older hardwood sites that may be at-risk for future logging.

#### *Farm Ponds:*

Farm pond protection is also an area of focus for this project. The Waterbody shapefile generated from the NHD data set was used to identify farm ponds within each subwatershed. Municipal ponds, lakes, and reservoirs were manually excluded. The area of each pond was calculated based on the NHD shapefiles. It should be noted that when compared to aerial imagery these polygons generally underestimate the extents of impoundments. It was not possible to determine whether individual farm ponds were at risk through the study. However, the data produced should be used to narrow any future field study or outreach efforts that might make site targeting more efficient.

#### *Logging Analysis:*

Visual inspection of aerial imagery identified logging as a substantial land disturbing activity. Since the visual effects of logging are short lived it is difficult to quantify using the available remote sensing datasets. A three pronged approach was used to identify and quantify logging activities within the watershed. It was discovered that the NLCD 'Shrub/Scrub' land cover type did well identifying areas that had been logged in recent years (young trees less the 5 meters tall). Comparing the land cover data set to multiple sets of aerial imagery on Google Earth it was determined that trees in these areas were harvested within the previous 5-10 years. Using the NLCD Land Cover Change from 2001 to 2006 areas that were previously forested were selected. These polygons represent areas that had trees in 2001 that no longer had trees in 2006. This same analysis was repeated using the NLCD 1992 to 2001 Retrofit Land Cover Change Product. To identify areas that had been logged since 2006 a manual analysis was done of the entire watershed. Using ESRI and Google Earth imagery tracts greater than 20 acres were identified by comparing the more recent imagery to the 2006 land cover file. Polygons outlining these tracts were manually drawn in Google Earth and imported into ArcMap for area calculations.

## MODELING REFERENCES

- Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PE&RS, Vol. 77(9):858-864. Accessed 09/17/2013.
- Fry, J.A., Coan, M.J., Homer, C.G., Meyer, D.K., and Wickham, J.D., 2009, Completion of the National Land Cover Database (NLCD) 1992–2001 Land Cover Change Retrofit product: U.S. Geological Survey Open-File Report 2008–1379, 18 p.
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for [Survey Area, State]. Available online at <http://soildatamart.nrcs.usda.gov> . Accessed 09/17/2013.
- Coordinated effort between the United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), the United States Geological Survey (USGS), and the Environmental Protection Agency (EPA). The Watershed Boundary Dataset (WBD) was created from a variety of sources from each state and aggregated into a standard national layer for use in strategic planning and accountability. Watershed Boundary Dataset for HUC# 03010103, NC/VA. Available URL: "<http://datagateway.nrcs.usda.gov>" Accessed 09/17/2013.
- United States Department of Agriculture National Agricultural Statistics Service (USDA-NASS) 2007 Census of Agriculture. [http://www.agcensus.usda.gov/Publications/2007/Full\\_Report/](http://www.agcensus.usda.gov/Publications/2007/Full_Report/). Rockingham County, NC, Henry County, Va, Pittsylvania County, Va. Accessed 11/5/2013.