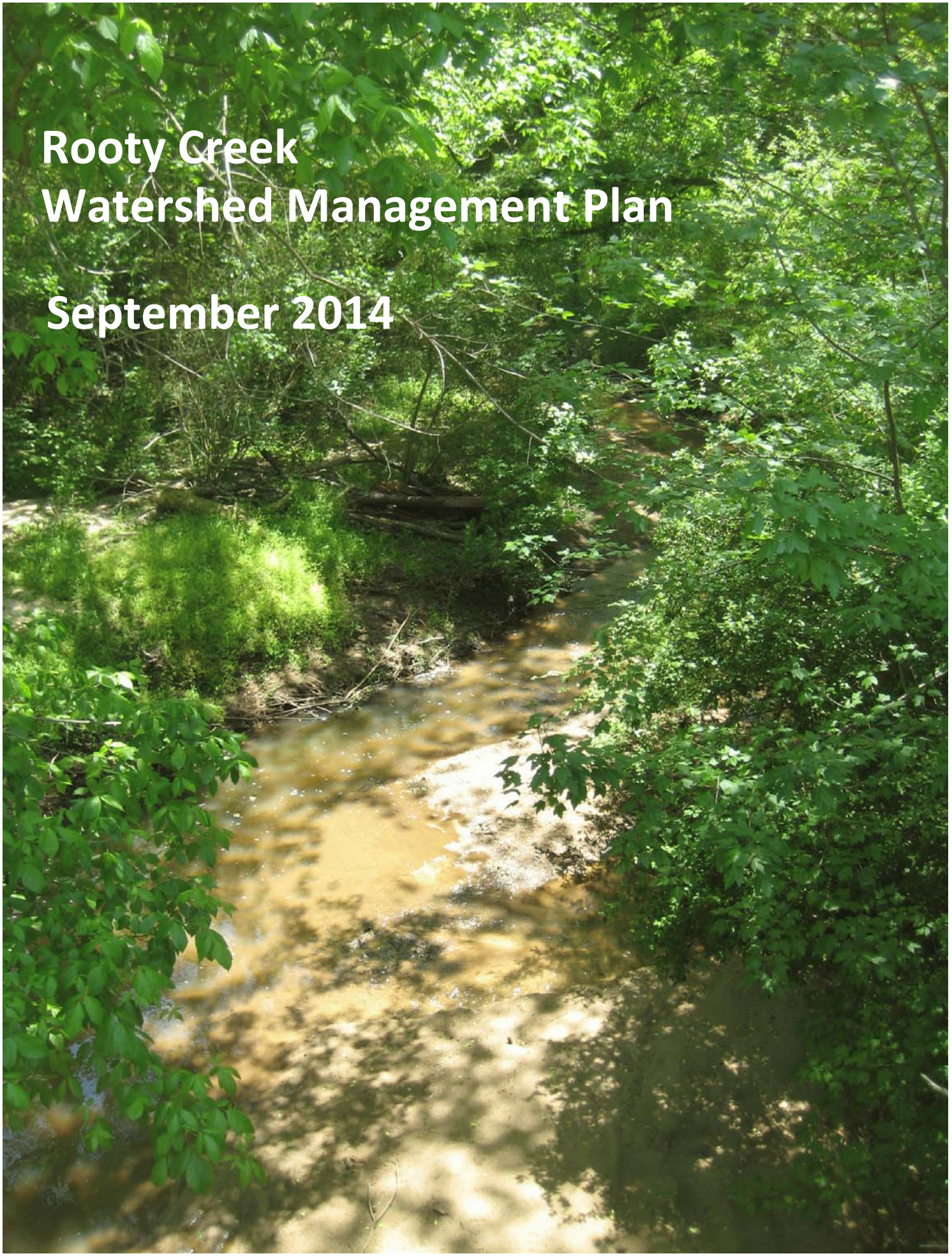

Rooty Creek Watershed Management Plan

September 2014

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I. Introduction

The purpose of developing the Rooty Creek Watershed Management Plan is to provide a tool that demonstrates a holistic approach to water quality management by actively engaging stakeholders within the watershed in the selection of management strategies that will be implemented to solve the problems.

This document is not regulatory. Its preparation process engages stakeholders to recognize issues and provide feedback on how to deal with them, as well as to develop momentum and contribute to the restoration effort. The Watershed Advisory Committee (WAC) identified the following goal of this plan's implementation:

GOAL: Improve Rooty Creek's water quality so that the creek is ultimately removed from Georgia's list of State Impaired Waters (Integrated 305(b)/303(d) List).

II. Stream Selection

In 2007, the Georgia Environmental Protection Division (GA EPD) developed two Total Maximum Daily Load (TMDL) Evaluations, one addressed fecal coliform[1], the other, sediment[2], for the Oconee River Basin which includes Rooty Creek. The TMDL establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream water quality conditions. Water quality standards for fecal coliform and sediment limit the amount of pollution allowed to load into a river or stream. If a stream does not meet water quality standards, a TMDL is established for that pollutant. Implementation tools, such as watershed-based plans, are then developed to reduce the pollutants loading into the stream from various (point and nonpoint) sources and restore the water body so that it meets water quality standards.

The TMDL Evaluations identified a nine-mile segment of Rooty Creek as not supporting its designated use of fishing. See Map 1. In order to meet state water quality standards, a load reduction of 97 percent for fecal coliform and 1.9 percent for sediment is required. Wildlife, agricultural livestock, and urban runoff were identified as typical sources of non-point source fecal coliform contamination in the river basin, although no specific sources were identified for Rooty Creek. Recommendations emphasized further source identification, the collection of data to support the current allocations and subsequent source reductions, increased public awareness and education of the impact of human activities on water quality, and application of Best Management Practices (BMPs) appropriate to agricultural or urban land uses.

Most of the sediment found in the Oconee River Basin streams, including Rooty Creek, was deemed "legacy", sediment occurring from past land use practices. The resulting recommendation was "no net increase"[3] in sediment delivered to the impaired stream segments, thus allowing streams to recover over time. In order to maintain total annual sediment loads at current levels, implementation of BMPs associated with agricultural and silvicultural practices, implementation of Erosion and Sedimentation Control Plans, and mitigation and prevention of stream bank erosion were recommended.

Based on a review of existing Evaluations and TMDL Implementation Plans, the WAC defined the following objectives that could lead to successful goal attainment of this Plan.

OBJECTIVES:

- Long-term monitoring to provide current data to support decision-making.
- Implementation of management practices to reduce E.coli contamination from identified sources.
- Improve vegetated stream buffers and restore eroded stream banks.
- Promotion of public awareness, understanding, and stewardship through public education and training opportunities for the general population and government agencies, and providing readily available technical and information-based resources.

[1]Georgia Department of Natural Resources, Total Maximum Daily Load Evaluation for Thirty-Two-Stream Segments in the Oconee River Basin for Fecal Coliform, January 2007.

[2]Georgia Department of Natural Resources, Total Maximum Daily Load Evaluation for Thirty-Two-Stream Segments in the Oconee River Basin for Sediment (Biota), January 2007.

[3]Ibid, p. 64.

As the Watershed Management Plan was developed, specific actions were identified and designed to meet the specific objectives thus insuring that the proposed actions could objectively achieve the goals of the Rooty Creek Watershed Management Plan.

III. Formation of Advisory Committee

This Plan's development relied upon the participation of a Watershed Advisory Committee (WAC) which represented the Rooty Creek watershed and consisted of major property owners, elected officials and staff from Eatonton and Putnam County, regional agencies, and state and federal agencies that would assist with plan implementation. Four meetings (January 23, February 27, May 28 and June 26, 2014) were held with the WAC to engage the public in the process of designing an implementation plan. Meetings focused on gathering input concerning potential problems and solutions, developing priorities, evaluating what BMPs might be met with the best public reception, and obtaining insight on the watershed management plan. Finally, approval was sought for the document to serve as the plan on which implementation efforts will follow to restore and maintain the watershed. See Appendix II for list of WAC members.

IV. Source Assessment

Based on the TMDL Evaluations, TMDL Implementation Plans, current water quality monitoring, visual survey, land use, tax assessor data, and WAC input, the potential causes of water quality impairment were determined as follows:

Table 1: Rooty Creek Potential Sources of Contamination

Identified Impairment	Potential Source/Cause
Fecal Coliform	Orangeburg or bituminous fiber pipe remains in some low–income areas in Eatonton
	Cracked terra cotta sewer pipes
	Sanitary Sewerage leak/overflow
	Urban Runoff from impervious surfaces
	Direct sewage discharge
	Agricultural practices in the northern portion of the watershed
	Leaking Septic Systems/Illicit Connections
Sediment	Forest land cleared and not replanted
	Legacy sediment
	Gullies and channeling from bridge construction at Rooty Creek and E. Sumter Street and Little Creek and US 441 South and culvert construction/agricultural activities at Rooty Creek and Martin Luther King Jr., Drive.

Percentage of Possible Pollution Source/Cause

After reviewing the 2014 water quality monitoring data, land use, and consultation with the Eatonton-Putnam County Water and Sewer Authority (EPWSA), the WAC identified agricultural operations, particularly upstream of the Lower Harmony Road monitoring site, and the condition of the EPWSA sanitary sewerage system as the primary causes Rooty Creek's fecal coliform contamination. A secondary identified source is likely urban runoff from impervious surfaces though, without specific testing at storm water outfalls, it is difficult to gage the true impact of the runoff on water quality.

Figure 1: Potential Sources of Pollution

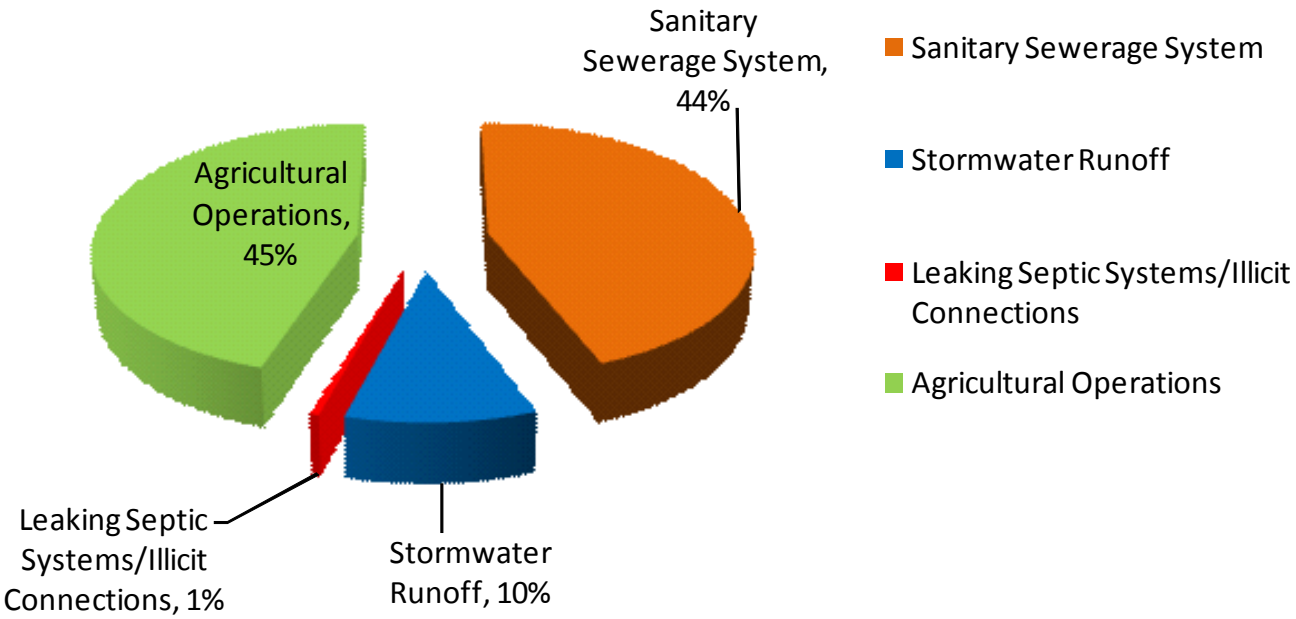
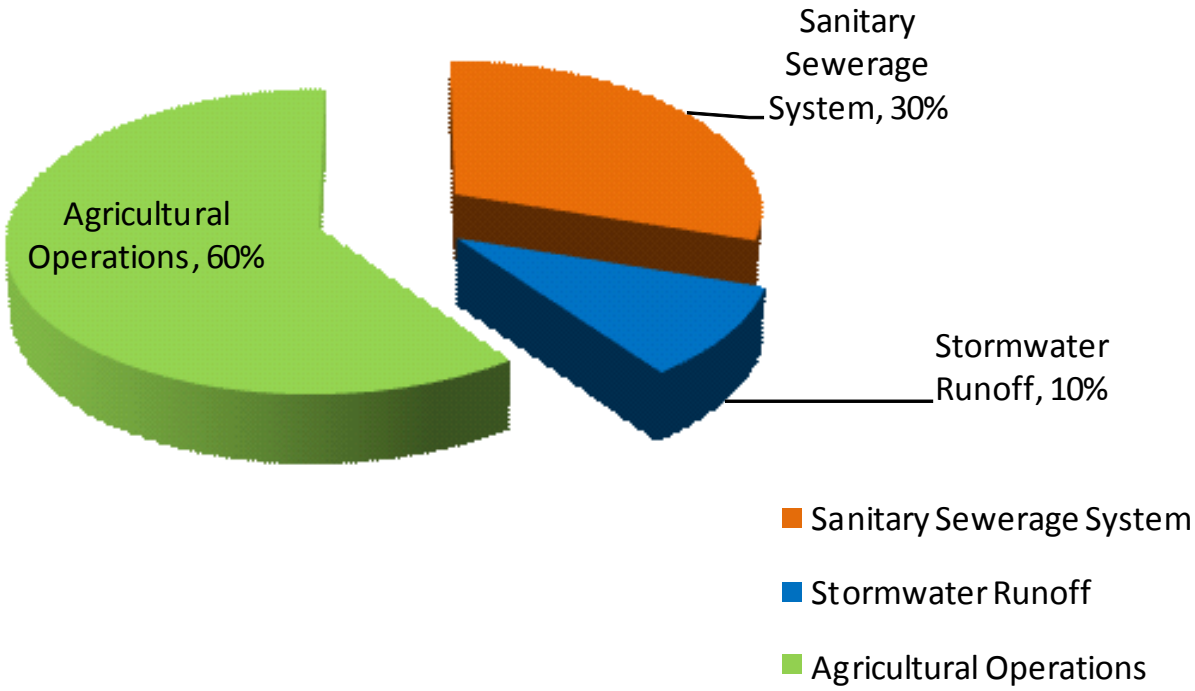


Figure 2: Reduction Goals



V. Assessment and Characterization of Current Conditions

The Rooty Creek watershed contains 29,965.17 acres of primarily agricultural and forested land in Putnam County and residential, commercial land, and limited agriculture in the City of Eatonton.

Rooty Creek's headwaters begin from a farm pond just south of Bethel Church Road. From there, it meanders southwest through an extensive pastureland area between Highway 129/441 and Lower Harmony Road. As it crosses Lower Harmony Road, it continues through a pastureland area for some distance and then enters a forested area north of E. Sumter Street. As the creek flows south to Lake Sinclair, a 15,330 acre reservoir, land use becomes primarily forested with scattered pastureland. Between E. Sumter Street and Martin Luther King, Jr., Drive, the creek is fed by three tributaries that flow through older urban residential areas in Eatonton.

There are several significant wetland areas along Rooty Creek, including the section in the vicinity of Park Road and north of Little Creek. Floodplain areas are located along the entire stretch of Rooty Creek. The terrain consists of primarily rolling hills with several areas of steep slopes. The lower portion of this watershed is located within the Lake Sinclair intake water supply watershed.

Within the Rooty Creek watershed is the nine-mile impaired segment of Rooty Creek (from road S926 in Eatonton to Little Creek in Putnam County). The segment is identified in Georgia's 305(b)/303(d) list as not supporting its designated use of fishing due to non-point source fecal coliform and sediment (biota) contamination. The designation of this segment as "not supporting" due to fecal coliform contamination is based on sampling data from May 2004 at Georgia Department of Natural Resources, Environmental Protection Division's (GA EPD) sampling station located at Martin Luther King Jr., Drive, in Eatonton. The sediment (biota) contamination designation resulted from GA EPD Wildlife Resources Division (WRD) study of fish populations from 1998-2003 at a number of monitoring sites in the Oconee River Basin. Biological monitoring is a method used to evaluate the health of a biological system in order to assess degradation from various sources and is based on direct observations of aquatic communities.

Physical and Natural Features

Hydrology

The Rooty Creek watershed is comprised of two, HUC-12 watersheds, numbers 030701011803 and 030701011804, 12.93 miles of major streams (Rooty Creek), 78.86 miles of minor streams, and 298.78 acres of lakes, excluding Lake Sinclair. Rooty Creek has three primary tributaries, Little Branch, Turkey Creek, and Little Creek. Small ponds are scatted throughout the watershed.

Stream Buffers

To help protect water quality, the state mandates wooded stream buffers of at least 25' on each side of the stream bank. Wooded buffers are adequate throughout much of the Rooty Creek watershed, along the main channel as well as its tributaries. However, Rooty Creek upstream of Lower Harmony Road and parts of Little Creek and Turkey Branch have significant areas of non-wooded stream buffers. See Map 2.

Soils

All of the Rooty Creek watershed is contained within the Southern Piedmont Major Land Resource Area (MLRA). Dominant soils of the Southern Piedmont have mostly clayey subsoils and kaolinitic mineralogy. Well-drained very gently sloping to strongly sloping Appling, Cecil, Davidson, Hiwassee, Madison, Pacolet, and Wedowee series are found on uplands. Ashlar, Gwinnett, Louisburg, Madison, Pacolet, Wedowee, and Wilkes series are located on the steeper slopes.

In some localities, these soils contain coarse fragments. Cartecay, Chewacla, Congaree, Toccoa and Wehadkee series are in alluvial flood plains. Erosion control is important when cultivating these soils.

Soils of the Piedmont are acidic and low in nitrogen and phosphorus. In many cases, much of the original topsoil has been eroded leaving the clayey subsoil exposed. The less steep slopes and areas where the topsoil has not been completely eroded are adapted to corn, cotton, soybean, and grain sorghum production. Although row crops are productive in this region, the area is better adapted to pasture production.

Almost 66 percent of the soils in the Rooty Creek watershed are Cecil and Davidson series soils.[4] Both series are well-drained and have moderate permeability. Because Davidson series soils are found on very gentle to gentle slopes, the association is suited to farming and responds well to good management practices. Cecil series soils however, consist of moderately steep to steep slopes that extend down to numerous defined drainage ways. The major soils in this series are eroded to severely eroded. Gullies are common.

The following table depicts the Rooty Creek watershed generalized soils and provides a general description of the soil associations found in the watershed. See Map 3.

Table 2: Rooty Creek Soils

Soil Series	Characteristic	Acres	Percent
Cecil	Well drained	12,227.92	41.44
Chewacla	Poorly drained	1,383.49	4.69
Congaree	Well drained	1,314.06	4.45
Davidson	Well drained	6,624.30	22.45
Enon	Well drained	116.53	0.39
Gwinnett	Well drained	17.19	0.06
Helena	Moderately well drained	1,272.87	4.31
Pacolet	Well drained	280.98	0.95
Starr	Well drained	280.98	0.95
Vance	Well drained	2,002.29	6.79
Wehadkee	Poorly drained	287.03	0.97
Wilkes	Well drained	2,570.84	8.71

Source: - Geospatial Data Gateway. Originator: U.S. Department of Agriculture, Natural Resources Conservation Service, 2013.

[4] Soil Survey of Baldwin, Jones and Putnam Counties Georgia, USDA Soil Conservation Service and Forest Service, 1972.

Climate

The Rooty Creek watershed is characterized by mild winters and hot summers. Average annual precipitation is 47.34 inches per year. Precipitation occurs chiefly as rainfall, and to a lesser extent, as snowfall. Rainfall is fairly evenly distributed throughout the year, but a distinct dry season occurs from mid-summer to late fall. Rainfall is usually greatest in March and least in October.[5] The average annual temperature in the watershed is 61.8 degrees F.[6]

Habitat

This watershed's ecosystem provides habitat for diverse species of aquatic and terrestrial wildlife including white-tailed deer, opossum, raccoon, a variety of songbirds, fox, horned owl, timber rattlesnake, turtle, frog, salamanders, and a variety of fish.

Groundwater Recharge Areas

The Georgia Department of Natural Resources mapped areas of high, average (or medium), and low susceptibility of groundwater to pollution in Georgia. This map is commonly known as Hydrologic Atlas 20 or the Groundwater Pollution Susceptibility Map of Georgia. The Rooty Creek watershed is located in a "low" groundwater pollution susceptibility area. However, within a pollution susceptibility area are significant groundwater recharge areas. These areas are mapped on the Hydrologic Atlas 18 or the Groundwater Recharge Area Map of Georgia.

The significant groundwater recharge areas are subject to pollution from spills, discharges, leaks, impoundments, applications of chemicals, injections and other human activities in the watershed. Once in the aquifer, pollutants can spread uncontrollably to other parts of the aquifer thereby decreasing or endangering water quality for an entire region. Once polluted, it is almost impossible for a groundwater source to be cleaned up.

A majority of structures in the watershed receive drinking water from the Eatonton-Putnam Water and Sewer Authority (EPWSA). Structures outside the EPWSA service area receive drinking water from wells.

Only portions of two groundwater recharge areas are located in the Rooty Creek watershed; however, no recharge area intersects the Rooty Creek impaired segment. See Map 5.

Wetlands

Small, fragmented wetlands are found throughout the watershed. See Map 6.

Topography

Elevations in the watershed are gently sloping and range from 298 feet to 810 feet.

[5]NRCS Field Office Technical Guide, Putnam County, GA.

[6]USA.com.

Land Use and Population Characteristics

Land Cover

The watershed's physical landscape is fairly homogenous with the stream flowing generally southeastward. Land cover in the watershed has been divided into eleven categories as shown in Table 3, below. The watershed encompasses 20,337 acres with forest the dominant land cover at almost 50% and agricultural, 27%. Residential land accounts for almost 7% of the watershed with most residential land located in the city of Eatonton. See Map 7.

While forest is the predominant land cover, no fecal coliform reductions are called for in this category due to significant compliance with silvicultural BMPs[7]. Only agricultural and residential land is targeted for fecal coliform reductions due to high e.coli counts associated with agricultural properties upstream of Lower Harmony Road and documented problems with the sanitary sewerage system.

Table 3: Rooty Creek Land Cover

Land Cover Classification	Acres
Open Water	231.00
Low Intensity Residential	1,035.00
High Intensity Residential	267.00
Commercial/Ind/Trans	138.00
Barren Rock/Sand/Clay	135.00
Quarries/Mines	205.00
Forest	10,103.00
Row Crops	30.00
Pasture/Hay	5,478.00
Other Grasses (Urban, recreational)	2,213.00
Woody Wetlands	503.00
TOTAL*	**20,337.00**

Source: Total Maximum Daily Load Evaluation for Seventy-Two Stream Segments in the Oconee River Basin for Fecal Coliform, January 2007, GA EPD, p. 13.
*Does not include the part of Lake Sinclair found in the Rooty Creek watershed.

Agriculture

Approximately 5,508 acres (27 percent) of land within the watershed is pasture/hay/row crops. While this may include some unforested non-farm land, it is assumed to be primarily agricultural—used mostly for active livestock grazing or as idle pasture land. Row crops account for only 0.1 percent of agricultural land.

According to the TMDL Evaluation for Thirty-two Stream Segments in the Oconee River Basin, 2007, agricultural livestock were identified as a potential source of fecal coliform to streams in the Oconee River Basin which includes the Rooty Creek watershed. The animals grazing on pastureland deposit their feces onto land surfaces, where it can be transported during storm events to nearby streams. Animal access to pastureland varies monthly, resulting in varying fecal coliform loading rates throughout the year. Beef cattle spend all of their time in pastures, while dairy cattle are periodically confined. In

[7]Results of Georgia's 2013 Silvicultural Best Management Practices Implementation and Compliance Survey, p.3, Georgia Forestry Commission, February 28, 2014.

addition, agricultural livestock will often have direct access to streams that pass through their pastures, and can thus impact water quality in a more direct manner.

The WAC reports that the number of dairy farms in the watershed has decreased since 2004, the year Rooty Creek was classified as impaired. Presently, two active dairy operations and one beef cattle operation are located in the watershed upstream of Lower Harmony Road. A third dairy operation, the Eatonton Dairy, is expected to resume operations during Summer 2014 and is located on E. Sumter Street. A fourth dairy or cattle operation is located on MLK Jr., Drive at Park Drive. Remaining parcels with agricultural animals are hobby farms with generally 25 or fewer animals.

The WAC noted that there are several waste treatment lagoons in the Rooty Creek watershed upstream of Lower Harmony Road that are no longer used and need to be closed.

As noted in the TMDL Evaluation, with the reduction in farmland, there has also been a decrease in the amount of soil erosion. The National Resources Inventory found the total wind and water erosion on cropland and Conservation Reserve Program land in Georgia declined 38 percent, from 3.1 billion tons per year in 1982 to 1.9 billion tons per year in 1997 (USDA-NRCS, 1997). This suggests that the source of sediment in many of the impaired streams in the Oconee River Basin may be the result of past land use practices. Thus, it is believed that if sediment loads are maintained at acceptable levels, streams will repair themselves over time.

Previously Installed Agricultural Best Management Practices

According to NRCS, between 2004 and 2014, 269 conservation practices were installed in the Rooty Creek watershed. Of those practices, 53.9 percent addressed fecal coliform and sediment and 46.10 percent addressed other issues. Of the total conservation practices installed, more than 78 percent were in the upper portion (HUC 307011803) of the Rooty Creek Watershed.

In 2006, the Oconee River RC&D Council received a 319(h) grant to install agricultural best management practices in the Rooty and Crooked Creek watersheds. Seven properties in the Rooty Creek watershed received grant-funded assistance. See Map 8.

LAS/NPDES Permits

The watershed is home to four active, large-scale dairy/cattle operations and a fifth dairy that will resume operation in Summer 2014. Such agricultural operations can be a source of non-point source pollution. Dairies with LAS or NPDES permits are:[8]

- Eatonton Dairy Farm, LLP. Located at 214 Greensboro Highway. As of September 2013, the farm had no cows but operates under permit, GAG 930020. According to the WAC, dairy cows will return to the farm in Summer 2014.

[8]Georgia Department of Agriculture Liquid Manure Handling Systems for LAS Permitted Swine and Non-swine Animal Feeding Operation Pollution Prevention Initiative, January 16, 2014, GA DNR, EPD.

Georgia Department of Agriculture Liquid Manure Handling Systems for NPDES Permitted Swine and Non-swine Animal Feeding Operation Pollution Prevention Initiative, January 16, 2014, GA DNR, EPD.

- Sunrise Dairy. This dairy farm, located at 157 Bethel Church Road, operates under an NPDES permit and as of September 2013 had 920 heads of cow.

- T&W Farms. Located at 384 Lower Harmony Road, this dairy farm had 540 heads of cow in 2013 and utilized a liquid manure handling system. The Farm operates under a GA EPD-issued permit, LAS GAU700000.

Wildlife

According to the Georgia Department of Natural Resources, Wildlife Resources Division (GA WRD), the impact of wildlife on fecal coliform contamination varies widely. The animals that spend a large portion of their time in or around aquatic habitats are the most important wildlife sources of fecal coliform. Waterfowl, most notably ducks and geese, are considered to potentially be the greatest contributors of fecal coliform. This is because they are typically found on the water surface, often in large numbers, and deposit their feces directly into the water. Other potentially important animals regularly found around aquatic environments include racoons, beavers, muskrats, and to a lesser extent, river otters, and mink. Population estimates of these animal species in Georgia are not available.

White-tailed deer have a significant presence in the watershed with an estimated 2004 population of 50 deer per square mile. According to GA WRD, fecal coliform bacteria contributions to water bodies from deer are generally considered less significant than that of waterfowl, racoon, and beaver due to a greater portion of their time being spent in terrestrial habitats. This is also true for other terrestrial mammals such as squirrels and rabbits, and terrestrial birds. While feces deposited on the land surface can result in the introduction of fecal coliform to streams during runoff from storm events, in the warm, humid environments typical of the southeast, there may be considerable decomposition of the fecal matter thus resulting in a decrease in the associated fecal coliform numbers introduced to streams during runoff from storm events by terrestrial mammals.

Water and Sewerage System

In 2005, the Eatonton – Putnam Water and Sewer Authority (EPWSA) assumed operation and management of the two water treatment plants as well as the sanitary sewer system formerly operated by the City of Eatonton. See Map 9.

Treatment and Distribution System

The water system consists of a surface water treatment facility that was constructed prior to 1980. The plant is a conventional rapid rate filtration plant permitted at 1.0 million gallons per day. The water distribution system consists of over 200,000 linear feet of 2-inch through 12-inch diameter water lines of various materials and four elevated water storage tanks.

Water Pollution Control Plant

The Eastside Water Pollution Control Plants (WPCP), located in the Rooty Creek watershed, was originally constructed in 1979 and consisted of a coarse screening and grit removal structure, aeration basin, clarifier, chlorine contact chamber and control building. In 1988, the Eastside plant was upgraded and the plant permitted capacity was increased to 275,000 gallons per day with the addition of a mechanically cleaned bar screen, influent pumping equipment, aeration basin, clarifier, chlorine contact

chamber, solids holding tank, and sludge drying beds. The plant updgrade design provided for a minimum removal efficiency of 85% for biochemical oxygen demand (BOD_5) and total suspended solids (TSS). The EPWSA operates another WPCP – the Westside plant, but it is located outside the Rooty Creek watershed.

In October 2004, both WPCPs were each issued new NPDES permits for flow capacities of 0.550 million gallons average daily flow. The new permits also had more strict discharge limits with a compliance schedule of October 2007.

Sanitary Sewerage System

In 2002, the Georgia Department of Natural Resources, Environmental Protection Division (GA EPD) issued a consent order requiring an inspection and evaluation of the existing sanitary sewerage system. The Order also placed a moratorium on all sewer connections in the service area of the Eastside WPCP. As of April 2005, most of the collector sewers were investigated and some repairs were accomplished.

Areas in need of emergency repairs were identified through evaluation of videos and sewer reports. These repairs consisted mainly of areas where pipes were severely deteriorated or collapsed entirely. In addition, many of the 15-inch interceptor lines had cracks several feet in length and were in need of repair. Repair work throughout the system was scheduled in phases, however, the areas having the highest priority for controlling inflow and infiltration (I/I) into the system were repaired first. Proposed improvements are as follows:

- Repair cracked or broken pipe sections and improperly constructed joints using cured-in-place pipe.
- Replace pipe in areas where pipe is collapsed and/or missing.

A June 2005 Preliminary Engineering Report for Wastewater System Improvements prepared by Carter and Sloope, Inc. noted that the existing sanitary sewerage system consisted of 15-, 14-, 12-, 10-, 8-, and 6-inch sanitary sewer lines of various materials, including vitrified clay pipe, PVC, reinforced concrete and ductile iron. Due to age and poor construction, the collection system has deteriorated and is allowing ground and surface water to leak into the system. Many of the lines contain offset joints, cracks, dips/sags, root intrusion and improperly constructed service connections resulting in I/I into the sanitary sewerage system. Deterioration of the manholes and missing manhole covers also contribute to I/I. The I/I hydraulically overloads the WPCPs and contributes to operational problems at the plants. The report concluded that the sanitary sewerage system is in critical need of improvements. See Map 10.

Unfortunately, due to inadequate funding, the phased repairs are several years behind schedule. According to the Preliminary Engineering Report, since EPWSA took over operation and management of the wastewater system, little has been done to accomplish needed repairs. Some sewer replacement has been done by the City of Eatonton in conjunction with Community Development Block Grant projects, but the city can only effect repairs inside the city limits.

Leaks and overflows were identified by the WAC as a significant source of urban contamination.

Private Septic Systems

County Boards of Health and the Geogia Department of Human Resources regulate the siting and installation of septic systems up to 10,000 gallon tank capacity. Larger systems are permitted by GA EPD. However, property owners are responsible for properly operating and maintaining the septic system to increase life expectancy and prevent failures.

Residential land accounts for 6 percent of the watershed. The majority of dwellings are served by the EPWSA sanitary sewerage system. Remaining watershed structures are on large tracts of land and utilize individual septic systems. The Health Department has not identified any areas of septic tank failure. Further, the WAC determined private septic systems did not have a measurable impact on water quality due to their distance from Rooty Creek or its tributaries.

Land Use

Approximately 71% of the watershed contains agricultural/forestry land use; however, this percent is likely low as numerous large-acre pasture and forest land parcels in Eatonton were categorized as undeveloped in the 2007 existing land use calculations. When the undeveloped parcels are appropriately recategorized, approximately 80% of the watershed is in agricultural/forestry land use.

Commercial land use occupies 0.25 percent of the watershed and is located primarily in downtown Eatonton. Residential land occupies 7.3 % of the watershed and is primarily located on small lots in Eatonton. There are numerous larger lot residential properties adjacent to and nearby Lake Sinclair but these properties were classified as agricultural for purposes of existing land use. Industrial land use comprises 2.8% of the watershed and is located almost entirely within Eatonton on a number of contiguous parcels. See Map 11.

Table 4: Rooty Creek Watershed Land Use

Existing Land Use (2007)	Acres	% of Watershed	Future Land Use (2030)	Acres	% of Watershed
Agriculture/Forestry (Rural)	21307.64	71.11	Agriculture/Forestry (Rural)	220.90	0.74
Commercial	74.40	0.25	Commercial	817.47	2.73
Industrial	838.67	2.80	Industrial	801.11	2.67
Mixed Use Development	0.00	0.00	Mixed Use Development	708.82	2.37
Parks/Rec/Conservation	112.57	0.38	Parks/Rec/Conservation	115.20	0.38
Public/Institutional	175.30	0.59	Public Institutional	176.46	0.59
Residential			Residential		
Mixed Residential	1810.04	6.04	*Mixed Use Residential*	2488.66	8.31
Multi Family Residential	0.98	0.00	*Multi Family Residential*	0.00	0.00
Rural Residential	0.00	0.00	*Rural Residential*	21926.89	72.81
Single Family Residential	385.67	1.29	*Low-Medium Density Residential*	2011.90	6.71
Trans/Comm/Utilities	13.13	0.04	Trans/Comm/Utilities	0.00	0.00
Undeveloped	2242.33	8.08	Undeveloped	0.00	0.00
Water – Lake Sinclair	807.75	2.70	Water – Lake Sinclair	807.75	2.70
TOTAL	**29965.17**	**100.00**	**TOTAL**	**29,965.17**	**100.00**

Source: Joint Comprehensive Plan for Putnam County and City of Eatonton, 2007–2030.

The Future Land Use Map indicates that most of the parcels currently identified as undeveloped or agriculture/forestry will transition to Rural Residential accounting for almost 87 percent of the watershed. See Map 12. The Rural Residential Character Area outlined in the Joint Comprehensive Plan for Putnam County and City of Eatonton, 2007 – 2030, Community Agenda, will:

- Provide for large-lot residential parcels in areas outside of the existing water and sewer service area;
- Conserve open land and set aside from development areas that contain unique and sensitive natural features such as woodlands, steep slopes, streams, floodplains, and;
- Protect areas with productive agricultural soils for continued or future agricultural use by conserving blocks of land large enough to allow for efficient farm operations.

However, the comprehensive plan does not define “large lot” therefore it is difficult to assess the impact of new impervious surfaces on stormwater runoff and stream water quality. Potentially, if large-lot development is implemented with conservation of open land, impact from impervious surfaces should be less than if small lots were anticipated. If these plans do not come to fruition and residential development continues in the form of existing newer subdivisions, the marked increase in impervious surfaces in the watershed will increase runoff and likely negatively effect water quality.

The Joint Comprehensive Plan Community Assessment and Participation Plan, indicates that the enormous amount of available land in Eatonton creates a prime opportunity for new development but the limiting factors are available water, and particularly sanitary sewerage infrastructure. It is anticipated that most future development will occur within two miles of Lake Sinclair and the corridor between US 441 North to Highway 16 which is largely outside the Rooty Creek watershed. The area within the watershed is expected to experience growth is north along E. Sumter Street from Eatonton.

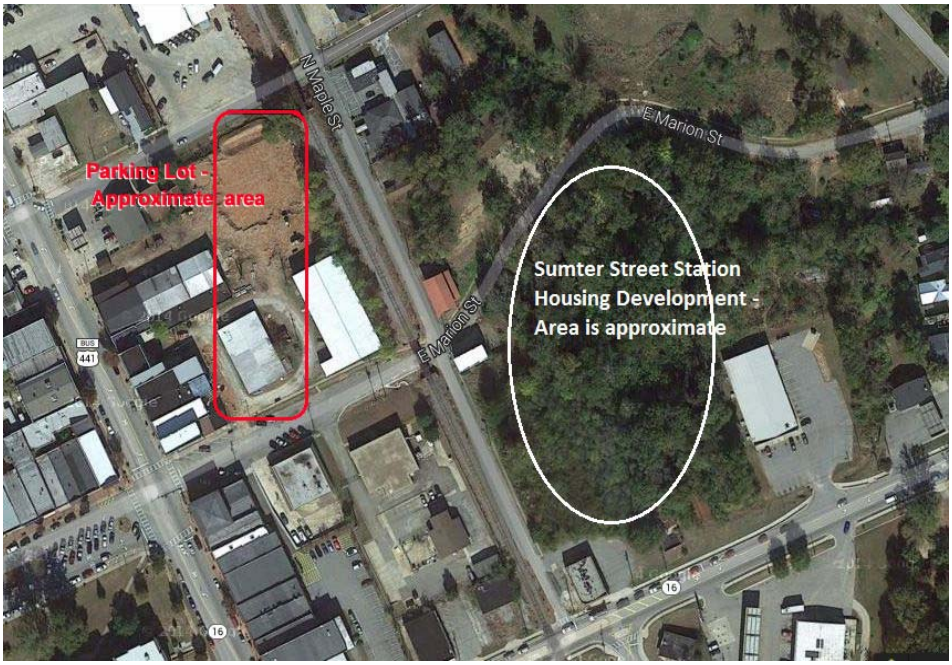
Impervious Surface

Impervious surface in the watershed was determined through the 2006 National Land Cover Dataset. The data set identified 2074.36 acres of impervious surface in the watershed. This includes roads, parking lots, and buildings, most of which are located in Eatonton. Impervious surfaces outside the city limits are primarily roads. See Map 13.

Due to the downturn in the economy, little change in impervious surface was noted during 2006 - 2013. However, in Summer 2014, the city will complete construction of a 6,200 SY surface parking lot in an area bounded by N. Jefferson Ave, Willie Bailey St., N. Maple Ave. , and E. Marion St. Runoff from the lot will discharge to the city’s storm water system.

Other planned development that will increase the amount of impervious surface is the proposed Sumter Street housing development. This project is in the conceptual stage but will be constructed in a presently forested area bounded by E. Marion St., N. Maple St., and E. Sumter St.

As more development occurs in the watershed, the amount of impervious surface will increase.



Source: City of Eatonton.

Roads

Roads are a major source of stormwater runoff but have a varied impact on sedimentation, depending on their surface. Primitive, unimproved or soil surface roads have the greatest impact, with gravel or stone roads, the next greatest impact. Erosion from unpaved roadways can be a significant sediment source to creeks. Road erosion occurs when soil particles are loosened and carried from the roadway, ditch or road

bank by water, wind, or traffic.

In 2007, GA EPD estimated that roads accounted for more than 13 percent of the sedimentation to the Rooty Creek watershed; however, in 2014 the WAC reports that there is only one unpaved road remaining in the Rooty Creek watershed.

Flooding

The 2008 Flood Insurance Study for Eatonton and Putnam County indicates that flooding problems in Eatonton are primarily due to overflow of Rooty Creek resulting from intense rainfall associated with frontal weather passages. See Map 14. The largest known floods occurred in 1902, 1908, and 1948 and produced a discharge that had a 2 percent annual chance recurrence.[9]

City administration reports that during heavy or prolonged rainfall events, the only area subject to flooding is the tributary east of Maple Street that begins south of E. Marion Street. This is a very narrow and shallow tributary and it cannot handle the increased volume associated with significant rainfall events.

Urban Runoff

Eatonton has an aging stormwater system. The stormwater system, including outfalls and storm drains, has not been mapped and the city reports that public works staff have been repairing and in some cases clearing storm drains as they are discovered. Staff have found storm drains covered with soil and vegetation and the drain pipes occluded with debris. Additionally, the city reports instances of collapsed catch basins. The city has not established a repair/cleaning schedule due to staff limitations, but instead addresses individual stormwater drains in association with other public works projects.

The 2007 comprehensive plan identified the following as the greatest contributors to Eatonton's stormwater runoff problems:

- Soil erosion from building and construction sites;
- Roads, parking lots, and driveways where vehicles have leaked fluids;
- Trash and litter from roadsides, parking lots, and yards; and,
- Chemicals from lawns.

The plan further identified the need to improve storm drainage in the downtown area and nearby residential areas and review the feasibility of requiring curb and gutter in new subdivisions in Putnam County.[10]

[9]Flood Insurance Study Putnam County, GA, p.3. Federal Emergency Management Agency, September 26, 2008.,

[10]Putnam County and City of Eatonton Comprehensive Plan, 2007-2030, p. 144.

Streambank erosion - Rooty Creek at E. Sumter Street bridge

Streambanks

Streambanks at Rooty Creek and E. Sumter Street and Park Road as well as Little Creek and US 441 S need to be stabilized as a result of Georgia Department of Transportation (GDOT) bridge construction. While rip-rap and scrub vegetation were installed at each location, bank erosion has occurred, particularly at the E. Sumter Street bridge, and contributes to sediment deposition to and contamination of Rooty Creek. Without stabilization, bank erosion will continue.

Streambank erosion at Rooty Creek and MLK Jr. Drive is likely due, in part, to installation/maintenance of the culverts, in addition to a drainage ditch running parallel to the southeast side of MLK Jr. Drive. The cultivated field adjacent to the drainage ditch drains, in part, directly into the ditch. At its confluence with Rooty Creek, stream banks are destabilized thus increasing sediment deposits in Rooty Creek as well as nutrients applied to the cultivated fields.

Silviculture

The majority of soil erosion from forested land occurs during timber harvesting and the period immediately following, and during reforestation. Once the forest is re-established, very little soil erosion occurs. Timber harvesting includes the layout of access roads, log decks, and skid trails, the construction and stabilization of these areas, and the cutting of trees. Compliance with silvicultural best management practices is at or near 100 percent.[11]

Streambank erosion - Rooty Creek at MLK Jr.

[11]Results of Georgia's 2013 Silvicultural Best Management Practices Implementation and Compliance Survey, Georgia Forestry Commission, February 24, 2014.

Demographics

From 1980-2000, Putnam County's total population grew by 83%; most of this growth took place in the Lake Oconee and Lake Sinclair areas. The City of Eatonton's population also grew significantly during that time period, but is largely attributed to the expansion of the City limit boundaries.

No population data exists solely for the Rooty Creek watershed, however, projections indicate that by 2030, Putnam County's total population will be 31,588, or a change of 48.8% from 2010-2030. The City of Eatonton's total population is expected to increase by 49.3% to 9,661.[12]

Streambank erosion - Rooty Creek at E. Sumter Street

Waterbody and Watershed Conditions

Visual Survey

A visual survey of the Rooty Creek watershed was conducted on January 8, 2014.

The purpose of a visual survey is to determine if there are observable problems in the stream and to characterize the environment through which the river flows. The visual survey helps pinpoint areas that may be the source of water quality impairments and determine the overall condition of the stream. Results of the visual survey did not indicate any obvious source(s) of water quality impairment.

Water Quality Standards and Data

Fecal coliform

Coliform bacteria are members of the Enterobacteriaceae family. While some coliform bacteria can be naturally found in soil, the type of coliform bacteria that lives in the intestinal tract of warm-blooded animals and originates from animal and human waste is called fecal coliform bacteria. Escherichia coli (*E.coli*) is one subgroup of fecal coliform bacteria and are good indicator organisms of fecal contamination because they are associated with warm-blooded animal wastes, generally live longer than pathogens, are found in greater numbers, and are less risky to culture in a laboratory than pathogens. However, their presence does not necessarily mean that pathogens are present, but rather indicates a potential risk to human health. Based on an assessment of aerial photography, monitoring data, land use, a 2005 report on the wastewater system, and input from the WAC, four potential sources of E. coli were identified in Rooty Creek; agricultural operations, sanitary sewerage system, urban runoff, and illicit connection/septic tank failures.

[12]DCA Data Views for Georgia, Georgia Department of Community Affairs.

Georgia's water quality standards set a maximum number of colony forming units (cfu) at 200 per 100 milliliters from May through October, or 1000 per 100 milliliters from November through April. Values in excess are in violation of the State bacteria water quality standard. In addition, a single sample in excess of 4000 cfu per 100 milliliters from November through April can also trigger adding a stream segment to the 303(d) listing. Georgia EPD 2004 monitoring data that initiated the listing of Rooty Creek as impaired is as follows:

Table 5: GA EPD Monitoring Data Rooty Creek at Martin Luther King Jr. Drive (County Road 90) near Eatonton

Date	Observed Count	Fecal Coliform Geometric Mean
04.12.04	220	
04.14.04	300	
04.26.04	1700	
04.28.04	80	308
05.03.04	16000	
05.12.04	5000	
05.19.04	3000	5886
08.05.04	5000	
08.11.04	800	
08.18.04	300	
08.24.04	700	696
11.17.04	1400	
11.23.04	500	
12.01.04	500	
12.08.04	300	440

Source: TMDL Evaluation, Oconee River Basin, January 2007.

Fecal coliform geometric means in May and August 2004 exceeded seasonal water quality standards.

In order to obtain more recent water quality data, monthly stream water quality monitoring for E.coli, conductivity, and sediment are being conducted by Resource Management Strategies under contract with the Oconee River RC&D Council, as well as the City of Eatonton, for the period January 2014 - August 2014. See Map 4.

E.coli

The current Georgia bacterial standard for fresh water is based on fecal coliform and varies with the designated use of the water. However, based on studies, USEPA concluded that E.coli was the preferred indicator organism for fresh waters. Using an illness rate of 8 illnesses per 1,000 swimmers (the estimated rate associated with the fecal coliform standard of 200 cfu/100 ml), the regression line was used to find the associated concentration. This associated concentration for E. coli was a geometric mean of 126 cfu/100 ml.[13]

USEPA recommendations for E.coli based on primary contact with the water are as follows:

[13]Scientific Basis for Bacterial TMDLs in Georgia, June 2006, pps. 13, 15.

Table 6: USEPA Recommendations for E. coli

Illness Rate/1000	Geometric Mean/100mL	Single Sample/100mL
8	126	235
9	206	300
10	206	383
11	263	490
12	336	626
13	429	799
14	548	1021

Georgia Adopt-a-Stream recommends that E.coli counts exceeding 1000 cfu/100 ml warrant special action which includes notifying the appropriate agency (local Health Department, local government, or GA EPD). A “high” bacterial count may be a one-time event or occurrence but, more sampling is encouraged.

Both dry and wet weather sampling was conducted. Dry weather is defined as no more than 1" of rain in the 48 hours preceding sampling. Wet weather is defined as at least 0.2" of rain in the 24 hours preceding sampling. Sampling data is found in Appendix B.

A ranking of monitoring sites based on average E.coli counts is as follows:

Table 7: Monitoring Site Rank

Rank	Site	Ave. E.coli cfu/100 ml
1	Rooty Creek at Lower Harmony Rd	2587.24
2	Rooty Creek at E. Sumter St.	1212.38
3	Rooty Creek at MLK, Jr. Dr. (GA EPD monitoring site)	591.61
4	Rooty Creek at Park Rd.	545.78
5	Little Creek at US 441 S	257.12

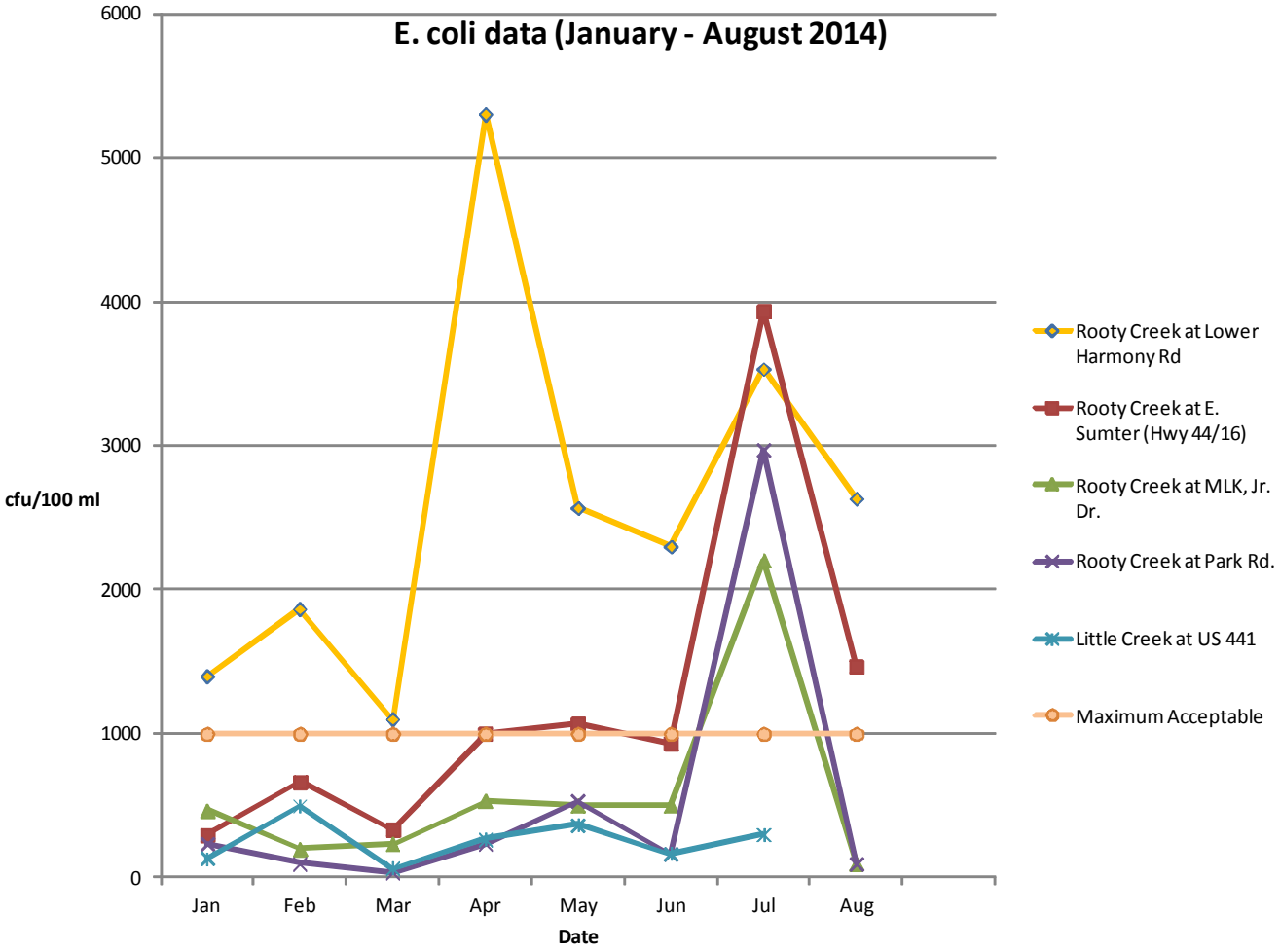


Figure 3

Sampling events throughout the watershed clearly focused the potential sources of contamination upstream of Martin Luther King Jr., Drive (the GA EPD monitoring site) though the potential sources vary as you move downstream through the watershed.

- Lower Harmony Road – E.coli counts at this site consistently exceeded 1,000 cfu/100 ml. The area is relatively undeveloped with dairy and beef farms as the primary land use. Public sanitary sewerage does not extend to the area that drains to Lower Harmony Road.

  Potential contamination source: dairy and beef farms and runoff associated with agricultural practices.

- E. Sumter Street – The land use in the area downstream of Lower Harmony Road that drains to E. Sumter Street is urbanized, including commercial and residential structures and their related impervious surfaces, as well as some agricultural land, and institutional uses. The downtown urbanized area and development along E. Sumter Street is served by the sanitary sewerage system which is plagued with root intrusion and deteriorating pipe that allows infiltration and inflow during wet weather when the creek level is high and also allows exfiltration in dry weather when the creek level is low thus contributing to the number of fecal coliform counts. Additionally, the city's storm water system discharges to the streams and carries everything from the roads, ditches, and yard runoff.

Potential contamination source: Sanitary sewerage system and storm water (urban) runoff from impervious surfaces. Future water quality monitoring is necessary to determine the impact on water quality, if any, of the Eatonton Dairy once operations resume.

- MLK Jr. Drive – The land use downstream of E. Sumter Street that drains to MLK Jr., Drive is urbanized containing residential and commercial uses and their related impervious surfaces, as well as agricultural (cultivated fields and pasture) and forested areas. The urbanized area is served by the sanitary sewerage system. Outside the urbanized area, residential structures are scattered and rely on individual septic systems though none are near Rooty Creek or a tributary.

  Documented infiltration and inflow in the sanitary sewerage system is a substantial contributor to contamination. Storm water runoff is also a likely contributor, though substantially less than that from the sewerage system. The city's storm water system discharges to the streams and carries everything from the roads, ditches, and yard runoff.

  Potential contamination source: Sanitary sewerage system and storm water (urban) runoff from impervious surfaces.

- Park Road – The land use downstream of MLK Jr., Drive that drains to Park Road is rural and comprised of pasture, forest, and agriculture with scattered residential structures. There is a dairy and/or cattle farm on the north and south side of Park Road at its intersection with MLK Jr. Drive (parcels 078 049 and 079 011). Only the parcel on the north side of Park Road ultimately drains to the monitoring site but it is approximately 3,000 feet to the east of Rooty Creek and there is a very small tributary or drainage ditch that flows from the parcel to Rooty Creek. The parcel on the south side of Park Road includes a narrow tributary that flows through the pasture containing livestock and drains to Rooty Creek though downstream of the monitoring site. Rooty Creek runs through the 192-acre Lockerly Arboretum. The property serves as a nature center and is used for educational programs, Boy Scout programs, and a summer camp program. Residential structures are served by septic tanks but none are within close proximity to Rooty Creek or its tributaries.

  Dry weather water quality monitoring demonstrates E.coli counts well within acceptable limits with an average of 216 cfu/100 ml. Counts were significantly elevated during the July 2014 wet weather sampling though the cause is unknown.

  Potential contamination source: Natural sources.

- Little Creek – The land that drains to Little Creek is forested with a few scattered residential structures and some silviculture. The area is served by septic tanks but non are within close proximity to Little Creek or its tributaries.

  Water quality monitoring demonstrates E. coli counts well within acceptable limits with an average of 257 cfu/100 ml. The source of this low level coliform contamination is unknown but is likely attributable to natural sources.

  Potential contamination source: Natural sources.

The Georgia Power Company conducts regular water quality monitoring in Lake Sinclair that includes a monitoring site just below Rooty Creek's confluence with the Lake (site SC 10). In the nine years of data provided, there are numerous instances of elevated fecal coliform counts yet the source of the fecal coliform contamination is unknown. Based on current Rooty Creek water quality monitoring data, with the exception of heavy rainfall events, the water quality at Park Road, the most downstream monitoring

site on Rooty Creek, is well within acceptable limits. If any elevated contamination is directly impacting the Lake Sinclair monitoring location, it is likely originating downstream of Park Road.

Conductivity

Conductivity of water measures the dissolved ions or salts in a stream and can be used as an indicator of pollution. Each stream tends to have a relatively constant range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream. High levels can indicate nutrients or other dissolved chemicals in the water column.

The conductivity of rivers in Georgia generally ranges from 0 to 1500 µs/cm. Studies of inland fresh waters indicate that streams supporting mixed fisheries have a range between 50 and 500 µs/cm. Some North Georgia streams may have natural background levels well below 50 µs/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates.[14]

A baseline conductivity was not established for Rooty Creek; however, data, found in Appendix B, does demonstrate a significant elevation of conductivity at Lower Harmony Road in April which coincidentally corresponds to the extremely elevated E.coli count for the same monitoring period.

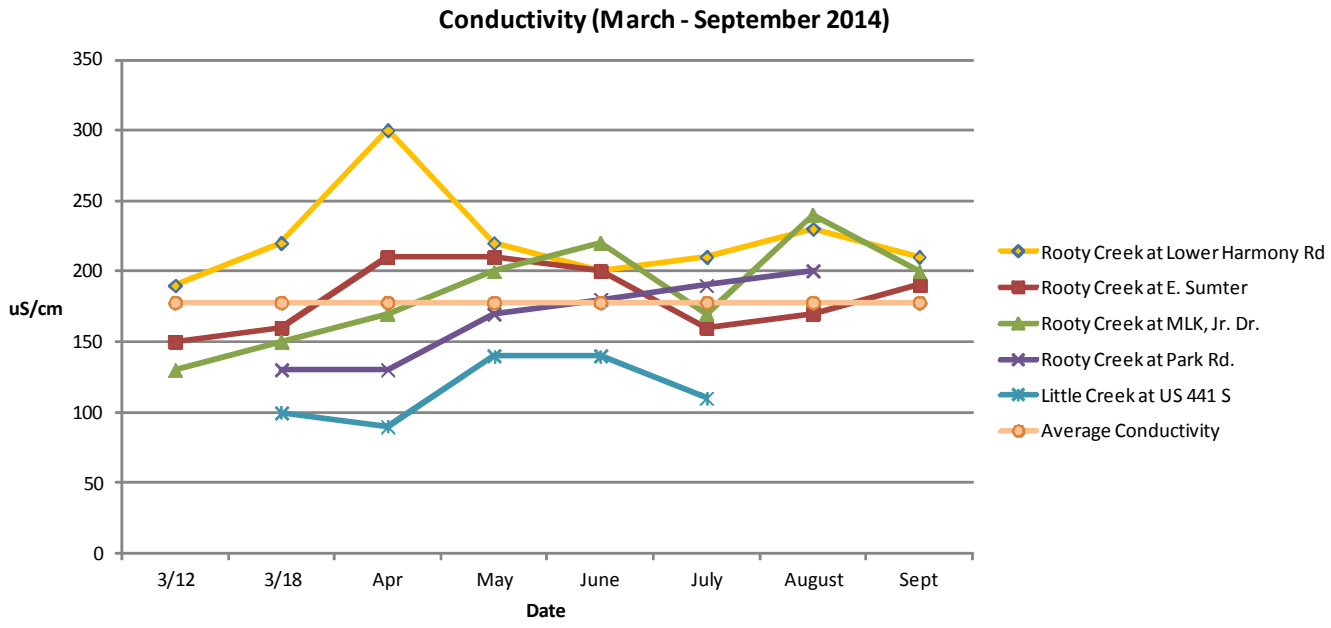


Figure 4

[14]Biological and Chemical Stream Monitoring, Chapter 2, Georgia Adopt-A-Stream, Department of Natural Resources, Environmental Protection Division, Spring 2009.

Sediment

The TMDL Evaluation suggests that the sedimentation observed in the Oconee River Basin may be legacy sediment resulting from past land use practices and "if sediment loads are maintained at acceptable levels, streams will repair themselves over time"[15]. However, the Evaluation did not specifically address Rooty Creek and no monitoring was conducted following previous remediation efforts to determine whether installed practices were successful in reducing sediment loading. Land use, specifically agricultural runoff, storm water runoff from impervious surfaces, and bank erosion were identified by the WAC as the greatest factors potentially influencing changes in TSS or turbidity in Rooty Creek. As the watershed develops, there will be an increase in disturbed areas (e.g., cropland or construction sites), a decrease in vegetation, and increases in the rate of runoff.

Sediment monitoring to support this plan's development consisted of Total Suspended Solids (TSS) and Turbidity. Total suspended solids (TSS) concentrations and turbidity both indicate the amount of solids suspended in the water, whether mineral (e.g., soil particles) or organic (e.g., algae). However, the TSS test measures an actual weight of material per volume of water, while turbidity measures the amount of light scattered from a sample (more suspended particles cause greater scattering). Measuring TSS and turbidity is valuable since high readings can be used as "indicators" of other potential pollutants. Additionally, concentrations of particulate matter can cause increased sedimentation and siltation in a stream, which in turn can ruin important habitat areas for fish and other aquatic life as well as impact recreational values (fishing, boating, swimming) in a waterbody.

TSS and turbidity monitoring for the period March – September 2014 were accomplished within 24 hours of at least 0.2" of rainfall with the exception of the May 30 and August monitoring at Park Road and Little Creek due to lack of rain. Georgia has no numerical standard for turbidity but instead requires "All watersheds shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.[16]

In general, a turbidity reading below 5 NTU appears clear, while a reading of 55 NTU will start to look cloudy and a reading over 500 NTU will appear completely opaque.[17] The average turbidity at Park Road and Little Creek was 21.4 and 24.9 NTUs, respectively, with a high of 33.5 NTUs at Park Road and 51.8 at Little Creek. Visually, water clarity at both monitoring sites has generally been very clear.

Water clarity at Lower Harmony Rd, E. Sumter Street, and MLK Jr. Drive has been more variable but has averaged 91, 59, and 51 NTUs, respectively. See Appendix B for detailed turbidity data.

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[15]Total Maximum Daily Load Evaluation for Two Stream Segments in the Oconee River Basin for Sediment (Biota Impacted), Georgia Department of Natural Resources, Environmental Protection Division, May 2012, p.v.

[16]Water Use Classification and Water Quality Standards, §391–3-6-.03.

[17] Turbidity, Total Suspended Solids and Water Clarity." Fundamentals of Environmental Measurements. Fondriest Environmental, 13 Jun. 2014. http://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/#Turbid5

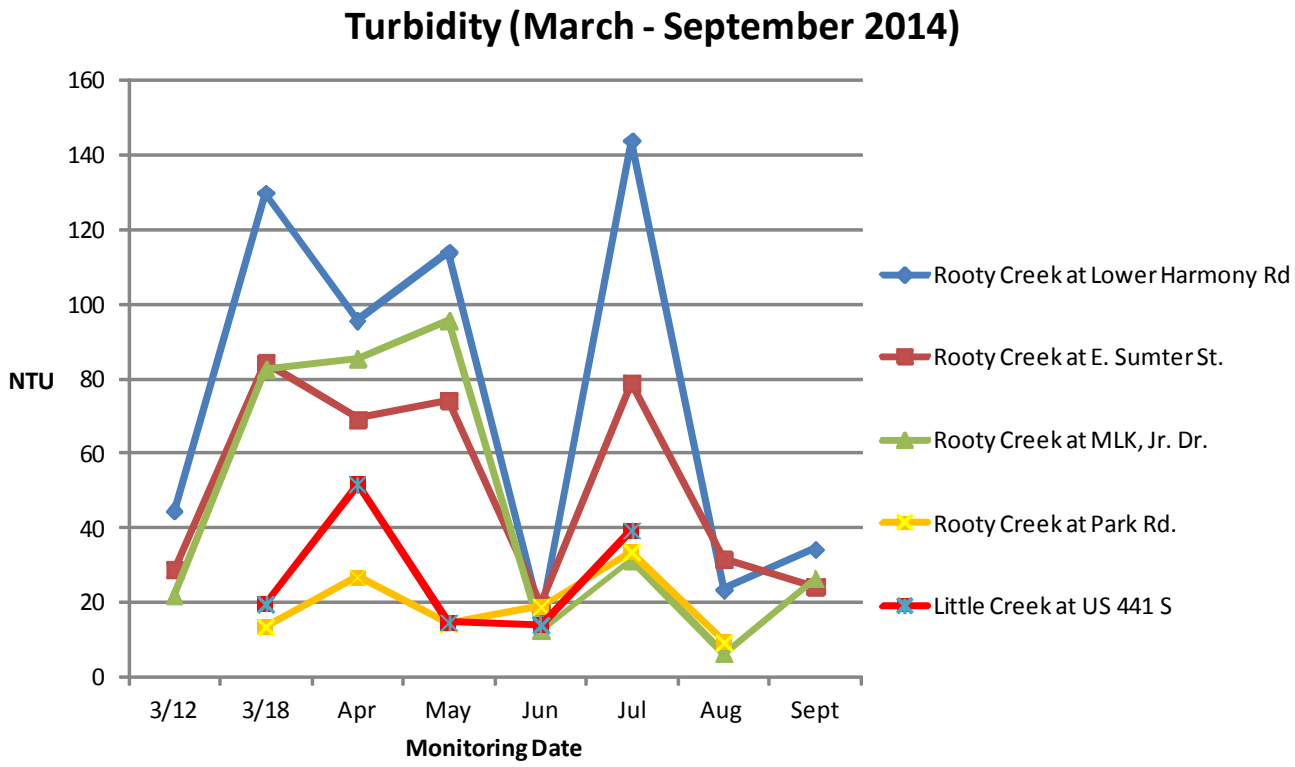

Turbidity (March - September 2014)
160
140
120
100
80
60
40
20
0
NTU
3/12
3/18
Apr
May
Jun
Jul
Aug
Sept
Monitoring Date
Rooty Creek at Lower Harmony Rd
Rooty Creek at E. Sumter St.
Rooty Creek at MLK, Jr. Dr.
Rooty Creek at Park Rd.
Little Creek at US 441 S

Figure 5

A TSS concentration below 20 mg/L appears clear, while levels over 40 mg/L may begin to appear cloudy.[18] The volume of suspended solids generally correlates to the amount of rain received. Rain events preceding TSS monitoring averaged ½ inch with the exception of June where there was insufficient rain. TSS concentrations throughout the watershed have not exceeded 5 mg/L. See Appendix B for detailed TSS data.

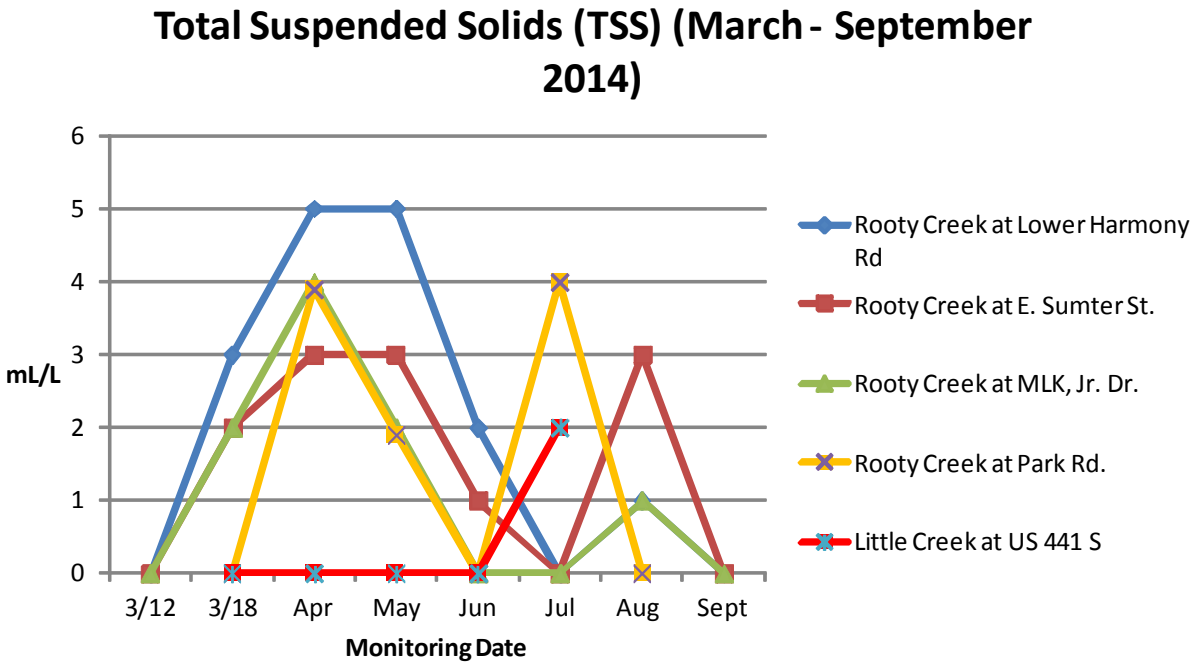


Figure 6

[18] Ibid.

Sediment Load Allocation by Land Use

The 2007 TMDL Evaluation for the Oconee River Basin, identified the relative sediment contributions from each significant land use for watersheds within the basin to determine current sediment loading rates to the streams. When these data were evaluated, Pasture/Hay, Low Intensity Residential, and Roads were identified as the primary cause of sediment in the Rooty Creek watershed.

Table 8: Rooty Creek Sediment Load Allocations by Land Use 2007[19]

	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Transitional	Deciduous Forest	Evergreen Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Roads	TOTAL	Load (tons/acre/yr)
Load by Land Use (tons/acre/yr)	213.50	1.90	0.20	5.70	0.60	0.50	273.40	23.80	31.10	18.70	88.20	657.50	0.12
Load by Land Use (%)	32.47	0.29	0.03	0.89	0.00	0.08	41.57	3.62	4.73	2.84	13.41		

For each of the watersheds monitored in the Oconee River Basin, the GA EPD estimated existing annual sediment load using the Universal Soil Loss Equation (USLE). The USLE predicts the average annual soil loss caused by sheet and rill erosion. Soil loss from sheet and rill erosion is mainly due to detachment of soil particles during rainfall events. Calculated 2007 sediment loads for Rooty Creek were 670.1 tons/yr. Allowable loads per year are 657.5 tons meaning the creek needs a sediment load reduction of 1.9 percent.[20]

[19] Ibid, Table 23a, p. 54.

[20] Ibid., Table 2, p. vi.

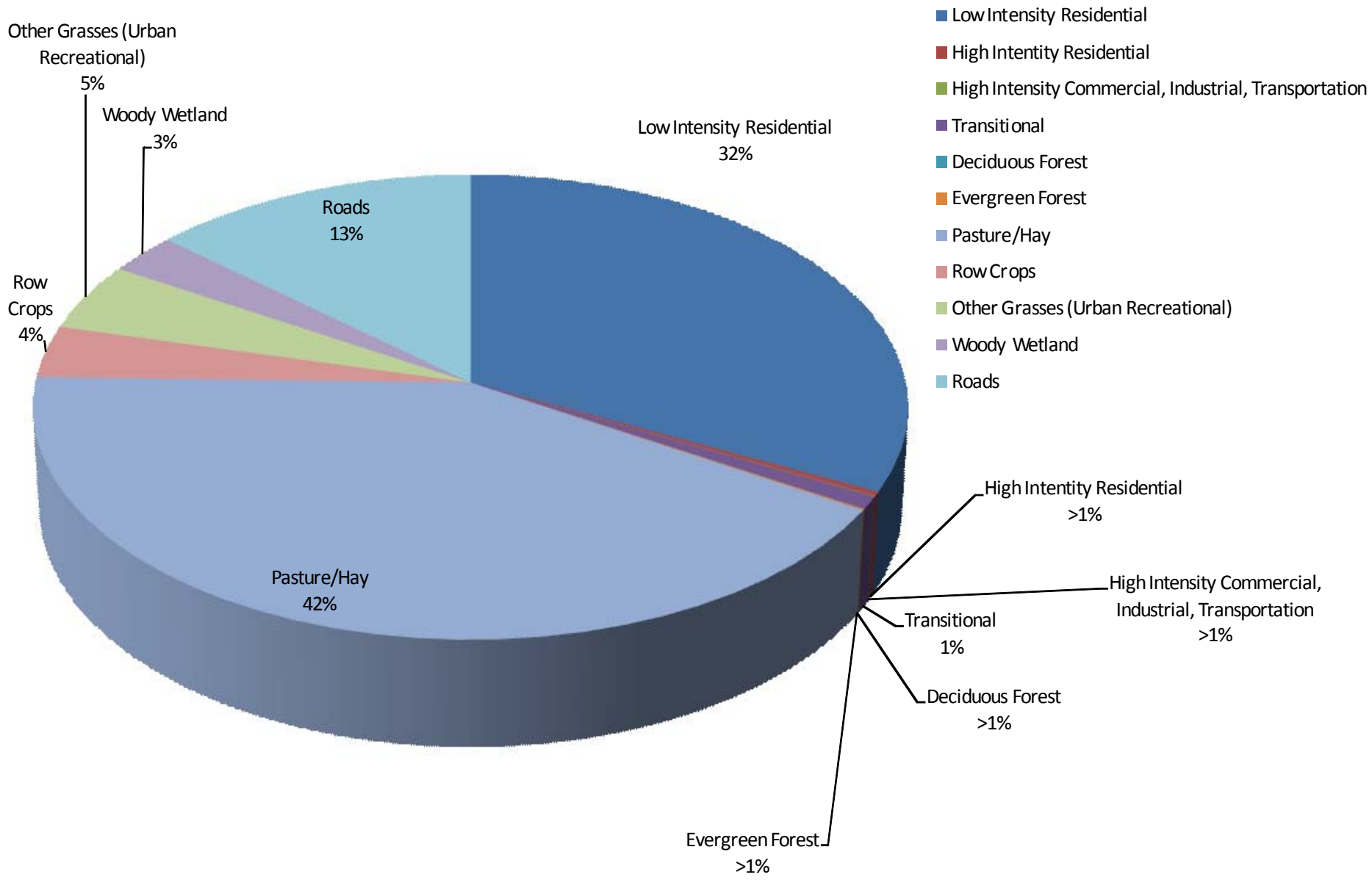

Sediment Load Allocation by Land Use, 2007
Low Intensity Residential
High Intentity Residential
High Intensity Commercial, Industrial, Transportation
Transitional
Deciduous Forest
Evergreen Forest
Pasture/Hay
Row Crops
Other Grasses (Urban Recreational)
Woody Wetland
Roads
Other Grasses (Urban Recreational) 5%
Woody Wetland 3%
Low Intensity Residential 32%
Roads 13%
Row Crops 4%
Pasture/Hay 42%
High Intentity Residential >1%
High Intensity Commercial, Industrial, Transportation >1%
Transitional 1%
Deciduous Forest >1%
Evergreen Forest >1%

Figure 7

Biological Monitoring

Between 1998 and 2003, the Georgia Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations at a number of monitoring sites in the Oconee River Basin, including Rooty Creek. Biological monitoring is a method used to evaluate the health of a biological system in order to assess degradation from various sources. It is based on direct observations of aquatic communities.

Two indices of fish community health were used to assess the biotic integrity of the aquatic systems: the modified Index of Well-Being (IWB) and the Index of Biotic Integrity (IBI). The IWB and IBI scores were classified as Excellent, Good, Fair, Poor, or Very Poor. Segments with fish populations rated as Poor or Very Poor were listed as Biota Impacted.

The modified IWB measures the health of the aquatic community based on the density and diversity or structural attributes of the fish community. The IBI assesses the biotic integrity of aquatic communities based on the functional and compositional attributes of the fish community.`

The IBI score for Rooty Creek was 30 (poor) and the IWB score was 5.9 (fair).

To supplement the findings of the fish community data, habitat assessments were also performed at each sampling site. Habitat scores evaluate the physical surroundings of a stream as they affect and influence the quality of the water resource and its resident aquatic community. These data may also help clarify the results of the biotic indices. The habitat assessment evaluates the stream's physical parameters.

Table 9: Rooty Creek Habitat Assessment, July 2, 1998[21]

	Embeddedness	Channel Alteration	Sediment Deposition	Riffle Frequency	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Instream Cover/ Epifaunal	Habitat Total
Rooty Creek	2.7	4.7	4.3	2.7	8.3	4.3	5	2.7	2.7	1.3	2	5.7	52

The 1998 habitat assessment data indicates Rooty Creek is a muddy bottom stream with some evidence of alteration and little habitat diversity. The stream has point bars or islands composed mostly of gravel and finer sediment of moderate size and frequency with sparse vegetation but little substrate is exposed in the channel. Vegetative coverage of streambanks ranges from mostly shaded by a variety of vegetation to somewhat shaded by less variety. The riparian zone is poor with little or no buffer present.

On April 24, 2014, habitat assessments of Rooty Creek were made at its intersection with Lower Harmony Road, E. Sumter St., Martin Luther King, Jr. Dr., and Park Road. Little Creek, the southern-most tributary to Rooty Creek was assessed at its upstream intersection with US 441 south. All assessment sites are inside the Eatonton City limits except Park Road and US 441 South. The habitat assessment evaluates the

[21]TMDL Evaluation for Thirty-Two Stream Segments in the Oconee Basin for Sediment (biota impacted), GA EPD, 2007, Table 8a, p.24.

upstream and downstream sections of the stream and includes: channel bottom materials, streamside vegetation, slope, and other channel characteristics.

Rooty Creek's stream bed ranges from approximately 15-20 feet wide. With the exception of the Park Road site, the stream has a muddy bottom and is shallow, averaging between 6" - 10" deep with occasional depressions of up to 2 feet.

Instream habitat diversity is limited with some areas demonstrating riffles, runs, and pools and others only runs. Sand bars void of vegetation are present throughout the stream when water levels are normal. However, as water levels decreased through Summer 2014 due to reduced rainfall, some sand bars became vegetated with grasses.

Steam channel flow generally partially filled the stream's channel and some substrate was exposed. Banks were eroded and undercut at road or bridge crossings which were the only areas where it appeared that the stream channel was affected by human activity.

At the assessment points, streambank vegetation was excellent beyond 10' - 15' of the road crossing, overhanging the stream channel and allowing only scattered sunlight.

Based on the habitat assessment and visual survey and an assessment of aerial photography, riparian vegetative zones vary considerably. Upstream of Lower Harmony Road, the zone appears to be inadequate not meeting the state-mandated width of 25 feet. Only the two most upstream tributaries provide adequate buffer.

The narrow riparian zone continues about ½ mile downstream of Lower Harmony Road where the zone dramatically transitions to a wide forested buffer on the creek's west bank but a minimal buffer on its east bank adjacent to a large cultivated area.

South to the Martin Luther King, Jr. Drive site, the stream has a wide forested buffer until it narrows to approximately 25' next to cultivated areas on both the east and west stream bank. Downstream of MLK, the stream primarily flows thought forested areas to its confluence with Lake Sinclair.

Other than songbirds, no wildlife or fish were observed along or in Rooty Creek.

Little Creek's habitat assessment yielded a evaluation similar to that of Rooty Creek inside the Eatonton City Limits. However, unlike Rooty Creek, small fish were observed in Little Creek (May 2014 sampling period). Evidence of deer is usually observed at the Little Creek/US 441 South site during monitoring events.

The stream habitat score for Rooty Creek is "fair" and Little Creek, "good".

Land Management Ordinances and Activities

A suite of land management ordinances are used in the watershed by Eatonton and Putnam County, though ordinances are only as effective as their enforcement and few address water quality. A number of ordinances are model ordinances developed by the State of Georgia and require property owners to meet state standards regarding stream buffers (25'), require protection of wetlands, require larger lot sizes in groundwater recharge areas where there is no public sewer, regulating land-disturbing activities, etc. Zoning ordinances in both jurisdictions focus on the types of permitted agricultural uses and their location relative to other uses in order to reduce the potential for conflict with non-agricultural land uses.

Ordinances in Eatonton and Putnam County that address water quality are:

- Soil Erosion and Sedimentation Ordinance. (Eatonton and Putnam County)
- Sewer Use Ordinance (Eatonton)
- Manual for On-Site Sewage Management Systems (Eatonton and Putnam County)

A detailed list of land management ordinances adopted by Eatonton and Putnam County is found in Appendix. B.

VI. Recommended Management Practices

Primary sources of fecal coliform pollution identified by the WAC are agricultural runoff upstream of E. Sumter Street, EPSWA sanitary sewerage system, and storm water runoff from impervious surfaces (urban runoff). Due to the results of water quality monitoring associated with this plan's development, addressing sources of fecal coliform contamination is the priority.

Sediment was not determined by the WAC to be a priority due to:

- The determination by GA EPD that "legacy" sediment was the cause of the elevated sediment load;
- The determination by GA EPD that the stream would repair itself provided there was "no net increase" in sediment in Rooty Creek;
- Water quality sampling associated with this plan's development did not evidence high TSS or turbidity data;
- The City of Eatonton and Putnam County enforce their respective Soil Erosion and Sedimentation Ordinance thus preventing additional sediment loading; and,
- In general, the buffers adjacent to Rooty Creek and its tributaries are wide and forested.

There are, however, eroding banks as a result of Georgia Department of Transportation bridge construction on E. Sumter Street and US 441 S as well as the banks on the upstream side of MLK Jr. Drive. These streambanks must be restored to prevent further erosion and future contamination of the stream.

The suite of potential structural and non-structural management practices identified to control the above-listed pollutant loadings are:

- agricultural best management practices.
- continued repair and replacement to the sanitary sewerage system.
- map, repair, replacement and maintenance to the city's storm sewer system with consideration, long-term, of installation of structures that promote on-site stormwater management.
- streambank restoration.

The following screening criteria established by the WAC, should be used to evaluate the suitability of a potential management practice: (Criteria are listed in descending order of importance).

- Critical Area – Will the management measure be implemented effectively within the identified critical areas in the watershed?
- Load Reduction – Will the management measure provide a significant load reduction?
- Ease of Implementation – Will the implementation of the management measure be easy to undertake (potential legal issues, permits, etc.)
- Maintenance – What level of maintenance is required for the measure to function optimally?
- Cost Effectiveness – Is the practice cost-effective when compared to the impact the measure will have on contamination?
- Unintended Impacts/Added benefits – Are the any unintended impacts or added benefits that result from installation of the management measure?
- Social Acceptance - Will the measure have public support?

Recommended Management Practice Effectiveness

Agriculture

The implementation of systems of BMPs reduces nonpoint source pollution. BMPs are defined as structural, vegetative, or managerial conservation practices which reduce or prevent detachment, transport and delivery of nonpoint source pollutants to surface or ground waters. The BMPs result in less soil being transported and deposited as sediment as well as fewer nutrients and waste being delivered to the water bodies.

The BMPs in a water quality project must be targeted to priority fields within the watershed. Priority fields are cropland, pastureland or hayland that contribute runoff to adjacent hydrologic systems such as lakes, streams, ditches, wetlands and flood plains. Additional priority areas are feedlots, water storage systems, and waste management systems. Reporting of specific pollutant load reductions will be calculated for all priority fields and areas where new BMPs are installed; however, a general estimated load reduction is provided below to assist with the suitability evaluation of a management practice.

Table 10: Agricultural Best Management Practices to Address Non-Point Source Pollution

Practice Number	Practice Name	Sediment	Fecal Coliform	Estimated Load Reduction	Cost
313	Waste Storage Facility		●	96%	medium - high
316	Animal Mortality Facility		●		
317	Composting Facility		●	70-80%	medium - high
327	Conservation Cover	●		90%	low
328	Crop Rotation	●		40-50%	low
329	Conservation Tillage - No Till	●	●	70%	
345	Conservation Tillage - Mulch Till	●	●		
346	Conservation Tillage - Ridge Till	●	●		
330	Contour Farming	●	●		
332	Contour Buffer Strip	●	●	20-75%	low
340	Cover Crop	●		40-60%	low
342	Critical Area Planting	●	●	75%	high
350	Sediment Basin	●		75-95%	moderate - high. Requires maintenance.
359	Waste Treatment Lagoon		●	80%	moderate - high
360	Waste Facility Closure		●	reduces likelihood of residual nutrients entering water.	
362	Diversion	●		30-60%	low - moderate
365	Anerobic Digester - Ambient Temperature		●	90-99%	high. Requires maintenance.
366	Anaerobic Digester - Controlled Temperature		●	90-99%	high. Requires maintenance.
367	Waste Facility Cover		●	protect integrity and capacity of storage facility and reduce overflow.	high
378	Pond	●			
382	Fence	●	●	50 - 90% in higher order streams, 99% in second order streams	low
386	Field Border	●		50-80%	low

Practice Number	Practice Name	Sediment	Fecal Coliform	Estimated Load Reduction	Cost
390	Riparian Herbaceous Cover	●	●	50-75%	low - moderate
391	Riparian Forest Buffer	●	●	50-75%	moderate
393	Filter Strip	●	●	50-80%	moderate, maintenance required
410	Grade Stabilization Structure	●		75 - 90%	moderate - high
412	Grassed Waterway	●		60 - 80%	moderate - high
466	Land Smoothing	●		reduces likelihood or sediment/erosion entering water	low - moderate
472	Access Control	●	●	50 - 90% in higher order streams, 99% in second order streams	low - moderate
511	Forage Harvest Management	●			
512	Forage & Biomass Planting	●			
516	Pipeline - Livestock	●	●		
528	Prescribed Grazing	●		75%	low
557	Row Arrangement	●			
558	Roof Runoff Structure	●			
560	Access Road	●			
561	Heavy Use Area Protection	●		80%	medium - high, maintenance required.
574	Spring Development	●	●		
575	Animal Trails & Walkways	●		significant	medium - high, periodic maintenance required
578	Stream Crossing	●	●		medium - high. Best to redirect around stream.
580	Streambank & Shoreline Protection	●		significant	medium - high
584	Channel Bed Stabilization	●		significant	medium - high
585	Contour Stripcropping	●		50 - 60%	low
586	Field Stripcropping	●	●	75%	low
590	Nutrient Management	●	●	35% P, 15% N	low - moderate
600	Subsurface Drain	●			
606	Tree & Shrub Establishment	●	●	50%	low - moderate
612	Water Facility	●			
614	Watering Facility	●		significant	moderate
620	Underground Outlet	●		beneficial if properly maintained	moderate
634	Waste Transfer		●	promote nutrient reduction in soil	moderate
635	Vegetated Treatment Area		●	80 - 90% in feedlots	low
638	Water & Sediment Basin	●		40 - 60%	low
642	Water Well	●	●		
657	Wetland Restoration	●		59% N, 66% P	moderate - high
658	Wetland Creation	●		59% N, 66% P	moderate - high
659	Wetland Enhancement	●		59% N, 66% P	moderate - high

Source: Best Management Practices for Georgia Agriculture, Georgia Soil and Water Conservation Comm., Sept 2013

Sanitary Sewerage System

To address contamination from the sanitary sewerage system, continued repair and replacement of the aging system is needed as detailed in the 2005 Preliminary Engineering Report for Wastewater System Improvements.

Stormwater System

Several initiatives are needed to address stormwater.

- Map the stormwater system.
- Repair and clean catch basins and pipes, as needed.
- Conduct specific water quality monitoring at outfalls to assess the impact of stormwater on Rooty Creek's water quality.
- Consider changes to city ordinances to require on-site management of runoff based on outfall water quality monitoring data.

There are a variety of practices a community can implement to mitigate the impact of stormwater on water quality. All practices are a component of low-impact development, a recommended development management tool identified in the Putnam County and City of Eatonton Comprehensive Plan.

Practices that are reasonable for a small city to implement are:

- Permeable pavements

  Permeable paving allows rainwater to percolate through the paving and into the ground before it runs off. This approach reduces stormwater runoff volumes and minimizes the pollutants introduced into storm water runoff from impervious surfaces. Permeable paving is appropriate for pedestrian-only areas and for very low-volume, low-speed areas such as overflow parking areas, residential driveways, alleys, and parking stalls. Depending on design, paving material, soil type, and rainfall, permeable paving can infiltrate as much as 70% to 80% of annual rainfall.[22]

Permeable Pavement (sidewalk)

[22] Low Impact Development Toolkit, Metropolitan Area Planning Council, http://www.mapc.org/sites/default/files/LID_Fact_Sheet_-_Permeable_Paving.pdf

- Rainwater harvesting

  By retaining stormwater runoff for on-site use, harvesting systems reduce the runoff volumes and pollutant loads entering the stormwater collection system, helping to restore pre-development hydrology and mitigate downstream water quality impacts. The impact of rainwater harvesting on pollutant load reduction varies widely.[23]

- Rain gardens

  A rain garden is a garden which takes advantage of rainfall and stormwater runoff in its design and plant selection. Usually, it is a small garden which is designed to withstand the extremes of moisture and concentrations of nutrients, particularly Nitrogen and Phosphorus, that are found in stormwater runoff. Rain gardens are ideally sited close to the source of the runoff and serve to slow the stormwater as it travels downhill, giving the stormwater more time to infiltrate and less opportunity to gain momentum and erosive power.

Rain Garden

- Bioswales

  Bioswales are landscape elements designed to remove silt and pollution from surface runoff water. They consist of a swaled drainage course with gently sloped sides (less than six percent) and filled with vegetation, compost and/or riprap. The water's flow path, along with the wide and shallow ditch, is designed to maximize the time water spends in the swale, which aids the trapping of pollutants and silt. Bioswales are commonly used around parking lots. Bioswales can reduce pollutant load by up to 94%.[24]

Bioswale

[23] Rainwater Harvesting - Conservation, Credit, Codes, and Cost Literature Review and Case Studies, U.S. Environmental Protection Agency, Office of Water, Office of Wetlands, Oceans, and Watersheds, January 2013. http://water.epa.gov/polwaste/nps/upload/rainharvesting.pdf

[24] Testing a Bioswale to Treat and Reduce Parking Lot Runoff, Qingfu Xiao, University of California - Davis and E. Greg McPherson, Center for Urban Forest Research, USDA Forest Service, February 24, 2009.

- Urban tree canopy.

  An American Forests study in 2008 measured the stormwater retention capacity of Montgomery, Alabama's urban tree canopy. The study measured the city's tree canopy at 34% and calculated its stormwater retention capacity at 227 million ft^3. [25]

Streambank Restoration

Streambank stabilization measures work either by reducing the force of flowing water, by increasing the resistance of the bank to erosion, or by some combination of both. Generally speaking, there are four approaches to streambank protection:

- the use of vegetation;
- soil bioengineering;
- the use of rock work in conjunction with plants; and
- conventional bank armoring.

Re-vegetation includes seeding and sodding of grasses, seeding in combination with erosion control fabrics, and the planting of woody vegetation (shrubs and trees). Soil bioengineering systems use woody vegetation installed in specific configurations that offer immediate erosion protection, reinforcement of the soils, and in time a woody vegetative surface cover and root network. The use of rock work in conjunction with plants is a technique which combines vegetation with rock work. Over time, the plants grow and the area appears and functions more naturally. Conventional armoring is a fourth technique which includes the use of rock, known as riprap, to protect eroding streambanks.

These relatively low-cost revegetation measures may suffice if the stream is small, the bed is stable, and banks are not seriously eroded; however, a specific evaluation of the appropriate restoration measures needs to be completed for identified Rooty Creek sites prior to installation of restoration measures.

http://www.fs.fed.us/psw/programs/uesd/uep/products/psw_cufr761_P47ReportLRes_AC.pdf

[25] Watershed Forestry Research Guide, A Partnership of the Center for Watershed Protection and the US Forest Service. http://www.forestsforwatersheds.org/urban-tree-canopy/

VI. Working With The Public

Public support is a key element in the implementation process. Education is extremely important for increasing public awareness of the water quality problems and offering feasible solutions for remediation and prevention of water quality degradation.

Outreach Goals

The overarching goal of the outreach campaign is to engage agricultural producers, residents, and government agencies in reducing fecal coliform and sediment non-point source pollution in the watershed. This will be accomplished by developing and promoting initiatives on water quality issues in the watershed, actions that may be taken to improve water quality, and programs available to assist with water quality improvement projects.

Objectives for education include:

- Educating agricultural producers on non-structural and structural agricultural best management practices that could be implemented.
- Increasing watershed residents and government agencies knowledge on the importance of water quality and controlling non-point source pollution in Rooty Creek for the benefit of the Rooty Creek and Lake Sinclair.

Goal 1: To educate the general public about the watershed plan and its implementation.

- Develop a Rooty Creek Watershed fact sheet. This should be a 2-page informational marketing tool to support and facilitate plan implementation distributed in the watershed via direct and electronic mail, at community meetings, and other appropriate venues. The fact sheet should also be available on the websites for the City of Eatonton, Eatonton-Putnam County Water and Sewer Authority, and the Oconee River RC&D. The fact sheet should be updated as needed to provide new information about programs and accomplishments resulting from project implementation.

- Develop a Rooty Creek Watershed Protection brochure to educate individuals on the impacts of human activities on water quality and steps that can be taken to reduce those impacts and improve water quality.

- Have a booth at the annual Dairy Festival to disseminate watershed information, including watershed maps, fact sheets, and handouts addressing plan implementation.

- Coordinate with the Eatonton Messenger for publication of quarterly news articles about the watershed. Articles should provide information from the Fact Sheet and activities and progress in the watershed.

- Post permanent signs along major roads notifying travelers that they are entering the Rooty Creek watershed.

- Coordinate with the local 4-H to hold cleanup events to remove smaller debris from watershed streams.

Goal 2: Educate elected officials and government agencies in the watershed about the watershed plan and its implementation.

- Convene a workshop to provide information on the watershed management plan and its implementation.

Goal 3: Educate agricultural producers in the watershed about watershed issues and solutions.

- Provide information on appropriate best management practices, their cost and effectiveness in reducing water quality impairment, and available funding assistance programs.

VIII. Long-Term Monitoring Plan

Instream monitoring is important to gage the recovery of streams after remediation projects are installed, and is also crucial to support partners as they engage in periodic strategic planning of remediation priorities.

Long-term monitoring associated with this watershed management plan will have the following objective:

- To verify long-term, whether water quality meets GA EPD fishing standards for fecal coliform following implementation of the measures outlined in this plan.

The most intractable sources of variation are likely to be changes over time. Since the primary sources of fecal coliform in the watershed are agricultural runoff, the sanitary sewerage system, and urban runoff, the concentration of fecal coliform will vary seasonally and with variations in precipitation. The most important quality assurance measure will be to sample many times throughout a range of hydrologic conditions.

A long-term monitoring plan for *E.coli* should:

- measure the long-term effectiveness of management practices;
- analyze trends; and
- redefine water quality problems, if any.

Monitoring should be accomplished by Adopt-a-Stream certified personnel and under a GAEPD–approved Targeted Monitoring Plan utilizing Adopt-A-Stream methodologies and should focus on Rooty Creek at Lower Harmony Road and E. Sumter St. This will give a broad picture of water quality conditions in the upper watershed, a rough assessment of potential pollutant sources, and a general assessment of management measure implementation.

IX. Implementation, Evaluation and Revision

Management Strategies

The basic strategy for implementation of this watershed management plan is to create and manage a program that features both structural and non-structural controls within the watershed to address the fecal coliform issues. The goal of this program is to restore the watershed to the extent that the impaired segment as well as all streams in the watershed meet State water quality standards. Measures that will be utilized to accomplish the goals are increasing installation of agricultural BMPs, repair and replacement of the sanitary sewerage system, repair to the stormwater system, restoring stream banks, and making available educational opportunities to encourage public and governmental participation in the watershed improvement process. The NRCS and GSWCC will assist with technical advisement with respect to agricultural projects. Other stakeholders, the City of Eatonton, Putnam County, and Putnam County 4-H, will make key contributions to other facets of the program, in particular education and outreach.

Management Plan

While inclusion of landowners from the entire watershed will be eligible for any cost-share or grant funded projects, the portion of the watershed upstream of E. Sumter Street has been designated by the WAC as a priority based on water quality monitoring data. Projects in this portion of the watershed are likely to have the greatest impact on fecal coliform load reduction upstream of E. Sumter Street.

Implementation Plan and Interim Milestones

This Watershed Management Plan anticipates an implementation period of 5 -10 years. However, specific projects may be implemented over shorter periods. This section outlines objectives that apply across the entire implementation process and measurable milestones that should reveal significant progress.

Implementation Plan

Goal: Improve water quality for the impaired stream segment to reduce fecal coliform loading by 97% and meet state water quality standards.

Task	Responsible Agency	Cost	Fund Source	Evaluation Measure	Milestone		
					Short (< 2 yrs)	Mid (2-5 yrs)	Long (>5 yrs)
***Objective 1**: Establish long-term monitoring program to provide current data to support decision making.*							
Task 1: Update EPD-approved Targeted Water Quality Monitoring Plan to provide for continued and post-BMP monitoring for fecal coliform or E. coli.	EPWSA	0	in-house	GA EPD approval of a Targeted Water Quality Monitoring Plan.	√		
Task 2: Conduct ongoing short-term monitoring by AAS-qualified personnel under EPD-approved Targeted Monitoring Plan.	EPWSA	0	in-house	Monthly E.coli or fecal coliform water quality data for Rooty Creek at Lower Harmony Road and E. Sumter Street.	√		
Task 3: Undertake long-term water quality monitoring by AAS-qualified personnel under EPD-approved Targeted Monitoring Plan.	EPWSA	0	in-house	Monthly E.coli or fecal coliform water quality data for Rooty Creek at Lower Harmony Road and E. Sumter Street.		√	√
***Objective 2**: Implement practices to reduce E.coli contamination from identified sources.*							
Task 1: Review NMP or CMP with agricultural producers to insure that they are being appropriately implemented.	NRCS, GSWCC, Ag. Ext., SWCD	0	Part of organization's responsibilities.	Number of plans reviewed.	√		

Task	Responsible Agency	Cost	Fund Source	Evaluation Measure	Milestone		
					Short	Mid	Long
					(< 2 yrs)	(2-5 yrs)	(>5 yrs)
Task 2: Contact agricultural producers for participation in cost-share programs – target producers in watershed upstream of Rooty Creek and E. Sumter Street.	NRCS, SWCD, GSWCC, ORRC&D, UGA Ag Extension,	0	Part of organization's responsibilities.	Number of producers contacted.	√		
Task 3: Install appropriate agricultural BMPs.	NRCS, SWCD, GSWCC, ORRC&D	Varies by BMP.	316(h) grant, NRCS, GSWCC, FSA landowner cost-share	Number of installed BMPs; estimated fecal coliform pollutant load reduction of 60%.	√	√	
Task 4: Continue planned upgrades to Eatonton-Putnam County Sanitary Sewerage System.	EPSWA, City of Eatonton	$4,691,855 (2014 dollars)	UP EPA Special Appropriations Project, Georgia SRF, USDA Rural Development, CDBG, GEFA loan, local	Percentage of repairs completed as outlined in Phases 1-4 of the Preliminary Engineering Report for Wastewater System Improvements, June 2005 and as may be updated.	√	√	√
Task 5: Map Storm Water System.	City of Eatonton	$5,000 - $7,500	GEFA, local	Completed inventory map of storm water system.		√	
Task 6: Develop report of needed repair/replacement and prioritize repairs.	City of Eatonton	$2,500 – $5,000	GEFA, local	Completed report.		√	
Task 7: Initiate Repairs to Storm Water System.	City of Eatonton	unknown	GEFA loan	Percentage of repairs/replacements completed annually.		√	√

Task	Responsible Agency	Cost	Fund Source	Evaluation Measure	Milestone		
					Short	Mid	Long
					(< 2 yrs)	(2-5 yrs)	(>5 yrs)
Task 8: Monitor water quality at selected Storm Water Outfalls.	City of Eatonton	NA	in-house	Number of outfalls monitored and number of water quality samples collected annually.		√	√
Task 9: Identify on-site storm water management strategies that could be incorporated into local ordinances to improve water quality.	City of Eatonton	Unknown. Depends on identified strategies.	City of Eatonton	Appropriate strategies identified that will lead to improvement in water quality.		√	
***Objective 3**: Improve stream buffers*.							
Task 1: Insure any agricultural, silvicultural or development practices maintain a minimum 25' vegetated buffer adjacent to the stream bank of Rooty Creek and its tributaries.	City of Eatonton, Putnam County, NRCS, GSWCC, GFC	0	NA	No encroachment into 25' buffer.	√	√	√
Task 2: Restore degraded stream buffers and stream banks adjacent to bridges at E. Sumter, Martin Luther King, Jr., Dr., and US 441 South.	City of Eatonton, Putnam County	unknown	local	Restoration of stream buffers and stream banks.	√		
Remove large debris in stream at bridge crossings. (E. Sumter Street, MLK Jr. Dr.)	City of Eatonton	Dependant on amount of debris removed.	local	Weight of debris removed and frequency of debris removal.	√	√	√

Task	Responsible Agency	Cost	Fund Source	Evaluation Measure	Milestone		
					Short	Mid	Long
					(< 2 yrs)	(2-5 yrs)	(>5 yrs)
***Objective 4**: Develop educational outreach materials and conduct outreach.*							
Task 1: Develop two-page watershed fact sheet.	City of Eatonton	Brochure design - $65/hr, Printing depends on number of copies produced.	US EPA Environmental Education (EE) grant.	Completed brochure.	√		
Task 2: Develop two-page watershed protection brochure.	City of Eatonton	Brochure design - $65/hr, Printing depends on number of copies produced.	US EPA Environmental Education (EE) grant	Completed brochure.	√		
Task 3: Distribute watershed fact sheet, watershed protection brochure, watershed-related materials and information at annual Dairy Festival and Briar Patch Arts Festival and post on Eatonton website.	City of Eatonton	-0-	US EPA Environmental Education (EE) grant	Number of brochures distributed.	√	√	
Task 4: Develop quarterly newspaper articles and publish in Lake Oconee News, Union Reporter, and Eatonton Messenger.	City of Eatonton	unknown	US EPA Environmental Education (EE) grant	Four articles published annually.	√	√	

Task	Responsible Agency	Cost	Fund Source	Evaluation Measure	Milestone		
					Short	Mid	Long
					(< 2 yrs)	(2-5 yrs)	(>5 yrs)
Task 5: Install watershed signage at watershed boundaries.	City of Eatonton, Putnam County	$60/sign (Sign produced by Prison Bureau)	local	A minimum of six signs installed.	√		
Task 5: Develop and hold workshop for elected officials and government agencies to inform of content of Rooty Creek Watershed Management Plan and its implementation.	City of Eatonton, Putnam County	$1,500	US EPA Environmental Education (EE) grant	Number of attendees.	√		
Task 6: Hold 1-2 annual river cleanup events.	Putnam County 4H	$250 - 1,000 depending on volume of trash collected.	River's Alive, Ag. Extension, City of Eatonton, Putnam County, EPWSA	Number of participants and amount of trash collected.	√	√	√

Indicators to Measure Progress

Targeted water quality monitoring is necessary to measure long-term progress of installed practices. Monitoring must take place under a GAEPD-approved Targeted/BMP Monitoring Plan. Monthly monitoring will occur at Lower Harmony Road and E. Sumter Street to provide current data and to evaluate water quality improvements in the upper Rooty Creek watershed as well as improvements to evaluate management practices with respect to effectiveness and/or location.

For more finite objectives, the Evaluation Measure associated with each task in the Implementation Plan will reveal progress that the implementation program is gaining momentum. Referencing these should provide an indication of specific tasks needing more focus. Eligible producer participation rates will be another useful tool in determining the success of grant implementation. Education and outreach participation rates will also be analyzed to help measure progress.

Indicators identified by the WAC to measure the status of the watershed management process and educational outreach outlined in this Plan are:

Type of Indicator	Specific Indicator
Environmental	E.coli bacteria - Direct water quality measurement of Rooty Creek.
Environmental	E. coli bacteria - Direct water quality measurement of storm water outfalls.
Programmatic	Number of urban and agricultural best management practices implemented.
Programmatic	Number of educational handouts developed and distributed.
Programmatic	Number of education programs held.
Programmatic	Number of river cleanup events.
Social	Participation rate in non-point source education outreach programs.

Of greatest importance, is the measure of how the various implementation projects have translated towards accomplishing the goal of attaining State water quality standards. Tracking water quality improvements will best indicate progress toward reducing fecal contamination.

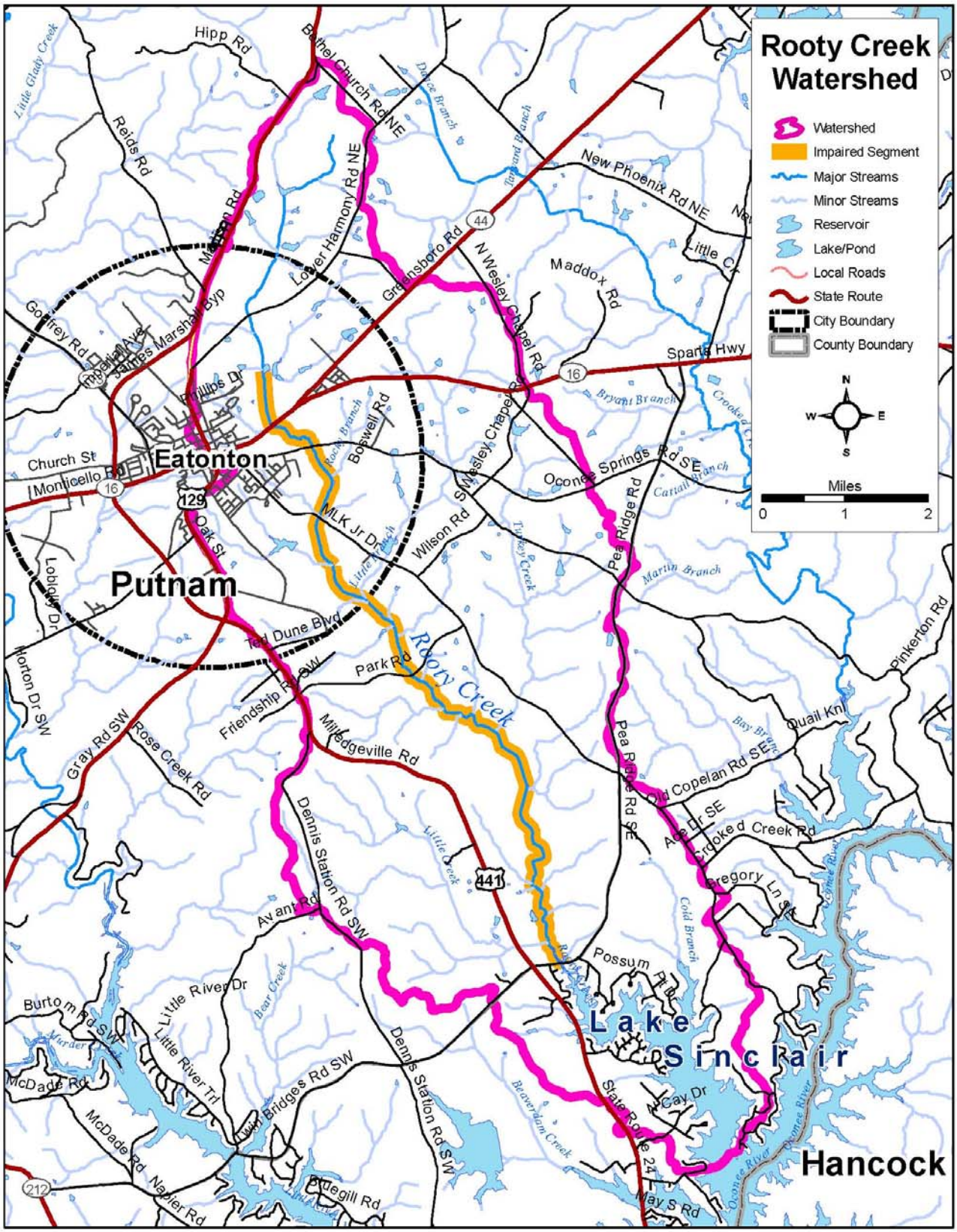
Periodic assessment of the implementation schedule and review of accomplishments are necessary to determine whether task milestones are being met.

Long-term Plan Implementation

NRCS, GSWCC, UGA Ag. Extension, and SWCD will continue to assist agricultural producers with BMP installation through their respective agency programs. However, funding for other plan implementation activities must be secured through grants, loans, or governmental agencies. Continued plan implementation will be dependent on available funding.

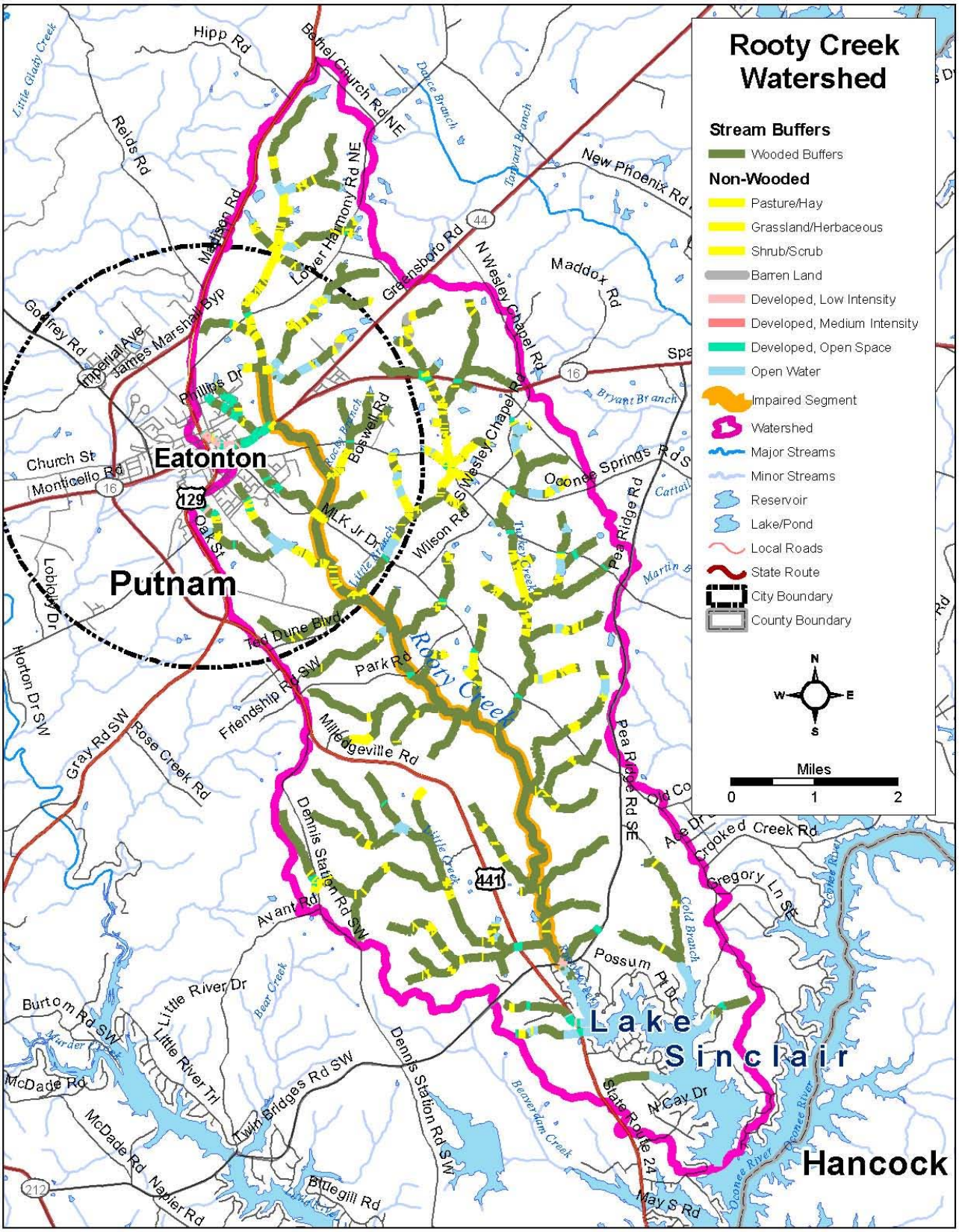
Appendix I. Maps

Map 1. Rooty Creek Watershed



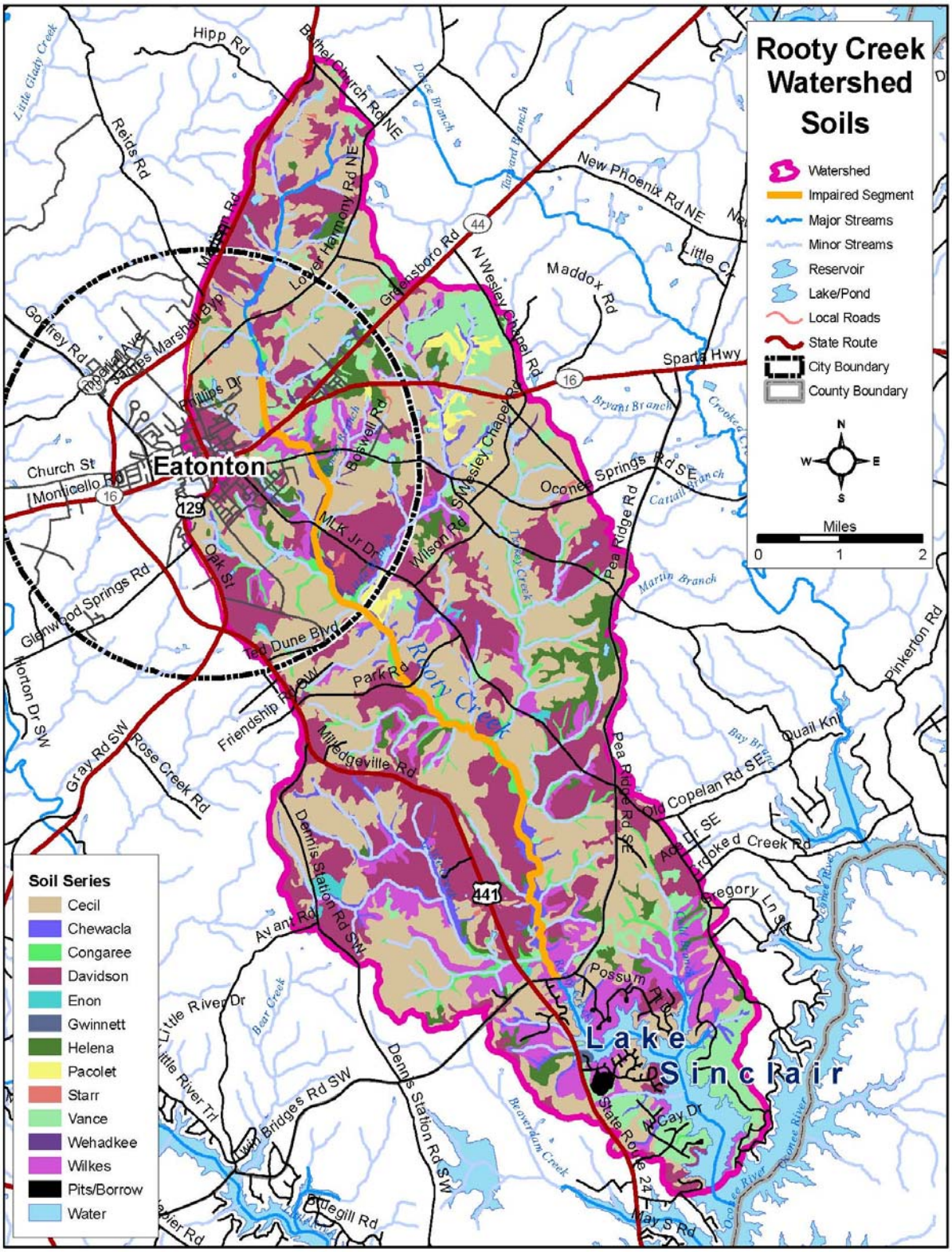
Source: Georgia GIS Data Clearinghouse, Originator – United States Geological Survey, 2000.

Map 2. Stream Buffers



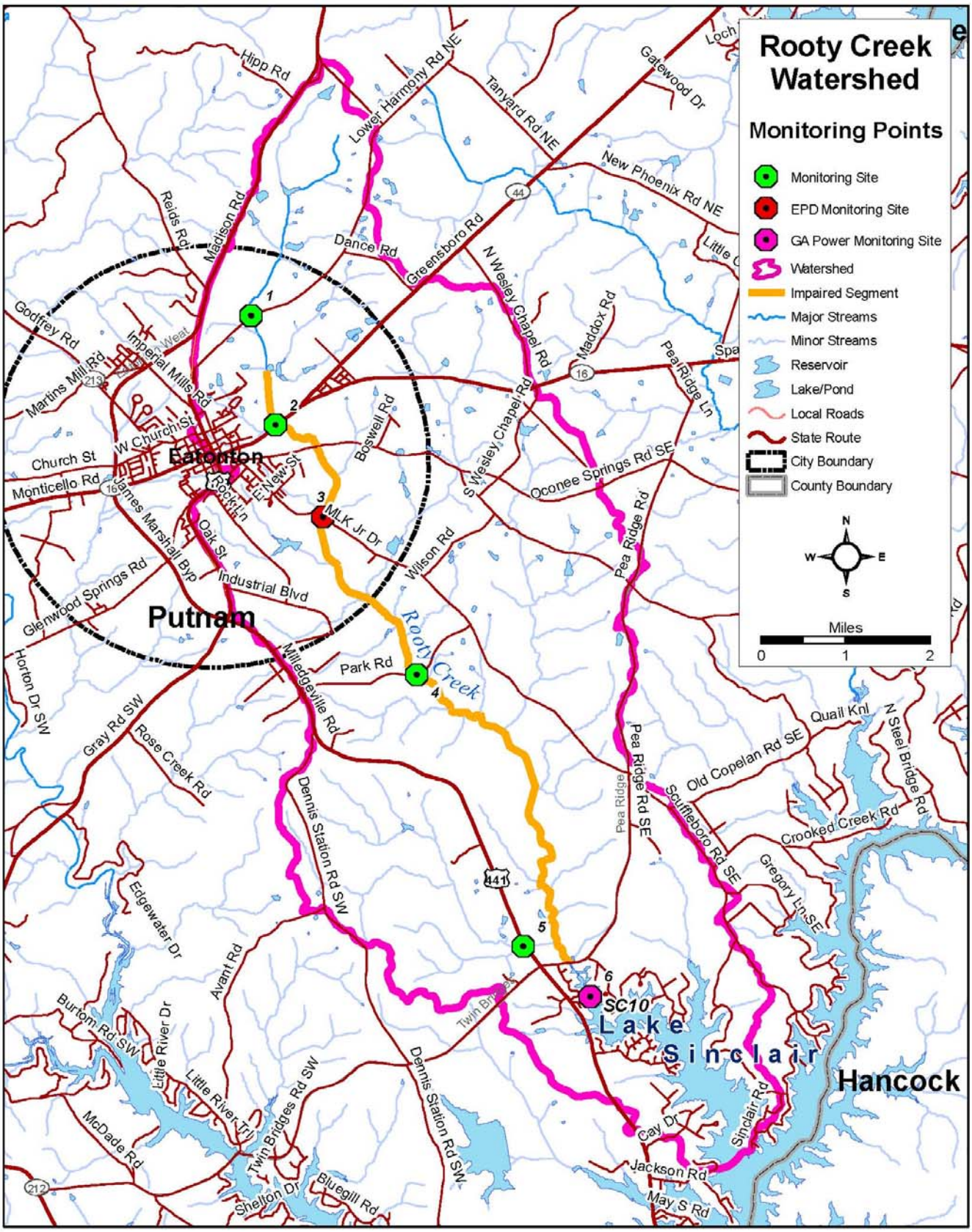
Source: Georgia GIS Data Clearinghouse, Originator, State Based Map of Georgia 2000, updated 2001.

Map 3: Soils



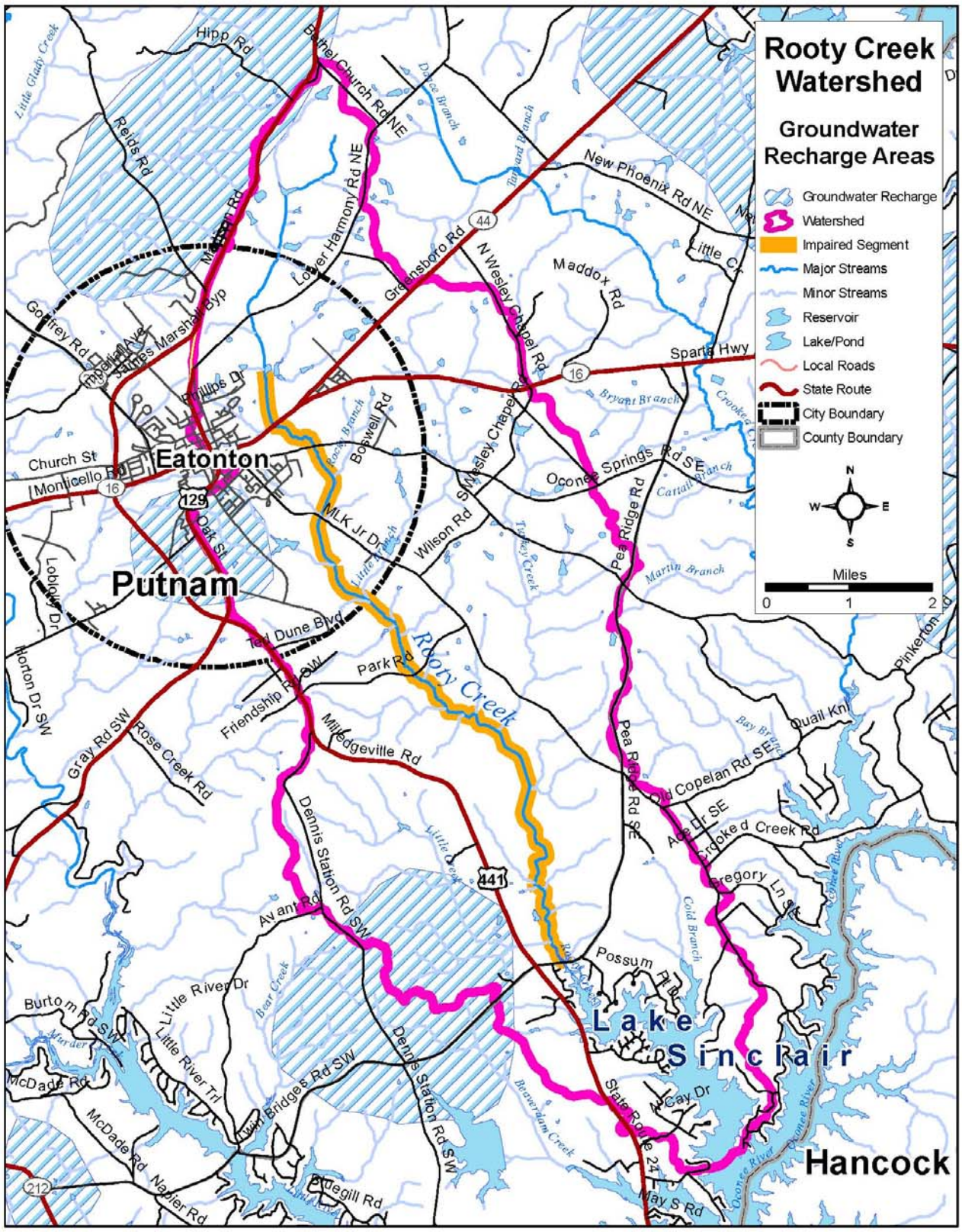
Source: Geospatial Data Gateway, Originator: U.S. Department of Agriculture, Natural Resources Conservation Service, 2013.

Map 4. Monitoring Points



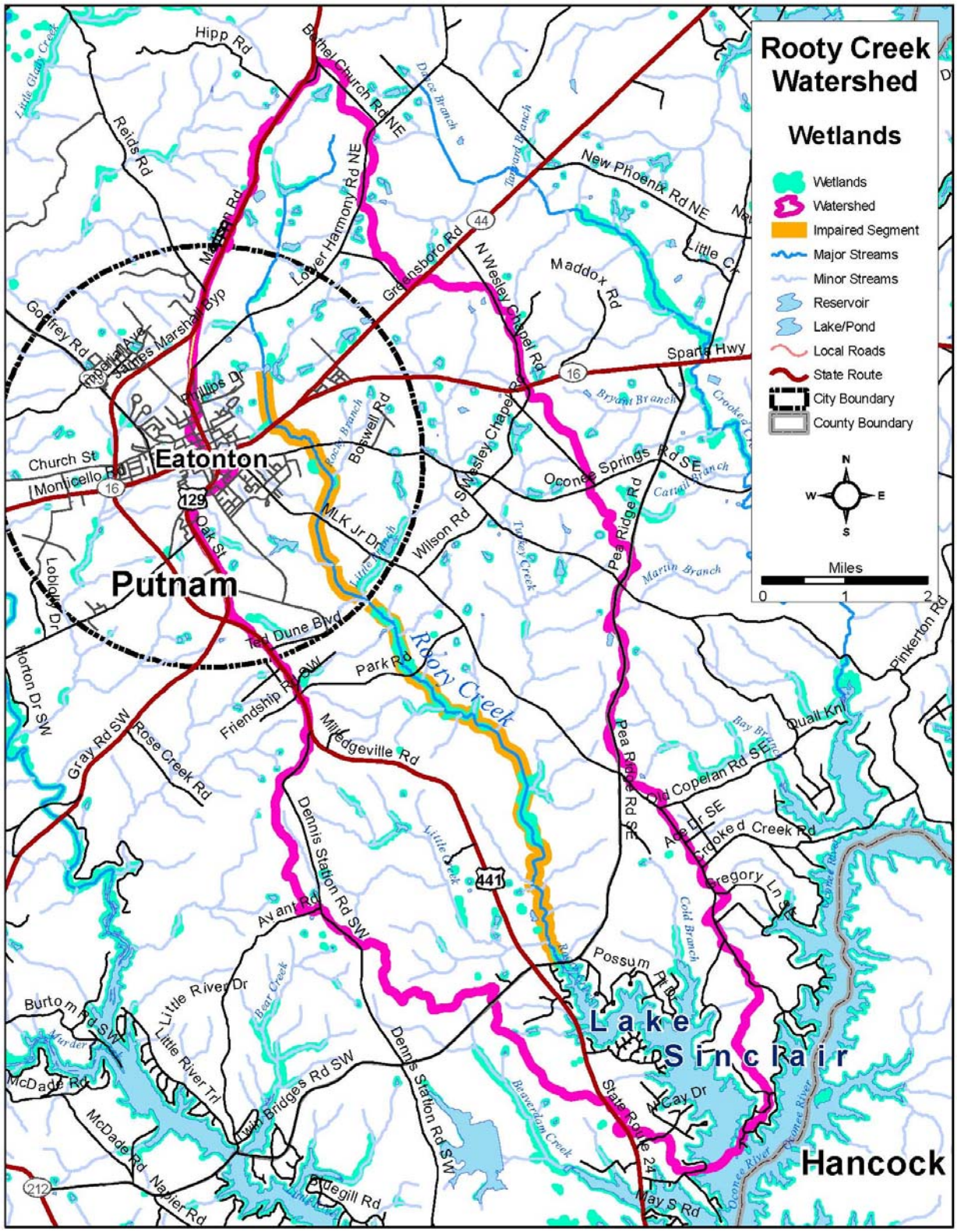
Source: Rooty Creek Targeted Monitoring Plan, January 2014.

Map 5. Groundwater Recharge Areas



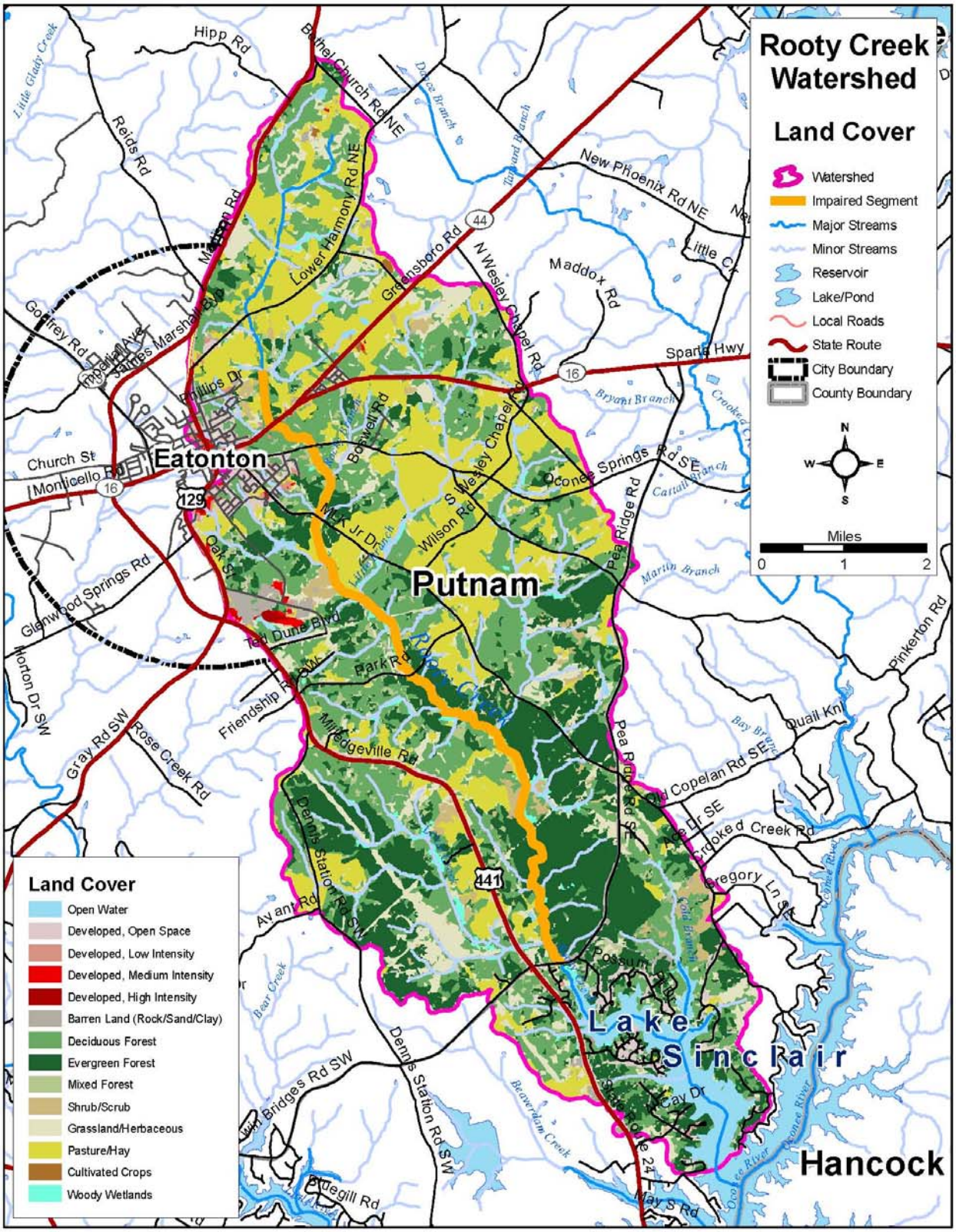
Source: Georgia Hydrologic Atlas Number 20.

Map 6. Wetlands



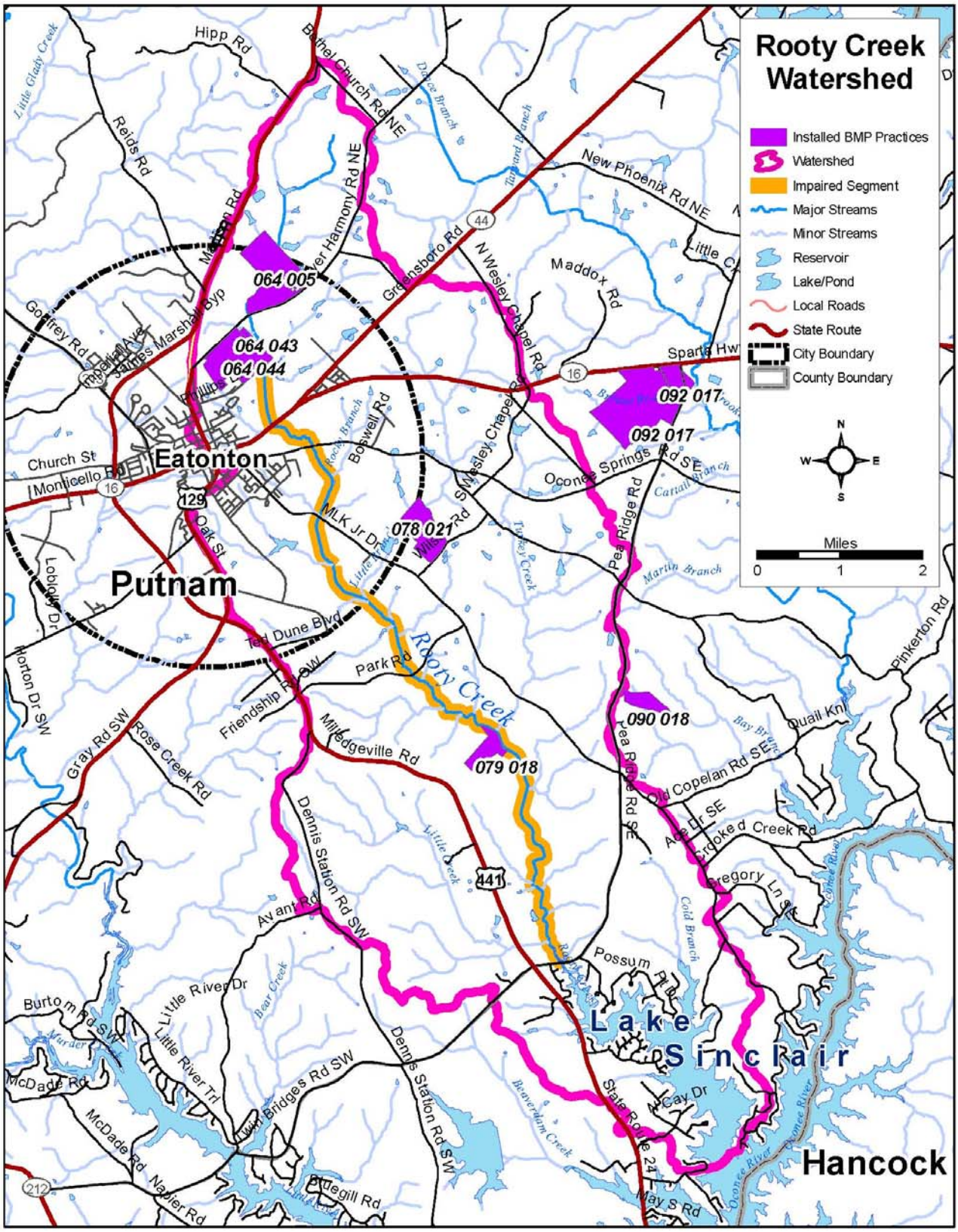
Source: National Wetlands Inventory

Map 7. Land Cover



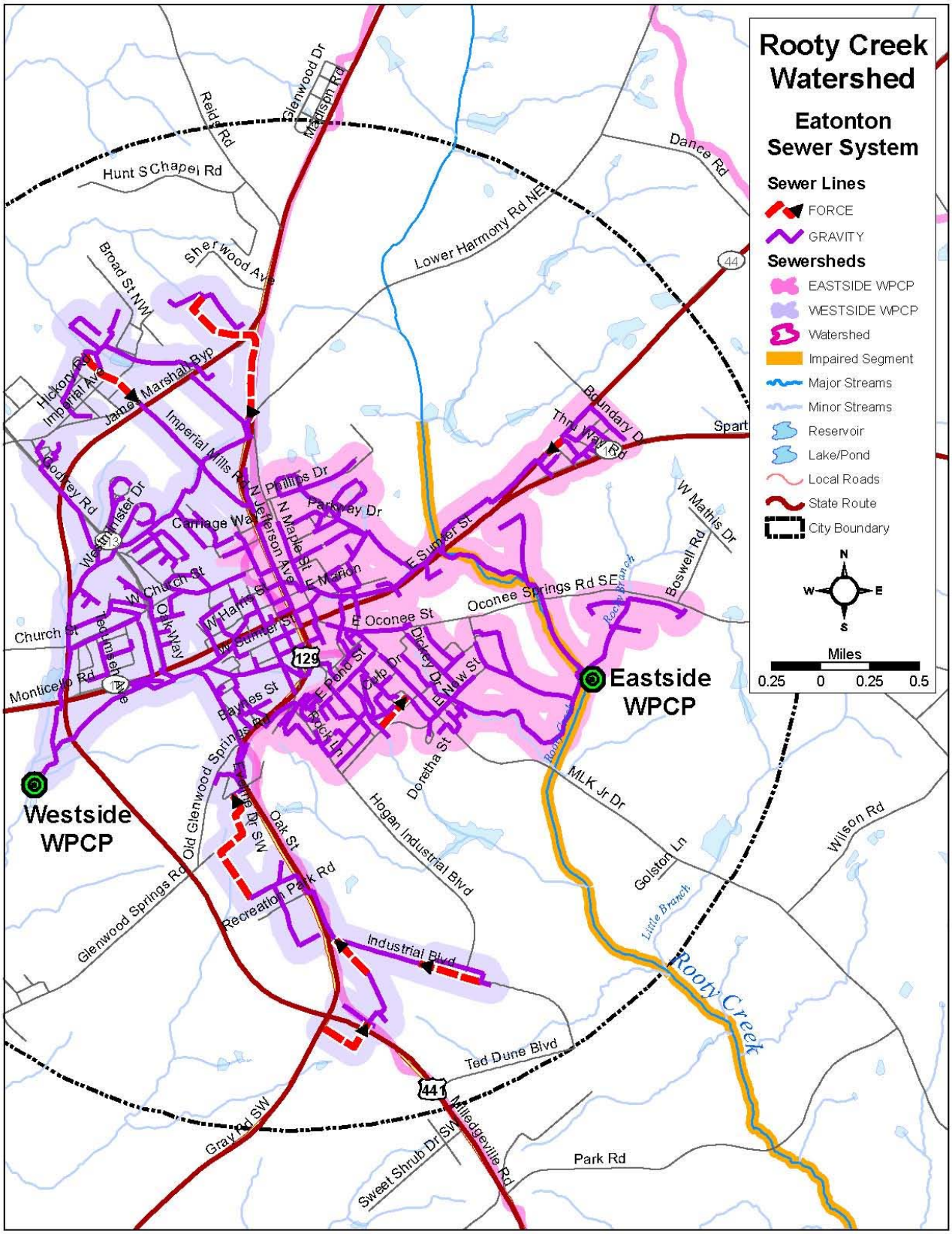
Source: USDA/NRCS Cartography & Geospatial Center, 1986-1993.

Map 8. BMP Installations



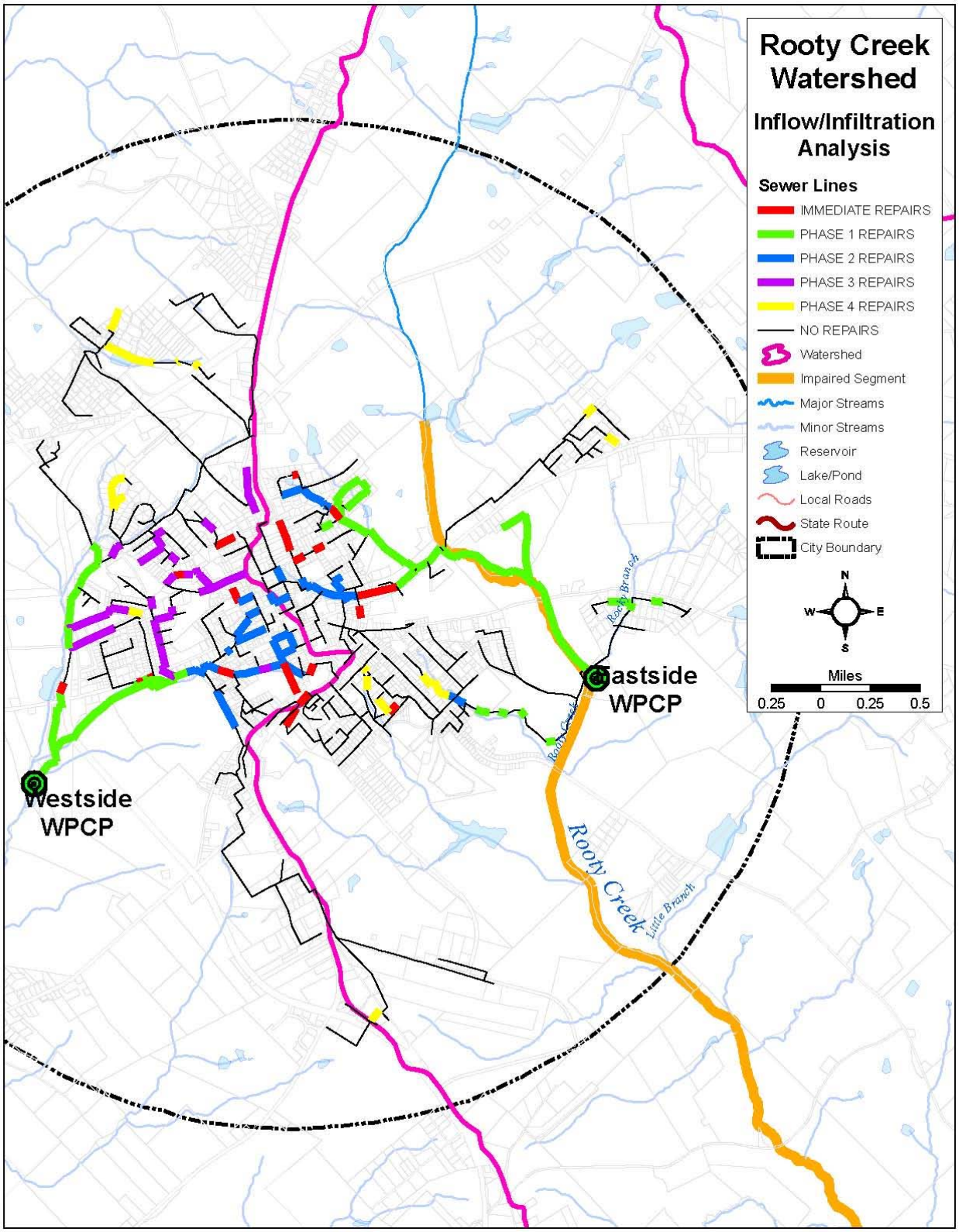
Source: Oconee River RC&D, 2006 319(h) Grant.

Map 9. Sewer Service Areas



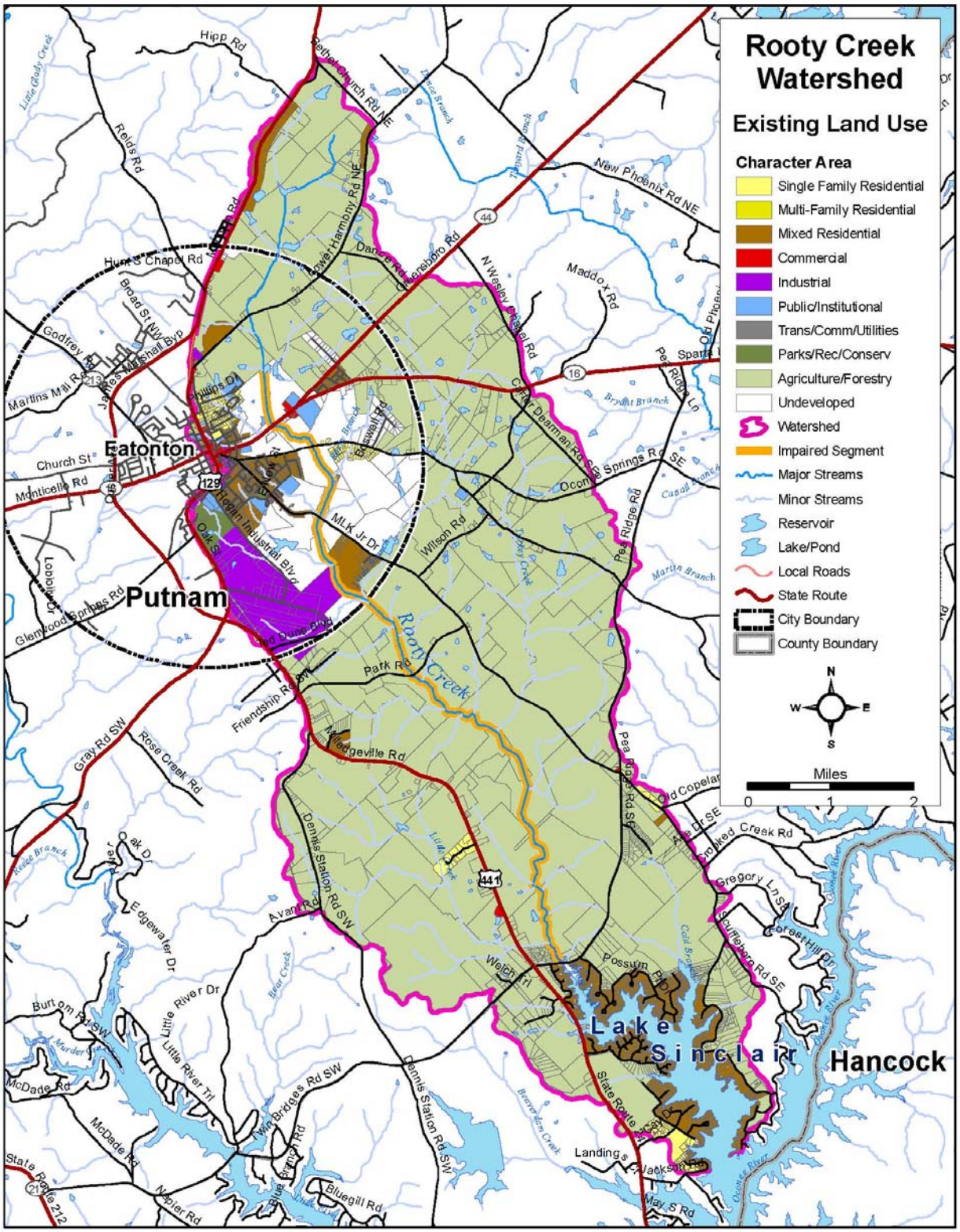
Source: Preliminary Engineering Report for Wastewater System Improvements for the City of Eatonton, June 2005, Carter and Sloope.

Map 10. Inflow/Infiltration Analysis



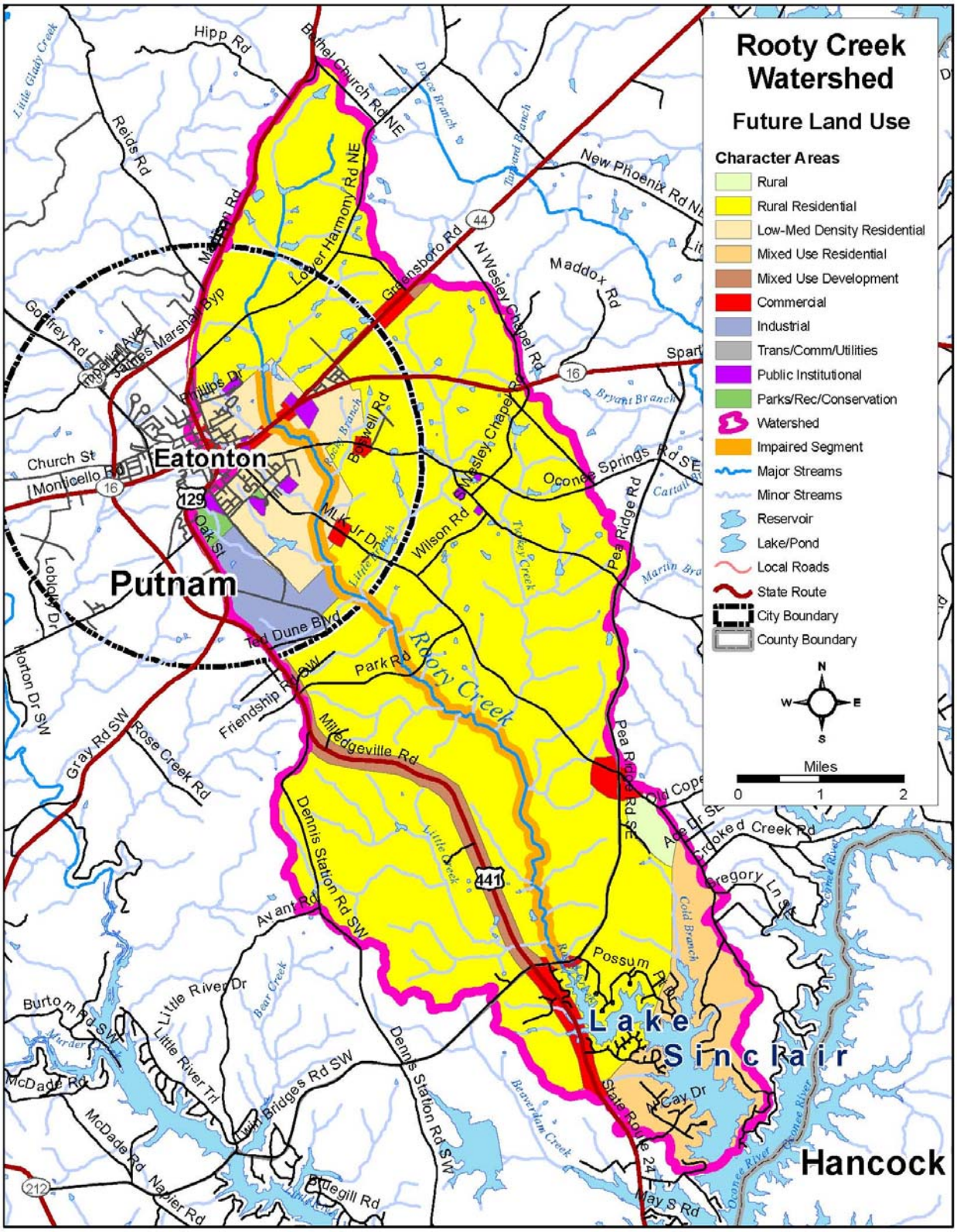
Source: Preliminary Engineering Report for Wastewater System Improvement for the City of Eatonton, Carter & Sloope, 2005.

Map 11 . Existing Land Use



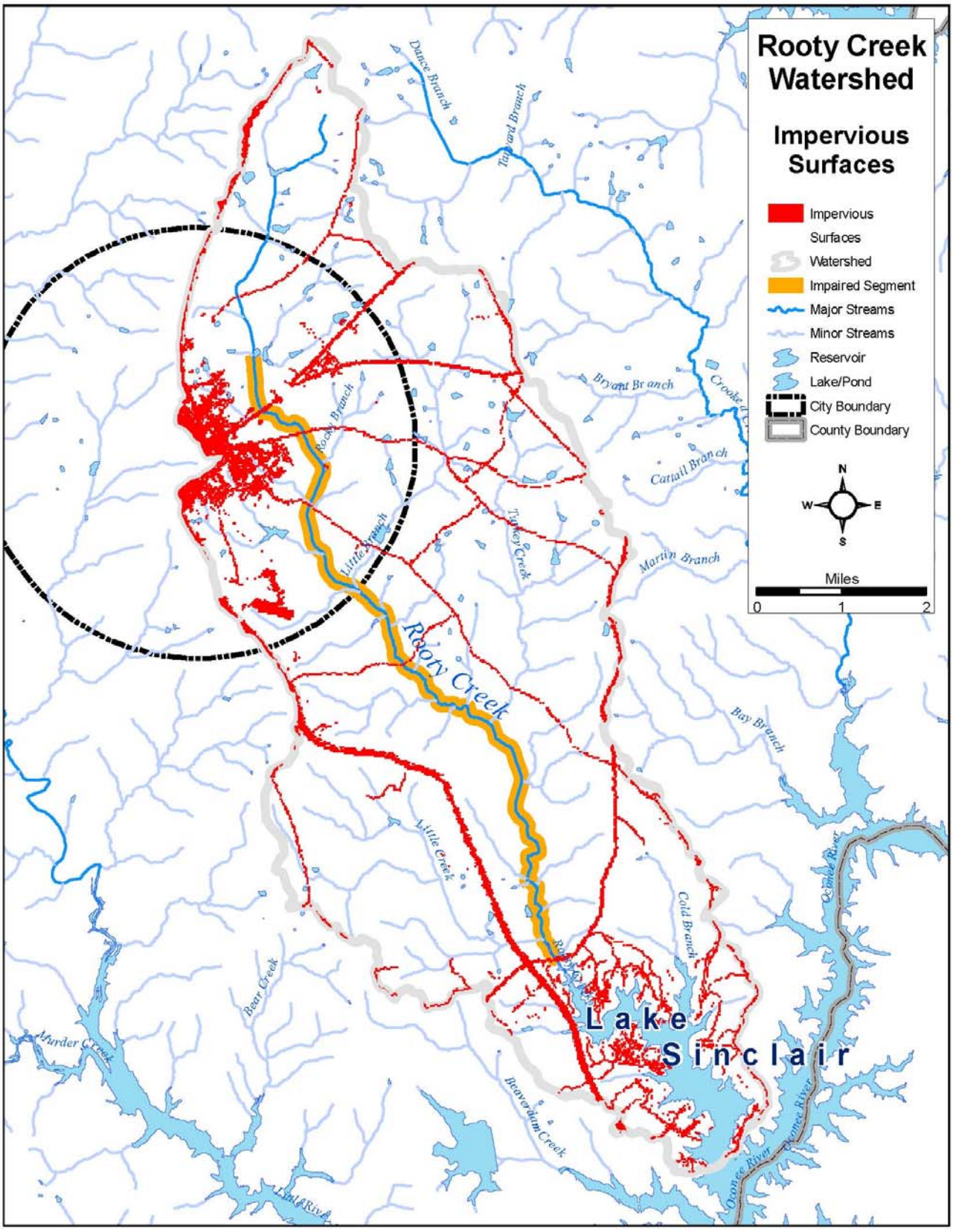
Source: Georgia Department of Community Affairs, Putnam County and the City of Eatonton Community Assessment, 2007-2030.

Map 12. Future Land Use



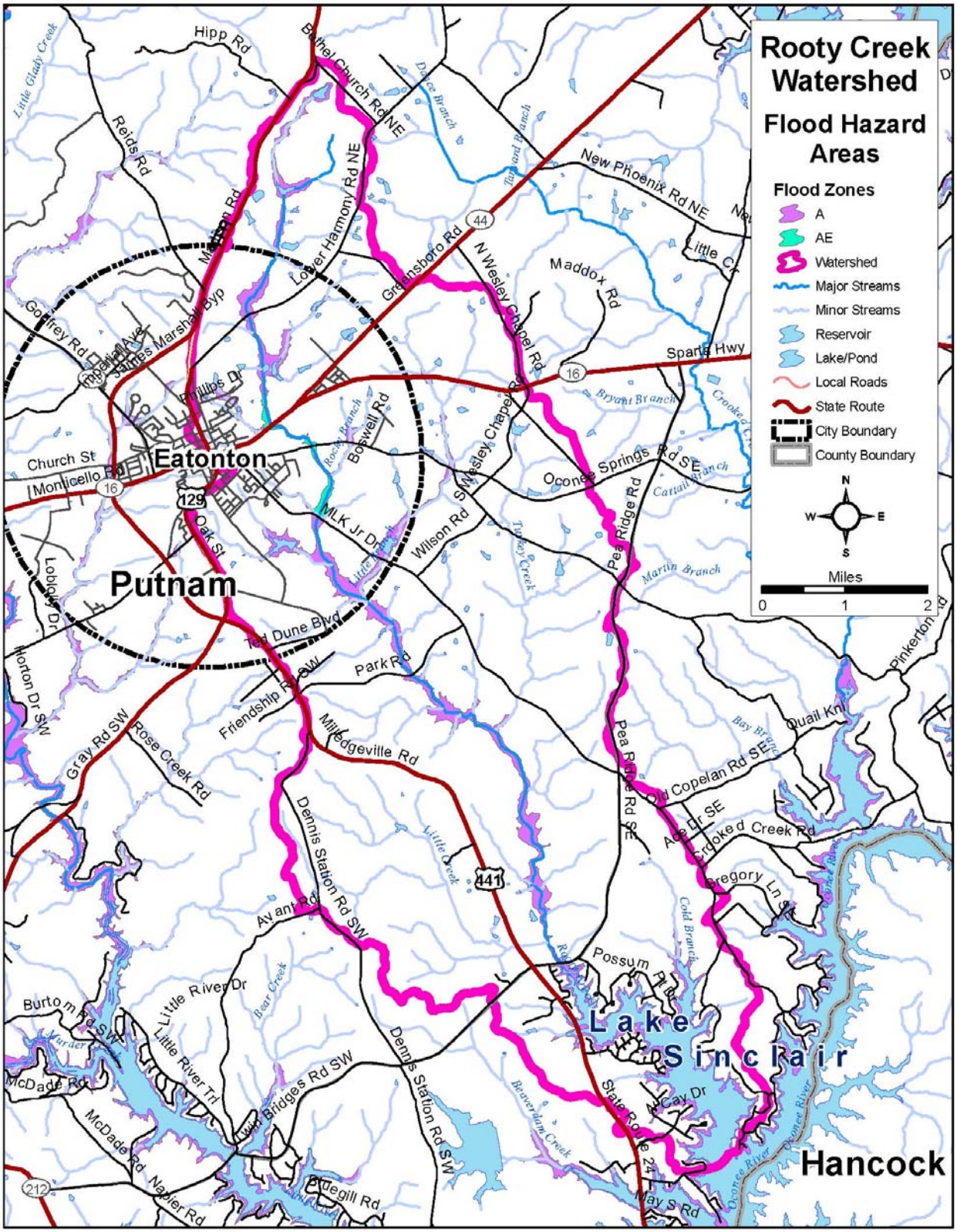
Source: Georgia Department of Community Affairs, Putnam County and the City of Eatonton Community Assessment, 2007-2030.

Map 13. Impervious Surfaces



Source: Source - Geospatial Data Gateway,. Originator - U.S. Department of Agriculture, Natural Resources Conservation Service, 2013.

Map 14. Flood Hazard Areas



Source: Geospatial Data Gateway, Originator – Federal Emergency Management Agency, 2008.

Appendix II.

Watershed Advisory Committee			
First Name	**Last Name**	**Affiliation**	**Title**
Jim	Candler	Georgia Power Company	Environmental Affairs Supervisor
Susan	Davis	Georgia Power Company	Senior Land Management Specialist
Melody	DeLoach	Jenkins Hill Farm	
Tony	Dodd	Georgia Power Company	Environmental Specialist
Cliff	Eaddy	Natural Resources Conservation Service	Soil Conservationest
Larry	Eley	Piedmont Soil & Water District	District Supervisor
Dan	Elmore	City of Eatonton	City Administrator
Steve	Erskine	Landowner	
Keith	Fielder	Putnam County Extension Service	County Extension Coordinator
Alan	Foster	Putnam County Board of Commissioners	District 3 Commissioner
Amanda	Goldberg	Putnam County 4-H	4-H Agent
Chris	Groskreutz	Natural Resources Conservation Service	Outreach Coordinator
Charles	Haley	Eatonton City Council	City Councilman
Jimmy	Harrell	Landowner	
Scott	Hendricks	Georgia Power Company	Lake Resources Manager
Steve	Hersey	Putnam County Commission	Chairman
Jim	Hines	Landowner	
Keegan	Malone	GSWCC	Region IV Representative
Bill	Millians	Oconee River RC&D	Board of Directors
Eric	Moseley	Georgia Forestry Commission	Wildfire Mitigation Specialist
Corey	New	Natural Resources Conservation Service	Soil Conservation Technician
Gary	Sanders	City of Eatonton	City Administrator
Tim	Savelle	Oconee River RC&D	Executive Director
Joe	Slaughter	Georgia Power Company	Fisheries Biologist
Donna	Van Haute	Putnam County Water & Sewar Authority	Director
Warren	Wagner	Georgia Power Company	Environmental Analyst
Dennis	Windnagle	Landowner	

Rooty Creek Monitoring Data - Summary Sheet

E.Coli (cfu/100ml)

	Jan-14	Feb-14	Mar-14			Apr-14		May-14	Jun-14	Jul-14	Aug-14	Sep-14		
Rooty Creek at Lower Harmony Rd	1399.86	1866.48	1099.89			5299.47		2566.41	2299.77	3532.98	2633.07	no data		
Rooty Creek at E. Sumter	299.97	666.6	333.3			999.9		1066.56	933.24	3932.94	1466.52	no data		
Rooty Creek at MLK, Jr. Dr.	466.62	199.98	233.31			533.28		499.95	499.95	2199.78	99.99	no data		
Rooty Creek at Park Dr.	233.31	99.99	33.33			233.31		533.28	166.65	2966.37	99.99	no data		
Little Creek at US 441	133.32	499.95	66.66			266.64		366.63	166.65	299.97	no data	no data		

wet weather sample

Conductivity (µS/cm)

	Jan-14	Feb-14	12-Mar-2014	18-Mar-2014	28-Mar-2014	15-Apr-2014	16-Apr-2014	15-May-2014	30-May-2014	30-Jun-2014	16-Jul-2014	21-Jul-2014	Aug-14	Sep-14
Rooty Creek at Lower Harmony Rd	no data	no data	190	220		300		220		200	210		230	210
Rooty Creek at E. Sumter	no data	no data	150	160		210		210		200	160		170	190
Rooty Creek at MLK, Jr. Dr.	no data	no data	130	150		170		200		220	170		240	200
Rooty Creek at Park Dr.	no data	no data			130		130		170	180		190	200	no data
Little Creek at US 441	no data	no data			100		90		140	140		110	no data	no data

Turbidity (NTU)

	Jan-14	Feb-14	12-Mar-2014	18-Mar-2014	28-Mar-2014	15-Apr-2014	16-Apr-2014	15-May-2014	30-May-2014	30-Jun-2014	16-Jul-2014	21-Jul-2014	Aug-14	Sep-14
Rooty Creek at Lower Harmony Rd	no data	no data	44.7	130		95.6		114		16.3	144		23.5	34.3
Rooty Creek at E. Sumter	no data	no data	28.8	84.3		69.3		74.4		19.4	79		31.7	24.4
Rooty Creek at MLK, Jr. Dr.	no data	no data	22.1	82.6		85.6		95.7		12.6	31.5		6.45	26.4
Rooty Creek at Park Dr.	no data	no data			13.5		26.8		14.3	18.9		33.5	9.49	no data
Little Creek at US 441	no data	no data			19.7		51.8		14.7	14.1		39.4	no data	no data

TSS (mL/L)

	Jan-14	Feb-14	12-Mar-2014	18-Mar-2014	28-Mar-2014	15-Apr-2014	16-Apr-2014	15-May-2014	30-May-2014	30-Jun-2014	16-Jul-2014	21-Jul-2014	Aug-14	Sep-14
Rooty Creek at Lower Harmony Rd	no data	no data	0	0.3		5		5		2	0		1	0
Rooty Creek at E. Sumter	no data	no data	0	0.2		3		3		1	0		3	0
Rooty Creek at MLK, Jr. Dr.	no data	no data	0	0.2		4		2		0	0		1	0
Rooty Creek at Park Dr.	no data	no data			0		4		2	trace		0	0	no data
Little Creek at US 441	no data	no data			0		0		0	trace		0	0	no data

Rooty Creek Land Management Ordinances (2014)		
Regulation/Ordinance	**Responsbile Entity**	**Description**
Zoning Ordinance	Eatonton	Establishes standards and permissible uses designed to, in part, improve the quality life through protection of the city's total environment including air and water. Does not address water quality.
Tree Ordinance	Eatonton	Provides for protection and management of existing trees and planting of new trees. Does not address water quality.
Soil Erosion and Sedimentation Control Ordinance	Eatonton	Establishes minimum requirements effecting land-disturbing activities. Addresses water quality.
Flood Damage Prevention	Eatonton	Establishes minimum standards for new construction in flood hazard areas to reduce damage from flooding. Does not address water quality.
Water Resources Protection	Eatonton	Addresses aquifer recharge, wetland, and water supply watershed protection. Parts of the Rooty Creek watershed include aquifer recharge areas and wetlands and these regulations address, in part, water quality. None of the Rooty Creek watershed is in a water supply watershed.
Sewer Use Ordinance	Eatonton	Requires and regulates use of public sewer system. Addresses water quality.
Zoning Ordinance	Putnam County	Establishes standards and permissible uses designed to, in part, conserve and protect the natural, economic and scenic resources of Putnam County. Does not water quality.
Soil Erosion and Sedimentation Control	Putnam County	Establishes minimum requirements effecting land-disturbing activities. Addresses water quality.
Flood Damage Prevention	Putnam County	Establishesminimum standards for new construction in flood hazard areas to reduce damage from flooding. Does not address water quality.
Water Resources Protection	Putnam County	Addresses aquifer recharge, wetland, and water supply watershed protection. Parts of the Rooty Creek watershed include aquifer recharge areas and wetlands and these regulations address, in part, water quality. None of the Rooty Creek watershed is in a water supply watershed.
Manual for On-Site Sewage Management Systems	State-wide	Requires use of on-site sewage management system when structure is not within 200' of public system. Addresses water quality.