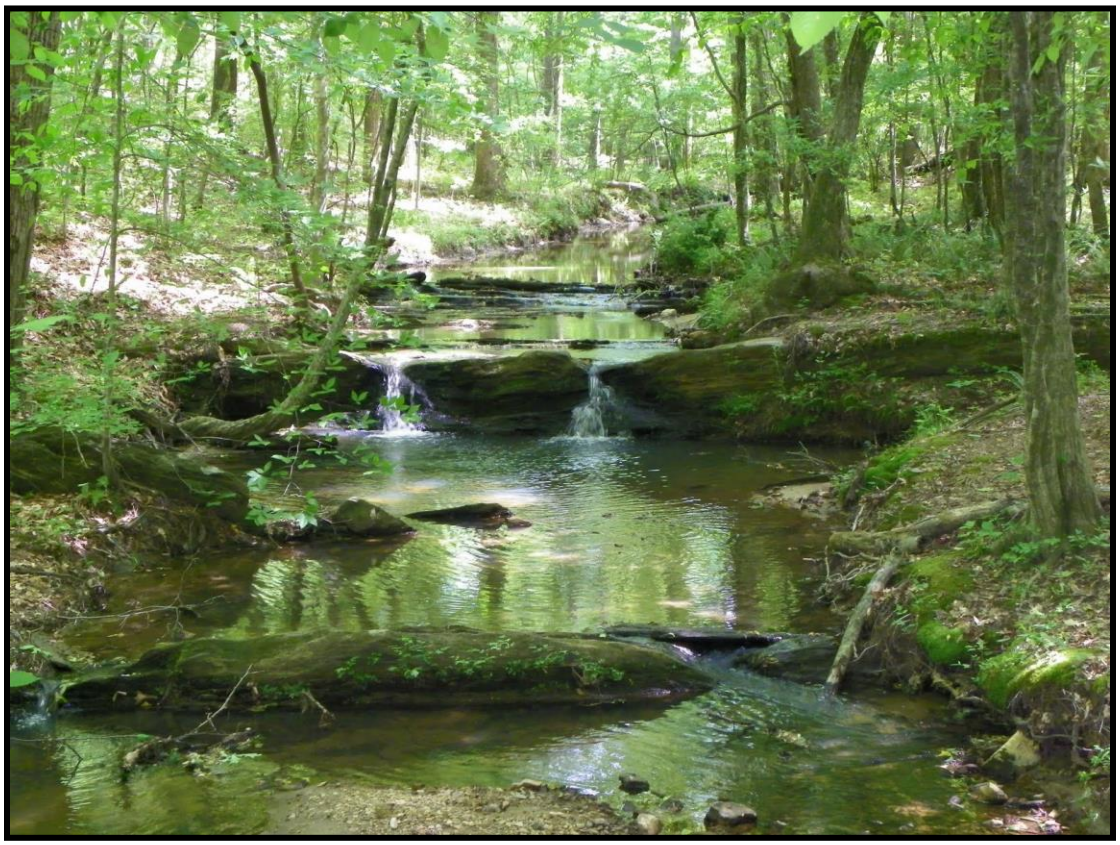

PUMPKINVINE CREEK
WATERSHED MANAGEMENT PLAN

A Comprehensive Watershed Management Plan

to improve the health of Pumpkinvine Creek Watershed.

NOVEMBER 2014

Acknowledgements

The construction of this watershed plan is certainly a cooperative effort that was made possible through the contributions and collaborations of many agencies, organizations and landowners. The Rolling Hills Resource Conservation and Development Council expresses its most sincere appreciation to these contributors. Without your input, interest in improving water quality in the Pumpkinvine Creek Watershed, and research, this goal would not have been achieved. Above all else, Rolling Hills would like to thank the Environmental Protection Agency for project funding, and for placing watershed protection and preservation as a budget priority. We would also like to convey our continued gratitude and appreciation to the Georgia Environmental Protection Division, and our dedicated project manager, Barbara Stitt-Allen, for many hours supporting our work and collaborating on this plan. Rolling Hills RC&D is a non-profit agency with a long history of supporting community and regional partnerships. Those partnerships have been essential to the completion of this plan. The Natural Resources Conservation Service continues to provide technical assistance and guidance to us in this, and many other endeavors. We would also like to thank the following organizations for their contributions to this plan: Paulding County Government, Bartow County Government, University of Georgia Cooperative Extension, Paulding County Environmental Health Department, Bartow County Environmental Health Department, Coosa River Soil and Water Conservation District, Seth Meador, and the Kennesaw State University GIS Department. It is the desire of Rolling Hills RC&D Council that this plan will be used as a tool to facilitate the improvement, protection and preservation of the Pumpkinvine Creek Watershed.

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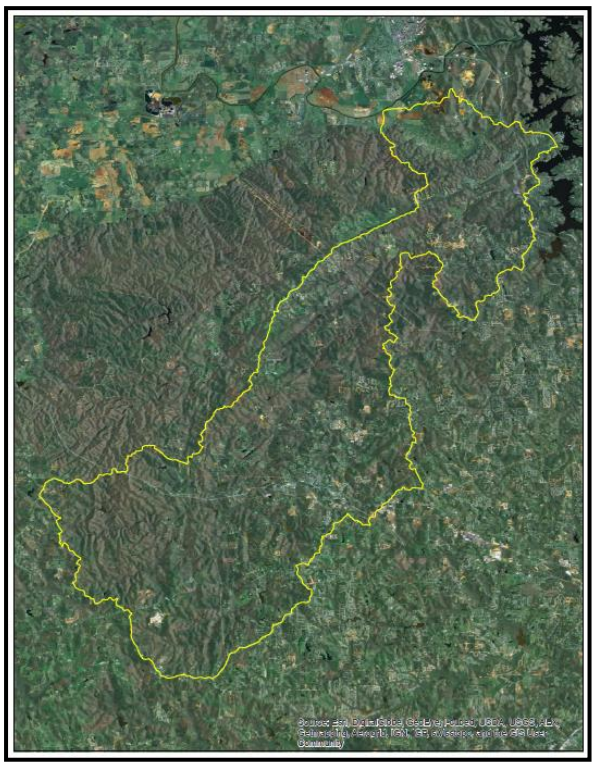
Pumpkinvine Creek Watershed Management Plan

Contents

EXECUTIVE SUMMARY



The Pumpkinvine Creek Watershed contains several stream segments that fail to meet their designated use of fishing as designated in the 2012 303d list of impaired streams in the state of Georgia. The headwaters of Pumpkinvine Creek to County Road 231 (7 miles) of the stream are currently listing as meeting its designated use of fishing. The next downstream segment is not listed. The next 14 mile reach (Weaver Creek to Little Pumpkinvine Creek) is listed for sediment impacts to fish. The lower 15 mile stream segment (Little Pumpkinvine Creek to the Etowah River) is listed for elevated fecal coliform levels. An additional 4 mile segment of Lawrence Creek is located within the subject watershed due to sediment impacts to fish from non-point source and urban runoff. A 2 mile segment of Dunaway Branch to Pumpkinvine Creek was recently documented by DNR as having sediment impacts to benthic macroinvertebrates. To alleviate these impairments, load reductions of these nonpoint source pollutants are necessary within the watershed. TMDLs (Total Maximum Daily Loads) for the two impaired stream segments were completed in 2009 and 2004, respectively. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.

This Watershed Management Plan has been created to further identify sources of pollutants and address means by which load reductions can be made. The plan includes the Nine Key Elements as recommended by the Environmental Protection Agency. These key elements help to outline a process to enable load reduction and begin watershed restoration. Development of the plan featured a stakeholder-driven process to build partnerships with the local community that will assist in the plan implementation. The plan has been written by Rolling Hills Resource Conservation and Development Council (Rolling Hills RC&D) as a deliverable associated with

an Environmental Protection Agency Clean Water Act (§319) grant administered by the State of Georgia. Assuming future 319 funding is available, Rolling Hills RC&D is committed to leading the collaborative restoration effort to help achieve the necessary load reductions of bacteria and sediment to improve the watershed. The Pumpkinvine Creek Restoration Program was developed in an effort to accentuate the strengths of project partners. This program will complement existing programs stormwater and wastewater management programs underway in Bartow and Paulding Counties. As part of this program, agricultural lands are identified for targeting load reductions by use of Best Management Practices (BMPs). The BMPs implemented will vary according to the best interests of the farmers. The practices recommended include, but are not limited to: heavy use area protection; stream bank stabilization; stream access control for cattle; alternative cattle watering systems; stream buffer enhancement; and nutrient management.

It is anticipated that the Natural Resource Conservation Service (NRCS) be a key contributor to the success of this part of the program. If necessary, septic system issues will be addressed to reduce fecal coliform bacteria from human sources in residential areas of the watershed. Issues to be addressed will include septic system repairs, educational workshops for homeowners, and the development of a septic tank pump-out program. It is anticipated that Paulding County and Bartow County Environmental Health Offices will be indispensible for the residential component of the WMP. In addition to actual land modification projects, this document outlines education and outreach activities identified by the stakeholder group to potentially reduce pollutant loads and educate the community about soil and water conservation. The success of outreach and education efforts will be maximized through effective partnerships with many government agencies, conservation groups and concerned residents. Cost-share of the above projects with farmers and homeowners will be used to stimulate interest in the community. The cost-share funds will be obtained through grants and nongovernmental agency donations.

1.0 Plan Preparation and Implementation

The Pumpkinvine Watershed Management Plan is not regulatory document, but can be a valuable tool and resource to develop a "whole watershed" approach upon which to initiate the restoration of the Pumpkinvine Creek Watershed. The Plan includes stakeholder input on local concerns and feasible resolutions. The goal of the plan is for the impaired segment to be de-listed. In addition to the geographic goal, the plan is also designed to educate the stakeholders and landowners to the concerns regarding watershed issues, such as how to minimize water and soil resource concerns through improved landscape management.

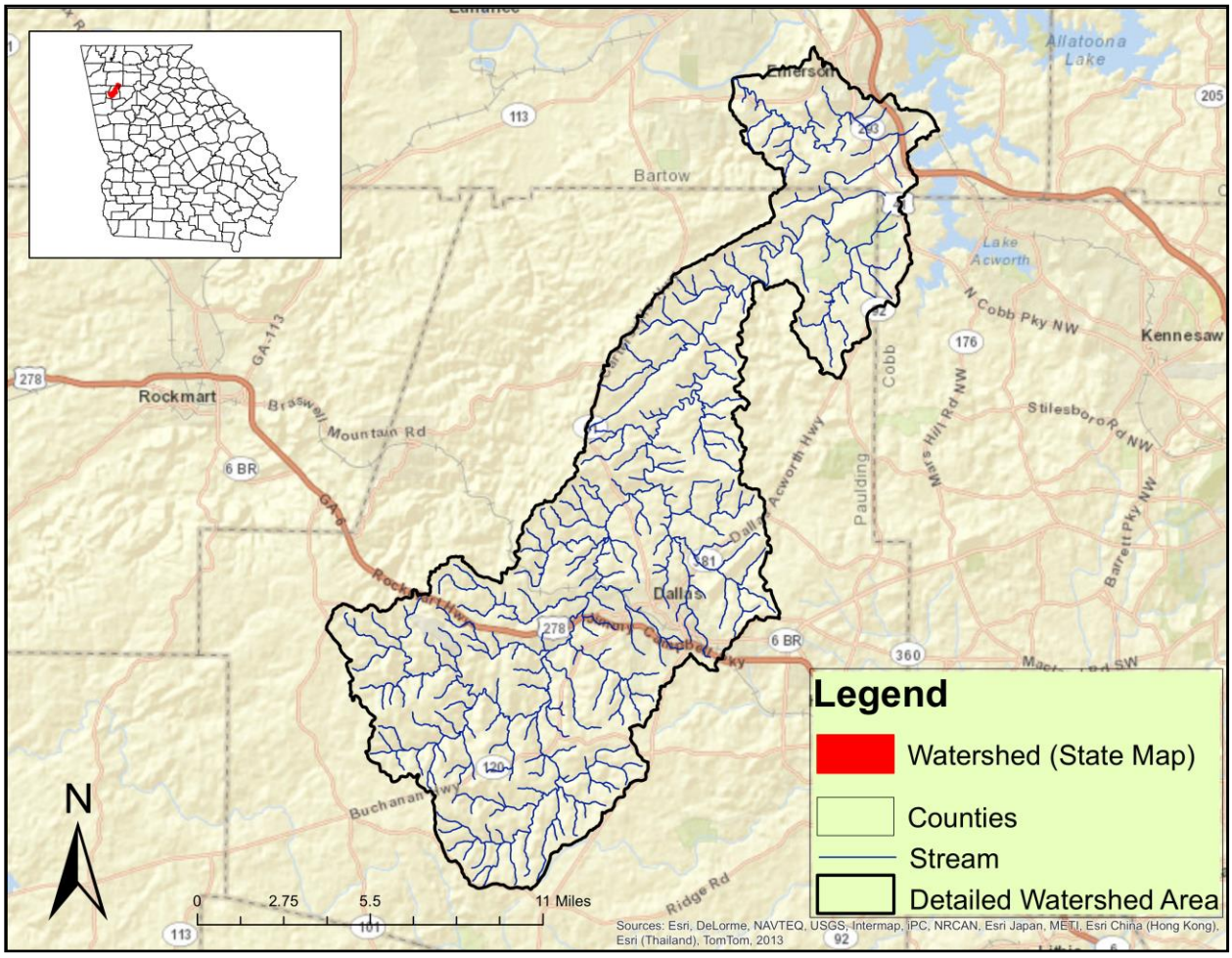


Figure 1. Pumpkinvine Creek Watershed

The Pumpkinvine Creek WMP coincides with a statewide effort by Georgia Environmental Protection Division (EPD) to update all Total Maximum Daily Load (TMDL) Implementation Plans to include the nine key elements (described below) as recommended by the US Environmental Protection Agency (EPA). These elements are recommended to help ensure stakeholder involvement and to eventually meet watershed restoration objectives. Specifically, the nine key elements are as follows:

1. Identify the sources or groups of similar sources contributing to nonpoint source (NPS) pollution to be controlled to implement load allocations or achieve water quality standards.
2. Estimate the load reductions needed to de-list impaired stream segments;
3. Describe the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality standards;
4. Describe sources of funding and/or authorities that will be relied upon, to implement the plan;
5. Outline an information/education component that will be used to enhance public understanding and participation in implementing the plan;
6. Provide a reasonable schedule for implementation of the management measures;
7. Describe interim measure milestones (e.g., load reductions, improvement in biological or habitat parameters) for determination of implementation of management measures and control actions;
8. List criteria for determination of progress towards attaining water quality standards and, parameters for pan revision;
9. Establish a monitoring plan to ensure the effectiveness of the implementation efforts as evaluated by the criteria established under item (8) above.

Rolling Hills RC&D opted to develop a more comprehensive WMP that also includes each of the key elements rather than more simply update the TMDL Implementation Plan, as part of an EPA Clean Water Act (§319) grant. The process used to construct this document utilized extensive research on the watershed, including long-term monitoring data on habitat, water

quality, fish and macro-invertebrate community assemblages, geology, soils, as well as current and future land use.

The development of the plan also relied upon the participation of a stakeholder group (Table 1.), which consisted of representatives from local and state government agencies, nonprofit groups, and the private sector. One meeting was held on June 18, 2013 to engage the public in the process of designing an implementation plan. Participants were invited to take part in the process due to their professional interests and familiarity with previous stakeholder efforts. The meeting focused on gathering input regarding potential problems and solutions, priority development, and the evaluation of what BMPs might be met with the best public reception, and obtainment of insight on the document. Unfortunately, stakeholder participation in this project was limited and so previous outreach efforts conducted during the preparation of the TMDL Implementation Plan for the fecal-impaired segment of Pumpkinvine Creek in 2005 were used to help guide recommendations that are included in this report. It is important to note that buy-in for the concepts presented in the plan is critical to encourage adoption of recommended implementation efforts to facilitate long-term restoration and maintenance of the watershed.

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Table 1. Pumpkinvine Creek WMP Stakeholder Committee

Plan implementation will focus to improve the watershed through specific project components. This includes reducing NPS pollution from septic systems and farm lands in the watershed. Another component will focus on educating the public about watershed processes in general and nonpoint source pollution. Stakeholder assistance in the implementation effort is key to the process. Plan implementation will respect private property rights and will rely on voluntary conservation. Voluntary conservation will involve participation from landowners on cost-shares to reduce NPS pollution on their properties. Individual parcels were not singled out as to not discourage participation. Instead, general NPS issues associated with specific land uses, which are predominant within the watershed, are discussed.

Although voluntary conservation objectives are difficult to achieve, relationship development in the community combined with a phased approach should increase the chance of successful watershed restoration. The WMP should be reassessed every five years, after an extensive assessment of the local water quality. This process will allow a chance for stakeholders and citizens to analyze project successes and failures, and provide opportunities for changes in restoration priorities.

2. Pumpkinvine Creek Watershed Description

Extensive knowledge regarding the watershed is paramount in making effective watershed planning decisions. This section will focus on providing background to the watershed as it relates to the development of a WMP for Pumpkinvine Creek. The sources for this information are many including, but not limited to the Paulding County and Dallas Watershed Protection Plans; Emerson Watershed Protection Plan Annual Progress Reports; citydate.com; historical TMDL Implementation Plans; and the Soil Surveys of Paulding and Bartow County, Georgia; among others.

2.1 Landscape Features

Watershed Geography

The Pumpkinvine Creek Watershed (PCW) drain approximately 106,550 acres of land primarily located in Northwest Georgia, and is classified as a "HUC 10" watershed (Hydrologic Unit Code #0315010411). Four smaller subwatershed (termed HUC 12) are included in the larger drainage basin. Three counties – Paulding, Bartow and Cobb County are responsible for managing land use in the watershed. Pumpkinvine Creek is located within the Ridge and Valley Physiographic province. While predominantly forested (73%), residential growth has been increasing at a rapid pace in the watershed, especially north of Dallas in Paulding County and southern Bartow County that includes Cartersville and Emerson, GA. At the time of the last TMDL residential acreage was estimated at 22,000acres or 18%, row crops comprised 5% and transitional, woody wetlands, pastures, quarries, and transportation each made up 1% of the total land use acreage.

Watershed Geology and Soils

The Pumpkinvine Creek Watershed is located within the Ridge and Valley physiographic region, which is dominated by northward-trending valleys separated by low, rounded ridges and by high, steep-sided ridges. The locations of these streams and high level of meander likely follow the more soluble carbonate formations in between more resistant rock types. Flowing over beds of exposed limestone, the streams have been found to have relatively high natural conductivity levels. Rocks in the Ridge and Valley physiographic region range from early

Cambrian to Mississippian age. The ridges in this area are typically composed of chert and capped sandstone, while the valleys are most often limestone or shale. The most common underlying rocks here are shale, slate, dolomite, limestone, and sandstone. Dolomite and limestone are porous rocks that can be found in aquifer forming layers that have cracked and faulted in the mountain building process. Sinkholes and springs are present as a result of the limestone and dolomite (karst) topography.

Climate/Precipitation

Cool winters and hot summers with a relatively lengthy growing season characterize the climate of Paulding and Bartow Counties. According to the Soil Survey for Paulding County, Georgia, the average temperatures for the summer season are relatively warm (76.2° daytime), and the sun shines much of the daylight hours (approximately 64% of the time). The winter is less sunny (51% of the daylight hours), and the average day temperatures relatively cool (41.6°).

Precipitation is plentiful in the area and in comparison to other areas of the country is spread somewhat evenly throughout the seasons. Winter and Spring, however, tend to be the wettest seasons of the year, and more precipitation in these seasons results in a higher water table. Annual precipitation averages approximately 54 inches, yet snow is rare, averaging about 3.2 inches per season. Local stream flows reflect seasonal precipitation, which is an important a factor when considering water quality concerns.

2.2 Important Flora and Fauna

Listed and Sensitive Species

Several endangered plant and aquatic species are believed to reside in the Pumpkinvine Creek watershed and nearby areas. These include: Bald eagle; Cherokee darter; Bay star-vine; and the Georgia aster. The Cherokee Darter was found in Pumpkinvine Creek in the fish study conducted during the summer of 2006. A listing of these species, federal and state status, habitat and threats are presented in Table 2.

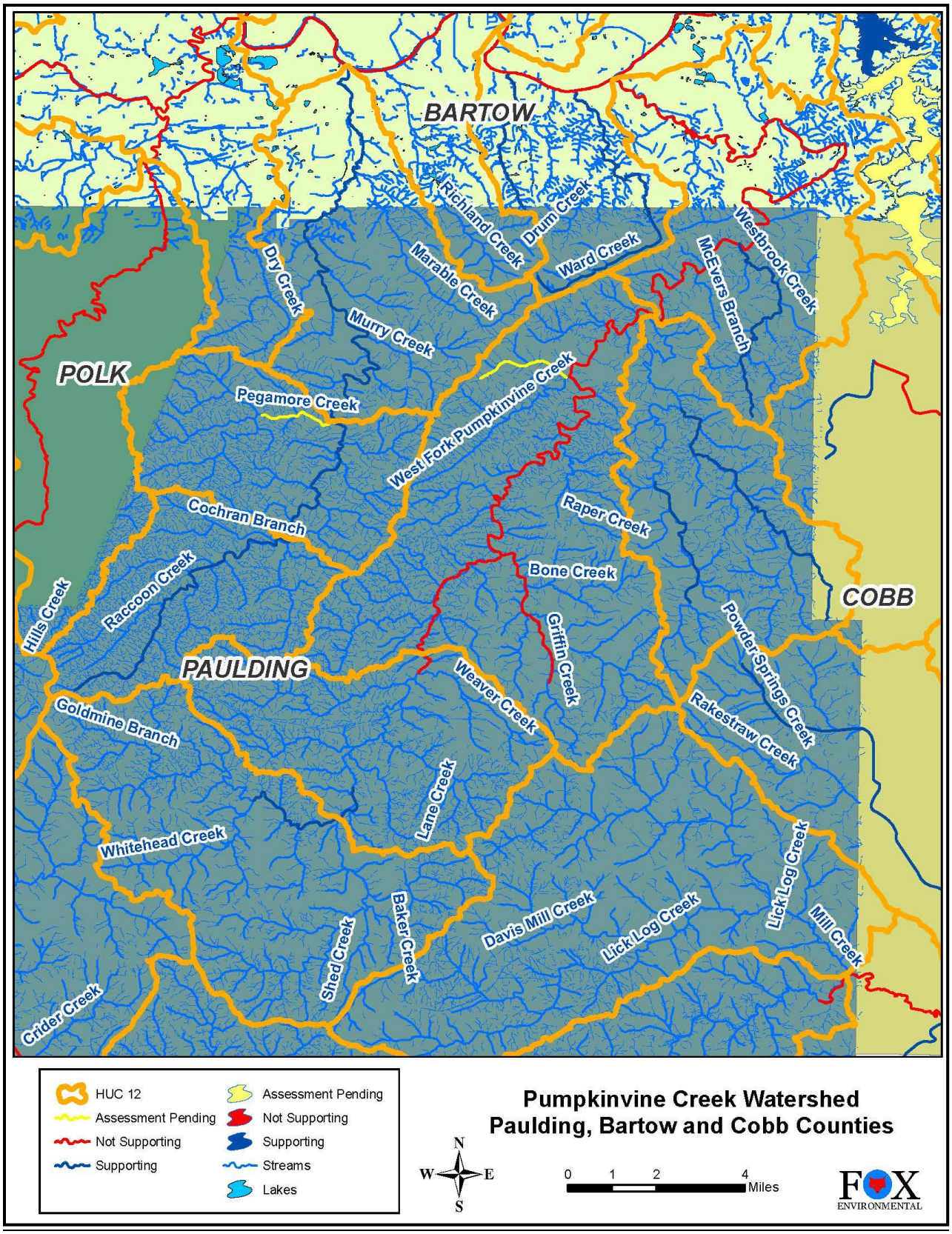

Figure 2. Pumpkinvine Creek Watershed

Species	Federal Status	State Status	Habitat	Threats
Bird				
Bald eagle *Haliaeetus leucocephalus*	T	E	Inland waterways and estuarine areas in Georgia.	Major factor in initial decline was lowered reproductive success following use of DDT. Current threats include habitat destruction, disturbance at the nest, illegal shooting, electrocution, impact injuries, and lead poisoning.
Fish				
Cherokee darter *Etheostoma scotti*	T	T	Shallow water (0.1-0.5 m) in small to medium warm water creeks (1-15 m wide) with predominantly rocky bottoms. Usually found in sections with reduced current, typically runs above and below riffles and at ecotones of riffles and backwaters.	Habitat loss due to dam and reservoir construction, habitat degradation, and poor water quality
Plant				
Bay star-vine *Schisandra glabra*	No Federal Status	T	Twining on subcanopy and understory trees/shrubs in rich alluvial woods	
Georgia Aster *Aster georgianus*	Candidate Species	T	Post oak savannah/prairie communities. Most remaining populations survive adjacent to roads, utility rights of way, and other openings.	

Table 2. Listed Species in Paulding County *(www.fws.gov, updated May 2004)*

2.3 Human Influences on the Environment

Land Resources and Land Use

The area is primarily forested property; however, forested areas are rapidly becoming residential and commercial areas along the major roads through Paulding County and into Bartow County. Mid watershed is the urban municipal area of Dallas, upstream and downstream of the city the watershed is more forest and low intensity residential.

January 2004 land use data indicated land within the watershed was predominately forest. In acres and percentages of the total land use data were as follows: Forest forms 72.8% of the watershed at 65,696 acres; low intensity residential forms 16.4% at 14,832 acres; row crops form 5.9% at 5,314 acres; and minor percentages of high intensity commercial/industrial/transportation; transitional; woody wetlands; pasture/hay; open water; quarries/strip mines/gravel pits; high intensity residential; other grasses; and emergent herbaceous wetlands. More recent data indicates a decrease in forested and agricultural areas coincident with an increase in residential and commercial land use. Current and future land use in the Pumpkinvine Creek watershed is a mix of agriculture, residential, mining and some industrial. The northern stream is located in an area poised for growth just north of the City of Acworth along Interstate Highway 75 and State Highway 41. According to the current future land use map, this area will be largely residential with little agriculture or mining anticipated in the future. A very large sports complex is under construction in this watershed with portions currently used for competitive tournaments and training. The southern portion of the watershed is similarly experiencing development in and around the City of Dallas. The following Figures 3 through 5 illustrate current land use in the watershed as well as the rapidly changing land use from 2003 to 2013.

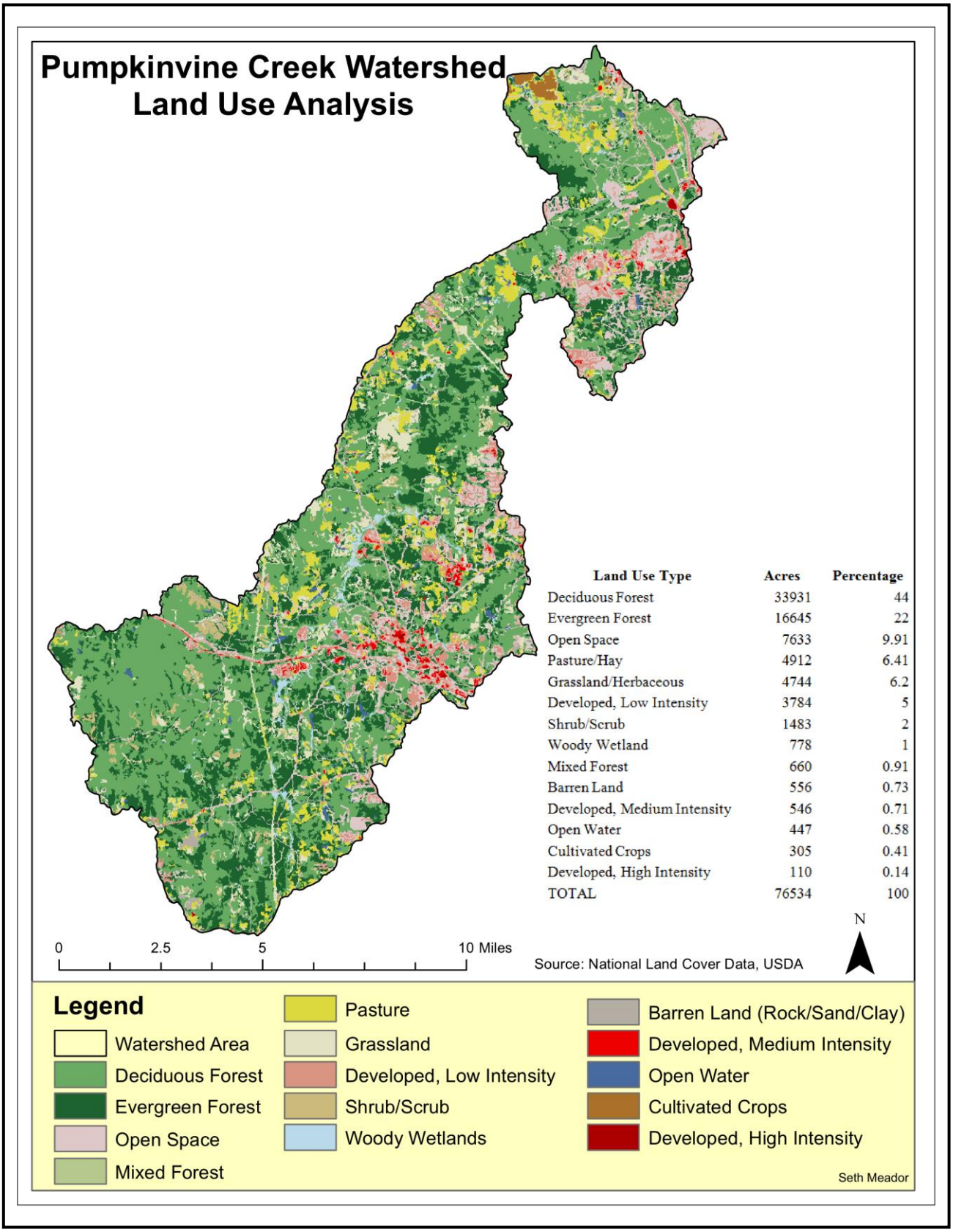

Figure 3. Current Land Use Analysis in the Pumpkinvine Creek Watershed

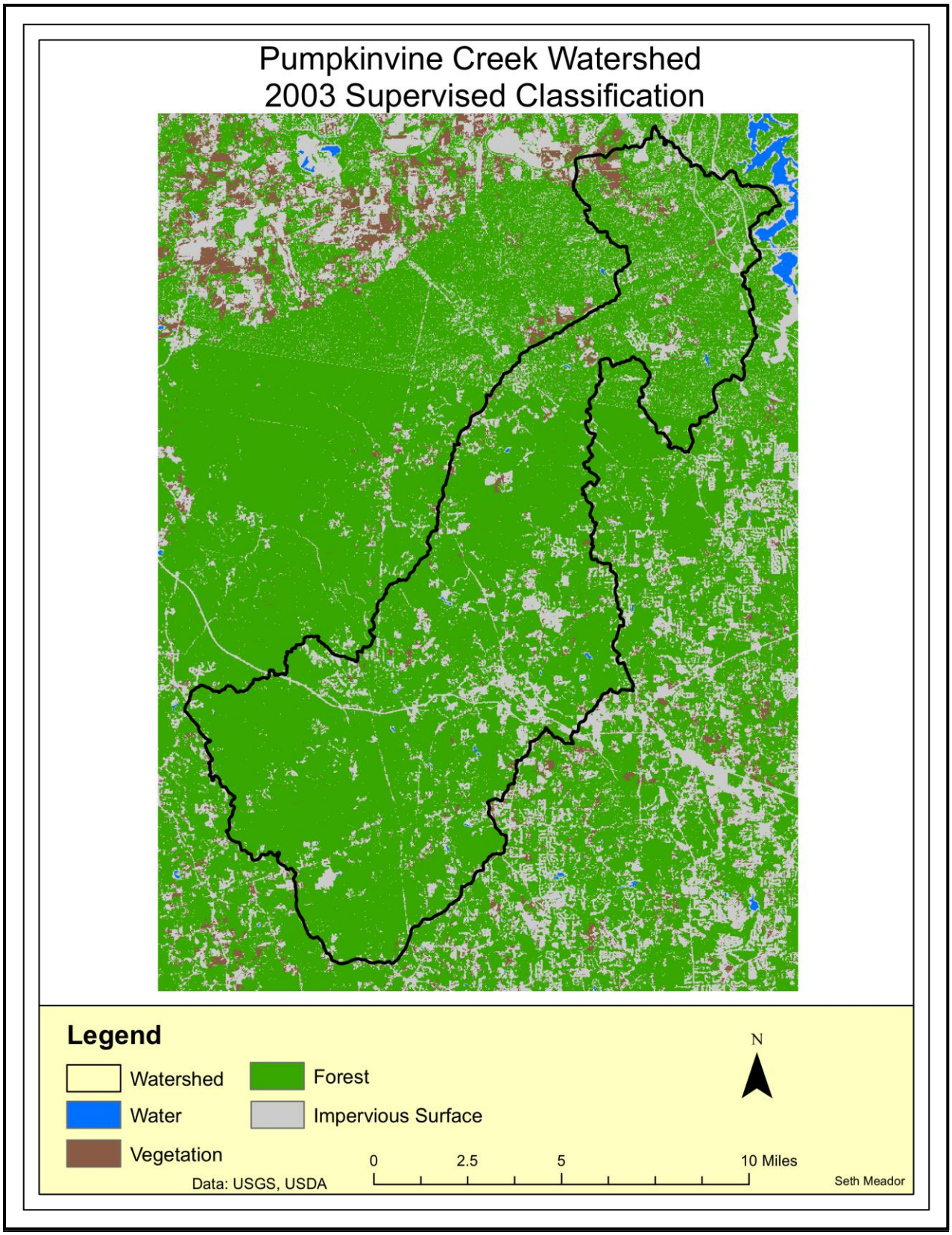

Figure 4. 2003 Land Use in the Pumpkinvine Creek Watershed

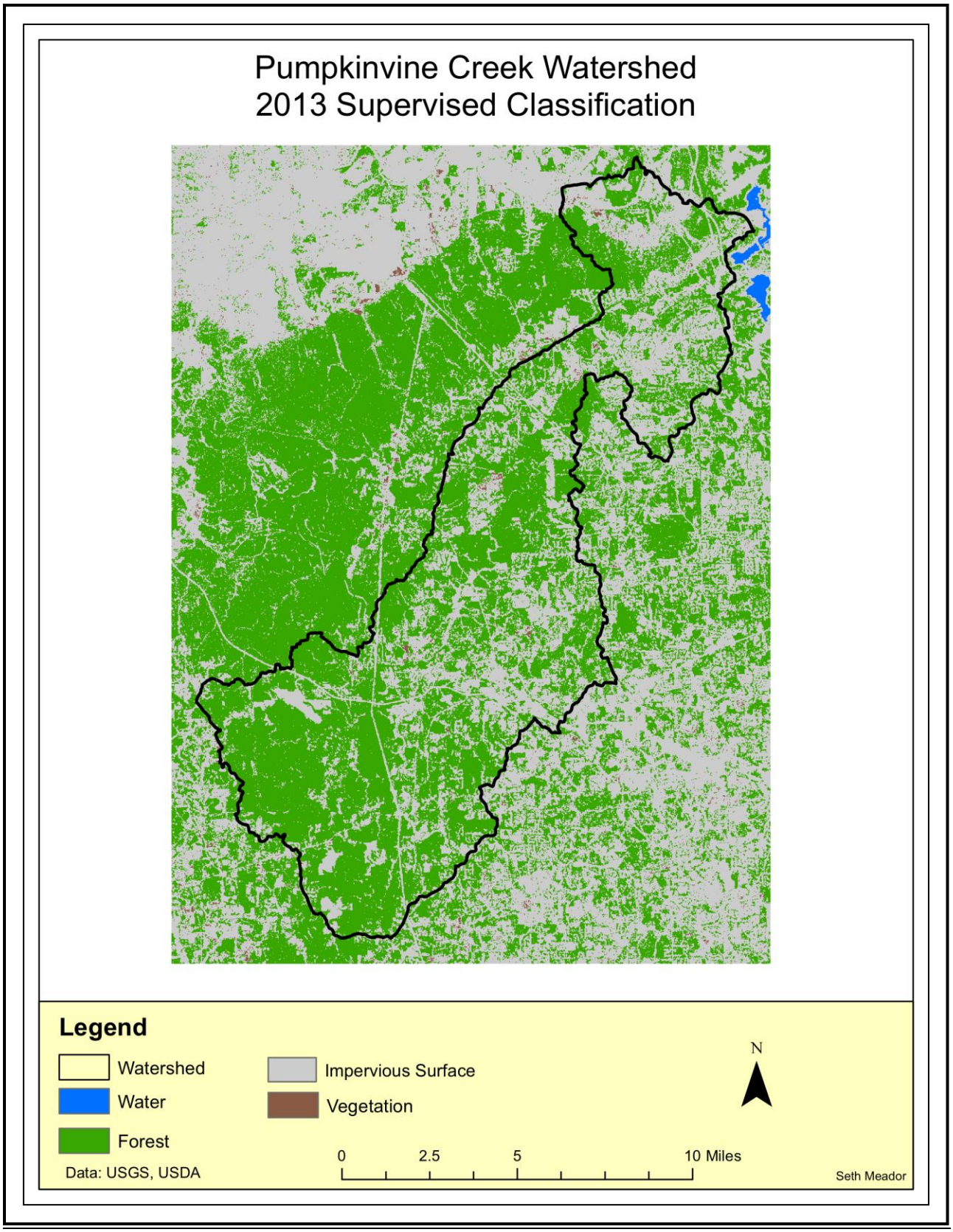

Figure 5. 2003 Land Use in the Pumpkinvine Creek Watershed

Protected Areas and Greenspace

Part of the Pumpkinvine Creek watershed falls within the Paulding Forest Wildlife Management Area, located 4 miles west of Dallas, north of Highway 278. This area includes 26,200 acres that provide recreation and hunting, fishing, and bird watching opportunities. The area is leased by the Georgia DNR as a wildlife management area. The DNR provides feeding management and regulates hunting and fishing in the area.

Paulding County also contains large designated wildlife management areas (WMA) located in the Raccoon Creek Watershed located immediately west and adjacent to the Pumpkinvine Creek Watershed. More than 12,200 acres, located on these properties, are now protected for use by hunters, anglers, hikers and birdwatchers. Additionally, the Paulding Forest WMA contains a portion of the Silver Comet Trail making it a favorite of bike riders

DNR manages the WMA for hunting in conjunction with the management of the natural habitat. The Howell Tract is heavily forested in a natural stand of timber, including globally rare montane longleaf pine, and a mature hardwood forest. These forests contribute to the high quality water found at Raccoon Creek, located on the property. This creek is one of the most important tributaries within the Etowah basin as it supports viable populations of the basin's diverse fish. The entire Etowah River system is a high priority area in Georgia's Comprehensive Wildlife Conservation Strategy.

Political Boundaries

The headwaters of Pumpkinvine Creek and associated tributaries begin in Paulding County and flow north to Bartow County where the stream enters the Etowah River. A small portion of the watershed extends into Cobb County. The Cities of Dallas, Emerson and a small portion of Cartersville are located within the watershed (see Figures 6 and 7). Although the City limits are not located within the Pumpkinvine Creek, growth associated with the City of Acworth have extended into the watershed and impact its health.

The population within the Pumpkinvine Creek watershed is rapidly increasing. For example, the City of Dallas has grown in population by 128% since 2000. The City of Emerson has

grown nearly 35% since 2000. By comparison, the state of Georgia and the United States has grown 18% and 9.7% in the same time period.

Community Water Resources

There are two wastewater treatment plants located within the Pumpkinvine Creek watershed owned by the City of Dallas and Emerson. The City of Dallas' North Plant discharges to Lawrence Creek, a tributary of Pumpkinvine Creek. The Dallas has a permit to discharge up to 0.5 MGD with plans to expand to 3 MGD in the near future. The City of Emerson operates a wastewater treatment plant in the northern portion of the watershed that is permitted to discharge up to 0.45 MGD to Pumpkinvine Creek. The City of Cartersville receives some wastewater from the northern portion of Emerson however it is pumped out of the watershed, treated and discharges to the Etowah River. As a condition of each wastewater permit, the Cities of Dallas and Emerson, Paulding County and Bartow County are each required to implement a Watershed Protection Plan that includes numerous bet management practices and monitoring requirements to promote the health of Pumpkinvine Creek and other watersheds within each jurisdiction.

The City of Emerson operates a drinking water plant within the Pumpkinvine Creek watershed. It is likely that some water is pumped out for use by local farmers. All local governments with jurisdiction in the watershed are currently designated as Municipal Separate Storm Sewer System (MS4) Permittees. This includes the Cities of Dallas, Emerson, Cartersville as well as Paulding County, Bartow County and Cobb County. The MS4 Stormwater Management Plans developed and implemented by each jurisdiction mandate six categories of best management practices, many of which overlap with those required by the previously discussed Watershed Protection Plans. The categories are as follows: (1) public education and outreach; (2) public involvement and participation; (3) illicit discharge detection and elimination programs; (4) construction site runoff control; (5) post-development stormwater management for new development and redevelopment; and (6) municipal pollution prevention program (including storm sewer system inspection, maintenance and repair). Each category includes multiple required activities designed to prevent, reduce, and/or eliminate stormwater pollution to local water resources. The three counties are required to implement these activities within their urbanized areas only whereas the three cities are mandated to implement their stormwater

programs throughout. Each local government must submit a MS4 Progress Report to EPD on an annual basis.

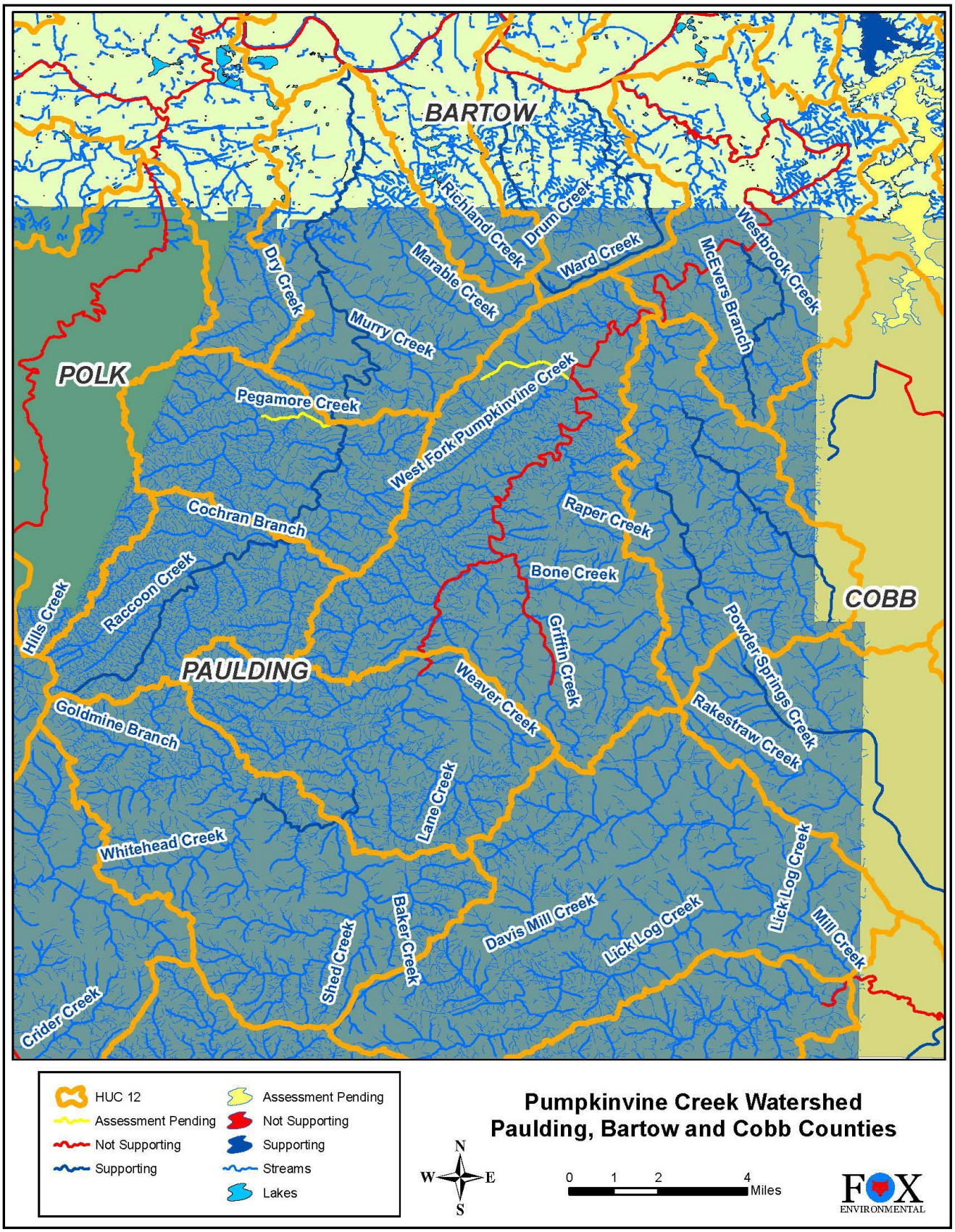

Figure 6. Counties in the Pumpkinvine Creek Watershed

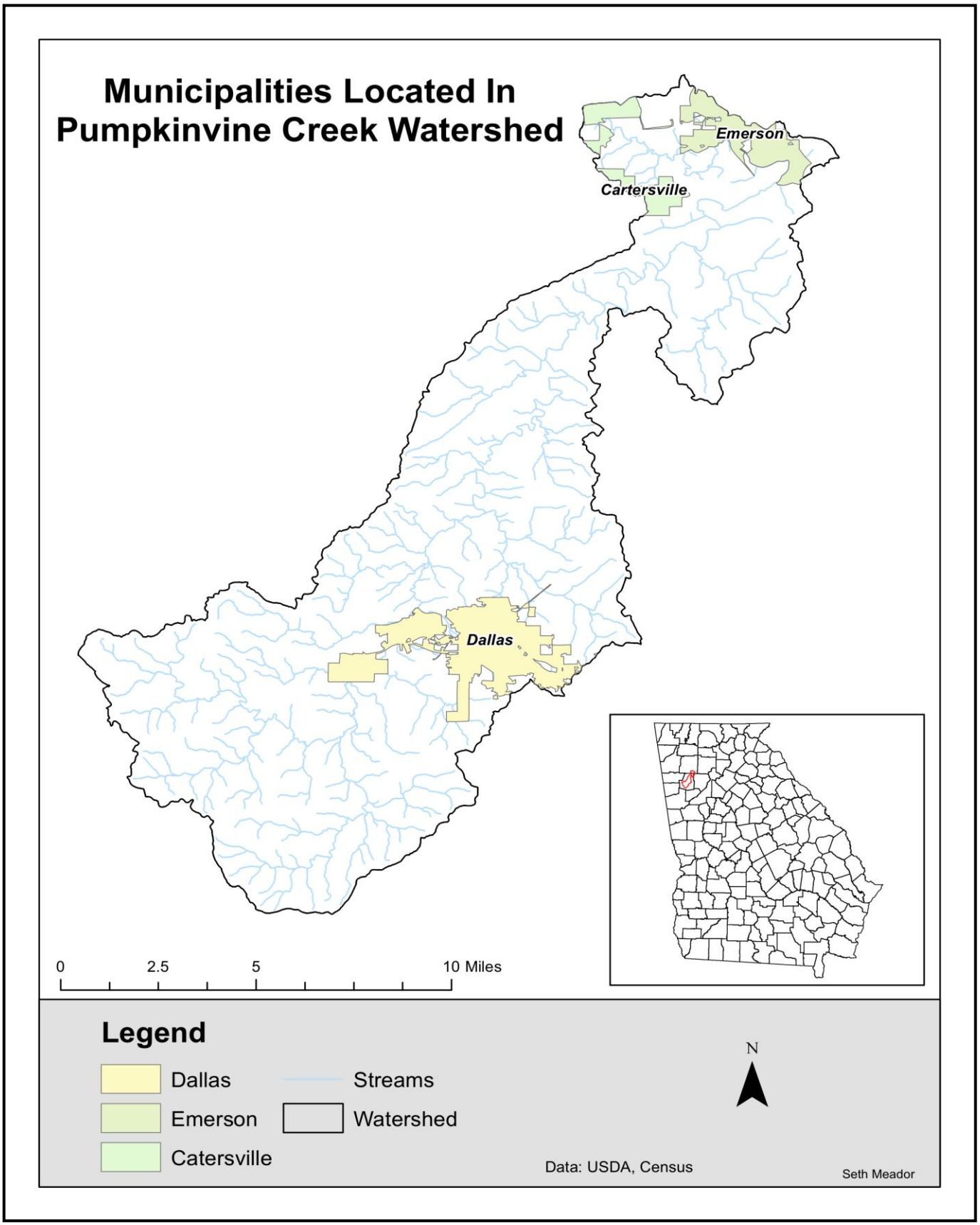

Figure 7. Municipalities in the Pumpkinvine Creek Watershed

3. Watershed Conditions

It is important to evaluate the health status and trends of the Pumpkinvine Creek watershed to determine the impact of local pollutant sources over time. The following section will introduce the state water quality standards and their importance, as well as impairments in the Pumpkinvine Creek Watershed, and sampling data from past and current monitoring endeavors. Assessments representative of current watershed conditions are also included.

3.1 Water Quality Standards and Impairments within the Pumpkinvine Creek Watershed

Georgia Water Quality Criteria

Georgia's water quality standards are made up of two different groups of criteria. The general criteria apply to all waters, and certain specific criteria exist for each of six designated uses. The six designated uses in Georgia, which vary in strictness of standards, are: (1) drinking water supply; (2) fishing; (3) wild river; (4) recreation; (5) coastal; and (6) fishing. The general criteria are more qualitative in nature, and include: (a) waters shall be free of materials, oils, and scum associated with municipal or domestic sewage, industrial waste or any other waste which will settle to form sludge deposits, produce turbidity, color, or odor, or that may otherwise interfere with legitimate water uses; and (b) waters shall be free from toxic, corrosive, acidic, and caustic substances in amounts that are harmful to humans, animals, or aquatic life.

Impairments in the Pumpkinvine Creek Watershed

The Pumpkinvine Creek Watershed contains several stream segments that fail to meet their designated use of fishing as designated in the 2012 303d list of impaired streams in the state of Georgia. The headwaters segment of Pumpkinvine Creek to County Road 231 (7 miles) of the stream is currently listing as meeting its designated use of fishing. The next downstream segment is not listed. The next 14 mile reach (Weaver Creek to Little Pumpkinvine Creek) is listed for sediment impacts to fish. The lower 15 mile stream segment (Little Pumpkinvine Creek to the Etowah River) is listed for elevated fecal coliform levels. An additional 4 mile segment of Lawrence Creek is located within the subject watershed due to sediment impacts to

fish from non-point source and urban runoff. A 2-mile segment of Dunaway Branch to Pumpkinvine Creek was recently documented by DNR as having sediment impacts to benthic macroinvertebrates. To alleviate these impairments, load reductions of these nonpoint source pollutants are necessary within the watershed. TMDLs (Total Maximum Daily Loads) for the two impaired stream segments were completed in 2009 and 2004, respectively. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.

Waterbody (Impaired Miles)	County	Criterion Violated
Lake Allatoona to Pumpkinvine Creek (6 miles)	Bartow	Fish Consumption Guidance, Dissolved Oxygen
Little Pumpkinvine Creek to the Etowah River (15 miles)	Bartow/Paulding	Fecal Coliform Bacteria
Braly Lake to Pumpkinvine Creek (4 miles)	Paulding	Biota Impacted (Fish Community)
Weaver Creek to Little Pumpkinvine Creek (14 miles)	Paulding	Biota Impacted (Fish Community), Fecal Coliform Bacteria
Griffin Creek/Lawrence Creek (4 miles)	Paulding	Biota Impacted (Fish Community)
Dunaway Branch Headwaters to West Fork Pumpkinvine Creek (2 miles)	Paulding	Assessment Pending for Biota Impacts (Macroinvertebrates)

Table 3. Pumpkinvine Creek Impaired Segments and Nearby Listed Tributaries/Lakes

3.2 Historical Monitoring Data

Water Quality Data

Water quality data has been measured at Site 1 in Bartow County over the past six years (see Figures 9 and 10). Parameters collected at each sampling event included in-situ measurements of dissolved oxygen, conductivity, pH, turbidity, water temperature and average stream flow. Additional parameters evaluated in the laboratory included: nutrients (ammonia, nitrate, nitrite, TKN, ortho and total phosphorus), oxygen (BOD, COD), sediment (total suspended solids) and metals (cadmium, lead, zinc and copper). Fecal coliform and E. coli samples were also collected on eight occasions to determine two separate geometric means. Rainfall occurred before and/or during the collections of bacterial samples on a few occasions. Water quality monitoring data were compared to the various thresholds, including water quality standards, to determine potential risk to human health and in-stream biota.

Data collected over the past six years at Site 1 in Bartow County indicates that Pumpkinvine Creek has experienced no problems with nutrients, BOD, COD, or metals during this time period. Elevated levels of sediment and bacteria were documented during the study, especially during and immediately after rain events. Results are presented in Table 4 below.

	2009	2010	2011	2012	2013	2014
Average Fecal Bacteria *cfu/100 ml*	631	552	360	469	1,409	245
Average E. coli Bacteria *cfu/100 ml*	526	493	309	320	1,160	197
Average Total Suspended Solids *mg/L*	11.9	9.6	9.5	8.2	54	7.2

Table 4. Average Bacteria and Sediment Levels in Pumpkinvine Creek at Site 1

The City of Emerson monitors the health of two tributaries that flow to Pumpkinvine Creek. The locations of these sites (E-1 and E-2) are depicted in Figure 8. Photographs are presented as Figure 9 and 11. Both sediment and bacteria were identified as potential issues of concern at both study sites. This occurred primarily during wet weather. The highest bacteria levels were observed during the rain event on September 5, 2011 at Sites 1 and 3. Site 1 measured 7,000

cfu/100 ml fecal coliform and 4,900 MPN/100 ml E. coli during the rain event. Concentrations were significantly lower at the Sites 2, especially during dry weather. The first and second geometric means of Site 2 averaged 299 cfu/100mls fecal coliform and 245 MPN/100 mls E. coli. Elevated sediment levels [as indicated by elevated total suspended solids (TSS greater than 20 mg/l) and turbidity (NTU greater than 25)] were present at both locations, primarily during wet weather. Site 1 is intermittent stream usually does not have flow during dry weather. Site 2 exhibited acceptable levels of sediment during dry weather. Over the past year or more, uncontrolled sediment from this construction project deposited a large amount of mud and dirt throughout the forest located within the stream's drainage area.

	2011	2012
Average Fecal Bacteria *cfu/100 ml*	328	268
Average E. coli Bacteria *cfu/100 ml*	276	226
Average Total Suspended Solids *mg/L*	14.3	7.5

Table 5. Average Bacteria and Sediment Levels at Site E2

Paulding County initiated a long-term monitoring program in January 2009. A map of the sampling locations is presented in Figure 12. No recent water quality for the segments of Pumpkinvine Creek located in Paulding County was available for inclusion in this report. Historical data from the 2000/2001 watershed study demonstrated impairments related to sediment and/or fecal coliform. Most of the impaired monitoring locations during this period were located within or downstream of the City of Dallas West Wastewater Treatment Plant (WWTP) located just outside the Pumpkinvine Creek watershed.

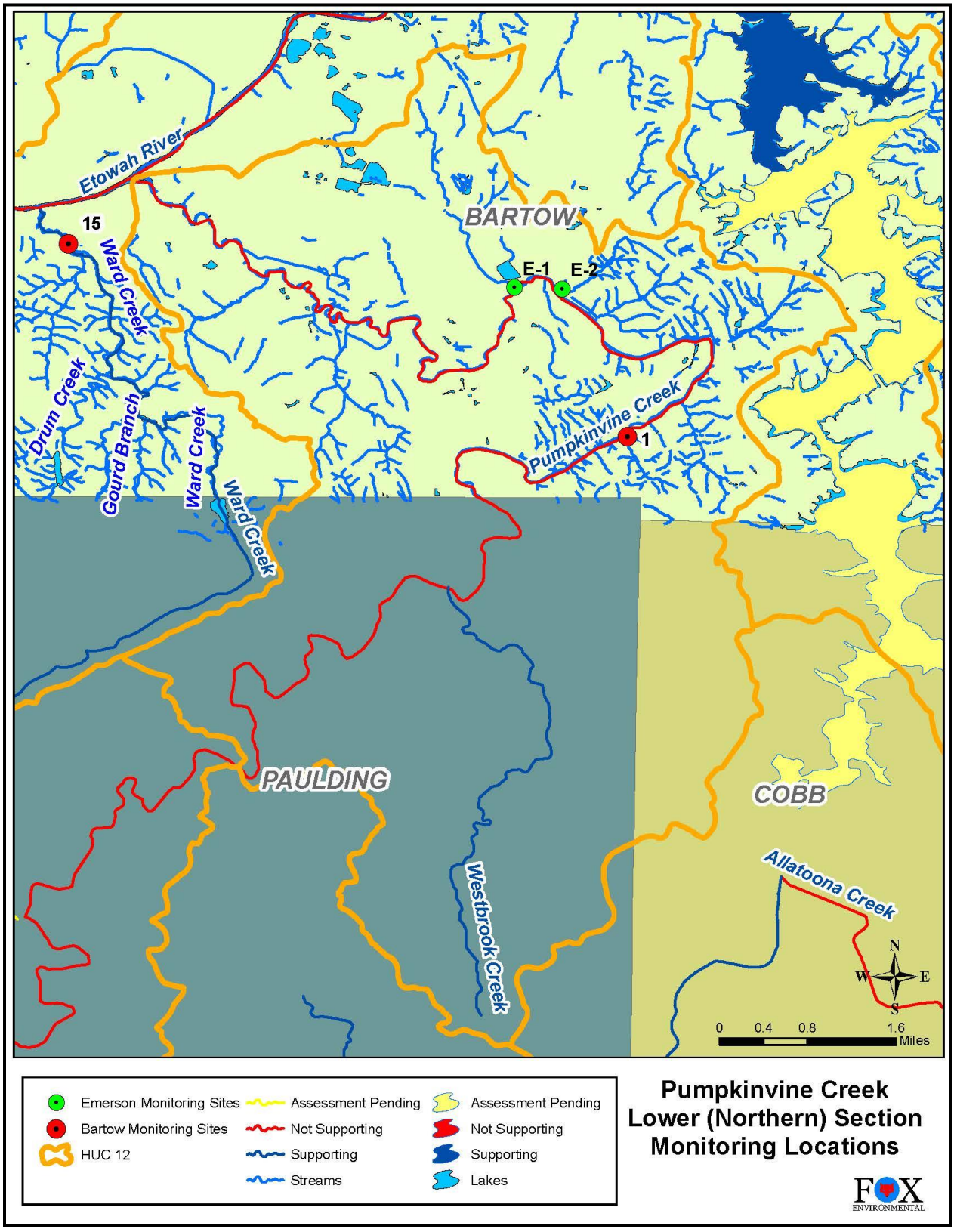

Figure 8. Monitoring Locations in Lower Pumpkinvine Creek

Figure 9. Pumpkinvine Creek - Site 1

Figure 10. Tributary to Pumpkinvine Creek - Site E-1

Figure 11. Tributary to Pumpkinvine Creek - Site E-2

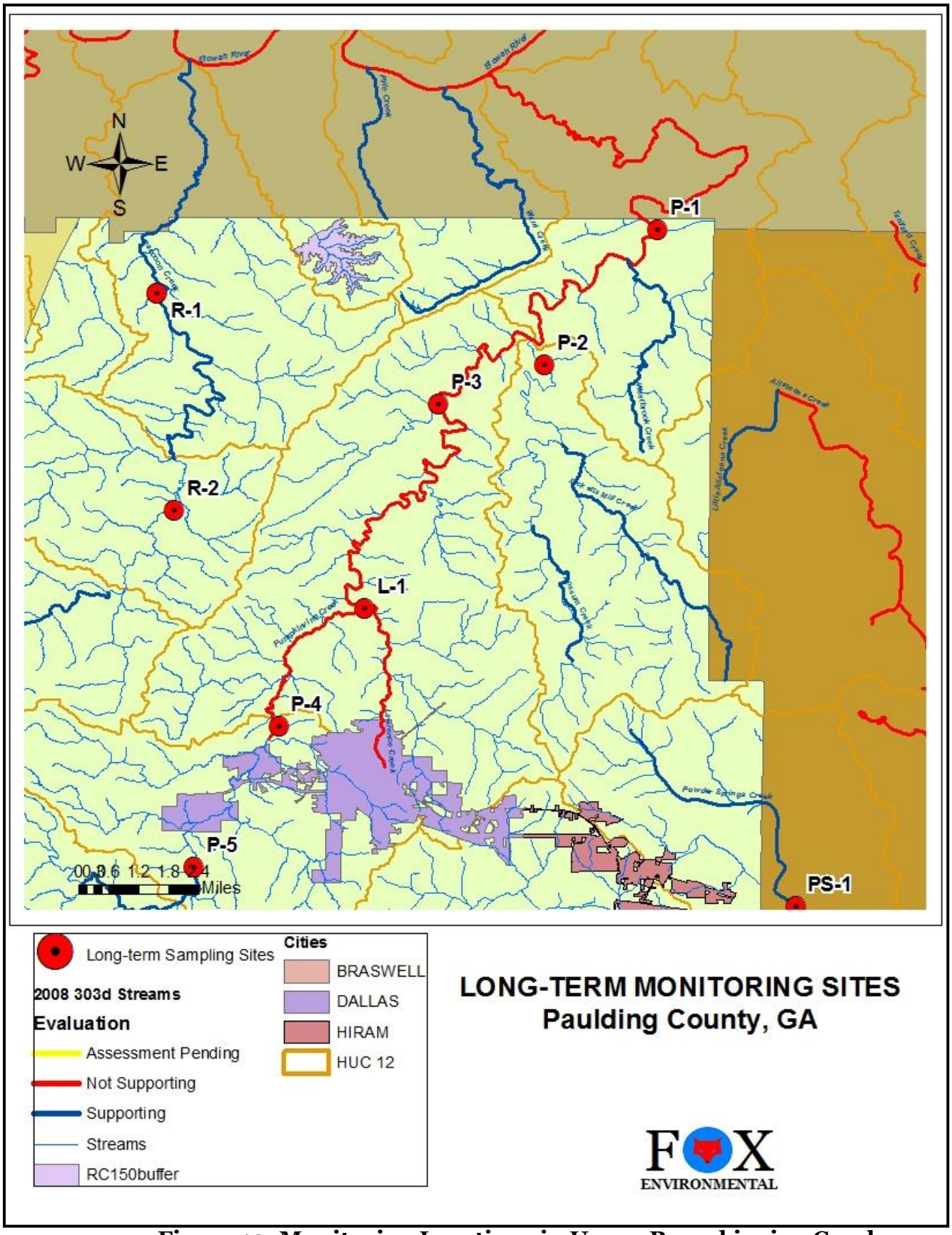

Figure 12. Monitoring Locations in Upper Pumpkinvine Creek

Biological Monitoring Data

Biological monitoring involves collecting and evaluating biological data to gauge the ecological health of aquatic ecosystems and to identify trends in the integrity of the stream and watershed. Habitat and benthic macroinvertebrate studies are performed by Bartow County and the City of Emerson at Sites 1 and E-2 at a regular basis. It is anticipated that similar studies are performed by Paulding County in upper segments of Pumpkinvine Creek however none was available for inclusion in this report.

The physical protocol requires visual evaluation of physical habitat parameters, including in-stream cover, substrate, channel morphology and flow, bank stability and vegetation, and riparian zone condition. The results of the physical habitat studies of Site 1 and E-2 indicated each location was in relatively good condition ranging from Suboptimal/marginal at Pumpkinvine Creek (Site 1) to Optimal/suboptimal at Site E-2.

Habitat Parameter Score	Site 1	Site E-2
HP#1 – Epifaunal Substrate/Instream Cover	9.5	16.5
HP#2 – Embeddedness	5.5	15.5
HP#3 – Velocity/Depth Combinations	12.0	10.0
HP#4 – Sediment Deposition	8.5	15.5
HP#5 – Channel Flow Status	14.5	14.5
HP#6 – Channel Alteration	15.0	16.5
HP#7 – Frequency of Riffles	2.0	15.0
HP#8 – Bank Stability	16.0	15.0
HP#9 – Bank Vegetative Protection	17.0	15.0
HP#10 – Riparian Vegetative Zone	19.0	18.0
Total Average Score	**119.0**	**151.5**
Condition Rating	**Suboptimal/ Marginal**	**Optimal/ Suboptimal**

Table 5. Physical Habitat Scores for Two Sites in Upper Pumpkinvine Creek Watershed

Benthic macroinvertebrate sampling and assessment was performed according to the most recent methodologies developed by the GADNR. Standardized semi-quantitative sampling for macroinvertebrates was conducted at each site for a variety of habitat types, including riffles, undercut banks/roots, woody debris, sand, leaf packs, snags and submerged macrophytes. The results indicated that Lower Pumpkinvine Creek (Site 1) had a moderately healthy benthic macroinvertebrate community. This is likely due to the relative abundance of habitat types and wide buffers. The small tributary to Pumpkinvine Creek is less healthy with fewer sensitive species despite the presence of good habitat. This was likely due to periods of low flow, elevated temperatures and low dissolved oxygen content.

Stream Name	Index Score	Numeric Ranking	Narrative Description	Stream Health Rating
Site 1: Lower Pumpkinvine Creek	54	2/3	Good/Fair	A/B
Site E-2: Tributary to Pumpkinvine Creek	33	3/4	Fair/Poor	B/C

Table 6. Benthic Macroinvertebrate Scores for Two Sites in Upper Pumpkinvine Creek Watershed

Fish sampling and analysis was performed in 2008 at Site 1 according to protocol established in EPD's "Standard Operating Procedures for Conducting Biomonitoring on Fish Communities in Wadeable Streams in Georgia." Because of the potential for impact to endangered species, fish shocking was no longer performed in the Lower Pumpkinvine Creek after this year. A total of 748 fish were collected from 21 species at Site 1. A list of all fish collected is presented in Table 7. A further assessment of the fish community through an Index of Biotic Integrity is presented in Table 8. The results scored 34 or an Integrity Class of "fair." An analysis of the data was also performed per the Index of Well Being. The results for this measurement scored 8.1 or "fair."

Scientific Name	Common Name	Site 1
Catostomidae	**Suckers**	
Hypentelium etowanum	**Alabama hogsucker**	16
Minytrema melanops	**spotted sucker**	3
Moxostoma duquesnei	**black redhorse**	50
M. erythrurum	**golden redhorse**	5
M. poecilurum	**blacktail redhorse**	79
Centrarchidae	Basses, Sunfish	
Ambloplites ariommus	**shadow bass**	4
Lepomis auritus	**redbreast**	304
L. cyanellus	**green sunfish**	4
L. macrochirus	**bluegill**	11
Lepomis sp.	**hybrid sunfish***	1
M. punctulatus	**spotted bass**	20
M. salmoides	**largemouth bass**	10
Campostoma oligolepis	**largescale stoneroller**	2
Cyprinella callistia	**Alabama shiner**	31
C. venusta	**blacktail shiner**	67
N. stilbius	silverstripe shiner	7
Ictaluridae	**Catfish**	
Ictalurus punctatus	**channel catfish**	7
Percidae	**Perches & Darters**	
E. stigmaeum	speckled darter	6
Percina nigrofasciata	blackbanded darter	111
Petromyzontidae	**Lampreys**	
Ichthyomyzon gagei	southern brook lamprey	3
Poecilidae	**Livebearers**	
Gambusia holbrooki	eastern mosquitofish	4
Sciaenidae	**Drums**	
Aplodinotus grunniens	freshwater drum	3
Total No. Fish		**748**
Total No. Species		**21**

Table 7. Summary of IBI Metric Scoring

METRIC	Site 1
1. Number of Native Fish Species	20 (3)
2. Number of Benthic Invertivore Species	2 (3)
3a. Number of Native Sunfish Species	---
3b. Number of Native Centrarchid Species	5 (1)
4. Number of Native Insectivorous Cyprinid Species	3 (1)
5. Number of Native Round-Bodied Sucker Species	5 (5)
6a. Number of Sensitive Species	---
6b. Number of Intolerant Species	3 (3)
7. Evenness	66.3 (1)
8. Proportion of *Lepomis* Species	42.8% (3)
9. Proportion of Insectivorous Cyprinids	14.0% (1)
10a. Proportion of Generalist Feeders and Herbivores	---
10b. Proportion of Top Carnivores	4.9% (5)
11. Proportion of Benthic Fluvial Specialists	40.2% (5)
12. Number per 200 Meters	316 (3)
13. DELTS	0.4% (0)
Total IBI Score	**34**
Integrity Class	**Fair**

Table 8. Summary of IBI Metric Scoring

Targeted Watershed Assessment of Lower Pumpkinvine Creek (Bartow County)

A targeted watershed assessment of the northern portion of Pumpkinvine Creek (segment located within Bartow County) and watershed was conducted in the fall of 2011. The assessments shall include, but not limited to, current and future land use characterizations, stream walks, identification of potential point and non-point pollutant sources and in-situ stream monitoring activities.

In-situ measurements of dissolved oxygen, conductivity, temperature, pH, and turbidity were measured at numerous locations along Pumpkinvine Creek segment from the Bartow County line north to the Etowah River. The results indicated that most parameters were present at acceptable levels. Noteworthy was an increase in turbidity from 3.36 NTU at a point where the stream entered the County to 7.14 NTU where the stream flows into the Etowah River. Oxygen levels increased slightly along the same reach.

Assessors divided the stream reach into four segments beginning at the point the stream crosses into Bartow County from Paulding County. The field assessment revealed that the first segment of the stream experienced large buffers, two subdivisions and a horse farm. The stream had a moderate amount of trash and significant erosion along both stream banks. Illegal dumping was more common along the second stream segment especially at road crossings (e.g., Highway 293 and behind lower income housing. Forests currently dominate land use in this area. Emerson Wastewater Treatment Plant discharges to Pumpkinvine Creek in this portion of the stream. The terrain in the next downstream portion of stream was less hilly with agricultural (e.g., cotton and hay) and livestock (e.g., cattle and horses) as dominant land uses. Stream buffers were not as wide and cattle sometimes had access to the stream. Again illegal dumping at road crossings was noted during the study. Stream bank erosion was less severe in this segment. Selected photos of the watershed are presented in Figures 13 through 16.

Figure 13. Large Cotton Fields and Other Agricultural Land Uses Exist in Pumpkinvine Watershed

Figure 14. Numerous Horse Farms and Agriculture Areas are Present in Lower Pumpkinvine Creek Watershed

Figure 15. Salvage Yard located Adjacent to Pumpkinvine Creek

Figure 16. Old Sanitary Sewer Line in Pumpkinvine Creek

3.3 Buffer Analysis

For the development of the Pumpkinvine Creek WMP, a stream buffer analysis was also performed to characterize the nature and extent of vegetative buffer zones (i.e., riparian zones) on stream and water quality conditions. As the name indicates, these zones literally serve as a buffer between activities that occur on the landscape and the water in the stream by physically catching pollutants (e.g., sediment, nutrients, bacteria) from runoff during rain events.

Buffers also serve many other functions that are important to the health of the stream. One of the functions of sufficiently intact buffers is the mitigation of stream bank erosion, which is a common contributor of sediment to streams. The roots of the vegetation help to hold the sediment in place during high flows, making the banks more stable. The vegetation also provides shade for the stream, which aids in keeping the temperatures low (and dissolved oxygen high). Dense vegetation in the riparian zone also contributes falling dead and dying vegetation into the stream channel, providing diverse habitat for aquatic life.

Conducting an analysis of buffers within an impaired watershed has become an acceptable way to assess areas in need of restoration. Insufficient riparian buffers often indicate sources of NPS pollution. These areas could simply be a place where pollutants enter the stream through runoff, or even a place where livestock enters the stream (heavy use inhibits vegetative growth) thereby allowing direct introduction of NPS pollutants.

The stream buffer analysis was conducted using GIS software and recent aerial imagery. The purpose of this analysis was to identify areas of inadequate vegetation within a 100 foot buffer of all streams. Every tributary was analyzed with the software and aerial imagery (viewed with the naked eye), to confirm insufficient buffers. The areas having insufficient riparian zones are depicted in red in Figure 17.

The buffer analysis shows several areas within the watershed lacking in riparian buffers. These areas include Pumpkinvine Creek and numerous tributaries located in both Paulding and Bartow Counties. Much of this acreage lies on grazing lands where a lack of riparian buffers when combined with cattle access can increase bank erosion, and thus sediment introduction, into the Pumpkinvine Creek system. Improving these buffers would reduce bank erosion and sedimentation issues and improve water quality within the watershed.

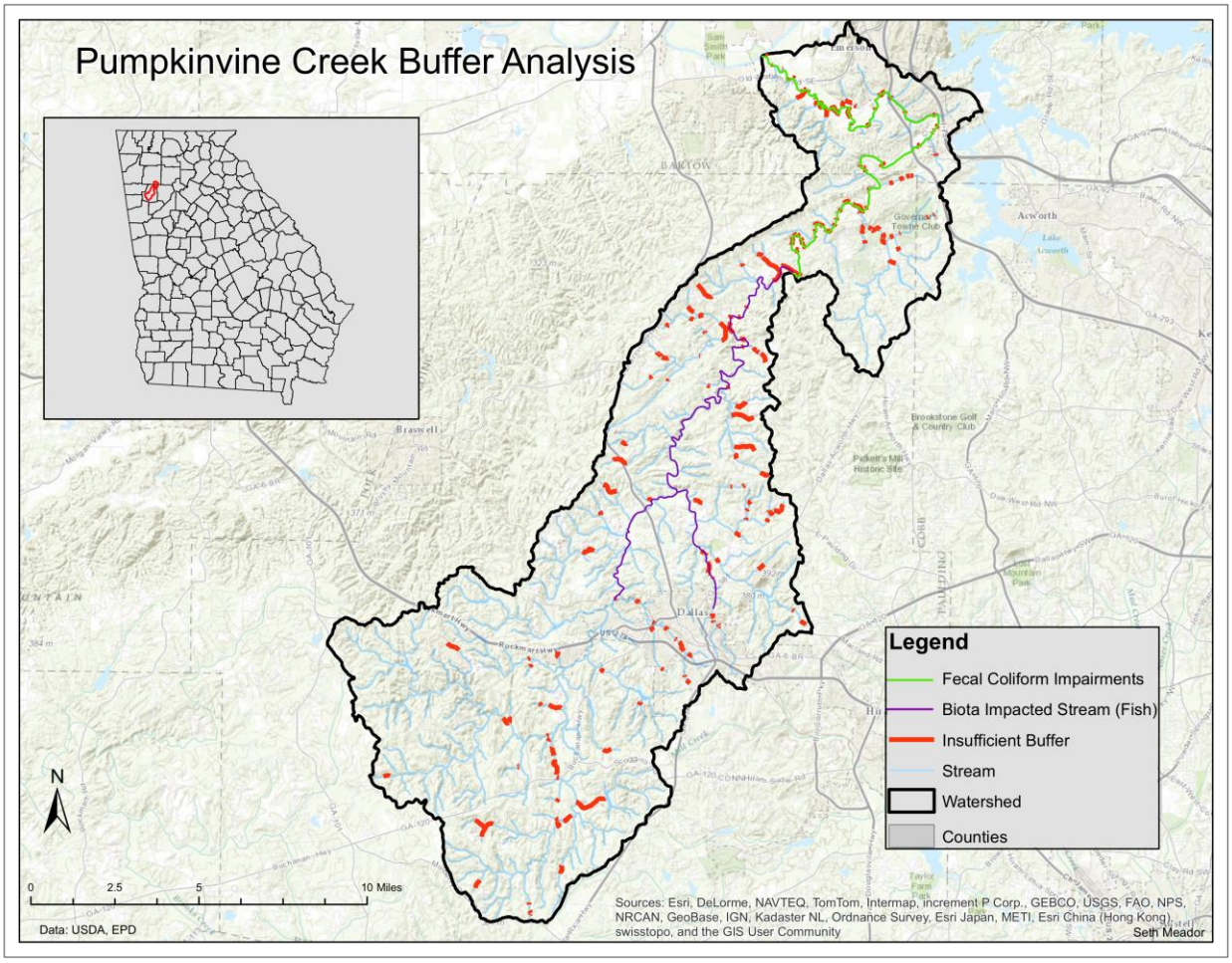

Figure 17. Buffer Analysis of the Pumpkinvine Creek Watershed

3.4 Structure Density Analysis

Additional GIS analysis was conducted to investigate the number of structures that occur within the watershed. This analysis generated the map in Figure 18. The greatest structure density is located within and near the City of Dallas and the urban sprawl associated with the City of Acworth. This data indicates the importance of collaboration not only among jurisdictions located within the Pumpkinvine Creek watershed, but also those adjacent to it that must work in partnership to identify and control pollutant sources as well as land use planning to protect buffers and greenspace to facilitate long-term sustainability of the Pumpkinvine Creek watershed.

4. Pollutant Source Assessment

The major watershed health issues in the watershed stem from excessive fecal coliform loads, and sediment from point and nonpoint sources. The quantity and type of pollutants found in a waterbody are directly related to the land uses within the watershed. See Figure 4 for a map depicting the distribution of land uses throughout the watershed. The following information was gathered through both research including information gained from the Pumpkinvine Creek Watershed Management Plan prepared by Limestone Valley Resource Conservation and Development Council, Inc.

4.1 Nonpoint Sources

Nonpoint sources encompass a wide range of pollutants distributed across the landscape and washed into our streams during rain events. These pollutant sources are sometimes difficult to identify and regulate since they are typically ubiquitous and originate from multiple land parcels with different owners. NPS pollution can also be variable over time due to grazing rotations, runoff events, and other factors. It is assumed that NPS pollution makes up a significant portion of the pollutant load in this watershed due to the scarcity of point sources permitted under the NPDES program.

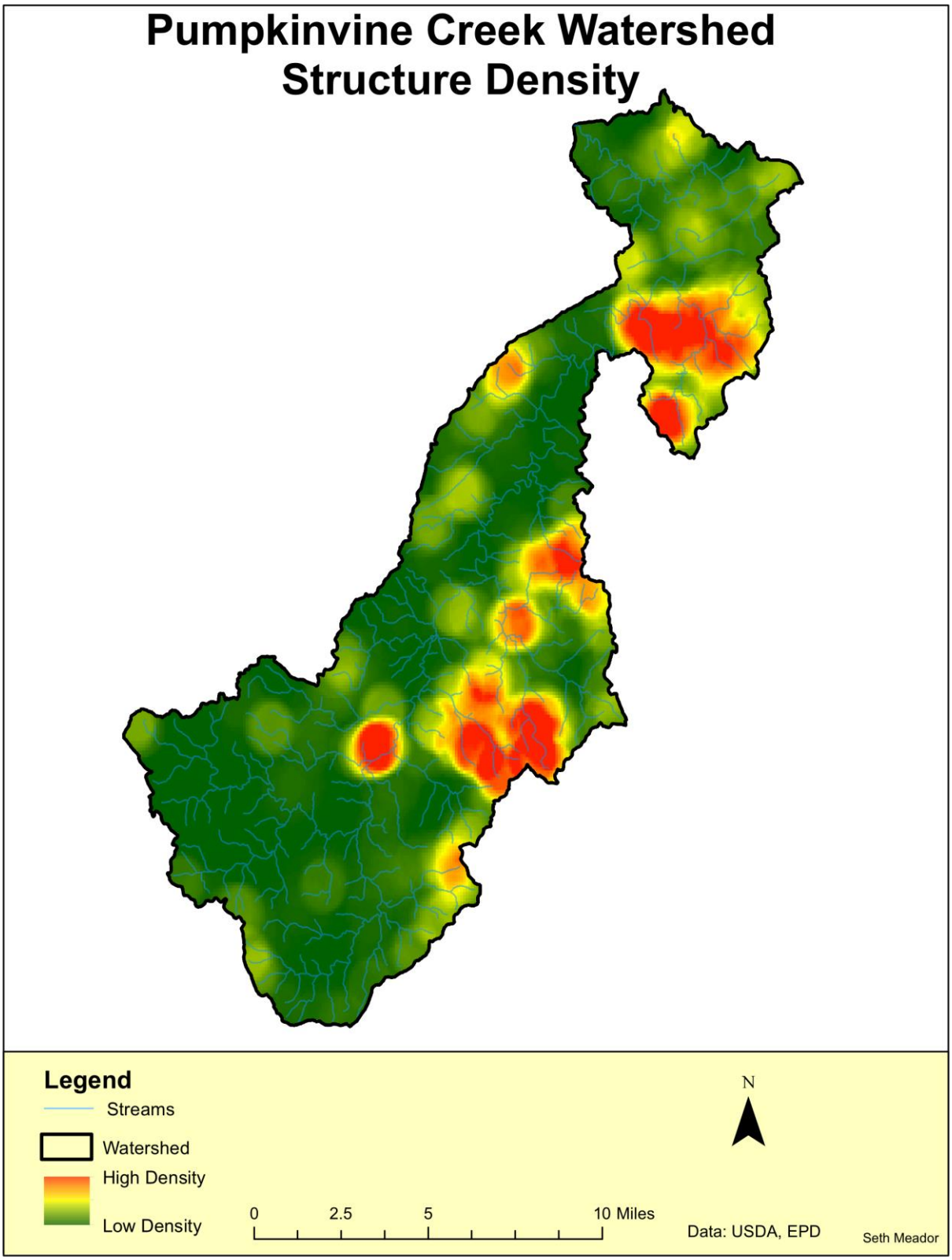

Figure 18. Structure Density Analysis of the Pumpkinvine Creek Watershed

Agriculture

Agriculture makes up a significant percentage of land use within the Pumpkinvine Creek Watershed. Activities range from livestock grazing and hay production to cultivation of crops. Some poultry operations are also located in the watershed. Agriculture, with the exception of forest, is the most dominant land use type; hence it likely plays a role in impairment issues. Thus installing agricultural best management practices would likely help reduce fecal coliform bacteria and sediment loads within the watershed. These agricultural programs could not only lead to nonpoint source pollution reduction, but will do so in a way that is already accepted in the local community, while also assisting farmers in their management operations. Croplands can also factor into sediment loading. According to the National Research Council (1989), sediment deposition into surface waters is significantly related to cropland erosion within basins. Sedimentation, in addition to impacting aquatic biota, also leads to increased retention of fecal coliform bacteria as well as serves as an additional source of the bacteria during storm events.

Livestock has the potential to be a significant contributor to non-point source pollution in the form of both fecal coliform and sediment loads. Although dairy cattle, hogs, and poultry spend a large portion of their time confined, beef cattle and horses spend the vast majority of their time in pastureland. In the pasture, the animals deposit their feces upon the land and may create erosion issues and destroy vegetative cover when overgrazed. When significant feces builds up and erosion becomes more prevalent on the landscape, fecal coliform bacteria and eroded soil become more frequently captured by storm runoff and delivered into nearby waterways.

In addition to nonpoint sources of pollution derived from the landscape, beef cattle often have access to streams that run through pastureland, giving them the opportunity to deposit feces directly into waterways. This stream access also generally contributes to the sediment load through streambank erosion, which is often significant. When cattle destroy much the vegetation in the riparian zone, the streambank may collapse into the waterway, increasing the sediment load further and leaving the bank unprotected where it happens again and again.

Poultry operations are also fairly common throughout the watershed. Depending on the number of animals present, these operations can be classified as potential nonpoint sources (< 125,000 animals) or potential point sources (> 125,000 animals; see Permitted CAFOs in 5.2) which require an NPDES permit to operate. Although there are several poultry operations within the Pumpkinvine Creek Watershed, although none are known to exceed the threshold above which NPDES permits are required. Despite this fact, these operations are still potential NPS contributors due to their production of large quantities of animal waste that is often applied to agricultural lands. According to Wang et. al. (2004), fecal coliform can survive for several months after animal waste excretion. This indicates that even aged manure could potentially be a significant contributor to the fecal coliform bacteria load when applied to the landscape.

Wildlife

Contributions of fecal coliform and sediment to streams from wildlife varies considerably depending on the animals present within the watershed. According to the Wildlife Resources Division of Georgia DNR, the animals that spend the majority of their time in and around aquatic habitats are the most important wildlife sources of fecal coliform bacteria. Waterfowl are considered to be significant contributors since they spend a large portion of their time on surface waters and deposit feces directly into the waterway. Other contributors include aquatic mammals such as beaver, muskrat, and river otters. Feral pig populations (*Sus scrofa*), known to exist along the floodplains of every major river in Georgia, have also been sighted locally. According to Kaller et. al. (2007), these animals can contribute both fecal coliform and sediment to waterways due to their numbers and behavior. Despite feral pigs and other animals that may be viewed as pests, wildlife populations are mostly naturally occurring and an indicator of the relative health of the environment. For this reason, minimization of fecal coliform contributions from wildlife will not be a major focus of the plan.

Urban/Suburban Runoff

In more urbanized areas such as Dallas, Emerson and the locations near Acworth, sediment pollution can originate from many sources. Land-disturbing activities are a consistent contributor of sediment to streams nationwide. These activities include clearing, grading, excavating, or filling of land. Disturbance of land typically removes the vegetation, which exposes the surface sediment to rain events resulting in erosion and sediment delivery into streams. For example, conversion of forests to developed land (clearing) is often associated with water quality degradation.

In more urbanized areas, stormwater runoff can also contribute to erosion issues in streams. This type of runoff originates from developed land that contains higher proportions of impervious surface cover (rooftops, parking lots, roads, etc.). These surfaces concentrate large quantities of water into the stream quickly, resulting in streambank erosion and incision.

Eventually, as banks collapse, streams tend to widen and collect additional sediment, which can lead to losses in habitat variation and increased fecal coliform retention. Additional stormwater practices and other green infrastructure may be able to reduce these issues in the Pumpkinvine Creek Watershed.

In addition to introduction of sediment into waterways, fecal coliform contributions can also occur as a result of stormwater runoff. Domestic pets and urban wildlife populations contribute waste and subsequently fecal coliform bacteria to the landscape, which is often washed directly into streams during rain events. Similar contributions in urban environments often originate from leaks and overflows from sanitary sewer systems, illicit discharges, and leaking septic systems in areas not serviced by sewer.

With an unknown number of septic systems in Paulding County and Bartow County, failing septic systems could be a contributor to the fecal coliform load in the watershed. Targeting these issues in the watershed should lead to water quality improvement, while also helping people in the community. In 2009, Bartow County Water Department partnered with the Bartow County Health Department to obtain a Section 319(h) grant to develop an inventory of septic tanks within the County. Geographical information contained in the database was used

to identify priority areas with a high septic tank inventory and fecal impaired sub-watersheds. Additional analysis was conducted to evaluate the age of the septic tanks (if known), location of nearby sources of fecal coliform (e.g., wastewater treatment plants), land use, historical water quality data, etc. Results suggested that eight sub-watersheds posed the greatest potential for a direct comparison between high density of older septic tanks and fecal-impaired stream segments. These watersheds include: Etowah River; Tanyard Creek; Euharlee Creek; Owl Creek; and Tom's Creek. Nine additional sub-watersheds, including Pumpkinvine Creek, were identified as those having both fecal impaired stream segments and sanitary sewer lines. Fifteen additional sub-watersheds were identified as potentially problematic, given there were a relatively high number of septic tanks present; however, no water quality data was available to determine if fecal bacteria were a concern in these areas.

Further evaluation of the data collected in this study suggest that septic tanks could be contributing to water quality impairments; however, it is difficult to separate their influence from other sources of bacteria (e.g., from cattle) within the watershed. This uncertainty is especially true in Euharlee Creek and Lower Two Run Creek watersheds. Other watersheds, such as Pumpkinvine Creek, contained fewer septic tanks, yet elevated bacteria have been historically problematic.

A similar septic tank study has not been initiated in Paulding County. However the County and City of Dallas require mandatory hookup to sanitary sewer for new construction (variance possible) in the Pumpkinvine, Sweet Water, Powder Creek, and Rakestraw Creek watershed. Paulding County Environmental Health also maintains septic tank locations in a database and provides educational material to all owners of new septic tanks and interested visitors to the Paulding County Environmental Health Office.

Silviculture

With approximately 70% of the Pumpkinvine Creek Watershed forested, forestry practices must have had some historical impact on the watershed in the form of erosion, siltation, and increased storm flows that generally occur after harvest. Although forestry practices presently are conducted in a way that very likely have a reduced effect on the environment, a high likelihood remains that some erosion, siltation, and increased storm flows still occur post-harvest on some parcels. Despite this being the case, these effects are generally minimized by avoidance of riparian zones and at least short-lived assuming a parcel is re-planted. In addition, much of the forest within the watershed lies on smaller plots. For these reasons, nonpoint source pollution in the watershed from harvesting timber is likely ongoing, yet relatively minor. Considering forest is the most healthy land use from a watershed standpoint, timber harvest when conducted using the industry's best management practices may be a net positive in that it at least incentivizes continuous retention of forest on private lands.

4.2 Point Sources

Industrial Sites

A GIS analysis of industrial sites within and near Pumpkinvine Creek was performed to identify potential sources of pollution to the watershed. Five permitted facilities were identified in the study: an adhesive manufacturer; two pesticide producers; a fabricated rubber manufacturer; and a wastewater treatment plant. The location of these facilities is shown in Figure 19. It is likely that more than five occur in the watershed however current data is difficult to obtain, especially because some facilities do not obtain the permits that are required. It is important to note that designation as a permitted facility does not necessarily indicate that a pollutant release has occurred; only that the potential exists that one could occur.

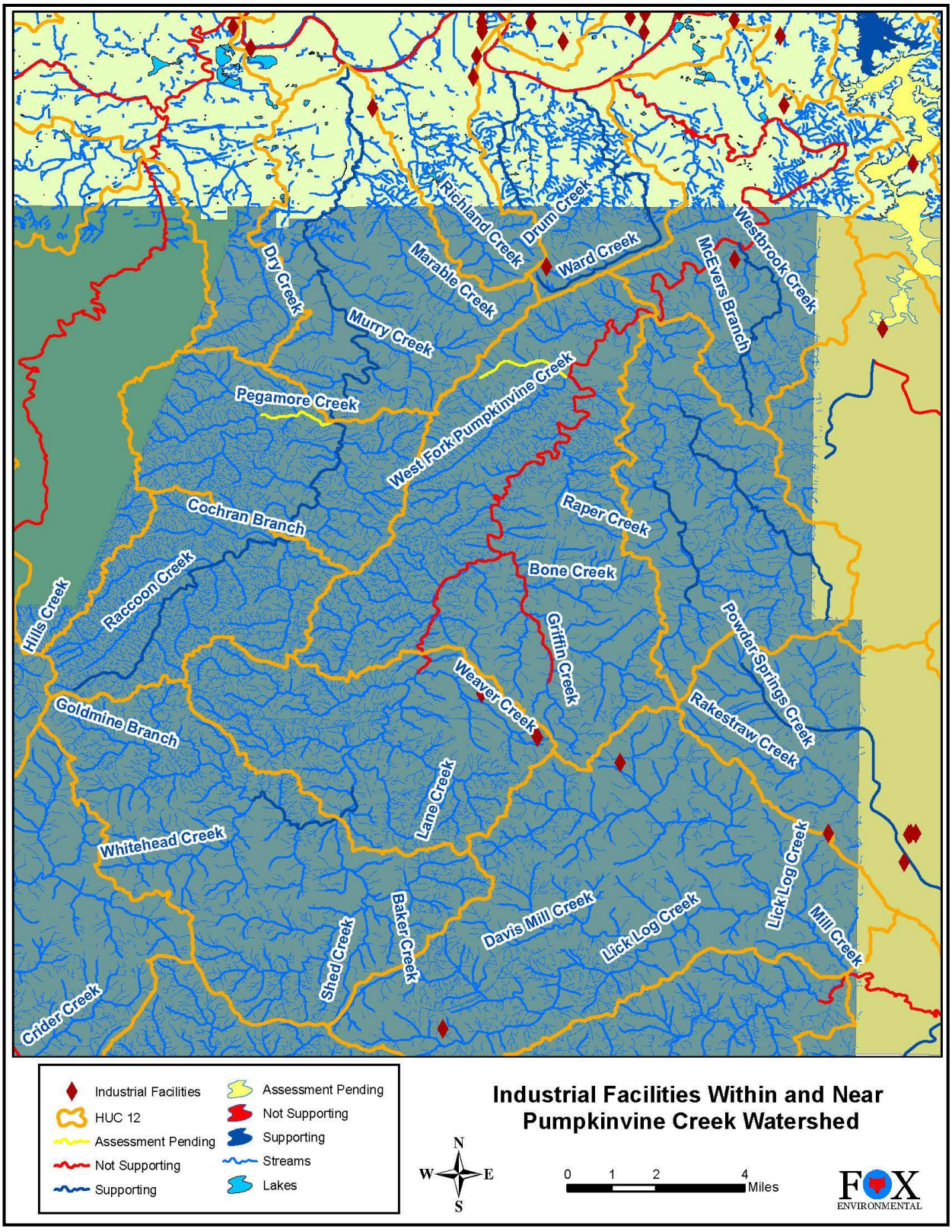

Figure 19. Permitted Facilities Located Within and Near Pumpkinvine Creek Watershed

CAFO Permits

Confined animal feeding operations (CAFOs) are considered a point source of pollution by Georgia EPD and require an NPDES permit as they reach certain capacity thresholds. Although there are many poultry operations with the Pumpkinvine Creek Watershed, none are large enough (>125,000 birds) to require an NPDES permit and therefore are characterized as point source pollution. No dairy or swine operations are present within the watershed either. Thus, no operations are present in the watershed that are large enough to require an NPDES permit. Permitted CAFOs are therefore not considered to be a source of impairment in the Pumpkinvine Creek Watershed.

5. Watershed Improvement Goals

This section of the WMP outlines the overall goals for the watershed improvement process in Pumpkinvine Creek Watershed. In addition, the minimum NPS load reduction objectives for each segment (as written in TMDLs) are included and describe the estimated necessary load reductions for streams to meet water quality criteria.

5.1 Overall Objectives

Restoration

The primary objective of this WMP is to outline a framework that will lead to the restoration of the Pumpkinvine Creek Watershed to the extent that compliance with state standards is achieved and maintained. Two segments are on Georgia's 303 (d)/305 (b) list, totaling twenty-nine miles of impairments. An important component of restoration efforts will include implementing cost-share programs that incentivize landowners to voluntarily address pollution sources on their privately-owned lands. Reductions in relevant pollutants will be tracked through water quality monitoring and potentially biotic monitoring. State-designated water quality collection and analysis protocols will be followed during periodic sampling events in an effort to de-list the stream segment impaired for high fecal coliform bacteria counts. In addition, sampling rotations by monitoring groups (from Georgia EPD) should help indicate improvements in biotic integrity as they occur within the streams of the watershed.

Education

A second important objective identified in this plan is to educate local citizens on the uniqueness of their watershed and its diverse fauna, the NPS threats present in the area, and what can be done to mitigate these issues. Education and outreach efforts are paramount if watershed goals and objectives are to be reached. Involving local communities in the watershed improvement process is a key to success, and providing an opportunity for locals to gain an understanding of the importance of watershed restoration needs to be a priority program component to supplement BMP installation efforts.

Presentations at local events would provide a means to reach a broad audience in the community. Creation of events with the sole purpose of gaining support was also suggested. Specific examples include stream cleanups, riparian tree planting events, and canoe cleanup floats down local waterways.

5.2 Load Reduction Targets

The 15 mile impaired segment of lower Pumpkinvine Creek is the result of past fecal coliform concentrations exceeding state standards. A TMDL was created for fecal coliform impairments in the Coosa River Basin that included this segment in 2004. This TMDL included an estimate of 89% of the required reduction of fecal coliform loadings likely to result in de-listing of the segment. The load reductions are to be derived from: (1) urban development (leaking septic tanks, land application systems, and landfills); and agriculture/livestock (animal grazing, animal access to streams, and application of manure to pastureland and cropland); and (3) wildlife.

The 14 mile impaired upstream segment is listed as a result of fish sampling efforts that revealed degraded fish communities. The most common cause is generally attributed to lack of fish habitat due to stream sedimentation. However, high levels of metals, ammonia, chloride, elevated temperatures, low dissolved oxygen levels and/or extreme pH levels are possible sources of toxicity and can adversely affect aquatic communities. Observations of extensive sedimentation and eroded stream banks in Pumpkinvine Creek demonstrate that sediment is responsible for the observed impacts in the watershed. The 2009 TMDL for this stream segment calls for a reduction of 56.12% reduction of sediment loading. Land use has changed significantly over time in this watershed from agriculture to residential. Sediment loading is thought to be decreasing with these changes. Management practices that may be used to help control and reduce the total allowable sediment loads at current levels include: (1) Compliance with the requirements of the NPDES permit program; (2) Implementation of GFC Best Management Practices for forestry; (3) Adoption of NRCS Conservation Practices; (4) Adherence to the Mined Land Use Plan prepared as part of the Surface Mining Permit

Application; (5) Adoption of proper unpaved road maintenance practices; (6) Implementation of Erosion and Sedimentation Control Plans for land disturbing activities; and, (7) Evaluation of the effects of increased flow due to urban runoff on stream bank erosion.

6. Pollution Reduction

This section explores management programs and strategies that exist within the Pumpkinvine Creek Watershed that are designed to reduce fecal coliform and/or sediment pollution. Many of these programs have been put in place by organizations both large and small, and most are meant to be mutually beneficial to multiple groups of people and the environment. More importantly for the purposes of this document, this section also explores a proposed program needed in the Pumpkinvine Creek Watershed in order for the previously identified restoration goals and objectives to be accomplished.

In the following sections, each program and the structural and non-structural practices they provide are discussed. Structural practices are those that are engineered, and result in a physical structure that is designed to reduce a specific type(s) of pollution. Non-structural practices are those that do not result in an engineered structure. Instead, these measures typically work to change the attitude or behavior of individuals.

6.1 Existing Conservation Programs

Existing Structural Programs and Practices

Within the Pumpkinvine Creek Watershed, several existing structural conservation programs are currently implemented (see Table 9), although none are generally unique to the area. Most programs that encourage water quality improvements are ubiquitous across Georgia, if not the nation. Only those that specifically relate to sediment and/or fecal coliform pollution reduction are displayed here. Some of these programs include non-structural components as well.

Structural Measure	Responsibility	Description	Impairment Source Addressed
Conservation Tillage Program	Rolling Hills RC&D, Coosa River SWCD	Makes conservation tillage equipment available for rent within the watershed, helping producers plant their crops with minimal disturbance to the soil. This reduces erosion from cropland, and increases water retention and nutrients.	Agriculture
Environmental Quality Incentives Program (EQIP)	NRCS	Works to address resource concerns on agricultural lands. EQIP is a cost-share program (75% typically) for landowners seeking to implement BMPs on their property.	Agriculture
Conservation Reserve Program	FSA, NRCS	Addresses problem areas on farmland through conversion of sensitive acreage to vegetative cover such as establishing vegetative buffers along waterways. Conversion costs are shared with FSA, and the landowner receives an annual payment for maintaining the conversion.	Agriculture
Septic System Permitting and Inspection Program	Health Department	Septic system repairs and installations are permitted and inspected by Paulding County, Cobb County and Bartow County Health Department Staff. This not only ensures that systems are functioning, but also that they are installed by a licensed individual according to state regulations.	Urban/ Residential

Table 9. Existing structural programs and practices in the watershed

Existing Non-structural Programs and Practices

Many programs also provide non-structural practices in the Pumpkinvine Creek Watershed (See Table 10), and again, most are not unique to the area. These practices, although not physically reducing pollution, can arguably improve water quality as much or more than structural practices themselves. Changing behaviors and/or attitudes can be contagious, making a real difference in both the cultural and natural landscape over time.

Non-Structural Measure	Responsibility	Description	Impairment Source Addressed
Georgia Water Quality Control Act (OCGA 12-5-20)	Georgia EPD	Makes it unlawful to discharge excessive pollutants into waters of the state in amounts harmful to public health, safety, or welfare, or to animals, birds, aquatic life, or the physical destruction of stream habitats.	All inclusive
Georgia Erosion and Sedimentation Act	Georgia EPD	Among other things, it prevents buffers on state waters from being mechanically altered without a permit.	All inclusive
Rules and Regulations for On-site Wastewater Management	Bartow/Paulding County Environmental Health Office	Enforcement and application of the regulations through permitting and inspection of new and repaired systems.	Suburban, Residential
Georgia Rules & Regulations of Water Quality Control for CAFOs 301 to 1,000 animal units	Georgia Department of Agriculture, Georgia EPD	Outlines the swine and non-swine Feeding Operation Permit Requirements. CAFOs in this category receive a land application system permit (LAS).	Agriculture
Conservation Technical Assistance Program	NRCS	Assists landowners with creating management plans for their lands, including but not limited to Farm and Forest Conservation Plans and Comprehensive Nutrient Management Plans (CNMPs).	Agriculture
UGA Cooperative Extension Program	Bartow/Paulding County Extension Office	Assists with general agricultural assistance, which includes providing suggestions for soil and water conservation.	Agriculture

Table 10. Existing non-structural programs in the Pumpkinvine Creek Watershed

6.2 Proposed Conservation Program for the Pumpkinvine Creek Watershed

In the Pumpkinvine Creek Watershed, the presence of impaired stream segments suggest that a collaborative program between Paulding County and Bartow County organizations (in addition to those already in existence) is likely needed to approach compliance with state water quality standards in a more expedient manner. The following proposed program, the *Pumpkinvine Creek Watershed Restoration Program* (PCWRP), would be an endeavor partially funded by Clean Water Act (§319) grants (and assisted by in-kind donations of certain stakeholders, agencies, and non-governmental organizations) that would provide cost-shares on practices that have been deemed by the stakeholder group as a means to address the water quality issues within the watershed. In addition, this program would attempt to raise awareness of the issues in the area, as well as educate citizens about potential solutions to these local problems and the importance of water quality.

<u>Proposed Structural Practices of the Pumpkinvine Creek Watershed Restoration Program</u>

It was evident in the water quality data and previous stakeholder surveys that although certain segments are listed for fecal coliform and others for impacted biota, both pollutants of concern are present in excess at times throughout much of the watershed. These data indicate the need to implement BMP installations throughout the watershed instead of only those locations in close proximity to the impaired segments themselves. In addition, as stated previously, reductions in sediment anywhere within the watershed will improve the water quality in the lower reaches of Pumpkinvine Creek. The stakeholders decided that at least some emphasis should be placed on the two potential sources of pollutants which include agriculture, livestock (primarily horses), failing septic systems, and potentially stormwater as well (streambank stabilization, etc.).

Since agricultural activity encompasses a large proportion of land use within the watershed, the PCWRP could include a cost-share program that will help local farmers afford conservation practices that reduce fecal coliform and/or sediment contributions to receiving waters. Many of these practices are also beneficial to landowners which will serve as additional motivation for participation in the program. Most of the agricultural lands within the watershed are used for grazing, so funds need to be available to assist farmers with an

interest in voluntary conservation to restrict livestock stream access and provide alternative watering sources. These practices would reduce the fecal coliform load from direct sources and agricultural runoff in the watershed. Projects that address erosion issues will likely include streambank and heavy use are stabilization.

In addition, funds are needed to establish riparian buffers where they are absent. GIS analysis indicated that a significant portion of the watershed has inadequate riparian buffers. Projects to improve riparian buffers would help reduce both fecal coliform and sediment pollution by acting as a physical barrier to runoff during rain events.

The PCWRP will also include a cost-share program to address failing septic systems, since this issue was determined by the stakeholder group to be a significant contributor to the fecal coliform bacteria load in the watershed. High failure rates are said to occur for several reasons, including poorly percolating soils in some areas, outdated systems, and the low-income financial condition of a portion of the local population. A cost-share program in the area would help to incentivize more of the population to get their systems repaired. Cost-share rates are likely to vary according to the likely contributions of the failed systems to pollutant loads, and in the cases of impoverished families, financial conditions. In addition, greater public demand for septic system repairs will likely result in lower cost-shares offered in order to assist more homeowners, as well as result in greater water quality benefit per dollar. Although higher rates will generally be offered on projects that more significantly reduce pollutant loads, inclusion of other property owners to be eligible for lower cost-share rates will maximize program participation while building important momentum within local communities.

Also of note is that several municipal wastewater treatment plants discharge to Pumpkinvine Creek or a tributary, several of whom have experienced operational challenges in the recent past. EPA's Enforcement and Compliance History On-line indicates the City of Dallas' North Plant and West Wastewater Treatment Plants were out of compliance several times in the past five years due to unpermitted releases of total suspended solids and ammonia. The City of Emerson's Wastewater Treatment Plant also has experienced violations for unpermitted releases of fecal coliform bacteria, total suspended solids, pH, and BOD. Improved operations of these facilities can be very expensive but mandatory for future delisting activities and successful restoration of the Pumpkinvine Creek Watershed.

Water quality data and the frequency of flooding in the watershed led the stakeholders to also desire an emphasis on stormwater BMPs, especially streambank stabilization, should opportunities arise. A cost-share program would incentivize private landowners to implement streambank stabilization techniques, as well as riparian restoration and practices that mitigate stormwater quantity (retention ponds, etc.).

Proposed Non-Structural Practices of the Pumpkinvine Creek Watershed Restoration Program

As previously discussed, all of the local governments responsible for management of this watershed are designated as MS4 communities. This includes the Cities of Dallas, Emerson, Cartersville as well as Paulding County, Bartow County and Cobb County. The MS4 Stormwater Management Plans developed and implemented by each jurisdiction mandate six categories of best management practices (BMPs), many of which overlap with those required by the previously discussed Watershed Protection Plans. The majority of these BMPs are non-structural practices, including: (1) public education and outreach; (2) public involvement and participation; (4) construction site runoff control; (5) post-development stormwater management for new development and redevelopment; and (6) municipal pollution prevention program (including storm sewer system inspection, maintenance and repair). Each category includes multiple required activities designed to prevent, reduce, and/or eliminate stormwater pollution to local water resources. The three counties are required to implement these activities within their urbanized areas only whereas the three cities are mandated to implement their stormwater programs throughout.

As a part of the PCWRP, an outreach plan will be developed for any and every grant that is received from the 319 program. This plan will identify annual or semi-annual events that will be held that encourage public participation in the watershed improvement process. These events could include canoe floats, stream cleanups, and the establishment of viable Adopt-A-Stream groups, among others.

In addition, the new program should include promotion of the watershed improvement process to local stakeholders to further develop and maintain program momentum. Press releases should be periodically issued to local newspapers highlighting program details, and the watershed issues it attempts to resolve. Promotions should also include local presentations to stakeholder groups. These promotions would serve to maintain community interest in the restoration effort by reminding local groups of the benefits the implementation effort is seeking to provide (e.g., reduced human health risk and water treatment costs and increased financial assistance within the community). These stakeholders should be also updated as significant progress is made toward water quality goals in order to show them that the goals of the restoration efforts are attainable.

7. Implementation Program Design

The objective of this WMP is to outline implementation efforts needed to result in the long-term goal of de-listing the vast majority impaired stream segments. This section of the WMP outlines specific restoration activities, how they relate to implementation milestones, and estimated dates of completion. In addition, costs associated with the measures needed for watershed restoration are estimated.

7.1 Management Strategies

The recommended strategy for implementation of this WMP is to create and manage a program that features both structural and non-structural controls within the watershed to address the fecal coliform and sediment issues. It is the intent of the proposed restoration program (PCWRP) to restore the watershed to the extent that impaired segments are eventually de-listed, while ensuring that additional segments are not listed. This should be accomplished by increasing the available agricultural BMP cost-share opportunities, creating a septic system repair cost-share program, assisting in the stabilization of problematic streambanks, improved WWTP operations, improving local stormwater management, making available educational opportunities to encourage public participation in the watershed improvement process, and monitoring water quality to track improvements and potentially de-list impaired segments. Septic system failures will be identified and addressed with the technical assistance provided by the Bartow and Paulding County Health District. The NRCS will assist with technical advisement with respect to agricultural projects and streambank projects. Other agencies and non-governmental organizations will make key contributions to outreach efforts, as well as other facets of the program. All participation in grant programs will be voluntary in nature, and great care should be taken to respect private property rights.

In order to de-list several stream segments through implementation of a number of small projects, it is likely that the investment of significant time and funding will be necessary. Assuming the behaviors and land management practices improve over time, the benefits of clean water can last generations. It has been estimated that approximately 25% of the

critical areas within the watershed can be treated with BMP installations to reduce NPS pollution through the implementation of multiple Clean Water Act §319 grants. The program, as outlined here, would cumulatively fund a maximum of approximately $700,000 worth of projects and at this point has been designed to be implemented over the course of thirteen years (including grant proposal submission periods). This proposed allocation of funds is similar to other restoration efforts that have been funded in the state, yet is to be focused on a smaller geographic scale, which should lead to more pronounced improvements. It is believed that both stream segments could be de-listed as a result of this effort or even before its completion, although there is also a small possibility that more funding could be necessary to accomplish that goal.

7.2 Management Priorities

Project Fund Allocation

Cost-share programs are to be developed for agricultural BMP installations, septic repairs, and stormwater and streambank stabilization projects. Stakeholders were solicited as to how to allocate the funds between these projects within the watershed. Stakeholder opinions were variable, but analysis of responses resulted in approximately 55% of the potential funds being allocated to septic system repairs, 20% to agricultural BMPs, and 25% for stormwater and streambank stabilization projects. Due to high demand for septic system repairs and unknown demand for stormwater, streambank stabilization, and riparian planting projects, we have estimated 60% of the funds to be allocated toward septic system repairs and 40% for agricultural BMPs as well as stormwater, streambank stabilization, and riparian planting projects.

Cost-Share Rates

Agricultural BMPs addressing water quality concerns should generally be cost-shared upon at a rate of 60%. This rate is such that these projects adequately assist in providing matching fund contributions that count toward grant requirements, while remaining reasonably competitive with the NRCS EQIP program, which cost-shares at 75% on estimated project costs for projects that receive funding.

Stormwater, streambank stabilization, and riparian planting projects should also be cost-shared upon at a rate of 60%. This rate again allows completed projects to adequately assist in providing matching fund contributions that count toward grant requirements. When the high costs of these practices are prohibitive, perhaps a portion of the cost-shares could be offset by donated advisement, planning, and expertise. In addition, the utilization of donated labor to assist with or complete stormwater, streambank stabilization, and riparian planting projects may contribute to cost-share obligations. On private lands, the cost-shares should incentivize landowners with considerable streambank concerns to act to improve their properties while assistance is available.

For septic system repair projects, cost-share rates should depend on the demand. If demand for repair assistance is high, cost-shares should be set at lower rates in order to accommodate as many projects as possible and achieve the greatest water quality improvement. The most ideal projects for water quality improvement will be those significantly addressing the pollutants in close proximity to streams within or just upstream of impaired reaches. However, inclusion of landowners from the entire Pumpkinvine Creek Watershed to be eligible for program cost-shares on projects that address water quality concerns is necessary to maximize program participation by building important momentum within the local community. In addition, since the problem areas are often in the downstream reaches, all areas of the Pumpkinvine Creek Watershed likely contribute to the impaired status of local stream segments, albeit to varying degrees.

Since certain septic system repair projects may address resource concerns more than others, variable cost-share rates will generally be utilized to reflect the anticipated water quality improvement. For example, a septic system within 100 feet of an impaired stream will generally receive a higher cost-share rate than one located much farther away. This method of incentivizing participation will bring about the greatest load reductions while maximizing the overall number of participants. Similarly, impoverished members of the community may be further incentivized with higher cost-share rates in order to ensure they get failing systems repaired.

7.3 Interim Milestones

To allow momentum to build in the community and ensure success, this WMP should be implemented for multiple years over several grants, each of which may have its own updated objectives and milestones according to changes in watershed conditions and/or management strategies. This section, however, seeks to outline objectives and milestones that could be used by any group (in any combination) seeking funds for restoration efforts in the watershed.

OBJECTIVE #1: Create a septic system repair cost-share program in the watershed.

MILESTONES:

- Identify local certified septic system contractors interested in participating in the program.
- Hold meetings with County Health Department representatives to design program.
- Establish initial cost-share criteria based on proximity of system to state waters.
- Hold a septic system installer's workshop to explain program details, and ensure standards for participation are understood.
- Maintain the septic repair program throughout the implementation process.

The repair process should involve the submission of bids from locally-owned businesses. These businesses should attend an installer's workshop to participate in grant projects. Bids should be requested from 3-5 contractors for each repair, and the specific businesses that receive the opportunity to bid should be determined by using a rotating list of approved contractors. The homeowner should be allowed to choose which bid to accept. The rate of cost-share should be on a sliding scale that will result in offering more assistance to projects that will likely result in the greatest load reductions.

OBJECTIVE #2: Create an agricultural BMP cost-share program in the watershed.

MILESTONES:

- Hold meetings with the NRCS to determine appropriate BMPs and cost-share rates.
- Advertise the available grant money through local media.
- Issue press releases for successful BMP installations.
- Maintain the agricultural BMP program throughout the implementation process.

Agricultural BMP installation is generally done on a voluntary basis, and landowner confidence and satisfaction the primary focus. This will allow any program to develop a positive reputation in the area, which is hoped to eventually garner more conservation interest in the watershed.

OBJECTIVE #3: Create a stormwater project and streambank restoration cost-share program in the watershed.

MILESTONES:

- Hold meetings with Bartow County, Paulding County and the Cities of Dallas, Emerson, Cartersville and Acworth stormwater experts to determine appropriate projects.
- Seek to incorporate trustee labor to cover cost-share contributions for projects in Trenton.
- Advertise the available grant money for projects on private lands through local media.
- Issue press releases for successful stormwater and streambank stabilization projects.
- Maintain the program throughout the implementation process.

Stormwater projects and streambank restoration efforts can be accomplished through voluntary efforts as well as through the use of incentives for new development and redevelopment projects. This will allow the program to garner more widespread use in the watershed.

OBJECTIVE #4: Implement BMPs to achieve load reductions specified in the TMDL.

MILESTONES:

- Identify farmers willing to cost-share on agricultural BMP projects.
- Identify property owners willing to address streambank issues and inadequate riparian zones.
- Identify homeowners within targeted subwatersheds with failing or without proper septic systems.
- Implement septic repairs and pump-outs in the watershed.
- Implement agricultural BMPs in the watershed.
- Implement stormwater and streambank BMPs in the watershed.
- Improved operations of wastewater treatment plants.
- Reduced sewer overflows caused by inadequate maintenance and repairs.
- Estimate load reductions from projects when possible.

BMPs that specifically address fecal coliform should be emphasized on agricultural lands. These include activities that restrict cattle access to the stream while providing alternative water sources, and enhancement of riparian zones that may prevent animal waste and sediment from entering the stream during runoff events. Failing septic systems and "straight-pipes" should be identified and repaired to reduce the contribution of fecal coliform originating from residential areas. Streambank stabilization projects should be sought on agricultural land, as well as in urban areas that experience heavy flows from increased impervious surface cover. Stormwater projects should be implemented in urban areas as well. Finally, a reduction in sewer overflows and improved treatment of permitted wastewater discharges are critical in this watershed, especially with respect to the Cities of Dallas and Emerson.

OBJECTIVE #5: Reduce pollution inputs from suburban and rural areas through education and outreach.

MILESTONES:

- Provide opportunities for the public to assist with stream restoration and cleanup efforts.
- Provide opportunities for the public to participate in Georgia's Adopt-A-Stream Program.
- Conduct presentations discussing watershed restoration efforts at local events.
- Submit press releases to inform the public of the restoration process and NPS pollution issues and solutions.

A key component of the education and outreach portion of implementation should be designed to raise the awareness of citizens in the area through local media and "hands-on" events. Stream cleanups, creek walks/floats, and rainbarrel workshops should be planned to be offered to interested citizens in the area throughout any implementation effort. Additional education and regulation of commercial grease traps must occur to prevent buildup of fats, oils and grease in the collection systems in both residential and commercial areas. This ensures that the general public is provided the opportunity to not only learn about the watershed, but also participate in restoration events. These events should have the ability to not only educate and empower local citizens about water quality, but also effectively provide program outreach that can lead to agricultural BMP and streambank stabilization projects, as well as septic system repairs.

OBJECTIVE #6: Document changes in water quality throughout WMP implementation.

MILESTONES:

- Submit a targeted water quality monitoring plan for each grant received.
- Monitor several sites regularly, including at locations previously sampled by Georgia EPD as well as those currently monitored by local governments.
- Conduct Pre- and Post-BMP monitoring for large agricultural BMP projects near significant streams.
- Sample to potentially de-list streams impaired for fecal coliform violations.
- Initiate WMP revisions.

Analysis of water quality and biological monitoring data collected by local jurisdictions should be performed on a regular basis to determine the average concentrations of pollutants found at various locations within the watershed. This would allow for comparisons to determine if improvements are measurable and if so, their significance. Alternately, if watershed monitoring at one or more location indicates degradation is occurring, additional measures should be taken to identify and eliminate pollutant sources to the greatest extent possible. Targeted monitoring (accompanied by a Targeted Water Quality Monitoring Plan) should occur at least once for each grant that is received.

When large agricultural BMP projects are implemented near significant streams, an effort should be made to sample for the pollutants of concern before and after project completion. This may allow inferences to be made about what projects are most beneficial, as well as build local confidence on finding solutions to water quality issues.

A SQAP should be also written for each grant that is received. This will guide efforts to sample fecal coliform according the procedure necessary to "de-list" stream segments should standards be found to have been met.

Biological monitoring will also be conducted as part of regular Georgia DNR/EPD rotations and will provide insight on whether the local biotic integrity in the impaired segments is improving as water quality improvement activities take place in the Pumpkinvine Creek watershed. Additional biotic monitoring (e.g., fish IBIs and IWBs, etc.) could be conducted to investigate whether the biotic community has improved in the impacted biota segments should funding be approved.

OBJECTIVE #7: Provide local community leaders with the knowledge to consider the effects management decisions may have on stream health in the watershed.

MILESTONES:

- Establish connections with local community leaders.
- Conduct presentations to community leaders discussing water quality issues and the solutions that BMPs can provide.
- Share water quality data and interpret the results with local community leaders for discussion purposes.

City and county personnel should be updated regularly through presentations at local meetings to keep up involvement and/or awareness during the restoration process.

IMPLEMENTATION SCHEDULE													
MILESTONE ACTIVITY	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Submit §319 Proposal to GA EPD	X		X			X			X				
Create septic cost-share program		X											
Create an agricultural BMP cost-share program		X											
Install agricultural, stormwater, and streambank BMPs		X	X	X	X	X	X	X	X	X	X	X	X
Install septic system BMPs		X	X	X	X	X	X	X	X	X	X	X	X
Establish AAS Monitoring Group			X		X		X		X		X		X
Update County Commission/press releases			X		X		X		X		X		X
Conduct education/outreach Events		X	X	X	X	X	X	X	X	X	X	X	X
Conduct WQ monitoring (targeted)		X			X			X			X		
Conduct WQ monitoring (de-listing)				X			X			X			X
Reevaluate milestones				X			X				X		
Initiate reassessment of WMP						X					X		

Table 11. Proposed Schedule of Milestone Activities in the Pumpkinvine Creek WMP.

7.4 Indicators to Measure Progress

The numbers of septic system projects, and agricultural, stormwater, streambank stabilization, and riparian planting projects completed as well as outreach event attendance should reveal progress that the implementation program is gaining momentum. Landowner participation rates can be another useful tool in determining the success of grant implementation. It is hoped that the rate will increase through subsequent years of watershed restoration due to education and outreach efforts, as well as the gradual acceptance of BMPs within the watershed. Education and outreach participation rates can be analyzed to help measure progress. It is anticipated that these rates will also increase through subsequent years as the events gain notoriety within the watershed.

Of more importance in the long run will be to measure how these projects have translated toward the goals of accomplishing the necessary load reductions and eventually de-listing the impaired segments within the watershed. For the stream segments impaired for high fecal coliform bacteria counts, tracking water quality improvements will best indicate progress toward reducing fecal contamination and eventually de-listing streams. Water quality improvements should be revealed using two water quality sampling regimes intermittently throughout the implementation process. Both types of water quality monitoring (targeted sampling and "de-listing" sampling) should be used to measure progress towards de- listing of segments impaired for exceeding fecal coliform standards.

For stream segments impaired for poor biotic diversity, progress may be more difficult to indicate. Targeted water quality monitoring may potentially reveal changes in TSS (total suspended solids) within the water column over time, but Georgia DNR/EPD will be relied upon to sample fish according to their scheduled rotations in order to determine whether biotic integrity has improved and to potentially de-list streams.

7.5 Technical Assistance and Roles of Contributing Organizations

This section will focus on the roles of various groups anticipated to contribute to make any restoration effort a success. Any organization seeking to aid in watershed restoration should rely on technical expertise from the NRCS with respect to agricultural BMP implementation, and Bartow County and Paulding County Public Health Departments with respect to septic system BMPs. The program also relies on in-kind assistance with logistics and education/outreach activities from other groups listed below (Table 12). While working towards accomplishing conservation goals, many of these activities could count towards non-federal match contributions associated with any funded 319 projects.

7.6 Estimates of Funding

As discussed in Section 6, many programs are already in place within the Pumpkinvine Creek Watershed that are designed to reduce NPS pollution. Despite the existence of these endeavors, impairments persist in the area. The estimates in this section for implementing the recommended comprehensive restoration program (PCWRP) are reliant on the 319 program as the main source of funding (in addition to key contributions from various groups as discussed above), and assume continuous consistent effort from the other programs previously mentioned in order for water quality improvements to occur.

In order to estimate the cost associated with the de-listing of impaired segments within the watershed using a comprehensive approach, an estimate of total watershed treatment was first calculated (Table 13). The Total Watershed Treatment Table is an estimate of the cost of a hypothetical instantaneous treatment for fecal coliform and sediment reduction at the Lookout Creek watershed located in Dade County, GA as calculated by the Limestone Valley RC&DC. The Lookout Creek Watershed is similar to the Pumpkinvine Creek Watershed because it also contains two impaired stream segments – one listed for fecal coliform and the second for impacts to fish biota from excess sediment. Despite this fact, it is important to estimate the

maximum restoration effort in the watershed based on actual watershed conditions and the amount of money needed to accomplish such an effort, so that lower estimates can be developed that are necessary to meet state criteria.

Many of the BMPs needed to de-list the stream were chosen based on knowledge of the area and input from stakeholders. The quantities of BMPs estimated in the Total Watershed Treatment Table were calculated using a variety of techniques. The septic system BMP needs were estimated based on information obtained from state health departments and failure statistics provided by the U.S. EPA. Agricultural BMP quantities were largely estimated through Geographic Information Systems analysis. Each tributary in the watershed was studied to determine the location of grazing lands and cropland. This information was coupled with an insufficient riparian buffer analysis to determine likely areas in need of BMPs. Many BMPs are often coupled with others, and the frequencies of these associations were calculated using conservative estimates. Streambank stabilization funding needs were estimated and stormwater and riparian planting project funds were added to this line item because they accomplish similar functions.

Efforts to begin working towards the de-listing of impaired stream segments are recommended to begin immediately with the approval of this WMP. A goal of approximately 25% of total watershed treatment has been set to be accomplished by 2027, which is believed to likely be sufficient to de-list impaired segments. In order to lay the framework to accomplish this, the recommended approach for fund requests, and collectively represents approximately 25% of the total watershed treatment costs excluding landowner contributions (see Table 14). The costs associated with these tables do not include landowner contributions to the project, and are displayed at 60% of the total cost in order to better describe federal funding needs.

Organization Roles and Responsibilities		
Organization Name	**Organization Type**	**Description of Role in Pumpkinvine Creek WMP Implementation**
Environmental Protection Agency	Federal Agency	Provide EPA Clean Water Act Section 319 funds to Georgia EPD to administer through the state 319 grant programs.
Georgia Department of Natural Resources	State Agency	Monitor sites in the watershed for fecal coliform bacteria and biota that can reveal improvements or aid de-listing efforts.
Georgia Environmental Protection Division	State Agency	Administer Clean Water Act Section 319 Grants to provide funding for this restoration program.
Coosa River Soil and Water Conservation District	State Agency	Assist with marketing for agricultural BMPs in the watershed. Potentially help identify willing landowners in the watershed that are interested in the program.
Rolling Hills RC & DC	Quasi-Governmental Organization	Lead implementation efforts including submitting grant applications, serving as grantee fulfilling reporting obligations, marketing program components, spearheading outreach efforts, managing finances, conducting monitoring, and managing projects.
Natural Resources Conservation Service	Federal Agency	Provide technical expertise for agricultural BMPs. This process will include multiple farm visits, the development of a conservation plan for the landowner, project supervision and project inspection. All projects will be installed according to NRCS specifications and standards.
Bartow County and Paulding County Public Health Departments	State Agency	Provide technical expertise for septic system repairs. This process will include assessing, planning, permitting, and inspection of installed or repaired septic system components. Help may also be provided through identification of potential septic system repair projects. Assistance may also be provided during workshop preparation if applicable.
Northwest Georgia Regional Commission	State Agency	Provide technical assistance for implementation efforts in the watershed. Serve as a vehicle to promote the Pumpkinvine Creek Restoration Project and assist in marketing its outreach efforts.
University of Georgia Cooperative Extension	State Agency	Assist in marketing efforts for program components and outreach events.
Bartow/Paulding County Commission	County Organization	Provide in-kind assistance to any grantee through donated office space, meeting space, and potentially equipment/labor for certain types of projects.

Table 12. Partnering Organizations and Roles

Agricultural BMPs (Name - Code)	Quantity	Cost/Unit	Cost Estimate
Fence - 382	684,252	$1.31/lin.ft.	$896,370
Heavy use area (pad – concrete 3'x4' pad; w/ 614 below) - 561	1,000	4.02/sqft	$4,020
Heavy use area (pad – geotextile/gravel 50' x 50') - 561	25,000	$1.50/sqft	$37,500
Pipeline - 516	46,500	$1.71/lin.ft.	$79,515
Riparian forest buffer -391	400	$256.82/ac	$102,728
Riparian herbaceous cover - 390	400	$228.50/ac	$91,400
Streambank stabilization (and stormwater and riparian planting projects)	5,000	$67.27/lin.ft.	$336,350
Water well - 642	30	$4,569.00 each	$137,070
Watering facility - 614	93	$968.12 each	$90,035
Septic System BMPs (Name - Code)	**Quantity**	**Cost/Unit**	**Cost Estimate**
Conventional system repair (5,500 homes on septic)	500	$4000 each	$2,000,000
Experimental system installation	50	$7000 each	$350,000
TOTAL WATERSHED TREATMENT COST			**$4,124,988**
TOTAL TREATMENT COST EXCLUDING LANDOWNER CONTRIBUTIONS (60%)			**$2,474,992***

Table 13. Cost Estimate of Hypothetical Watershed-wide Treatment
(*60% of Total Watershed Treatment Cost)

	Septic System Funds	Agricultural/ *Other Project Funds	TOTAL
Proposal 1 - 2015	$80,000	$55,000	$135,000
Proposal 2 - 2018	$100,000	$55,000	$155,000
Proposal 3 - 2021	$100,000	$55,000	$155,000
Proposal 4 - 2024	$115,000	$60,000	$175,000

*Includes Streambank Stabilization, Stormwater, and Riparian Projects

Table 14. Recommended Financial Requests for Four 319 Grants for Comprehensive Watershed Restoration.

7.7 Getting Started

A goal of approximately 25% watershed treatment has been set to be accomplished by 2027 through the recommended comprehensive approach (assuming funding needs are met). This treatment prescription is believed to be enough to de-list the Pumpkinvine Creek segment. Efforts to begin working towards the de-listing of impaired stream segments are recommended to begin immediately with the approval of this document by Georgia EPD and the US EPA.

8. Education and Outreach Strategy

Outreach associated with watershed restoration efforts should seek to put volunteers to work in ways that assist with cleaning up Pumpkinvine Creek, enhancing the riparian buffer, reducing non-point source pollution, and sampling water quality parameters. These events have been recommended, since they aid in raising awareness of local nonpoint source issues and lay the groundwork for implementation through the establishment of partnerships and identification of potential BMP projects. This idea is based on stakeholder opinions and Rolling Hills RC&CD's past experience with implementing 319 grant projects, which revealed that the general public is one of the most valuable sources of information with respect to identifying both general and specific sources of pollutants. With each commitment from a citizen to volunteer their time, the likelihood of successful watershed restoration increases. The following descriptions are recommended events that could be held in and adjacent to the watershed. A value could be placed on many of these events through calculating volunteer labor, supplies, or other in-kind donations. This value, with all supporting documentation, could then be reported as match to the federal funds distributed through any applicable 319 grant.

<u>Riparian Tree Plantings</u>

Riparian tree planting events with volunteers could be held on the banks of streams and creeks in the Pumpkinvine Creek Watershed. It is anticipated that trees and the tools with which to plant them would be obtained through the use of grant funds or donations from non-federal sources. The volunteers to plant the trees could be acquired through newspaper articles and word-of-mouth. The primary purpose would be to utilize volunteer labor to plant trees in an effort to increase the riparian buffer within the watershed. Another purpose of this event is to identify potential BMP

projects through personal interaction with volunteers that encourage them to assist in "spreading the word" about grant funds and opportunities. These events should include a presentation about the non-point source pollution issues that face Pumpkinvine Creek. Other educational materials on septic system repairs and maintenance, and stormwater practices (rainbarrels, raingardens) should be made available.

Rainbarrel Workshops

During past 319(h) grant implementation projects in Northwest Georgia, rainbarrel workshops have proven to be one of the more useful tools to garner public support for watershed restoration efforts. Through these past projects, the workshops not only develop a relationship with the local Coca-Cola plant that provides the barrels, but also assess the level of interest from the public. In the past, these events have generated overwhelming interest from local communities, and have attracted the most enthusiastic volunteers. Furthermore, rainbarrels are desired by a diverse array of citizens including both farmers and homeowners, which is the exact demographic that is needed to implement BMPs that address resource concerns on residential and agricultural lands.

For the purposes of conducting outreach through a 319(h) grant project, this outreach activity would have the primary objective of incentivizing rainbarrel construction and installation to reduce NPS pollution, but would also serve as the sounding board from which to advertise available BMP funds. At these events, citizens should receive specific information about cost-share funds for projects that benefit both landowners and our natural resources, information about Pumpkinvine Creek's water quality issues (with watershed map visual aids), and the opportunity to work to construct and take home a free rainbarrel to affix to the guttering system of their home. Volunteers from these events should be encouraged to participate further in identifying potential BMP sites and assisting with other outreach events. Follow-up communications should be initiated to keep these interested citizens engaged throughout the implementation process. The barrels donated from Coca Cola, the parts used to retrofit them, and the homeowners' labor and time spent constructing rainbarrels are

all values that could be calculated and compiled for matching purposes for any applicable 319 grant.

Adopt-A-Stream Workshops

These events are designed to train volunteers on how to use Adopt-A-Stream (AAS) monitoring equipment to sample water quality parameters and inform them of non-point source pollution issues. At these workshops, volunteers should be informed of the basics of water quality sampling and watershed science, as well as how to use the AAS website to enter all collected data from the stream that they choose to adopt. The hours that volunteers spend in the training workshop, along with subsequent hours of actual sampling, could be used to calculate a match value that could be reported with supporting documentation to Georgia EPD. In addition, volunteers should be given information advertising potential available cost-share funds for both agricultural projects and septic system repairs that reduce non-point source pollution. Some workshop components may be featured in events that fall under a different category (e.g., Water Quality Monitoring Canoe Float).

River's Alive Cleanup

As part of 319 planning efforts in the watershed, a partnership has been formed with Rolling Hills RC&D, UGA Cooperative Extension, as well as Keep Bartow Beautiful and Keep Paulding Beautiful to host a river cleanup. It is planned that this cleanup event will occur annually, and (since many volunteers are from the watershed) could be continuously used as sounding board for advertising available BMP project funds while providing opportunities for NPS education. Volunteer labor and donated material values from sites within and near the Pumpkinvine Creek Watershed could be recorded and reported for matching purposes.

Recycling Events

Both Keep Paulding Beautiful and Keep Bartow Beautiful have active recycling programs. Local residents are invited to recycle all types of materials including: tires; electronics; paint; paper; and more. The Lake Allatoona Junk Dump is held annually and encourages the low-income community that lives near the lake to pick up excess trash and household debris to the landfill at no cost. Continuation of these and other activities are critical to public understanding of the importance of protecting local streams and lakes.

Water Quality Monitoring and Stream Cleanup Canoe Floats

These events should be designed to attract members of the local community to volunteer to clean up our local waterways from a canoe and/or sample water quality during a training session on how to use Adopt-A-Stream equipment for water quality sampling. These volunteers could paddle while picking up all accessible trash within the stream and on the banks, and/or sample water quality at several sites, while learning about the importance of varying water quality parameters, agricultural and residential runoff issues and how they pertain to Pumpkinvine Creek. Maps and handouts should be distributed at stops along the way to discuss pollution sources, BMPs, and steps they can take on their own property to reduce pollution. In addition, local aquatic fauna should be a topic of discussion in order to convey what could be at stake should pollution problems continue. Volunteer labor and donated material values will be recorded and reported as matching funds for any applicable 319 grant.

9. Summary of Nine Key Elements

The following is a summary of the Nine Elements addressed in the Pumpkinvine Creek Watershed as identified in the Watershed Management Plan (WMP).

1. Identify causes and sources of pollution.

The Pumpkinvine Creek Watershed has streams that fail to meet the criteria within the State of Georgia for pathogens and impacted biota, which respectively result from fecal contamination and excessive sediment loads. Load reductions of these pollutants are necessary in two stream segments, so the WMP focuses on fecal coliform bacteria and sediment as the nonpoint source (NPS) pollutants of concern and identifies several consistent sources for 9.these pollutants (discussed in detail in Section 4), each of which relates to land use. This WMP identifies agricultural lands for targeting load reductions of both fecal coliform bacteria and sediment pollution through the installation of Best Management Practices (BMPs; e.g., controlling livestock access to water sources, installing alternative watering sources, protecting heavy use areas, etc.). In addition, residences will be targeted for septic system repairs to reduce the contributions of fecal coliform bacteria from failing septic systems. Streambank stabilization and stormwater projects will be completed on agricultural and/or urban land when feasible.

2. Estimate pollutant loading into the watershed and the expected load reductions.

The load reductions recommended in Total Maximum Daily Load (TMDL) documents are featured in Section 5. Management measures that will be implemented to achieve load reductions include agricultural projects, stormwater and streambank stabilization projects, and septic system repairs. Agricultural BMPs will vary according to the interests of the farmers, and it is difficult to predict the frequency that each practice will be used during implementation, as well as where projects will be located, the current onsite conditions, and the significance of the NPS pollution at each site to

be ameliorated. Septic system repairs will also be conducted as part of the WMP implementation process, especially in close proximity to blueline streams. However, the type of repairs, the proximity to streams, and the contributions to instream fecal coliform counts may vary for each septic repair project. Complicating matters further, conditions within the watershed will change over time. Due to the complexity involved in predicting the load reductions from the broad management measures provided below, the WMP instead seeks to focus on the completion of multiple projects and intermittently evaluating where the watershed is within the restoration process. Eventually, the management measures implemented should result in restoration to the extent that the necessary load reductions will be met and the impaired segments will be able to remain delisted.

3. Describe management measures that will achieve load reductions and targeted critical areas.

A number of management measures including both structural and non-structural practices have already accomplished and will continue to accomplish various objectives. These practices are highlighted within Section 6. WMP implementation will also aim to execute additional structural controls to include some combination of the agricultural practices, streambank stabilization efforts, and a number of septic system repairs directed toward NPS load reductions (discussed in Chapters 6 and 7). The management measures should be implemented across several grants with each involving monitoring to gain updates on current watershed conditions and completing projects potentially according to changing priorities. In conjunction with these efforts, we recommend implementing non-structural controls geared towards promoting watershed improvements with educational involvement within the community (also described in Chapters 6 and 7).

4. Estimate amounts of technical and financial assistance and the relevant authorities needed to implement the plan.

The groups responsible for each existing and new management measure are described within Section 7 of the WMP. Estimates of funding needs are indicated only for activities conducted exclusively for WMP implementation. In order to come up with an estimate, an estimate was made of the extent of work within the watershed potentially needed for complete watershed treatment. Next, the extent of that treatment that would likely result in the de-listing of impaired streams was estimated. It was assumed that completion of approximately 25% of total watershed treatment would suffice to meet this objective, and each series of projects and monitoring events may allow for a better estimate. The process used to estimate the financial resources utilized is described in greater detailed in Section 7, and was chosen due to the complexities of implementing load reductions "on the ground" through voluntary conservation practices. The anticipated sources of funding to achieve restoration goals are several Environmental Protection Agency (EPA) Section 319 grants administered by the Georgia Environmental Protection Division (EPD), in conjunction with in-kind services from Bartow/Paulding County, Northwest Georgia Health District, and volunteers from across the region.

5. Develop and information/education component.

Public education and outreach recommendations are identified in Section 8. The more successful programs should remain standard practices for the duration of the implementation process. The recommended educational programs focus on water quality monitoring, septic system maintenance, and stream cleanups, among others. Additional programs should be designed and implemented as necessary for successful implementation.

6. Develop a project schedule.

The proposed implementation schedule is found in Section 7 and initially estimates implementation activities to occur through 2026. This includes water quality monitoring and implementation activities (e.g., agricultural BMPs, and septic system repairs), in addition to education and outreach. Each of these activities will continue through each grant implementation period, although priorities may be reevaluated and subsequently altered with each grant period. Currently, it is anticipated that four grant implementation periods may allow for the goals of the WMP to be accomplished.

7. Describe the interim, measurable milestones.

A number of goals and objectives are recommended as interim milestones proposed to implement the management measures of this watershed improvement plan. These are included in Section 7. The initial goals of the WMP include developing a septic system cost-share program, building momentum toward implementation of agricultural management practices, completing septic, stormwater, streambank stabilization, and agricultural projects that reduce pollutant loads, carrying out educational activities, and monitoring to observe where extra focus is necessary and maintain that load reductions are occurring as a result of implementation. Over the course of implementation, each grant will include interim milestones with more finite objectives for each of the overall goals (i.e., number of agricultural and septic projects, number of newspaper articles, number of Adopt-A-Stream (AAS) programs initiated, multiple years of water quality monitoring data, etc.).

8. Identify indicators to measure progress.

Several sources of the pollutants of concern will be addressed by WMP implementation. Water quality data collection is ongoing to determine priorities and current conditions and will continue intermittently to indicate how projects on the landscape are translating into water quality changes. Yet, it may be a few years

before enough projects are completed in each subwatershed to significantly affect water quality. Therefore, throughout the implementation process, project types and locations will be documented to get an idea of the extent of water quality improvements as projects become more prevalent within each subwatershed and the Pumpkinvine Creek Watershed. This will allow management measures to be adapted to effectively address concerns that may arise with improvements in the implementation strategy. In the interim, continued monitoring of water quality and determination of the success of completed projects is necessary to determine if revisions are needed. At the least, revisions should be submitted in an addendum to this document in 2019 to evaluate successes and adaptations to the initial management measures recommended in this WMP. Section 7 includes how progress will be indicated and considers documenting the details of each project, load reductions per project when applicable, increased public interest, and changes in water quality that indicate progress toward the overall goal of de-listing impaired segments within the watershed.

9. Develop a monitoring component.

In Section 7, the WMP recommends that two different monitoring protocols continue to be conducted within the watershed as the new management measures (and the ongoing programs discussed in Section 6 are implemented. One type of monitoring is identified as "Targeted Monitoring", and involves sampling at specific sites in both wet and dry periods to help establish baseline conditions and monitor for improvements. Some of this monitoring is currently on-going by Bartow and Paulding County governments as conditions of each jurisdiction's WWTP permit requirements. The second type of monitoring is for "de-listing" purposes, and follows a strict procedure (regardless of weather) in an attempt to show that restoration has been achieved.

Glossary of Acronyms

AAS - Adopt-A-Streams
BMP - Best Management Practice
CNMP - Comprehensive Nutrient Management Plan
DNR - Department of Natural Resources
EPA - Environmental Protection Agency
EPD - Environmental Protection Division
GIS - Geographic Information Systems IBI - Index of Biotic Integrity
IWB - Index of Well Being
PCWRP – Pumpkinvine Creek Watershed Restoration Program NPS - Nonpoint Source
NRCS - Natural Resource Conservation Service
RC&D - Resource Conservation and Development Council
SQAP - Sampling and Quality Assurance Plan
TMDL - Total Maximum Daily Loads WMP - Watershed Management Plan

List of References

Georgia Department of Natural Resources. 2013. Known occurrences of special concern plants, animals and natural communities Chickamauga Creek 12 Watershed — HUC10 Watershed Code: 0602000112. http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/text/html/huc10_eos/chickamauga creek 12.html

Georgia Department of Natural Resources: Environmental Protection Division. 2004. Total Maximum Daily Load Evaluation for Nineteen Stream Segments in the Tennessee River Basin for Fecal Coliform.

Georgia Department of Natural Resources: Environmental Protection Division. 2009. Total Maximum Daily Load Evaluation for Sixteen Stream Segments in the Tennessee River Basin for
Sediment (Biota Impacted).

Georgia Department of Natural Resources: Environmental Protection Division: Georgia Adopt-A-Stream. 2009. Bacterial Monitoring.

Kaller, M. D., J. D. Hudson, E. C. Achberger, and W. E.Kelso. 2007. Feral hog research in western Louisiana: expanding populations and unforeseen consequences. Human-Wildlife Conflicts 1(2):168– 177.

National Research Council. 1989. Alternative Agriculture. National Academy Press, Washington, D.C.

U.S. Department of Agriculture: Soil Conservation Service. 1993. Soil Survey of Catoosa County, Georgia. National Cooperative Soil Survey, Lincoln, Nebraska.

Wang, L., K. R. Mankin, and G. L. Marchin. 2004. Survival of Fecal Bacteria in Dairy Cow Manure. Transactions of the American Society of Agricultural Engineers, 47(4): 1239−1246.