Draft Watershed Management Plan for East Fork Trail Creek

Athens-Clarke County

April 2018

Prepared For:

Athens-Clarke County
Transportation and Public Works
120 W Dougherty Street
Athens, GA 30601

Prepared By:

Tetra Tech
1899 Powers Ferry Rd SE
Suite 400
Atlanta, GA 30339

ARCADIS
2410 Paces Ferry Rd SE
Suite 400
Atlanta, GA 30339

TETRA TECH

ARCADIS

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Executive Summary

The objective of this watershed management plan (WMP) is to provide ACC with a guidance document that characterizes the East Fork Trail Creek watershed and provides recommendations for structural and programmatic BMPs that can be implemented to reduce nonpoint source pollution and improve the overall health of the watershed. This WMP is the result of a collaborative effort between Tetra Tech, ARCADIS, and ACC, and incorporates the United States Environmental Protection Agency's (EPA's) Nine Key Elements for WMPs that guide watershed management efforts throughout the country. A watershed characterization was conducted as part of this WMP to document current conditions and watershed impairments through a review of existing information, including watershed models, geographical information system (GIS) data, water quality data, and previous reports and studies. A comprehensive analysis of potential site-specific and watershed-wide management improvement opportunities based on watershed needs has identified structural and programmatic BMPs that are recommended for implementation.

The East Fork Trail Creek watershed is located in eastern ACC and is contained entirely within ACC. The study area is 5.2 square miles. East Fork Trail Creek joins West Fork Trail Creek to form Trail Creek, which flows into the North Oconee River. The confluence of Trail Creek with the North Oconee River is the most downstream point of the study area. The North Oconee River then joins the Middle Oconee River to form the Oconee River. Land cover in the study area primarily consists of forest, developed land, and pastureland/cropland, with about 14 percent impervious cover. Apart from small patches of various wetlands along East Fork Trail Creek identified by the National Wetland Inventory (NWI) Map, no other environmentally sensitive areas were identified.

East Fork Trail Creek and Trail Creek are on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams, as not supporting their designated use of fishing due to fecal coliform bacteria (FC). The impaired reaches include East Fork Trail Creek, from its headwaters to West Fork Trail Creek, and Trail Creek from the confluence of the East and West Forks downstream to the North Oconee River. A Total Maximum Daily Load (TMDL) covering the entire Trail Creek watershed was completed for FC in 2007. The TMDL requires a 61 percent reduction in FC loads for East Fork Trail Creek, a 75 percent reduction in FC loads for Trail Creek, and a 40 percent FC load reduction in West Fork Trail Creek. Urban runoff is identified as the cause of impairment in all three streams.

There are several point sources in the study area, but none of these facilities discharge to water bodies. Potential nonpoint sources of pollution in the East Fork Trail Creek watershed include stormwater runoff from ACC's municipal separate storm sewer system (MS4) as well as runoff from forested and agricultural lands. Results of the water quality sampling effort suggest that surface waters in the study area are generally in compliance with the DO, pH, and temperature standards adopted by the State of Georgia, with few exceptions. Average total phosphorous (TP), total nitrogen (TN), TSS, and conductivity results meet the ACC's benchmarks. FC bacteria data indicate that East Fork Trail Creek does not comply with the May-through-October standard.

Based on information obtained in the watershed characterization, FC bacteria and hydrology were identified as watershed-wide management needs. Wetland preservation is a management need for a small portion of East Fork Trail Creek and its tributaries. Buffer enhancement is a management need for the upper portion of the East Fork Trail Creek watershed.

A desktop GIS analysis and field assessment was conducted to identify potential watershed improvement opportunities. Structural projects, including stormwater control best management practices (BMPs) and restoration BMPs were evaluated and prioritized. Six site-specific management measures are recommended for implementation in the East Fork Trail Creek watershed, including one restoration BMP and five stormwater control BMPs (Table ES-1). Concept plans and cost estimates were developed for the recommended projects. Programmatic measures that can be implemented watershed-wide are also recommended.

Table ES-1. Recommended Site-Specific Management Measures

BMP ID	Project Name
EFT-Res-01	Dudley Park Stream Buffer Restoration
EFT-Str-01	Stroud Elementary Detention Pond Retrofit
EFT-Str-02	Athens Housing Authority – Bonnie Lane Detention
EFT-Str-03	Athens Housing Authority – Vine Circle Bioretention
EFT-Str-04	Athens Housing Authority – Vine Circle Detention
EFT-Str-05	Solid Waste Management Complex Stormwater Retrofit and Trash Barrier

This WMP includes an implementation schedule with suggested annual activities, activities that can be taken every 3-5 years, and long-term efforts spanning 5-10 years. As changes occur in the watershed and additional data become available, however, watershed management needs and management opportunities might change. Therefore, this WMP should be revisited regularly and revised as needed to ensure that the watershed continues to be managed effectively into the future.

1 Introduction

1.1 Background

Since 2010, Tetra Tech and ARCADIS, in partnership with Athens-Clarke County (ACC), Georgia, have produced several guidance documents to assess and improve the health of ACC's rivers and streams in support of the Countywide Watershed Improvement Program. The work completed through this partnership has led to development of an analytical process that informs the monitoring and characterization of watershed conditions. This includes the establishment of goals, objectives, indicators, and benchmarks for evaluating management needs and measuring success; and the identification and prioritization of management opportunities, including the use of hydrologic and water quality models to assess structural best management practices (BMPs).

Prior to this effort, the Tetra Tech-ARCADIS-ACC team created watershed management documents for Big Creek, Brooklyn Creek, Carr Creek, Cedar Creek, Hunnicutt Creek, McNutt Creek, Shoal Creek, Tanyard Creek, and Trail Creek in accordance with the overarching goals of the Watershed Improvement Program. In 2016, the team proceeded with development of watershed management plans (WMPs) for nine more watersheds: Bear Creek, East Fork Trail Creek, Malcolm Branch, Middle Oconee River, North Oconee River, Sandy Creek, Sulphur Springs Branch, Turkey Creek, and Walton Creek.

1.2 WMP Objectives

The objective of this WMP is to provide ACC with a guidance document that characterizes the East Fork Trail Creek watershed and provides recommendations for structural and programmatic BMPs that can be implemented to reduce nonpoint source pollution and improve the overall health of the watershed. The methodology used by the Tetra Tech-Arcadis-ACC team to identify appropriate management measures to accomplish this objective are discussed throughout the following sections.

The East Fork Trail Creek WMP incorporates the United States Environmental Protection Agency's (EPA's) Nine Key Elements for WMPs. Following are the nine key elements:

1. Identifying sources contributing to nonpoint source pollution.
2. Estimating expected load reductions.
3. Describing nonpoint source management measures.
4. Estimating implementation costs.
5. Educating the public to engage public support.
6. Developing an implementation schedule.
7. Describing interim milestones.
8. Implementing adaptive management measures to gauge success.
9. Monitoring the effectiveness of implementation efforts.

1.3 Stakeholders

Many departments and entities are stakeholders in ACC's watershed management activities. Following are the key stakeholders:

- ACC Central Services
- ACC Leisure Services
- ACC Mayor and Commission
- ACC Planning
- ACC Public Utilities
- ACC Transportation and Public Works Department Stormwater Management Program
- Georgia Department of Environmental Protection (GaEPD)
- The Public (Businesses, Residents, and other Members of the Community)

The ACC Transportation and Public Works Department Stormwater Management Program coordinates closely on watershed management efforts with other ACC departments, including Public Utilities, Planning, Central Services, and Leisure Services.

To meet National Pollutant Discharge Elimination System (NPDES) permit requirements, the Public Utilities Department has conducted watershed assessments in all of the county's watersheds and developed a watershed protection plan (WPP) in 2009 (JJG 2009). This WMP builds on and supplements information provided in the WPP. The Leisure Services Department manages all of ACC's park properties. These parks compose a large area of land that is owned and managed by ACC and are, therefore, high-priority areas for implementing watershed improvement projects. Interdepartmental meetings are held with these departments, the Planning Department, and the Central Services Department to promote communication and coordination between departments on large projects in order to meet the overall needs of ACC.

2 Watershed Characterization

This watershed characterization describes existing conditions in the East Fork Trail Creek watershed in ACC. Geographical information system (GIS) data, along with information from previous studies and monitoring efforts, were reviewed and assessed in order to understand the nature and condition of the watershed. A watershed model was also used to characterize nutrient and total suspended solids (TSS) loads. The following sections include information on watershed location and water resources, land cover, ecoregion, environmentally sensitive areas, potential sources of pollution, stream walk assessments, water quality, and nutrient and TSS loading. Key information is provided in the narrative and depicted in figures and summary tables. Additional details, including stream walk assessment notes and data tables and water quality data, are provided in the appendices.

2.1 Location and Water Resources

East Fork Trail Creek joins West Fork Trail Creek to form Trail Creek, which flows into the North Oconee River. The North Oconee River joins the Middle Oconee River to form the Oconee River. The Oconee River then joins the Ocmulgee River to form the Altamaha River, which flows to the Atlantic Ocean. The study area portion of the East Fork Trail Creek watershed is part of the Trail Creek-North Oconee River Hydrologic Unit Code 12 (HUC 12) watershed (30701010505).

East Fork Trail Creek is located in eastern ACC and is contained entirely within ACC. The watershed is roughly bounded by Spring Valley Road, Pittard Road, Hull Road, and Oak Street. The farthest downstream point of this study area is the confluence of Trail Creek with the North Oconee River. The study area is 5.2 square miles. The location of the watershed within ACC is shown in Figure 2-1 and a detailed map of the study area is shown in Figure 2-2.

East Fork Trail Creek and Trail Creek are on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams, as not supporting their designated use of fishing due to fecal coliform bacteria (FC). The impaired reaches include East Fork Trail Creek, from its headwaters to West Fork Trail Creek, and Trail Creek from the confluence of the East and West Forks downstream to the North Oconee River (Figure 2-2). West Fork Trail Creek, which is outside of the study area, is also impaired for FC. Urban runoff is identified as the cause of impairment in all three streams.

A Total Maximum Daily Load (TMDL) covering the entire Trail Creek watershed was completed for FC in 2007. The TMDL requires a 61 percent reduction in FC loads for East Fork Trail Creek, a 75 percent reduction in FC loads for Trail Creek, and a 40 percent FC load reduction in West Fork Trail Creek. The 2007 TMDL for fecal coliform recommends the following management practices to achieve instream fecal coliform source loads:

- Compliance with National Pollution Discharge Elimination System (NPDES) permit limits and requirements;
- Adoption of Natural Resource Conservation Service (NRCS) conservation practices; and

- Application of best management practices (BMPs) appropriate to agricultural or urban land uses, where applicable.

There are no United States Geological Survey stream gages in the watershed study area. There also are no groundwater recharge areas in the watershed study area, according to the map of the Most Significant Groundwater Recharge Areas of Georgia (GaEPD 1982).

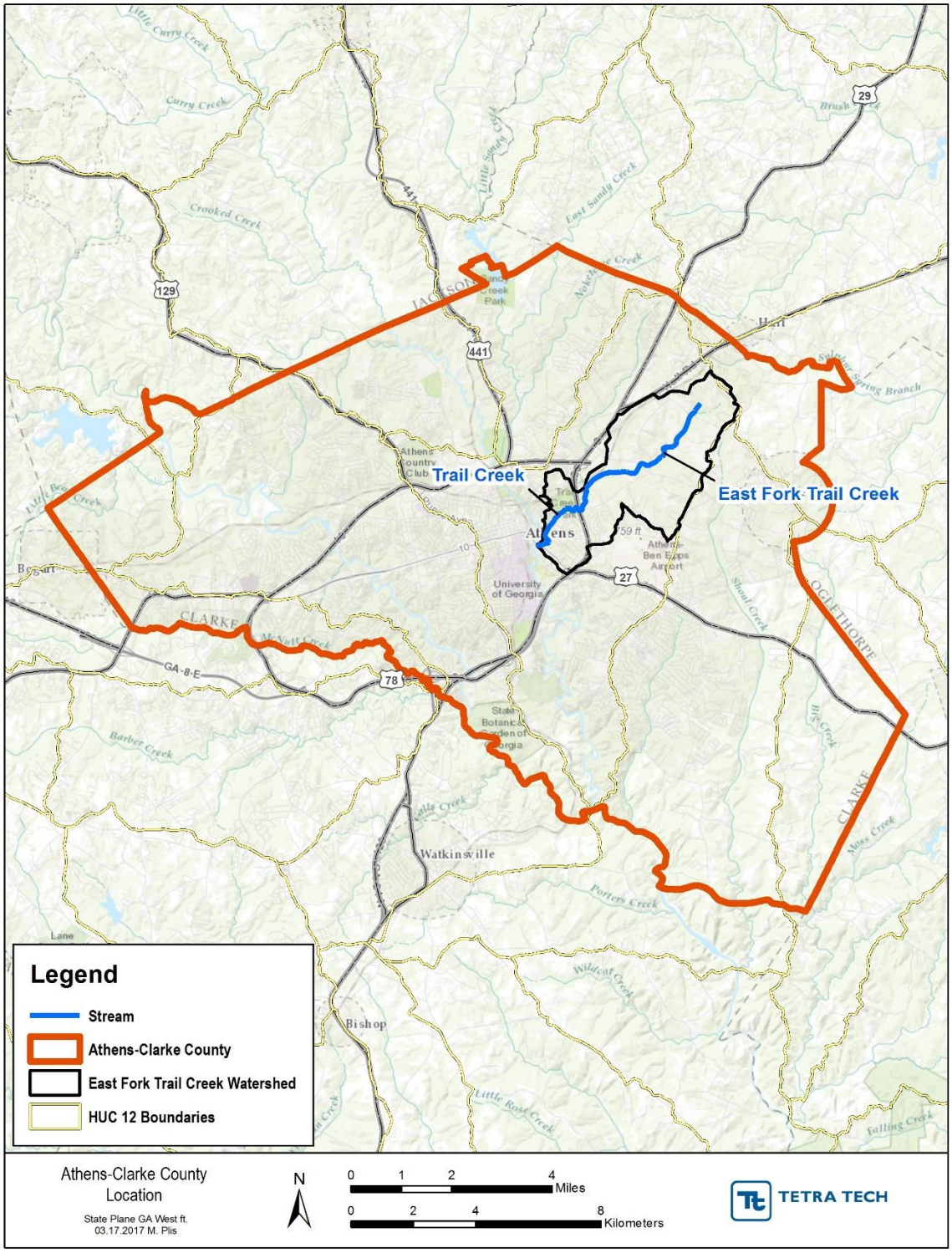

Figure 2-1. East Fork Trail Creek Watershed Location

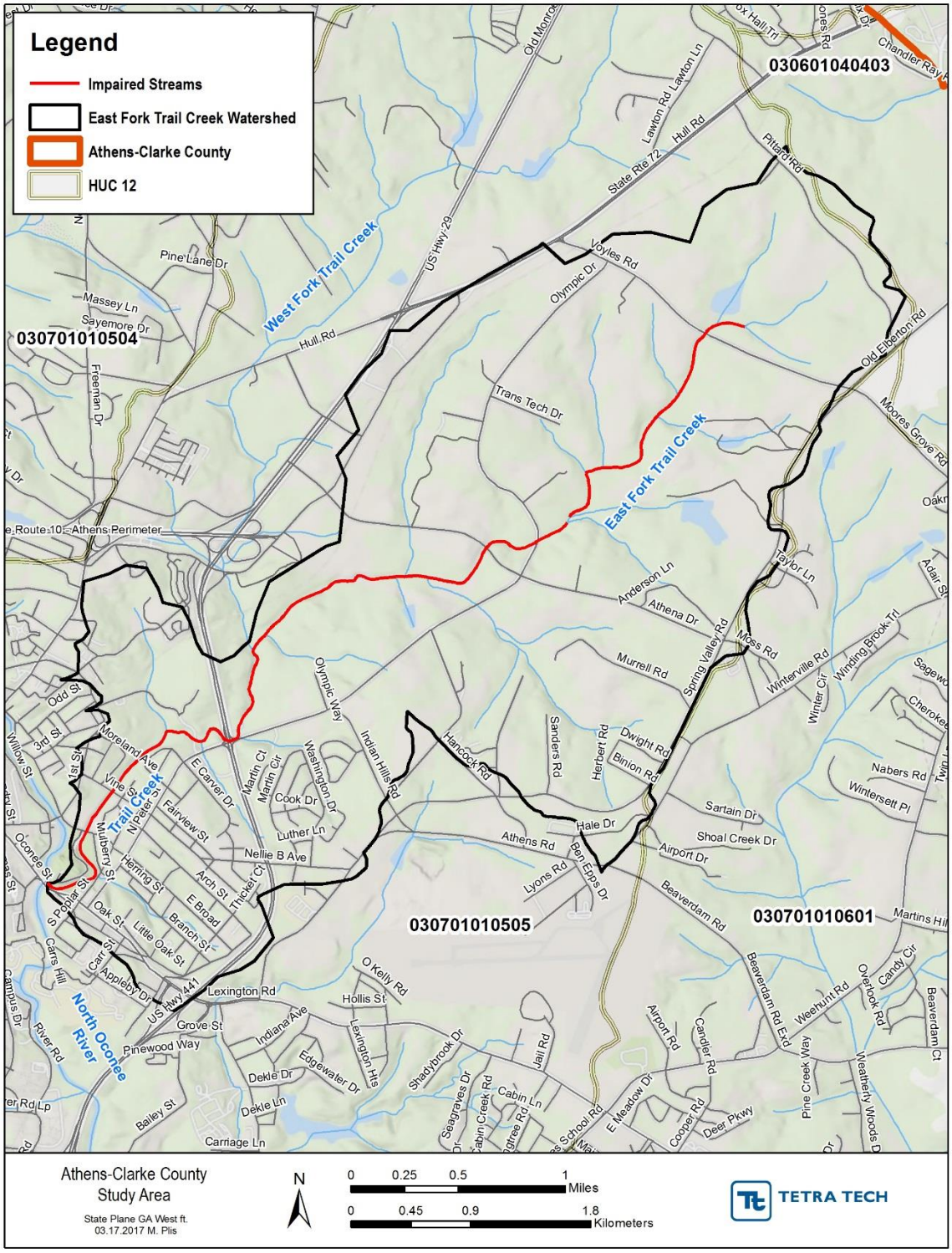

Figure 2-2. East Fork Trail Creek Watershed Study Area

2.2 Land Cover

The land cover in the study area consists of approximately 34 percent forest, 32 percent developed land, 18 percent pastureland/cropland, and 5 percent wetland, and the remainder is comprised of other land covers. Land cover information for the watershed was obtained from the 2011 National Land Cover Database (NLCD) as shown in Figure 2-3. This NLCD coverage has a spatial resolution of 30 meters. The percent breakdown by land cover in the study area portion of the watershed is shown in Table 2-1.

Table 2-1. Athens-Clarke County East Fork Trail Creek Watershed 2011 NLCD Land Cover

NLCD Land Cover	% Land Cover
Open Water	0.9%
Developed	32.0%
Barren	0.3%
Forest	33.5%
Shrub/Scrub	1.5%
Herbaceous	10.9%
Pasture/Crop	17.5%
Wetland	3.5%

There are 17.7 miles of streams in the study area. Based on the 2011 NLCD land use and land cover data, 1.7 miles of streams (approximately 9 percent) are directly connected to cropland or pasture land.

The study area is about 14 percent impervious, with the largest amount of impervious area located along Hull Road and U.S. 29 on the northern edge of the watershed. Impervious cover is shown in Figure 2-4 and is based on the 2011 NLCD impervious coverage.

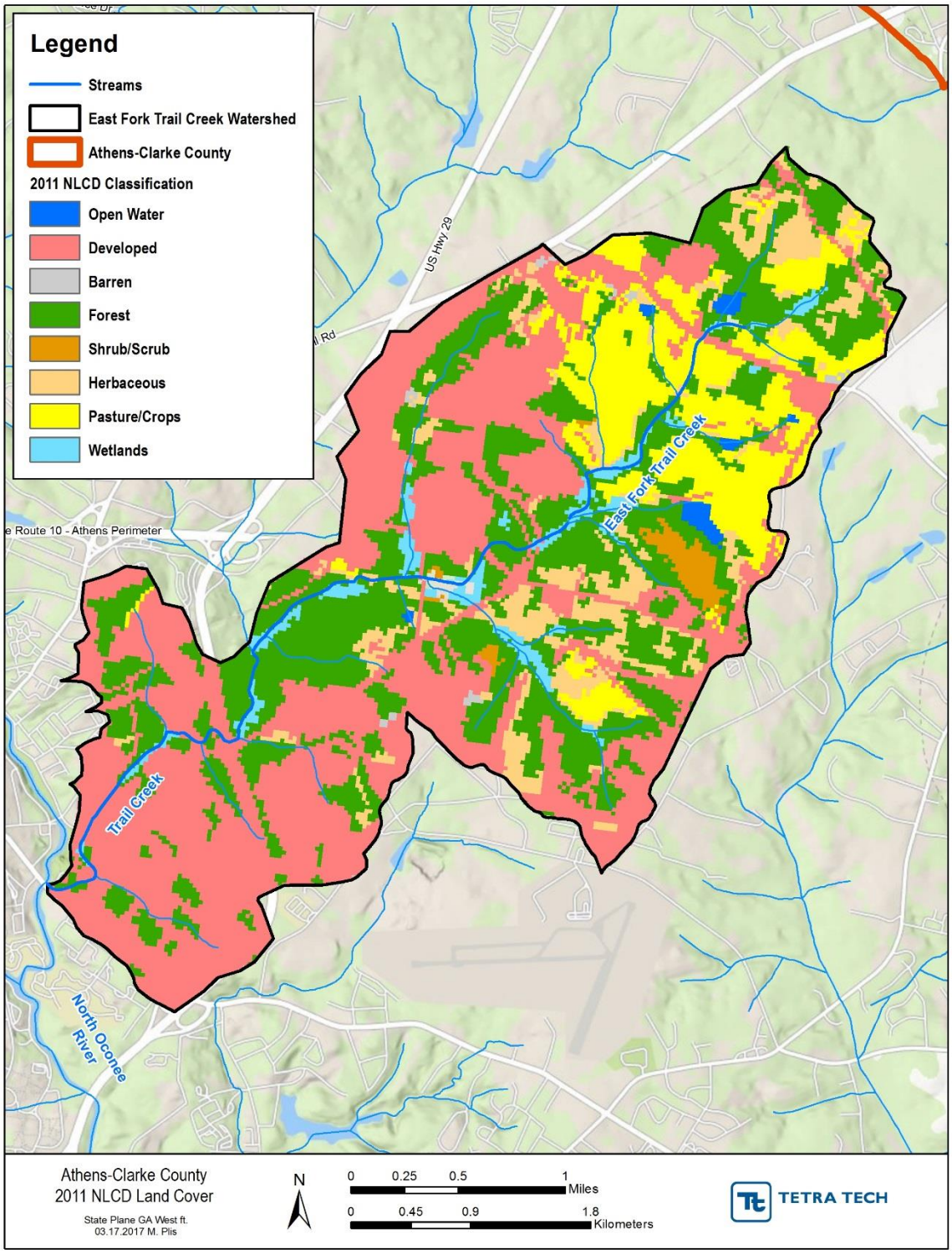

Figure 2-3. 2011 NLCD Land Cover

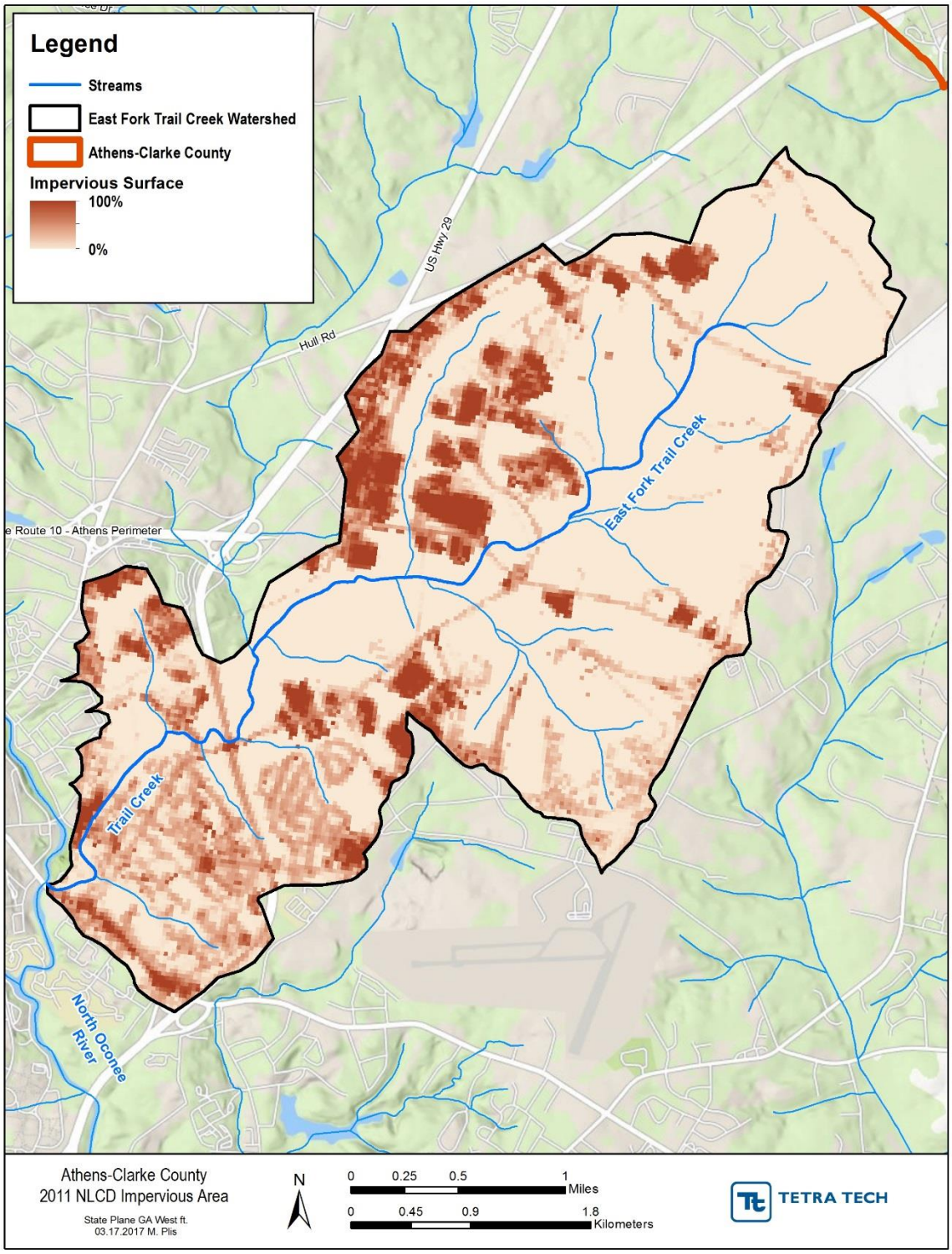

Figure 2-4. 2011 NLCD Impervious Cover

2.3 Ecoregion

The study area and all of ACC are located within the Southern Outer Piedmont level IV ecoregion (45b). This ecoregion has lower elevations, less relief, and less precipitation than the Southern Inner Piedmont ecoregion (45a) to the northwest. Loblolly-shortleaf pine is the major forest type, with less oak-hickory and oak-pine than 45a. Gneiss, schist, and granite are the dominant rock types, covered with deep saprolite and mostly red, clayey subsoils. The majority of soils are Kanhapludults. The southern boundary of the ecoregion occurs at the Fall Line, where unconsolidated coastal plain sediments are deposited over the Piedmont metamorphic and igneous rocks (Griffith et al. 2001).

2.4 Environmentally Sensitive Areas

Environmentally sensitive areas include wetlands, water supply watersheds, and other natural areas that are important for wildlife habitat and/or recreational use. There are no water supply watersheds in the watershed. The National Wetland Inventory (NWI) Map identifies small patches of forested, emergent, and scrub-shrub wetlands along East Fork Trail Creek and its tributaries, as shown in Figure 2-5. Where present, these wetlands provide wildlife habitat and serve as a buffer around the streams, receiving and treating runoff and protecting the stream from nonpoint sources of pollution.

No other environmentally sensitive areas were identified.

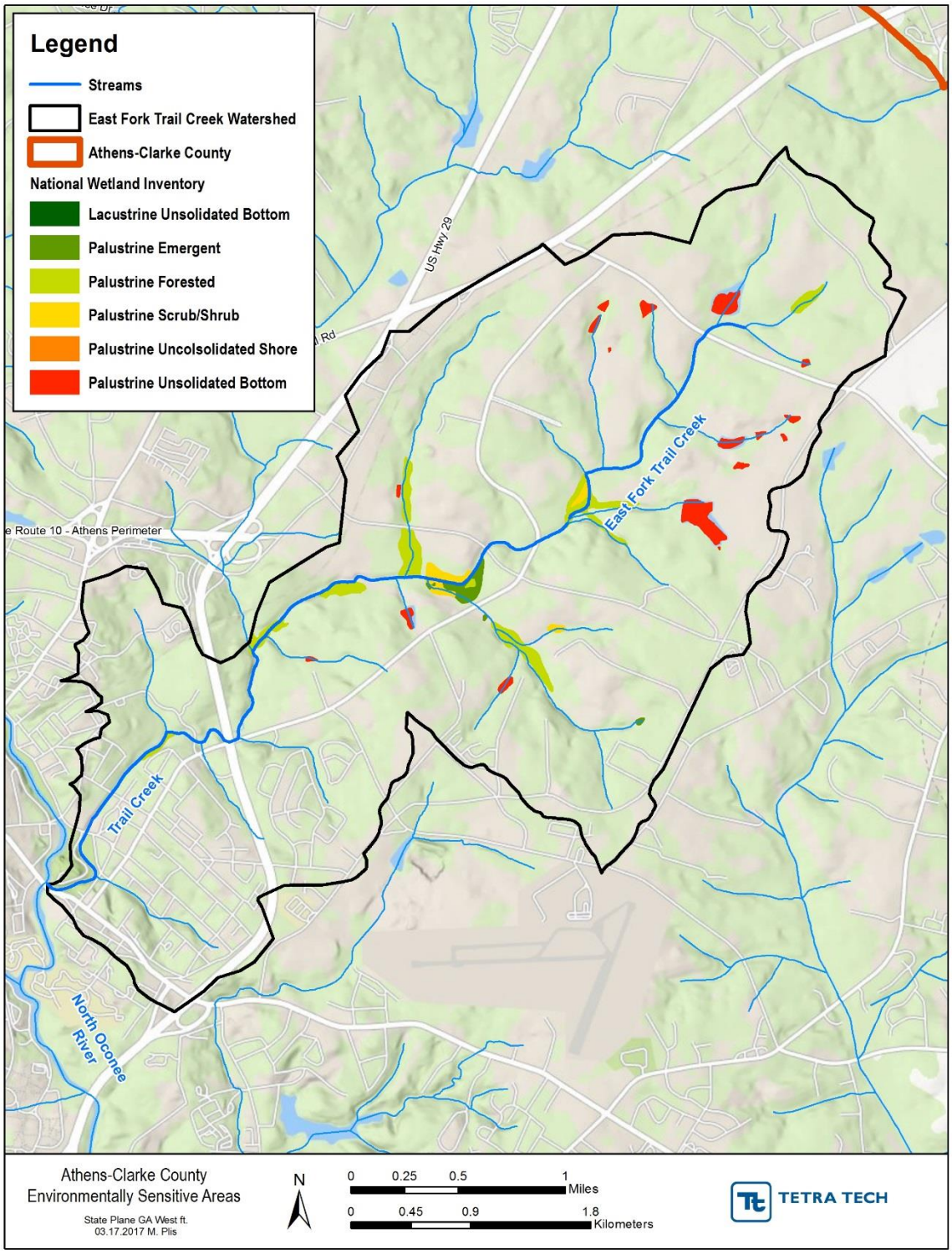

Figure 2-5. Environmentally Sensitive Areas

2.5 Potential Sources of Pollution

A search was conducted for known point sources of pollution from state and federal databases including the GaEPD database of NPDES permits (GaEPD 2013) and the United States Environmental Protection Agency (USEPA) Envirofacts Multisystem Search (USEPA 2016). The online EPA Multisystem Search pulls multiple environmental databases for facility information. The known point sources obtained from these databases are shown in Figure 2-6 and listed in Table 2-2. None of these facilities discharge to waterbodies.

Table 2-2. Point Sources in East Fork Trail Creek Watershed in Athens-Clarke County (USEPA 2016)

Facility Name	EPA ID	Data Source
Athena Service Center	110038657691	AFS
Athena Warehouse	110009356605	RCRA
Athens Plant	110009357212	RCRA
Carrier Transicold	110000358559	RCRA/AFS/EIS/TRIS
Certainteed Corp	110000511107	RCRA/AFS/EIS/TRIS/TSCA
City Wide Paint & Body Shop	110005704737	RCRA
Conwed Corporation	110005705763	RCRA
Del Mar Window Coverings	110000899190	RCRA/AFS/TRIS
Eaton Supercharger	110005282489	RCRA/AFS/TRIS
Ethicon	110058884783	RCRA
Fibervisions Incorporated	110016751610	RCRA/SSTS
Hilton Enterprises Inc Ranick Ltd	110002101822	TRIS
J&J Chemical Co	110020517396	TRIS
Janssen Pharmaceuticals, Inc.	110000358611	RCRA/AFS/TRIS
Lectro Products Inc	110005683411	RCRA
Merial Limited	110064187507	RCRA
Merial Ltd	110000789193	TRIS/SSTS
Noramco, Inc	110069289004	RCRA
Overhead Door Corp/Georgia Div	110007046589	RCRA
Peterson Spring Georgia Plant	110000358568	TRIS/AFS
The Loef Company Inc.	110001325986	RCRA/AFS
University Of Georgia (Chicopee Complex)	110067547248	RCRA
Usps Athens Vmf	110016724838	RCRA
Veratec	110001325995	AFS

Notes: RCRA = Resource Conservation and Recovery Act; AFS = Air Facility System; EIS = Emission Inventory System; TRIS = Toxic Release Inventory System; TSCA = Toxic Substances Control Act; SSTS- Section Seven Tracking System.

Potential nonpoint sources of pollution in the East Fork Trail Creek watershed include stormwater runoff from ACC's municipal separate storm sewer system (MS4) as well as runoff from forested and agricultural lands. Oil, grease, and metals are common pollutants in runoff from urban areas. Fertilizers

(nutrient pollution), herbicides, and pesticides can enter streams through runoff from agricultural and residential lands. Fecal coliform bacteria (FC) and other bacteria that are a concern for human health can come from the waste of humans and other animals. These sources can include pets, wild animals, farms, leaky sewer pipes, and septic systems. Sediment can also be a pollutant when excess amounts enter surface waters from eroding upland areas and from eroding stream banks. The sources of greatest concern in this watershed include crop and pasture land, especially those areas adjacent to streams, because of their potential to deliver fecal coliform bacteria, as well as nutrients, pesticides, and herbicides directly into the streams.

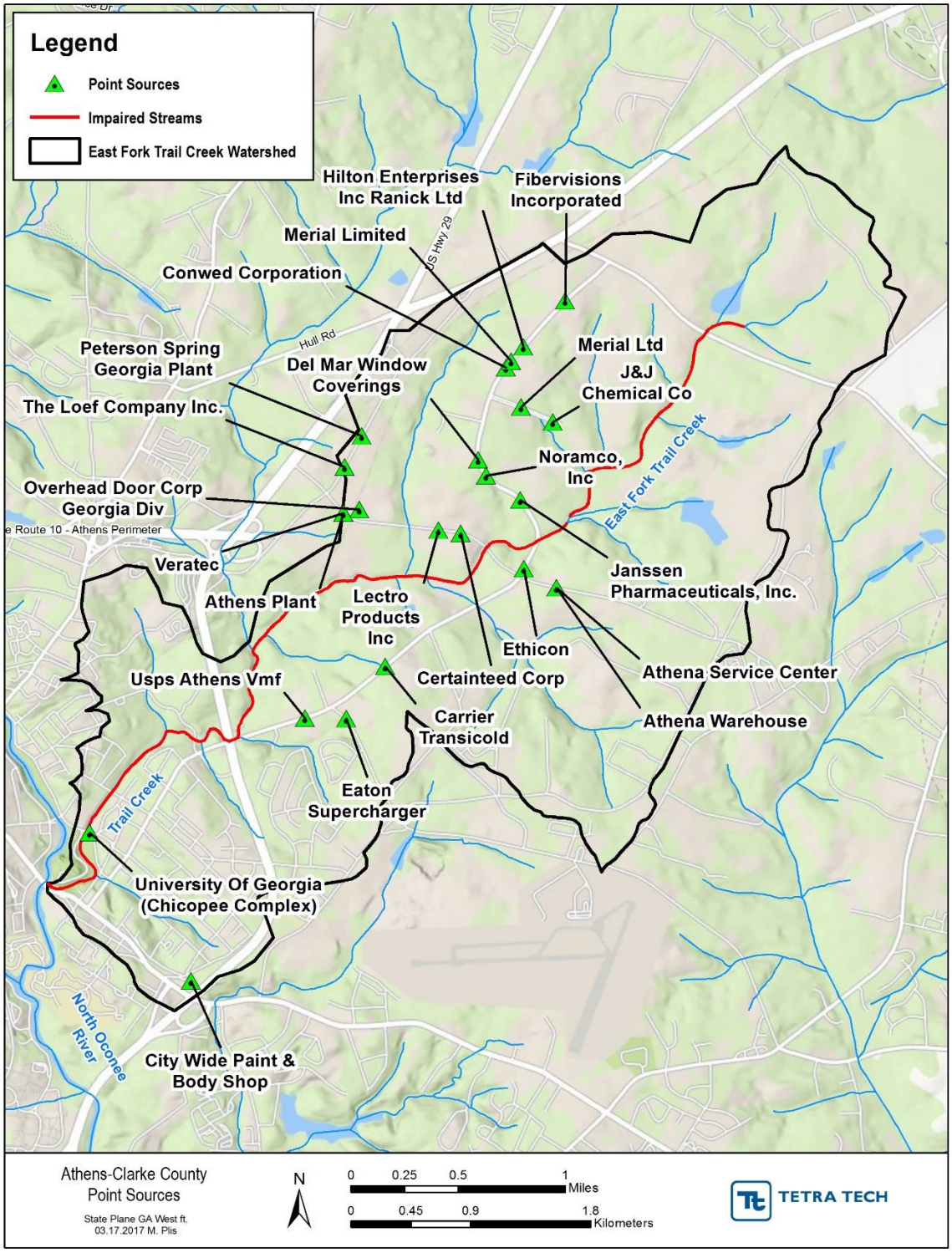

Figure 2-6. Point Sources (USEPA 2016)

2.6 Stream Condition

Stream walks were conducted in October 2016 through December 2016 to characterize existing stream conditions, identify areas of impairment, help identify potential causes of impairment, and help identify priority areas for management efforts. This assessment did not include an assessment of East Fork Trail Creek. Therefore, the only part of the 2014 assessment area that is within the East Fork Trail Creek Watershed Management Plan study area is Trail Creek, from its confluence with the North Oconee River upstream to the confluence of East and West Forks. Trail Creek was divided into reaches at break points such as road or railroad crossings, in-line ponds, or tributaries. East Fork Trail Creek was characterized for the Watershed Management Plan without a stream assessment, through an analysis of GIS data and water quality data.

2.6.1 Methodology

ACC Stormwater Staff physically walked Trail Creek from the North Oconee River to the confluence of the East and West Forks in April of 2014 and conducted an inventory of bed, stream bank, and stream buffer condition.

To quantify stream condition, each of four stream condition parameters—in-stream habitat rankings, bankface vegetation density, bank erosion ratings, and floodplain connection—were scored on a scale of 0 to 20, with 20 being the best possible individual parameter score. Overall stream condition for each reach was determined by totaling the scores of the four parameters, with 80 being the best possible score. The total numerical scores were given narrative condition ratings as follows:

- Poor: 0-23
- Marginal: 24-40
- Suboptimal: 41-63
- Optimal

In addition to the stream condition scores, a reach level assessment was performed that characterized surrounding land use, base flow as a percentage of channel width, dominant substrate, water clarity, aquatic plants in stream, wildlife in and around the stream, stream shading, channel dynamics, and reach accessibility. Cross sections were taken at the beginning and end of each reach, and sketches were made indicating channel width, depth, and other notable features. Photographs were taken capturing general stream features.

Stream condition and other data collected during this assessment were used to help identify and prioritize capital improvement projects such as stormwater control and stream restoration measures.

ACC Public Utilities Department staff conducted stream walks in East Fork Trail Creek in February 2017 because of historically high fecal coliform concentrations found in this watershed through ACC monitoring efforts. Stream walks were conducted in an effort to identify the source(s) of bacterial contamination.

2.6.2 Results

The 2014 stream condition scores for each reach in the study area are provided in Table 2-3. Each assessment Reach ID and the overall condition rating of each stream reach is shown in Figure 2-7.

Stream walk assessment figures are included in appendix A. Assessment forms and data sheets with notes are provided in appendix B. Stream walk photos are included as appendix C.

Table 2-3. 2014 Stream Condition Assessment Scores

Reach	In-Stream Habitat Score	Vegetative Protection Score		Bank Erosion Score		Floodplain Connection	Total Score	Condition Rating
		Left Bank	Right Bank	Left Bank	Right Bank			
TR-1A	6	5	3	2	2	8	26	marginal
TR-1B	9	4	2	7	7	2	31	marginal
TR-1C	5	5	7	5	6	7	35	marginal
TR-1D	4	4	9	2	2	11	32	marginal

Stream walks conducted in East Fork Trail Creek by Public Utilities Department staff found evidence of livestock access to the stream from Olympic Drive to the headwaters.

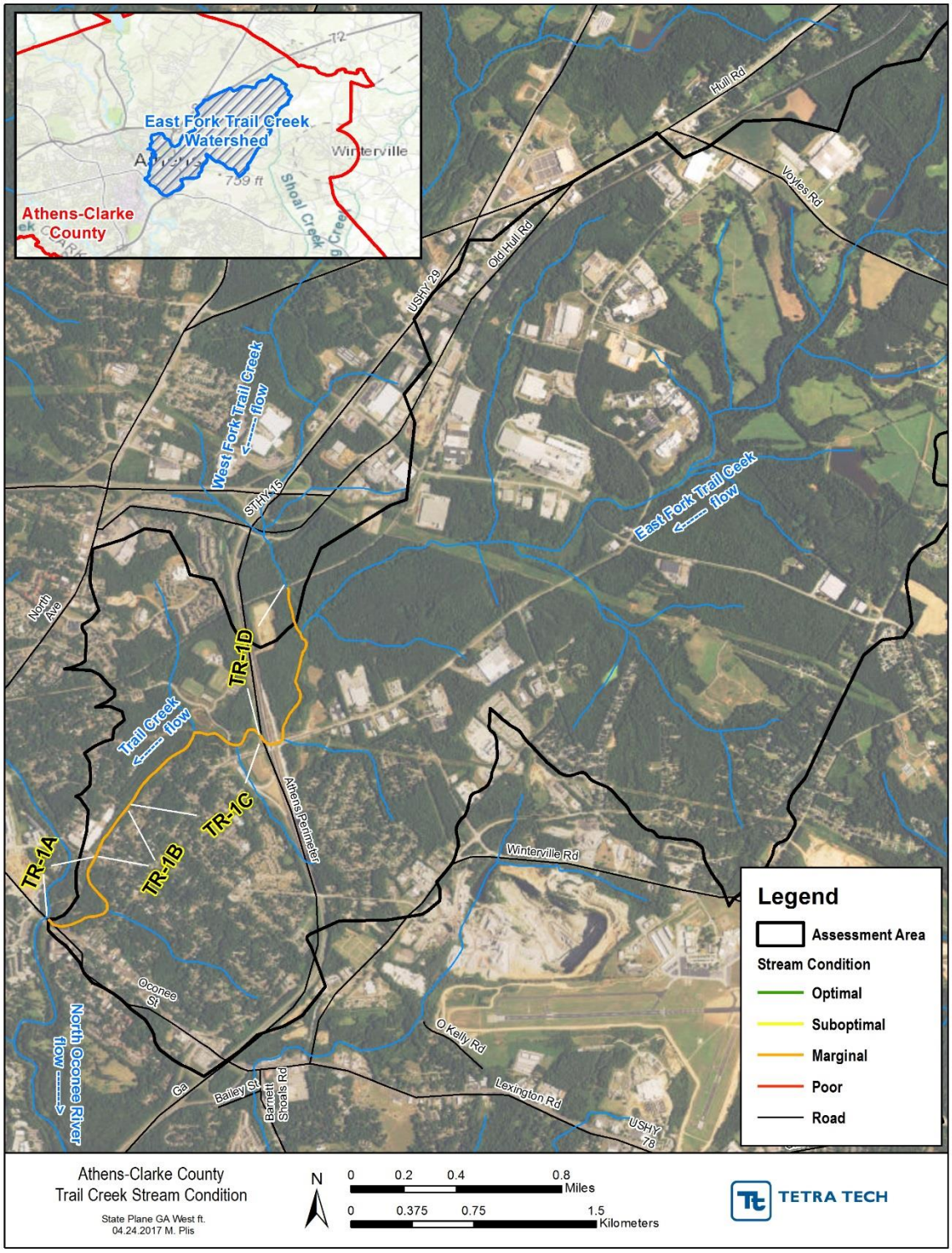

Figure 2-7. 2014 Stream Reach Condition Ratings

2.7 Water Quality

There are two water quality monitoring stations in the study area that were monitored by ACC. Both of these stations (TR-2 and TR-3.1) are on the main stem of Trail Creek. Monitoring stations are shown in Figure 2-8. Station TR-2 was monitored from 2009 to 2011; TR-3.1 was monitored in 2014. ACC does not have a regulatory obligation to conduct long-term monitoring. However, they have a proactive Stormwater Management Program that includes conducting monitoring on a rotating basis between the different watersheds in ACC to get representative conditions in the major streams and track trends in water quality over time. Collecting and testing water quality samples over time will provide a general picture of what pollutants are a concern in ACC's waterways.

There are also four impaired waters monitoring stations in the watershed including two on East Fork Trail Creek (ETR-1 and ETR-2) and two on the main stem of Trail Creek (TR-1 and TR-3), where fecal coliform (FC) bacteria monitoring was initiated in 2015 and is ongoing (Figure 2-8). This monitoring is required by GaEPD per the ACC Impaired Waters Monitoring Plan because East Fork Trail Creek and Trail Creek are on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams, as not supporting their designated use of Fishing because of FC bacteria.

The federal Clean Water Act has led to the development of water quality standards to restore and maintain the chemical, physical, and biological health of the nation's surface waters. Agencies use these standards to guide watershed management activities. The classification of a water body's designated use (e.g., drinking water supply) determines the applicable water standards. East Fork Trail Creek has a designated use of fishing according to Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03 (O.C.G.A. 2015[1]). State standards for dissolved oxygen (DO), pH, FC bacteria, and temperature for waters with the designated use of fishing are listed in Table 2-4.

Table 2-4. Georgia Water Quality Standards for Designated Use of Fishing (GaEPD 2015)

Dissolved Oxygen	pH	FC Bacteria	Temperature
Daily average of 5.0 mg/L and no less than 4.0 mg/L at all times	6.0-8.5	May-Oct < 200 colonies/100 mL as a geometric mean based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours, and 4,000 colonies/100 mL as a single-sample maximum.	Not to exceed 90 degrees Fahrenheit (32 degrees Celsius)
		Nov–Apr < 1,000 colonies/100 mL as a geometric mean based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours, and 4,000 colonies/100 mL as a single-sample maximum.	

Notes: mg/L = milligrams per liter; mL = milliliters.

[1] O.C.G.A (Official Code of Georgia Annotated). 2015. Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03. Amended: F. Oct. 2, 2015; eff. Oct. 22, 2015.

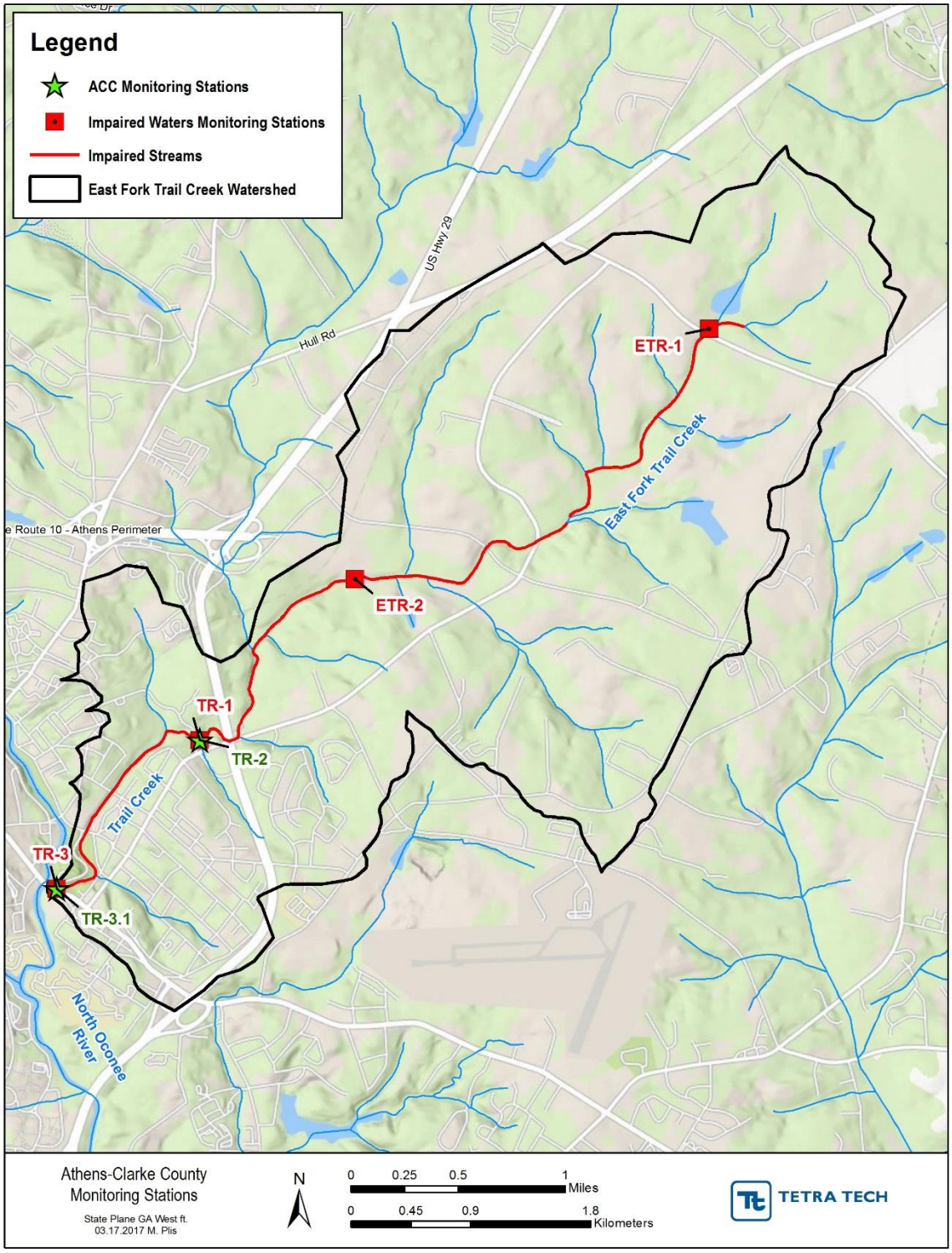

Figure 2-8. Water Quality Monitoring Stations

Water quality data collected by ACC from 2009 to 2014 is summarized in Table 2-5. In this table, standards are based on the state standards for DO, pH, FC, and temperature, as shown in Table 2-4. Standards for all other parameters are based on benchmark values used by ACC that are not regulatory standards. FC bacteria geometric means calculated from the impaired waters monitoring data are shown in Table 2-6.

Plots of the raw grab sample data for DO, FC, pH, and temperature collected at each station are shown in Figure 2-9 through Figure 2-12. Data for station TR2 was collected from January 2009 through April 2011, and data for station TR3.1 was collected from July through October 2014.The full set of tabulated data is provided in appendix D.

Table 2-5. ACC Monitoring Station Water Quality Data (2009-2014)

Parameter	Unit	Standard	TR2				TR3.1			
			Samples	Average	Min	Max	Samples	Average	Min	Max
Conductivity	mS/cm	≤ 0.3	27	**0.102**	0.035	0.416	6	**0.007**	0.006	0.010
Dissolved Oxygen	mg/L	≥ 4*	27	**8.25**	3.84	12.67	6	**7.13**	6.13	8.69
Fecal Coliform Bacteria	cols/100mL	Varies	26	**458**	39	2,420	6	**2,801**	890	6,000
Ammonium (NH_4)	mg/L	not established	25	**20.84**	0.00	135.45	1	**37.56**	37.56	37.56
pH	Standard units	6.0 - 8.5*	27	**6.71**	5.39	8.02	6	**6.48**	5.70	6.98
Temperature	Degrees Celsius	≤ 32*	27	**14.54**	2.46	25.06	6	**20.78**	13.71	23.88
Total Nitrogen	mg/L	≤3	21	**0.89**	0.42	2.00	1	**1.35**	1.35	1.35
Total Phosphorus	µg/L	≤ 200	20	**18.37**	0.00	236.20	1	**17.65**	17.65	17.65
Total Suspended Solids	mg/L	≤ 13	13	**10**	6	19	2	**5**	5	6

Notes: cols/100 mL = colonies per 100 milliliters; µg/L = micrograms per liter; mg/L = milligrams per liter; max = maximum; min = minimum; mS/cm = millisiemens per centimenter. Orange cells indicate minimum or maximum values not meeting the standard. * indicates state standard.

Table 2-6. Fecal Coliform Impaired Waters Monitoring Data (2015-2016)

Parameter	Unit	Standard	Sample Dates	ETR1				ETR2				TR1				TR3			
				Samples	Geomean	Min	Max	Samples	Geomean	Min	Max	Samples	Geomean	Min	Max	Samples	Geomean	Min	Max
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	Oct 15-28, 2015	4	**211**	170	300	4	**579**	200	1,600	4	**385**	80	5,000	4	**1,294**	130	3,000
Fecal coliform bacteria Nov - Apr	cols/ 100 mL	<1,000	Nov 10-Dec 2, 2015	4	**518**	230	1,300	4	**651**	80	9,000	4	**425**	130	2,400	4	**2,683**	800	9,000
Fecal coliform bacteria Nov - Apr	cols/ 100 mL	<1,000	Mar 8-22, 2016	4	**91**	40	300	4	**163**	40	700	4	**108**	40	220	4	**540**	20	5,000
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	May 17-Jun 7, 2016	4	**179**	40	800	4	**542**	109	2,400	4	**724**	110	2,400	4	**3,258**	1,300	17,000
Fecal coliform bacteria May - Oct	cols/ 100 mL	<200	Aug 2-24, 2016	4	**636**	300	1,700	4	**408**	230	800	4	**693**	300	1,400	4	**3,681**	1,700	9,000
Fecal coliform bacteria Nov - Apr	cols/ 100 mL	<1,000	Nov 10-22, 2016	4	**473**	130	1,100	4	**187**	140	300	4	**118**	40	170	4	**145**	80	230

Notes: cols/100 mL = colonies per 100 milliliters; max = maximum; min = minimum. Red cells indicate averages not meeting the standard. Orange cells indicate minimum or maximum values not meeting the standard.

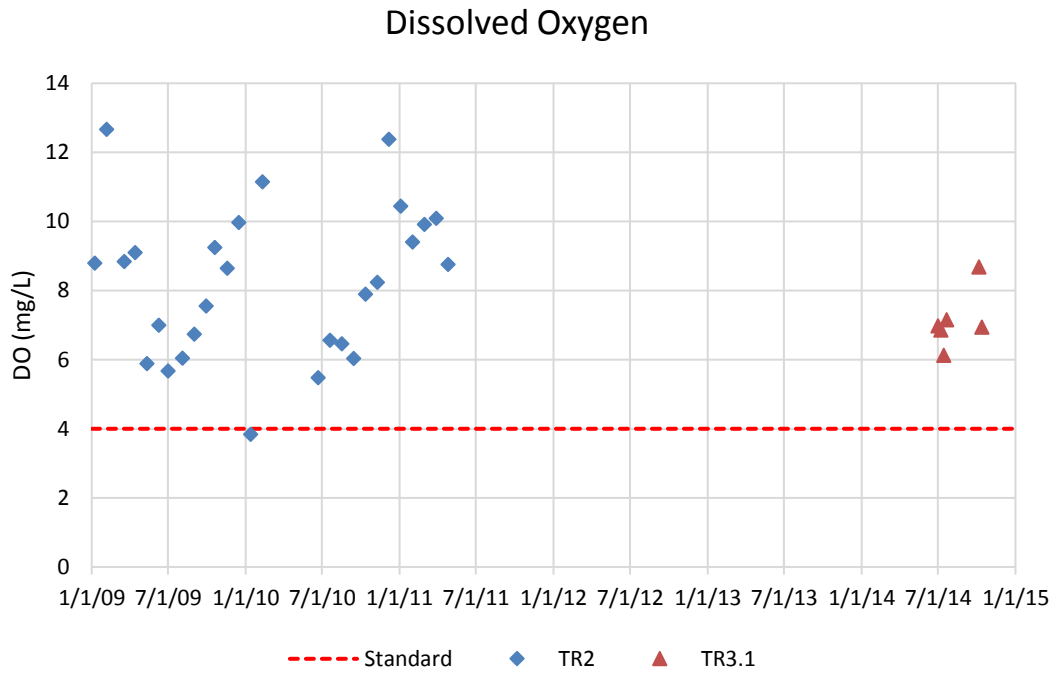

Figure 2-9. Dissolved Oxygen Grab Sample Results for Trail Creek Stations

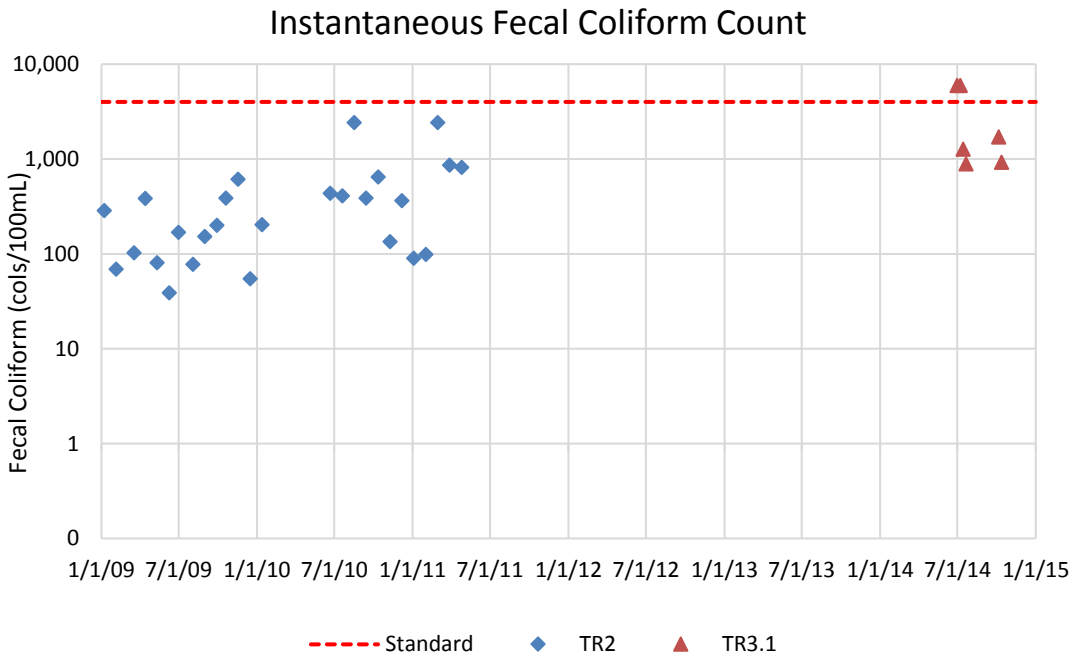

Figure 2-10. FC Bacteria Grab Sample Results for Trail Creek Stations

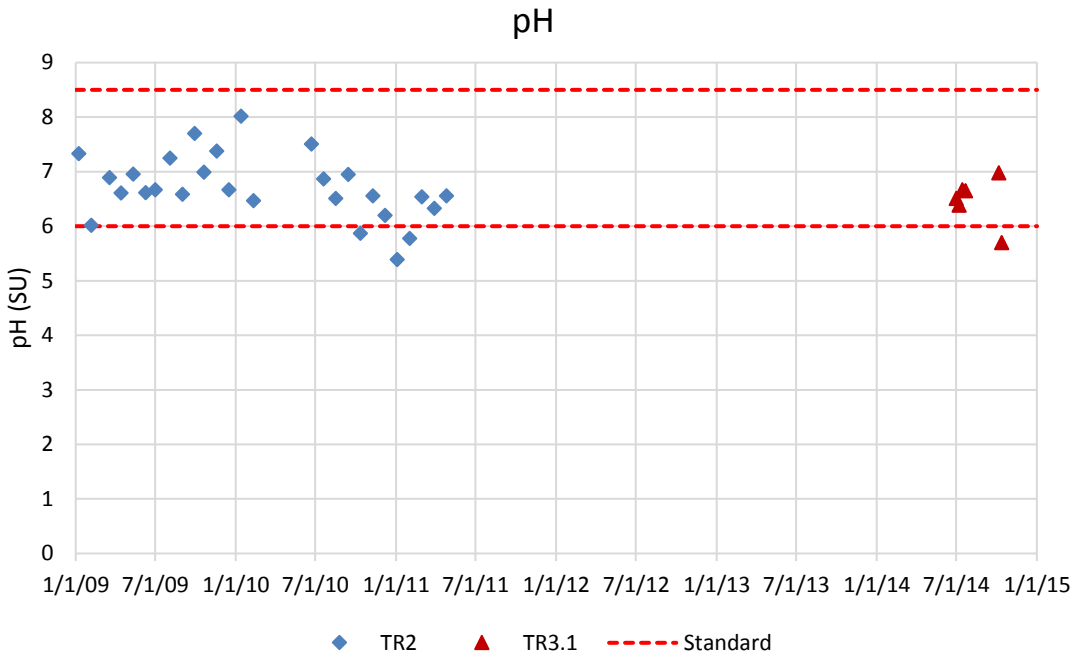

Figure 2-11. pH Grab Sample Results for Trail Creek Stations

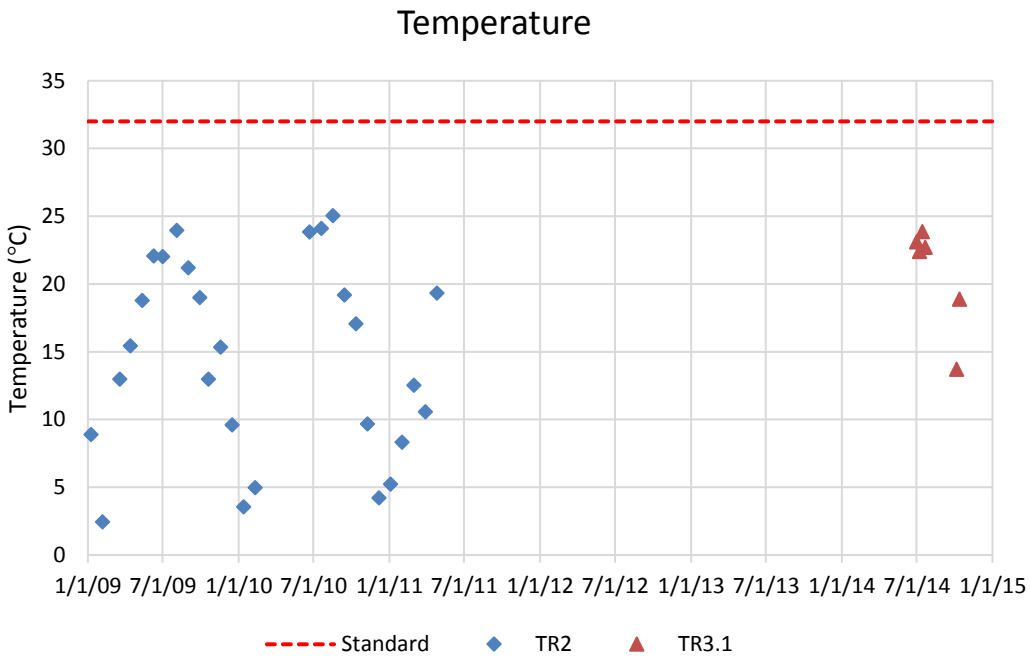

Figure 2-12. Temperature Grab Sample Results for Trail Creek Stations

Results of the water quality sampling effort suggest that surface waters in the study area are generally in compliance with the DO, pH, and temperature standards adopted by the State of Georgia. Average concentrations of DO and average measurements of pH and temperature for all stations are well within the state standards. On occasion, individual measurements did not meet the State standards, but do not appear to be indicative of chronic water quality problems. The minimum DO standard of 4.0 was not met on one occasion at station TR-2. The pH standard minimum of 6.0 was not met on three occasions at station TR-2 and was not met on one occasion at station TR-3.1.

FC bacteria data show that all stations in the study area comply with the November-through-April standard, except for station TR-3. Station TR-3 had one exceedance from November through April. However, none of the stations comply with the May-through-October standard. Three of the four stations have exceeded the instantaneous maximum standard at least once from May through October (Table 2-6). Average total phosphorous (TP), total nitrogen (TN), TSS, and conductivity results meet the standards at all stations.

2.8 Nutrient and TSS Loading

2.8.1 LSPC Watershed Model

The Loading Simulation Program C++ (LSPC) was used to represent the hydrologic and water quality conditions for the study area. LSPC is a comprehensive data management and modeling system that is capable of representing loading, both flow and water quality, from nonpoint and point sources and simulating in-stream processes. It is capable of simulating flow, nutrients, TSS, and other conventional pollutants, as well as temperature and pH for pervious and impervious lands and water bodies. LSPC was configured to simulate the watershed as a series of hydrologically connected subwatersheds. LSPC is based on the Mining Data Analysis System (MDAS), with modifications for nonmining applications such as nutrient modeling. MDAS was developed by EPA Region 3 through mining TMDL applications.

2.8.2 Watershed Segmentation

The contributing drainage area was represented by a series of subwatersheds to evaluate the sources contributing to a water body and to represent the spatial variability of these sources within the watershed model. Subwatersheds were delineated using the National Elevation Dataset in 1/3-arc-second resolution (10 meters) and the National Hydrography Dataset.

2.8.1 Simulation Period

The ACC LSPC model was set up and calibrated to simulate a 10-year period from January 1, 1998, through December 31, 2009. That calibration time period was selected as it captured two drought periods (1999-2001 and 2006-2007) and several wet years, including 2003 and 2005.

2.8.2 Land Cover Representation

The watershed model uses land cover data as the basis for representing hydrology and nonpoint source loading. Land cover data was used from the University of Georgia (UGA) Georgia Land Use Trends (GLUT) coverage, and included urban, forest, crop and pasture land, wetlands, water, barren, golf courses and utility swaths. The GLUT coverage represented conditions in year 2008 based on an existing model developed as part of State water planning efforts. In addition, the LSPC model requires division of land cover in each subwatershed into separate pervious and impervious land units. For this, the GLUT impervious cover was intersected with the GLUT land cover. Again, the GLUT land cover data was used in modeling because of its consistency with State water planning efforts and because it is more representative of the modeled simulation period (January 1, 1998, through December 31, 2009) than the NCDC 2011 Land Cover described in section 1.2.

2.8.3 Loading Maps

Loading maps were created to represent average TN, TP, and TSS loading rates in pounds per acre per year for each of the subwatersheds in the study area (Figure 2-13 through Figure 2-15) using results from the LSPC model developed for ACC. The modeled results identified the greatest TN loads in the most downstream portion of the watershed, and one unnamed tributary in the upper portion of the watershed that consists primarily of developed land. The modeled results identified the greatest TP loads in the most downstream portion of the watershed, and one unnamed tributary in the upper portion of the watershed that consists primarily of crop/pasture land. Modeled TSS loads were relatively low throughout the watershed. There are no numeric standards for TN, TP, or TSS loads in streams in Georgia, so the figures are not meant to show areas that exceed an allowable value, but to depict average nutrient and sediment loads across the watershed based on land use.

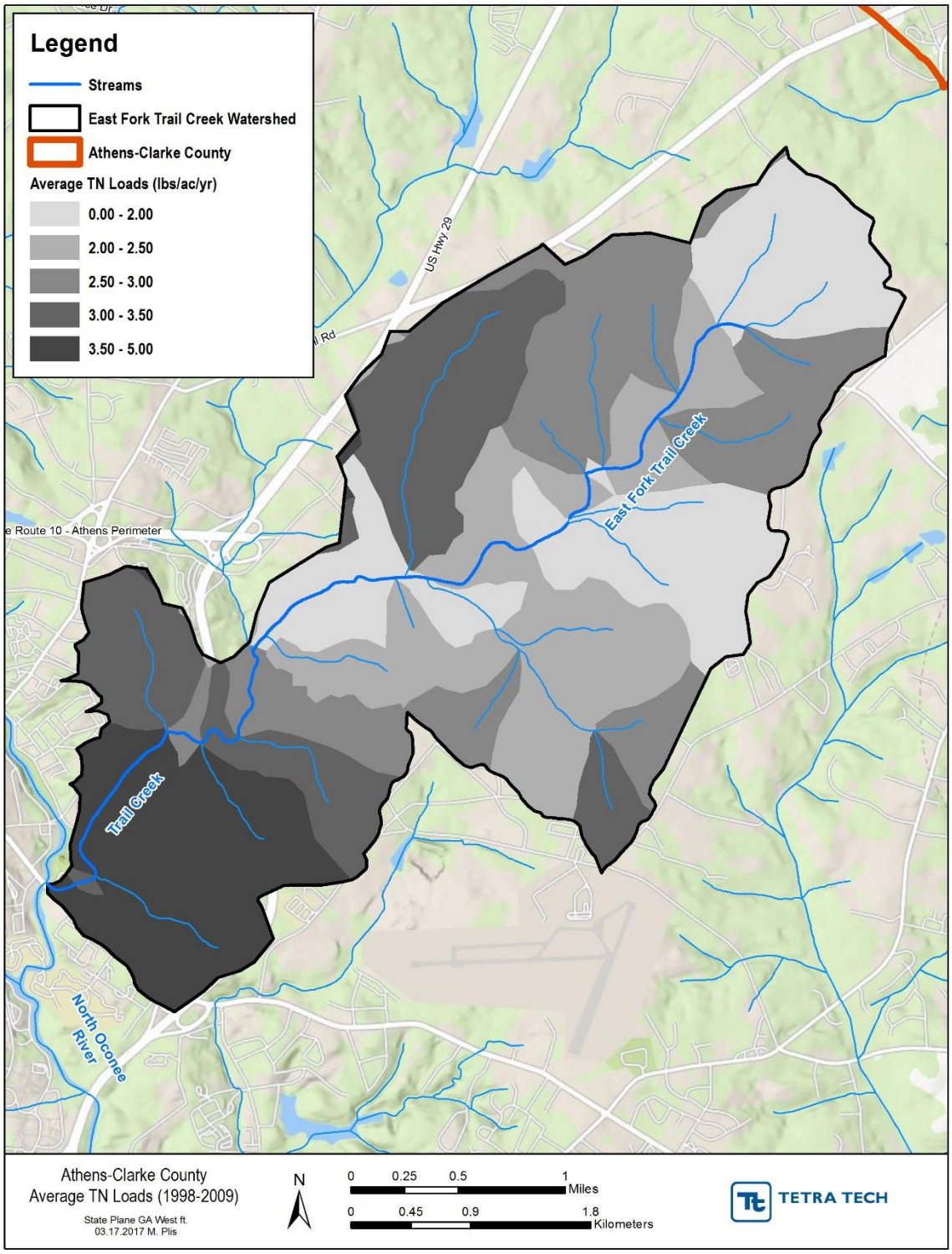

Figure 2-13. Average TN Modeled Loads

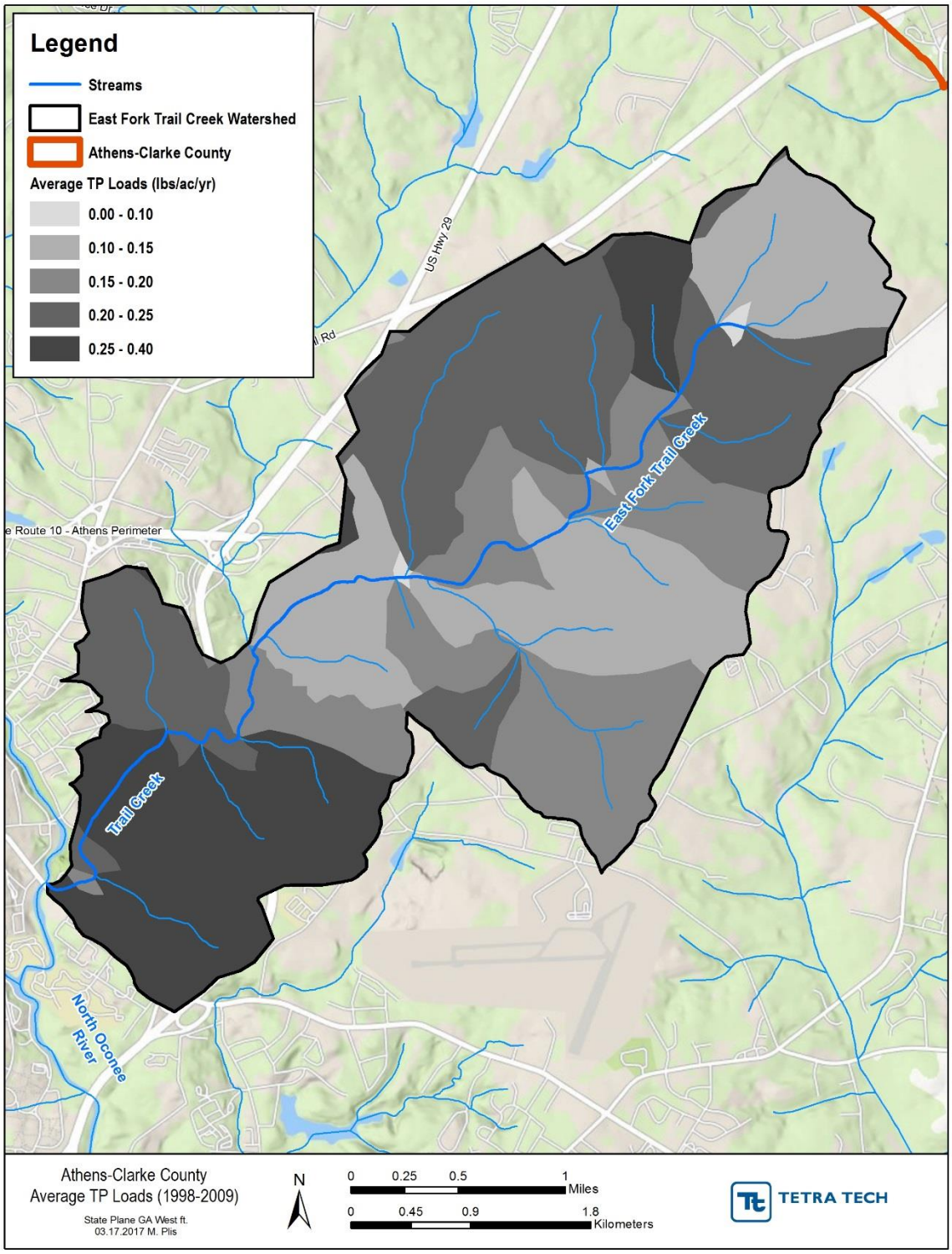

Figure 2-14. Average TP Modeled Loads

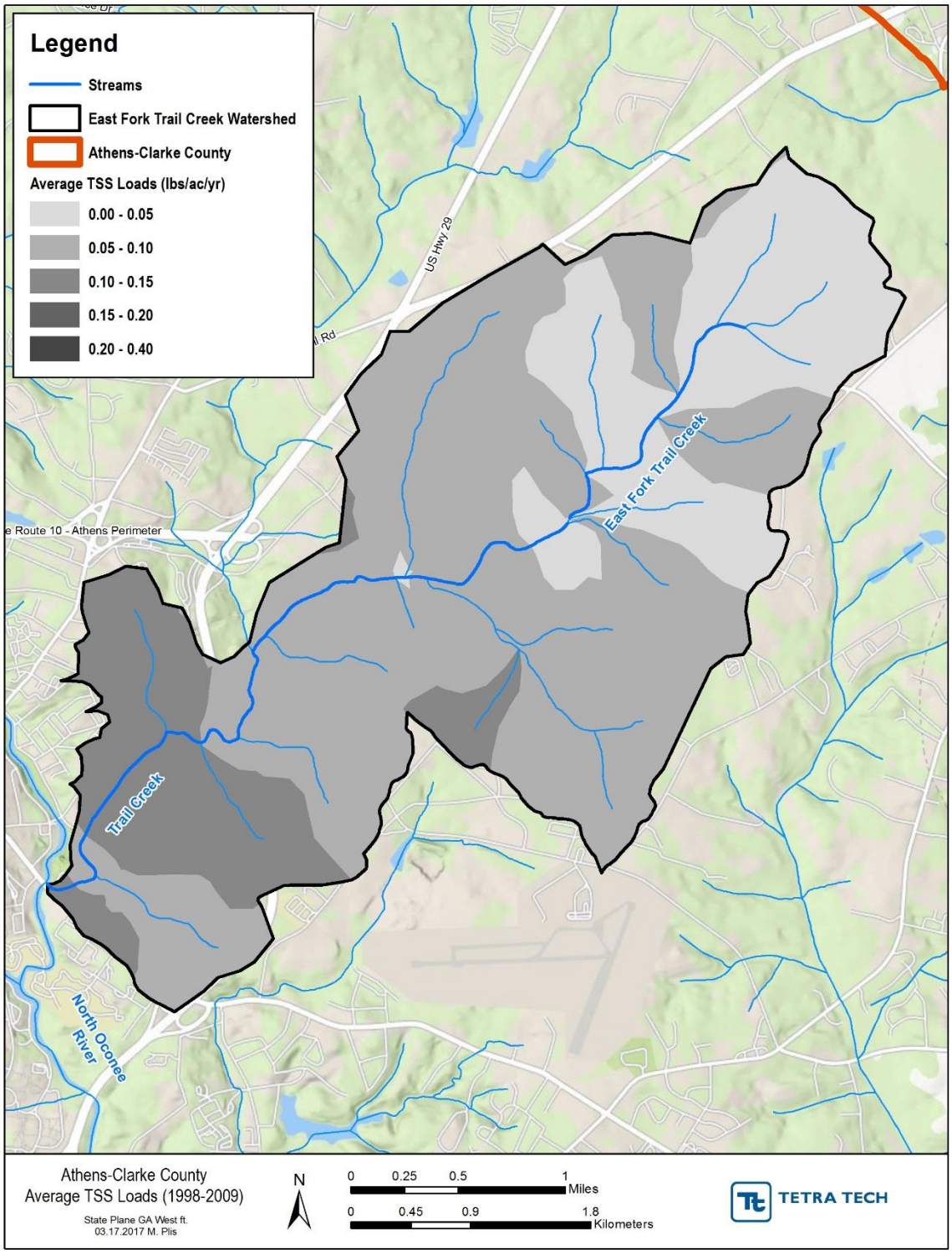

Figure 2-15. Average TSS Modeled Loads

2.9 Summary

This watershed characterization describes existing conditions in the East Fork Trail Creek and Trail Creek watersheds within ACC. The nature and condition of the study area was characterized from previous studies, monitoring efforts, and stream assessments. A watershed model was also used to identify subwatersheds contributing to nutrient and TSS loads.

The East Fork Trail Creek watershed is approximately 14 percent impervious and composed primarily of forest, developed, and pasture/crop land, in order of decreasing percent coverages. Trail Creek and East Fork Trail Creek are both listed as impaired on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams for FC bacteria.

Water quality monitoring data indicate that FC bacteria is a concern in the study area, with each station having exceeded the state standard on more than one occasion. This finding is in line with the fact that Trail Creek and East Fork Trail Creek are listed as impaired on the 305(b)/303(d) List because of FC bacteria.

Notable key findings from the stream assessment include the following:

- The condition of Trail Creek is marginal throughout its length.
- There are isolated areas of severe erosion along all reaches, including the left bank along Oak Street near the confluence of Trail Creek with West Fork Trail Creek.
- Stream buffer impacts include utility corridors, parking lots, residential and commercial buildings, and recreational park land (Dudley Park and Trail Creek Park).
- Sanitary sewer lines are exposed at the railroad trestles in reach TR-1A and reach TR-1D.
- There is no floodplain connection in reach TR-1B.
- Trash dumping was noted at a residential location on reach TR-1C.
- Bank armoring was noted on sections of reach TR-1C.
- Invasive Chinese privet was noted throughout reach TR-1C.
- Potential sources of FC bacteria include deer and human.

3 Watershed Management Measures

3.1 Current Measures

ACC is currently implementing numerous structural and programmatic management measures to maintain and improve water quality throughout the county. The implementation of these measures is a collaborative effort by various ACC departments and other stakeholders mentioned in section 1.3.

As part of ACC's efforts to implement watershed protection strategies, measures have been taken to prevent detrimental changes in hydrologic conditions and reduce, prevent, or treat stormwater pollutants through protective ordinances, development reviews/inspection programs, staff training sessions, public education and outreach, compliance with ACC's Phase II MS4 permit, water quality monitoring, and long-term watershed characterization studies. A complete list of BMPs and programmatic management activities implemented from July 2016 through June 2017 is included in Table 2-1 of the 2016-2017 Public Utilities Department WPP Annual Report and provided as appendix E of this WMP.

3.2 Watershed Management Needs

3.2.1 Method for Determining Management Needs

Eight watershed management needs were identified across ACC based on information obtained from the watershed characterizations. Decision criteria were developed to determine if a management need applied to each assessed watershed. The criteria for determining ACC management needs are listed in Table 3-1. The table also identifies which of these management needs apply to the East Fork Trail Creek watershed. Shaded cells indicate that the need is watershed-wide.

Table 3-1. Watershed Management Needs Decision Criteria

Management Need	Decision Criteria	Applicable to East Fork Trail Creek[a]
FC Bacteria	Listed as impaired for FC; or Geometric mean not meeting state WQ standards.	Yes
Sediment	Listed as impaired for biota (fish or macro) due to sediment; or Average TSS value greater than standard of 13 mg/L.	
pH	Average value not meeting state WQ standards.	
Conductivity	Average value greater than the standard of 0.3 mS/cm.	
Dissolved Oxygen	Average value not meeting state WQ standards.	
Wetland Preservation	Large wetland areas identified in NWI Map.	Yes
Buffer Enhancement	High percentage of cropland/pastureland directly adjacent to streams.	Yes
Hydrology	Watershed is $\geq$ 10% impervious; or Poor stream condition scores.	Yes

Note: mg/L = milligrams per liter; mS/cm = millisiemens per centimenter.

a Dark shading indicates the management need is watershed-wide.

3.2.2 Management Needs by Area

The East Fork Trail Creek watershed was determined to have the following watershed management needs. For each management need a rationale is provided in addition to identifying to what area of the watershed it applies. Refer to Figure 3-1 for locations of management needs by area.

FC Bacteria: Trail Creek and East Fork Trail Creek are both listed as impaired on the draft Georgia 2016 Integrated 305(b)/303(d) List of Streams for fecal coliform bacteria. Water quality monitoring data verifies that each station has exceeded the state standard on more than one occasion. Therefore, fecal coliform bacteria was determined to be a watershed-wide management need.

Wetland Preservation: Wetland preservation is a management need for a small portion of East Fork Trail Creek, as well as portions of a few of its tributaries because the NWI Map identifies a great deal of palustrine, lacustrine, and scrub/shrub wetlands along the streams in these areas that serve as a buffer between stormwater runoff and the stream. Preservation could be achieved through land acquisitions or conservation easements.

Buffer Enhancement: Buffer enhancement is a management need for the upper portion of the East Fork Trail Creek watershed because there is a high percentage of crop/pasture land directly adjacent to streams in this area.

Hydrology: Hydrology was identified as a watershed-wide management need because the East Fork Trail Creek watershed is greater than 10 percent impervious. As the percentage of impervious area increases in a watershed, stream hydrology is altered. This altered hydrology, sometimes referred to as “urban stream syndrome,” causes streams to have lower baseflow and higher peak storm flows than they would in a less developed watershed. Stormwater management practices that help detain stormwater runoff and release it slowly, and those that help infiltrate water into the ground can help restore a more natural hydrology to the receiving streams.

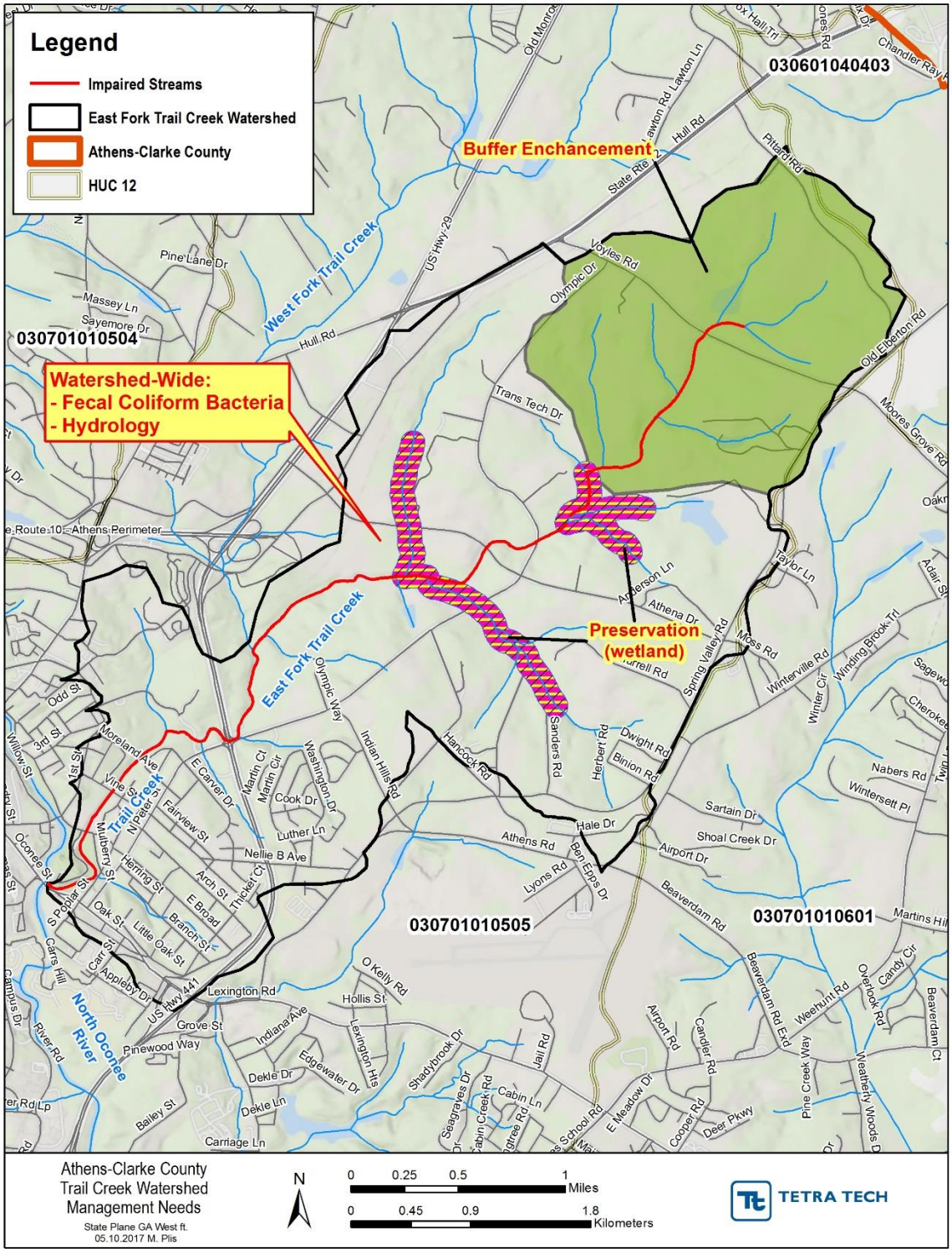

Figure 3-1. East Fork Trail Creek Management Needs

3.3 Management Opportunities

The Tetra Tech-Arcadis-ACC team conducted a GIS analysis and field assessment to identify watershed management opportunities, including stormwater control, restoration, and programmatic measures. Particular consideration was taken by the team to identify and prioritize opportunities that target the management needs specific to the East Fork Trail Creek watershed. This section presents details and results of the analytical methodology employed by the team to develop a prioritized list of viable opportunities, including parcel screening criteria, field assessment information, BMP modeling scenarios, and scoring and ranking metrics.

3.3.1 Identification of Potential Sites for Management Opportunities through GIS Analysis

A GIS screening analysis was conducted as an initial step in identifying potential sites for watershed improvement measures. Eleven metrics were used to score all parcels in the watershed. Point values were assigned to different categories within each metric so that preferred attributes received a higher score (Table 3-2). Some site features were preferred over others when selecting candidate sites because they had features such as publicly owned land, large parcel size, and close proximity to an impaired stream. Weighting of preferred features was done within the scoring system itself, rather than applying a weighting factor to each metric. Therefore, the total possible points are different for individual metrics. Individual metric scores were summed to obtain a total score for each parcel in the watershed. The maximum score possible was 119. All parcels in the watershed were scored and ranked based on this system.

The top 20 ranked sites in each watershed were evaluated further using GIS data and Google Earth images to evaluate the potential for management opportunities on these parcels. Some parcels were removed from further consideration if opportunities were limited (based on ownership information, existing land use, position in the watershed, access constraints, and other factors). Some parcels had characteristics that informed programmatic management opportunities (e.g., preservation opportunities, stream buffer enhancement, and agricultural BMPs), but did not require a site visit.

Additional sites were added to the list of places to visit in the field following consultation with the Transportation and Public Works Department and the Leisure Department, both of which provided a list of sites already identified as having stormwater management concerns and other potential management opportunities. Other sites were added based on opportunities identified from stream walks or from a visual scan of the watershed in Google Earth and GIS. The visual scan helped identify sites that might not have been captured by the scoring metrics such as highly disturbed or erosional areas. A list of the sites identified for field assessments is included in Table 3-3 and their locations are shown on Figure 3-2.

Table 3-2. Metrics and Scoring System for Site Prioritization

Parcel Metric		Score	Source	Notes
Publicly Owned	County Gov	20	ACC GIS layer	Higher scores assigned to publicly owned parcels.
	Other County	15		
	State Owned	10		
	No	1		
Planned Development	Yes	20	ACC GIS layer	Targets parcels slated for development as opportunities for BMP incorporation.
	No	0		
Within 150 ft of Agricultural Stream Segment	Yes	10	Based on National Land Cover Database (NLCD)	Targets parcels contributing runoff from agricultural and/or livestock activity.
	No	0		
Impervious Cover %	76-100	10	Based on National Land Cover Database (NLCD)	Targets parcels with higher impervious cover.
	51-75	7.5		
	26-50	5		
	0-25	2.5		
Hydrologic Soil Group	A	10	USDA Web Soil Survey coverage	Targets parcels with more permeable soils.
	B	7.5		
	C	5		
	D	2.5		
Parcel Size (ac)	1.52+	10	ACC tax parcel data	Higher scores for large parcels as they are more suitable for BMP opportunities.
	0.61-1.51	7.5		
	0.34-0.60	5		
	0.0-0.33	0		
Within 150 ft of Impaired Stream Segment	Yes	10		Targets parcels in proximity to stream segments listed as Impaired on the 303(d) list.
	No	0		
Erosion Score	Poor	8	On-site visual assessment	Higher scores assigned to parcels proximal to stream segments with obvious erosion issues.
	Marginal	6		
	Suboptimal	4		
	Optimal	0		
Vegetation Score	Poor	8	On-site visual assessment	Higher scores assigned to parcels lacking vegetative coverage along banks.
	Marginal	6		
	Suboptimal	4		
	Optimal	0		
Overall Score	Poor	8	On-site visual assessment	Composite score combining bank erosion, vegetation coverage, in-stream habitat conditions, floodplain connection, and accessibility.
	Marginal	6		
	Suboptimal	4		
	Optimal	0		
Zoning	C-G	5	ACC GIS layer	Commercial – General.
	C-D	5		Commercial – Downtown.
	C-N	5		Commercial – Neighborhood.

Parcel Metric		Score	Source	Notes
	C-O	5		Commercial – Office.
	E-I	2.5		Employment – Industrial.
	I	2.5		Industrial.

Notes: ac = acres; ft = feet; USDA = U.S. Department of Agriculture.

Table 3-3. Sites Identified for Field Assessment

Parcel No.	Owner	Publicly Owned	Planned Development Parcel	Agricultural Stream Segment	Impervious Cover %	Hydrologic Soil Group	Parcel Size	Impaired Stream Reach	Erosion Score	Vegetation Score	Overall Score	Parcel Zoning	Total Score	Rank in Watershed[a]
Public														
171B4 J001	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	4	0	66	3
164 023	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	1	0	63	4
172A3 C001E	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	1	0	63	4
171B2 E006A	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	1	0	63	4
172A3 C001C	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	1	0	63	4
171B4 J001	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	10.0	10	6	6	1	0	63	4
171B4 G004	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	5	7.5	5.0	10	6	6	1	0	60.5	9
171B4 I001	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	7.5	7.5	10	6	6	1	0	60.5	9
172A3 C001	ATHENS-CLARKE COUNTY UNIFIED GOVERNMENT	20	0	0	2.5	5.0	10.0	10	6	6	1	0	60.5	9
164 015	CLARKE COUNTY SCHOOL DISTRICT	15	0	10	2.5	7.5	10.0	0	6	6	1	0	58	13
172A1 A001A	HOUSING AUTHORITY OF THE CITY OF ATHENS	15	0	0	2.5	7.5	10.0	10	6	6	1	0	58	13
Private														
221 008H	DEVELOPMENT AUTHORITY OF THE UNIFIED GOVERNMENT OF ATHENS CLARKE COUNTY	1	20	0	2.5	7.5	10.0	0	6	6	1	5.00	59.0	12
222 002B	WOOD RUTH H & ETALS	1	0	10	2.5	7.5	10.0	10	6	6	1	2.50	56.5	20
221 022	KESLER BUFORD TRUST & RUBY DORIS KESLER	1	0	10	2.5	7.5	10.0	10	6	6	1	2.50	56.5	20

Note:

a Rank indicates rank among all parcels in the watershed. Parcels with the same total score received the same rank.

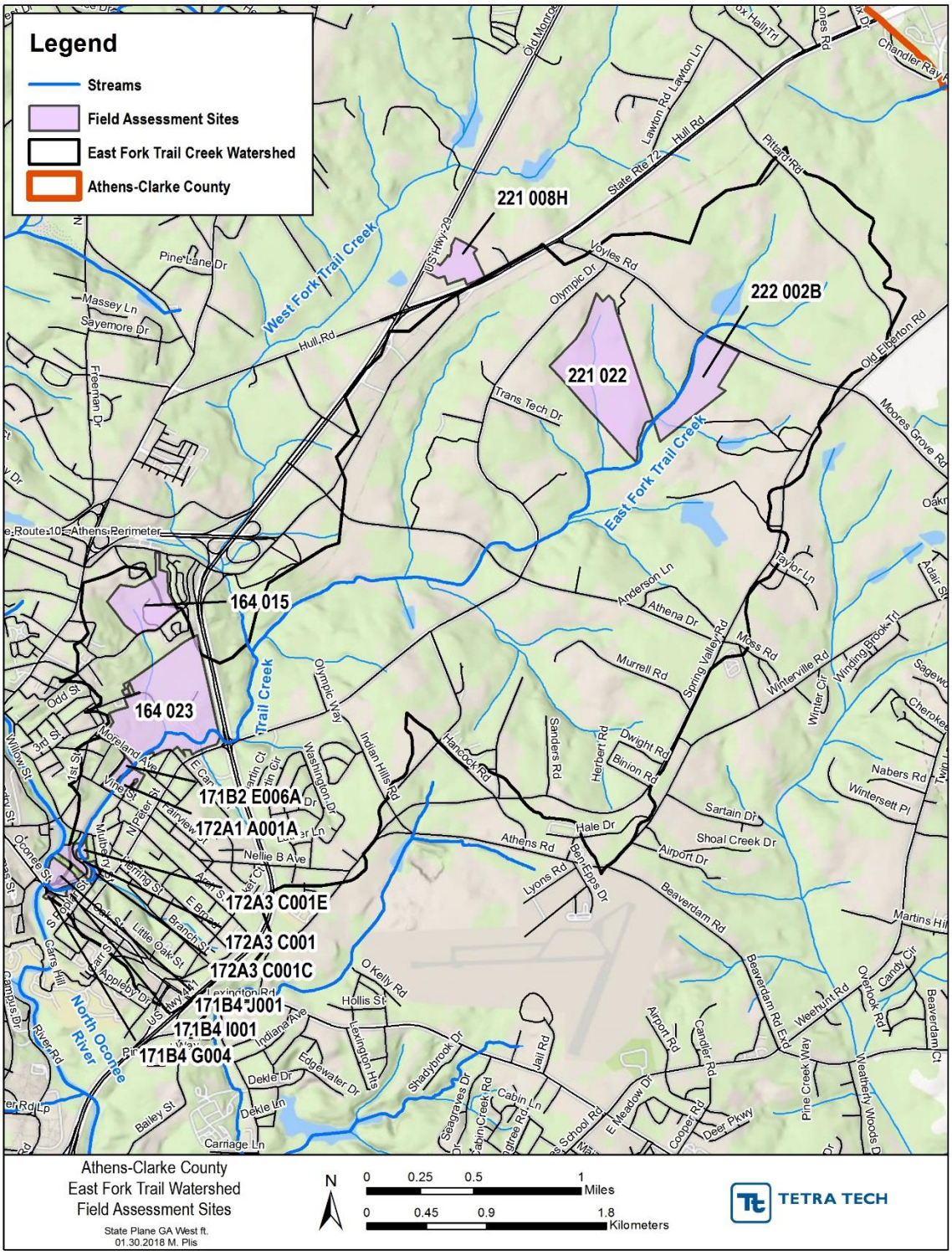

Figure 3-2. East Fork Trail Creek Field Assessment Sites

3.3.2 Field Assessment

Each site identified for field assessment was visited to further evaluate opportunities for management measures. Access to some sites was limited, either because of private ownership or because of fencing. In addition to the identified site field assessments, a windshield survey was performed while traveling throughout the study area to identify other parcels where opportunities might exist. If new opportunities were identified, they were assessed at that time.

Watershed Improvement Opportunity Field Assessment forms (appendix F) were filled out for sites where management opportunities exist and for sites where it was important to document existing site conditions in support of the general watershed characterization. The forms include information about landowners, existing conditions, land use, and potential utility conflicts as well as a description of proposed management measures and photo notes.

3.3.3 Initial Site Screening and Identification of Management Opportunities

Following the field assessments, sites that had no viable management opportunities and those that had significant constraints or challenges were removed from further consideration. The remaining sites were identified as candidate sites for watershed improvement opportunities. Five sites were identified in the East Fork Trail Creek watershed. Parcel information and potential opportunities for the candidate sites are listed in Table 3-4 and the site locations are shown in Figure 3-3. BMPs were assigned a unique ID based on an abbreviation of the watershed name and whether the BMP is structural stormwater control (Str), restoration (Res), or programmatic (Prog).

Table 3-4. Candidate Sites for Watershed Improvement Opportunities

Watershed	Parcel Number	Owner	Description	Opportunity	BMP ID
East Fork Trail Creek	171B4 J001	Athens-Clarke County Unified Government	Dudley Park	Stream buffer restoration	EFT-Res-01
East Fork Trail Creek	164 015	Clarke County School District	Stroud Elementary	Detention pond retrofit	EFT-Str-01
East Fork Trail Creek	164C1 A005	Housing Authority of the City of Athens	Athens Housing Authority Bonnie Lane	Detention pond	EFT-Str-02
East Fork Trail Creek	172A1 A001A	Housing Authority of the City of Athens	Athens Housing Authority Vine Circle	Bioretention area	EFT-Str-03
East Fork Trail Creek	172A1 A001A	Housing Authority of the City of Athens	Athens Housing Authority Vine Circle	Detention pond	EFT-Str-04
East Fork Trail Creek	223 008D	Athens-Clarke County Unified Government	Solid Waste Management Complex	Stormwater retrofit and trash barrier	EFT-Str-05

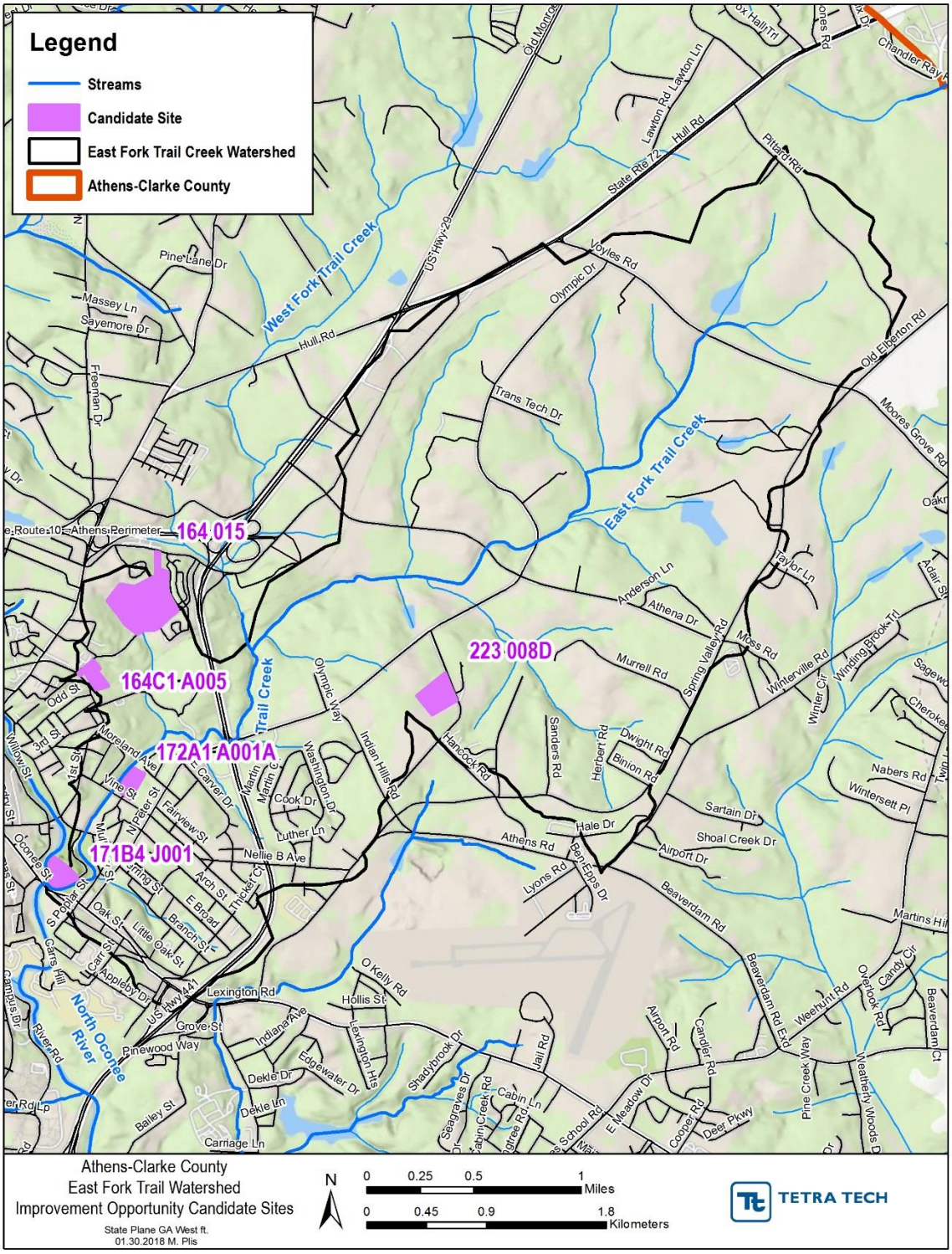

Figure 3-3. East Fork Trail Creek Watershed Improvement Opportunity Sites

Programmatic watershed improvement opportunities were identified through the GIS analysis and field assessments. These programmatic opportunities include measures such as the development or modification of standard operating procedures for vegetation management, review of inspection and maintenance programs, development of education programs, creation of incentives for stormwater management retrofits, encouragement of green infrastructure and low impact development practices, and the development of a more comprehensive stormwater inventory. A full list of programmatic management opportunities that are not parcel-specific is provided in Table 3-5.

Table 3-5. Programmatic Watershed Improvement Opportunities (not parcel-specific)

Measure	Description
Bacterial Source Tracking	Bacterial source tracking (BST) may help identify the source (e.g., human, dog, goose, or deer) of FC bacteria in the watershed. Specific sampling locations may be selected based on anecdotal evidence to help determine the type of management measures that will be most effective at reducing FC levels.
Vegetated Stream Buffers	Educate Department of Leisure Services and contractor personnel not to mow within the 75-ft buffer along perennial streams. Allow limited mowing once or twice a year in specific areas to limit growth of woody vegetation. Leave as tall as possible. Educate landscape companies, farmers, golf courses, and homeowners to leave a vegetated buffer along streams. Fliers and/or in-person meetings with farmers about federal programs that provide funding to move feeding operations away from streams.
Mowing Maintenance Practices[a]	Develop standard operating procedures for ACC departments and contractors mowing ACC and ACC School District properties about landscaping BMPs for protection of water resources. Mowing height should be at least 2 inches.
Bank Stabilization[a]	Use site-specific measures to stabilize eroding banks, using vegetation and natural materials that will provide wildlife habitat where feasible.
Retrofit Incentives	Increase incentives to retrofit older developments that have no stormwater management so they provide it, possibly through utility fee credit.
New and Redevelopment Inspections[a]	Continue NPDES inspections of new and redevelopment sites for compliance with required erosion and sediment control practices.
Linear Infrastructure BMPs	For linear projects such as transportation, sanitary sewer, or stormwater sewer improvements, assist in reducing sediment and pollutant loading in streams through inspections and education.
Cisterns on Public Buildings	Assess the need for harvested rainwater. Does ACC currently use potable water for irrigation, dust control, or other needs? Use cisterns at ACC facilities to reduce cost, increase infiltration, recharge the groundwater, and reduce runoff from impervious surfaces, thereby helping protect the county's streams. Filtration may be needed/considered for specific sites.

Measure	Description
GIS Stormwater Inventory	Develop a more comprehensive stormwater inventory, including a complete inventory of structures, conveyances, outfalls, stormwater ponds, and runoff reduction BMPs. This watershed improvement opportunity will help the Transportation and Public Works Department analyze the stormwater system capacity, determine BMP inspection schedules, and assist in future development plans.
Green Infrastructure / Low Impact Development	Include in development and redevelopment an assessment of opportunities for runoff reduction through green infrastructure and low impact development practices, including permeable pavement, cisterns, bioretention, and green roofs. This could be incorporated into plan review or ordinance revisions.

Note:
a Some of these measures may already be partially addressed by programs from other departments. Similar BMPs are listed in Table 2-1 of the 2016-2017 ACC Watershed Protection Plan Public Utilities Department Annual Report.

3.3.4 BMP Modeling and Optimization

Potential watershed improvement measures identified in the East Fork Trail Creek watershed include stormwater control measures, restoration measures, and programmatic measures (structural BMPs). Stormwater control measures are stormwater best management practices (BMPs) that store and/or infiltrate stormwater runoff. These measures address both water quality and water quantity concerns. BMP simulation and optimization modeling was performed on site-specific stormwater control measures to evaluate BMP effectiveness at reducing flows and pollutant loads and to optimize the BMPs to identify the best size to achieve the greatest benefit for the least cost. Modeling results were then used to help develop cost estimates, and to help score and rank potential projects.

Proposed BMPs were modeled using the Stormwater Management Optimization Tool (Opti-Tool) developed by Tetra Tech for EPA Region 1.

After the model was used to optimize the size of BMPs, engineers estimates of probable cost were developed for each BMP. Without detailed engineering data, these costs are assumed to be accurate within plus 50 percent to minus 30 percent of actual implementation costs. Each cost estimate is comprised of construction costs, mobilization, and design. Land acquisition costs were not incorporated into the cost estimates and need to be considered should any of the proposed structural measures be selected for implementation.

The construction costs were estimated with RSMeans CostWorks software, using construction cost data for the Athens area. The unit rate cost assumptions are shown in the final cost opinions in appendix I. Design and engineering costs were assumed to be 25 percent of the construction cost. Table 3-6 provides a summary of the runoff volume and peak flow reductions and estimated total cost for each of the modeled structural BMPs in the East Fork Trail Creek watershed.

Table 3-6. Modeling Results and Cost Estimates of Stormwater Control BMPs in the East Fork Trail Creek Watershed

Parcel Number	Project Name	BMP ID	Drainage Area (ac)	BMP Area (ac)	Runoff Volume % Reduction	Runoff Peak Flow % Reduction	Total Cost
172A1 A001A	Athens Housing Authority - Vine Circle Detention	EFT-Str-03	1.28	0.02	1%	80%	$64,000
172A1 A001A	Athens Housing Authority - Vine Circle Bioretention	EFT-Str-04	1.27	0.06	63%	24%	$86,000
164 015	Stroud Elementary Detention Pond Retrofit	EFT-Str-01	27.70	0.39	1%	76%	$360,000
223 008D	Solid Waste Management Complex Stormwater Retrofit and Trash Barrier	EFT-Str-05	1.20	0.18	63%	24%	$130,000
164C1 A005	Athens Housing Authority - Bonnie Lane Detention	EFT-Str-02	7.23	0.12	1%	81%	$141,000

3.3.5 Evaluation and Prioritization of Stormwater Control and Restoration BMPs

A meeting was held with Tetra Tech, Arcadis, and ACC to discuss the identified watershed improvement opportunities. Tetra Tech and ACC staff visited several sites to discuss potential improvement measures and to see examples of current management practices that appear to be working well. Feedback from this meeting was used to develop a list of attributes for prioritizing projects.

Stormwater control BMPs were evaluated based on 10 attributes and restoration BMPs were evaluated based on 9 attributes:

Stormwater Control BMP Attributes

- Drainage Area
- Ownership
- Education Potential
- Public Amenity Potential
- Constructability/Conflicts
- Maintenance Needs
- Storm Flow Control
- Runoff Reduction
- Overall Impact or Environmental Benefit
- Cost level

Restoration BMP Attributes

- Drainage Area
- Ownership
- Education Potential
- Public Amenity Potential
- Constructability/Conflicts
- Maintenance Needs
- Habitat Enhancement
- Overall Impact or Environmental Benefit
- Cost level

BMPs were evaluated by scoring the attributes for each project, with each attribute receiving a possible score between 0 and 10. The attributes and scoring system were developed in close coordination with ACC so that they reflect the priorities important to ACC.

Some attributes were recognized as having more importance for than others for the purpose of achieving the goals and objectives of the WMP. To account for this relative difference in attribute importance, weighting factors of 0.5, 1, or 2 were applied to each attribute. This was done in such a way that the total the total possible score is 100 points after the weightings are applied, for both stormwater control and restoration projects. Attribute weighting factors for stormwater control and restoration BMPs are shown in Table 3-7.

Table 3-7. BMP Attribute Weighting Factors

BMP Ranking Attribute	*Weighting Factors*	
	Stormwater Control BMPs	Restoration BMPs
Drainage area treated	2	N/A
Stream Size	N/A	2
Ownership	2	2
Education potential	0.5	0.5
Public amenity potential	0.5	0.5
Ease of Constructability	0.5	0.5
Maintenance Needs	0.5	0.5
Storm flow control	1	N/A
Runoff Reduction	1	N/A
Habitat Enhancement	N/A	1
Overall Impact/ Environmental Benefit	1	2
Cost Level	1	1

Once all projects were evaluated and scored, they could be ranked from highest to lowest score. Higher ranking projects represent higher priority projects for ACC. A complete description of the methodology used to evaluate and prioritize projects is provided in appendix G, including a detailed description of the scoring criteria for each BMP attribute. A prioritized list of stormwater control and restoration projects for the East Fork Trail Creek watershed is provided in Table 3-8.

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Table 3-8. Scoring and Prioritization for Stormwater Control and Restoration Projects in the East Fork Trail Creek Watershed

Parcel Number	BMP ID	Drainage Area/Stream Size	Ownership	Education Potential	Public Amenity Potential	Constructability/ Conflicts	Maintenance Needs	Storm Flow Control	Runoff Reduction	Habitat Enhancement	Overall Impact or Environmental Benefit	Cost Level	Total Weighted Score	Rank
		Attribute Score												
171B4 J001	EFT-Res-01	10	10	10	10	10	10	N/A	N/A	10	10	5	95	1
223 008D	EFT-Str-05	7	10	0	0	10	5	0	10	N/A	5	5	61.5	2
164C1 A005	EFT-Str-02	8	7.5	10	0	5	10	7.5	0	N/A	5	5	61	3
164 015	EFT-Str-01	10	7.5	10	0	5	10	7.5	0	N/A	0	2.5	57.5	4
172A1 A001A	EFT-Str-04	7	7.5	10	0	5	10	7.5	0	N/A	0	7.5	56.5	5
172A1 A001A	EFT-Str-03	7	7.5	10	0	5	0	0	10	N/A	0	7.5	54	6

3.4 Recommended Management Measures

Stormwater control, restoration, and programmatic management measures have been selected to serve as the basis for this WMP, which is tailored to ACC's watershed goals and objectives. The selection of site-specific opportunities was based on a comprehensive prioritization using remote spatial data, on-site review of opportunities and constraints, and modeling.

3.4.1 Stormwater Control and Restoration Management Recommendations

Stormwater control and restoration BMPs can be very effective at improving watershed health by reducing storm flows and harmful pollutants in stormwater runoff, or they can address a particular watershed concern. This WMP prioritized project opportunities that target multiple objectives in the East Fork Trail Creek watershed. Recommended projects are listed in Table 3-9, from highest to lowest priority based on the project ranking from Table 3-8. Concept plan sheets for these projects are provided in appendix H and planning level cost estimates are provided in appendix I.

Table 3-9. Recommended Stormwater Control and Restoration Measures

BMP ID	Project Description
EFT-Res-01	**Dudley Park Stream Buffer Restoration** This project involves restoring the stream buffer along a section of Trail Creek just before the confluence with the North Oconee River in Dudley Park. Current vegetative cover is lacking and the banks of the channel are experiencing substantial erosion and sloughing. Benefits include nutrient uptake, sediment removal, beautification, and improved stream function.
EFT-Str-05	**Solid Waste Management Complex Stormwater Retrofit and Trash Barrier** This project involves the regrading and conversion of an existing swale to a bioswale and possibly connecting it to an existing retention BMP that treats runoff from the main building near the street. Install a chain link fence to keep trash out of the swale and stream. Another component of the project proposes the installation of a chain link fence along the border of the asphalt behind the trash sorting area to prevent trash from entering the swale. Benefits include nutrient uptake, sediment removal, and beautification.
EFT-Str-02	**Athens Housing Authority – Bonnie Lane Detention** This project involves the construction of a dry detention pond in the southeast corner of the parcel to treat stormwater runoff from the entire property. The existing stormwater drainage system consists of concrete flumes, inlets, and stormwater pipes that are routed to an outfall at the bottom of the retaining wall on the southeast corner of the property. Benefits include peak flow attenuation and sediment removal.
EFT-Str-01	**Stroud Elementary Detention Pond Retrofit** This project includes the hydraulic model investigation and possible reconstruction or retrofit of the existing stormwater detention pond with wetland features. The existing detention facility receives overland runoff from forested areas and industrial parcels to the north and northwest in addition to a small stream of unknown origin. Benefits include peak flow attenuation, nutrient uptake, sediment removal, and beautification.
EFT-Str-04	**Athens Housing Authority – Vine Circle Detention** This project involves the construction of a small dry detention pond on the northwest side of the parking lot to treat most of the impervious surface of the parcel. Current stormwater drainage is provided by a concrete flume that receives runoff from the road and parking lot and directs it towards Trail Creek, which comprises the northwest border of the property. Benefits include peak flow attenuation and sediment removal.

BMP ID	Project Description
EFT-Str-03	**Athens Housing Authority – Vine Circle Bioretention** This project involves construction of a bioretention cell or bioswale on the northwest side of the parking lot to treat most of the impervious surface of the parcel. Current stormwater drainage is provided by a concrete flume that receives runoff from the road and parking lot and directs it towards Trail Creek, which comprises the northwest border of the property. Benefits include nutrient uptake, sediment removal, and beautification.

The design of structural BMPs should follow guidelines set forth in the *2016 Georgia Stormwater Management Manual* (ARC 2016). This manual provides estimated pollutant load reductions for various BMPs. Pollutant removal estimates for applicable measures are shown in Table 3-10.

Table 3-10. BMP Pollutant Removal Estimates

BMP Type	TSS	Total Phosphorus	Total Nitrogen	Metals	Fecal Coliform
Dry Detention Basins	60%	10%	30%	50%	NA*
Stormwater Wetlands	80%	40%	30%	50%	70%
Bioretention Basin	85%	80%	60%	95%	90%

Notes:

* - Helps restore pre-development hydrology, which implicitly reduces post-construction stormwater runoff rates, volumes, and pollutant loads.

3.4.1 Programmatic Management Recommendations

General programmatic recommendations for watershed improvement are listed in Table 3-5. Concept plan sheets for two of these programmatic measures (mowing maintenance practices and bank stabilization) are provided in appendix H. Pollutant load reductions are expected from the recommended programmatic measures, but cannot be accurately quantified.

4 Plan Implementation and Evaluation

4.1 Implementation Schedule

Scheduling the implementation of management measures is crucial to the success of the WMP. The challenge in creating a realistic schedule is balancing the WMP objectives with the different components that dictate the timeline of their required tasks, such as securing funding, stakeholder approval and participation, and public involvement. The WMP schedule should be adaptable and easily revised by ACC according to shifting priorities, unexpected constraints and delays, and new opportunities as they appear. Table 4-1 proposes a WMP implementation schedule that ensures that watershed conditions are assessed regularly and that ACC will continue implementing watershed management measures.

Table 4-1. WMP Implementation Schedule

Time Frame	Watershed Management Measure
Annually	Review the recommended projects from each of the ACC WMPs and determine which projects will be implemented in ACC over the next 1–3 years. Coordinate with other ACC departments as necessary on the planning and design stages of structural and restoration projects. Develop a plan for implementing selected programmatic measures.
Annually	Develop a monitoring and maintenance plan for stormwater improvement projects under construction.
Annually	Monitor and maintain all ACC-managed BMPs according to the monitoring and maintenance schedule. Maintain a database of records of monitoring and maintenance events, including BMP monitoring checklists.
Annually	Review water quality data from the previous year and flag or highlight measurements that exceed state water quality standards or ACC benchmark values.
Annually	Document progress such as monitoring, maintenance, and project implementation in the annual report to GaEPD.
Every 3–5 Years	Review water trends and identify areas of improvement or degradation. If the monitoring results indicate water quality degradation, ACC should: o Try to identify point sources of any degradation; o Attempt to identify the cause of the degradation; o Evaluate the current BMPs established; and o Propose additional BMPs that might address the cause of the degradation.
Every 3-5 Years	Review the long-term monitoring program. Plan which watersheds will be monitored over the next 3 years as part of the rotating schedule. Determine if there should be any changes to monitoring station locations.
Every 5-10 Years	Conduct stream assessments in the watershed to identify areas of erosion, maintenance needs, and opportunities for bank stabilization or stream restoration.
Every 5-10 Years	Update the WMP to reflect changes in the watershed, updated stream assessment and water quality data, BMPs that were implemented (remove from the list), and new watershed management opportunities.

4.2 Monitoring and Maintenance

Regular monitoring and maintenance will need to be conducted for any site-specific management measures that are implemented. Visual assessments should be conducted regularly to ensure that measures are functioning properly and in good repair, and that the vegetation is healthy and well maintained. Structural measures should be monitored at least quarterly during the first 2 years after construction and annually thereafter. Additionally, they should be inspected after the first couple of large rain events following construction to assess their performance following storm events.

Regular monitoring events should include an assessment of general site conditions, notes on areas of failure or instability, a vegetation assessment, photographic documentation, and identification of any maintenance needs or adaptive management measures that might be required. BMP monitoring checklists are provided for numerous types of BMPs in the *2016 Georgia Stormwater Management Manual* (ARC 2016).

4.3 Potential Funding Sources

The implementation costs for both programmatic and structural BMPs can be restrictive for local governments when budgeting for projects across several departments. Fortunately, a number of programs exist to help fund projects to achieve water resource management goals. The following list summarizes the most relevant funding opportunities for ACC:

- **USEPA Clean Water Act Nonpoint Source Grant (Section 319 Grants):** Funded by USEPA through the Clean Water Act and administered by GAEPD, these grants provide funding for best management practices (BMPs) and other water quality improvement efforts. They require a 40% non-federal match that can be met through local funds, in-kind services, or other non-federal sources. Applications are typically due in the fall of each year, and awards are announced in the spring.
  https://epd.georgia.gov/section-319h-georgias-nonpoint-source-implementation-grant

- **USEPA Clean Water State Revolving Fund (CWSRF):** Administered by the Georgia Environmental Finance Authority, the CWSRF provides low-interest loans for a variety of pollution prevention projects, including: water quality and water conservation; repairing and replacing stormwater control projects; and implementing water conservation projects and programs. Loans are available at a low interest rate for a maximum of 30 years. http://gefa.georgia.gov/clean-water-state-revolving-fund

- **U.S. Department of Transportation (USDOT) Transportation Alternatives Set-Aside:** The Transportation Alternatives Set-Aside provides funding for many activities relating to highways, including stormwater management, control, and water pollution prevention or abatement related to highway construction or due to highway runoff. Projects involving streetscaping and corridor landscaping may also be eligible. Transportation projects funded under this grant program must originate through a competitive grant project selection process in consultation

with Georgia DOT. Most awards require a 20% state or local match. http://www.fhwa.dot.gov/environment/transportation_alternatives/

4.4 Milestones and Evaluation Criteria

The achievement of any plan requires evaluation criteria and measures of success. Milestones met relative to this WMP (such as completion of a management action from the implementation schedule) will be noted in appropriate sections of the annual report.

Short-term and long-term evaluation criteria listed in this section can be used to determine the level of success of WMP implementation.

4.4.1 Short-Term Criteria

- Have BMPs been monitored according to schedule? Are records up to date?
- Has water quality monitoring been conducted as scheduled? Are records up to date?
- Have stream assessments been conducted as scheduled? Are records up to date?
- Have watershed improvement projects been implemented as planned?

4.4.2 Long-Term Criteria

- Does water quality monitoring indicate an improvement in water quality?
- Have BMPs implemented as part of the Impaired Waters Monitoring Plan made progress towards addressing stream impairments? This can be measured through BMP monitoring or through documenting the utilization of ACC programs (i.e. attendance at educational workshops or use of pet waste stations).

4.5 Adaptive Management

This WMP was developed based on the best available information at the time. As changes occur in the watershed, or additional water quality data become available, or as funding opportunities change, watershed management needs and management opportunities might change. Sometimes the best opportunities are those that take advantage of other planned projects or situations of the time such as a planned transportation or infrastructure project in which stormwater improvement measures could be incorporated cost effectively, or the presence of a strong advocate or partner such as a school superintendent who wants to use green infrastructure as an educational opportunity for the school system. Therefore, this WMP should be revisited regularly and revised as needed to ensure that the watershed continues to be managed effectively into the future.

5 References

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