Watershed Plan for Sediment in the South Saluda River

July 2020

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LIST OF ACRONYMS

ALUS - Aquatic Life Use Support
BMP - Best Management Practice
DOT - Department of Transportation
ECU - Easley Combined Utilities
EPA - Environmental Protection Agency
EQIP - Environmental Quality Incentives Program
GI - Green Infrastructure
HSG - Hydrologic Soil Groups
HUC - Hydrologic Unit Code
LID - Low Impact Development
MRLC - Multi-Resolution Land Consortium
MSL - Mean Sea Level
NCBI - North Carolina Biotic Index
NLCD - National Land Cover Database
NRCS - Natural Resources Conservation Service
NTU - Nephelometric Turbidity Unit
RC&D - Resource Conservation and Development
SC - South Carolina
SCAAS - South Carolina Adopt-A-Stream
SCDHEC - South Carolina Department of Health and Environmental Control
SCDNR - South Carolina Department of Natural Resources
SCFC - South Carolina Forestry Commission
SFI - Sustainable Forestry Initiative
SGCN - Species of Greatest Conservation Need
SOS - Save Our Saluda
SRCWF - Savannah River Clean Water Fund
SSR - South Saluda River
STEPL - Spreadsheet Tool for the Estimation of Pollutant Load"
SWAP - State Wildlife Action Plan
SWCD - Soil and Water Conservation District
TASC - Technical Advisory Stakeholder Committee
TMDL - Total Maximum Daily Load
USDA - United States Department of Agriculture
USGS - United States Geological Survey

USLE - Universal Soil Loss Equation
WBP - Watershed Based Plan

1. EXECUTIVE SUMMARY

This watershed-based plan (WBP, or Watershed Plan) was developed to address sediment runoff in the South Saluda River Watershed (the Watershed). The Watershed planning area encompasses the entire drainage area of the South Saluda River above its confluence with the North Saluda River. It includes the Middle Saluda River, the Upper Saluda River, the Oolenoy River, and the Lower Saluda River subwatershed areas. The Plan was developed by Save Our Saluda (SOS) in cooperation with partnering organizations and represents the second phase of watershed planning for the Upper Saluda Watershed above Saluda Lake. It lays the groundwork for implementation of practices and measures to reduce sediment runoff and help prevent future sediment runoff to the South Saluda River. Implementation of the Plan is voluntary and not tied to any regulatory requirement.

Saluda Lake and its contributing rivers in the Upper Saluda Watershed are vital water resources for local communities in the Upstate of South Carolina. Headwaters of both the North and South Saluda Rivers feed reservoirs which supply water to the greater Greenville area. Watershed areas above the two reservoirs are protected and provide some of the highest quality drinking water in the country. The Mountain Bridge Wilderness Area includes two state parks and is part of a network of protected lands in the Watershed. The Upper Saluda rivers support local business and industry, provide recreational opportunities to thousands of Upstate residents and visitors, and generally support a rich diversity of wildlife. Downstream near Greenville, Saluda Lake supplies water to the Easley area and its dam supplies hydropower.

Sediment is a significant problem for Saluda Lake. In 2011-2012, approximately 366,600 cubic yards of sediment were dredged from the lake at a cost of approximately seven million dollars to Easley Combined Utilities. Upper parts of Saluda Lake are rapidly filling in again. Projected future dredging costs are near ten million dollars.

Water quality in the lake and rivers upstream is impaired, aquatic habitat is degraded, and recreation is diminished due to sediment runoff in the South Saluda River Watershed. Cost effective and sustainable watershed-based solutions are needed for long-term erosion prevention and sediment control. Strategies recommended to minimize soil loss from the Watershed will help protect drinking water sources and downstream property, improve river and lake water quality, restore aquatic habitat conditions, and enhance recreational experiences for property owners and the public.

After previously prioritizing the North Saluda River for initial focus and developing the Watershed Plan for Sediment in the North Saluda River and Saluda Lake, project partners continued to work together through the Technical Advisory Stakeholder Committee (TASC) and provide support for the development of this Watershed Plan to address sediment in the remainder of the drainage area to Saluda Lake (i.e. the South Saluda River Watershed). The project was funded through the South Carolina Department of Health and Environmental Control (SCDHEC) Nonpoint Source Program with support from the partnership. Partners included multiple utilities, county stormwater programs, agricultural agencies, universities, and nonprofit groups whose representatives comprised the TASC to help oversee and guide the project. Additional focus meetings were held throughout the two planning projects with agricultural, urban, and forestry stakeholders to discuss practices, regulations, conservation measures, and landowner issues related to sediment runoff in both watershed planning areas. A workshop on cover crops and soil health was held in the South Saluda Watershed and an online survey was conducted to gather public input.

WATERSHED ASSESSMENT AND PLAN

The primary goal of this Watershed Plan is to reduce sediment loading to the South Saluda River. The Watershed planning area spans the Blue Ridge and Piedmont physiographic regions and encompasses approximately 171.1 square miles in Greenville and Pickens Counties.

Methods

The watershed assessment involved desktop and field surveys to gather land use and water quality data for the watershed planning area. A windshield survey was conducted, and recent aerial photos were evaluated to verify land use mapping and to identify sediment source areas. Modeling of the watershed area was done to estimate existing sediment loading using the Environmental Protection Agency's (EPA's) "Spreadsheet Tool for the Estimation of Pollutant Load" (STEPL). STEPL incorporates watershed characteristics such as soils, land use, rainfall data and number of agricultural animals. STEPL utilizes the Universal Soil Loss Equation (USLE) to estimate sediment load from surface runoff of different land use areas.

Best management practices (BMPs) and measures were identified and prioritized to address the greatest sources of sediment pollution. These include vegetative, structural, programmatic, and educational BMPs. Sediment load reduction from implementation of the selected BMPs/management measures was estimated using a number of assumptions, including level of participation and the effectiveness of the practice for reducing sediment loading.

Watershed Assessment Results

Land use data indicate that 88 percent of the South Saluda River Watershed planning area is forested land. Managed rural areas (pastures, crops and hay) make up 3.3 percent of the total area and 7.8 percent of land use is categorized as urban. Thirty-six percent of lands in the South Saluda River Watershed are protected either through ownership by the state, local government, or a local land trust, or through conservation easement agreements. As such, the Plan focuses on those areas of the Watershed in greatest need of restoration and protection.

Assessment of existing water quality data corroborates designated impairments in Adams Creek, the Oolenoy River, and Saluda Lake related to sediment. Since the watershed assessment area is largely forested and forests are a fairly stable land use, this indicates that the sediment runoff originates from a relatively small proportion of the watershed drainage area.

Sedimentation is ongoing in the upper parts of Saluda Lake. Data indicate that turbidity in the lake is increasing. STEPL model results indicate that 40% of the overall sediment load from surface runoff originates from the Oolenoy River subwatershed and that 57% of the overall sediment load is coming from croplands. STEPL only estimates sediment runoff from the land. It does not estimate gully, streambank, or in-stream erosion (remobilization of legacy sediment), which are significant in different parts of the Watershed.

Watershed modeling and field observations confirm that intensively managed crop areas in floodplains are large contributors of sediment loading to the river and lake downstream. Therefore, these land use areas are the focus for ongoing and future sediment control projects as part of the watershed protection plan described below. Other sediment source areas addressed in the Plan include livestock areas, urban areas (development sites and unpaved driveways), forestry sites, and eroding streambanks.

Watershed Plan

This Watershed Plan for Sediment in the South Saluda River identifies priority areas and strategies for watershed restoration and protection. BMPs identified for sediment control are listed below for priority areas.

Agricultural BMPs include:

- Cover crops
- Intercropping
- Residue and tillage management
- Vegetated filter strips
- Field borders
- Conservation Cover
- Culvert/ditch stabilization
- Farm road stabilization
- Vegetated waterways
- Sediment control basins
- Terracing and contouring
- Vegetated riparian buffers
- Streambank stabilization
- Stream improvement
- Critical area planting
- Wetland restoration/enhancement
- Livestock exclusion fencing/watering
- Loafing sheds
- Stream crossings
- Cross fencing
- Pasture planting
- Heavy use area stabilization
- Conservation plans

Programmatic measures for sediment control for existing and future urban source areas include:

- Land development regulations
- Riparian buffer protections
- Land conservation easement program
- Citizen training and reporting
- Education and outreach
- Watershed Manager

The Plan identifies technical and financial assistance needed for implementation and proposes solutions to help meet those needs. These include grants and programs such as 319 Nonpoint Source Pollution Grants and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP). Community outreach and education efforts were aimed at building community awareness of the

Plan and support for the protection and enhancement of land and water resources in the Upper Saluda Watershed. These included a workshop in the South Saluda River Watershed on soil health and cover crops with a rainfall simulator demonstration, an online survey for community feedback, and a field tour of the implementation project/demonstration site at a crop farm along the nearby North Saluda River near Marietta. Project fact sheets and website materials were developed, and an educational video is currently under development.

The following project partners provided technical support and guidance for the Watershed Plan:

Clemson Cooperative Extension
Easley Combined Utilities
Furman University
Greenville County
Greenville County Soil and Water Conservation District
Greenville Natural Resource Conservation Service
Greenville Water
Mountain Bridge Trout Unlimited
Naturaland Trust
Pickens County
Pickens County Soil and Water Conservation District
Oolenoy River Watershed Conservation District
Powdersville Water
Renewable Water Resources
Save Our Saluda
South Carolina Department of Health and Environmental Control
South Carolina Department of Natural Resources
South Carolina Rural Water Association
United States Environmental Protection Agency
Upstate Forever
Wood Environment & Infrastructure Solutions, Inc.

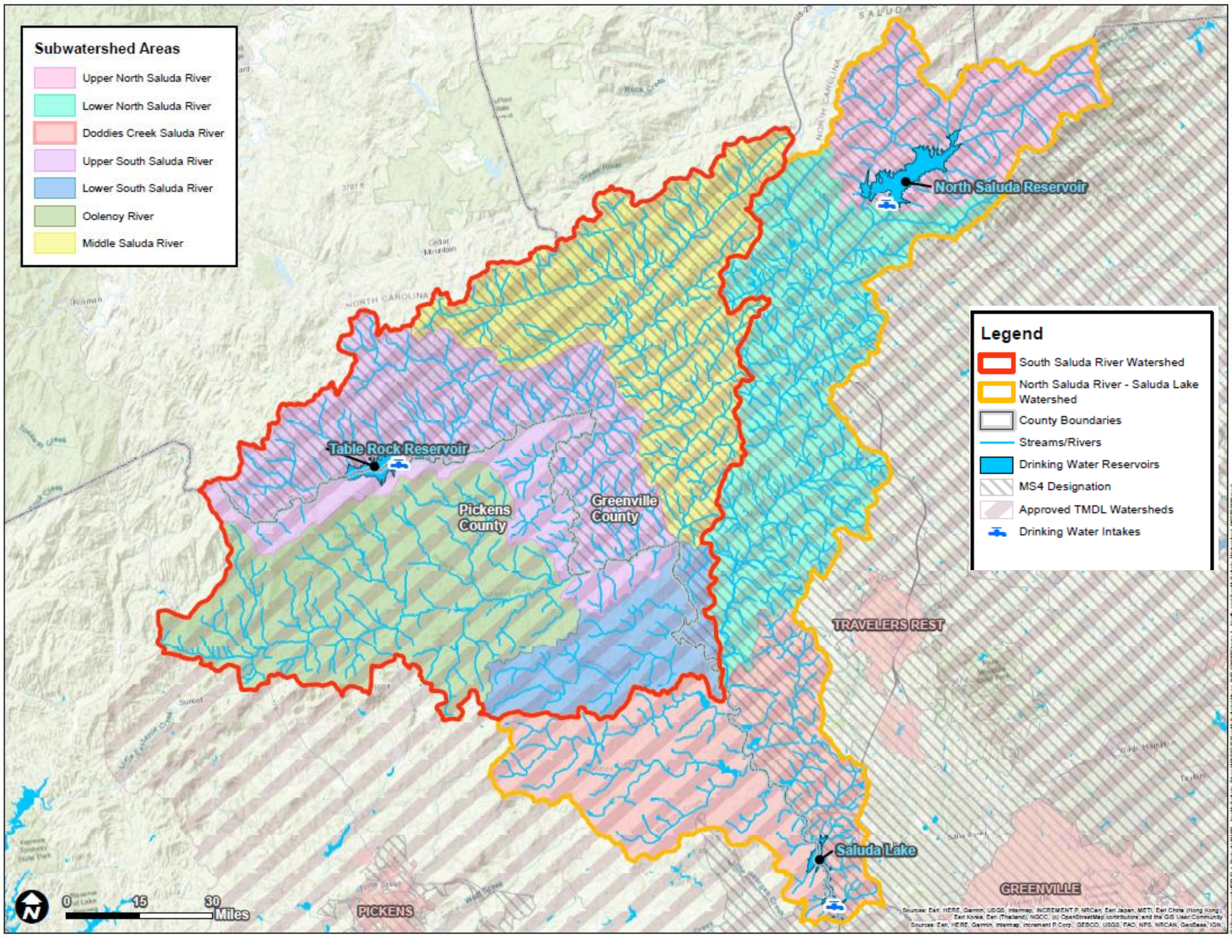
2. INTRODUCTION

The purpose of a watershed-based plan (WBP) is to identify and assess specific causes and sources of water quality impairments in a given watershed and develop a strategy to address impairments. The WBP presents a course of action for protection and improvement of water quality and provides an approach to manage and maintain or restore waterbodies to their designated use. Community stakeholders play a critical role in plan development, and the final plan reflects the community's goals for their watershed. The Technical Advisory Stakeholder Committee (TASC) was originally formed during the North Saluda-Saluda Lake Plan to provide support and technical guidance throughout the watershed planning process.

The ultimate goal of this cooperative planning effort for the South Saluda River WBP (the Watershed Plan) is to create a roadmap for implementation of best management practices (BMP) projects and other protective measures to help control and minimize sediment runoff to the South Saluda River. The TASC will continue to work together beyond this initial planning effort to obtain public support of the plan and facilitate its implementation, with assistance from Save Our Saluda (SOS). It is anticipated that implementation funding will be sought through grants, including 319 implementation funding, and support from local community businesses and partnering organizations.

The Upper Saluda Watershed above Saluda Lake originates from the South Saluda River near Table Rock, the Middle Saluda River near Caesars Head and Jones Gap, and the North Saluda River above the North Saluda Reservoir. The South Saluda River joins the North Saluda River to form the Saluda River, which flows into Saluda Lake. (Figure 1).

Figure 1. Upper Saluda Watershed



After previously developing the Watershed Plan for Sediment in the North Saluda River and Saluda Lake, the South Saluda River Watershed was prioritized next for watershed planning due to its contribution of sediment to the Saluda Lake (Photo 1). The watershed assessment area for this WBP encompasses 109,488 acres (171 mi^2) in Greenville and Pickens Counties in the South Saluda River Watershed. It includes drainage areas of the Middle Saluda River, Upper South Saluda River, Oolenoy River, and Lower South Saluda River (Figure 2). Saluda Lake and adjacent upstream drainage areas are not included in the current planning area but are covered in the North Saluda River and Saluda Lake Watershed Plan.

Photo 1. Confluence of the North and South Saluda Rivers facing downstream during stormflow

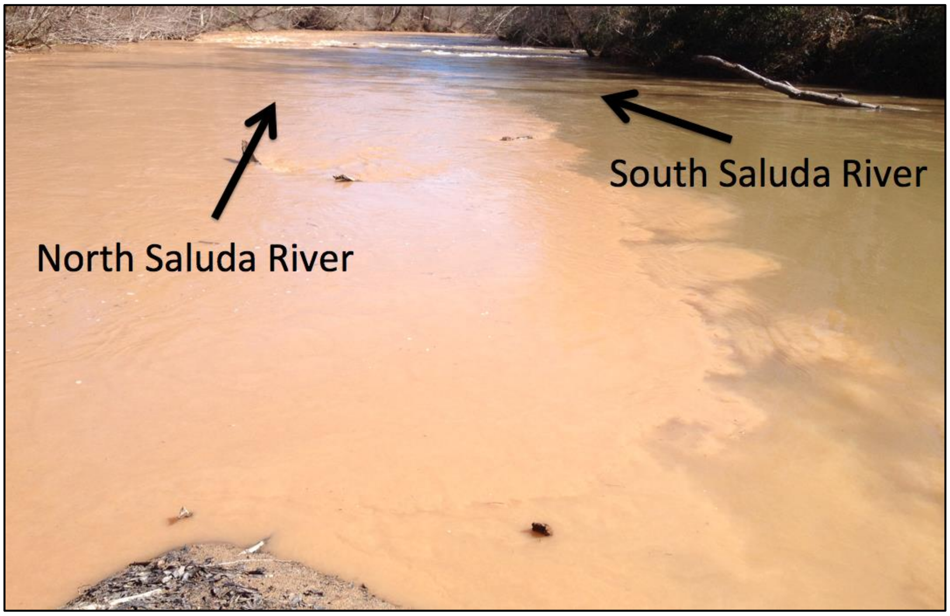


Photo 2. Confluence of the North and South Saluda Rivers facing upstream during dry weather

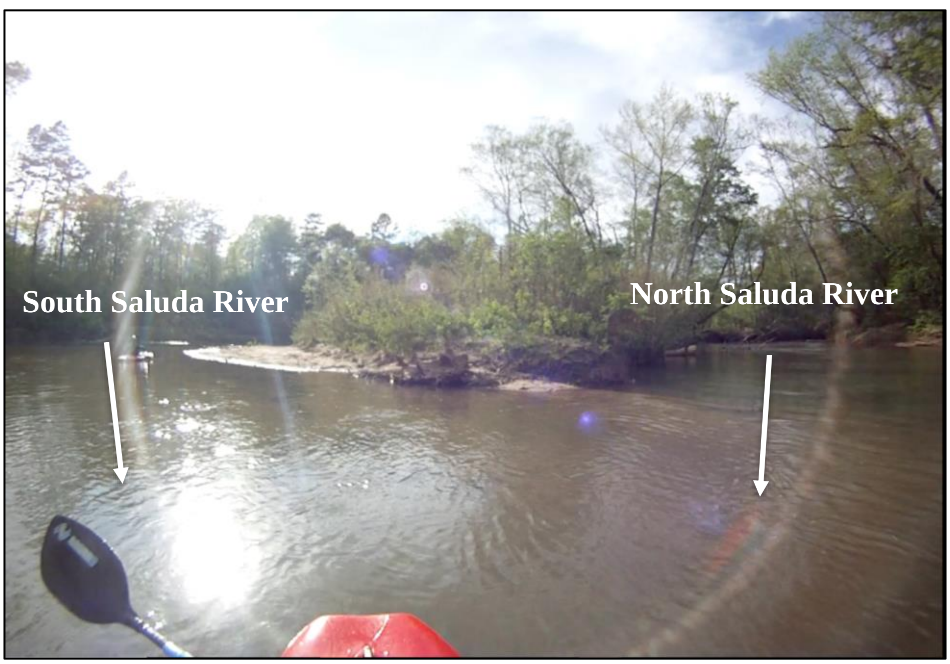
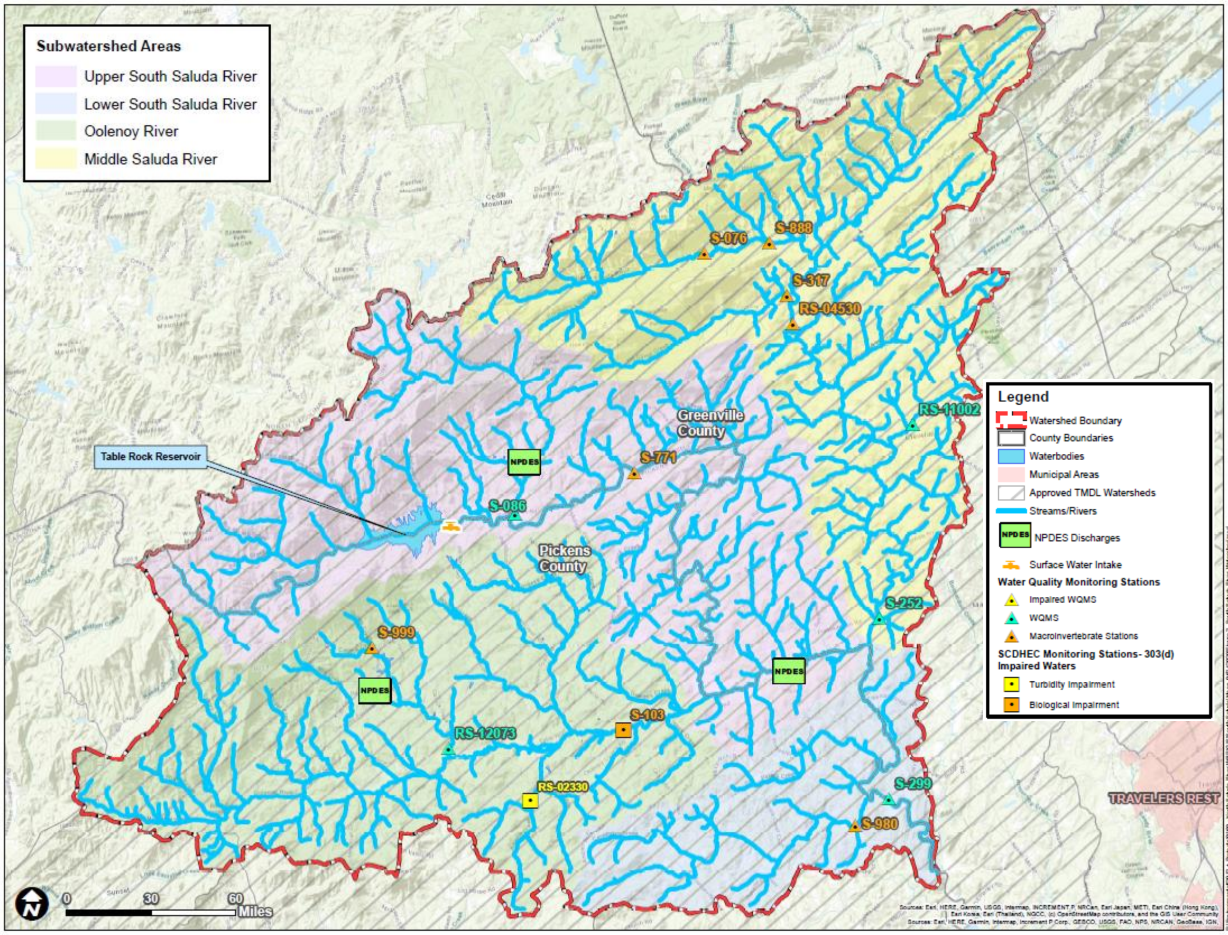


Figure 2. South Saluda River Watershed



2.1. Purpose and Need

The South Saluda River and its tributaries are important water resources for local communities in the Upstate of South Carolina. The South Saluda River is one of three primary drinking water sources for the greater Greenville area (Figure 2, Photo 3). Greenville Water supplies drinking water to approximately 500,000 customers, including local industries, institutions, and other retail and wholesale customers in Greenville, Pickens, and Anderson Counties. The river provides irrigation for farms, nurseries, and golf courses and assimilates domestic and industrial wastewater discharges.

Photo 3. Table Rock Reservoir

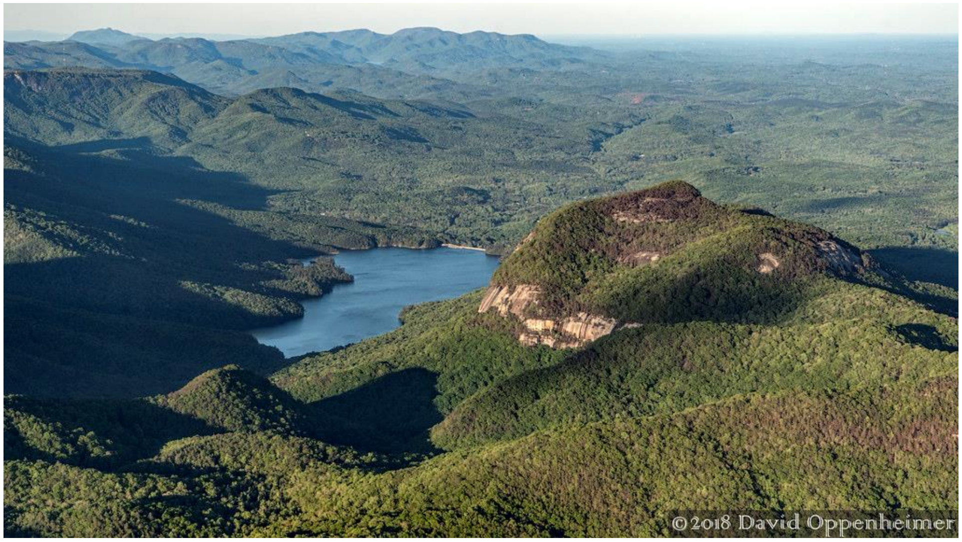


Photo credit: David Oppenheimer

Located approximately seven miles downstream of the North-South confluence, Saluda Lake is the primary source of water for the greater Easley area. Easley Combined Utilities (ECU) supplies drinking water to approximately 13,000 direct customers in Pickens and Greenville Counties and provides wholesale drinking water to four water districts, serving a total population of approximately 80,000 to 100,00 people in Pickens and Anderson Counties. The dam on the Saluda Lake generates hydropower (Photo 4).

Photo 4. Saluda Lake Dam (2017)

The South Saluda River provides numerous recreational opportunities, including fishing, boating, and swimming. Streams and rivers of the Upper Saluda Watershed generally support a rich diversity of aquatic life; one third of all freshwater fish species in South Carolina can be found here.

Sediment accumulation has been a concern for Saluda Lake for a number of years as upper parts of the lake became filled with sediment, reducing the lake's storage capacity and impacting recreational uses. In the early 1990s, the Pickens and Greenville Soil and Water Conservation Districts (SWCD), the Foothills Resource Conservation and Development (RC&D) Council, the Natural Resource Conservation Service (NRCS), and the South Carolina Department of Natural Resources (SCDNR) partnered to evaluate the lake and develop a plan for sediment removal. A tax district was formed to generate funds to support dredging operations, which began in 2002. The effort was marginally successful and resulted in the recognition of the need for more significant resources to remove the massive amount of accumulated sediment in the lake (see Appendix B of the Watershed Plan for Sediment in the North Saluda River and Saluda Lake).

Additional evaluations of Saluda Lake sedimentation were conducted by ECU and in 2011-2012, approximately 366,600 cubic yards of sediment were dredged from the upper lake at a cost of approximately seven million dollars (Photo 5).

Photo 5. Saluda Lake dredging operation, 2012

Comparison of a 2018 bathymetric survey of the lake to an as-built survey following the 2012 dredging indicated that approximately 66.5 percent of the lake volume regained from sediment removal was lost again to sediment deposition in only six years. The "Saluda Lake Sedimentation Analysis" can be found in Appendix C of the Watershed Plan for Sediment in the North Saluda and Saluda Lake. Dredging will be required on a regular basis to reclaim lost reservoir storage and restore recreational areas unless upstream controls are put in place. Dredging is very expensive and does not address upstream sources of sediment, water quality impairments, or loss of topsoil and land from the contributing watershed area.

Excess sediment levels are also a concern for the health of the streams and rivers that drain to Saluda Lake. Sediment can clog and damage sensitive fish gill tissues and can suffocate organisms that live on or in the bed of lakes and streams. Sediment impairs habitat where thick deposits of suspended material settle out of the water (EPA Victoria, 2012). High amounts of suspended sediment in the water column reduces the amount of light available for plant growth, decreasing the supply of food for other organisms. Sediment is also an effective carrier of other water quality pollutants.

Other pollutants such as bacteria and nutrients also contribute to water quality impairments in the river and lake. Since sediment is a carrier of other pollutants (e.g. phosphorus, bacteria, metals, pesticides), recommendations presented in this Watershed Plan to correct and remediate the sediment pollution can also be used to address other known and unknown water quality problems.

In addition, because parts of the watershed assessment and planning area are situated between the rapidly growing areas of Easley and Greenville, it is important not only to address current pollution levels, but also to prevent future pollution as growth and development continue to place additional stress on local water resources.

Cost effective and sustainable watershed-based solutions are needed for long-term erosion and sediment control to protect downstream uses. Strategies to minimize soil loss from South Saluda River Watershed will help protect drinking water supplies, safeguard property values, protect and restore river and lake water quality, enhance recreational values, preserve and improve soil health, and support and maintain healthy aquatic ecosystems. Protection and improvement of water quality in the South Saluda River and Saluda Lake will help sustain and improve the local economy and quality of life for these rapidly growing communities.

Photo 6. Blythe Shoals on the Upper South Saluda River

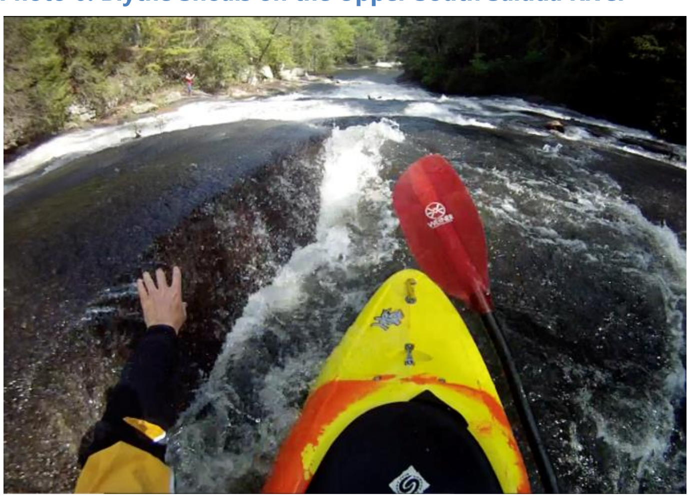


Photo credit: Ben Peters, Foothills Paddling Club

The following sections describe the Watershed Plan for Sediment in the South Saluda River.

2.2. Watershed Plan Development

The Watershed Plan for Sediment in the South Saluda River was developed using a collaborative approach. This approach aimed to actively involve local stakeholders with shared goals for watershed protection and restoration in selecting management strategies that may be implemented over time to solve water quality problems within the South Saluda River Watershed. SOS managed and administered the overall project and raised supplemental funding from the partnership to support the development of this Watershed Plan.

Cooperating organizations included:

- Clemson Cooperative Extension
- Easley Combined Utilities
- Furman University
- Greenville County
- Greenville County Soil and Water Conservation District
- Greenville Natural Resource Conservation Service
- Greenville Water
- Mountain Bridge Trout Unlimited
- Naturaland Trust
- Pickens County
- Pickens County Soil and Water Conservation District
- Oolenoy River Watershed Conservation District
- Powdersville Water
- Renewable Water Resources
- Save Our Saluda
- South Carolina Department of Health and Environmental Control
- South Carolina Department of Natural Resources
- South Carolina Rural Water Association
- Unites States Environmental Protection Agency
- Upstate Forever
- Wood Environment & Infrastructure Solutions

Representatives from these partnering organizations comprise the TASC. Over the span of fifteen months, the TASC met, participated in a field tour, and were given online updates and opportunities for input and feedback to help coordinate and steer project activities. In addition, two brainstorming sessions were held with these and other stakeholders. The first meeting was a focused discussion with agricultural partners on cover crops, conservation tillage, and equipment. The second meeting was a strategy session of stakeholders interested in protecting undeveloped land in the Watershed. A workshop on cover crops and soil health was held in the

South Saluda River Watershed to obtain feedback and generate interest in the 319 program from local landowners. A new online survey was conducted to reach community members to obtain their input on watershed issues. See Section 10 for additional details about the workshop and survey.

The following data and information were used along with information obtained during brainstorm sessions and TASC meetings to assess watershed conditions, water quality, and to develop and refine management strategies:

- Total Maximum Daily Load (TMDL) developed in 2004 for the Upper Saluda River Basin,
- SCDHEC surface water monitoring data and list of impaired waters,
- Greenville County MS4 stream monitoring data,
- Easley Combined Utilities lake monitoring data,
- SOS stream monitoring data,
- SCDNR fish data,
- Land use data,
- A windshield survey of the watershed assessment area, and
- Stakeholder knowledge of the watershed planning area.

This Watershed Plan incorporates this data and information and includes all SCDHEC's requirements for a Watershed Plan to protect and restore impaired waterbodies in the watershed planning area. This alignment with SCDHEC guidance is intended to enable current and/or future project partners to seek future SCDHEC funding to help implement the Plan.

2.3. How the Plan Will Be Used

Municipalities and local groups can use this plan as the foundation for local action for sediment control in the South Saluda River Watershed. Local, state and federal agencies can use this plan to enhance their understanding of watershed conditions and water quality impairments and to support coordination of monitoring, planning, permitting and regulatory decisions. Implementation of the Plan is voluntary and may be accomplished through financial incentives for landowners.

The following sections provide a detailed assessment of the Watershed, water quality impairments, and a watershed implementation plan for protection and restoration of the South Saluda River Watershed. Data and information on land use, water quality and water quality impairments, sources and causes of impairments, and pollutant loading are presented in the following sections. Plan goals, practices and measures to address pollutant loading, guidance for monitoring and evaluation, and information regarding technical and financial assistance are also detailed in the Plan.

3. Watershed Characteristics

3.1. Watershed Assessment Area

The Upper Saluda Watershed begins in the Blue Ridge Mountains at the North Carolina state line, descends into the Piedmont/Foothills region of South Carolina, and flows south to Saluda Lake near Easley and Greenville. The South Saluda River Watershed is situated within the Upper Saluda Watershed and is the focus area for this Plan (Figure 1). It includes portions of Greenville and Pickens Counties and is drained by the Oolenoy, South Saluda, and Middle Saluda Rivers. It encompasses approximately 171 square miles (443 km^2 or 109,488 acres), which is approximately 58% of the drainage area for Saluda Lake.

The watershed assessment and planning area includes two municipal drinking water sources. Table Rock Reservoir was constructed in the headwaters of the South Saluda River and began service in 1930 as a water source for the Greenville area. Saluda Lake was built on the Saluda River near Greenville in 1905 or the purpose of hydropower generation and later began to be used as a drinking water source for the Easley area in the 1970s.

The watershed plan area encompasses four 12-digit HUCs:

- The *Middle Saluda River* (030501090203) subwatershed includes drainage areas of the Middle Saluda River, Gap Creek, Oil Camp Creek, and Devils Fork Creek. The Middle Saluda River originates in Caesars Head State Park and receives drainage from Cold Spring Branch, Cox Camp Creek, Rock Branch, Buck Hollow Creek, and Head Foremost Creek before its confluence with Gap Creek. Gap Creek originates in the Saluda Mountains to the northeast and receives drainage from Cherry Branch, Peters Branch, Tankersley Branch, Bluff Branch, and Falls Creek before discharging to the Middle Saluda. Oil Camp Creek is the next major tributary flowing into the Middle Saluda, followed by Devils Fork Creek, Cox Creek, Mill Creek, Wolf Creek, and Sprout Spring Branch. The Middle Saluda flows into the South Saluda River north of Freeman Bridge Road. The subwatershed is mostly forested. Agricultural lands occur in lower watershed areas and along with some minor rural development.
- The *Upper South Saluda River* (030501090202) subwatershed includes the catchment area to Table Rock Reservoir and other drainage areas to the South Saluda River downstream to its confluence with the Oolenoy River. The headwaters of the South Saluda River above the reservoir include Laurel Creek and its tributaries (Big Spring Creek, Rock Laurel Branch, and Sunfish Creek). Slicking Creek (Little Table Rock Creek, Chestnut Cove) and Galloway Branch flow directly into the reservoir. Matthews Creek (Julian Creek) enters the South Saluda River below the reservoir followed by Wattacoo Creek (West Fork Wattacoo Creek, Robinson Branch), Tall Pines Lakes, Duck Creek, Marked Beech Creek, and Camp Marietta Creek. The Upper South Saluda subwatershed is mostly forested. Agricultural lands occur in lower subwatershed areas along with some minor rural development. There are two permitted discharges in the Upper South Saluda River, one minor domestic and one major industrial.

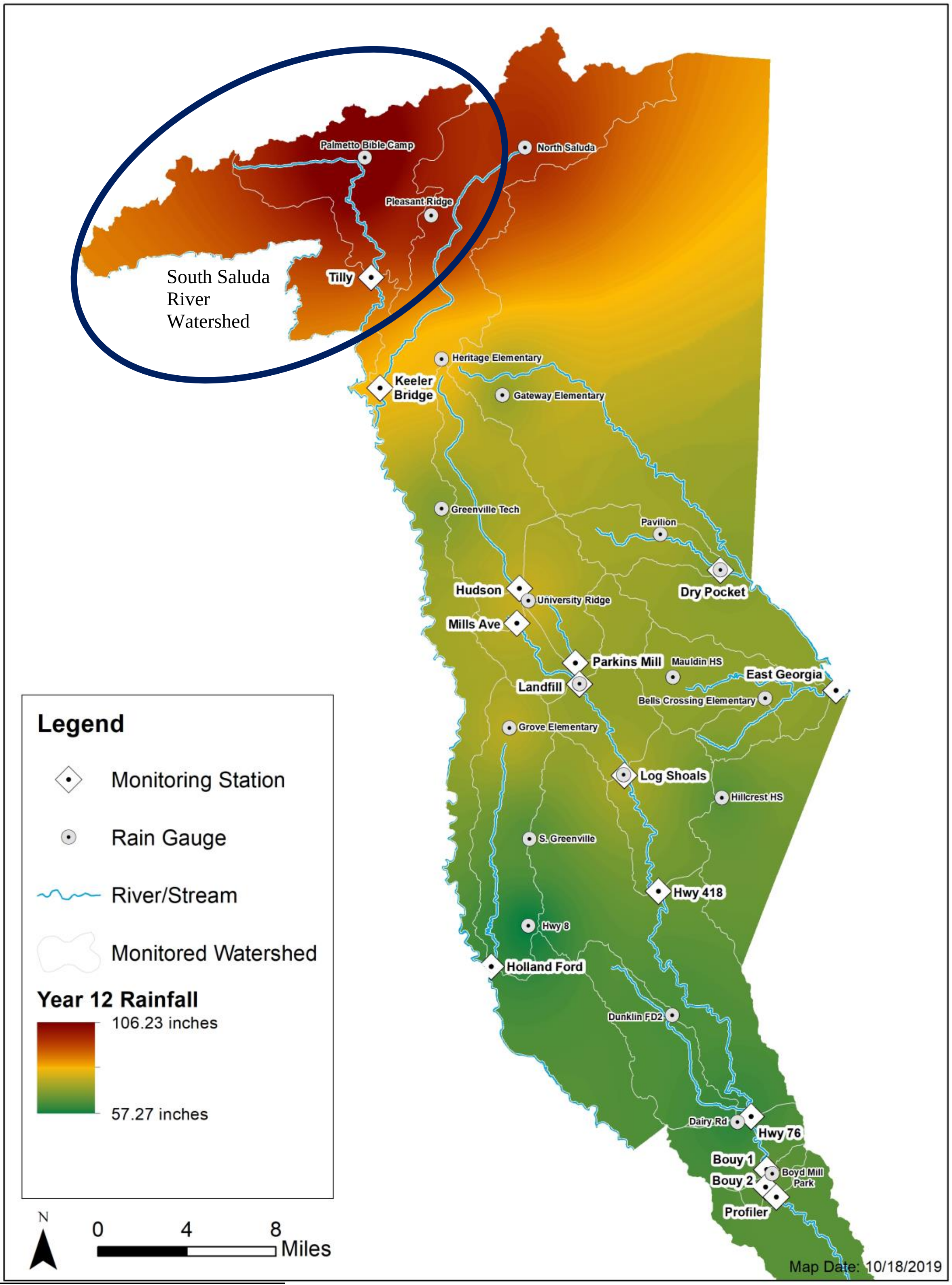
- The *Oolenoy River* (030501090201) subwatershed includes contributing drainage areas of Willis Creek, Emory Creek, Rachael Creek, Mill Creek, Carrick Creek (Green Creek, Pinnacle Lake, Oolenoy Lake), Adams Creek (Molly Branch), Weaver Creek (Burgess Creek, Cisson Creek), Hawk Creek, and Gowens Creek. This subwatershed is mostly forested with agricultural areas common in floodplains throughout lower reaches, and with some rural development throughout and a golf course development in headwater areas north of Hwy 11. There are water quality impairments for both turbidity and biological (macroinvertebrates) in the Oolenoy River subwatershed. The Oolenoy River flows into the South Saluda River east of Pumpkintown upstream of the confluence of the South and Middle Saluda Rivers. There is one permitted discharge (minor domestic) in the Oolenoy River.
- The *Lower South Saluda River* (030501090204) includes the drainage areas of Peters Creek and Carpenter Creek that meet the South Saluda River upstream of its confluence with the North Saluda River. Land use is largely forested with a mix of agricultural and rural development.

For the purposes of this Watershed Plan, these four subwatersheds are herein collectively referred to as the "South Saluda River Watershed," or simply the "Watershed." An online interactive map of the Watershed can be found on the Save Our Saluda website: www.saveoursaluda.org/webmap.

3.2. Climate

South Carolina is situated within the humid subtropical zone. Because the Watershed spans physiographic regions, there is some variability in climatic conditions. According to the SCDNR website, Pickens County has an average mean temperature of 59.7 °F and an annual average precipitation of 59.0 inches per year, as measured from 1951 to 2016 (http://www.dnr.sc.gov/climate/sco/ClimateData/countyData/county_pickens.php). Most of the Pickens County portion of the Watershed is in the Piedmont region which experiences slightly less rainfall compared to mountainous areas to the north. Greenville County has an average mean temperature of 60.5 °F and an annual average precipitation from 1893 to 2016 of 50.2 inches per year (http://www.dnr.sc.gov/climate/sco/ClimateData/countyData/county_greenville.php). Rainfall amounts can vary significantly, up to more than 20 inches per year between northern and southern areas of the County (Figure 3). Accordingly, rainfall also varies between upper and lower sections of the Watershed.

Figure 3. Interpolated rainfall totals in Greenville County for 2019[1]



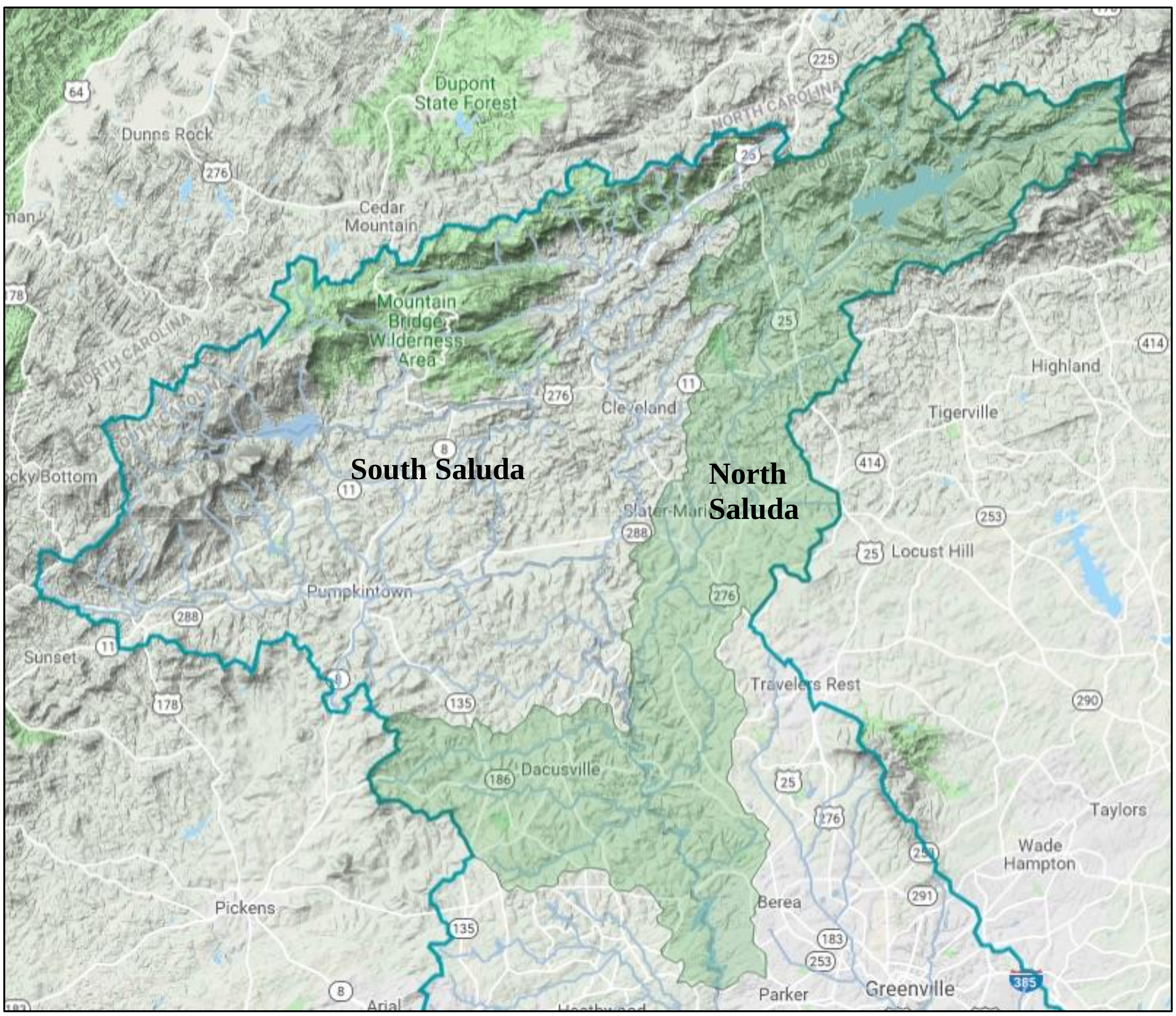
[1] Figure 3 was provided by Greenville County and was interpolated from rainfall totals for the Greenville County 2019 NPDES Permit Year 12 using inverse distance weighting.

3.3. Topography

Greenville and Pickens Counties lie within the Blue Ridge Mountain and Piedmont physiographic regions of South Carolina. These regions are characterized as mountainous and hilly. The highest elevation in the Watershed is over 3,400 feet above mean sea level (MSL) in the upper mountainous areas and the lowest is around 900 feet MSL in the lower reaches of the Watershed.

Figure 4 is a screenshot of the online interactive watershed map on the SOS website showing the terrain of the watershed planning area. Detailed topographic information can be obtained by visiting saveoursaluda.org/webmap and clicking on Watershed Plan Areas to turn on the data layer showing the South Saluda Watershed area. Users can then zoom in and pan to see detailed topography for specific areas.

Figure 4. Terrain map of the South and North Saluda Watersheds



3.4. Soils

Soils in very steep to moderately steep mountainous areas in the upper parts of the Watershed are generally well drained and loamy throughout. Soils in gently sloping to moderately steep Piedmont upland areas have loamy surface soils and clayey subsoils and are generally well drained. Soils in level floodplains are loamy throughout and are well to poorly drained.

Soil associations are shown on the general soil maps for Greenville and Pickens Counties (Figures 5 and 6). Soil series mapped in the area of focus within the Watershed (floodplain row crops) include Chewacla, Toccoa, Cartecay, and Wehadkee. These deep bottomland soils formed in alluvial sediments, range from well-drained to poorly drained, and are frequently flooded.

Figure 5. Map of soil associations in Greenville County

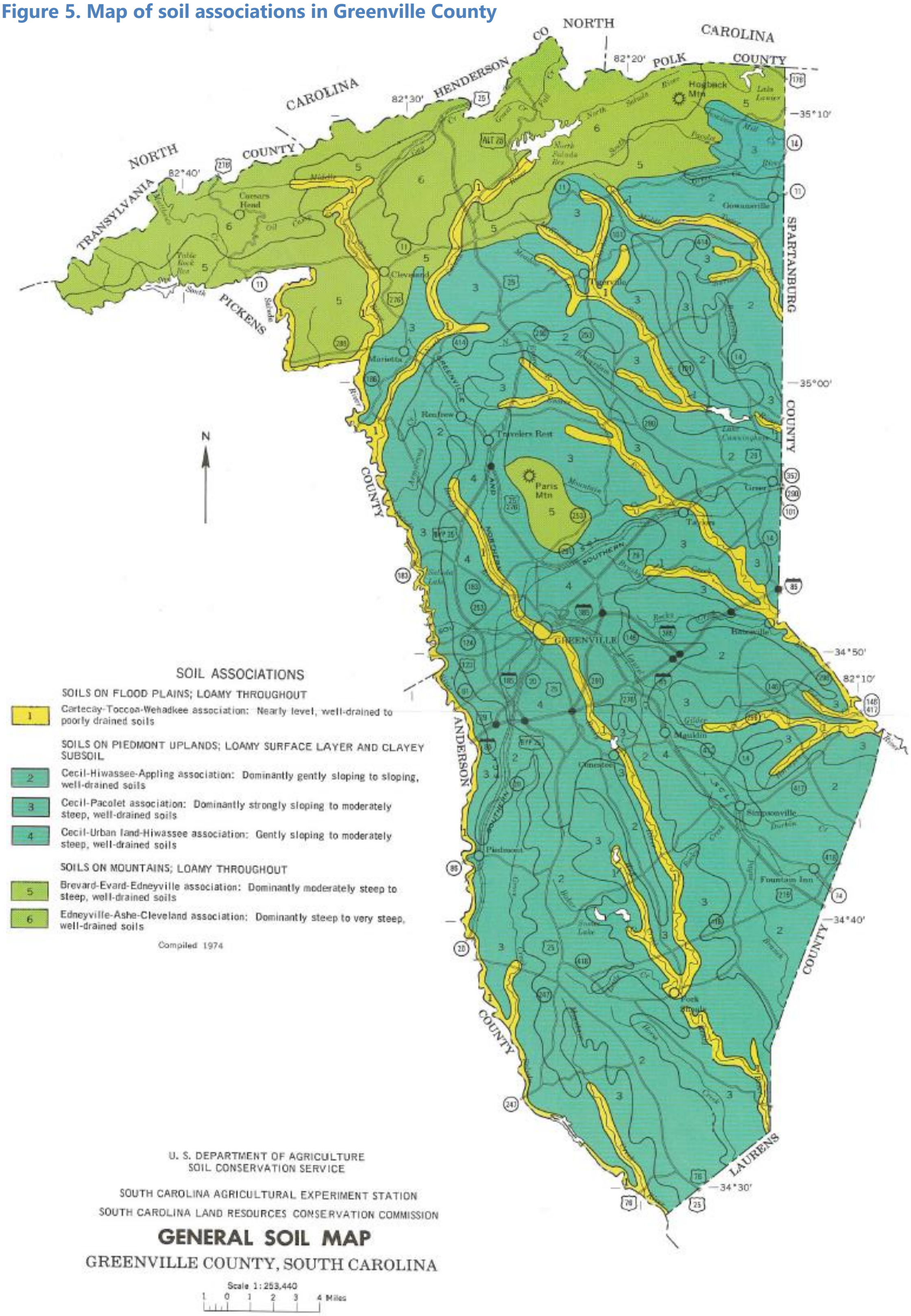
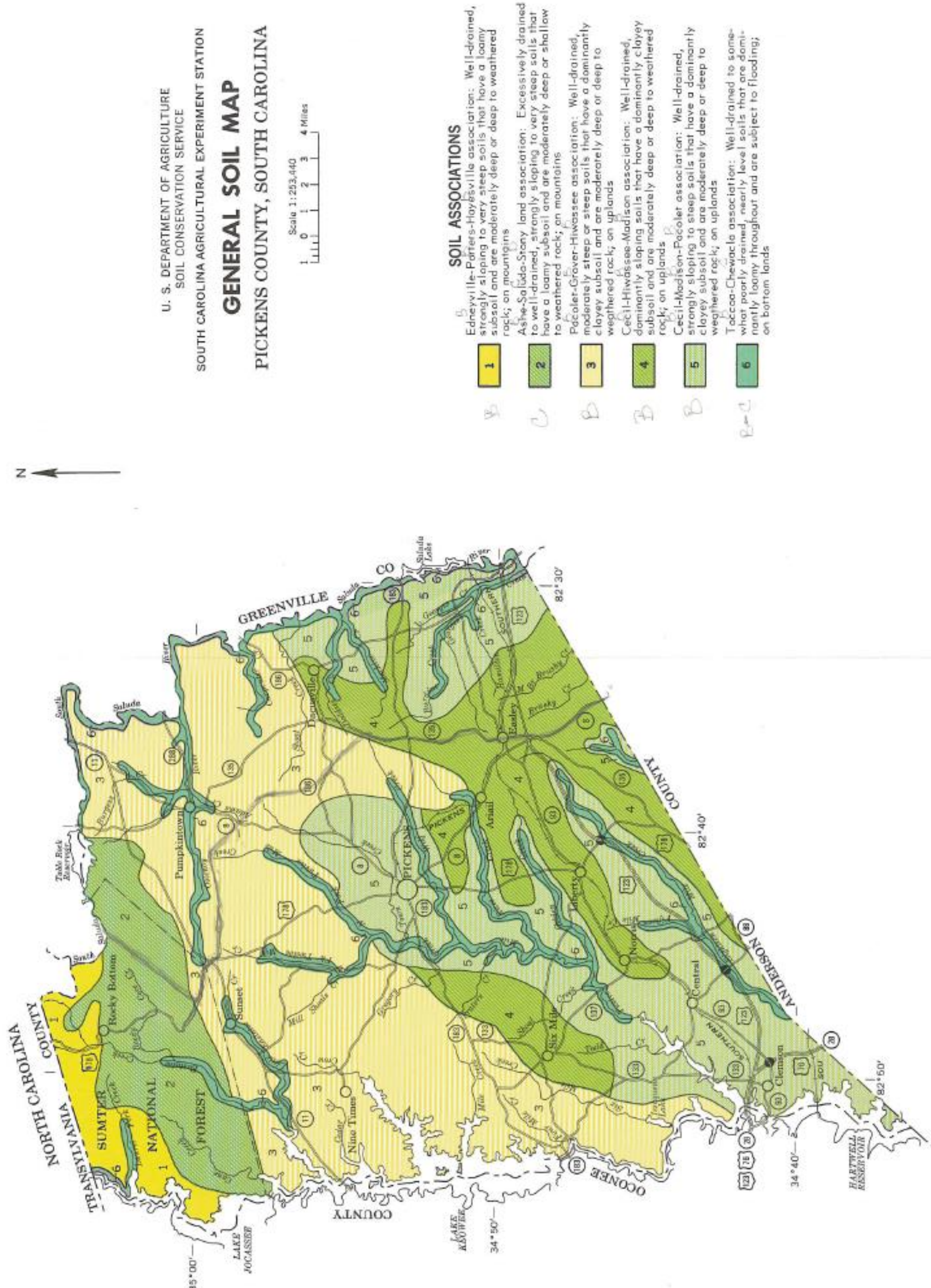


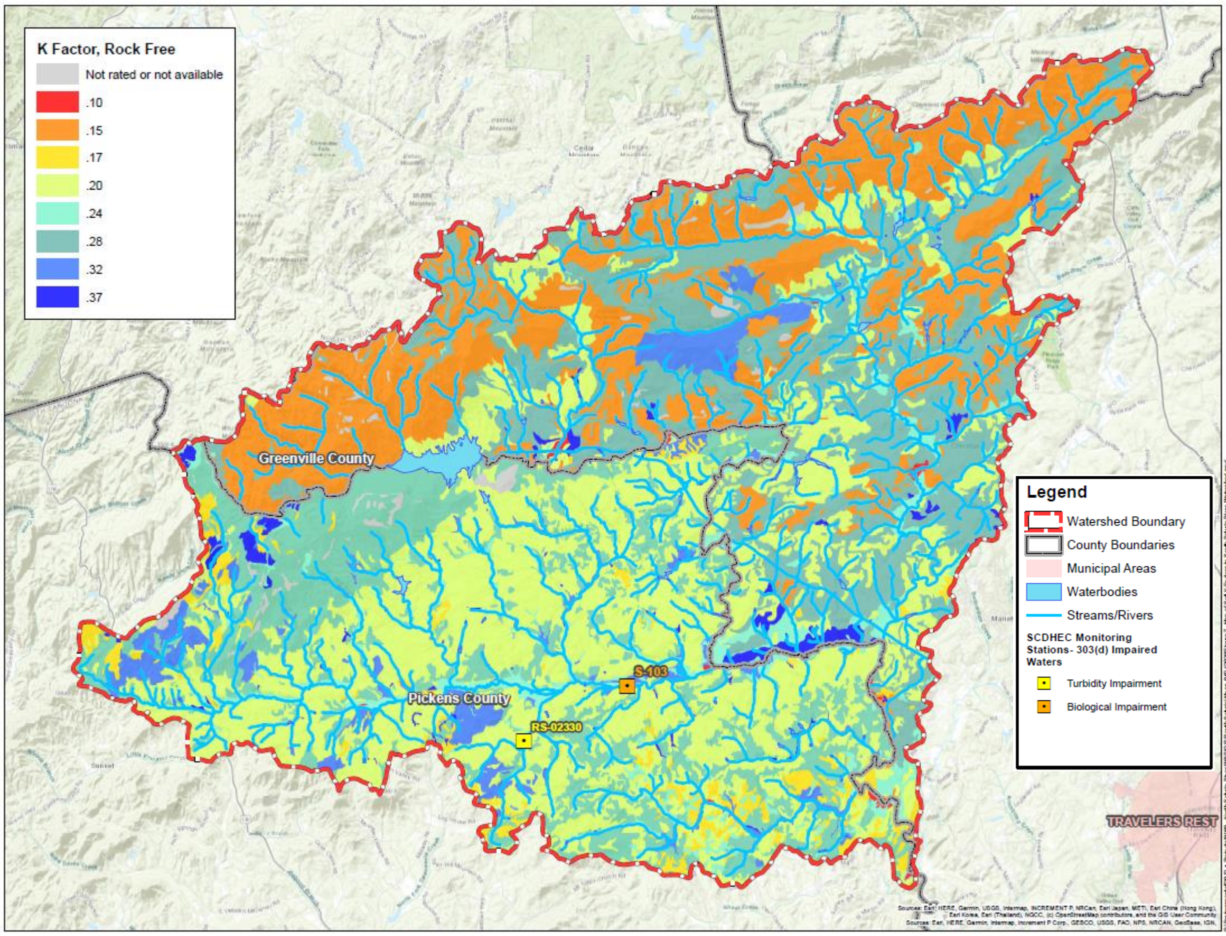
Figure 6. Map of soil associations in Pickens County



The remainder of this section discusses spatial soils data that was used for watershed modeling to estimate sediment runoff (Section 7).

Figure 7 shows the K Factors of soils in the South Saluda River Watershed. The K Factor is an index which quantifies the relative susceptibility of the soil to sheet and rill erosion. As shown, the soils located in headwater areas have higher K Factor soils (more susceptible to sheet and rill erosion) than soils in the lower subwatershed areas.

Figure 7. Map of Soil K-Factors in South Saluda River Watershed



Hydrologic Soil Groups (HSG) are designations developed by the NRCS which describe the conductivity of water through soil and are used to estimate runoff potential. HSGs are described in greater detail below, categorized in decreasing water transmission capacity from A to D:

Group A is sand, loamy sand or sandy loam types of soils. These soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 inches/hour).

Group B is silt loam or loam. These soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 inches/hour).

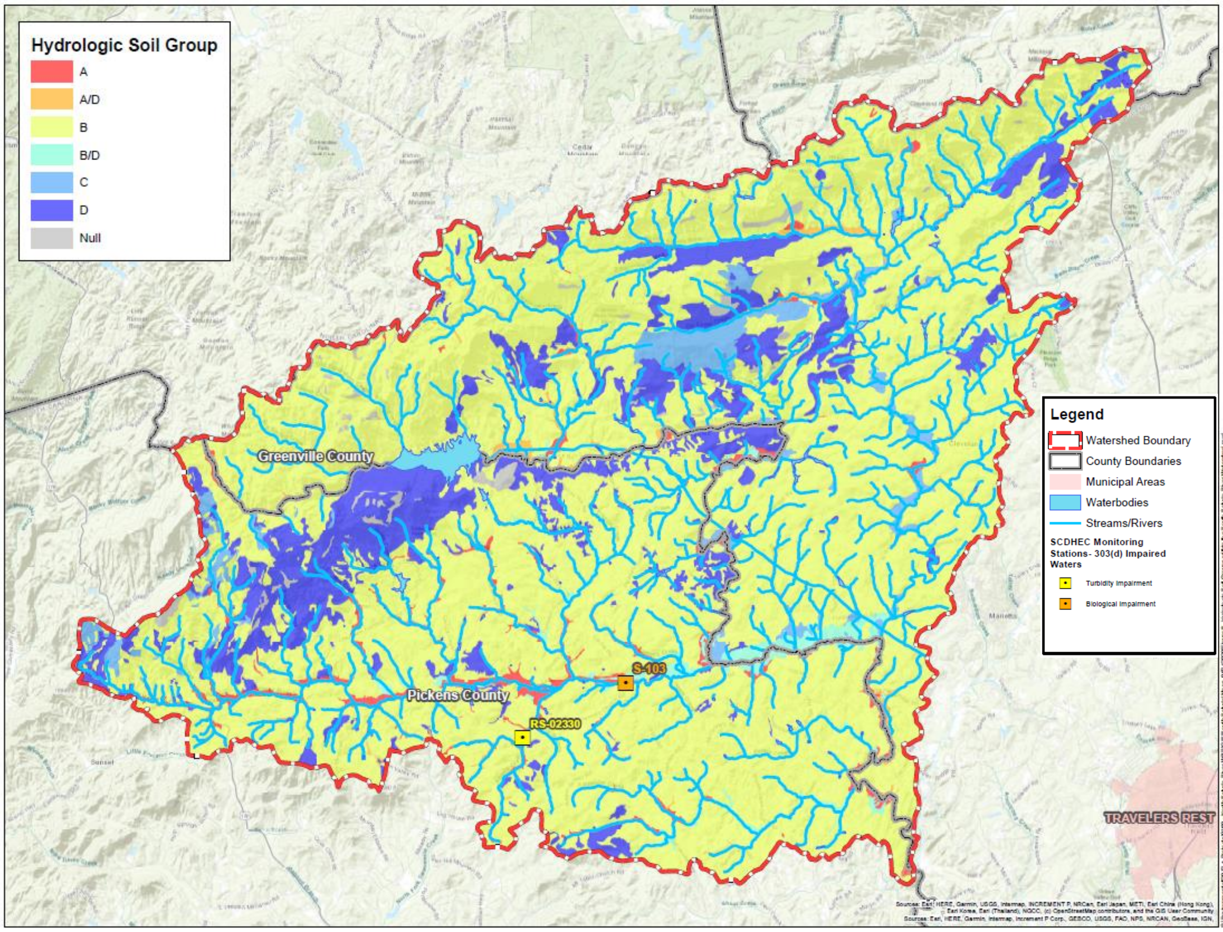
Group C is sandy clay loam. These soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission of (0.05-0.15 inches/hour).

Group D is clay loam, silty clay loam, sandy clay, silty clay or clay. These soils have the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 inches/hour).

While the slope of the soil surface is not considered when assigning HSGs, it can help estimate soil erodibility. Soil erodibility is an estimate of the ability of soils to resist erosion, based on the physical characteristics of each soil. Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to erosion. Sand, sandy loam and loam textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils. Therefore, HSGs can aid the decision process of narrowing down potential sources of pollution via increased sediment loads. Understanding the watershed's runoff potential will help narrow down areas that may have a higher potential for pollutant runoff.

HSGs in the South Saluda River Watershed are primarily HSG B soils. HSG A soils exist along much of the Oolenoy River floodplain, a high priority watershed area (Figure 8). Additional priority areas along streams and rivers are HSG B/D and C soils.

Figure 8. Hydrologic Soil Groups within the South Saluda River Watershed



3.5. Land Use

The following sections describe historic and existing land use/land cover in the Watershed.

3.5.1. Historic Land Use

Historic land use practices have had a long-term cumulative impact on sediment loading and sediment distribution patterns in the Watershed. Throughout the 1800s and early 1900s, the availability of inexpensive land and labor facilitated the widespread conversion of forestland throughout the southeast Piedmont for cultivation of row crops, primarily cotton and corn. Rapid land clearing and nonconservative agricultural practices combined with the cumulative effects of intense rainfall, steep slopes, and highly erosive soils resulted in significant topsoil loss and accelerated erosion and sedimentation across the region during this time. In the South Carolina Piedmont, erosive land use peaked around 1920. The average depth of total erosion from 1700 to 1970 was estimated between 7 and 12 inches for most areas in this region (Trimble, 2008). Over time, streams, rivers, and floodplains became choked with sediment. Formerly cultivated bottomlands became covered with thick deposits of unfertile erosional debris and sediment and were subject to increased frequency of flooding due to the decreased capacity of stream channels to convey floodwaters.

In 1931, over half of the formerly cultivated alluvial land in the southeast Piedmont region was covered by erosional material from a few inches to more than six feet (Bennett, 1931). Approximately 60 percent of South Carolina Piedmont bottomlands became unsuitable for cultivation due to the effects of accelerated sedimentation (Happ, 1945). Streams and rivers began cutting through unstable agricultural sediments deposited in channels and valleys.

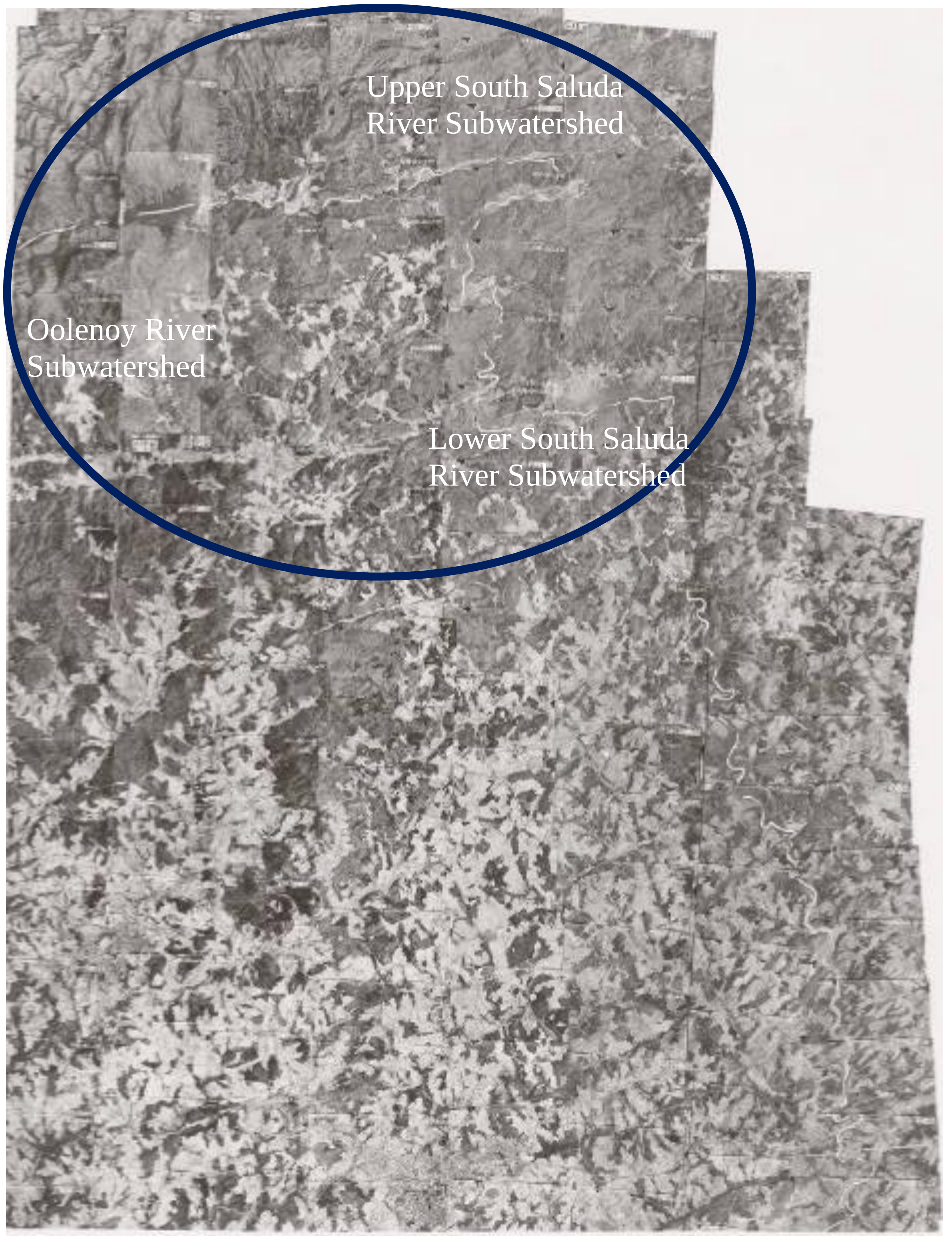
The Great Depression of the 1930s led to the creation of various federal jobs programs for soil conservation, flood control and drainage. Many streams and rivers throughout the southeast were straightened and channelized during this time and wetland areas were drained to reclaim flooded alluvial lands. In the decades that followed and with the decline of cotton, many row crop areas were converted to pasture or reverted back to forested land. Erosion and sediment delivery rates also began to decline (Trimble, 2008).

Historic aerial photographs of the South Saluda Watershed show that historic farming was more prevalent in south and southwest part of the watershed and was limited mainly to bottomlands and floodplains in more northern mountainous areas (Photos 7 and 8). In the decades that followed, many farmed areas in the Watershed reverted back to forested land.

A 1978 archeological survey in the Oolenoy Watershed revealed the following insight into early Watershed conditions:

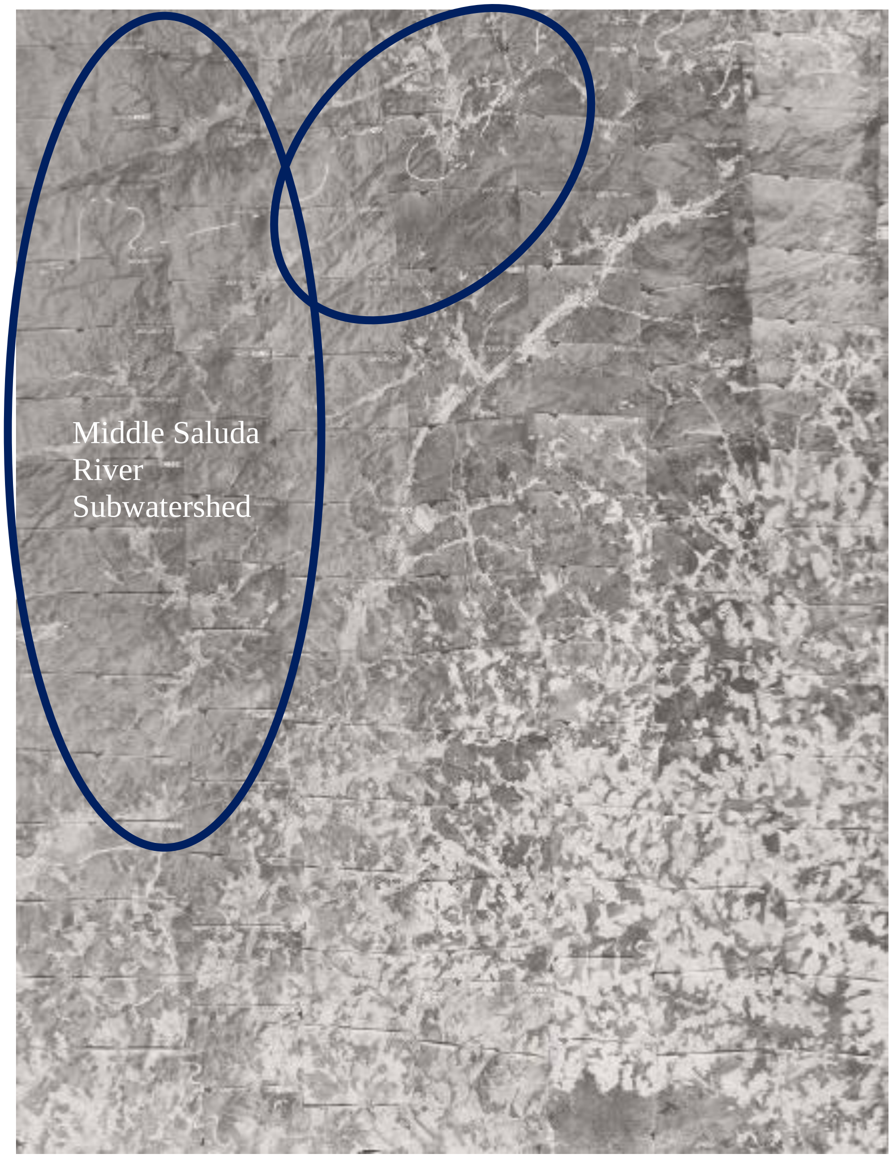
> *"Field investigations performed in March 1977 showed no sites to be present within the project area. This inability to find sites is probably explained as a result of site destruction by intensive farming and consequent erosion during the 19th and 20th centuries, and as a result of heavy sedimentation of the Carrick Creek bottomlands. Erosion on the slopes, combined with attempts at terrace farming in at least one area of the proposed project, probably destroyed evidence of archeological sites, if they were once present on the slopes and terraces forming the margins of the project area. Heavy erosion of the slopes blanketed the creek bottom lands with sediment and caused the creeks to aggrade, raising the water table. If sites once existed in the creek bottoms, they are now buried under several feet of sediment and lie below the present water table."* (Brockington, 1978)

Photo 7. Northeastern Pickens County - Portion of watershed area, 1943



Source: University of South Carolina Historic Aerial Photographic Collection

Photo 8. Greenville County portion of Watershed area, 1943



Source: University of South Carolina Historic Aerial Photographic Collection

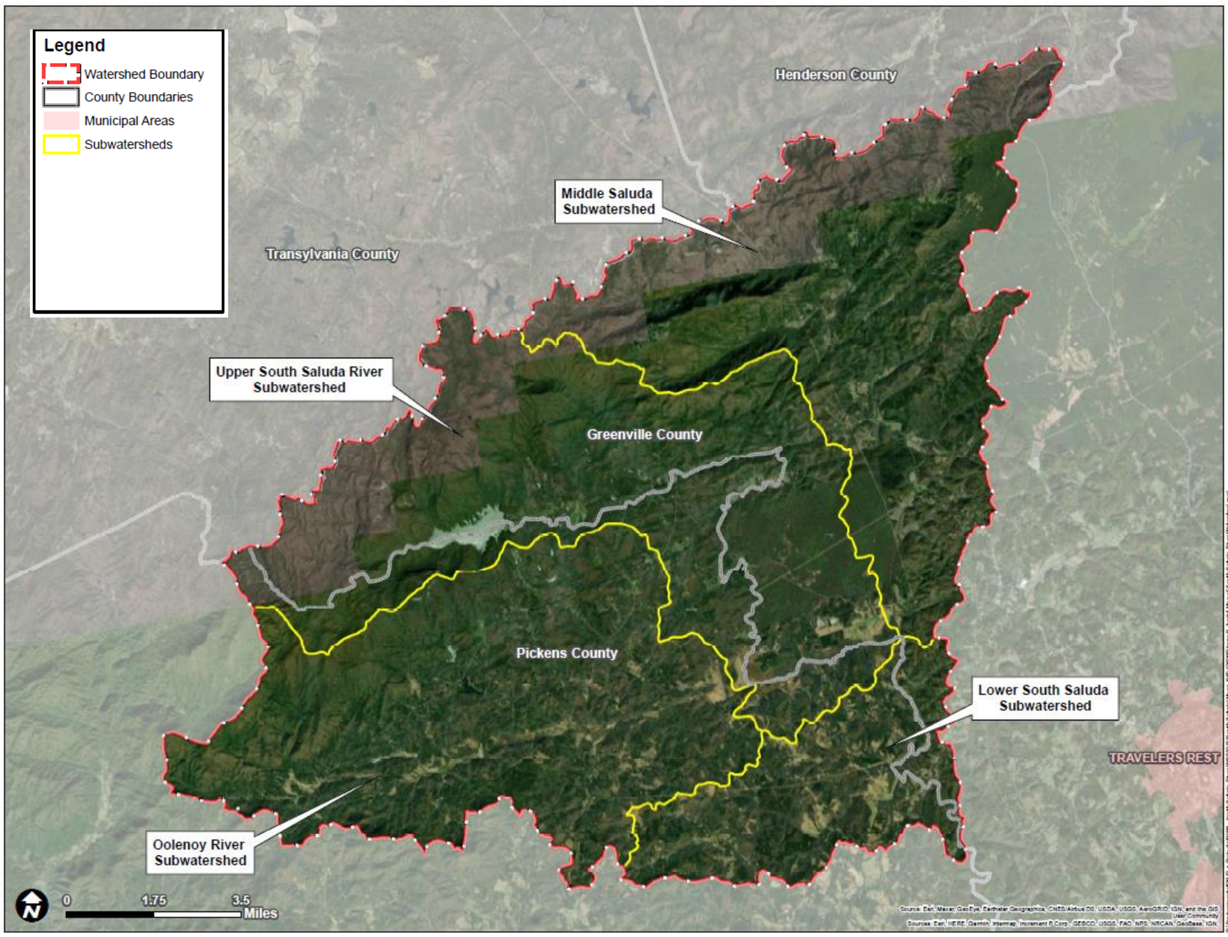
In addition to early land use practices, limited development of the Watershed has contributed to historic sediment loading due to increased stormwater runoff to the river and lake caused by increases in impervious and semi-pervious surfaces. This includes most notably construction of highways and roads, rural development, and a golf course in the headwaters of the Oolenoy subwatershed.

3.5.2. Existing Land Use

The watershed assessment involved desktop and field surveys to gather current land cover/land use data for the Watershed. The most current Multi-Resolution Land Consortium (MRLC) National

Land Cover Database (NLCD) land cover data (2016) was used as a baseline Geographic Information System (GIS) data layer to represent existing conditions. The 2016 data was revised using analysis of 2018 aerial photography (Figure 9) and information gathered from a windshield survey of the watershed in 2019. This data was compared to 1992 NLCD land cover data to determine land use change.

Figure 9. Aerial map of South Saluda River Watershed



Results of the desktop and field analysis indicate that approximately 88 percent of the watershed is forested, 8 percent is developed, 3 percent is agricultural, and 1 percent is water/wetlands (Figure 10). Priority agricultural land use acreages (cropland and pasture) are generally evenly distributed across the Oolenoy, Upper South Saluda, and Middle Saluda subwatersheds, with a smaller relative amount in the Lower South Saluda subwatershed (Figure 11).

Figure 10. South Saluda River Watershed land use

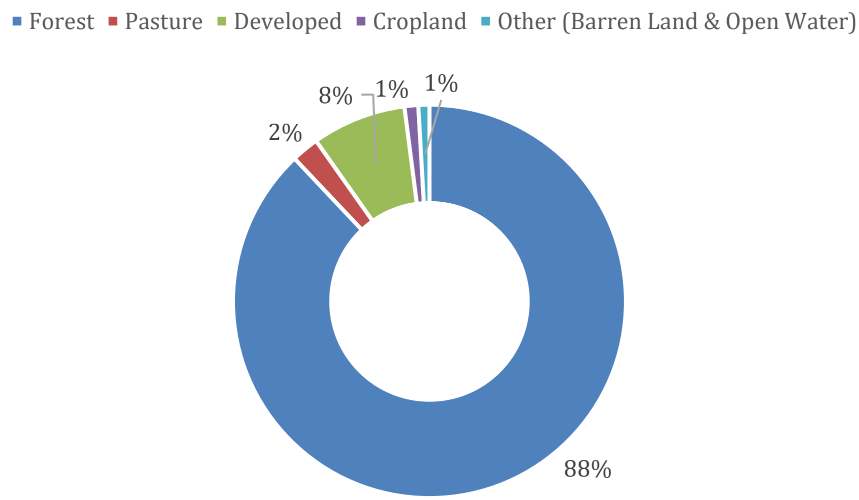


Figure 11. Crop land use by subwatershed in South Saluda River Watershed

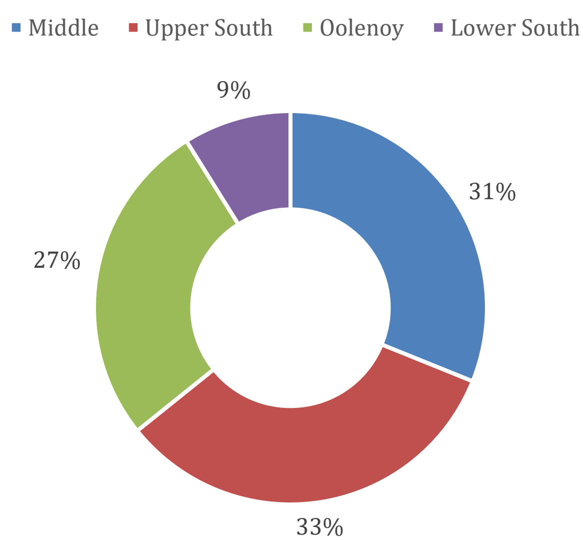
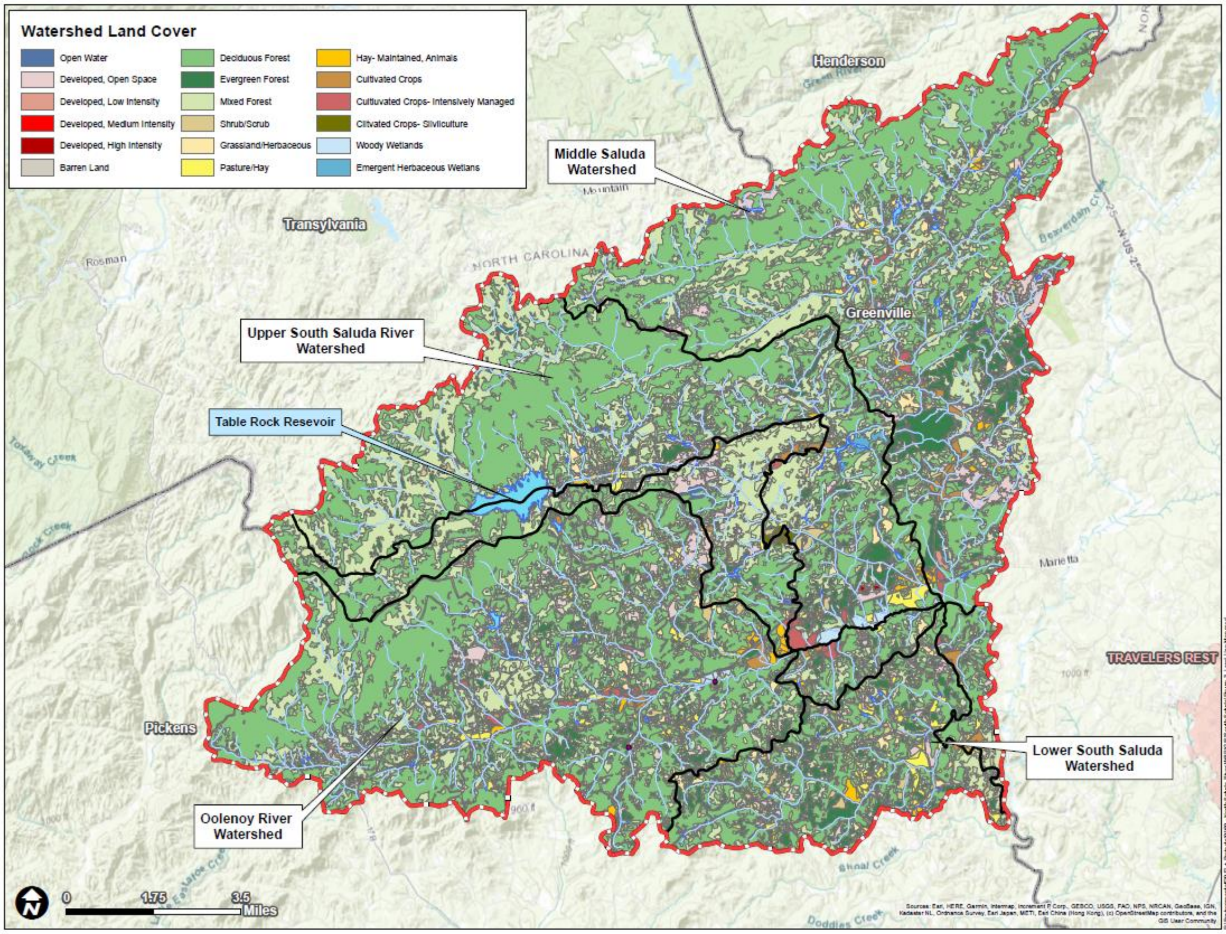


Figure 12 shows the distribution of refined land cover categories across the Watershed. Headwaters of the Oolenoy, Upper South Saluda, and Middle Saluda subwatersheds contain the highest amount of contiguous forest land, much of which is protected, as described below.

Figure 12. South Saluda River Watershed land cover



The remainder of the South Saluda River Watershed is also mostly forested land, with agricultural and low intensity or open space developed areas distributed throughout and with only a very small amount of high intensity development (e.g. the Sage/Milliken Plants on Pumpkintown Road (Figure 12). Crop farms are situated primarily in floodplain areas of the Oolenoy, Upper South Saluda and Middle Saluda River subwatersheds. A majority of hay and pastureland is distributed throughout the Oolenoy, Lower South and Upper South Saluda River subwatersheds.

There are three permitted discharges in the South Saluda Watershed:

- A minor domestic discharge in the Upper South Saluda subwatershed (a church camp) that discharges to Matthews Creek,
- A minor domestic discharge in the Oolenoy subwatershed (a state park) that discharges to Carrick Creek, and
- A major industrial discharge in the Upper Saluda subwatershed (a textile plant) that discharges to the South Saluda River).

Comparison of the 1992 and 2018 Watershed land cover data reveals the following trends (Table 1):

- The predominant land use (forest/shrubland/herbaceous) decreased by 7.3%, with a decrease of over 7,580 acres,
- Developed land increased by 1,650% from less than 1% to 7.8% percent of the Watershed with an increase of over 8,000 acres, and
- Agricultural areas (croplands and pastures) decreased approximately 17% from 4.1% to 3.4% of the Watershed, with a smaller decrease in pasture/hay (174 acres) and a larger decrease in cultivated crops (603 acres).

Table 1. Land cover distributions in the South Saluda River Watershed 1992 vs. 2018/2019

	1992 Land Cover Data		2018/2019 Desktop/ Field Analysis		Increase/ Decrease (Acres)
Land Cover Classification	**Area (Acres)**	**Percent of Watershed**	**Area (Acres)**	**Percent of Watershed**	
Forest/Shrubland/ Herbaceous	104,020	95%	96,440	88%	-7,580
Developed	486	0.4%	8,499	7.8%	+8,013
Cultivated Crops	1,845	1.7%	1,241	1.1%	-603
Pasture/ Hay	2,650	2.4%	2,477	2.3%	-174
Water/Other	642	0.6%	995	0.9%	+353
Total	**109,643**	**100%**	**109,652**	**100%**	

Land cover distributions by subwatershed are given below in Table 2 and illustrated in Figure 13. All four subwatershed areas have greater than 80% forest land cover and generally less than 10% developed land, with the exception of the Lower South Saluda, which is slightly more developed (11%). Agricultural land use/land cover is generally less than 5% across subwatersheds, with the exception of the Lower South Saluda, which is 8%. Cultivated crops, which are a priority land use for this Plan, are fairly evenly distributed across the Upper South Saluda, Middle Saluda, and Oolenoy subwatersheds.

Table 2. Land cover distributions by subwatershed the South Saluda River Watershed

	Middle Saluda		Upper South Saluda		Oolenoy		Lower South Saluda	
Land Cover Classification	**Area (Acres)**	**% of Watershed**	**Area (Acres)**	**% of Watershed**	**Area (Acres)**	**% of Watershed**	**Area (Acres)**	**% of Watershed**
Forest/ Shrubland/ Herbaceous	27,957	89%	31,789	90%	27,436	87.0%	9,258	81%
Developed	2,694	8.6%	1,761	5.0%	2,799	8.9%	1,245	10.9%
Cultivated Crops	386	1.2%	411	1.2%	3334	1.1%	110	1.0%
Pasture/ Hay	355	1.1%	566	1.6%	760	2.4%	797	6.9%
Water/Other	107	0.3%	634	1.8%	187	0.6%	66	0.6%
Total	**31,498**	**100%**	**35,162**	**100%**	**31,516**	**100%**	**11,476**	**100%**

Figure 13. Middle Saluda River subwatershed land use

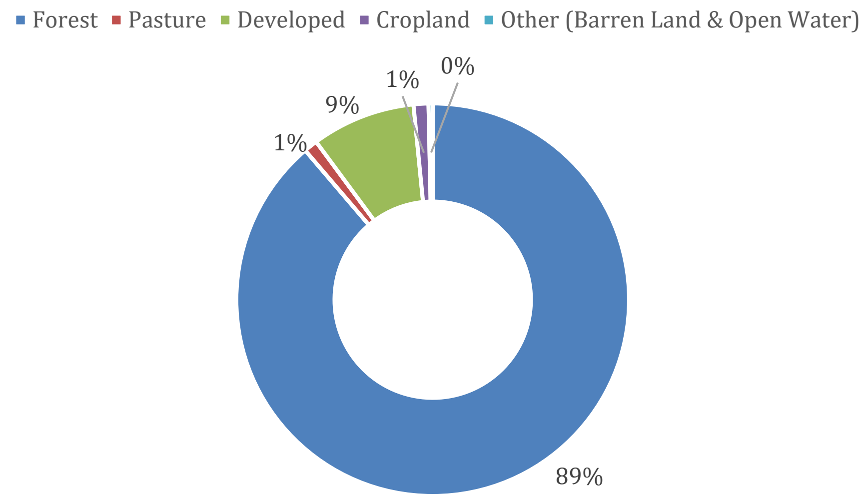


Figure 14. Upper South Saluda River subwatershed land use

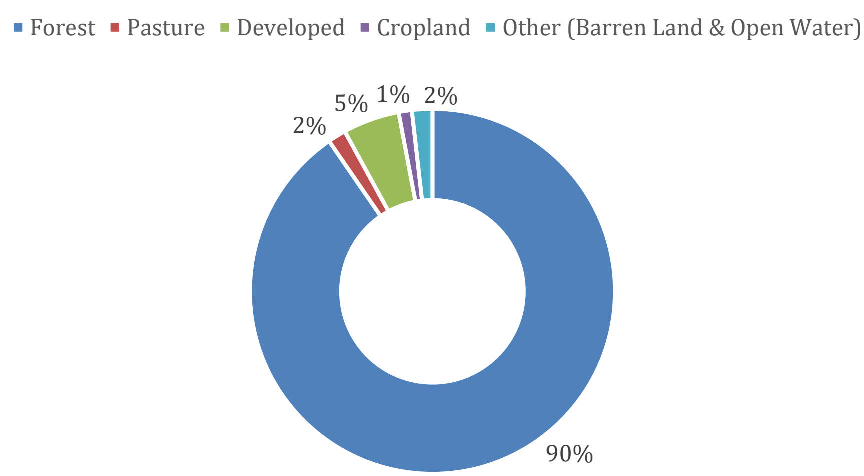


Figure 15. Lower South Saluda River subwatershed land use

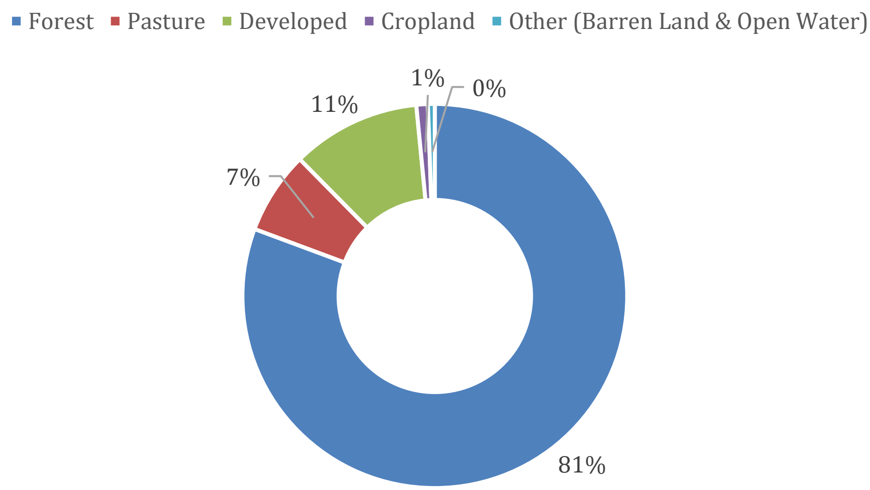


Figure 16. Oolenoy River subwatershed land use

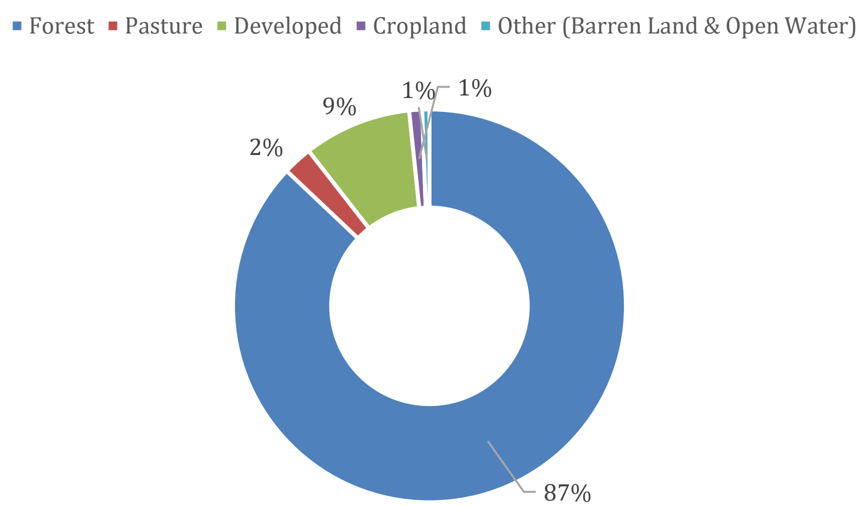


Figure 17 shows protected lands in the Upper Saluda Watershed. Approximately 36% of land in the South Saluda River Watershed (39,634 acres) and 23% of land in the North Saluda River – Saluda Lake Watershed (18,146 acres) is currently protected, for a total of 57,780 acres in the entire Upper Saluda Watershed.

Figure 17. Protected areas in the Upper Saluda River Watershed

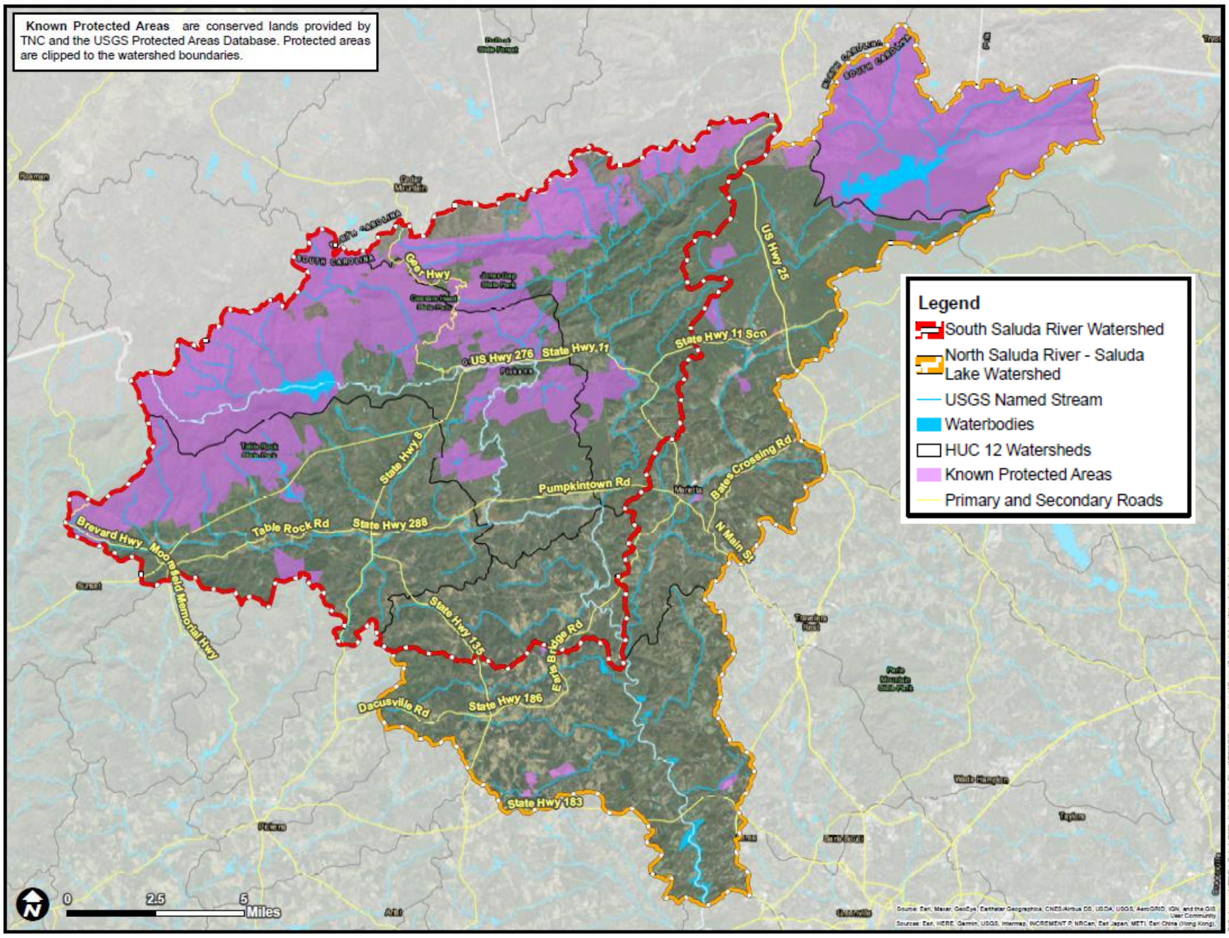


Table 3 shows the acreage and percent of each subwatershed protected. Note that more than 60% of the Upper South Saluda River subwatershed is already protected.

Table 3. Acres of known protected lands in the South Saluda River Watershed

Watershed Name	Watershed, acres	Protected Area, acres	% of Watershed Protected
Upper South Saluda River	35,174	21,578	61%
Middle Saluda River	31,509	10,100	32%
Oolenoy River	31,502	7,952	25%
Lower South Saluda River	11,480	4	0%
Total South Saluda River	**109,665**	**39,634**	**36%**

The Mountain Bridge Wilderness Area is a 14,000-acre area of pristine mountain forest that spans the northern reaches of the Watershed. It refers to the land connecting Table Rock Reservoir on the South Saluda to the Poinsett Reservoir on the North Saluda. Protection of much of these predominantly forested headwater areas is largely secured through ownership by the state, conservation/land trust organizations, and through conservation easement agreements.

State parks in the Watershed include Table Rock State Park, Caesars Head State Park, and Jones Gap State Park. Within Joes Gap, approximately five miles of the Middle Saluda River and its major tributary, Coldspring Branch, are protected by a 600-foot wide scenic corridor established through an agreement with the South Carolina Department of Parks, Recreation and Tourism.

Upstate Forever was selected to receive a Regional Conservation Partnership Program (RCPP) award from the NRCS to protect the region's most critical lands for water quality, with an emphasis on priority farmland. Focus areas for RCCP-funded conservation projects include farms, ranches, croplands, agricultural neighborhoods, equestrian areas, and watershed lands across the Upstate, including in the Upper Saluda River Watershed. Landowners in the Oolenoy subwatershed have committed to easements through the program.

4. STREAM CLASSIFICATIONS, USES AND IMPAIRMENTS

4.1. Stream Classifications

Numerous streams in the mountainous headwater areas of the Upper South Saluda, Oolenoy, and Middle Saluda subwatersheds are classified as Outstanding Resource Waters (ORW) and Trout - Natural (TN). Streams and rivers in the Oolenoy and Upper South Saluda subwatersheds also have sections classified as Trout - Put, Grow and Take (TPGT). All other streams in the South Saluda Watershed are classified as Freshwaters (FW) (see R.61-68, Water Classifications and Standards; R.61-69, Classified Waters, and https://gis.dhec.sc.gov/watersheds/).

FW are freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of SCDHEC (SCDHEC R.61-68). Freshwaters are suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Freshwaters are also suitable for industrial and agricultural uses.

ORW are freshwaters (or saltwaters) that are of exceptional recreational or ecological importance or of unusual value or those freshwaters suitable as a source for drinking water supply with minimal treatment. Such waters may include, but are not limited to: waters in national or state parks or wildlife refuges; waters supporting threatened or endangered species; waters under the National Wild and Scenic Rivers Act or South Carolina Scenic Rivers Act; waters known to be significant nursery areas for commercially important species or known to contain significant commercial or public shellfish resources; or waters used for or having significant value for scientific research and study (SCDHEC R.61-68).

TN are freshwaters suitable for supporting reproducing trout populations and a cold water balanced indigenous aquatic community of fauna and flora. TPGT are freshwaters suitable for supporting the growth of stocked trout populations and a balanced, indigenous aquatic community of fauna and flora. Both TPGP and TN are suitable for primary and secondary contact recreation, as a source for drinking water supply with minimal treatment, and for industrial and agricultural uses. TPGT and TN waters are also suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora (SCDHEC R.61-68).

4.2. Designated Uses

Designated uses in the Watershed that are protected through SCDHEC's water quality standards regulations include:

- Contact recreation (swimming or primary and boating/wading or secondary),
- Drinking water supply,
- Aquatic life uses, which include fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora, and
- Agricultural and industrial uses.

4.3. Water Quality Standards

It is a goal of SCDHEC to maintain and improve all surface waters to a level to provide for the survival and propagation of a balanced indigenous aquatic community of flora and fauna and to provide for recreation in and on the water. Narrative criteria are determined by SCDHEC based on the condition of the waters of the State by measurements of physical, chemical, and biological characteristics of the waters according to their classified uses. In order to determine the biological quality of the waters of the State, it is necessary that the biological component be assessed by comparison to a reference condition(s) based upon similar hydrologic and watershed characteristics that represent the optimum natural condition for that system (SCDHEC R.61-68). SCDHEC's procedures for determining the Aquatic Life Use Support (ALUS) of a stream are in Appendix D of the Watershed Plan for Sediment in the North Saluda River and Saluda Lake. The procedures clarify criteria used to determine if a stream is fully supporting, partially supporting or not supporting its designated use (SCDHEC, 2012).

In addition to the narrative biological criteria, the numerical water quality standards for freshwater include turbidity levels (except for lakes) not to exceed 50 nephelometric turbidity units (NTUs) provided existing uses are maintained. For freshwater lakes, turbidity levels are not to exceed 25 NTUs provided existing uses are maintained.

4.4. Water Quality Impairments

Water quality in the upper reaches of the watershed is excellent with natural trout, stocked trout, and ORW in the headwater areas. Water quality impairments are located at multiple sites further downstream. In addition to biological and turbidity impairments described below, the South Saluda River Watershed is also within an approved TMDL watershed for bacteria.

As explained in Section 2.1, this Watershed Plan focuses most directly on water quality impairments detailed below as they relate to sediment loading from sources in the South Saluda River Watershed. Sediment runoff is causing sustained high turbidity levels, habitat degradation, and impaired stream biota in streams and rivers throughout the Watershed and in the lake downstream. Additional data corroborating impairments due to sediment can be found in Section 5.

- S-103 (Oolenoy River at Oolenoy Church Road) does not meet its designated use for supporting aquatic life due to biological impairment.
- RS-02330 (Adams Creek at Pumpkintown Hwy near Midway Rd intersection) does not meet its designated use for supporting aquatic life due to turbidity.
- RL-08056 (Saluda Lake near the end of Club Circle. *Downstream of the South Saluda River Watershed, but its water quality is impacted by the South Saluda River watershed drainage*) does not meet its designated use for supporting aquatic life due to turbidity.

Because sediment is a carrier of bacteria and nutrients, the BMPs included in this Watershed Plan can also directly and indirectly address other known water quality impairments in the Watershed (e.g. bacteria; see the SC Watershed Atlas for the Upper Saluda River Basin TMDL for Fecal Coliform: https://gis.dhec.sc.gov/watersheds/), and can also help prevent future impairments (e.g. nutrients).

5. STREAM ASSESSMENTS

Stream assessments were completed for the Watershed area using a combination of existing water quality and biological data. Water quality data included SCDHEC ambient surface water quality monitoring data, Greenville County MS4 stream monitoring data and ECU lake data and SOS data. Biological data includes SCDHEC macroinvertebrate data, Greenville Water macroinvertebrate data, and SCDNR fish data.

5.1. Water Quality Data

Water quality was evaluated using turbidity and suspended sediment monitoring data as indicators of river and lake sediment levels. Water quality data collected within the South Saluda Watershed by SCDHEC, Greenville County, ECU and SOS are described below. Monitoring data are variable in terms of monitoring frequency and time period.

5.1.1. SCDHEC Surface Water Quality Monitoring Data

SCDHEC maintains a network of different types of surface water quality monitoring stations throughout the Watershed. The following water quality assessment information was obtained from the South Carolina Watershed Atlas (https://gis.dhec.sc.gov/watersheds/), the National Water Quality Monitoring Council Water Quality Data (https://www.waterqualitydata.us/portal/), and from other public sources.

SCDHEC monitoring stations that meet their designated uses for turbidity include:

- RS-11002 (located at Mill Creek at Hwy 11 near Deer Stalk Road),
- RS-12073 (Carrick Creek at Table Rock Road), and
- S-299 (located at South Saluda River at Dacusville Road).

Turbidity data for Mill Creek, which drains a small forested watershed near Cleveland, is limited and mostly dated (Figure 18). Data for Carrick Creek, which drains Table Rock State Park, is also limited and indicates high water quality (Figure 19). Figure 20 shows turbidity for the South Saluda River at Dacusville Road (Hwy 186). Data collection was more frequently between 2001 and 2008 compared to 2010 through 2019. Earlier data indicated several exceedances over the water quality standard of 50 NTUs.

The following SCDHEC monitoring stations have not been sufficiently assessed to state whether they meet their designated uses for turbidity:

- S-086 (Matthews Creek near Table Rock Road),
- S-252 (Middle Saluda River at Pumpkintown Road), and
- S-103 (Oolenoy River at Oolenoy Church Road).

Matthews Creek flows from a largely forested watershed with protected headwaters which drain the western end of Caesar's Head State Park. The limited turbidity data indicate excellent water quality (Figure 21). Turbidity levels at the Middle Saluda River at S-252 were higher (Figure 22).

Turbidity levels measured for the Oolenoy River between 2001 and 2008 at S-103 were also generally higher and included several water quality standard exceedances (Figure 23). RS-02330 (Figure 24) on Adams Creek at Midway Road is impaired for turbidity according to the 2016 303d list of impaired waters.

Figure 18. Turbidity at SCDHEC monitoring station RS-11002 (Mill Creek at Hwy 11 near Deer Stalk Road)

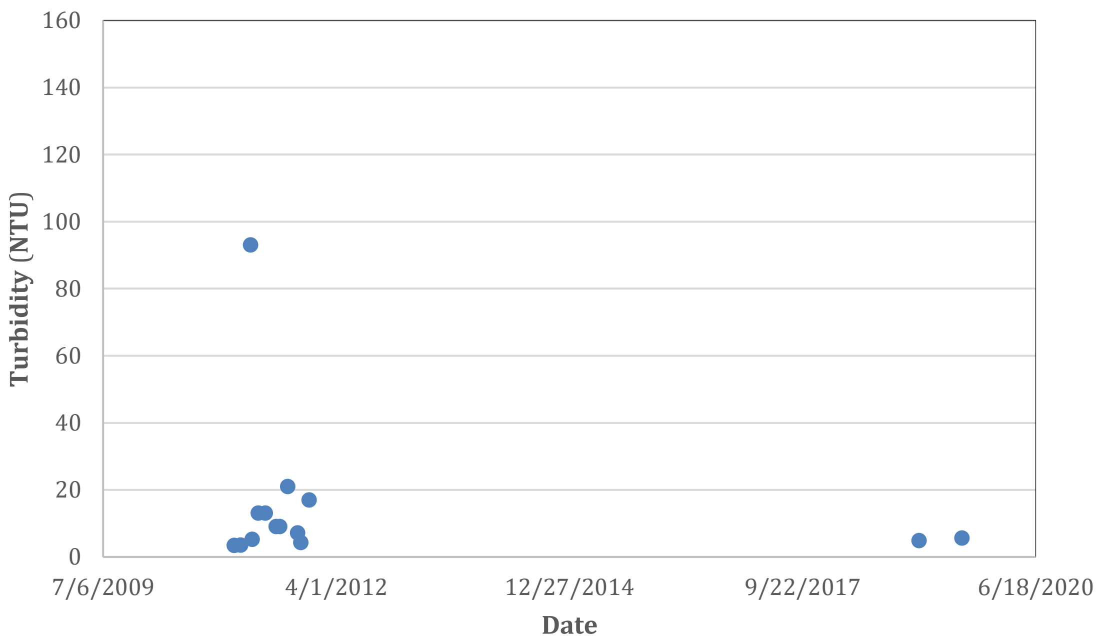


Figure 19. Turbidity at SCDHEC monitoring station RS-12073 (Carrick Creek at Table Rock Road)

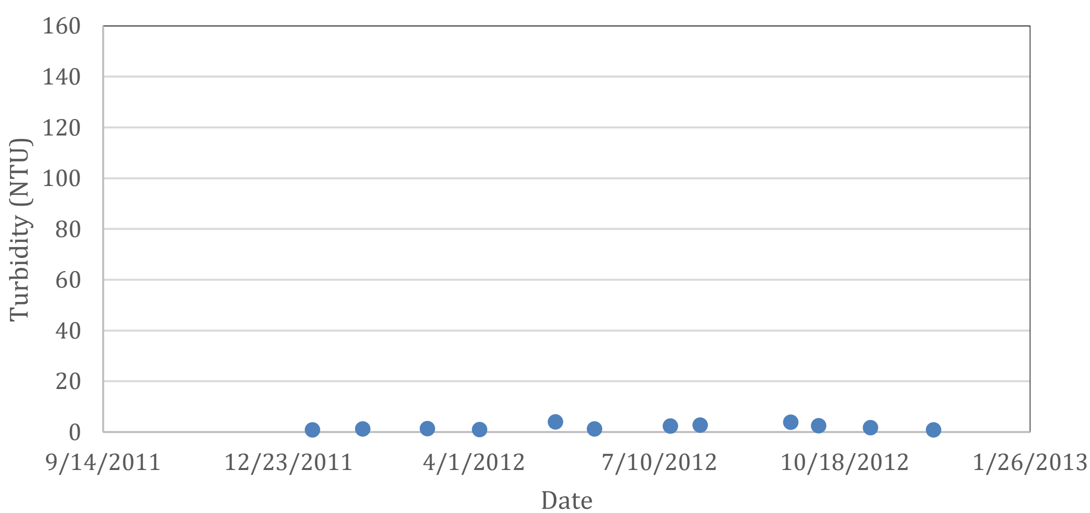


Figure 20. Turbidity at SCDHEC monitoring station S-299 (South Saluda River at Dacusville Road)

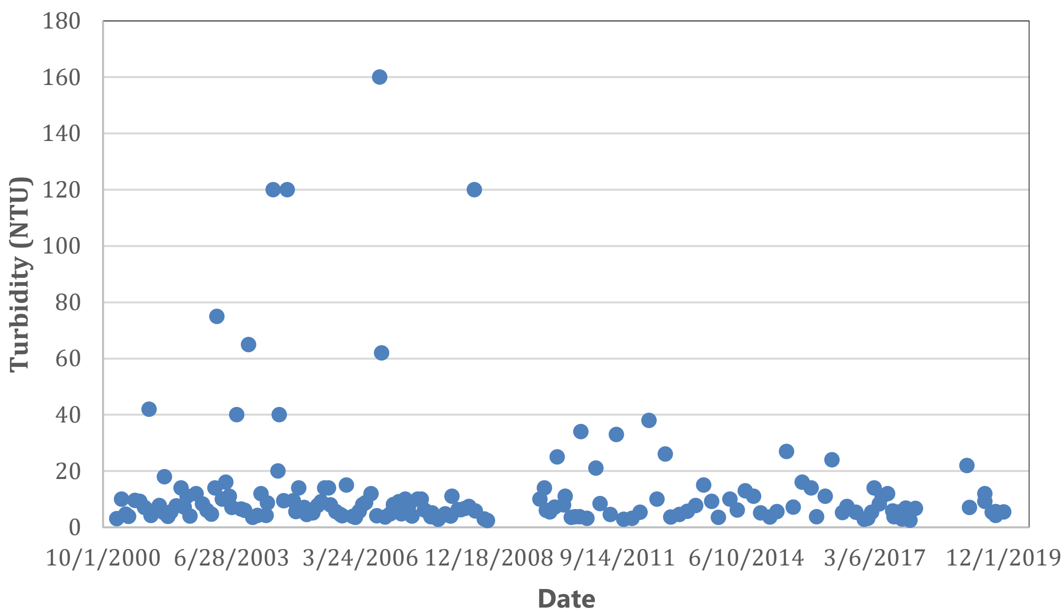


Figure 21. Turbidity at SCDHEC monitoring station S-086 (Matthews Creek near Table Rock Road)

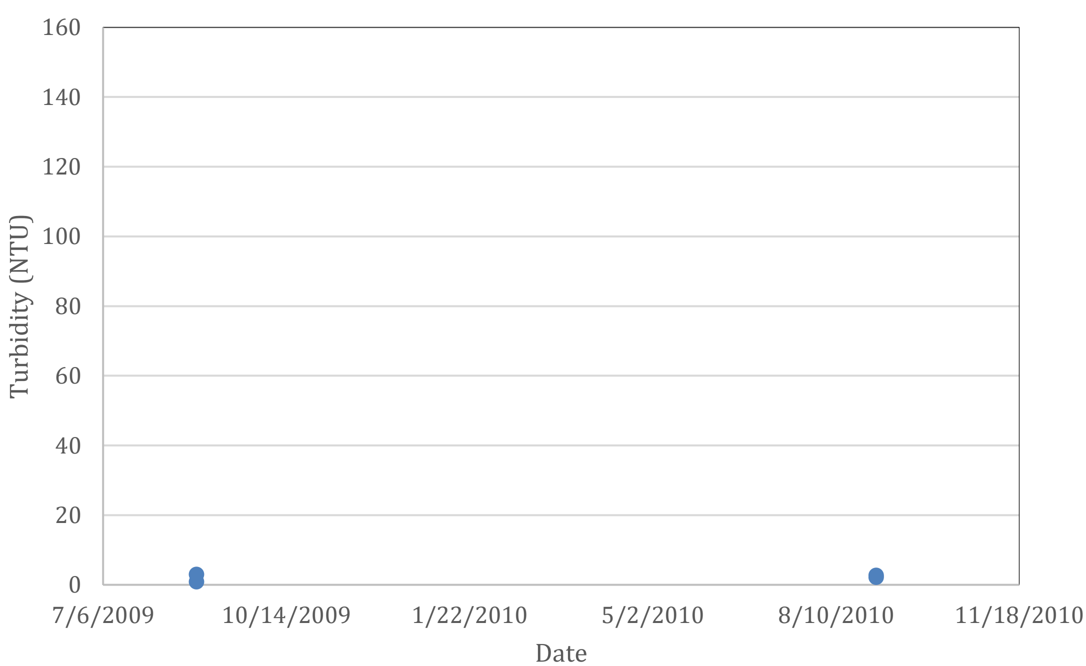


Figure 22. Turbidity at SCDHEC monitoring station S-252 (Middle Saluda River at Pumpkintown Road)

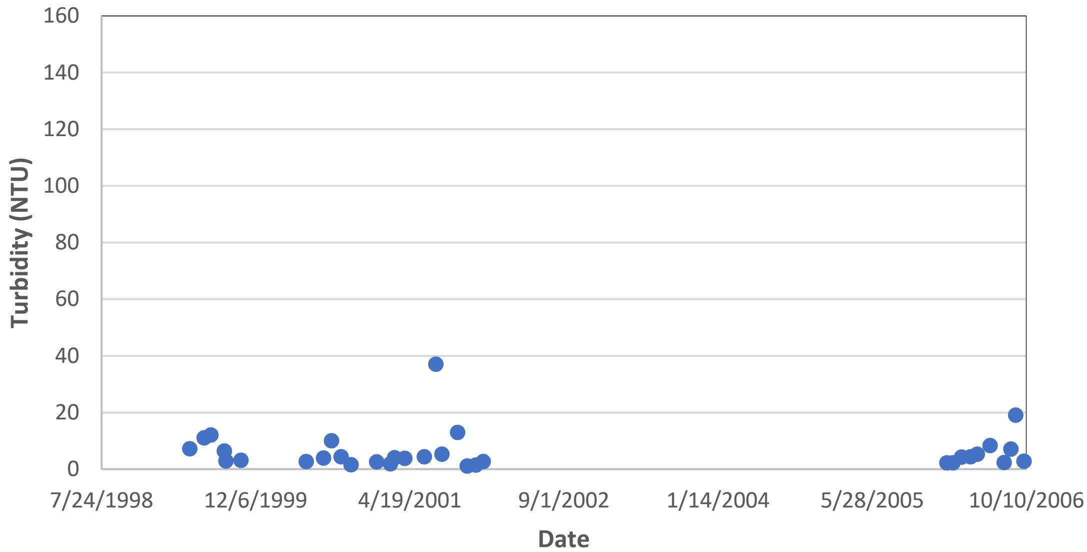


Figure 23. Turbidity at SCDHEC monitoring station S-103 (Oolenoy River at Oolenoy Church Road)

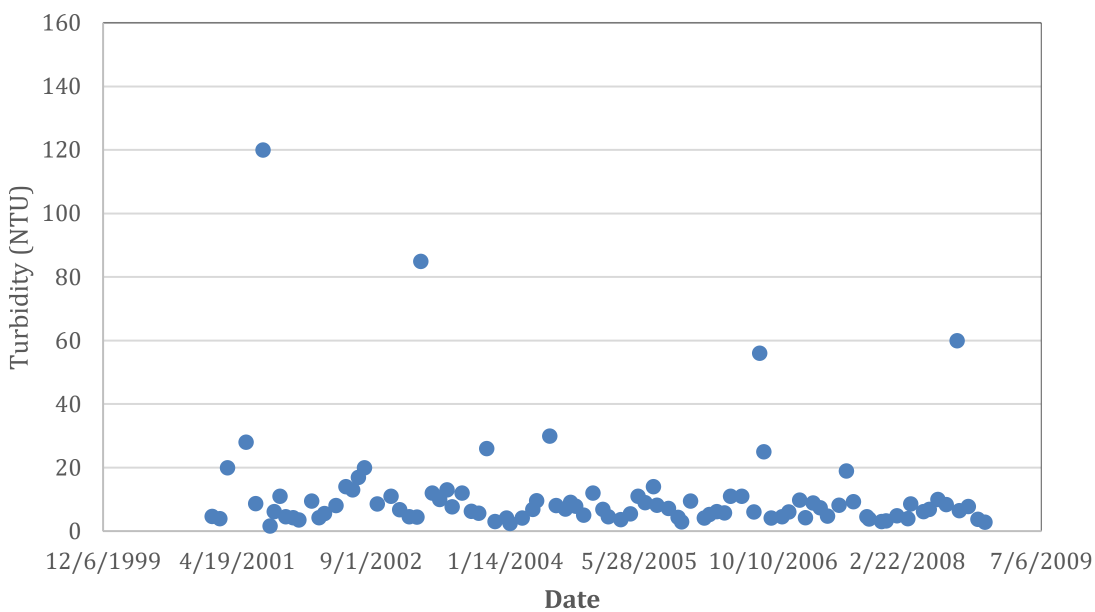
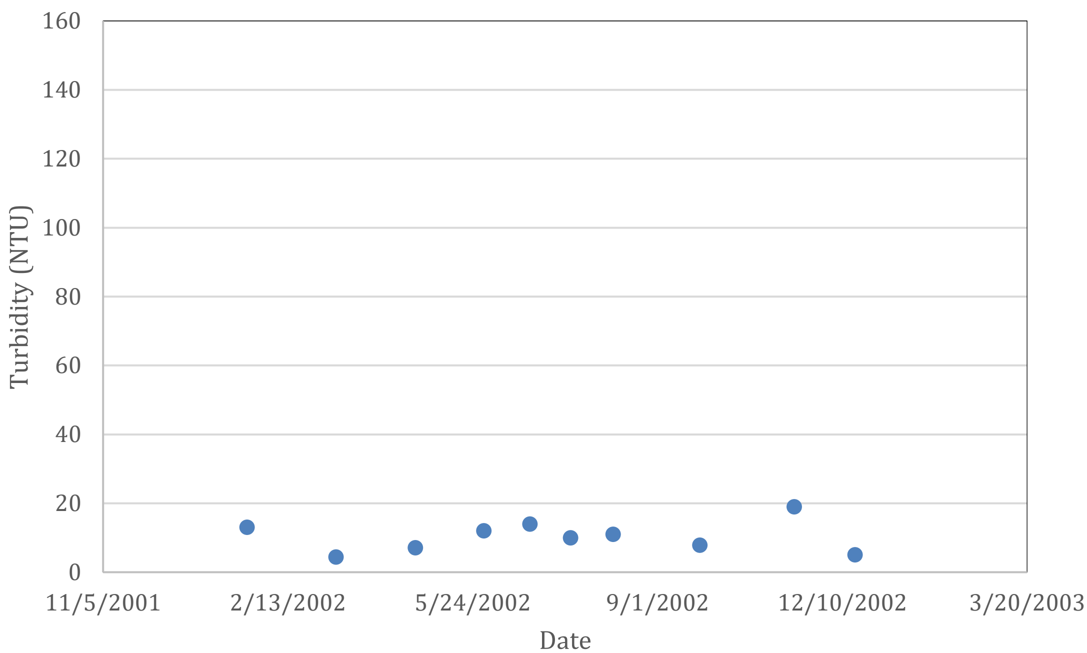


Figure 24. Turbidity at SCDHEC monitoring station RS-02330 (Adams Creek at Midway Road)



5.1.2. Greenville County MS4 Water Quality Data

Greenville County maintains sixteen continuous stream monitoring gages across the County that record turbidity at 15-minute intervals. Figure 25 shows turbidity distributions at County monitoring stations. Figure 26 shows the comparison of average turbidity levels to percent forested land use in the drainage area of the monitoring station. The red arrow points to the Middle Saluda River station at Tilly Road. There is not a continuous monitoring station on the South Saluda, which forms the border between Pickens and Greenville Counties.

The Middle Saluda Station, has the lowest overall mean turbidity of all the County's continuous monitoring stations (Figure 25) and is reflective of its watershed area having the highest percentage of forest cover (nearly 90%, Figure 26). Because forest is a fairly stable land use, this indicates that the sediment runoff reaching this monitoring station is coming from a relatively small proportion of the Watershed (the 20% of non-forested cover), as described in Section 7.

Figure 27 is a graph of turbidity levels at Greenville County's Tilley monitoring station from April 2016 to June 2019. Evaluation of data from the Tilley station revealed that turbidity levels exceeded the 50 NTU standard 2.2% percent of the time during this period. The threshold for impairment is exceedance of the water quality standard for over ten percent of the time.

Figure 25. Daily average turbidity distributions at Greenville County monitoring stations

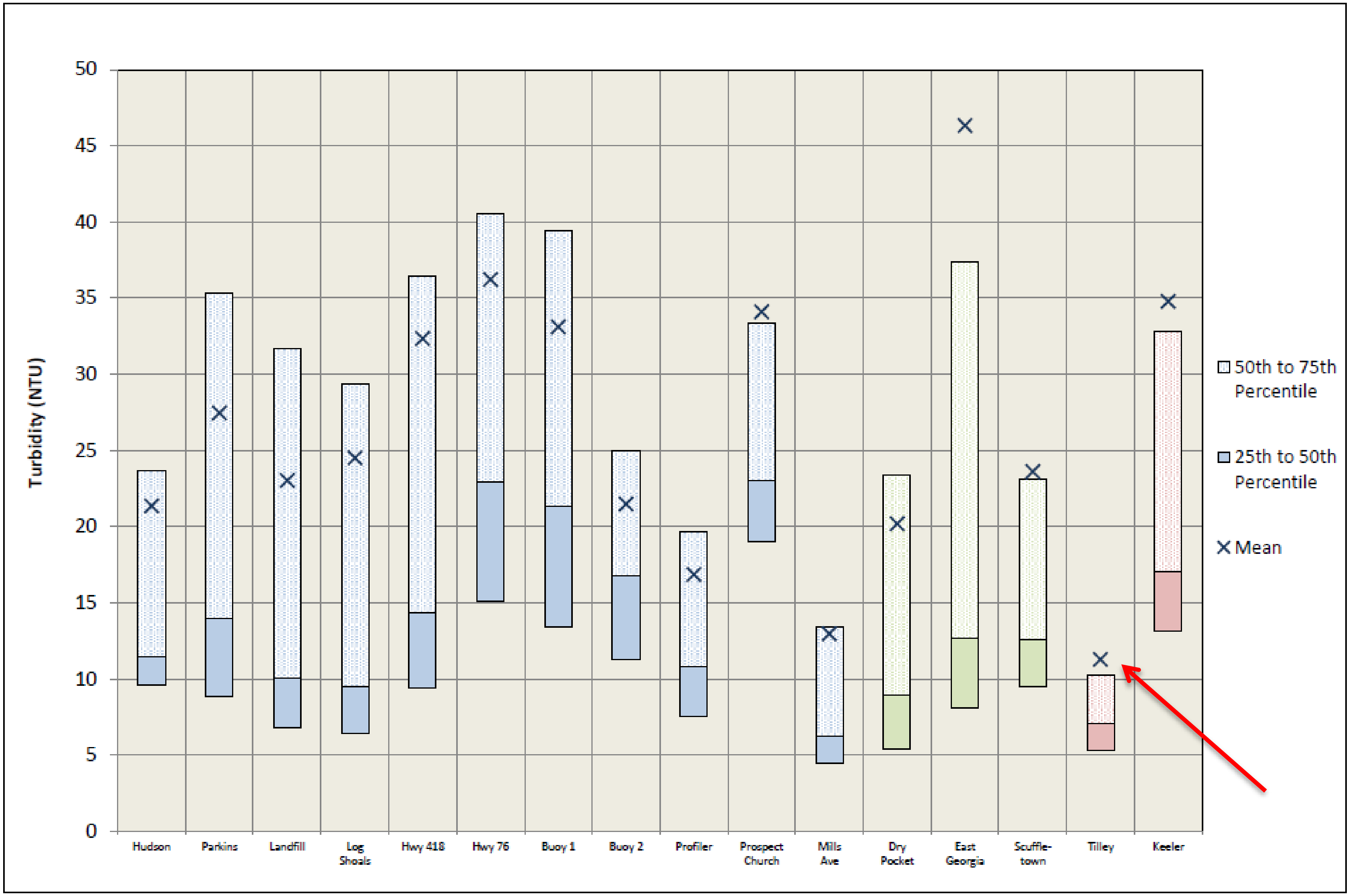


Figure 26. 2018 average turbidity vs. forested percentages at Greenville County monitoring stations

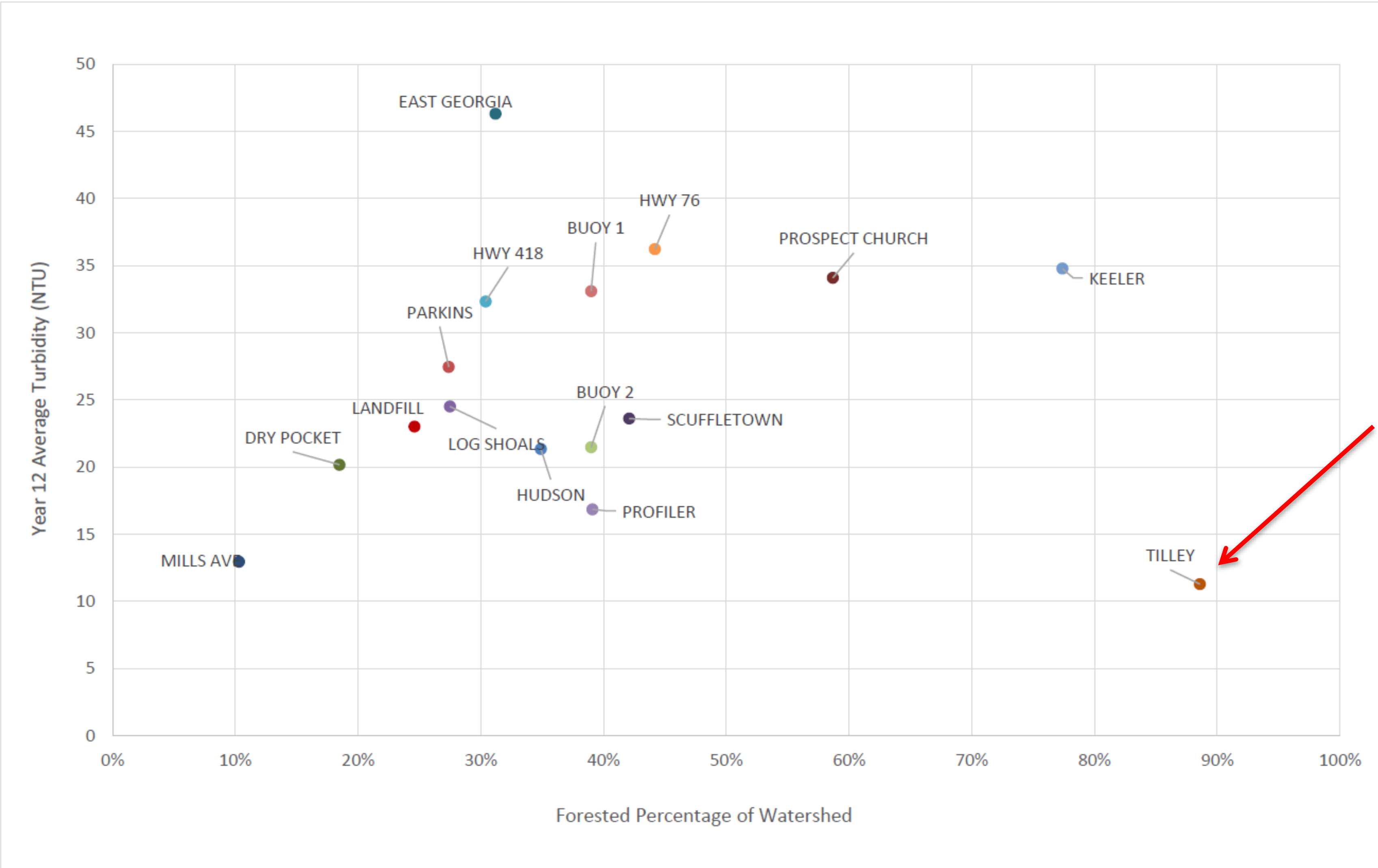
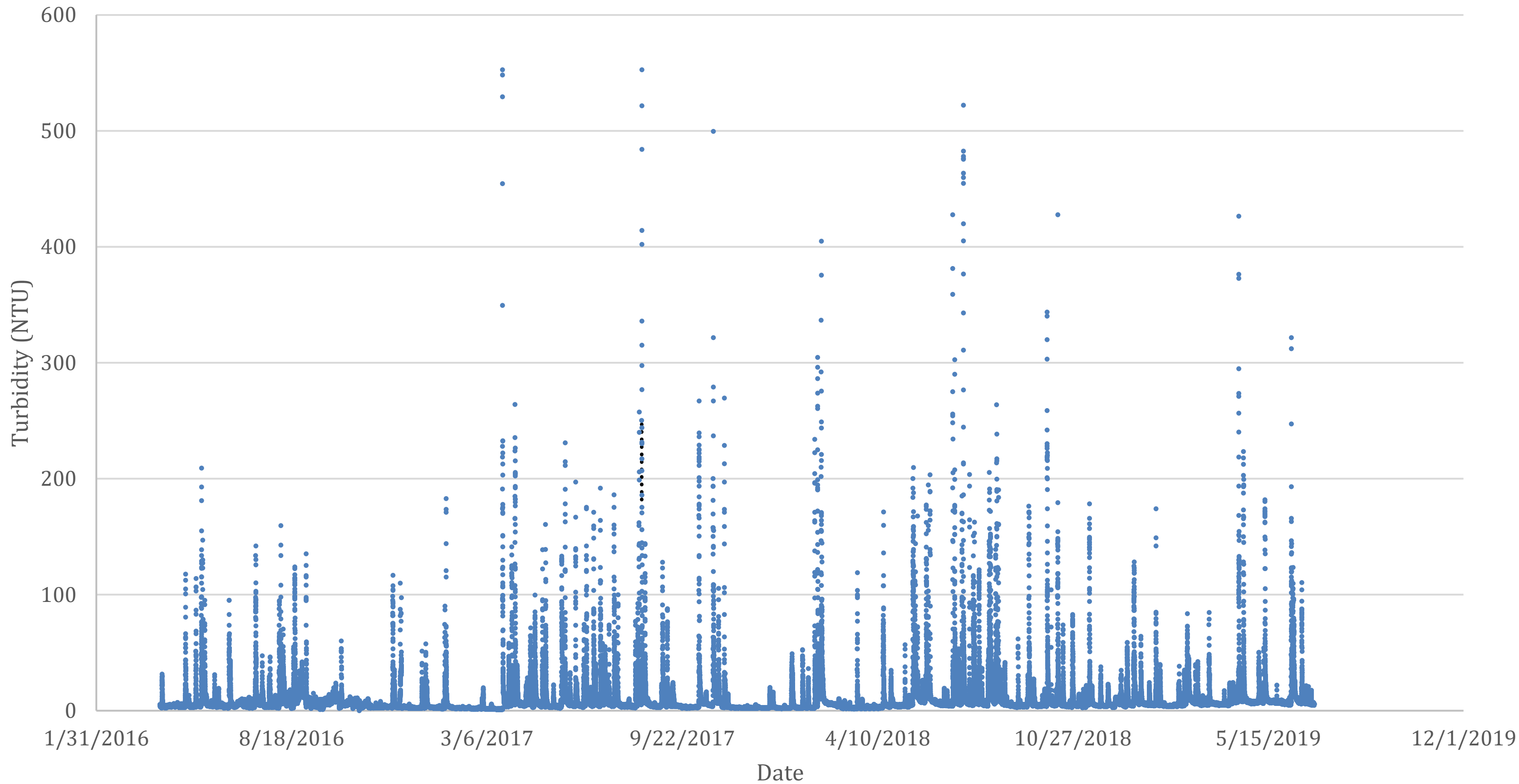


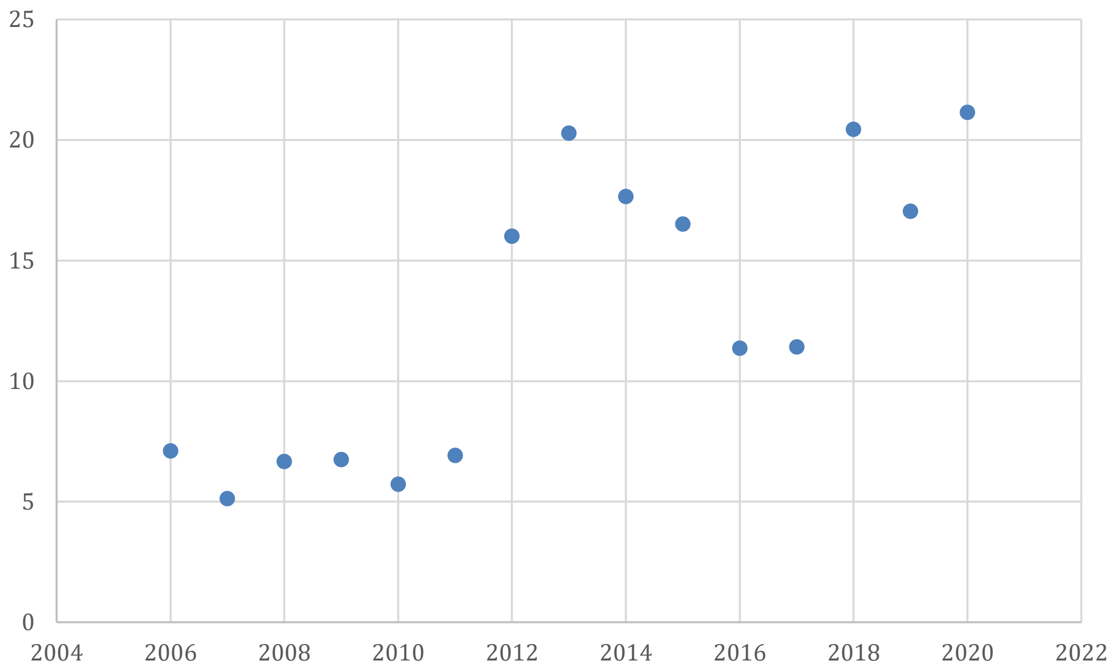
Figure 27. Turbidity at the Middle Saluda monitoring station "Tilley" (Data provided by Greenville County)



5.1.3. Easley Combined Utilities Water Quality Data

Turbidity is measured daily at the Saluda Lake water treatment plant intake. Turbidity data collected between 2006 and 2020 was evaluated. The annual geometric mean of daily peak turbidity increased after lake dredging in 2011/2012 and then slowly decreased until 2018 (Figure 28). Frequent and heavy rainfall in the past three years has caused an increase in average peak turbidity levels that are significantly higher than pre-dredging levels.

Figure 28. Annual geometric mean of daily peak turbidity in Saluda Lake January 2006 – May 2020



5.1.4. Save Our Saluda Water Quality Data

Save Our Saluda collected turbidity data from July through November 2018 at the South Saluda River at Dacusville Road/Hwy 186. This site corresponds with SCDHEC monitoring station S-299. Samples were collected during three baseflow and two stormflow events. Turbidity exceeded the water quality standard during the August stormflow sampling event (Table 4).

Table 4. Turbidity at South Saluda River at Dacusville Road/Hwy 186/Hwy 186

Date	Flow	Turbidity (NTU)
7/16/18	baseflow	4
7/31/18	baseflow	6
8/02/18	stormflow	62
11/1/18	baseflow	4
11/13/18	stormflow	33

5.2. Biological Data

5.2.1. SCDHEC Macroinvertebrate Data

Macroinvertebrate data was obtained by SCHDHEC from nine biological monitoring stations in the South Saluda Watershed (Table 5, Figure 2).

Recent data exists for two of the stations:

- S-771 - South Saluda River at Highway 11, and
- S-103 – Oolenoy River at Oolenoy Church Road (SR 47).

S-103 is on the current SCDHEC 303(d) list of impaired waters for not meeting its designated use of supporting aquatic life due to biological impairment. Habitat in the Oolenoy River is impacted by sediment. Sampling was done for this site in 2017 and the bioclassification score was 2.8 (Good/Fair).

S-771 was sampled in 2019 and the bioclassification score was 5.0 (Excellent), indicating it fully supports its designated use of supporting aquatic life.

Other stations had somewhat older data with bioclassification scores ranging from Good to Excellent (Table 5). Sites with the highest bioclassification scores are situated in upper parts of the Watershed.

Table 5. SCDHEC macroinvertebrate data for the South Saluda Watershed

WQMS	Date	County	Stream	Bioclassification Score	Bioclassification
Middle Saluda River subwatershed					
S-076	9/6/06	Greenville	Middle Saluda R. @ Jones Gap St. PK	4.6	Excellent
S-888	9/9/99	Greenville	Middle Saluda River 30-100 meters downstream of Hugh Smith Rd.	3.8	Good
RS-04530	7/21/04	Greenville	Middle Saluda River just downstream of Oil Camp Creek near Jones Gap	4.8	Excellent
S-317	9/7/06	Greenville	Oil Camp Creek @ SR 97	4.4	Good
Upper South Saluda River subwatershed					
S-771	7/31/19	Greenville	South Saluda R. @ SC Hwy. 11	5	Excellent
S-086	9/18/13	Greenville	Matthews Creek @ SR 90	5	Excellent
Oolenoy River subwatershed					
S-999	8/4/09	Pickens	Green Ck. @ Table Rock State Park	4.6	Excellent
S-103	8/16/17	Pickens	Oolenoy River @ SR 47	2.8	Good/Fair
Lower South Saluda River Subwatershed					
S-980	6/13/08	Pickens	Carpenter Creek @ Pace Bridge Road NE of SC 186/SC 135 intersection	4.2	Good

5.2.2. Greenville Water Macroinvertebrate Data

Greenville Water commissioned a study in 2017 to assess macroinvertebrates in the watershed areas above the reservoirs they manage on the South and North Saluda Rivers. The macroinvertebrate sample result from the South Saluda River upstream of the Table Rock Reservoir was a North Carolina Biotic Index (NCBI) rating of "excellent." Since the site is situated in a protected portion of the watershed, this data can help define reference conditions.

Additional macroinvertebrate data is needed to assess additional stream and river reaches in lower areas of the Watershed.

5.2.3. SCDNR Fish Data

Natural trout waters are found in three subwatersheds of South Saluda Watershed:

- Middle Saluda subwatershed: Gap Creek, the Middle Saluda River, and Oil Camp Creek, and their tributaries,
- Upper South Saluda subwatershed: Matthews Creek and its tributaries, and
- Oolenoy subwatershed: Emory Creek and Willis Creek and their tributaries.

Trout are stocked in the Upper South Saluda near Hwy. 11 and in the headwaters of the Upper Oolenoy River.

The following information was obtained from a SCDNR publication on trout fishing (http://www.dnr.sc.gov/fish/pdf/TroutBook.pdf):

> *In South Carolina, the Middle Saluda River begins above Caesars Head near US 276 and tumbles downstream through the Mountain Bridge Wilderness approximately 5 miles to Jones Gap State Park. This superbly scenic stream plunges almost 1,000 feet in five miles. The Middle Saluda River was designated the first SC Class I Natural River under the 1974 Scenic Rivers Act. The Middle Saluda runs through a mountain gorge known as Jones Gap State Natural Area, one of the state's genuine wilderness parks...A small river with swift, rapidly moving pocket water, this tributary is predominantly a wild rainbow trout stream, but also supports a fair brown trout population in its lower reaches. Occasional catches of brook trout occur as a result of fish moving down from tributary streams...The lower reaches of the Middle Saluda River near SC 11 are stocked with catchable trout during Spring and Fall...The South Saluda River, from the Table Rock Reservoir down to the Blythe Shoals area (S Blythe Shoals Road), and the North Saluda River, from the North Saluda Reservoir down to Goodwin Branch, both offer good fishing for stocked trout.*

SCDNR fish data collected between 2004 and 2016 from the Middle Saluda, South Saluda, and Oolenoy Rivers were analyzed to determine fish assemblage composition and relative abundance of priority species (species of greatest conservation need due to habitat loss[2]). Relative abundance of priority species was determined for each river by averaging sample percentages of the relative number of individuals in a sample representing priority species (Table 6). The assessment did not include tributary data. A list of species collected and their occurrence in each river is given in Table 7. The South Saluda River had the highest percentage of priority species, though with only two samples. If the Oolenoy River data is included with data from the South Saluda River, the relative abundance of priority species drops considerably and is similar to results from the Middle Saluda River. The Middle Saluda River had a lot of priority species individuals but also many other fish in general (good abundance and diversity); therefore, that the proportion of priority species individuals was not that large. Other observations included:

- The Middle Saluda River yielded the only stonerollers among analyzed samples (though they are known elsewhere in the Upper Saluda, e.g. Matthews Creek),
- The Middle Saluda River appears to support notably higher numbers of thicklip chub and fieryblack shiner (and to some degree seagreen darter) than other Upper Saluda rivers, and
- The Middle Saluda River appears to support notably higher numbers of Carolina fantail darter.

Data limitations/considerations include time gaps between samples, slight differences in sample methods, and variations due to spatial distribution along the rivers and associated local habitat quality.

Additional biological data are needed to assess other areas of the Watershed.

Table 6. Relative abundance of priority fish species between 2004 and 2016

River	Number of Samples	Relative Abundance of Priority Species
Middle Saluda River	4	27.7%
South Saluda River	2	40.2%
South Saluda Plus Oolenoy River	6	27.9%

[2] Priority species are defined by SCDNR as those species that are currently rare or designated as at-risk, those for which there are known deficiencies, and those that have not received adequate conservation attention in the past. Additionally, SCDNR included species for which South Carolina is "responsible," that is, species that may be common in the state, but are declining or rare elsewhere. SCDNR also included species that could be used as indicators of detrimental conditions. These indicator species may be common in South Carolina; as such, changes in their population status are likely to indicate stress to other species that occur in the same habitat.

Table 7. Fish species occurrence in rivers of the South Saluda Watershed (SCDNR data, 2006 – 2016)

Species	Common Name	Middle Saluda River	South Saluda River	Oolenoy River
Catostomus commersoni	White Sucker	X	X	X
Hypentelium nigricans	Northern Hog Sucker	X	X	X
Moxostoma collapsum	**Notchlip Redhorse**	**X**	**X**	**X**
Moxostoma pappillosum	**V-Lip Redhorse**	**X**	**X**	
Scartomyzon rupiscartes	Striped Jumprock	X	X	X
Scartomyzon sp.	Brassy Jumprock		X	
Lepomis auritus	Redbreast Sunfish	X	X	X
Lepomis cyanellus	Green Sunfish		X	
Lepomis gulosus	Warmouth	X	X	X
Lepomis macrochirus	Bluegill	X	X	X
Lepomis microlophus	Redear Sunfish		X	X
Micropterus dolomieu	Smallmouth Bass	X	X	
Micropterus salmoides	Largemouth Bass	X	X	X
Dorosoma cepedianum	Gizzard Shad		X	
Campostoma anomalum	**Stoneroller**	**X**		
Cyprinella chloristia	**Greenfin Shiner**		**X**	**X**
Cyprinella labrosa	**Thicklip Chub**	**X**	**X**	
Cyprinella nivea	Whitefin Shiner		X	
Cyprinella pyrrhomelas	**Fieryblack Shiner**	**X**	**X**	**X**
Cyprinella zanema	**Santee Chub**		**X**	**X**
Hybognathus regius	Eastern Silvery Minnow			X
Hybopsis rubrifrons	**Rosyface Chub**	**X**	**X**	**X**
Nocomis leptocephalus	Bluehead Chub	X	X	X
Notropis chlorocephalus	Greenhead Shiner	X	X	X
Notropis hudsonius	Spottail Shiner		X	X
Notropis scepticus	**Sandbar Shiner**	**X**	**X**	**X**
Semotilus atromaculatus	Creek Chub		X	X
Esox niger	Chain Pickerel		X	
Ameiurus brunneus	**Snail Bullhead**	**X**		**X**
Ameiurus platycephalus	**Flat Bullhead**	**X**	**X**	**X**
Noturus insignis	Margined Madtom	X	X	X
Etheostoma brevispinum	**Carolina Fantail Darter**	**X**		**X**
Etheostoma thalassinum	**Seagreen Darter**	**X**	**X**	**X**
Perca flavescens	Yellow Perch		X	
Percina crassa	**Piedmont Darter**		**X**	**X**
Gambusia holbrooki	Eastern Mosquitofish			
Oncorhynchus mykiss	Rainbow Trout	X		
Salmo trutta	Brown Trout	X		

Bolded species are listed on the State Wildlife Action Plan (SWAP) as Species of Greatest Conservation Need (SGCN)

5.3. Monitoring Summary

Assessment of existing water quality and biologic data confirms high quality of water in the headwaters of the Upper South Saluda and Middle Saluda subwatersheds and impairments related to sediment lower in the Watershed, particularly in the Oolenoy River, Lower South Saluda River, and downstream in Saluda Lake.

6. SEDIMENT SOURCES AND CAUSES

Several possible sources and causes of sediment runoff from the South Saluda River Watershed were identified and evaluated as part of the watershed assessment as a first step towards determining sediment loading to the river and ultimately Saluda Lake. These included agricultural, urban, and other sources. Focus meetings were held, and outreach was conducted to address major sources as described below.

6.1. Agricultural Sources

6.1.1. Cultivated Crops

Sediment loading from floodplain croplands in the South Saluda River Watershed is attributed to frequent soil disturbance and poorly stabilized soils that easily erode into nearby streams and rivers during storm events. Plasticulture row crops are most susceptible to erosion since the plastic is an impervious surface that, along with frequent tillage, decreases overall rainfall infiltration and increases stormwater runoff (Photo 9). Other row crops, such as soybeans and corn, are somewhat less susceptible to increased runoff and soil loss since there is generally less soil disturbance and no plastic mulch.

Photo 9. Runoff from plasticulture row crop field in the Upper Saluda Watershed

According to the NLCD, in 1992, cultivated crops accounted for approximately 1.7 percent of the South Saluda River Watershed with a total of 1,845 acres. The 2018 desktop/field analysis indicates that croplands now cover 1.1% percent of the Watershed, or about 1,241 acres (Table 1, Figure 12). The majority of the intensively managed cropland can be found in floodplain areas along the middle and lower reaches of the Middle Saluda, Upper South Saluda and Oolenoy Rivers. There are no crops in the steeper headwaters areas and very little in the Lower Saluda subwatershed.

Although the overall acreage of cropland within the Watershed has decreased from historic and from more recent years, remaining croplands in these areas continue to experience significant soil loss on a continuous basis (Photos 10 and 11).

A brainstorming session for agricultural sources was held in 2018 as a part of the North Saluda River Watershed planning effort to further evaluate the crop farming activities that can contribute to sediment loading, to utilize stakeholders' knowledge of farms in the watershed, and to identify agricultural BMPs that help prevent sediment runoff. The attendees at the 2018 brainstorming session covered both the North Saluda and South Saluda Watershed areas: Greenville County SWCD, Greenville NRCS, Clemson Extension, and Save Our Saluda. Agricultural sources, including runoff from croplands, animal access areas, and eroding streambanks were discussed along with existing programs to address these sources. Intensively managed (plasticulture) croplands in floodplains were identified as appropriate priority areas for restoration in the North Saluda River Watershed due to their high likelihood of runoff and proximity to the river.

The importance of BMPs that can serve the dual purpose of improving soil health and preventing soil loss was emphasized. Through subsequent conversations with agricultural stakeholders and observations in the Watershed, intensively managed (plasticulture) crops farms and other cultivated crop farms were identified as priority areas in the South Saluda River Watershed. Cover crops were identified as an accepted and cost-effective BMP to help stabilize and improve cropland soils during the off-season. During the development of this South Saluda River WBP, a cover-crop specific brainstorming session was held on November 21, 2019 and included similar stakeholders and the State NRCS soil conservation agronomist. Other potential BMPs and barriers to implementation were also discussed and are further detailed in Section 9.

Photos 10 and 11. Runoff from cultivated crop areas in the Upper South Saluda and Middle Saluda subwatersheds

Photo 12. Sediment at the South Saluda (L) – Middle Saluda (R) confluence downstream of agricultural areas

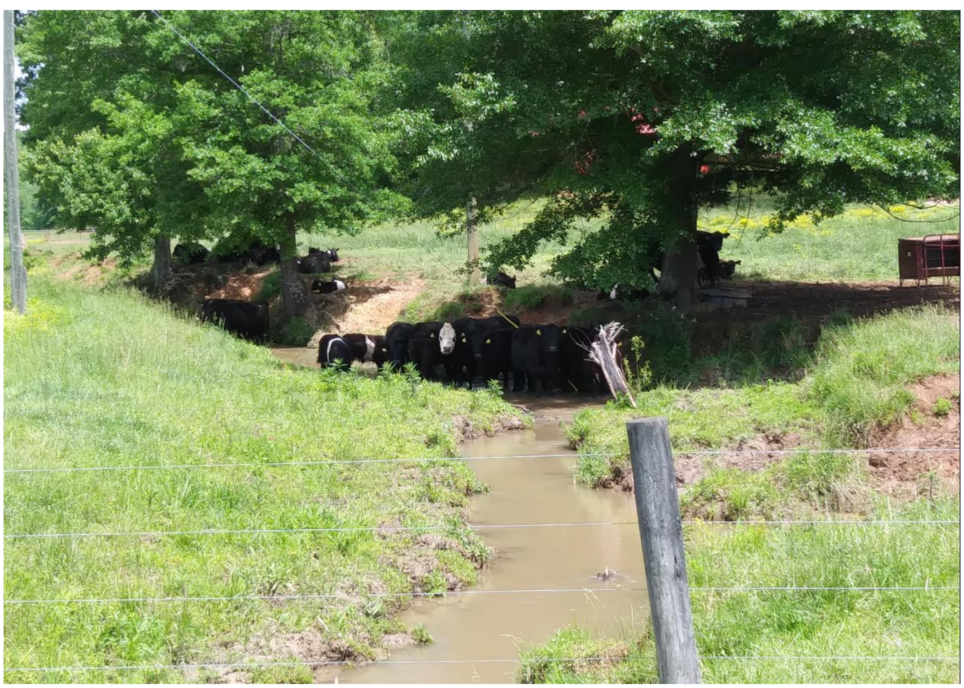
6.1.2. Livestock

Pasturelands where livestock such as cattle and horses graze can be a source of sediment to streams, rivers, and other waterbodies.

A primary source of sediment runoff from pastures comes from trampling of streambanks as animals access streams for drinking. Livestock concentrated in smaller areas such as shaded areas, water sources, or feeding areas, often create bare soil conditions leaving such areas vulnerable to erosions. Collectively, runoff from unstabilized or poorly stabilized pastures, high traffic areas, and stream access locations can cause significant sediment loading to nearby waterbodies (Photos 13 and 14). Pasturelands currently cover approximately 0.7% of the Watershed (about 783 acres, Table 1).

Photo 13. Poorly managed pastureland along a tributary in the Upper Saluda Watershed

Photo 14. Cattle in a tributary of the Middle Saluda River



An estimate of livestock numbers in the watershed was obtained using the best available data. The USDA National Agricultural Statistics Service reported 4,554 total cattle in Greenville County and 3,342 total cattle in Pickens County in 2017. The non-urbanized Greenville County portion of the Watershed is approximately 19 percent of Greenville County's non-urbanized area, and the non-urbanized Pickens County portion of the Watershed is approximately 17 percent of Pickens County's non-urbanized area. Total livestock in the Watershed was estimated by assuming that all livestock are located in the non-urbanized area and non-protected portions of each county, and assuming that the percentage of livestock is distributed evenly among the subwatersheds (Table 8). Though these livestock estimates are not technically used in STEPL, the acres of pastureland is used in the USLE in STEPL to estimate sediment load, as described in Section 7. Figure 12 displays the overall acreage of livestock farms (shown in yellow). Livestock farms are more prevalent in lower parts of the Upper and Lower South Saluda subwatersheds than in the Middle or Oolenoy subwatersheds.

Table 8. Livestock estimates for the South Saluda River Watershed

Livestock	Estimated quantity in Middle Saluda River subwatershed	Estimated quantity in Upper South Saluda River subwatershed	Estimated quantity in Lower South Saluda River subwatershed	Estimated quantity in Oolenoy River subwatershed	Estimated quantity in total Watershed
Beef Cattle	257	148	122	242	770
Dairy Cattle	7	4	4	8	22
Equine	107	61	50	98	314
Goat/Sheep	105	67	64	132	367
Hogs	76	32	14	19	141
Poultry	86	44	30	54	213

6.2. Urban/Rural Sources

Urban/rural sources of sediment in the South Saluda River Watershed include runoff from land disturbance at development sites with inadequate erosion and sediment control and poor stormwater management, dirt driveways, and unstabilized open areas and ditches. Urban sources can also cause downstream erosion and sedimentation due to increases in stormwater runoff from connected impervious surfaces. Because urban stormwater flows over hard surfaces and is often concentrated in pipes that discharge directly to surface drainage systems, the increase in the amount and rate of urban runoff can be erosive.

The 2018 land use analysis in Table 1 suggests that developed areas account for approximately 8% (8,499 acres) of the Watershed. Developed areas include the Rock at Jocassee Golf Course community in the headwaters of the Oolenoy River subwatershed, and the Sage/Milliken Enterprise plants in the Upper South Saluda River subwatershed. Low intensity rural development is scattered throughout middle and lower portions of the Watershed.

There is potential for growth in the Watershed as growth pressures continue from Travelers Rest and the anticipated expansion of the Swamp Rabbit Trail in the upper Watershed, and from the rapidly growing urban areas of Easley and Greenville to the south. Therefore, sediment is of concern with regards not only to existing land uses, but also to future growth and development in the Watershed.

Greenville County is one of three permitted medium municipal separate storm sewer system (MS4s) in South Carolina. According to the SCDHEC Watershed Atlas, the eastern and northern portions of the Watershed fall under Greenville County MS4 permit coverage (59,388 acres), which requires implementation of a program to reduce pollutants in storm water runoff to the County's MS4 conveyances from construction sites. Pickens County is one of approximately 70 permitted small MS4s in the state, though their MS4 is not County-wide. None of the South Saluda River Watershed falls within the Pickens MS4 area. However, Pickens County's Stormwater Ordinance No. 392 is implemented County-wide.

To better understand the impact that urbanization and increased impervious surfaces may have on the watershed, a brainstorming session for urban sources was previously held with stakeholders during the development of the North Saluda River WBP. Stakeholders at the meeting included Greenville County Stormwater, Pickens County Stormwater and Save Our Saluda. The goal of the meeting was to gain knowledge of the urbanized areas of the watershed, to discuss any erosion and sediment control construction and post-construction issues, as well as discuss potential preventative measures for the watershed such as the possible revisions of regulations for future development. Minutes from the meeting can be found the North Saluda River – Saluda Lake WBP. Programmatic measures identified for urban sources in the South Saluda River Watershed are detailed in Section 9.2.

6.2.1. Land Development

Greenville County requires land disturbance permits for land disturbance greater than 5,000 square feet that include requirements for erosion and sediment control. According to the County in 2018, there were six Greenville County inspectors, one of which was permanently assigned to northern Greenville County.

Greenville County currently has a permanent water quality stream buffer requirement of 30 feet of undisturbed area next to streams draining more than 100 acres and is currently implementing a County-wide Tree Preservation Ordinance requiring a 20-foot buffer around new developments.

Greenville County is investigating revisions to ordinances for expansion of existing riparian buffer and tree protection requirements, both of which could help reduce the impact of future development in the Watershed. A general discussion of post-construction stormwater design standards was held during the Urban Brainstorm Session in relation to water quality and channel erosion concerns within the Watershed and how potential incentives could encourage the use of Low Impact Development (LID) and Green Infrastructure (GI) to help minimize runoff. Greenville County has prioritized the Reedy River Watershed to focus on water quality improvements for nutrient impairments.

Pickens County requires land disturbance permits for land disturbance greater than one acre and for less than one-acre in a larger common plan. As of 2018, Pickens County had two construction inspectors to address land disturbance projects county-wide. Pickens County does not have plans to revise their stormwater design regulations or buffer requirements beyond the minimum regulations required by SCDHEC.

During a previous urban brainstorming session, both counties identified unpermitted clearing and grading and misuse of exemptions for forestry and agriculture as common problems related to erosion and sediment control (Photos 15 and 16).

Photos 15 and 16. Runoff to Middle Saluda from unpermitted land clearing and grading

6.2.2. Driveways

Most of the County roads and SC Department of Transportation (DOT) roads in the Watershed are paved. There are very few dirt roads. However, there are many unpaved driveways that erode and cause sediment to be transported into waterways during rain events (Photo 17).

Photo 17. Erosion from a driveway draining to the Middle Saluda River

6.3. Other Sources

Other sources of sediment addressed in this Plan include forestry (silvicultural operations) and streambank erosion. These other sources are discussed in more detail below.

Although wildlife can cause erosion (e.g. feral hogs[3]) and influence sediment distribution patterns in streams and rivers (e.g. beaver), wildlife are recognized as potential minor sources/causes of sediment and are not addressed in this Watershed Plan.

There are several areas of open land on private property throughout the watershed. Unstabilized soils in these areas can also be a source of sediment to waterbodies in the watershed.

Photo 18. Sediment in the South Saluda River from Marked Beech Creek

In addition, there is much historic, or legacy sediment stored in stream and river channels that continues to be remobilized and redistributed within the Watershed drainage system (Photo 18). This Watershed Plan does not address existing in-stream bedload sediment from historic sources and causes.

6.3.1. Forestry (Silvicultural Operations)

Forestlands are present throughout the Watershed and tracts are occasionally timbered. When forestry BMPs are not used in conjunction with planning and executing timbering operations, severe erosion, excessive sediment loading, and stream channel/bank instability can result, particularly in hilly or mountainous areas.

[3] Greenville Water and SCDNR have programs to control feral hogs in the Upper Saluda Watershed.

Potential sources of sediment runoff associated with forestry activities include soil disturbance from roads, skid trails, stream crossings, harvesting and site preparation operations, and removal of streamside vegetation and subsequent channel/bank destabilization.

Forestland accounts for the large majority of land use 88% (96,440 acres) in the Watershed (Table 1). Much of this forestland is likely to remain as managed forest into the future. To better understand the impact forestry activities may have on the Watershed, a brainstorming session for forestry sources was held during the development of the North Saluda River WBP to utilize cooperators and stakeholders' knowledge of forestry management in the Watershed. Attendees included the South Carolina Forestry Commission, Wood, and Save Our Saluda.

The following are findings from the meeting:

- South Carolina's Best Management Practices for Forestry Manual (1994): Compliance with BMPs is required for forestry activities which involve discharge of dredge or fill materials into jurisdictional wetlands to qualify for the silvicultural exemption under Section 404(f) of the Clean Water Act. Compliance with BMPs is recommended on all sites on which there is a potential for violating water quality criteria as defined by the South Carolina Pollution Control Act.
- The South Carolina Forestry Commission (SCFC) is the lead agency in South Carolina in designing, interpreting, monitoring, and updating forestry BMPs. Sustainable Forestry Initiative (SFI) mills require loggers to take BMP training and implement BMPs according to the Clean Water Act. Most mills are SFI certified which makes the logger training essentially a requirement across the board. Mills who are SFI certified require loggers to be in compliance with SFI and will reject lumber from loggers who do not meet requirements. SCFC provides the half day BMP training to meet the SFI requirement. As well, SCFC conducts monthly courtesy exams on active sites and SCDHEC is responsible for enforcement of issues identified by the SCFC. SCFC's responses to issues found during courtesy exams vary depending on severity but range from requirement of the logger to go back through training, take the necessary remediation steps on the ground, or face fines.
- Silviculture activities are required to have streamside management zones with 40-foot buffers. The latest SCFC BMP implementation survey indicates a 95.5% BMP implementation rate but acknowledge that one bad job or rain event can cause an issue. Monitoring activities include observations for activities that have the potential to impact water quality (skid trails, harvesting to trucking, haul roads, rutting, severely exposed soils, stream crossings), with a focus on stream crossings due to high potential for impacting water quality.
- If land use is changing from forestry to land disturbance for development, SCFC does not have authority and any such unpermitted land disturbance should be reported to the appropriate county.

Greenville Water implements a watershed management plan developed in concert with the Nature Conservancy for the watershed above Table Rock Reservoir and actively manages vegetative communities and road systems to prevent sediment runoff to the reservoir. The plan is available on the Greenville Water website under Water Resources:

(https://www.greenvillewater.com/wp-content/uploads/2014/02/GW_Watershed_Management_Plan.pdf)

6.3.2. Streambank Erosion

Eroding streambanks are a source of sediment throughout the Watershed outside of protected headwater areas. Streambank instability can be caused by several factors. Upper soil layers along most Piedmont stream and river corridors are comprised of highly erodible unconsolidated historic sediments that are vulnerable to erosive flows. Erosive stormwater runoff from urban areas and roads further accelerates streambank and stream channel erosion. Streams and rivers lacking adequate streamside vegetation (riparian buffers) are also highly susceptible to streambank erosion and loss of riparian land. Riparian buffers are often inadequate to provide stable streambank conditions in agricultural areas.

Streams and rivers in southeast Piedmont areas have cut through legacy sediments leaving deep and wide stream channels with overall larger-than-historic channel capacities.

Many rivers and tributaries were straightened and channelized. Consequently, overbank flows occur less frequently now than they once did due to historic accelerated sedimentation and subsequent channel expansion (Ruhlman and Nutter, 1999). A decreased frequency of overbank flows means less flood flow energy dissipation and increased erosive flows downstream, and that sediment carried during stormflow is less often redistributed in adjacent floodplain areas.

Streams and rivers in the Watershed have undergone similar land use and channel response patterns. Streambank instability and erosion is not uncommon in middle and lower reaches of the Watershed, particularly downstream of floodplain agricultural areas. Excessive bedload sediment in these reaches has caused the channel to aggrade and widen and large trees to collapse into the river. Fallen trees create woody debris dams, which further obstruct and often re-route erosive flows to exposed riverbanks, causing further streambank scour and erosion (Photos 9 through 21). In some reaches, the riverbanks are stabilized with boulder toe rock and small boulder rock veins that have been installed along the riverbanks in erosive sections, allowing and woody and herbaceous vegetation to take hold (Photos 22 and 23).

Photo 19. Bedload sediment in the Oolenoy River

Photo 20. Eroding riverbank on the South Saluda River

Photo 21. Channel widening and tree obstruction in Lower Saluda River

Photo 22. Rock Toe Bank stabilization on the South Saluda River

In other eroded reaches, debris has been piled on the streambank (Photo 24). This is a common practice along riverbanks in agricultural areas in the Upper Saluda that have eroded due to a lack of riparian vegetation. While it may offer a short-term solution, piling debris on the bank does not provide long-term bank stability. Furthermore, the woody debris eventually gets washed downstream where it often becomes a problem causing more streambank scour and erosion.

An EF-2 tornado touched down on April 13, 2020 in the Laurel and Hardy Lakes community along the South Saluda River. Mature riparian forested areas were devastated, along with homes, and previously stabilized river banks in this reach above Hwy 288 are now vulnerable to erosion.

Photo 23. Rock veins in the Oolenoy River

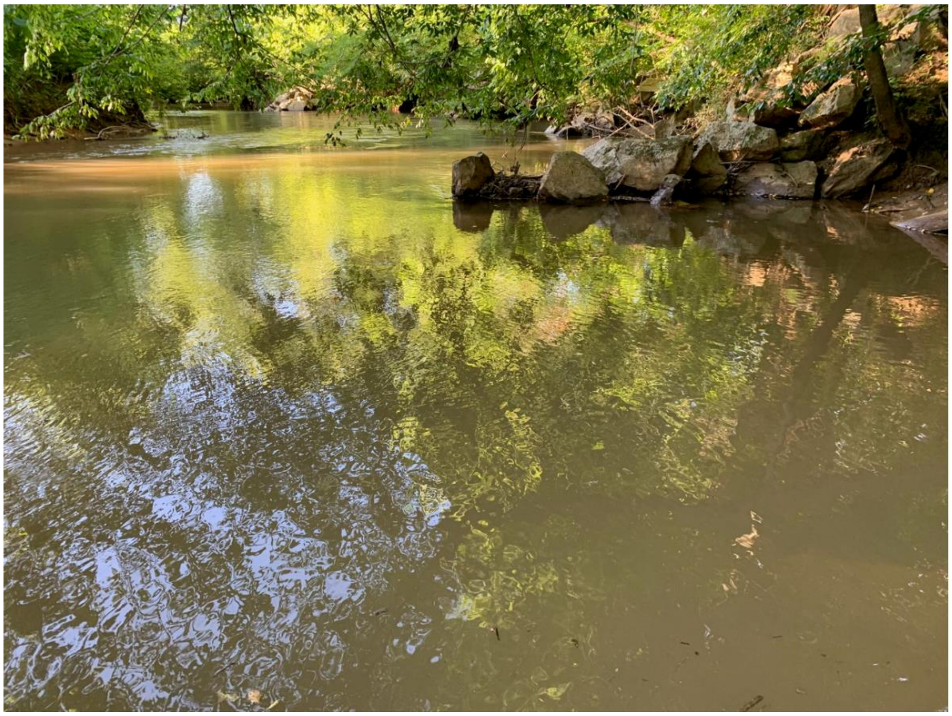


Photo 24. Woody debris dumped along erosional reach of the South Saluda River

6.3.3. Dredging

While dredging itself is not a source of sediment, it affects stream dynamics and sedimentation distribution patterns in the Watershed. Dredging removes eroded soil/sediment from drainage systems; however, it can be very harmful to streams and rivers and can lead to channel instability, head cutting, increased water velocity and scour, increased stream bank erosion, elevated suspended sediment and turbidity levels, rapid downstream sediment deposition, and damage to aquatic environments. Riparian vegetation is typically removed for operation of the dredge, which creates a point of instability. Channelization and dredging alter channel morphology and result in the disconnection of streams and rivers from adjacent floodplain systems, diminishing their ability to capture, detain, and filter floodwaters. Many tributaries and some main channels in agricultural areas of the Watershed have been channelized and dredged (Photos 10 and 25 through 29). Continued soil loss from floodplains where crops are grown not only diminishes soil quality but can also exacerbate drainage problems over time. BMPs to improve infiltration and minimize runoff can help reduce the need for dredging for drainage purposes. Streambank stabilization and reestablishment of riparian buffers can greatly benefit areas that have undergone channel alteration and can help prevent further streambank loss, particularly for reaches in which woody riparian vegetation is absent or lacking.

See Section 2.1 for details about historical dredging in Saluda Lake.

Photo 25. Sand dredging on the South Saluda River

Photos 26 and 27. Unstable riverbanks near sand dredging operation

Photos 28 and 29. Before (1997) and After (2003) channelization on the South Saluda River

7. EXISTING SEDIMENT LOAD

The existing sediment load in the Watershed was estimated using the Environmental Protection Agency (EPA) "Spreadsheet Tool for Estimating Pollutant Load" (STEPL) model (http://it.tetratech-ffx.com/steplweb/). STEPL incorporates watershed characteristics such as soils, land use, rainfall data and number of agricultural animals. The model utilizes the Universal Soil Loss Equation (USLE) to estimate sediment load (sheet and rill erosion only) from surface runoff of different land use areas and the load reductions that would result from the implementation of various BMPs. The USLE is composed of six factors to predict the long-term average annual soil loss (A). The equation includes the rainfall erosivity factor (R), the soil erodibility factor (K), the topographic factors (L and S, slope length and slope angle) and the cropping management factors (C and P, cropping management and conservation practices factors).

Different crop management factors (C) were used for each subwatershed to account for and differentiate between the relative proportion of intensively managed plasticulture row crop farming (fruits and vegetables) and less intensively managed croplands (soybeans and corn): The factors were selected based on the types and relative distribution of crops and soil management practices observed in each subwatershed.

- Oolenoy River subwatershed: a C factor of 0.8
- Upper South Saluda River subwatershed: a C factor of 0.6
- Middle Saluda River subwatershed: a C factor of 0.5
- Lower South Saluda River subwatershed: a C factor of 0.2

Figures 7 and 8 show the range and distribution of K values and HSG values used in the STEPL model. Values for other factors were selected based on published factors for the corresponding counties.

Table 9 shows estimated sediment loading results by subwatershed for each sediment source.

Table 9. Current sediment load estimates in the North Saluda River – Saluda Lake Watershed

Source		Sediment Load (ton/year)			
	Middle Saluda	Upper South Saluda	Lower South Saluda	Oolenoy	Total Watershed
Urban	682	183	145	326	1335
Cropland	1282	1251	247	2589	5369
Pastureland	108	63	400	290	863
Forest	639	708	349	796	2492
Total	**2,711**	**2,206**	**1,142**	**4,002**	**10,060**

The STEPL model estimates approximately 10,060 tons of sediment erode from the Watershed into the South Saluda River and its tributaries each year. The data input into STEPL is included in Appendix E.

Photo 30. Confluence of the Oolenoy River (top) and Upper South Saluda River (bottom)

The following pie charts show the estimated sediment load by land use for each subwatershed (Figures 29 through 34). The data input into STEPL is included in Appendix F. According to these estimates, 40% of the total sediment load from the Watershed is attributed to erosion from the Oolenoy River subwatershed (Figure 29), and 27% and 22% is attributed to the Middle and Upper South Saluda, respectively. Overall, 53% is attributed to erosion from croplands (Figure 30).

Figure 29. Estimated sediment load by subwatershed

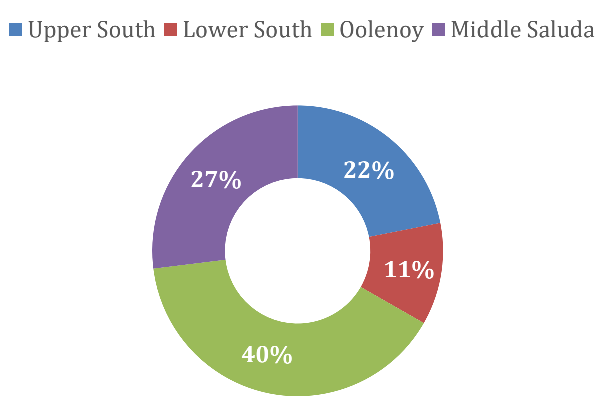


Figure 30. Estimated sediment load by land use in the South Saluda Watershed

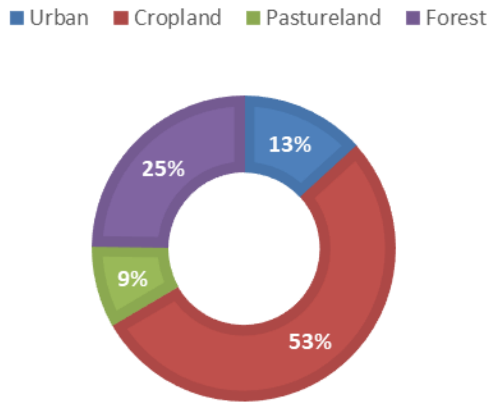


Figure 31. Estimated sediment load by land use in the Middle Saluda River subwatershed

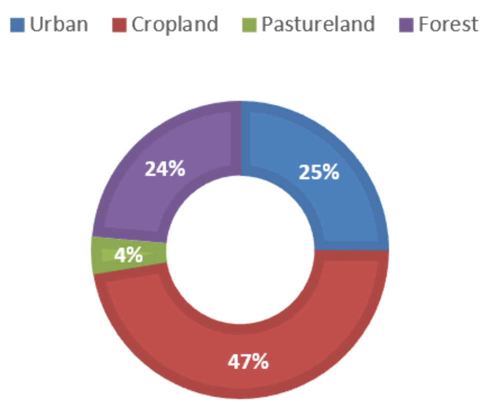


Figure 32. Estimated sediment load by land use in the Upper South Saluda River subwatershed

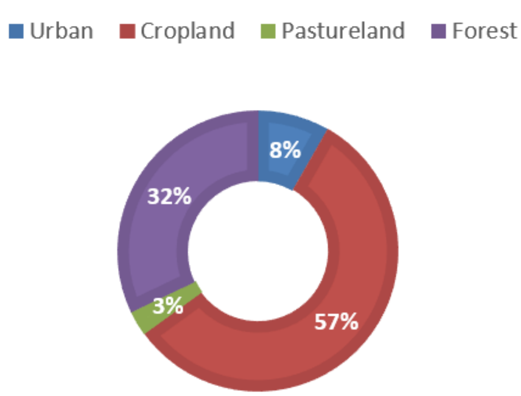


Figure 33. Estimated sediment load by land use in the Lower South Saluda River subwatershed

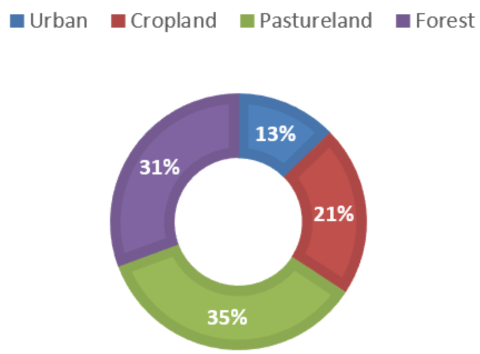
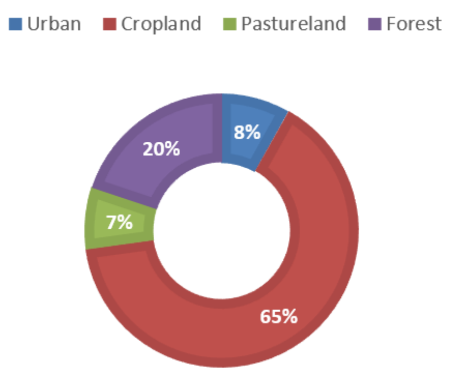


Figure 34. Estimated sediment load by land use in the Oolenoy River subwatershed



It is important to note that STEPL calculates sheet and rill erosion only and does not account for gully erosion, streambank erosion, or in-stream erosion of bedload sediment. Therefore, load calculations do not include legacy sediment that is already in the streams and rivers, which is significant. However, the BMPs in this Plan do address gully erosion and streambank erosion.

The South Saluda River and the North Saluda River drain to Saluda Lake. A 2018 Saluda Lake sedimentation analysis conducted by Easley Combined Utilities concluded the rate of sediment deposition in the lake, both from runoff and from legacy sediment that is moving down the watershed, was approximately 54,870 tons per year during the six years after the lake was dredged. The full Saluda Lake Sedimentation Analysis report can be found in a Appendix C of the Watershed Plan for Sediment in the North Saluda River – Saluda Lake. Since the study, there have been several flooding events that have resulted in accelerated erosion and sedimentation and the mobilization of significant sediment loading to the lake. In February 2020, the Saluda River below the dam crested at 16.1 feet. This was in response to a 5 to 10 year rain event, which resulted in a 50-100 year flood elevations in the Upper Saluda Watershed. Many floodplain areas in the Upper Saluda Watershed have lost flood attenuation function due to historic and current intensive agricultural management practices that have caused not only soil loss but also loss of infiltration and water holding capacity. Soils in these areas have been adversely impacted by frequent tillage and soil compaction and are highly susceptible to runoff and erosion.

8. WATERSHED PLAN GOALS

The overarching goal for the Watershed Plan for Sediment in the South Saluda River is to improve water quality by reducing sediment runoff to the South Saluda River. The following goals and objectives were established by the TASC to help meet this central goal:

Goal #1 – Improve water quality in the South Saluda River Watershed (reduce sediment)

- Ensure that waterbodies in the South Saluda River Watershed meet or exceed water quality standards
- Ensure that recreational use in South Saluda River is not diminished
- Ensure that waterbodies in the South Saluda River Watershed support aquatic life and restore trout populations

Goal #2 - Protect and maintain water quality, recreational use, and aquatic habitat in the South Saluda River Watershed

- Work with Greenville and Pickens Counties to improve land use regulations and enforcement to guide new development in a manner that protects waterbodies in the South Saluda River Watershed
- Ensure that recreational use in South Saluda River is not diminished
- Coordinate efforts with other groups in the Watershed focused on land conservation and protection strategies

Goal #3 - Build community support for the protection and enhancement of the land and water resources of the South Saluda River Watershed

- Strengthen ties with the local farmers and residents to promote and implement the Watershed Plan and encourage environmental stewardship within the South Saluda River Watershed

9. IMPLEMENTATION PLAN

9.1. Best Management Practices and Programmatic Measures

The implementation plan for the South Saluda River Watershed includes BMPs and programmatic measures to reduce sediment runoff, as well as protective measures to prevent runoff.

BMPs and programmatic measures were identified and evaluated to address the sediment sources identified and prioritized during the development of this Watershed Plan. A list of BMPs and programmatic measures selected for each source type in the Watershed is outlined in Table 10 and further described in the following sections.

Grant funding can be pursued to provide cost share assistance for the installation of BMPs to reduce sediment loadings from agricultural land and for some of the programmatic measures, such as public education and a Land Conservation Easement Program. Because participation in the implementation program is voluntary, and since landowners are traditionally somewhat skeptical of interference in their operations, effective outreach will be crucial in reaching the appropriate participants. Outreach efforts will aim to recruit farms which would have the biggest impact on water quality improvement and protection.

The following sections describe best management practices and measures and the anticipated level of participation for implementation, which was used to determine sediment load reductions.

Table 10. Best management practices and programmatic measures for sediment sources in the South Saluda River Watershed

Sources	BMPs	Programmatic Measures
Agricultural		
Runoff from Croplands	• Cover crops and intercropping • Residue and tillage management • Vegetated filter strips • Field border • Conservation cover • Culvert/ditch stabilization • Farm access road stabilization • Vegetated waterways • Sediment control basins • Terracing and contouring • Vegetated riparian buffers • Streambank stabilization • Stream improvement • Critical area planting • Wetland restoration/enhancement • Conservation plans	• Landowner lease conditions (e.g. cover crops, buffers, soil stabilization) • Workshops and field days for farmers • Education and outreach
Livestock in Streams	• Exclusion fencing/well/water trough • Loafing shed • Stream crossings • Vegetated riparian buffers • Stream bank stabilization • Conservation plans	• Land conservation easements program • Education and outreach
Runoff from Pastures	• Cross fencing/pasture planting • Heavy use area stabilization • Conservation plans	• Farm workshops and field days • Education and outreach
Urban/Rural		
Dirt Driveways, Dirt Roads and Roadside Ditches		• Education and outreach • Training citizens "Muddy Water Watch" • Report issues requiring maintenance to County or DOT
Urban Development	• Watershed signs	• Recommendations for permanent water quality buffers • Recommendations for Land development regulations • Recommendations for improving/expanding construction inspection/enforcement

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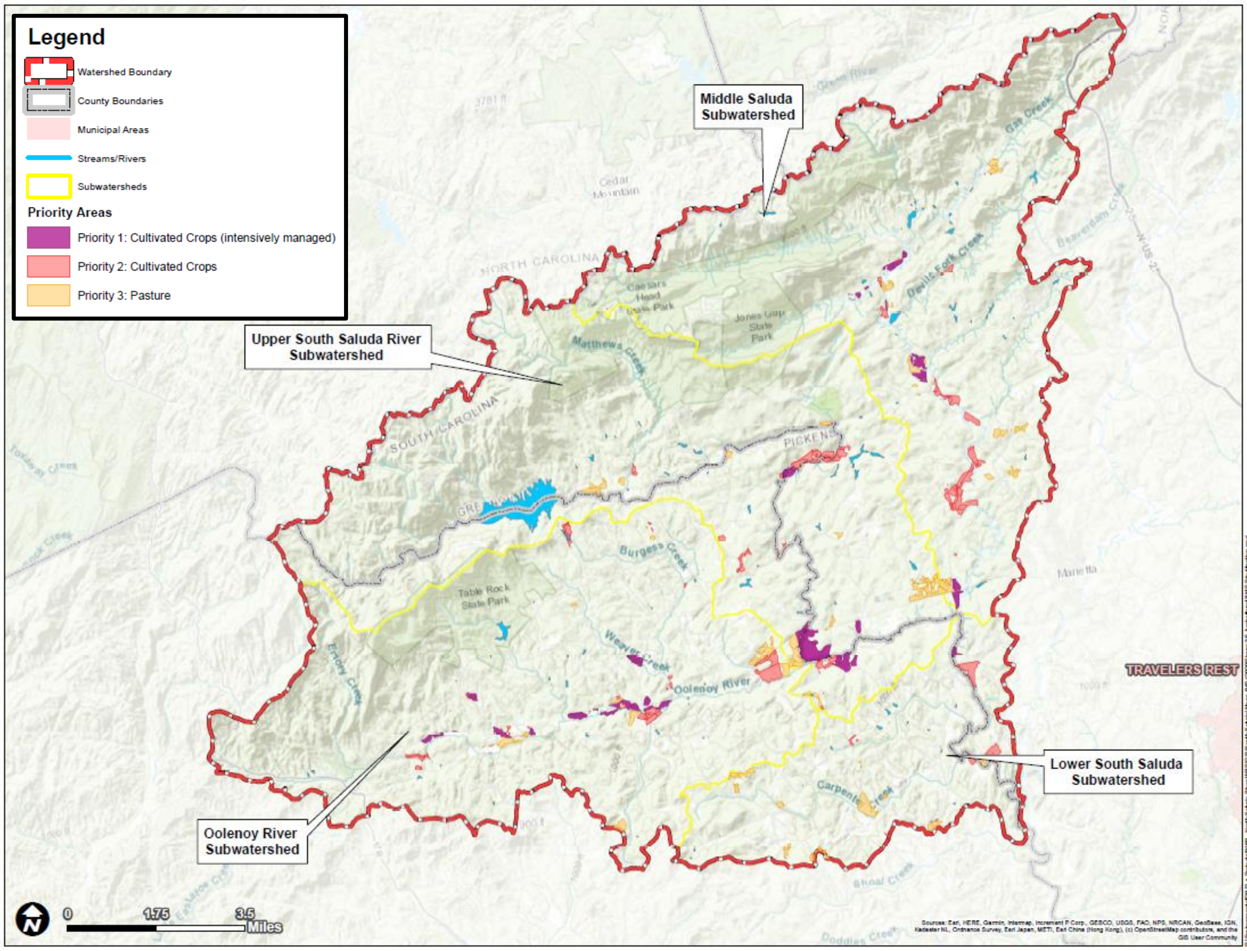
9.1.1. Agricultural Sources – Crop BMPs

It is anticipated that overall approximately 75% of the croplands in the South Saluda River Watershed will participate in implementing BMPs for sediment control, and 20% of the 75% will participate every 3 years. This is equivalent to approximately 931 acres of croplands addressed in 15 years. Intensively managed crop farms will be prioritized based on the highest potential for water quality improvements. Figure 35 shows crop farms (purple and pink) identified during the desktop and field evaluation. Photos 31 through 36 are examples of BMPs for crop farms.

Figure 35. Agricultural BMP Prioritization



A workshop on soil health and cover crops was held in September 2019 in the South Saluda River Watershed and a number of local farmers attended and expressed interest in 319 and EQIP programs and in additional workshops and field tours, which are anticipated as part of the implementation plan. Save Our Saluda is currently working with Naturaland Trust to develop a demonstration project for agricultural BMPs on land leased for crop farming along the nearby Lower North Saluda River.

Agricultural stakeholders such as NRCS and SWCD will be asked to assist in reviewing participants' farm operations, assessing their resource concerns, developing conservation plans, recommending and selecting appropriate BMPs, technical specifications, and practice standards, and helping to ensure that BMPs are installed correctly. Table 10 provides estimated quantities of crop farm BMPs proposed for the Plan.

Photo 31. Crop farm best management practice - Riparian Buffer

Riparian buffers *are vegetated areas next to streams, rivers, and wetlands that provide protection from the impacts of adjacent land uses. They can trap sediment and other pollutants thereby providing stream and water quality protection. Riparian buffers also help provide streambank stabilization, flood control, wildlife habitat and other valuable ecosystem benefits.*

Photo 32. Crop farm best management practice – Cover Crops

Cover crops *can provide multiple benefits in a cropping system. They prevent erosion, improve soil's physical and biological properties, supply nutrients, suppress weeds, improve the availability of soil water, and break pest cycles along with providing various other benefits.*

Photo 33. Crop farm best management practice – Intercropping

Intercropping *is growing two or more crops in close proximity to each other to prevent erosion, improve soil and water quality, and provide pest management benefits.*

Photo 34. Crop farm best management practice – No Till Seeding/Planting

***No-till** farming is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till is an agricultural technique which increases the amount of water that infiltrates into the soil, the soil's retention of organic matter, and its cycling of nutrients. **No-till** protects the soil from excessive erosion, reduces soil aeration from tillage, allows organic matter to accumulate, and improves the overall health of the soil.*

Photo 35. Crop farm best management practice – Vegetated Filter Strips

*A **vegetated filter strip** is a strip of herbaceous vegetation that filters runoff and removes contaminants before they reach water bodies such as streams and wetlands or water sources. They help reduce soil erosion and protect water quality, among other benefits.*

Photo 36. Crop farm best management practice - Ditch Stabilization

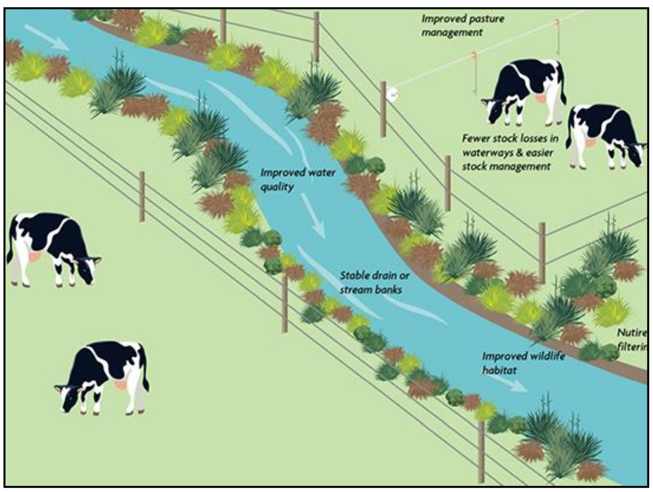
***Ditch stabilization** involves vegetative and/or structural measures to stabilize drainage ditches and prevent erosion and sedimentation from entering downstream waterbodies.*

9.1.2. Agricultural Sources – Livestock BMPs

It is anticipated that overall approximately 25% of the livestock farms in the South Saluda River Watershed will participate in projects implementing BMPs for sediment control, and 20% of the 25% will participate every 3 years. This is equivalent to approximately 619 acres of livestock farms (purple) will be addressed in 15 years. Livestock farms located near waterbodies will be prioritized to maximize the potential for water quality improvements. Figure 35 shows the livestock farms (orange) in the Watershed.

As with crop farms, agricultural stakeholders, such as NRCS and SWCD, will be asked to assist in reviewing participants' farm operations, assessing their resource concerns, developing conservation plans, technical specifications and practice standards, and recommending and selecting appropriate BMPs, and helping to ensure they are installed correctly. The BMPs listed in Table 10 and shown in and Photos 37 through 41 are typical BMPs which will be installed to reduce the amount of sediment from livestock farms entering waterbodies. Table 11 gives quantities of livestock BMPs proposed for the Plan.

Photo 37. Livestock farm best management practice - Livestock Exclusion



*A **livestock exclusion** system is a system of permanent fencing to exclude livestock from streams and critical areas not intended for grazing to improve water quality and stream health. Benefits include reduced soil erosion, sedimentation, pathogen contamination and pollution from dissolved, particulate, and sediment-attached substances. The system includes an alternative water source (typically a well), which also improves livestock health.*

Photo 38. Livestock farm best management practice – Heavy Use Area Stabilization

Heavy use area stabilization *is the stabilization of areas frequently and intensively used by people, animals or vehicles by establishing vegetative cover, surfacing with suitable materials, and/or installing needed structures to protect or improve water quality.*

Photo 39. Livestock farm best management practice – Cross Fencing

Cross-fencing *divides an area to allow rotational grazing of animals. Rotational grazing can help control erosion and prevent sediment runoff, increase pasture yields, improve pasture quality, provide a healthier plant community, better livestock health and performance, and reduced costs to the landowner while providing pasture management flexibility.*

Photo 40. Livestock farm best management practice – Stream Crossings

Stream crossings *provide a hard, stable area where livestock or equipment can cross streams without damaging the streambed or banks thereby maintaining a higher riparian area/stream quality. They help keep farm water cleaner which can provide health benefits to animals and crops. Stream crossings with stream bank fencing are cost-effective BMPs that can help protect and improve water quality.*

Photo 41. Best management practice – Stream Stabilization

***Streambank stabilization** refers to vegetative and/or structural treatment(s) used to stabilize and protect banks of streams, lakes or other waterbodies to prevent the loss of land and reduce the downstream effects of sediment resulting from bank erosion.*

9.1.3. Barriers to Agricultural Implementation

Barriers to farmer participation in BMP implementation projects include a reluctance to change common practices and resistance to perceived interference of their operations. Several other barriers are leased properties (different owner and operator), language barrier with Hispanic farmers, and hesitancy to reduce acreage for BMPs or conservation easements. Fortunately, many of the BMPs selected to reduce sediment in the streams will also improve soil health, the health of livestock animals, and help preserve land for future generations. Public education will help emphasize the benefits to the landowners.

9.1.4. Urban/Rural Sources

In general, urban/rural sources of pollution should be addressed by the MS4s (Greenville and Pickens Counties and the Department of Transportation). However, it is not possible for County personnel to know the locations of all areas of concern for sediment runoff at all times. Therefore, in order to help address the current urban sources of sediment in the Watershed (land development sites, dirt driveways, dirt roads and roadside ditches), the Plan includes offering "Muddy Water Watch" training to residents in the Watershed to recognize potential issues with sediment runoff (e.g. Photos 42 and 43), whether BMPs are properly installed and maintained, where to report various types of issues, and how and when to follow-up. Greenville and Pickens County, SCDOT Stormwater, and SCDHEC staff could benefit from citizens helping to make them aware of problems so that they can determine the corrective actions and enforcement measures needed. A "Who to Call" list of local jurisdictions in the Upper Saluda Watershed for water quality concerns is available on the Save Our Saluda website:

https://www.saveoursaluda.org/images/Who%20to%20Call.pdf

Photo 42 and Photo 43. Examples of issues for Muddy Water Watch

Eroding streambanks in urban/rural areas are an additional source of sediment in the Watershed. Stream stabilization is an additional BMP to address these eroding streambanks in these urban/rural areas. See Section 9.2 for protective measures identified to address future urban sources of sediment.

9.1.5. Other Sources

This Plan includes incorporating silviculture sources of sediment in the "Muddy Water Watch" training for residents in the Watershed to recognize sediment issues related to forestry operations, whether BMPs are properly installed and maintained, where to report forestry related issues and how and when to follow-up. The SC Forestry Commission has only one inspector in 20 counties, and thus could benefit from citizens helping to make them aware of problems so that they can determine whether the issue is a water quality violation and if so, report to SCDHEC for enforcement.

9.1.6. BMP Prioritization

The following order of prioritization has been selected for BMP implementation. Land areas are shown in Figure 35. Priorities were determined based on the sediment load estimations by source and by subwatershed (Section 7):

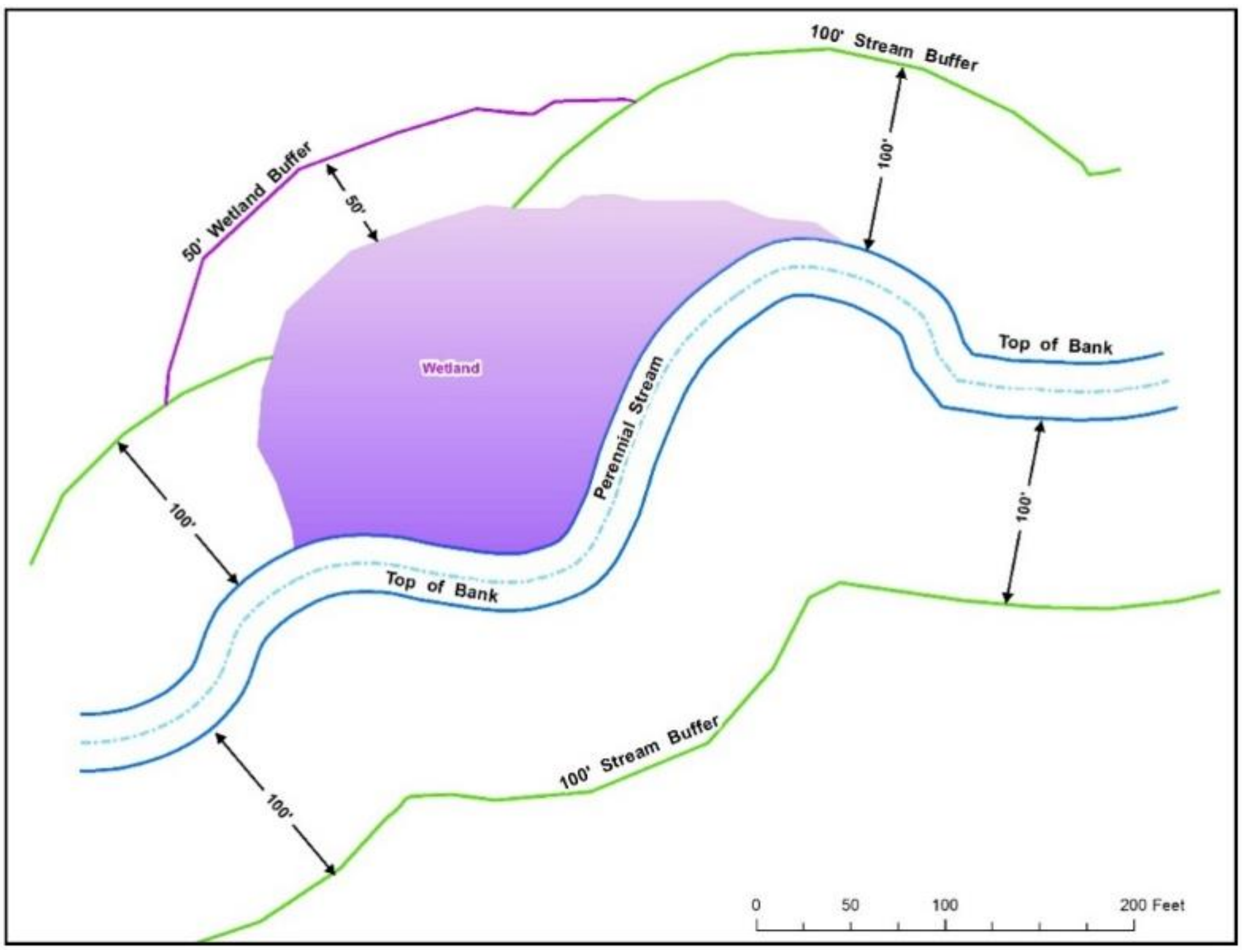
- **Priority 1**: Intensively managed row crop farms (plasticulture) in the Middle Saluda, Upper South Saluda and Oolenoy River subwatersheds
- **Priority 2**: Other cultivated/crop farms in the South Saluda River Watershed
- **Priority 3**: Livestock farms throughout the Watershed

9.2. Programmatic Measures

9.2.1. Land Development Regulations

In addition to current urban-related sources, future urban development can result in additional sediment pollution in the Watershed. The Plan includes continuing pursuit of improvements in land development regulations (such as permanent water quality buffers (Figure 36), tree ordinances, and post construction stormwater standards that incentivize designs for minimal runoff). Greenville County has permanent riparian buffer requirements which are above the state minimum standards (protection only during construction). Pickens County does not have permanent water quality buffer protection requirements in the Watershed.

Figure 36. Example schematic of permanent water quality riparian buffers



9.2.2. Land Conservation

Land conservation is a tool to help protect water quality by permanently protecting existing lands from future development. It includes both land acquisition and protection through conservation easements. Conservation easements are legal agreements between a landowner and a non-profit land trust or public agency (qualified to hold such interests) that limits uses of the land while offering private landowners flexibility in managing their land. The land trust/agency is responsible for monitoring the easement area and enforcing the terms of the agreement. The land trust is responsible for monitoring the easement and enforcing its terms, including annual monitoring visits. Landowners benefit from granting conservation easements to a qualified holder through monetary or tax incentives associated with the easement value. If donating to a land trust permanently protects important conservation resources, then the donation qualifies as a tax-deductible, charitable donation. The Plan includes potential 319 grant funding to develop a land conservation easement program in the Watershed in cooperation along with project partners.

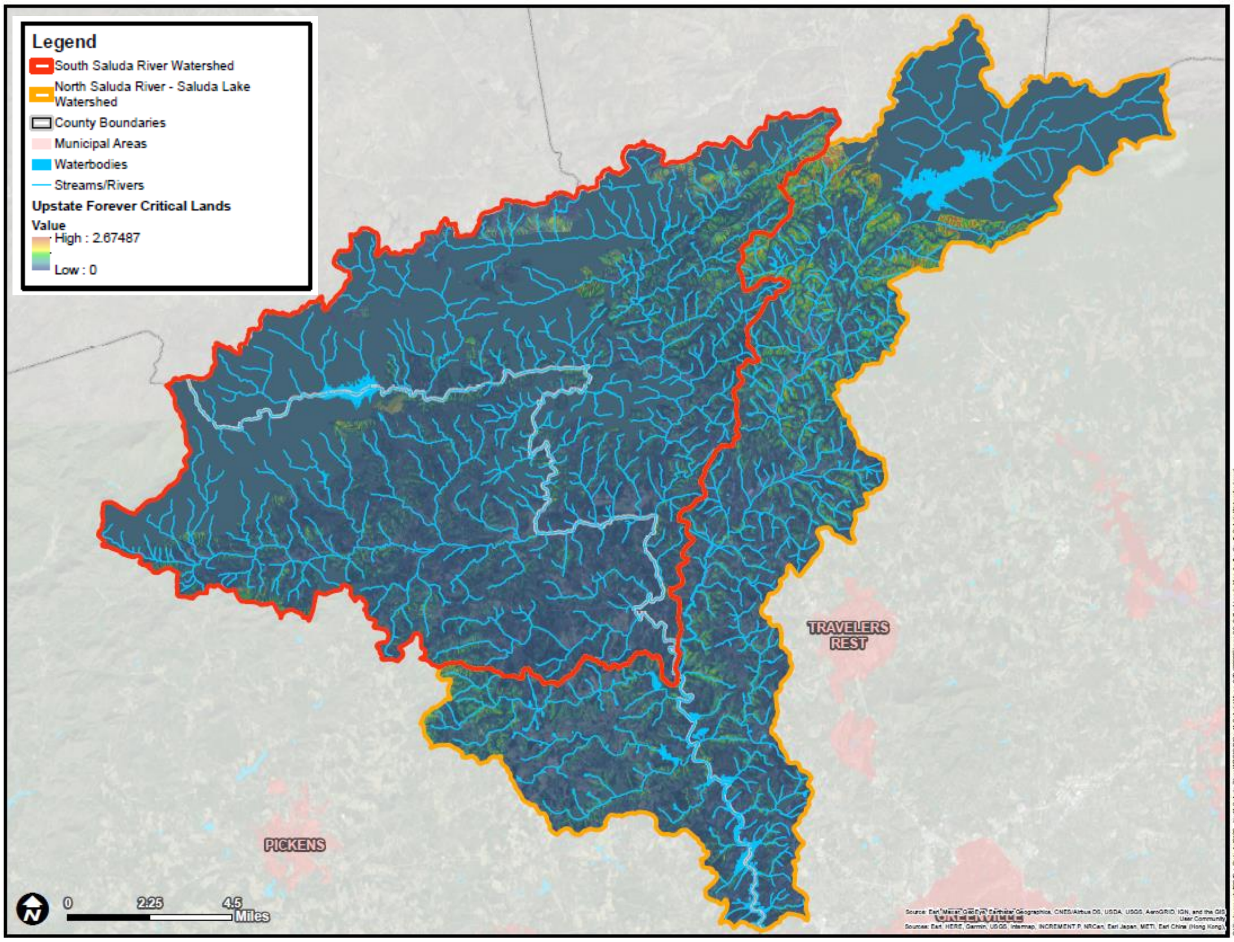
Project partners recently worked together to secure protection for water quality and conservation. In 2018 and 2019, ECU, Naturaland Trust, and Save Our Saluda cooperated to achieve conservation of 225 acres of land that includes over 15,000 feet of river front on the South and North Saluda Rivers near the confluence.

In March 2020, an expanded group that included these same stakeholders, including ECU, Naturaland Trust, Upstate Forever and Save Our Saluda and Wood, met to discuss strategies and opportunities for land conservation in the Upper Saluda Watershed.

Photo 44. Example conservation easement property

Upstate Forever, with assistance from Furman University, developed a watershed map of high value lands for protection of water quality in the Upstate. The map was developed using the Invest Model (http://naturalcapitalproject.stanford.edu/invest/) to assess ecosystem services and included factors such as mature forests, bird diversity, carbon sequestration, and areas in which water quality would be impacted if developed. Figure 37 is a map showing critical lands in the South Saluda River Watershed prioritized for protection by Upstate Forever. Lands that are currently protected are excluded and shown as low (0) priority. This map can be used to identify priority parcels for land conservation.

Figure 37. Critical Lands map for the South Saluda Watershed (Data source: Upstate Forever)



9.2.3. Public Education and Outreach during Plan Implementation

Education and outreach during implementation of the Plan will be crucial. Examples of activities include educational workshops and field days focused on soil health, cover crops, pasture management, stream restoration and riparian buffer management, estate planning, etc. These should be planned to help engage with landowners in the Watershed. The Save Our Saluda website and social media will be used to keep the public informed about the progress of implementation of the Plan. Landowners who participate in implementing BMPs will also be educated on the operation and maintenance of the BMPs.

Signs at stream crossings, entering the watershed or at participating/qualifying landowners ("Upper Saluda River Steward") are also valuable tools for raising public awareness (Photos 45 and 46).

Photos 45 and 46. Examples of public education signs

Public education and outreach activities conducted as part of the Plan development are described in Section 10.

9.3. Plan Implementation

The TASC members involved with the creation of the South Saluda River Watershed Plan to address sediment will continue to oversee the Plan implementation. Currently, the members of the TASC are:

- Clemson Cooperative Extension
- Easley Combined Utilities
- Furman University
- Greenville County
- Greenville County Soil and Water Conservation District
- Greenville County Natural Resources Conservation Service
- Greenville Water
- Mountain Bridge Trout Unlimited
- Naturaland Trust
- Pickens County
- Pickens County Soil & Water Conservation District
- Oolenoy River Watershed District
- Powdersville Water
- Renewable Water Resources
- Save Our Saluda
- South Carolina Department of Health and Environmental Control
- South Carolina Department of Natural Resources
- South Carolina Rural Water Association
- Upstate Forever

9.4. Milestones

This Plan includes milestones to meet the Watershed Plan goals outlined in Section 8 within 15 years. Interim and long term measurable milestones and the schedule are outlined in Table 11 below. As funding is obtained to implement this Plan, progress evaluations will be provided to the TASC and DHEC, and possible adjustments or revisions of the Plan may be needed.

Table 11. South Saluda River Watershed Plan measurable milestones and schedule

Sources	BMPs		Years 1 - 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15		Programmatic Measures	Years 1 - 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15
Agricultural Sources														
Crop Farms (Total estimated 1,241 acres, assuming 75% overall participation in 15 years, 931 acres)	Cover Crops, Intercropping, Vegetated Riparian Buffers, Conservation Tillage, Vegetated Filter Strips/Field Borders/Pollinator Strips, Culvert/Ditch stabilization, Farm access road stabilization, Vegetated Waterways, Sediment control basins, Terracing and contouring, Stream bank stabilization, Conservation Plans	Crop Farms, 186 acres	20%						Landowner lease conditions (buffers, stabilization requirements, etc)	✓	✓	✓	✓	✓
		Crop Farms, 186 acres		20%										
		Crop Farms, 186 acres			20%				Workshops/Field Days	✓	✓	✓	✓	✓
		Crop Farms, 186 acres				20%								
		Crop Farms, 186 acres					20%							
Livestock Farms (Total estimated 2,476 acres, assuming 25% overall participation in 15 years, 619 acres)	Exclusion fencing/well/water trough, Loafing shed, Vegetated Riparian Buffers, Stream Crossings, Cross fencing/Pasture Planting, Heavy Use Area Stabilization, Stabilization of Stream Banks, Conservation Plans	Livestock Farms, 124 acres	20%						Workshops/Field Days	✓	✓	✓	✓	✓
		Livestock Farms, 124 acres		20%										
		Livestock Farms, 124 acres			20%									
		Livestock Farms, 124 acres				20%								
		Livestock Farms, 124 acres					20%							
Urban/Rural Sources														
Eroding Streambanks	Streambank Stabilization	5,000 linear feet	✓											
		5,000 linear feet		✓										
		5,000 linear feet			✓									
		5,000 linear feet				✓								
		5,000 linear feet					✓							
Dirt Driveways, Dirt Roads and Roadside Ditches	See Programmatic Measures								Public Education and Outreach	✓	✓	✓	✓	✓
									Training citizens "Muddy Water Watch"	✓	✓	✓	✓	✓
Urban Development	See Programmatic Measures								Recommendations for Permanent Water Quality Buffer Regulations and Management	✓	✓			
									Recommendations for Post-Construction Design Regulations		✓	✓	✓	
									Set- Up Land Conservation Program	✓				
									Implement Land Conservation Program		✓	✓	✓	✓
									Public Education Signs (50 signs)	20%	20%	20%	20%	20%

10. PUBLIC INPUT DURING WBP DEVELOPMENT

Several strategies were employed to obtain public input into the development of the Plan. The TASC was formed at the outset of the North Saluda Watershed planning project and has continued contributing during the development of this South Saluda River Watershed Plan. The partnership has since grown to twenty-one cooperating stakeholder organizations, each with a different role in the process and each with valuable input to the Plan including support and guidance on technical and financial decisions.

A workshop entitled "Improving Soil Health to Boost the Bottom Line" was held on September 24, 2019 in the Watershed that focused on soil health and runoff prevention for croplands (Appendix D). The workshop included presentations from Save Our Saluda about water quality, a USDA/NRCS Conservation Agronomist about cover crops and soil health and Upstate Forever about an agricultural conservation easement program.

The workshop was designed to meet several goals:

- To obtain input from local farmers and other stakeholders on sources of sediment,
- To educate farmers on the importance of stabilizing soil, and
- To begin networking with landowners for current and future grant funding for agricultural BMPs in the Upper Saluda Watershed.

A video entitled "Farmer Scientists: Five Trials in Managing for Soil Health" about five South Carolina farmers' experience with cover crops and no-till farming was presented during lunch. A demonstration of a rainfall simulator on various cover crop types was also given by the Greenville County SWCD and USDA NRCS, with support from the South Carolina Forage and Grazing Lands Coalition (Photo 47). A soil slake test was also performed to demonstrate the impact of regular tillage on soil resistance to erosion (Photo 48).

Videos of a rainfall simulator demonstration can be found on the project website: https://www.saveoursaluda.org/projects/watershed-planning.html

Photo 47. Rainfall simulator demonstration at soil health workshop

Photo 48. Soil Slake Test demonstration at Soil Health workshop

A survey of workshop attendees indicated concern for sediment in the South Saluda River and Saluda Lake, interest in more workshops and field tours particularly for cover crops, and interest in learning more about EQIP and 319 programs for assistance with BMP implementation. The surveys and the workshop flier and agenda are included in Appendix C.

Save Our Saluda also conducted online surveys in 2018 during the development of the North Saluda River and Saluda Lake Watershed Plan, and again in 2020 to obtain additional feedback from the public on concerns and solutions regarding sediment control in the Upper Saluda Watershed, and to identify landowners potentially interested in soil stabilization projects. The feedback obtained from the 23 participants in the online survey in 2020 is included in Appendix E. The following is a summary of the results from the citizen survey:

- 100% stated that water quality of local streams, rivers and lakes are very important to them,
- 96% have concerns about sediment in the Upper Saluda Rivers or Saluda Lake,
- 100% think protective measures are needed to protect local streams, rivers, wetlands and lakes as development of the watershed increases, and
- 100% support riparian buffer requirements at new development sites for protection of streams, rivers, lakes and wetlands.

Through information gathered from the workshop, the online survey, and from other communications, a database of contacts was developed of potential landowners for implementation.

The watershed project was presented at various community meetings and information regarding the project was shared on social media throughout the planning period. A manuscript of the presentation about the watershed which was presented at the 2018 South Carolina Water Resources Conference can be found in Appendix I of the Watershed Plan for Sediment in the North Saluda River and Saluda Lake.

Filming for a project video is underway, which will help raise awareness of issues related to sediment in the Watershed and resources available to help support restoration and protection efforts. Photos for the video have been collected during flights across the Watershed.

For additional information about public education activities outlined for Plan implementation, see Section 9.

11. MEASURES OF SUCCESS

11.1. Monitoring Plan

11.1.1. SCDHEC Monitoring

According to the 2020 State of South Carolina Monitoring Strategy (SCDHEC 2020) there is only one active ambient water quality monitoring station in the South Saluda River Watershed: S-299, located at the bottom of the Lower South Saluda River subwatershed. To better understand the impact of project implementation, if 319 grant funding is awarded, SOS plans to request that SCDHEC activate S-103 (just below numerous crop farms in the floodplains of the Oolenoy River).

11.1.2. Easley Combined Utilities Monitoring

Easley Combined Utilities plans to continue to monitor turbidity in Saluda Lake at the intake to their water treatment plant. Turbidity is measured daily.

11.1.3. Greenville County Monitoring

Greenville County plans to continue to collect continuous turbidity data for the Middle Saluda River at Tilley Road.

There currently is not a continuous water quality monitoring station on the South Saluda River. Greenville County and/or other cooperating organizations could consider partnering to establish a continuous monitoring station in the lower South Saluda Watershed at S-299. This would mirror watershed monitoring for the North Saluda Watershed, in which there is both an SCDHEC ambient monitoring station and a county continuous monitoring station in the same location in the lower watershed area.

11.1.4. University Monitoring

Additional water quality monitoring could include future studies conducted through Furman University and/or Clemson University.

11.1.5. Adopt-A-Stream Volunteer Monitoring

There are currently no active SC Adopt-A-Stream (SCAAS) volunteer monitoring sites within the South Saluda Watershed. There are five inactive sites located across the broader Upper Saluda Watershed: Oil Camp Creek, Middle Saluda River, South Saluda River, North Saluda River, and Saluda Lake. Volunteer monitoring data collected by citizens certified through the SCAAS program, particularly macroinvertebrate data, could be useful for helping to monitor and assess water quality throughout and following Plan implementation. More information about SCAAS can be found at: https://www.clemson.edu/public/water/watershed/scaas/index.html.

11.2. Sediment Loading Sources

11.2.1. Evaluation Method

In addition to evaluation of monitoring data proposed above, the success of this Plan will be evaluated based on the following criteria as defined for each source:

Agricultural Sources

1. Crop Farms
   - The quantity of crop farmers within the watershed who participate in outreach initiatives
   - The quantity of crop farmers who develop conservation plans
   - The quantity of BMPs that are implemented at crop farms
   - The quantity of landowners that update their lease conditions
2. Livestock Farms
   - The quantity of livestock farmers within the watershed who participate in outreach initiatives
   - The quantity of livestock farms who develop conservation plans
   - The quantity of BMPs that are implemented at livestock farms

Follow up surveys will be conducted to determine if there has been a change in attitudes, knowledge, and future conservation efforts regarding agricultural practices.

Urban/Rural Sources

- The quantity of sediment-related illicit discharges reported to counties and DOT
- The acres of land with land conservation easements
- Improvements in post-construction stormwater regulations
- The quantity of watershed/stream signs installed
- The quantity of citizens who participate in outreach initiatives

Follow up surveys will be conducted to determine if there has been a change in attitudes and knowledge about water quality.

11.2.2. Anticipated Sediment Load Reductions

Implementation of BMPs on agricultural properties is voluntary.

Agricultural – Crop Farm Sources

The Plan assumes BMP implementation/plan participation by 75% of crop farms over 15 years. Sediment load reductions for crop farm sources were estimated using this participation rate. Because current practices at crop farms in the Watershed typically include leaving soils unstabilized between cash crops, it is anticipated that the use of cover crops and other BMPs would result in a 50% reduction in sediment load from these sources. This percent reduction was applied to the sediment load coming from crop farms. Therefore, based on these assumptions, it was determined that BMP implementation will reduce sediment input from crop farm runoff to the South Saluda River Watershed by an estimated 2,013 tons per year throughout the duration of this 15 year Plan. Estimated current annual sediment loadings and load reductions for typical crop farms and crop farm BMPs are detailed in Section 7. Table 12 provides details of the estimated load reduction calculations to the South Saluda River Watershed from proposed BMPs by Year 15.

Agricultural – Livestock Sources

As noted above, implementation of BMPs on agricultural properties is voluntary. The Plan assumes BMP implementation/plan participation by 25% of livestock farms over 15 years. Sediment load reductions for livestock sources were estimated using this participation rate. Because it is anticipated that the bulk of the livestock load reductions will result from stream exclusion fencing with alternative water sources, the 40% sediment load reduction factor cited for "off stream watering with fencing" was applied to the livestock sediment load of 25% of the livestock farms: (Simpson and Weammert 2009). Therefore, based on these assumptions, it was determined that BMP instllation will reduce sediment input from livestock areas to the South Saluda River Watershed by an estimated 86 tons per year once the 15-year Plan is implemented. Estimated current annual sediment loadings and load reductions for typical livestock BMPs are detailed in Section 7. Table 12 provides details of the estimated load reduction calculations to the South Saluda River Watershed from proposed BMPs by Year 15.

Urban/Rural Sources

The education and implementation of "Muddy Water Watch" will have some effect on sediment load from urban sources in the Watershed, though it is difficult to quantify. The other urban source BMPs which include watershed signs, a Land Conservation Program and improved land development regulations are protective in nature and thus would prevent future sediment load, but will not reduce current load.

Table 12. Estimated load reductions to the South Saluda River Watershed from proposed BMPs by Year 15

Loading Source	BMPs/ Load Reduction Efficiencies (STEPL)	Existing Sediment Loading (tons/yr)	Comments	Estimated % participating	Estimated % Reduction	Sediment Load Removed by BMPs (tons/yr)
Agricultural - Croplands	*Total loading	5,369				
	Cover Crops/Intercropping (0.2) Conservation Tillage (0.40-0.77), Vegetated Riparian Buffers (0.53 - 0.59) Vegetated Filter Strips/Field Borders, Culvert/Ditch stabilization, Access road stabilization, Vegetated Waterways, Sediment control basins (0.80), Terracing (0.4) Contour Farming (0.34) Streambank stabilization (0.75) Conservation Plans		75% crop acreage participate of approximately 1,241 acres: 931 acres participating	75%	50%	2,013
Agricultural - Livestock	*Total loading	863				
	Livestock exclusion fencing (0.62) Alternative Water Supply (0.19) Critical Area Planting (0.42) Heavy Use Area Protection (0.33) Vegetated Riparian Buffers (0.53-0.59) Stream bank stabilization with fencing (0.75), Loafing shed, Stream Crossings, Conservation Plans		25% livestock acreage participate of approximately 2,476 acres: 619 acres participating	25%	40%	86
			TOTAL LOAD REDUCTIONS			**2,099**
						21% reduction

The combination of crop farm and livestock farm sediment load reduction after the 15-year plan is implemented will be 21% reduction in sediment per year.

12. FINANCIAL NEEDS AND OPPORTUNITIES

12.1. Financial Needs

Table 13 shows the estimated costs to implement this Plan. The costs have been broken down into 3-year periods to coincide with a typical 319 grant period.

Table 13. Estimated financial needs for South Saluda River Watershed Plan implementation

Sources	BMPs		Years 1 - 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15	Programmatic Measures	Years 1 – 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15
Agricultural Sources													
Crop Farms (Total estimated 1,241 acres, assuming 75% overall participation in 15 years, 931 acres)	Cover Crops, Intercropping, Vegetated Riparian Buffers, Conservation Tillage, Vegetated Filter Strips/Field Borders/Pollinator Strips, Culvert/Ditch stabilization, Farm access road stabilization, Vegetated Waterways, Sediment control basins, Terracing and contouring, Stream bank stabilization, Conservation Plans	Crop Farms, 186 acres	$334,000					Landowner lease conditions (buffers, stabilization requirements, etc)	✓	✓	✓	✓	✓
		Crop Farms, 186 acres		$334,000									
		Crop Farms, 186 acres			$334,000			Workshops/Field Days	$10,000	$10,000	$10,000	$10,000	$10,000
		Crop Farms, 186 acres				$334,000							
		Crop Farms, 186 acres					$334,000						
Livestock Farms (Total estimated 2,476 acres, assuming 25% overall participation in 15 years, 619 acres)	Exclusion fencing/well/water trough, Loafing shed, Vegetated Riparian Buffers, Stream Crossings, Stabilization of Stream Banks, Cross fencing/Pasture Planting, Heavy Use Area Stabilization, Conservation Plans	Livestock Farms,124 acres	$166,000					Workshops/Field Days	$10,000	$10,000	$23,000	$23,000	$23,000
		Livestock Farms, 124 acres		$166,000									
		Livestock Farms, 124 acres			$166,000								
		Livestock Farms, 124 acres				$166,000							
		Livestock Farms, 124 acres					$166,000						
Urban/Rural Sources													
Eroding Streambank	Stream Stabilization	5,000 linear feet	$250,000										
		5,000 linear feet		$250,000									
		5,000 linear feet			$250,000								
		5,000 linear feet				$250,000							
		5,000 linear feet					$250,000						
Dirt Driveways, Dirt Roads and Roadside Ditches	See Programmatic Measures							Public Education and Outreach	See above	See above	See above	See above	See above
								Training citizens "Muddy Water Watch"	$13,000	$13,000	$13,000	$13,000	$13,000
Urban Development	See Programmatic Measures							Recommendations for Permanent Water Quality Buffer Regulation and Management	✓	✓			
								Recommendations for Post-Construction Design Regulations		✓	✓	✓	
								Set- Up Land Conservation Program	$100,000				
								Implement Land Conservation Program		$150,000	$150,000	$150,000	$150,000
								Watershed Signs (50 signs)	$10,000	$10,000	$10,000	$10,000	$10,000
TOTAL Per 3-Year Period			$750,000	$750,000	$750,000	$750,000	$750,000		$143,000	$193,000	$193,000	$193,000	$193,000
											TOTAL	**$4,665,000**	

12.2. Watershed Manager

This Plan reinforces the need for ongoing support for a watershed manager to address current and future water quality issues in the Upper Saluda River Watershed above Saluda Lake and to facilitate implementation of this Plan. Easley Combined Utilities is currently providing financial support to Save Our Saluda for watershed management services for the Upper Saluda Watershed above Saluda Lake. There are currently no such positions within any local government, private or non-profit organizations specifically for this purpose.

12.3. Grant Funding Opportunities

Several types of grant and self-supporting funding may be available to implement watershed restoration and protection practices and land conservation measures outlined in this Watershed Plan.

Nonpoint Source Grants Programs (319 Grants)
SCDHEC receives an annual grant allocation from EPA to implement nonpoint source abatement strategies as described in the state's Nonpoint Source Management Plan. A portion of these funds are passed on through a competitive grant process to stakeholder groups, government entities, or other agencies interested in conducting projects that reduce or prevent nonpoint source water pollution through the implementation of an approved Watershed Plan that addresses impaired waters. These funds are known as Section 319 grants and pay up to 60% of eligible project costs, with the applicant providing a 40% non-federal match.

NRCS Programs
The USDA NRCS has several programs for watershed protection:

The Environmental Quality Incentives Program (EQIP) is a voluntary program administered by the USDA NRCS that provides financial and technical assistance to farmers to help plan and implement conservation practices that improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland.

In South Carolina, EQIP will pay 75 percent of the costs of eligible conservation practices under the general sign-up. Eligible landowners who are historically underserved, of limited resources, socially disadvantaged, and beginning farmers are eligible for 90 percent cost share. A ranking tool is used to prioritize applications based on the resource concerns that each county selected. Farms within an approved TMDL watershed and farms that are part of a 319 implementation grant are typically ranked high to receive EQIP funds. Therefore, landowners may apply for EQIP funds to potentially maximize the effect of 319 grant funds.

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to landowners, land trusts, and other entities to help protect, restore, and enhance wetlands, grasslands, and working farms and ranches through conservation easements.

The Regional Conservation Partnership Program (RCPP) promotes coordination of NRCS conservation activities with partners to provide assistance to producers and landowners through partnership agreements and through program contracts or easement agreements. Upstate Forever has received an RCPP award to support local conservation efforts to protect critical lands in the Upstate area for water quality, with an emphasis on priority farmland.

The Conservation Stewardship Program (CSP) helps agricultural producers maintain and improve their existing conservation systems.

The National Water Quality Initiative (NWQI) is a partnership among NRCS, state water quality agencies, and the U.S. Environmental Protection Agency to identify and address impaired waterbodies through voluntary conservation. NRCS provides targeted funding for financial and technical assistance in small priority watersheds. In FY19, NRCS expanded the scope of NWQI to include source water protection.

New provisions of the 2019 Farm Bill require that ten percent of NRCS conservation funding be allocated for source water protection in collaboration with local water utilities in priority watersheds. None of the 12-digit subwatersheds in the Upper Saluda Watershed are designated as priority watersheds for this purpose.

Other Grant Sources

Other grant sources may be available to help with funding needs. These include private grants from foundations, corporations, businesses, and individuals, and additional financial and in-kind support from cooperating partner organizations.

12.4. Self-Supporting Funding

Land Conservation Fund

Utilities, counties, and/or local municipalities could consider developing a local land conservation bank to fund land conservation in the Watershed. Purchased land or land protected through conservation easements can serve to protect water quality and downstream drinking water sources and help mitigate the impact of future development. The fund could help support land acquisition and/or costs associated with setting up and maintaining conservation easements on critical riparian lands that have been prioritized for water quality protection.

One example of a Land Conservation fund in South Carolina is the Savannah River Clean Water Fund (SRCWF) which arranges financing and uses partnerships to stretch and multiply conservation investments and reach conservation goals on a regional or watershed scale. The fund has five water utilities signed on to provide approximately $1,000,000 annually for Land Conservation and Management. The SRCWF has hired an executive director, constituted a board of directors and received their non-profit, tax exempt status. The SRCWF has concluded that high priority lands should be permanently protected, identified conservation easements as the most cost-effective tool, and recognizes that important but less critical lands can help water quality through adoption and use of appropriate land management practices. This results in a total financial need (with cost share contributions) of $67 Million. Assuming individual landowner transactions over multiple decades, the SRCWF's goal is to raise on average $2 Million per year to implement their plan for Land Conservation and Management.

Stormwater Utility Fee

Greenville County has a stormwater utility fee that could help fund implementation of portions of the Watershed Plan. Pickens County does not have a stormwater utility fee.

Landowner Support

If 319 grant opportunities are made available for implementation of this Plan, landowners could be asked to provide match for installation of BMPs to satisfy match requirements of the grant. Some landowners may be able to perform in-kind labor as a way to match these funds.

13. TECHNICAL ASSISTANCE

Assistance from local agricultural and cooperative extension agencies will be crucial to recruiting landowners and developing conservation plans and recommendations for agricultural BMPs. The participation of the TASC will impact the ability to conduct an effective and efficient social marketing campaign and ensure implementation of the Plan. A consultant may be needed at times to assist with tasks such as project oversight, stream restoration design and permitting, reporting, and/or social marketing.

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APPENDIX A
FIGURES

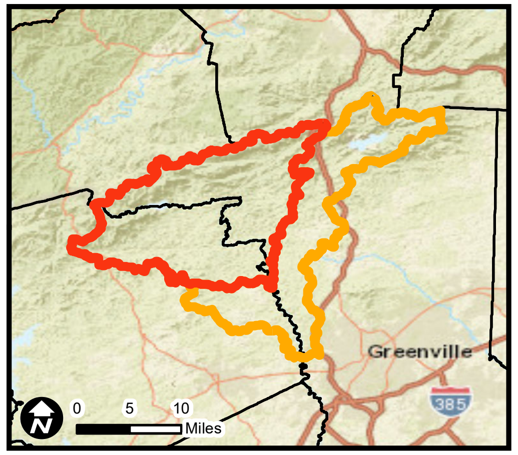

Figure 1. North and South Saluda Watershed

South Saluda River Watershed
Greenville and Pickens County,
South Carolina

Legend

- South Saluda River Watershed
- North Saluda River - Saluda Lake Watershed
- County Boundaries
- Streams/Rivers
- Drinking Water Reservoirs
- MS4 Designation
- Approved TMDL Watersheds
- Drinking Water Intakes

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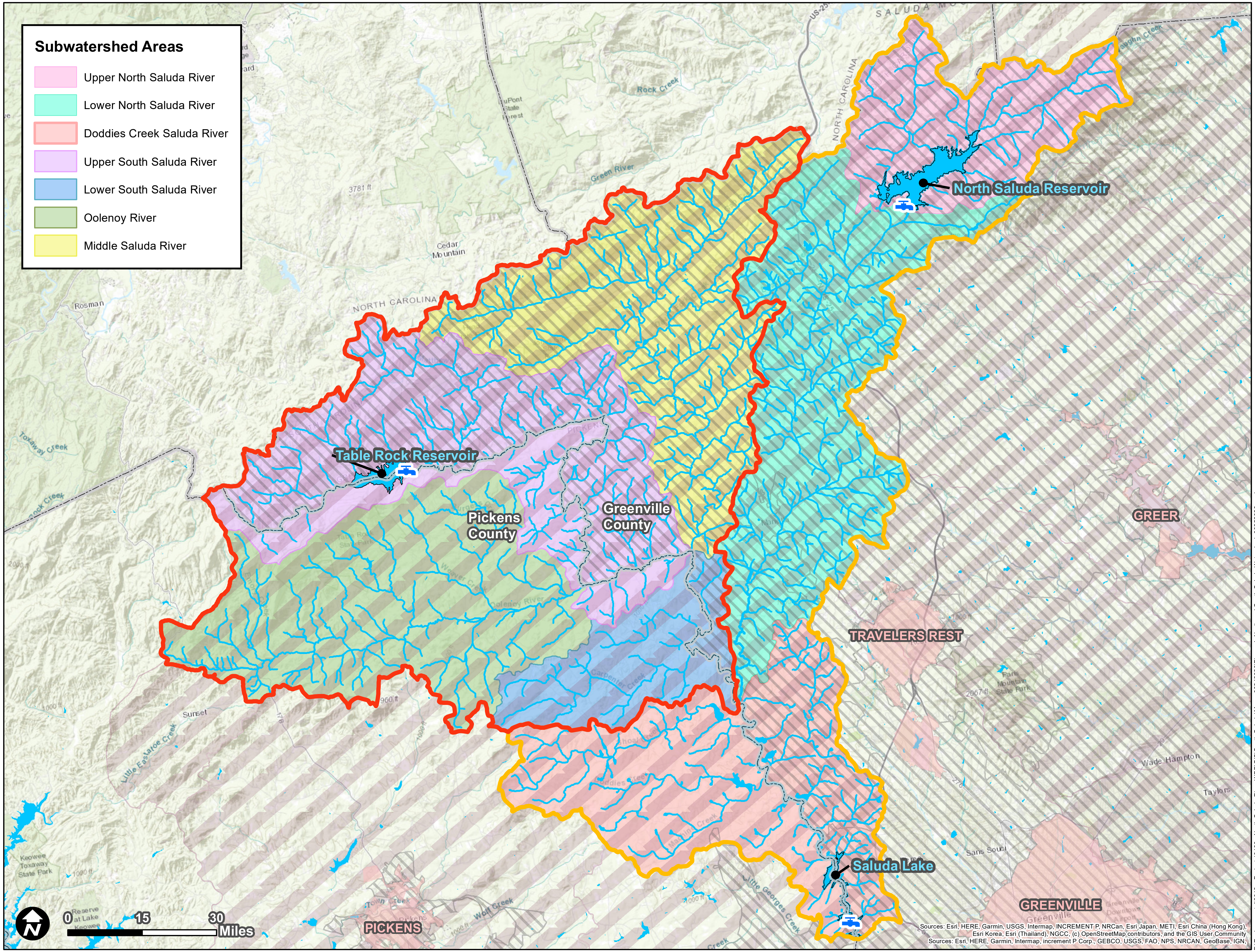

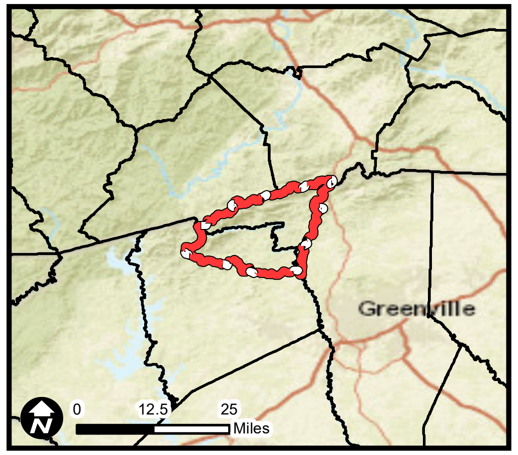

Figure 2. South Saluda River Watershed

South Saluda River Watershed
Greenville and Pickens County, SC

Legend

- Watershed Boundary
- County Boundaries
- Waterbodies
- Municipal Areas
- Approved TMDL Watersheds
- Streams/Rivers
- NPDES Discharges
- Surface Water Intake

Water Quality Monitoring Stations

- Impaired WQMS
- WQMS
- Macroinvertebrate Stations

SCDHEC Monitoring Stations- 303(d) Impaired Waters

- Turbidity Impairment
- Biological Impairment

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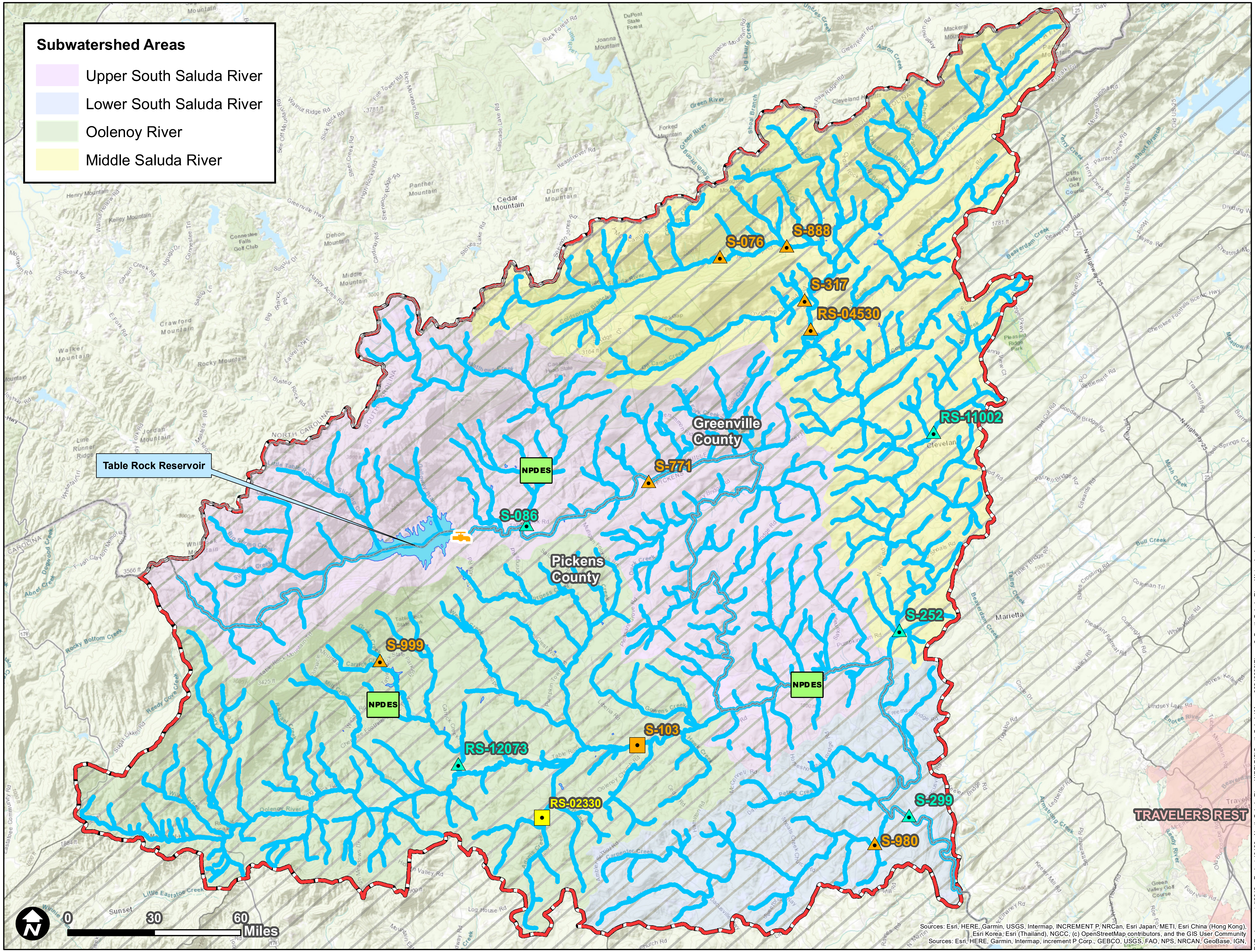

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN.

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\South Saluda\Maps_06242020\Figure 2. South Saluda River Watershed.mxd

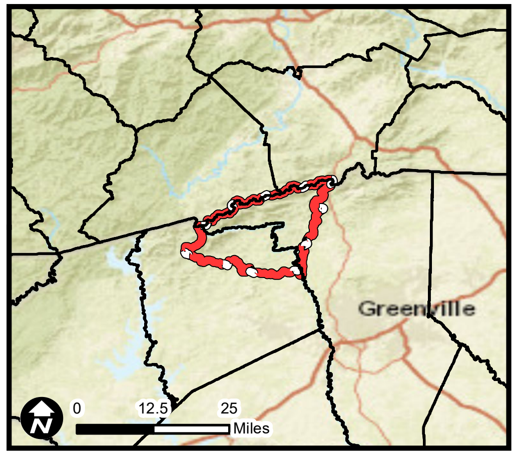

Figure 7. Map of Soil K-Factors in South Saluda River Watershed

South Salud River Watershed
Greenville and Pickens County, SC

Legend

- Watershed Boundary
- County Boundaries
- Municipal Areas
- Waterbodies
- Streams/Rivers

SCDHEC Monitoring Stations- 303(d) Impaired Waters

- Turbidity Impairment
- Biological Impairment

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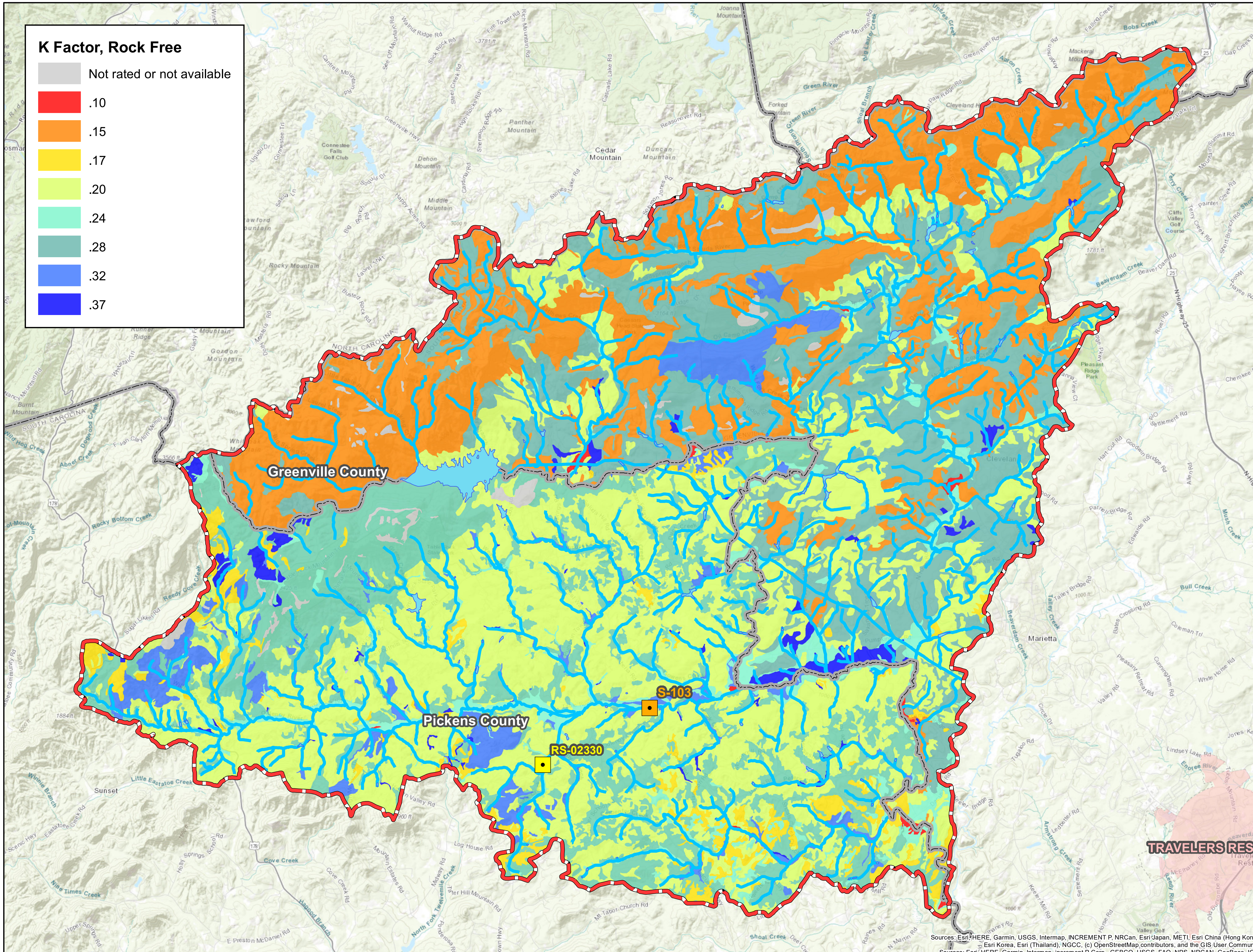

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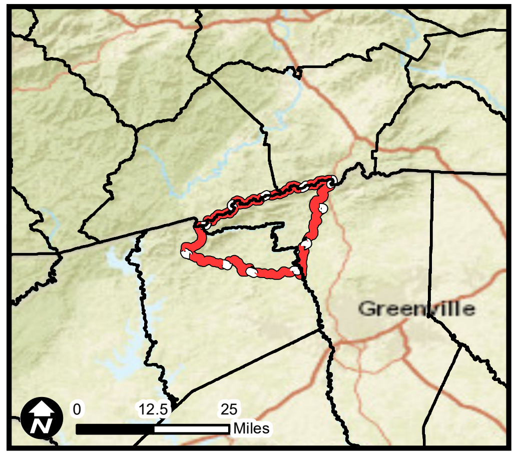

Figure 8. Hydrologic Soil Groups within the South Saluda River Watershed

South Salud River Watershed
Greenville and Pickens County, SC

Legend

- Watershed Boundary
- County Boundaries
- Municipal Areas
- Waterbodies
- Streams/Rivers

SCDHEC Monitoring Stations- 303(d) Impaired Waters

- Turbidity Impairment
- Biological Impairment

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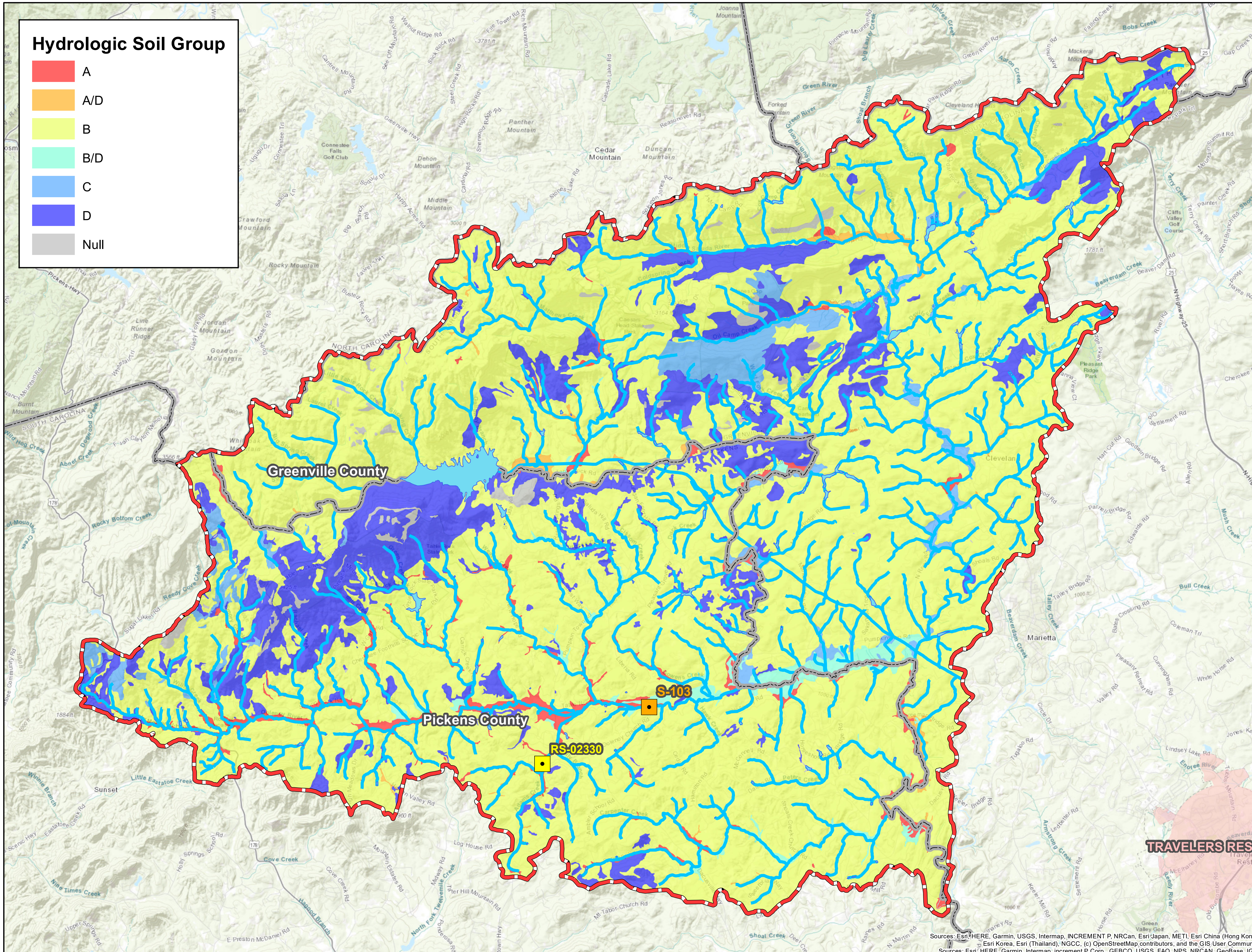

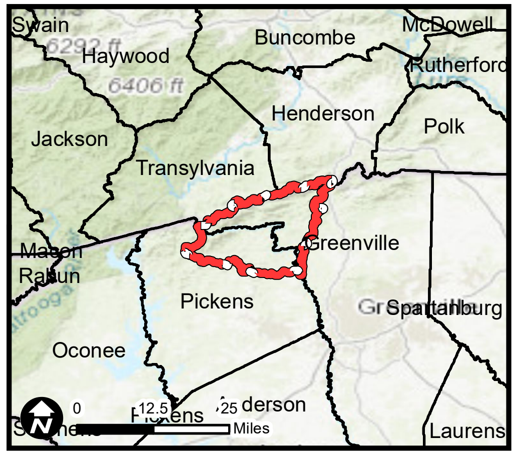

Figure 9. Aerial Map of South Saluda River Watershed

South Saluda River Watershed
Greenville and Pickens County,
South Carolina

Legend

- Watershed Boundary
- County Boundaries
- Municipal Areas
- Subwatersheds

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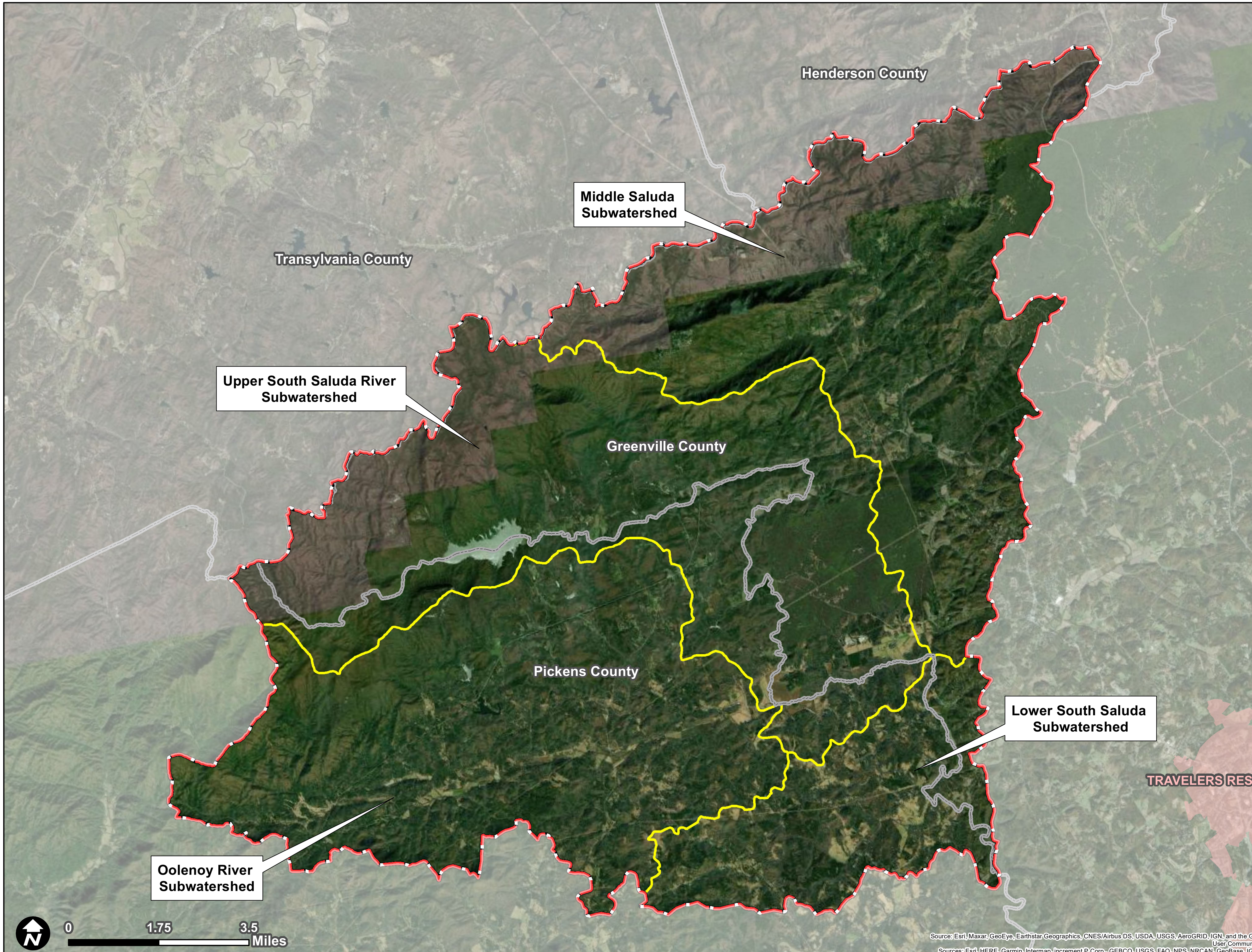

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\South Saluda\Maps_06242020\Figure 9. Aerial Map of South Saluda River Watershed.mxd

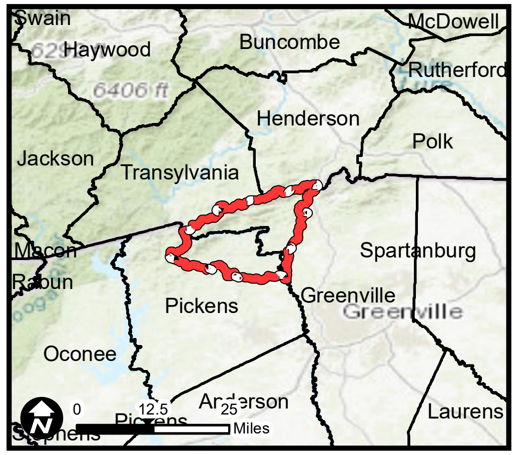

Figure 10. South Saluda River Watershed Land Use

South Saulad River Watershed
Greenville and Pickens County,
South Carolina

Legend

- Watershed Boundary
- County Boundaries
- Municipal Areas
- Streams/Rivers
- Subwatersheds

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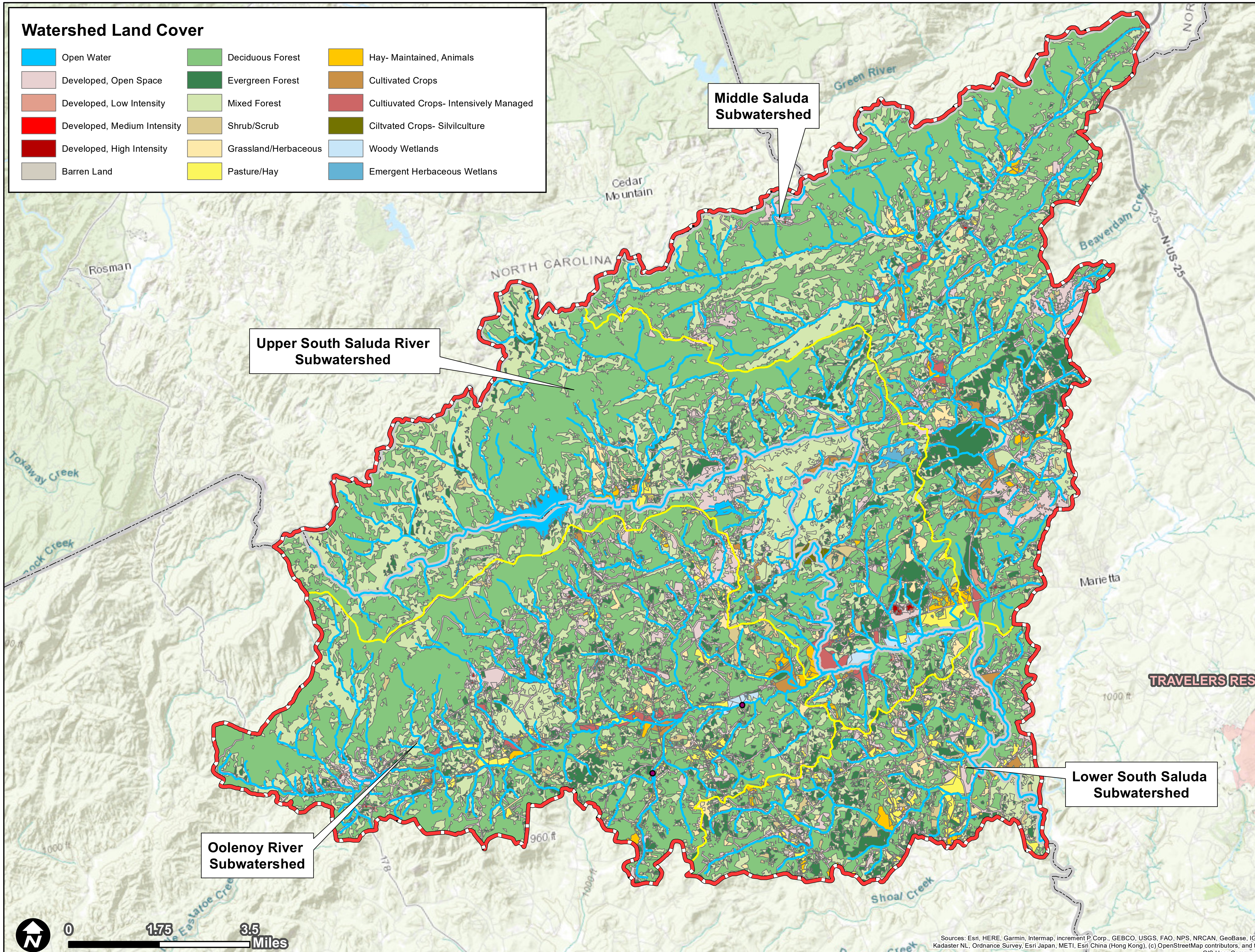

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\South Saluda\Maps_06242020\Figure 10. South Saluda River Watershed Land Use.mxd

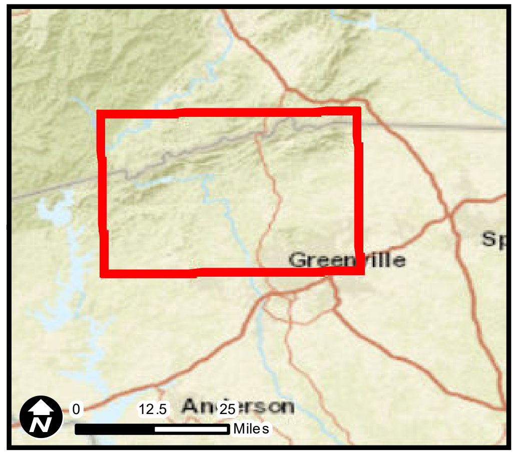

Figure 11. Protected Areas in the Upper Saluda River Watershed

Upper Saluda Watershed
Greenville and Pickens County,
South Carolina

Legend

- North Saluda River - Saluda Lake Watershed
- South Saluda River Watershed
- USGS Named Stream
- Waterbodies
- HUC 12 Watersheds
- Known Protected
- Primary and Secondary Roads

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wood.

Job No.	6250-18-0106
Drawn By:	BWS
Reviewed By:	AV
Date:	6/24/2020

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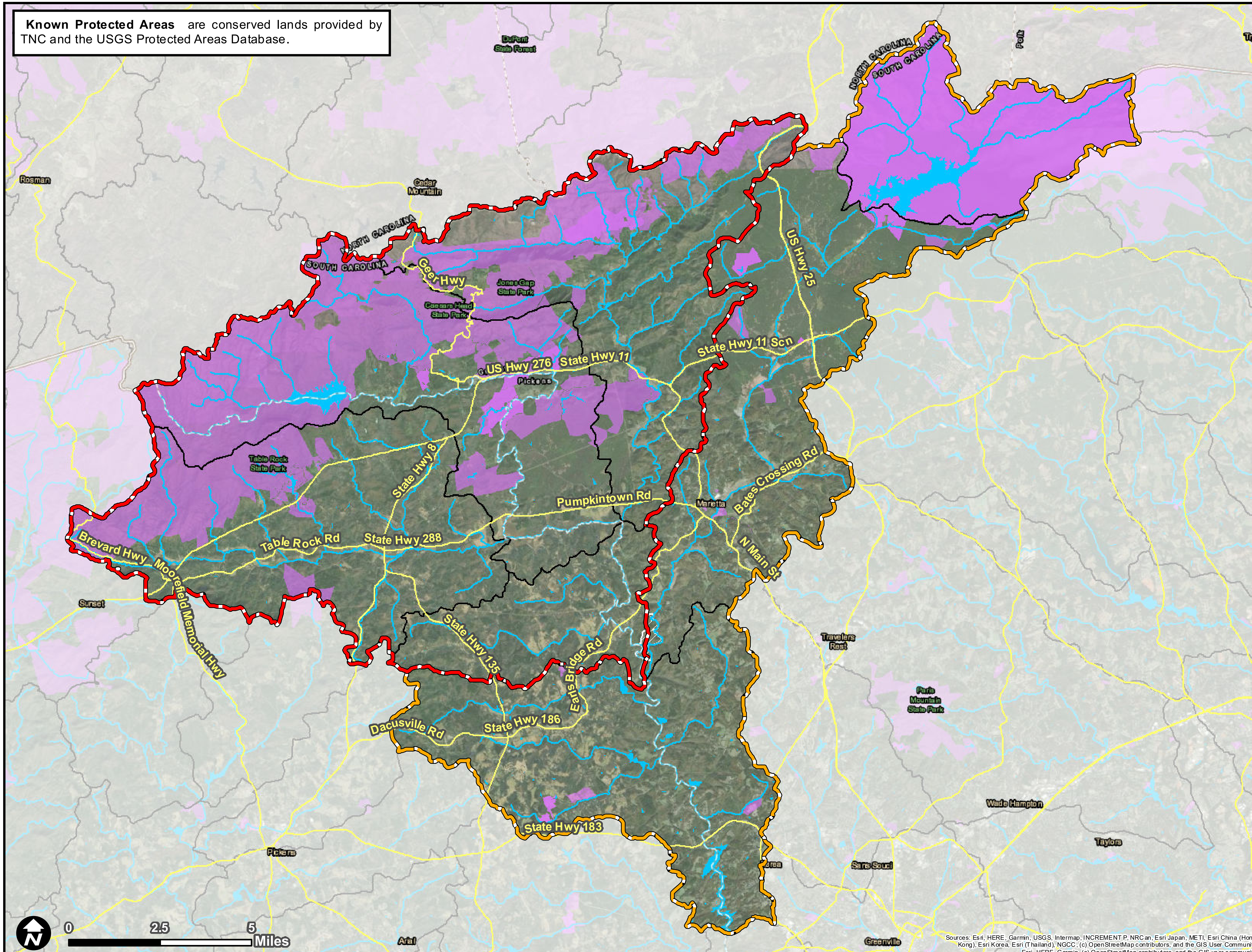

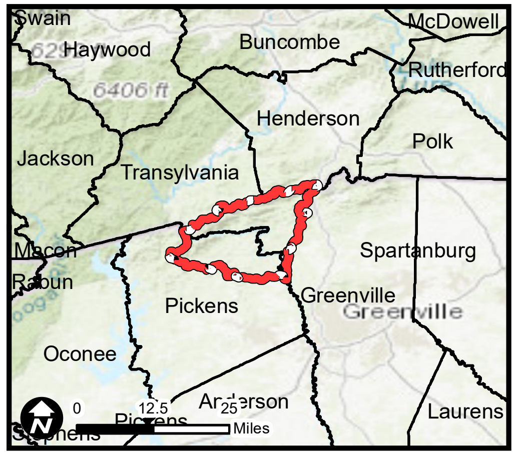

Figure 12. South Saluda RiverWatershed Land Use

South Saulad River Watershed
Greenville and Pickens County,
South Carolina

Legend

- Watershed Boundary
- County Boundaries
- Municipal Areas
- Streams/Rivers
- Subwatersheds

Job No. 6250-19-0195

Drawn By: KNS

Reviewed By: AV

Date: 6/25/2020

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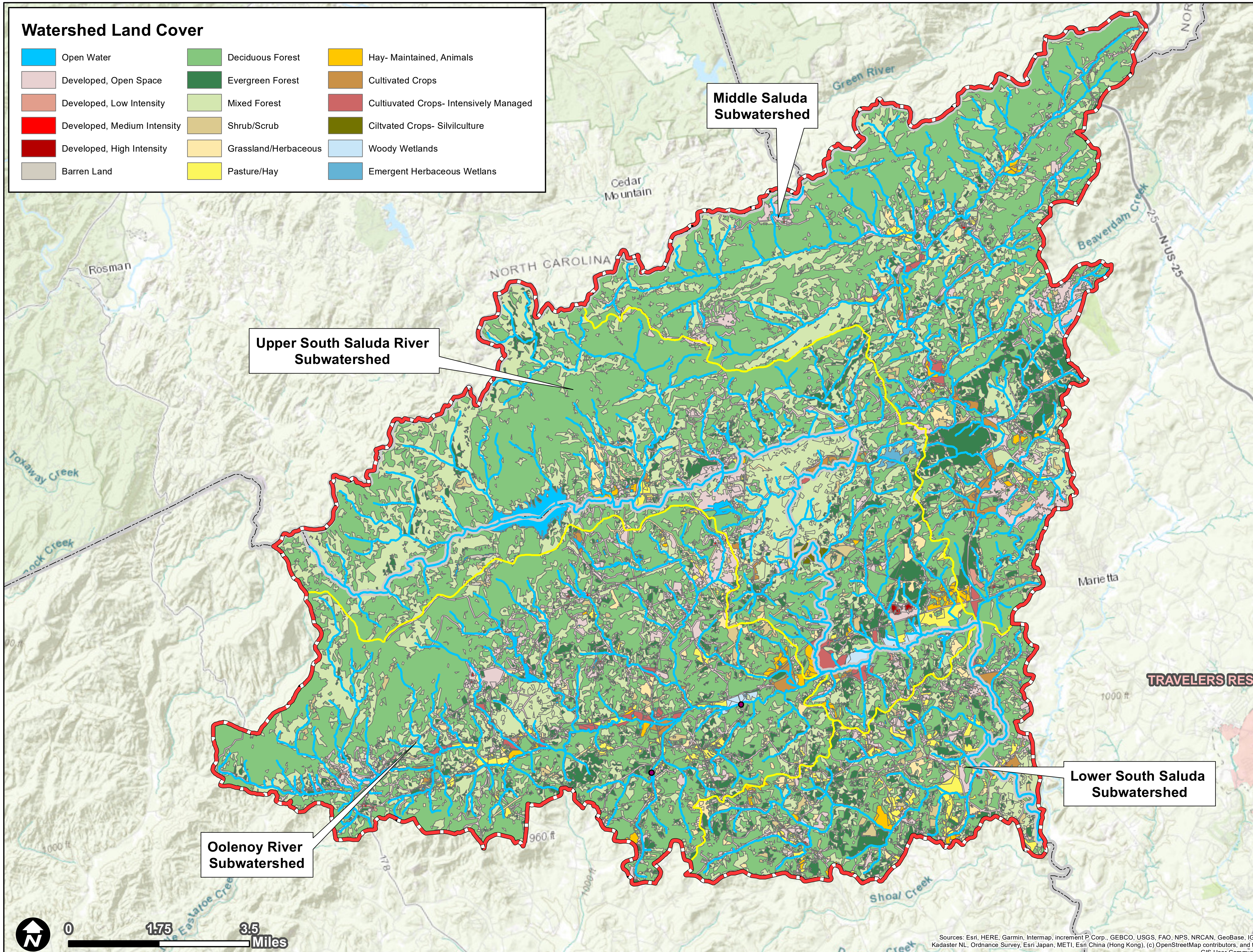

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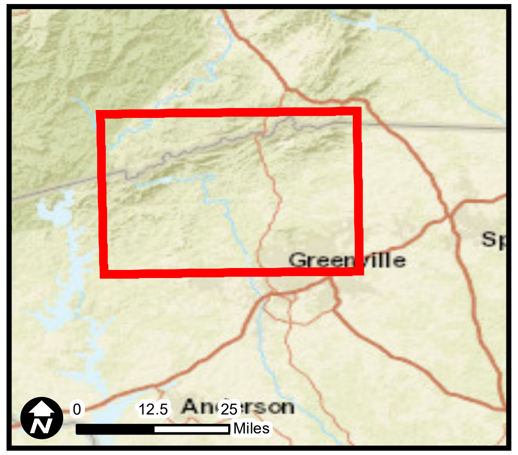

Figure 17. Protected Areas in the Upper Saluda River Watershed

Upper Saluda Watershed
Greenville and Pickens County,
South Carolina

Legend

- South Saluda River Watershed
- North Saluda River - Saluda Lake Watershed
- USGS Named Stream
- Waterbodies
- HUC 12 Watersheds
- Known Protected Areas
- Primary and Secondary Roads

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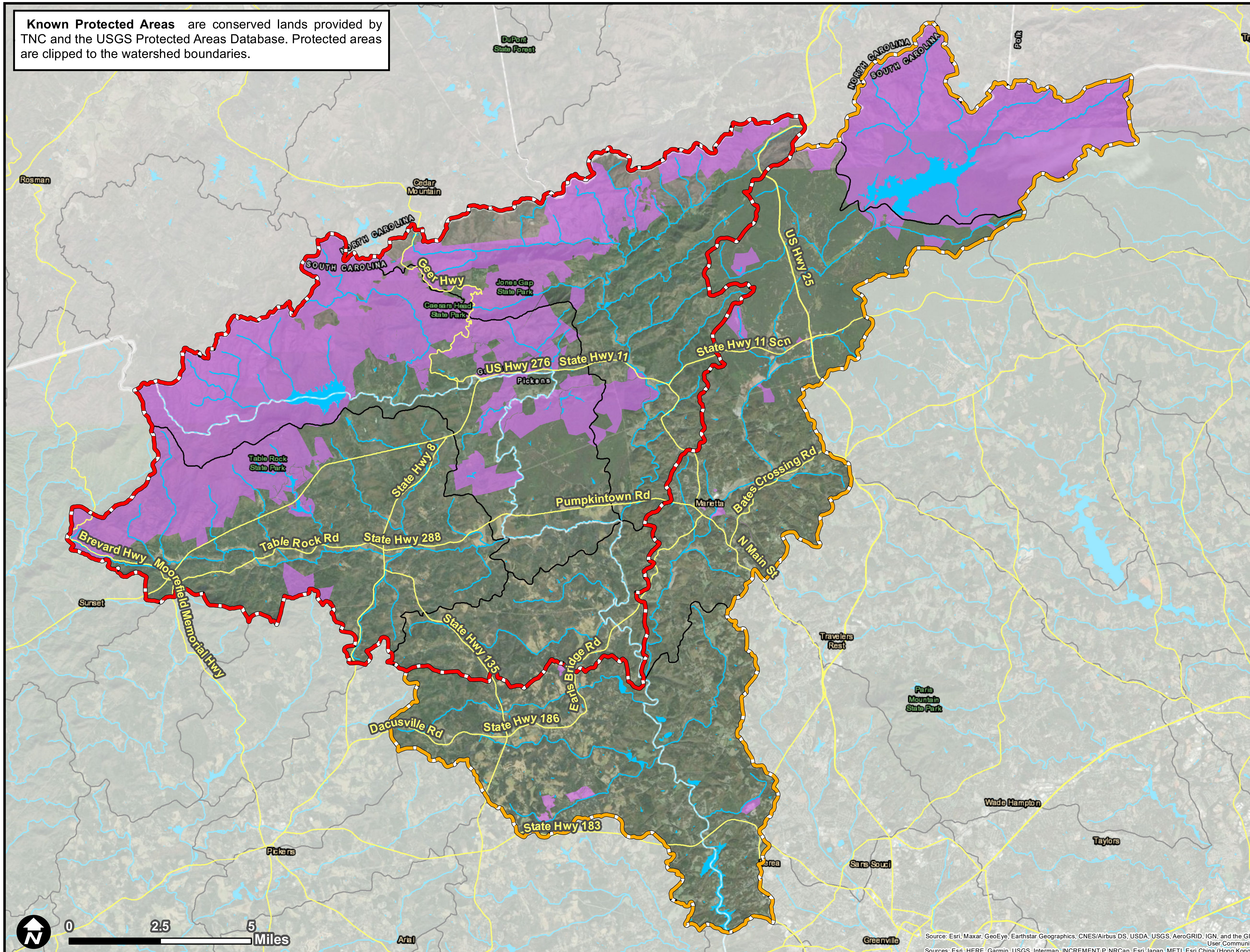

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\Conserved Lands\Figure 17. Upper Saluda Watershed Protected Lands.mxd

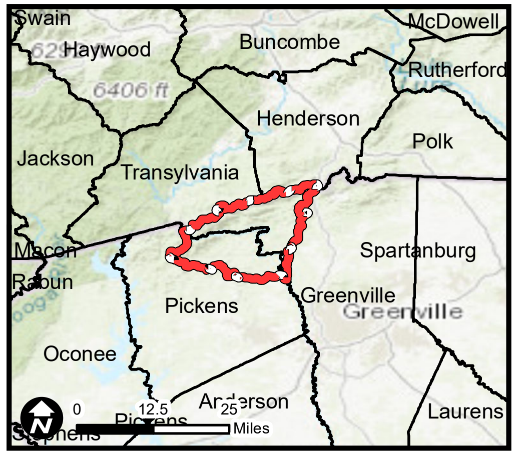

Figure 35. Agricultural BMP Prioritization

South Saulad River Watershed
Greenville and Pickens County,
South Carolina

Legend

- Watershed Boundary
- County Boundaries
- Municipal Areas
- Streams/Rivers
- Subwatersheds

Priority Areas

- Priority 1: Cultivated Crops (intensively managed)
- Priority 2: Cultivated Crops
- Priority 3: Pasture

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Date: 6/26/2020

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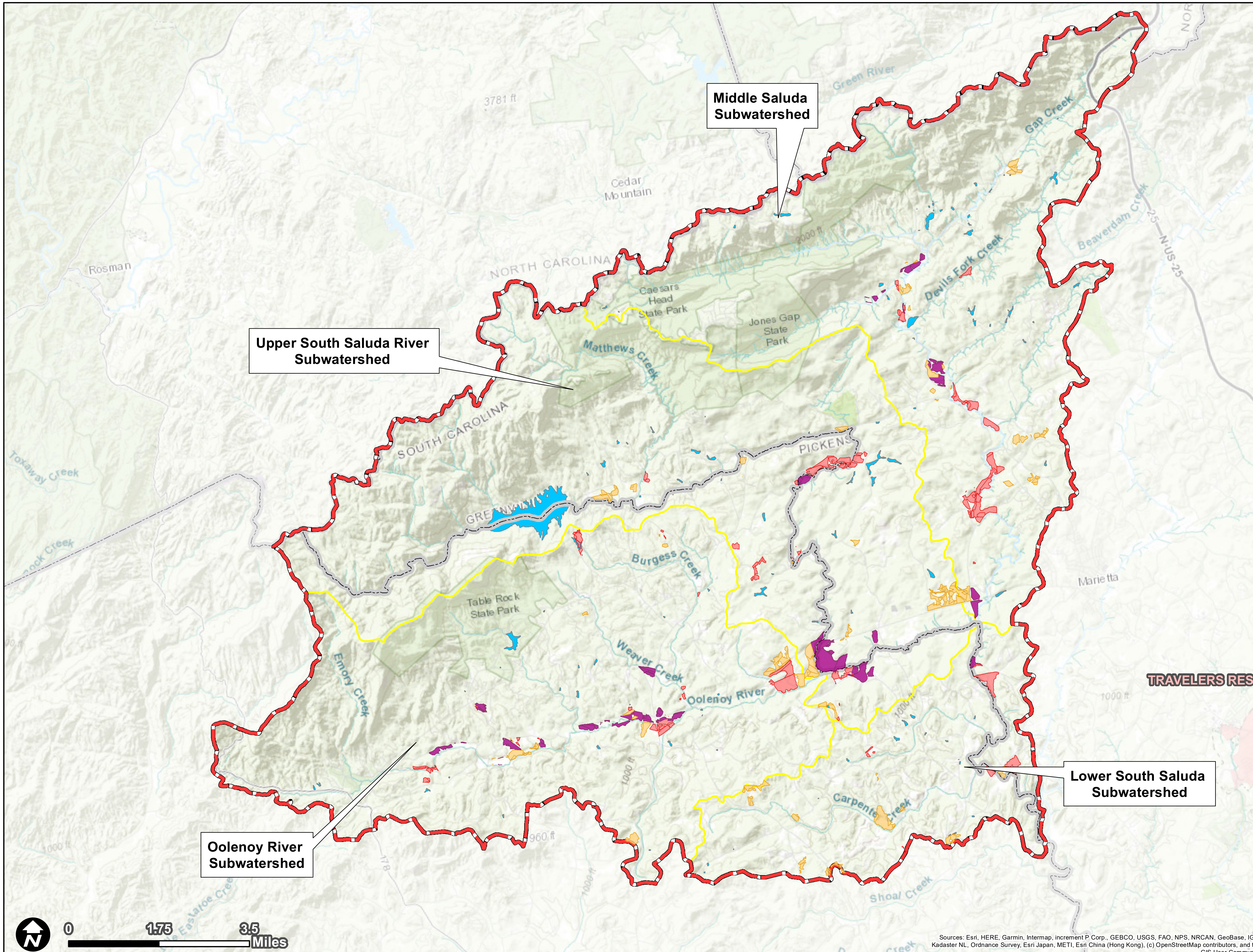

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\South Saluda\Maps_06242020\Figure 35. Agricultural BMP Prioritization.mxd

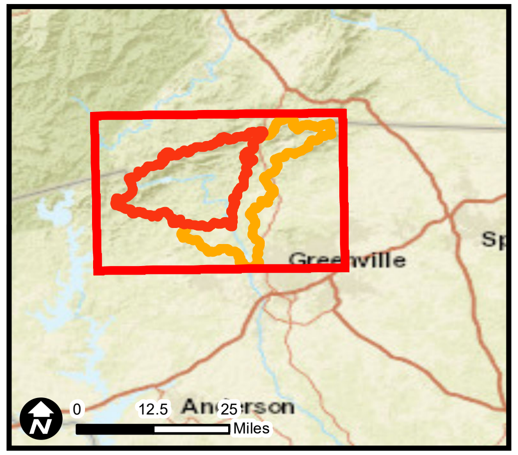

Figure 37. Critical Lands Map for the South Saluda Watershed

Upper Saluda Watershed
Greenville and Pickens County, SC

Legend

- South Saluda River Watershed
- North Saluda River - Saluda Lake Watershed
- County Boundaries
- Municipal Areas
- Waterbodies
- Streams/Rivers

Upstate Forever Critical Lands

Value

High : 2.67487

Low : 0

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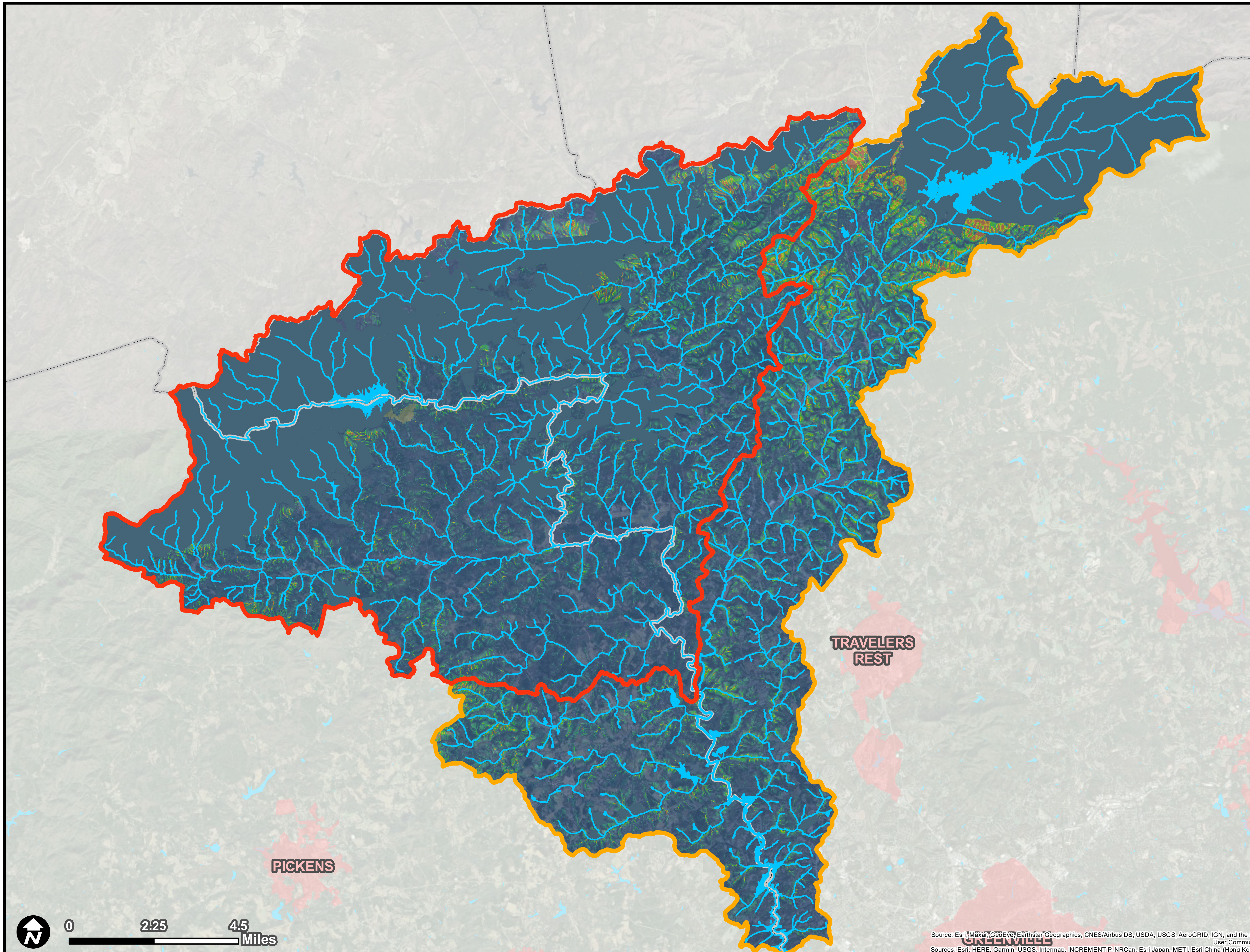

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong),

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\South Saluda\Maps_06242020\Figure 39. Critical Lands Map for the South Saluda Watershed.mxd

APPENDIX B
TASC MEETING
AGENDAS AND MINUTES

TECHNICAL ADVISORY STAKEHOLDER COMMITTEE

Watershed-Based Plan
for Sediment in the North Saluda River and Saluda Lake

TASC MEETING AGENDA

Date: May 28, 2019
Time: 10:00 a.m.
Location: Beechwood Farms, Marietta, SC

- Field Tour & Questions
- Presentation
    - Background
    - N. Saluda Watershed Plan
    - 319 Application / Recruitment
    - S. Saluda Watershed Plan
    - Ag Demo Site
    - Land Conservation
    - Other Implementation

TASC MEETING MINUTES

Date: May 28, 2019
Time: 10:00 a.m.
Location: Lions Club, Marrietta, SC

Present: Joel Ledbetter, Easley Combined Utilities
Mac Stone, Naturaland Trust
Nick Rubin, SC Rural Water Association
Kyle Bennett, Pickens County
Kirsten Robertson, Greenville Soil Water Conservation District
Lynne Newton, Greenville NRCS
Mark White, Mountain Bridge Trout Unlimited
Carmony Corley, SCDHEC
Jordan Elmore, SCDHEC
Andy Rollins, Clemson Extension
Megan Chase Upstate Forever
Erika Hollis, Upstate Forever
Scott Park, Upstate ForeverMelanie Ruhlman, Save Our Saluda
Angela Vandelay, Amec Foster Wheeler

- **Meeting Purpose:** Project kick-off meeting for South Saluda River Watershed and update on North Saluda River and Saluda Lake implementation efforts.
- **Tour of Crop Farm Demonstration Site -** Melanie Ruhlman introduced the Demonstration Site and narrated 2-stop tour of the site:
    - First stop was at the future extension of the Swamp Rabbit Trail. Melanie described the implementation projects to date (vegetation of the ditch, replacement of the culvert, gravel stabilization of farm access roads, vegetated field borders, cover crops, and attempts at intercropping).
    - Melanie shared some lessons learned during the implementation projects, including communication with farmers (spraying herbicide on newly planted intercropping seeds), heavy rainfalls washing away newly planted cover crop seeds, crop rows aligned such that vegetated swales are short-circuited).
    - Melanie showed a comparison of rich worm-filled soil from her floodplain garden, which has been enhanced with compost, vs. a neighbor's yard (previously farmed) vs. the Demonstration crop field. The garden sample even had worms, a good sign of healthy soil, whereas the Demonstration crop field sample had a very dense soil structure, low porosity and very low in organic matter.
    - The second stop was at the sediment basins at the bottom of the farm near the confluence of Old Railroad Creek and the North Saluda River. Melanie described the additional implementation projects to date (the 2 sediment basins, removal of beaver dam, stream buffer plantings and live stake plantings on the stream bank). She also discussed the issues with invasive species such as kudzu.
- Presentation/Meeting
    - Angela Vandelay presented an overview of: the benefits of developing a Watershed Plan, why sediment is the pollutant of concern, the importance of the TASC, the goals of the

North Saluda Watershed Plan, the sources of sediment in the North Saluda, existing load estimates, load reduction estimates, priority areas, agricultural BMPs and programmatic BMPs, barriers to implementation, the Cover Crop Workshop and the results from the public survey.

- A question was asked about who responded to the survey. Of the 78 responses, 27 live in or own land in the Upper Saluda River Watershed, and 17 own or know someone who owns a farm in the Upper Saluda River Watershed.
- Angela also presented an overview of the North Saluda River – Saluda Lake 319 implementation grant application, which, if approved, will offer a 90% cost share to farmers in the watershed. It also includes the purchase of 2 crimpers and a No-Till transplanter.
- A big Thank You to the donors for the 319 grant match: North Saluda Watershed Fund, Easley Combined Utilities, ReWa and Powdersville Water.
- We anticipate hearing whether we are awarded the North Saluda River and Saluda Lake implementation grant about July, with a potential contract in September or October.
- We asked the TASC for input on the best way to recruit farmers if/when we get an implementation grant. Lynne Newton offered to talk to farmers about the grant and to put them in touch with us if they are interested. She said that a simple brochure about the grant would be helpful. Andy Rollins agreed to include grant information in his email list serve and for us to speak and/or table at an annual conference Clemson Extension holds in the Upstate. Additional state-wide conferences were discussed, but would likely be too broad an audience. We also discussed Wood identifying the specific target crop farms for the stakeholders to review and identify contacts for personal recruitment efforts. In addition, we would appreciate all TASC members sharing the information on their social media and list serves when the time comes.
- If awarded, we will be looking for a part-time Conservation Technician to develop conservation plans, conduct inspections, recruit participants, etc. This person would ideally be a retired NRCS or SWCD employee with experience with these tasks. If you know someone who may be qualified for this position, please let us know.
- Angela also kicked off the Watershed Planning effort for the South Saluda, sharing some photos from the windshield survey, the observed differences. (approximately 85% forested and only 9% agricultural in the South Saluda vs. the North Saluda with 76% forested and 8% agricultural). The accuracy of these numbers will be improved with newer 2016 NLCD data which was recently issued along with the windshield survey data.
- We will evaluate agricultural, urban runoff and forestry/other sources in the South Saluda.
- We will be requesting additional (and updated) monitoring data from stakeholders.
- Melanie answered additional questions about the Demo site, including whether we would include site-specific Invasive Species Plans. We agree that information about invasive species would be included in our educational outreach, but site-specific Invasive Species Plans are not budgeted.

- **Minutes and other meeting materials will be uploaded to the shared TASC folder.*

Cover Crop Brainstorming Session

November 21, 2019, 10am

In attendance:

Kerry Walker, Clemson Extension
Andy Rollin, Clemson Extension
Kirsten Robertson, Greenville SWCD
Melanie Ruhlman, Save Our Saluda
Gordon Mikell, NRCS (via phone)
Angela Vandelay, Wood Environment & Infrastructure Solutions (via phone)

Melanie provided an overview of the watershed planning efforts in the Upper Saluda River Watersheds with the goal to reduced sediment in the rivers and Saluda Lake. Save Our Saluda (SOS) has received a grant award of $533,000 from SCDHEC to protect water quality in the North Saluda River and Saluda Lake Watershed, with up to 90% cost share for installation of agricultural BMPs and $25,000 for the purchase of cover crop-related equipment. SOS has prioritized intensively managed row crops located in floodplains for installation of BMPs.

Cover crops have been determined to be the most effective BMP and easiest to convince farmers to participate. Winter cover crop should be relatively easy sell to farmers; cover crops in row middles will be a harder sell. The 319 grant will pay for 2 years of cover crops (1st year – single species, terminate any method, but no livestock grazing; 2nd year – multi-species and leave some residual on field).

Although terraces were not included as a BMP in the grant proposal, the grant does allow flexibility if terraces are recommended to control erosion on a site.

Recommend information be shared in Spanish due to the number of Hispanic farmers in the watershed. There is a Spanish speaking Clemson Extension agent in Lancaster. Reginald Hall would need to be contacted if Spanish speaking NRCS staff needed.

We discussed a field tour less than 1 hour away with incentives for attending, potentially a 2-stop field tour (Hendersonville, Beechwood), ideally in late February.

<u>Equipment</u>

The grant will pay for $25,000 of equipment, but the equipment needs to be housed, maintained and rented to farmers in the watershed.

Greenville Cattleman’s Association has a No Till Seed Drill. Rents for $7 to $8.50/acre, but they only rent to larger farmers with experience with seed drills.

Pickens SWCD has three No Till Seed Drills and will rent to Pickens and Greenville farmers (slightly higher rent for Greenville County farmers). Used regularly for forage use. At this time, there is no real need for crimpers in Pickens.

Greenville SWCD would like a crimper but need to find housing for the machine.

Gordon pointed out no extra equipment is needed if a farmer is going to plant cover crops in the winter only and then till it before spring planting.

Kerry encouraged us to "meet farmers where they are" and take baby steps with them. Encourage farmers to start small – perhaps start with a sample plot of cover crops.

Gordon also encouraged us to apply for a "Conservation Innovation Grant", which can be run through the SWCD or Clemson Extension for Demo project(s).

Sharing cover crop research is important but needs to be research conducted in the southeast, not the Midwest, etc.

Kirsten pointed out that we don't have to be experts, and we are all experimenting together. Encourage the curiosity and creativity in farmers.

It was decided that the best equipment purchases would be:

1. Crimper – 4' or 6'
2. Trailer for Crimper
3. No Till Transplanter – single row

We will work to finalize which specific models of these equipment to purchase and would like agreement in the final model decisions from our Ag stakeholders prior to purchase.

We will develop procedures and responsibilities for those storing and maintaining the equipment as well as farmers who lease the equipment.

Notes:

- After this meeting, Melanie met with a landowner, Donna Tesner, who expressed that she may be willing to house the equipment and lease to farmers on behalf of the SWCD. This is preliminary, but a possible solution to the need.

APPENDIX C
WORKSHOP MATERIALS

IMPROVING SOIL HEALTH TO BOOST THE BOTTOM LINE

September 24, 2019
9 am to 1 pm
Oolenoy Community Center, Pickens, SC

AGENDA

9:00	Welcome and Introduction *Melanie Ruhlman, Save Our Saluda*
9:15	South Saluda Watershed Plan and North Saluda 319 Grant *Angela Vandelay, Wood Environment & Infrastructure Solutions*
9:30	Agricultural Conservation Easement Program *Drew Brittain, Upstate Forever*
9:40	Cover Crops and Soil Health *Gordon Mikell, Natural Resources Conservation Service*
10:25	Break
10:40	Rainfall-Runoff Simulator Demonstration *SC Forage & Grazing Lands Coalition*
11:15	Video: Farmer Scientists: Five Trials in Managing for Soil Health
11:45	Lunch and Raffle
12:30	Panel Discussion
1:00	Adjourn

Please join us for a free workshop

IMPROVING SOIL HEALTH TO BOOST THE BOTTOM LINE

Oolenoy Community Center | *5301 Dacusville Hwy, Pickens*

Sept. 24 • 9 am to 1 pm

FEATURED SPEAKERS:
Gordon Mikell, Soil Agronomist from USDA-NRCS
Testimonials by South Carolina farmers

FREE LUNCH

RAFFLE PRIZES!

PLUS A RAINFALL SIMULATOR DEMONSTRATION!

Pesticide Applicators wll receive 1 Continuing Credit Hours (CCH)

SAVE OUR SALUDA

Protecting and Restoring the Upper Saluda Watershed

Please RSVP by Sept 20th (space is limited)
Call or text: (864) 270-7629 or
email: info@saveoursaluda.org

Sponsors include:

dhec
soil&water CONSERVATION DISTRICT PICKENS COUNTY
SCACD
Forage & Grazing Lands Coalition
NatGLC NATIONAL GRAZING LANDS COALITION
USDA
DNR

Cover Crop Resource Series

COVER CROP FACTS

Cover Crops at Work: Increasing Soil Organic Matter

An overview of cover crop impacts on soil organic matter[1]

Photo Credit: Edwin Remsberg

ABOUT COVER CROPS

Cover crops are tools to keep the soil in place, bolster soil health, improve water quality and reduce pollution from agricultural activities.

- They include cereals, brassicas, legumes and other broadleaf species, and can be annual or perennial plants. Cover crops can be adapted to fit almost any production system.
- Popular cover crops include cereal rye, crimson clover and oilseed radish. Familiar small grain crops, like winter wheat and barley, can also be adapted for use as cover crops.

Learn more at www.sare.org/cover-crops

What is Soil Organic Matter?

- Soil organic matter is decomposed organic material (leaves, roots, microorganisms) that exists in the soil and acts as a reservoir of water and nutrients.
- Many analogies have been drawn likening organic matter in the soil to a sponge, a medium in which water and nutrients are stored.
- Soil organic matter is often a measure of a soil's fertility, and even a soil's resilience.

Cover Crops Increase Soil Organic Matter

- Cover crops are able to increase soil organic matter by protecting the soil surface from erosion, adding biomass to the soil (especially below the soil surface), and creating a habitat for microorganisms like fungi that contribute to the soil biology and provide more pathways for nutrient management in the soil ecosystem.
- Legume crops were found to increase levels of soil organic matter by 8% to 114%.
- Non-legume cover crops, including grasses and brassicas, were found to increase soil organic matter levels by 4% to 62%.

Soil Organic Matter is a Boon for Water Quality

- By providing these services, cover crops contribute to enhanced water quality because soil organic matter enhances soil processes and properties, including soil structure, and alleviates soil compaction.
- Additions of organic matter also increase water retention capacity, stabilize the soil during extreme weather events like drought or rainfall, and absorb and filter pollutants in runoff.
- Research into the composition of soil organic matter has shown that it's comprised of about 58% carbon.[2] Attempts have even been made to put a dollar value on soil carbon, asserting that restoring soil carbon levels could result in savings of about $25 billion per year.

In summary, cover crops are a good management strategy for increasing soil organic matter levels, a benefit that also has positive water quality, air quality and soil health implications. Cover crop management decisions are very important in maximizing their benefits, especially the decision to use no-till practices in conjunction with cover crops.

[1] Unless otherwise cited, all data comes from a bibliography compiled by SARE and the University of Missouri.

[2] Pribyl, D.W. 2010. A critical review of the conventional SOC to SOM conversion factor. *Geoderma*. 156(3-4):75:83.

SARE Sustainable Agriculture Research & Education

This publication was developed by Sami Tellatin and Rob Myers of NCR-SARE and the University of Missouri under Cooperative Agreement No.83695601 awarded by the U.S. Environmental Protection Agency. EPA made comments and suggestions on the document intended to improve the scientific analysis and technical accuracy of the document. However, the views expressed in this document are those of the author. The EPA, the USDA and SARE do not endorse any products or commercial services mentioned in this publication. The SARE program is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2014-38640-22173.

July 2017

Cover Crop Resource Series

COVER CROP FACTS

Cover Crops at Work: Increasing Infiltration

An overview of cover crop impacts on water infiltration to the soil[1]

Photo Credit: Edwin Remsberg

ABOUT COVER CROPS

Cover crops are tools to keep the soil in place, bolster soil health, improve water quality and reduce pollution from agricultural activities.

- They include cereals, brassicas, legumes and other broadleaf species, and can be annual or perennial plants. Cover crops can be adapted to fit almost any production system.
- Popular cover crops include cereal rye, crimson clover and oilseed radish. Familiar small grain crops, like winter wheat and barley, can also be adapted for use as cover crops.

Learn more at www.sare.org/cover-crops

Cover Crops and Infiltration

Cover crops can successfully increase the infiltration of water into the soil layer. They do this by covering the ground with their biomass and by improving soil structure with their roots. Some specific mechanisms include:

- Preventing soil surface sealing (where the soil becomes impermeable after rainfall)
- Improving soil structure with increased soil aggregate stability, soil porosity and water storage capacity

Different types of cover crops may have different effects on infiltration because of their unique biomass growth and composition, and results vary based on how long the cover crop is grown.

- Non-legume cover crops, including bromegrass and rye, increased infiltration by 8% to 462%, based on a range of studies.
- Legume cover crops, including crimson clover, hairy vetch and strawberry clover, increased infiltration by 39% to 528%.
- Soil surface cover by residue alone increased infiltration by up to 180% in field trials.

Management Decisions Matter

Management that encourages continuous ground coverage by residues and cover crops will be best suited to positively impact the infiltration of water to the soil surface. Tillage practices are another important management decision for water infiltration.

- No-till management has been found to increase rainfall infiltration.
- One study reported that runoff from no-till fields was two to four times less than from conventional-till plots.

A Far-Reaching Solution

When water is able to enter the soil profile, rather than running off the soil surface, there is less risk of displacing soil particles through erosion. Increased infiltration also signals possible benefits to the water conditions within the soil profile. By keeping the soil in place and improving soil conditions, cover crops are mitigating pollution risk while also boosting the productive capacity of the soil.

[1] Unless otherwise cited, all data comes from a bibliography compiled by SARE and the University of Missouri.

SARE Sustainable Agriculture Research & Education

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July 2017

Economics of Cover Crops I: Profitability of Cover Crops in Row Crop Production and Federal Cost Share for Cover Crops

Presented by Leah Duzy (USDA-ARS, NSDL, Auburn, AL), Amanda Smith (University of Georgia—Tifton, Tifton, GA), Don Barker (USDA-NRCS, Goldsboro, NC), and Myron Johnson (Farmer, AL)

An Introduction to the Economics of Cover Crops

Cover crops are not new to the Southern U.S. The "Old Rotation" in Auburn, Alabama was started in 1896 and is the oldest, continuous cotton (*Gossypium hirsutum* L.) experiment in the world. One of the objectives was to test the effect of winter legumes in cotton production. In 1978, researchers and producers gathered in Georgia for the 1st Annual No-till Systems Conference; however, they did not talk only about no-till. They discussed the role of related practices, such as cover crops, in conserving moisture and reducing erosion, as well as the financial benefit to adopting cover crops (Touchton and Cummins, 1978).

For the first time, in the 2012 Census of Agriculture, producers were asked, considering the total acres on their operation, how many cropland acres were planted to a cover crop (excluding CRP acres). Across the Southern SARE region, cover crop acres as a percent of total cropland acres ranged from 1.3% in Mississippi to over 10% in Virginia (USDA-NASS, 2016; Fig. 1). Differences between states depend on crops grown by producers, climatic differences, and challenges faced by producers.

Many agronomic benefits of covers are also economic benefits. In formal surveys, farmers have identified the following benefits of cover crops: increased soil health and soil organic matter; reduced erosion and soil compaction; weed control; provided a nitrogen source; increased cash crop yields; reduced cash crop yield variability; economic return from yield or haying, grazing, or biomass; and increased plant available water (SARE, 2015). By reducing soil erosion, producers lose less of their soil during heavy rain events and have to spend less time on land repair. Controlling weeds and providing a nitrogen source lowers production costs in the subsequent cash crop. An increase in plant available water can potentially lower water requirements thereby lowering production costs for irrigated operations and minimizing the impact of droughty periods.

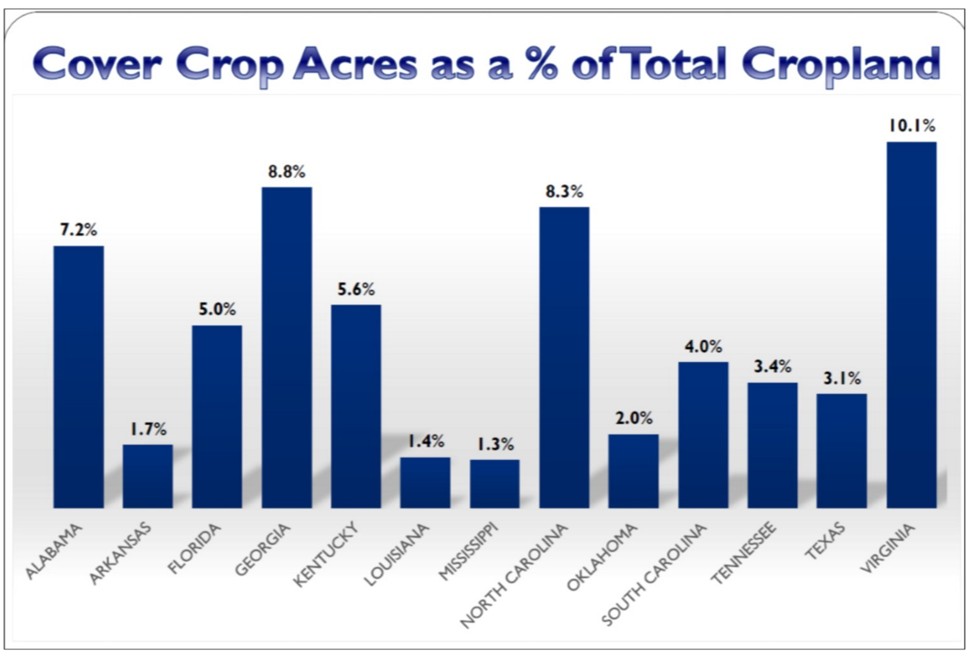

Fig.1. Cover crop acres as a percent of total cropland acres for states in the Southern SARE Region (USDA-NASS, 2016).

There are real and perceived agronomic and economic challenges to adopting cover crops. Producers are concerned about the time and labor required for planting and managing cover crops, as well as the cost of planting and managing the cover crops. Seed costs are routinely identified as a challenge to adopting cover crops. There is concern that the use of cover crops increases overall crop production risk and has the potential to reduce yield in the following cash crop. There may be a learning curve for producers who have never worked with high residue cover crops and/or have limited experience with conservation tillage and/or cover crops. Researchers at the USDA-ARS, National Soil Dynamics Laboratory (NSDL) in Auburn, Alabama and at the University of Georgia—Tifton have past and current research that addresses the challenges faced by producers.

Fig. 2. Triticale, radish, and crimson clover mixture in Alabama. Photo Leah Duzy

Researchers at the USDA-ARS, NSDL are developing conservation systems that will maximize benefits through the production of a high residue cover crop that is intensively managed while minimizing associated production costs. Ongoing research includes investigating methods of combining operations, cover crop establishment (planting date and seeding and fertilizer rates), and the use of mixtures (Fig. 2). Additional information about past and current research at the USDA-ARS, NSDL, please visit http://www.ars.usda.gov/sea/nsdl.

Cover Crop Economics: A Glance at Research in Georgia

As interest in cover crops has grown in Georgia, producers are interested in how adopting cover crops impacts their production costs and resulting revenue. To gain a better understanding of the current conservation environment in Georgia, researchers surveyed farmers to find out the most common conservation practices and the motivation behind their use. The respondents stated that cover crops was the top conservation practice used, followed very closely by strip tillage and nutrient management. Farmers were more likely to use a conservation practice that reduces soil erosion and improves soil condition, both benefits of cover crops.

Cover crops are an important part of an organic production system; however, organic cover crop seed is difficult to source for many producers. To help determine if organic cover crop seed production was a viable option in Georgia, researchers developed organic cover crop seed budgets (Gaskin et al., 2014) and related guidance (Fig. 3). They conducted two separate two-year on-farm trials with cereal rye (*Secale cereale* L.) and crimson clover (*Trifolium incarnatum* L.). They included the cost of the seed, fertilizer, fuel and lube, repair and maintenance on equipment, labor, as well as hauling and cleaning of the seed. They concluded that, based on their assumptions, cereal rye yields of greater than 17 bu/acre, sold at $36/bu, and crimson clover yields of at least 150 lbs/acre, sold at $2/lb could be profitable. It is important to understand that marketing certified organic cover crop seed is new in Georgia, and no convenient markets have been established. Producers wanting to sell seed should secure a market prior to planting to help reduce price variability. Secondly, costs will vary with pest pressure, weather, and equipment. Finally, organic cover crop seed production is labor intensive, which may limit producers' ability to grow it on a large scale.

Organic and traditional producers are interested in using cover crops to reduce fertilizer inputs since cover crops and fertilizer impact profitability. Research was conducted to determine how cover crops and supplemental nitrogen impacted cotton profitability. In Tifton, Georgia, a two-year experiment was conducted in an irrigated cotton production system with five cover crop treatments: crimson clover, hairy vetch (*Vicia*

Organic Cover Crop Seed Production in Georgia

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Cover crops are an essential part of an organic production system. There are many benefits of using cover crops. They build organic matter in the soul, recycle nutrients, suppress weeds, and (in the case of legumes) provide nitrogen.

The National Organic Program standards require farmers to use organic seeds when the varieties needed by the farmer are available; otherwise, untreated seeds can be used. Finding organic cover crop seeds can be a challenge for farmers. There is relatively little organic cover crop seed available, and many times the varieties that are available are not the best adapted for growing conditions in Georgia.

For example, cover crop seed is normally produced in the Northwest and Northeast, but varieties developed for the Southeast often do not produce good yields in these areas. This is one reason that it is difficult to find seed for these varieties.

There is a national effort to produce more organic seeds so that the varieties needed for different climates, soils, and crop rotations are available to farmers. Consequently, there has been interest in seeing if cover crop seed production could be a viable enterprise for organic growers in Georgia. If organic cover crop seed production is a viable enterprise for growers, it could improve the availability of varieties adapted to the Southeast; provide a source for locally grown seeds; and provide another profit center for certified organic growers, seed cleaners, and local seed companies.

Fig. 3. Producers interested in organic cover crop seed production can find more information in the publication *Organic Cover Crop Seed Production in Georgia* (http://extension.uga.edu/publications/files/pdf/B%201436_2.PDF).

Table 1. Average systems costs per acre for cover crop and supplemental fertilizer experiment in Tifton, GA in 2011 to 2012.

Cover Crop	Fertilizer (lb N/acre)			
	0	30	60	90
Crimson Clover	58.26	88.50	108.90	129.30
Hairy Vetch	68.06	98.30	118.70	139.10
Cereal Rye	65.37	95.61	116.01	136.41
Wheat	52.86	83.10	103.50	123.90
No Cover	8.47*	38.71	59.11	79.51

*The no cover, 0 lb N/acre plots had a cost (herbicide and application) to terminate winter weeds.

villosa), cereal rye, wheat (*Triticum aestivum* L.), and a no cover crop. Four fertilizer treatments (0, 30, 60, and 90 lb N/ac) were then compared following each cover crop treatment. Using a partial budgeting approach based on the costs in Table 1, results showed that cotton following hairy vetch appeared to have the most profit potential. There was no profitability advantage of a grass cover crop over the no cover crop control; however, benefits like reduced soil erosion should still be considered. Cotton following a legume cover crop may allow for reduced sidedress N applications.

Farmers in Georgia plant cover crops to help reduce soil erosion; however different tillage systems may cause more rapid decomposition of cover crops. Research was conducted to determine how covers crops and tillage impact profitability in Tifton, Georgia in a cotton production system with two types of tillage (conventional and reduced tillage), and four cover types (crimson clover, cereal rye, wheat, and a no cover control). Results showed that total costs were higher for conventional tillage treatments and for cover crop treatments. Averaged over the two years, there was no statistical difference between cover crop treatments.

While cotton is a major crop in the Southeast, peanut (*Arachis hypogaea* L.) are also an important regional commodity. Nutrient management is critical for peanut, and, with nutrient price volatility, questions were raised regarding the option to incorporate cover crops into peanut production systems to provide nutrients. Research was conducted to assess the effect of cover crops on peanut yield, costs of production, and revenue in Tifton, Georgia. The experiment consisted of three cover crops (crimson clover, cereal rye, and wheat) and two tillage systems (strip-till and conventional tillage). Systems with crimson clover had higher total costs than cereal rye and conventional tillage had higher total costs than strip-tillage. Peanut appeared to do better following a grass cover crop than a legume cover crop.

In Georgia, cover crops are an important conservation practice for producers. For producers interested in producing cover crop seeds having a market for the seed is vital. Cover crops have a cost, but more often than not, the benefits outweigh the costs. It is essential to consider the benefits, such as improvements to soil and reduced erosion, that are difficult to monetize. For more information on extension and outreach related to agricultural and applied economics at UGA-Tifton, visit http://www.caes.uga.edu/departments/agecon/extension.

Working with NRCS to Develop Good Recommendations for Planning and Contracts

For many producers, participating in federal conservation programs have helped them to adopt cover crops and other conservation practices on their operations. There are five steps (Fig. 5) to getting assistance from NRCS for producers: 1.) Visit your local NRCS field office to discuss the goals and work with staff on a conservation plan; 2.) With the help of NRCS, complete an application for financial assistance, which can be completed online through the Conservation Client Gateway (Fig. 6); 3.) As part of applying, NRCS will file paperwork to ensure you are eligible for assistance; 4.) NRCS will rank applications according to local resource concerns; and 5.) Put conservation to work by signing a contract and implementing conservation practices.

For a successful conservation cover crop management specifications, planners and producers should identify and understand 1.) the primary resource concern specific to the

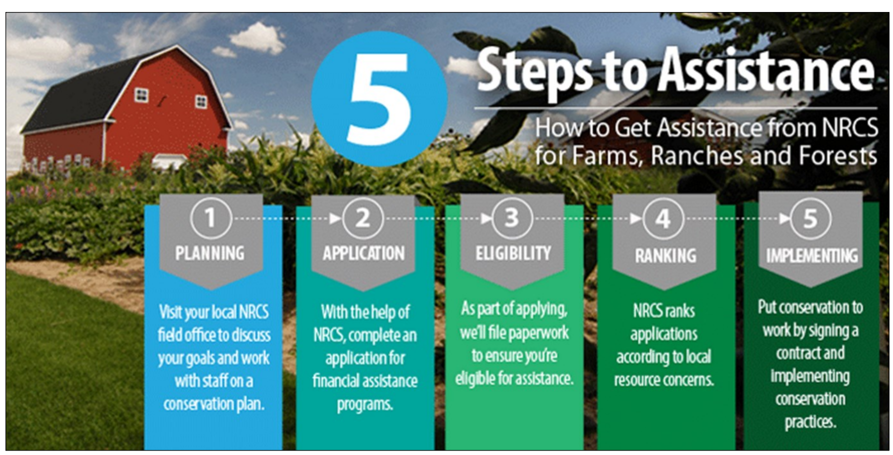

Fig. 5. Five steps to getting technical and financial assistance from USDA-NRCS for farms, ranches, and forests.

operation; 2.) the objectives; 3.) current cropping/tillage system; 4.) level of expertise, management capabilities, and commitment to adopting cover crops; 5.) the appropriate cover crops to address the resource concerns and meet the objectives; and 6.) the planning site.

Producers interested in establishing cover crops with assistance from USDA-NRCS should contact their local NRCS field office to learn more about opportunities in their county and state. More information about USDA-NRCS is available at www.nrcs.usda.gov.

Fig. 6. Conservation Client Gateway (http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/cgate/) is a secure online web application that gives landowners and land managers, operating as individuals, the ability to track their payments, report completed practices, request conservation assistance, and electronically sign documents anytime, anywhere. Conservation Client Gateway provides users the flexibility to determine when they want to engage with NRCS online and when they prefer in-person conservation planning assistance.

Conclusion

Myron Johnson, a dryland crop farmer from Henry County, Alabama, relies heavily on cover crops on his small grain, cotton, and peanut farm. He adopted cover crops to reduce soil erosion, increase soil organic matter, and increase water holding capacity on his operation. He grows primarily cereal rye as a cover crop due to the amount of biomass it produces; however, he recently planted cover crops mixtures to see how they will perform on his operation compared to cereal rye. Myron overcame the challenges of adopting a conservation system with cover crops and plans to continue to utilize this system into the future.

Adopting a conservation system is an investment. More specifically, adopting a conservation system is a long-term investment. Just like soil degradation does not happen overnight, improving soil quality also takes time. There are agronomic benefits that result in economic benefits, such as reduced yield variability. In order to realize the greatest benefits from a conservation system, producers and planners have to determine the system that works best for the operation, given the challenges and goals.

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This product was developed with support from the Southern Sustainable Agriculture Research and Education (Southern SARE) program, which is funded by the U.S. Department of Agriculture—National Institute of Food and Agriculture (USDA-NIFA). Any opinions, findings, conclusions or recommendations expressed within do not necessarily reflect the view of the Southern SARE program or the U.S. Department of Agriculture. USDA is an equal opportunity provider and employer.

Cover Crop Resource Series

COVER CROP FACTS

Cover Crops at Work: Covering the Soil to Prevent Erosion

An overview of cover crop impacts on soil losses from agricultural production systems[1]

Photo Credit: Edwin Remsberg

ABOUT COVER CROPS

Cover crops are tools to keep the soil in place, bolster soil health, improve water quality and reduce pollution from agricultural activities.

- They include cereals, brassicas, legumes and other broadleaf species, and can be annual or perennial plants. Cover crops can be adapted to fit almost any production system.
- Popular cover crops include cereal rye, crimson clover and oilseed radish. Familiar small grain crops, like winter wheat and barley, can also be adapted for use as cover crops.

Learn more at www.sare.org/cover-crops

Cover Crops and Erosion

Cover crops can successfully decrease, or almost completely eliminate, soil loss from various production systems. They do this by:

- Providing coverage of the soil surface and protecting it from rain and wind
- Rooting into the soil profile and improving soil structure
- Encouraging water infiltration to the soil profile

Studies have shown decreases in soil loss from fields planted into different types of cover crops.

- Non-legume cover crops, including rye, ryegrass, triticale, barley, and wheat, reduced soil loss by 31% to 100% as compared to fields in which no cover crops were grown.
- Legume cover crops, including red clover, crimson clover, lentil and pea, reduced soil loss by 38% to 69% as compared to no cover crops.
- Mustard, a brassica, reduced soil loss by up to 82% as compared to no cover crop.
- On average, cover crops reduced sediment losses from erosion by 20.8 tons per acre on conventional-till fields, 6.5 tons per acre on reduced-till fields and 1.2 tons per acre on no-till fields.

Management Decisions Matter

- The best management practices for preventing soil loss are those that maximize ground coverage year-round, and these include no-till management in combination with cover crop growth.
- Conservation tillage practices were responsible for an 89% reduction in soil loss as compared to conventional tillage.

Cover Crops Can Steward Water Quality and Soil Health

- Erosion is a costly depletion of resources, a displacement of soil from where it is needed to where it becomes a pollutant in waterways. Displaced soil can carry nutrients, like nitrogen and phosphorus, which further pollute waterways.
- We can invest in reduced rates of soil loss from agricultural fields, whether in vineyard rows or corn fields, by planting cover crops, maintaining constant ground cover and utilizing no-till management.

[1] Unless otherwise cited, all data comes from a bibliography compiled by SARE and the University of Missouri.

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This publication was developed by Sami Tellatin and Rob Myers of NCR-SARE and the University of Missouri under Cooperative Agreement No.83695601 awarded by the U.S. Environmental Protection Agency. EPA made comments and suggestions on the document intended to improve the scientific analysis and technical accuracy of the document. However, the views expressed in this document are those of the author. The EPA, the USDA and SARE do not endorse any products or commercial services mentioned in this publication. The SARE program is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2014-38640-22173.

July 2017

Cover Crops for Weed Management in Row Crops

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Fig. 1. A roll-killed cereal rye and crimson clover cover crop mulch suppressing weeds in a conventional cotton trial in Lewiston, NC. Photo Rachel Atwell

Cover crops can be used to provide weed suppression in subsequent cash crops (Fig. 1). In the Southeastern and Mid-South U.S., questions concerning management of herbicide-resistant *Amaranthus* species, horseweed, and Italian ryegrass, comprise the majority of Cooperative Extension Service calls. Conservation agriculture practices are especially threatened by the emergence and rapid spread of glyphosate-resistant Palmer amaranth. The use of cover crops for weed control can help conventional producers combat herbicide-resistant weeds and organic producers reduce dependency on cultivation as their primary weed control mechanism. When using cover crops for weed control, cover crops are often terminated via roller-crimping that leaves a weed-suppressive mulch on the soil surface into which the cash crop can be directly planted. A roller-crimper terminates weeds by rolling the cover crop down at an appropriate growth stage and simultaneously crimping the cover crop stems which accelerates desiccation. A surface mulch can reduce weed pressure through physical impedance, depriving weeds of light, and through allelopathy. A key to successful weed control when using this system is to achieve high cover crop biomass. Cereal rye (*Secale cereale*) is a popular cover crop choice in this system for its ability to produce a large quantity of biomass. Cereal rye can be easily terminated via roller-crimping at soft dough stage. However, planting into a high cover crop biomass mulch can be a challenge. Conventional producers can use strip-till rigs, which will move the cover crop residue several inches away from the crop row and allow for good cash crop seed-to-soil contact. Non-organic producers can then affordably use a banded herbicide application to control in-row weeds. For an organic producer, it is important to keep as much cover crop residue in the crop row as possible due to lack of affordable and effective in-row weed control options. Researchers and producers have been working on planter designs which can plant reliably and efficiently into heavy cover crop biomass mulches (Fig. 2).

Weed Suppression Using Cover Crops in Conventional Corn and Cotton Production

Field experiments were conducted from autumn of 2003 through cash crop harvest in 2006 at three locations. The treatments were five cover crop seeding dates each autumn and four cover crop termination dates each spring. The five crimson clover or cereal rye seeding dates were: on the first average 32° F temperature date, two and four weeks prior and two and four weeks after the average 0° C temperature date. Termination dates were four, three, two, and one week prior to the average date for the establishment of the cash crop.

Results showed that biomass production by winter covers decreased with even a week's delay in winter cover crop seeding and resulted in a corresponding increase in summer annual weed biomass (Fig. 3). More than ten times difference in clover biomass was observed when clover was planted on the earliest date and terminated on last date compared to late planting and early termination. Correspondingly, weed biomass was 496 lb/ac in the treatment with the least rye biomass, which was eight times higher than the treatment with the greatest rye biomass.

In this experiment, earlier cover crop planting and leaving cover crops alive up to one week before planting corn and cotton increased cover crop biomass accumulation compared with planting later and terminating the cover crop four weeks before planting. Increased cover crop biomass suppressed subsequent total weed dry biomass. These findings indicate that high residue cover crops have predictable potential for suppressing early season weeds in corn and cotton. If farmers are utilizing glyphosate-resistant corn-cotton rotation systems these findings hold particular importance with regard to current glyphosate resistant weed control issues. Because corn and cotton yields were not negatively impacted, we can conclude that high residue obtained by planting crimson clover or rye cover crops timely and terminating either a week or two prior to cash crop planting is feasible assuming soil moisture is not limiting at this time. Ideal management will result in maximum cover crop biomass production that provides effective weed suppression.

Weed Suppression Using Cover Crops in Organic Corn and Soybean Production

Using cover crops for weed control can help reduce dependency on cultivation as the primary weed control mechanism in organic grain production. For organic producers, it is important to achieve greater than 8,000 lbs dry cover crop biomass/ac (8,891 kg/ha) to get consistent weed control from the cover crop mulch. Cereal rye can serve as an excellent cover crop for weed suppression prior to organic soybean production. Soybeans fix their own nitrogen and, therefore, limited nitrogen release from the cereal rye cover crop is not problematic. More information on weed control from a cereal rye cover crop in organic soybean production can be obtained from Chapter 9 in the North Carolina Organic Grain Production Guide. Using cover crops for weed control in organic corn production is more complicated. Consistent weed control and nitrogen availability are limiting factors to yield in organic corn production. While a cereal rye cover crop can provide excellent weed suppression in the subsequent cash crop, it has limited value for nitrogen release due to a high C:N. A legume cover crop can provide substantial nitrogen release to a corn crop, but a legume cover crop has limited value for season long weed control because the cover crop residue breaks down rapidly. Using a cover crop mixture of

Fig. 2. Added front toolbar equipped with residue managers to aid planting into high cover crop biomass mulches. Photo Rachel Atwell

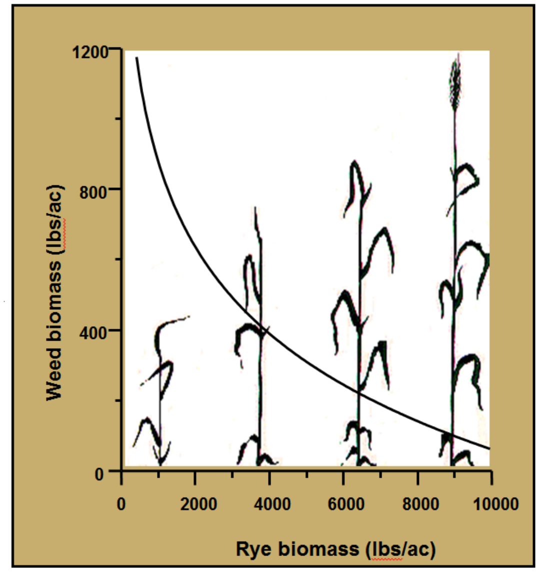

Fig. 3. Rye biomass (depicted) influencing weed biomass.

a small grain and a legume may be the best option that a producer can use to maximize both the weed suppressive and nitrogen fertility benefits necessary from a cover crop mulch in organic corn production. Additional nitrogen fertility beyond that provided through a cover crop mixture is likely necessary to maximize organic corn yield. A study was conducted at three locations (the Rodale Institute, North Carolina State University, and the USDA-ARS Beltsville) evaluating different starter fertilizer sources and application methods in organic corn production using a cover crop mulch for weed suppression. At six of the seven study sites, additional fertility was necessary to maximize organic corn yield. Additional information on this study can be found on the North Carolina Organic Grain Production website (link below).

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APPENDIX D
ONLINE AND WORKSHOP SURVEY RESULTS

UpperSaludaWatershedSurvey_Id	DoYouLiveInOrOwnLandInTheUpperSaludaRiverWatershedwatershedPicturedAbove	DoesYourDrinkingWaterComeFromAWellOrPublicWaterSystem	IfPublicPleaseChooseTheSpecificSourceOfWater	DoYouAccessWatersOfTheUpperSaludaForFishingPaddlingSwimmingOrOtherRecreationalPurposes	RatingScaleQuestions_HowImportantToYouIsWaterQualityOfLocalStreamsRiversAndLake	RatingScaleQuestions_HowImportantToYouIsWaterQualityOfLocalStreamsRiversAndLake_Rating	RatingScaleQuestions_HowImportantToYouIsRecreationalUseOfLocalStreamsRiversAndLakes	RatingScaleQuestions_HowImportantToYouIsRecreationalUseOfLocalStreamsRiversAndLakes_Rating	RatingScaleQuestions_HowImportantToYouAreHealthyFisheriesAndAquaticConditionsOfLocalWaters	RatingScaleQuestions_HowImportantToYouAreHealthyFisheriesAndAquaticConditionsOfLocalWaters_Rating	RatingScaleQuestions_HowImportantToYouIsLandConservationForProtectionOfDrinkingWater	RatingScaleQuestions_HowImportantToYouIsLandConservationForProtectionOfDrinkingWater_Rating	RatingScaleQuestions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	RatingScaleQuestions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth_Rating	RatingScaleQuestions_HowImportantToYouIsLandConservationForWildlifeAndOtherEnvironmentalBenefits	RatingScaleQuestions_HowImportantToYouIsLandConservationForWildlifeAndOtherEnvironmentalBenefits_Rating	DoYouThinkProtectiveMeasuresAreNeededToProtectLocalStreamsRiversWetlandsAndLakesAsDevelopmentOfTheWatershedIncreases	IfYesDoYouHaveSuggestionsForProtectiveMeasuresOrPractices2	DoYouSupportRiparianBufferRequirementsAtNewDevelopmentSitesForProtectionOfStreamsRiversLakesAndWetlands	DoYouHaveConcernsAboutSedimentInTheUpperSaludaRiversOrSaludaLake	IfYesDoYouHaveSuggestionsForProtectiveMeasuresOrPractices	DoYouHaveOtherConcernsRegardingRiversOfTheUpperSaludaWatershedOrSaludaLake	dingAvailableToHelpPayForAgriculturalManagementPracticesOnFarmsInTheNorthSaludaRiverWatershedFundedPracticesIncludeCove	DoYouOrDoesSomeoneYouKnowOwnAFarmInTheUpperSaludaRiverWatershed	InformationAboutTheFundingAvailableToHelpPayForAgriculturalManagementPracticesInTheNorthSaludaWatershedsuchAsCoverCrop	Name_First	Name_Last	Email	Phone	WouldYouLikeToReceiveInformationAboutFuturePublicMeetingsworkshopsAboutWatershedPlanningProtectionAndRestoration	Name2_First	Name2_Last	Email2	Phone2	Entry_Status	Entry_DateCreated
101	No	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes	Bigger fines for littering / trail camera surveillance?	Yes	Yes		Trash. So r	No	No	No					Yes	Matthew	Carter	matthew@	(864) 243-	Submitted	6/13/2020 3:39 PM
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97	Yes	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	Yes			No	No	No					Yes	Kelly	Brogdon	kbrogdon(	(864) 907-	Submitted	6/12/2020 1:02 PM
96	Yes	well		Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes	Manage development practices and buffer zone in sensitive areas	Yes	Yes			No	No	No					Yes	William	Vermeal	Williamver	(864) 346-	Submitted	6/12/2020 10:54 AM
95	Yes	well		Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	Yes			No	No	No					Yes	Tricia	Kyzer	tricia.kyzer	(864) 918-	Submitted	6/11/2020 11:16 PM
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93	Yes	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes	Better development policy to control hard scape erosion	Yes	Yes			No	No	No					Yes	Jason	Greer	greerjason	(864) 525-	Submitted	6/11/2020 9:39 PM
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90	Yes	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	Yes			No	No	No					No					Submitted	6/3/2020 5:55 PM
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85	Yes	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	Yes			No	No	No					Yes					Submitted	6/2/2020 8:42 PM
84	No	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	Yes			No	No	No					Yes	Diane	Petrice	petricedia	(864) 640-	Submitted	6/2/2020 4:36 PM
83	Yes	public wat	Greenville	No	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	Yes			No	No	No					Yes	Concetta	Ruff	concetta.r		Submitted	6/2/2020 4:36 PM
82	Yes	well		Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes	Clearly written and effective buffer ordinances would be a good start.	Yes	Yes	Widesprea	Agricultura	Yes	Yes	No					Yes	Tony	Ruhlman	trcarex@g	(864) 270-	Submitted	6/2/2020 3:50 PM
81	Yes	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes		Yes	No		Litter	No	No	No					Yes	Mallory	Dailey	mallord@	(724) 612-	Submitted	6/2/2020 3:30 PM
80	No	well		Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes	Mandatory stream buffers on all blue line streams for single family residential homes. We see too many people mowing grass up to their stream banks and not understanding why their streams eroding and full of sediment.	Yes	Yes			Yes	No	No					Yes	Alex	Kostik	a.kostik@	(754) 953-	Submitted	6/2/2020 3:14 PM
79	Yes	public wat	Greenville	Yes	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	1 – Very In	4.0	Yes	Greenville county needs to be more diligent in their investigation and approval of new development. Their current Laissez-Faire attitude towards development is becoming a huge problem in our area. New subdivisions are popping up everywhere destroying habitat and silting in waterways.	Yes	Yes	Riparian b	Waterway	Yes	No	No					Yes	Taylor	LeBlanc	taylorklebl	(864) 404-	Submitted	6/2/2020 3:09 PM

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY

September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session
   1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied

• Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
• Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
• Rainfall simulator	1	2	3	4	5
• Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? ______

3. Do you think installing soil stabilization practices at your farm might benefit your operation? yes

   In what way(s)? Decreased input costs.

4. Have you ever used EQIP funding for your farm? no If not, why not? I wasn't sure if it applied to leased land

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
   absolutley

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? yes If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?
   I'll share with them

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? yes
   Please explain your concerns. I want to minimize my impact on the watershed, maintain habitat, and ensure clean water

8. Do you have additional suggestions for improving soil health? not beyond what was covered

9. Do you have additional suggestions for reducing runoff? Maybe incorporating hedgerows of permanent plants

10. What types of workshops/field tours would you be interested in attending in the future? Always more to learn about the soil, Pest control best practices

11. Any additional comments or questions? (use back for more space, if needed)

12. (Optional): Name: Ian Harding Phone Number: 864-927-6871
Email: hardingian5@gmail.com

Thank you for your feedback!

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session

Session	1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied				
• Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
• Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
• Rainfall simulator	1	2	3	4	5
• Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? ______

3. Do you think installing soil stabilization practices at your farm might benefit your operation? ______

   In what way(s)? ______

4. Have you ever used EQIP funding for your farm? ______ If not, why not? ______

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?

   ______

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? ______ If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?

   ______

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? ______

   Please explain your concerns. ______

8. Do you have additional suggestions for improving soil health? ________________________________

9. Do you have additional suggestions for reducing runoff? ________________________________

10. What types of workshops/field tours would you be interested in attending in the future? _______

11. Any additional comments or questions? (use back for more space, if needed)____________________

12. (Optional): Name: ________________________________ Phone Number: ____________________

Email: ________________________________

Thank you for your feedback!

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session
   1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied

Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
Rainfall simulator	1	2	3	4	5
Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? ____

3. Do you think installing soil stabilization practices at your farm might benefit your operation? Yes

   In what way(s)? - erosion control, soil health & habitat improvement

4. Have you ever used EQIP funding for your farm? No If not, why not? unaware of it.

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
   Possibly

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? ____ If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?
   I'll share

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? ____
   Please explain your concerns. Yes - I see it in Molly Branch & know it must be much more severe in Saluda

8. Do you have additional suggestions for improving soil health? ______________________________

____

____

9. Do you have additional suggestions for reducing runoff? ______________________________

____

____

10. What types of workshops/field tours would you be interested in attending in the future? _______

____

____

11. Any additional comments or questions? (use back for more space, if needed)__________________

____

____

12. (Optional): Name: ______________________________ Phone Number: ____________________

Email: ______________________________

Thank you for your feedback!

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session
1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied

Session					
Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
Rainfall simulator	1	2	3	4	5
Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? business cards of presenters

3. Do you think installing soil stabilization practices at your farm might benefit your operation? ______
In what way(s)? more yield, less cost

4. Have you ever used EQIP funding for your farm? No If not, why not? don't have farm

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
no

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? no If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? yes
Please explain your concerns. erosion, loss of wildlife and fish

8. Do you have additional suggestions for improving soil health? more knowledge even to young school children

9. Do you have additional suggestions for reducing runoff? ______

10. What types of workshops/field tours would you be interested in attending in the future? more ways to improve soil and environment for homeowners

11. Any additional comments or questions? (use back for more space, if needed) great info and great speakers

12. (Optional): Name: ______ Phone Number: ______
Email: Racss1084@gmail.com

Thank you for your feedback!

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session

	1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied				
• Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
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• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
• Rainfall simulator	1	2	3	4	5
• Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? ______

3. Do you think installing soil stabilization practices at your farm might benefit your operation? ______

   In what way(s)? ______

4. Have you ever used EQIP funding for your farm? yes If not, why not? ______

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? NO If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? ______

   Please explain your concerns. ______

8. Do you have additional suggestions for improving soil health? ______________________________

____

____

9. Do you have additional suggestions for reducing runoff? __________________________________

____

____

10. What types of workshops/field tours would you be interested in attending in the future? _______

____

____

11. Any additional comments or questions? (use back for more space, if needed)___________________

____

____

12. (Optional): Name: ______________________________ Phone Number: ___________________

Email: ______________________________

Thank you for your feedback!

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session
   1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied

Session					
Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
Rainfall simulator	1	2	3	4	5
Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? Better description of living soil - break down the role of microbes and plant > microbe > soil relationships

3. Do you think installing soil stabilization practices at your farm might benefit your operation? yes
   In what way(s)? Improved water quality - indirect
   Direct - Improved soil quality - porosity etc

4. Have you ever used EQIP funding for your farm? yes If not, why not?

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
   Yes - ditch stabilization - buffer areas

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? _______ If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake?
   Please explain your concerns. Yes - improve bank stabilization on S. Saluda river.

8. Do you have additional suggestions for improving soil health? New technologies eg. Microbial biostimulant use.

9. Do you have additional suggestions for reducing runoff?

10. What types of workshops/field tours would you be interested in attending in the future?

11. Any additional comments or questions? (use back for more space, if needed)

12. (Optional): Name: Glen Crowe Phone Number: 864-245-6344
Email: glen.crowe@gmail.com

Thank you for your feedback!

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session
1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied

Session					
• Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
• Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
• Rainfall simulator	1	2	3	4	5
• Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? No

3. Do you think installing soil stabilization practices at your farm might benefit your operation? Yes

   In what way(s)?

4. Have you ever used EQIP funding for your farm? No If not, why not?

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
   MAYBE

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? No If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?
   will Share

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? Yes
   Please explain your concerns.
   The Sediment will Continue to Back up up the Basen of Riveirs.

8. Do you have additional suggestions for improving soil health? No

9. Do you have additional suggestions for reducing runoff? No

10. What types of workshops/field tours would you be interested in attending in the future? would like to look @ farms that use Cover Crop

11. Any additional comments or questions? (use back for more space, if needed)

12. (Optional): Name: Phone Number:

Email:

Thank you for your feedback!

THANK you for discussing grazing pasture management

IMROVING SOIL HEALTH TO BOOST THE BOTTOM LINE
WORKSHOP SURVEY
September 24, 2019

1. How satisfied were you with today's workshop? Please rate each session
   1-very unsatisfied, 2-unsatisfied, 3- neutral, 4- satisfied, 5-very satisfied

• Welcome and Introduction (Melanie Ruhlman)	1	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	1	2	3	4	5
• Agricultural Conservation Easement Program. (Drew Brittain)	1	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	1	2	3	4	5
• Rainfall simulator	1	2	3	4	5
• Video: Farmer Scientists: Five Trials in Managing Soil Health	1	2	3	4	5

2. Do you have suggestions for improving this workshop? ______

3. Do you think installing soil stabilization practices at your farm might benefit your operation? ______

   In what way(s)? ______

4. Have you ever used EQIP funding for your farm? ______ If not, why not? ______

5. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?

6. Do you know any other farmers who may be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? ______ If so, would you be willing to provide their contact information? If not, would you please share with them what you learned today?

7. Do you have concerns about sediment in the Upper Saluda rivers, and/or Saluda Lake? ______

   Please explain your concerns. Yes - turbidity is extremely damaging to rivers & lakes

8. Do you have additional suggestions for improving soil health? ______________________________

____

____

9. Do you have additional suggestions for reducing runoff? _________________________________

____

____

10. What types of workshops/field tours would you be interested in attending in the future? _______

____

____

11. Any additional comments or questions? (use back for more space, if needed)________________

____

____

12. (Optional): Name: ______________________________ Phone Number: ___________________

Email: ______________________________

Thank you for your feedback!

APPENDIX E
STEPL INPUT SHEET

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 10 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2;
(c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, you may proceed with optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6;
(c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheets.

Export input/output data: Export Data

☐ **Treat all the subwatersheds as parts of a single watershed** ☐ **Groundwater load calculation**

State	County	Weather Station
South Carolina	Pickens	_SC-Pickens_Mean

Calculate Manure Application Months: Manure Application

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors		
									0.940	0.610	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1 - Upper S	1760.9	411.4	565.9	31789.3	0	0	0-24%	34527.5	65	117	0.849
W2 - Lower S	1244.7	110.3	796.5	9258.1	0	0	0-24%	11409.6	65	117	0.849
W3 - Oolenoy	2799.2	342.7	750.7	27435.6	0	0	0-24%	31328.2	65	117	0.849
W4 - Middle	2693.7	386.1	354.6	27956.8	0	0	0-24%	31391.2	65	117	0.849
W5	0	0	0	0	0	0	0-24%	0	65	117	0.849
W6	0	0	0	0	0	0	0-24%	0	65	117	0.849
W7	0	0	0	0	0	0	0-24%	0	65	117	0.849
W8	0	0	0	0	0	0	0-24%	0	65	117	0.849
W9	0	0	0	0	0	0	0-24%	0	65	117	0.849
W10	0	0	0	0	0	0	0-24%	0	65	117	0.849
	8498.5	1250.5	2467.7	96439.8							

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1 - Upper S	148	4	32	67	61	44	0	0	9	6
W2 - Lower S	122	4	14	64	50	30	0	0	0	0
W3 - Oolenoy	242	8	19	132	98	54	0	0	0	0
W4 - Middle	257	7	76	105	107	86	0	0	0	0
W5	0	0	0	0	0	0	0	0	0	0
W6	0	0	0	0	0	0	0	0	0	0
W7	0	0	0	0	0	0	0	0	0	0
W8	0	0	0	0	0	0	0	0	0	0
W9	0	0	0	0	0	0	0	0	0	0
W10	0	0	0	0	0	0	0	0	0	0
Total	769	23	141	368	316	214	0	0		

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	0	2.43	2	0	0
W2	0	2.43	2	0	0
W3	0	2.43	2	0	0
W4	0	2.43	2	0	0
W5	0	2.43	2	0	0

W6	0	2.43	2	0	0
W7	0	2.43	2	0	0
W8	0	2.43	2	0	0
W9	0	2.43	2	0	0
W10	0	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1 - Upper S	300.000	0.247	0.858	0.620	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W2 - Lower S	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W3 - Oolenoy	300.000	0.238	1.130	0.800	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W4 - Middle	300.000	0.247	0.858	0.466	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W5	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W6	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W7	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W8	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W9	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000
W10	300.000	0.238	1.130	0.200	0.976	300.000	0.238	1.130	0.040	1.000	300.000	0.238	1.130	0.003	1.000

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc. (#/100mg)
W1 - Upper S					B	0.080	0.031	0.160	0.000
W2 - Lower S					B	0.080	0.031	0.160	0.000
W3 - Oolenoy					B	0.080	0.031	0.160	0.000
W4 - Middle					B	0.080	0.031	0.160	0.000
W5					B	0.080	0.031	0.160	0.000
W6					B	0.080	0.031	0.160	0.000
W7					B	0.080	0.031	0.160	0.000
W8					B	0.080	0.031	0.160	0.000
W9					B	0.080	0.031	0.160	0.000
W10					B	0.080	0.031	0.160	0.000

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportatior	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultiva	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L-Croplan	**1.9**	**0.3**	**4**	0
1a. w/ manure	8.1	2	12.3	0
2. M-Croplan	**2.9**	**0.4**	**6.1**	0
2a. w/ manure	12.2	3	18.5	0
3. H-Croplan	**4.4**	**0.5**	**9.2**	0
3a. w/ manure	18.3	4	24.6	0
4. Pastureland (see Table 10 for default values with manure)				
5. Forest	**0.2**	**0.1**	**0.5**	0
6. User Defin	0	0	0	0

7a. Nutrient concentration in shallow groundwater (mg/l) and E. coli (MPN/100ml)(may be modified)

Landuse	N	P	BOD	E. coli
Urban	1.5	0.063	0	0
Cropland	1.44	0.063	0	0
Pastureland	1.44	0.063	0	0
Forest	0.11	0.009	0	0
Feedlot	6	0.07	0	0
User-Defined	0	0	0	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1	1760.9	0	2	0	3	0	0	0	0	95	100
W2	1244.7	1	1	0	4	0	12	0	0	82	100
W3	2799.2	2	0	0	4	0	14	0	0	80	100
W4	2693.7	15	10	10	10	10	30	5	5	5	100
W5	0	15	10	10	10	10	30	5	5	5	100
W6	0	15	10	10	10	10	30	5	5	5	100
W7	0	15	10	10	10	10	30	5	5	5	100
W8	0	15	10	10	10	10	30	5	5	5	100
W9	0	15	10	10	10	10	30	5	5	5	100
W10	0	15	10	10	10	10	30	5	5	5	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	411.4	0	0	0	0
W2	110.3	0	0	0	0
W3	342.7	0	0	0	0
W4	386.1	0	0	0	0
W5	0	0	0	0	0
W6	0	0	0	0	0
W7	0	0	0	0	0
W8	0	0	0	0	0
W9	0	0	0	0	0
W10	0	0	0	0	0