Total Maximum Daily Load

Evaluation

for

One Segment

in the

Oconee River Basin

for

Cadmium

Submitted to:
The U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:
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Atlanta, Georgia

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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list, as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* (EPD, 2014).

Some of the 305(b) not supporting water bodies are also assigned to Georgia's 303(d) list, named after that section of the CWA. Water bodies on the 303(d) list are denoted by a Category of 5, and are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality criteria. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

The State of Georgia has identified one stream segment located in the Oconee River Basin as impaired for cadmium. The water use classification of the impacted stream is Fishing. The general and specific water quality criteria for Fishing streams are stated in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03, Sections (5) and (6).

The calculation of the cadmium load at any point in a stream requires the cadmium concentration and stream flow. The availability of water quality and flow data varies considerably in the listed segment. The Mass Balance Approach was used to determine the current cadmium load and TMDL. The cadmium load and required reduction for the listed streams are summarized in the table below.

Total Dissolved Cadmium TMDL Summary for the Impaired Stream Segment in the Oconee River Basin

Stream Segment	Criteria	Current Load	WLA	WLA_{SW}	LA	MOS	TMDL	Reduction
Little Commissioner Creek	Acute	Q x 2.55 µg/L	-	-	1.02×10^{-2} kg/day for the 1Q10 ΣQ_{LA} x 0.87 µg/L for all conditions and flows	Implicit	1.02×10^{-2} kg/day + WLA for the 1Q10 Q_{total} x 0.87 µg/L for all conditions and flows	65.9%
	Chronic	Q x 2.55 µg/L	-	-	5.21×10^{-3} kg/day for the 7Q10 ΣQ_{LA} x 0.4 µg/L for all conditions and flows	Implicit	5.21×10^{-3} kg/day + WLA for the 7Q10 Q_{total} x 0.4 µg/L for all conditions and flows	84.3%

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list, as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* (EPD, 2014).

A subset of the water bodies that do not meet designated uses on the 305(b) list are also assigned to Georgia's 303(d) list, named after that section of the CWA. Although the 305(b) and 303(d) lists are two distinct requirements under the CWA, Georgia reports both lists in one combined format called the Integrated 305(b)/303(d) List, which is found in Appendix A of *Water Quality in Georgia* (EPD, 2014). Water bodies included in the 303(d) list are denoted by Category 5, and are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality criteria. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

The State of Georgia has identified one segment, Little Commissioner Creek, located in the Oconee River Basin as not supporting its designated use due to exceedances of water quality standards for cadmium. This stream segment has been included on the 2014 303(d) list for exceedance of the cadmium criteria (Table 1).

Table 1. Water Body Listed for Cadmium in the Oconee River Basin

Reach ID	Water body	Segment	County	Segment Length (miles)	Designated Use
R030701020503	Little Commissioner Creek	Ga. Hwy. 18 to Commissioner Creek	Wilkinson	9	Fishing

1.2 Watershed Description

The Oconee River Basin is located in central Georgia, occupying an area of approximately 5,326 square miles (EPD, 2003). The Upper Oconee Basin is made up of the Oconee River, Apalachee River, Indian Creek, and Murder Creek sub-watersheds. These converge at Lake Sinclair. The City of Athens is a major populated area through which the Upper Oconee River flows. From Lake Sinclair, the Oconee River flows south and southeast past the City of Milledgeville, continues south through the City of Dublin, and then travels approximately 110 miles until it finally joins the Ocmulgee River near the City of Hazlehurst, to form the Altamaha River.

The Upper Oconee River lies in the Piedmont Physiographic Province and the Lower Oconee River occurs in the Coastal Plain Physiographic Province. Little Commissioner Creek flows into Commissioner Creek near the City of McIntyre. Commissioner Creek continues eastward approximately 18 mile where it joins the Lower Oconee River. The Oconee River Basin includes two United States Geologic Survey (USGS) eight-digit hydrologic units, HUC 03070101 (Upper Oconee River watershed), and HUC 03070102 (Lower Oconee River watershed. Figure 1 shows the location of the Oconee River Basin in the State of Georgia. Figure 2 shows the locations of the two hydrologic units within the Oconee River Basin, and Figure 3 indicates the location of the 303(d) listed stream segment in the Oconee River Basin.

The land use characteristics of the Oconee River Basin watersheds were determined using data from the Georgia Land Use Trends (GLUT) for year 2008, which was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL). Table 2 lists the watershed land use distribution for each watershed.

1.3 Regional Water Planning Councils

The 2008 Comprehensive State-wide Water Management Plan established Georgia's ten Regional Water Planning Councils (RWPCs). The boundaries of these ten RWPCs, in addition to the Metropolitan North Georgia Water Planning District or MNGWPD, established under a separate statute, are shown in Figure 4. In 2011, each RWPC developed and adopted Regional Water Plans, which identify ranges of actions or management practices to help meet the state's water quality challenges. Implementation of these plans is critical to meeting Georgia's water resource challenges. The specific regional plan(s) applicable to this TMDL are discussed in Sections 6 and 7.

1.4 Water Quality Standards

The water use classification for the listed stream segment in the Oconee River Basin is Fishing. The Fishing classification, as stated in Georgia's Rules and Regulations for Water Quality Control Chapter 391-3-6-.03(6)(a) (EPD, 2015), is established to protect "Propagation of Fish, Shellfish, Game and Other Aquatic Life; secondary contact recreation in and on the water; or for any other use requiring water of a lower quality."

Chapter 391-3-6-.03(5)(e)(ii) of Georgia's Rules and Regulations establishes criteria for metals that apply to all waters in the state. These are based on EPA's national recommended aquatic life ambient water quality criteria. Recently, EPA updated its national recommended criteria for dissolved cadmium. EPA's updated national recommended aquatic life ambient water quality acute and chronic criteria for dissolved cadmium are as follows:

$$\text{acute criteria dissolved cadmium} = (e^{(0.9789[\ln(\text{hardness})] - 3.866)})(1.136672 - [\ln \text{hardness})(0.041838)])\ \mu g/L$$

$$\text{chronic criteria dissolved cadmium} = (e^{(0.7977[\ln(\text{hardness})] - 3.909)})(1.101672 - [\ln \text{hardness})(0.041838)])\ \mu g/L$$

The State of Georgia is in the process of adopting updated criteria for cadmium in Chapter 391-3-6-.03(5)(e)(ii) of Georgia's Rules and Regulations to reflect EPA's updated criteria. The calculated TMDLs in this document are based on EPA's updated cadmium criteria.

The hardness of the water body is used in the above equations, and is expressed in mg/L as $CaCO_3$.

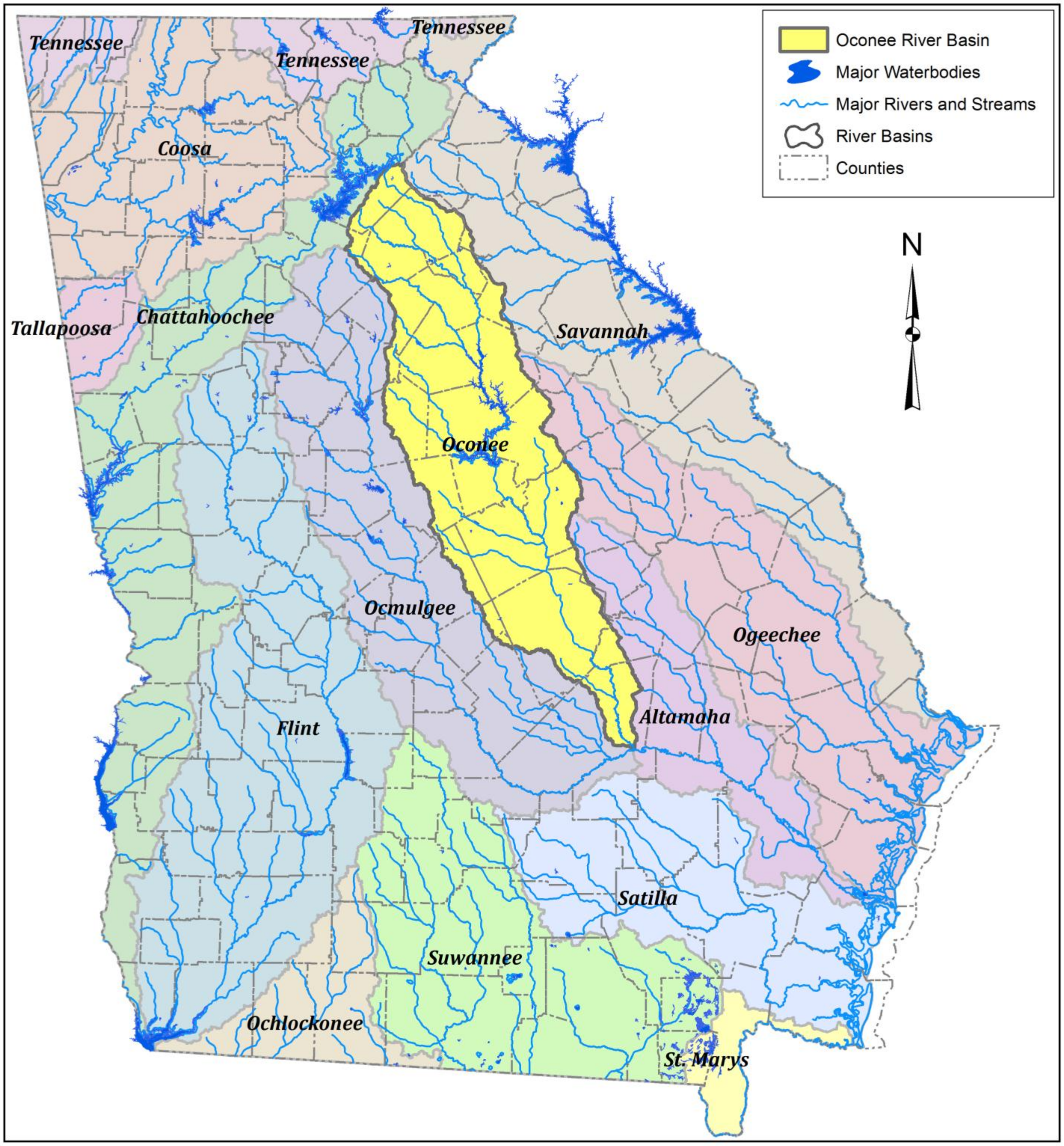

Figure 1. Location of the Oconee River Basin in the State of Georgia

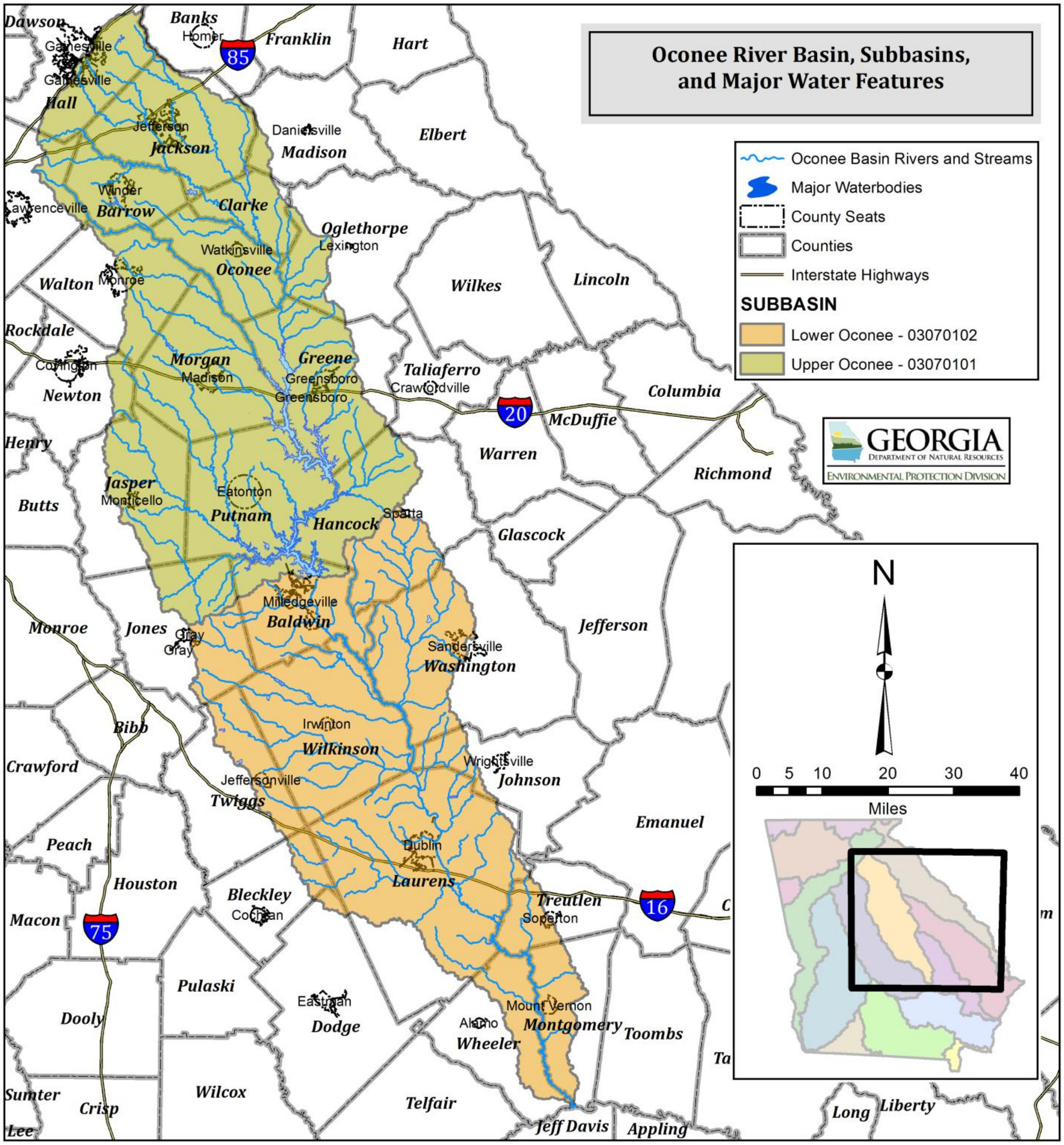

Figure 2. Location of the Two USGS 8-Digit HUCs of the Oconee River Basin

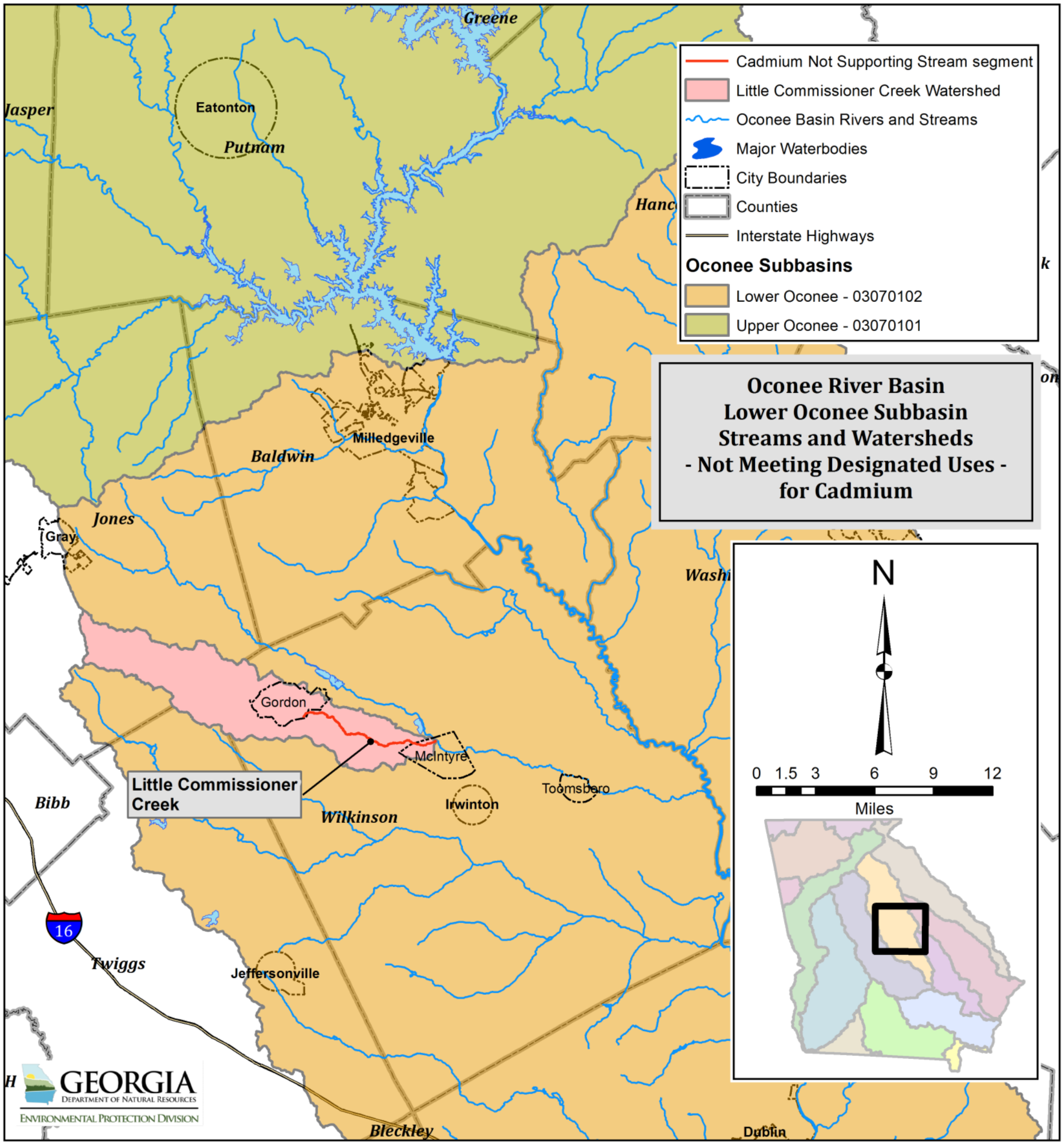

Figure 3. Location of the 303(d) Stream Segment Listed for Cadmium in the Oconee River Basin

Table 2. Oconee River Watersheds Land Cover Distribution, Acres (Percentage)

Stream/Segment	Land Use Categories - Acres (Percent)													
	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total
Little Commissioner Creek	358	750	252	273	62	836	1,880	2,0028	2,068	744	1,195	2,870	33	31,348
	1.14%	2.39%	0.80%	0.87%	0.20%	2.67%	6.00%	63.9%	6.6%	2.37%	3.81%	9.16%	0.11%	100.0%

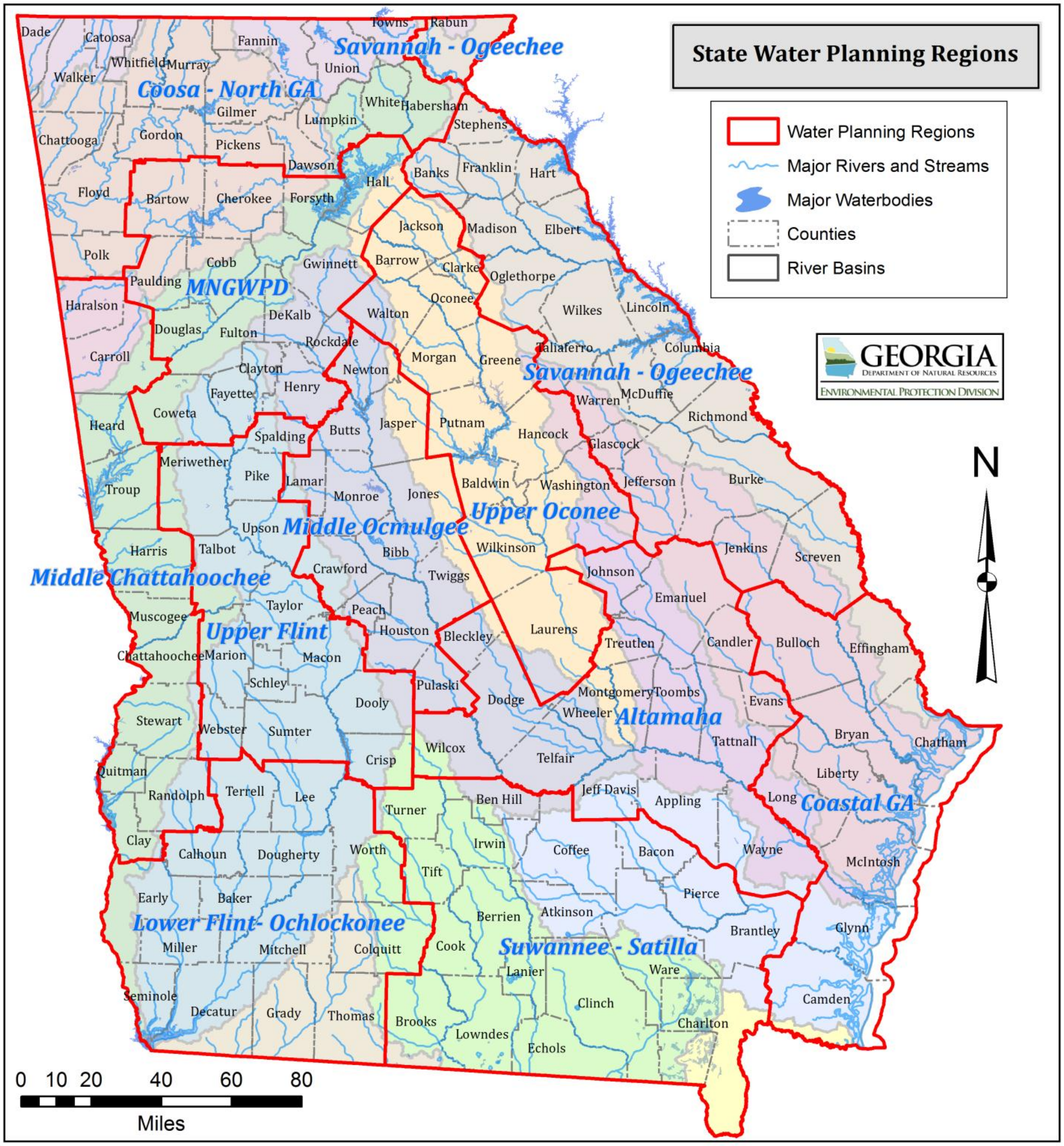

Figure 4. Boundaries of the Regional Water Planning Councils and the Metropolitan North Georgia Water Planning District

The regulation cited above requires that instream concentrations of the dissolved metals shall not exceed the acute criteria, under 1Q10 or higher stream flow conditions, and shall not exceed the chronic criteria indicated above, under 7Q10 or higher stream flow conditions.

1.5 Background Information for Cadmium

Cadmium is a relatively rare, naturally occurring metal found in mineral deposits and distributed widely at low concentrations in the environment. Cadmium enters the environment as a result of both natural processes (weathering and erosion of rock and soils), and anthropogenic sources (mining, agriculture, manufacturing, urban activities, waste streams from industrial processes and municipal effluent, burning of fossil fuels). Cadmium is also present as an impurity in mining ores that also contain zinc, lead and copper. Cadmium is no longer actively mined in the U.S. or Canada, but it is produced domestically as a by-product of the extraction, smelting and refining of zinc, copper and lead ores (USGS 2013).

Cadmium's primary industrial uses are for the manufacturing of nickel-cadmium batteries, pigments, plastic stabilizers, metal coatings, alloys and electronics. Recently, cadmium has been used in manufacturing nanoparticles for use in solar cells and color displays (EPA, 2016).

Cadmium is a non-essential metal with no biological function in aquatic animals. It is an extremely toxic industrial and environmental pollutant. It is classified as a human carcinogen. Inhaling cadmium-laden dust quickly leads to respiratory tract and kidney problems which can be fatal (often from renal failure). Ingestion of any significant amount of cadmium causes immediate poisoning and damage to the liver and the kidneys (ATSDR, 2008). In aquatic organisms acute effects cause an increase in mortality. Chronic exposure can lead to adverse effects on growth, reproduction, immune and endocrine systems, development, and behavior (EPA, 2016).

2.0 WATER QUALITY ASSESSMENT

The designated use support determinations for the impaired stream segment in the Oconee River Basin were made for cadmium based on water quality samples taken by the Georgia Environmental Protection Division (EPD) Watershed Planning and Monitoring Program for year 2011. Fish kill events occurred in Little Commissioner Creek in September 2011 following a series of small storm events (see Section 3.3 for further information regarding measured precipitation and stream flows). The EPD conducted the water quality sampling over the next two months at several locations along Little Commissioner Creek to determine the cause of the fish kills.

The water quality data for the listed segment of Little Commissioner Creek are provided in Table 3. For comparison with Georgia's instream water quality standards, the total recoverable cadmium values must be converted to estimated equivalent dissolved concentrations using a calculation translator. The translation is based on total suspended solids (TSS). As the TSS increases, less of the total cadmium will be in dissolved form. The sample results presented in Table 3 include total recoverable cadmium, TSS, and the translated dissolved cadmium concentrations. It also shows the sample hardness values, and the calculated acute and chronic cadmium criteria for Georgia's instream water quality standards, which are based on the hardness using the equations presented in Section 1.3.

The first sampling events were conducted September 29 and 30, 2011 shortly after the fish kills were reported. Cadmium was not detected at the upstream sites. However, elevated levels of cadmium were observed at both the downstream sites at Owens-Sheppard Road and Claymont Road, with the instream chronic criteria being exceeded at Claymont Road.

During the second round of sampling conducted approximately 3 weeks later in October 2011, cadmium concentrations at Owens-Sheppard Road dropped to below the reportable detection limit. At the same time, the calculated dissolved cadmium concentration had increased by nearly four times at Claymont Road, exceeding the acute criteria by two times, and exceeding the chronic criteria by nearly five times (Table 3).

The measured exceedances of the acute and chronic cadmium criteria by samples collected in Little Commissioner Creek resulted in the placement of this stream segment on Georgia's 2014 303(d) list.

Table 3. Cadmium Data Collected from Little Commissioner Creek, Oconee River Basin

Location	Date	Measured Total Recoverable Cadmium (μg/L)	Total Hardness (mg/L as $CaCO_3$)	TSS (mg/L)	Corresponding Dissolved Cadmium (μg/L)	Acute Criterion (μg/L)	Chronic Criterion (μg/L)
At Fall Line Road	9/30/2011	<0.7	NS	4.7	-	-	-
At US Hwy 18	10/19/2011	<0.7	21	5.8	-	-	-
At Owens-Sheppard Rd	9/30/2011	2.4	NS	190	0.80	-	-
At Owens-Sheppard Rd	10/19/2011	<0.7	NS	29	-	-	-
Claymont Road near. McIntyre, GA	9/29/2011	3.1	50	2.2	0.67	0.94	0.43
Claymont Road near. McIntyre, GA	10/19/2011	11.0	66	4.3	2.55	1.22	0.53

NS = Not Sampled

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of the potential sources of pollutants. A source assessment characterizes the known and suspected sources of cadmium in the watershed for use in the development of the TMDL. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of pollutants on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. There are two basic categories of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated storm water discharges.

3.1.1 Wastewater Treatment Facilities

In general, municipal and industrial wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or on water quality standards (water quality-based limits).

The United States Environmental Protection Agency (USEPA) has developed technology-based guidelines, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

The USEPA and the States have also developed numeric and narrative water quality standards. Typically, these standards are based on the results of aquatic toxicity tests and/or human health criteria and include a margin of safety. Water quality-based effluent limits are set to protect the receiving stream. These limits are based on water quality standards that have been established for a stream based on its intended use and the prescribed biological and chemical conditions that must be met to sustain that use.

For purposes of this TMDL, NPDES permitted wastewater treatment facilities are considered point sources, and include municipal, industrial, private, and Federal facilities. Currently, there are 5 NPDES permitted wastewater treatment facilities located within the impaired stream segment watershed. None of these facilities have permit limits that include cadmium or cadmium compounds, and they are not considered sources of cadmium for the impaired stream segment.

Combined sewer systems convey a mixture of raw sewage and storm water in the same conveyance structure to a wastewater treatment plant. These are considered a component of municipal wastewater treatment facilities. When the combined sewage exceeds the capacity of the wastewater treatment plant, the excess is diverted to a combined sewage overflow (CSO) discharge point. There are no CSO outfalls located within the impaired stream segment watersheds.

3.1.2 Regulated Storm Water Discharges

Certain sources of storm water runoff are covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe pollutant limits, storm water NPDES permits establish controls that are intended to reduce the quantity of pollutants that storm water picks up and carries into storm sewer systems during rainfall events. Currently, regulated storm water discharges include those associated with industrial activities, construction sites one acre or greater, large and medium municipal separate storm sewer systems (MS4s), and small MS4s serving urbanized areas.

3.1.2.1 Industrial General Storm Water NPDES Permit

Storm water discharges associated with industrial activities are currently covered under Georgia's General Industrial Storm Water NPDES Permit (GAR050000). This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (BMPs), preparation of a Storm Water Pollution Prevention Plan (SWPPP), and annual reporting (EPD, 2014). The Industrial General Permit (IGP) requires that storm water discharging into an impaired stream segment or within one linear mile upstream of, and within the same watershed as, any portion of an impaired stream segment identified as "not supporting" its designated use(s), must satisfy the requirements of Appendix C of the permit if the pollutant(s) of concern for which the impaired stream segment has been listed may be exposed to storm water as a result of industrial activity at the site. If a facility is covered under Appendix C of the IGP, then benchmark monitoring for the pollutant(s) of concern is required. There are no facilities in the Little Commissioner Creek watershed covered under the IGP that are considered to have the potential for discharging cadmium based on their SIC Codes, Sector designation, and required benchmark monitoring.

3.1.2.2 MS4 NPDES Permits

The collection, conveyance, and discharge of diffuse storm water to local water bodies by a public entity are regulated in Georgia by the NPDES MS4 permits. These MS4 permits have been issued under two phases. Phase I MS4 permits cover medium and large cities, and counties with populations over 100,000. Each individual Phase I MS4 permit requires the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. A program to monitor and control pollutants in storm water discharges from industrial facilities, construction sites, and highly visible pollutant sources that exist within the MS4 area must be implemented under the permit. Additionally, monitoring of not supporting streams, public education and involvement, post-construction storm water controls, low impact development, and annual reporting requirements must all be addressed by the permittee on an ongoing basis.

Small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Thirty (30) counties, fifty-six (56) communities, seven (7) Department of Defense facilities, and the Georgia Department of Transportation (GDOT) are permitted under the Phase II regulations in Georgia. All municipal Phase II permitees are authorized to discharge under Storm Water General Permit GAG610000. Department of Defense facilities are authorized to discharge under Storm Water General Permit GAG480000. GDOT owned or operated facilities are authorized to discharge under Storm Water General Permit GAG410000. Under these general permits, each permittee must design and implement a SWMP that incorporates BMPs that focus on public education and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction storm water management, and pollution prevention in municipal operations.

Table 4. Permitted MS4s in the Oconee River Basin

Stream Segment	MS4 Permittees	MS4 Phase
Little Commissioner Creek	Jones County	2

Source: Nonpoint Source Program, GA DNR, 2015

The land use types that are considered urbanized and include regulated storm sewer systems are 1) developed open space, 2) developed low intensity, 3) developed medium intensity, 4) developed high intensity, 5) utility swaths, and 6) golf courses. A portion of the Little Commissioner Creek watershed is located in Jones County, an MS4 Phase 2 permittee (Table 4). However, there are no areas within its watershed that are defined as urbanized with regulated storm sewer systems.

3.2 Nonpoint Source Assessment

In general, nonpoint sources cannot be identified as entering a water body through a discrete conveyance at a single location. In urban areas, a large portion of the storm water contribution may enter waterways as point sources from MS4 NPDES permitted outfalls, or from industrial sites covered under the Georgia Industrial General Permit. The remainder of the storm water runoff will come from nonpoint sources.

Potential nonpoint sources include the following:

- Storm water runoff as overland flow from improper disposal of waste materials;
- Deposition of particulates from air emissions;
- Contaminated groundwater seepage;
- Leaking or overflowing sanitary sewer lines;
- Failing septic systems;
- Leachate from landfills within the watershed;
- Storm water runoff from private outfalls not covered under NPDES MS4 permits;
- Storm water runoff from industrial sites not currently included under the Georgia General Industrial Permit;

An assessment of the potential sources of cadmium in impaired stream segments was performed using available resources, which included the following databases:

- USEPA Toxics Release Inventory (TRI)
- USEPA List of Superfund Sites (SEMS)
- USEPA Brownfields Program
- EPD Brownfields Public Record
- EPD Hazardous Site Inventory (HSI)
- EPD Inventory of Permitted Solid Waste Disposal Facilities

3.2.1 Toxic Release Inventory (TRI)

The TRI is a database maintained by the USEPA that provides information about facilities that handle toxic chemicals. Facilities in certain industry sectors that manufacture, process, or otherwise use these chemicals in amounts above established levels, must report how each chemical is managed. The TRI contains information about releases of these chemicals to the environment, including air emissions, surface water discharges, releases to the land, and off-site transport to disposal facilities.

There are no facilities included on the TRI that have reported releases of cadmium or cadmium compounds above established reportable levels within the Little Commissioner Creek drainage area.

3.2.2 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sites

The Comprehensive Environmental Response, Compensation, and Liability Act, otherwise known as CERCLA or Superfund, along with Superfund Amendments and Reauthorization Act (SARA) of 1986, provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. EPA maintains SEMS (formerly CERCLIS), which is a list of Superfund sites for all States in the U.S. There are no sites included in SEMS that are located within the Little Commissioner Creek drainage area that are known to have released cadmium or cadmium compounds above reportable quantities as determined by EPD.

3.2.3 Hazardous Site Index (HSI)

The HSI is maintained by EPD. Industrial sites are placed on the list by EPD when there has been a known release into the environment of a regulated substance above a reportable quantity that may pose a risk to human health and the environment. There are no sites on the HIS located within the Little Commissioner Creek drainage area that are known to have released cadmium or cadmium compounds above reportable quantities as determined by EPD.

3.2.4 Brownfields

A brownfield is a property on which activities, often by former owners or tenants, have resulted in the presence or potential presence of a hazardous substance, pollutant, or contaminant. EPA maintains a list of known brownfields that have been identified as potential candidates for cleanup activities through its Brownfields program, and for sites where cleanup operations are underway or have been completed. Georgia has developed a public record of Brownfields located within the State through funding provided by the EPA. The Brownfield public record is maintained by EPD’s Land Protection Branch Brownfield Development Unit. There are no Brownfields listed on either EPA’s Brownfields list or Georgia’s Brownfield public record that are located within the Little Commissioner Creek drainage area.

3.2.5 Solid Waste Disposal Facilities

Leachate from landfills may contain dissolved cadmium or cadmium compounds that could at some point reach surface waters. Sanitary landfills receive household wastes that may include household and yard chemicals and relatively small amounts of construction and demolition wastes generated from private homeowner activities. Active sanitary landfills are lined and have leachate collection systems. The large portion of waste generated from construction and demolition activities are sent to landfills designated for these materials. Because these wastes are mostly inert and have a low potential to leach to groundwater, construction/demolition landfills are not lined and do not have leachate collection systems. Older sanitary landfills were not lined and most have been closed. Those landfills that are not lined and remain active operate as construction/demolition landfills. Also, landfills associated with mining operations are usually not lined and ground water monitoring is not required (EPD, 2016). Currently, active sanitary landfills are lined and have leachate collection systems. All landfills, excluding inert landfills, are now required to install environmental monitoring systems for groundwater and methane sampling. There are three known landfills located within the impaired stream segment watershed (Table 5). Of these, one is an active landfill, and two are closed.

Table 5. Landfills Upstream of 303(d) Listed Segment in the Oconee River Basin

Name	303(d) Listed Stream Segment	County	Permit No.	Status
SR 57 Public Works Camp	Little Commissioner Creek	Wilkinson	158-010D(SL)	Closed
BASF-McIntyre #2	Little Commissioner Creek	Wilkinson	158-013D(LI)	Closed
BASF Corp-Gordon #2	Little Commissioner Creek	Wilkinson	158-014D(LI)	Operating

Source: Land Protection Branch, GA DNR, 2015

3.3 Mining Operations

Kaolin clay is found primarily in 13 counties in middle Georgia: Glascock, Jefferson, Richmond, Twiggs, Warren, Washington, Wilkinson, McDuffie, Hancock, Baldwin, Houston, Macon, and Sumter ("Georgia's Best Management Practices for Mining", 2008). The region in which Little Commissioner Creek is located is an area of intense kaolin mining. In Georgia, kaolin clay mining and production is associated with the majority of the land permitted by EPD for mining. Making a finished kaolin product requires considerable mechanical and chemical processing and typically requires numerous environmental permits such as air (Title V, PSD, Synthetic Minor, etc.), NPDES wastewater, NPDES storm water, and water withdrawal permits ("Georgia's Best Management Practices for Mining", 2008). Several large mining and processing facilities are located in the Little Commissioner Creek watershed. Due to the widely-dispersed nature of kaolin deposits of varying composition and quality within this region an extensive network of pipelines was developed to carry raw material, usually in the form of kaolin slurry, between the various mines and the processing facilities. The processing facilities can often be several miles from the mines.

Commercial kaolin mining and processing activities have taken place in Georgia for more than 100 years, with kaolin operations in McIntyre beginning as early as 1908 (BASF, 2017). BASF operates a kaolin processing plant in Gordon located at the upstream end of Little Commissioner Creek. Active Minerals International has a kaolin processing facility located adjacent to a small tributary that enters Little Commissioner Creek, approximately two miles downstream from the BASF Gordon facility. BASF operates a large kaolin mine located further downstream in the vicinity of the confluence with Commissioner Creek, near the City of McIntyre. Although the kaolin clay is the primary focus of these operations, the mined clay deposits contain small amounts of other naturally occurring metals. For example, the kaolin ores in the region where Little Commissioner Creek is located contain varying amounts of zinc, and as mentioned in Section 1.5, cadmium may be present as an impurity in mining ores that also contain zinc, lead and copper.

3.3.1 EPD Sampling Results

In September 2011, fish kills occurred in Little Commissioner Creek following a series of rain events. The EPD conducted an investigation that included water quality sampling at several locations along the creek to determine the cause of the fish kill. The first round of sampling was conducted on September 29 and 30, 2011, on Little Commissioner Creek, shortly after the fish kills were reported. Precipitation records from the NOAA Gray weather station, located approximately 9 miles west of the headwaters for Commissioner Creek, showed that the accumulated rainfall for the eight days prior to the sampling event was 6.45 inches (NOAA, 2016). For the same time period, the USGS weather station in McIntyre, GA (USGS 02223190), located downstream on Commissioner Creek at U.S. 441, recorded an accumulated rainfall of only 1.47 inches. The USGS flow gage located on Commissioner Creek at McIntyre, GA (USGS 02223190) shows a modest rise in average daily flow occurred, going from 9.3 cfs prior to the start of the rain events to a peak of 25 cfs four days later. Because no flow gage exists on Little Commissioner Creek, flows were calculated for this same time period based on Commissioner Creek flows using the proportion of the Little Commissioner Creek drainage area at its confluence with Commissioner Creek, to that of Commissioner Creek. The calculated average daily flow for Little Commissioner Creek was estimated to increase from a baseflow of 2.9 cfs to a peak flow of 7.9 cfs over the same four days.

The EPD sampling results for Little Commissioner Creek are presented in Table 6. The table shows the sample site locations, a description of each site in relation to the kaolin operations within the Little Commissioner Creek watershed, the dates samples were collected, and the recoverable cadmium and calculated dissolved cadmium concentrations for each sample.

During the first round of sampling conducted on September 29 and 30, the total cadmium concentration in Little Commissioner Creek at Fall Line Road, located upstream from the kaolin facilities, showed the total recoverable cadmium concentrations to be below the detection limits (Table 6). Total cadmium concentrations increased downstream from the kaolin operations. At Owens-Sheppard Road the total cadmium was 2.4 µg/L. At Claymont Road the total cadmium concentration was 3.1 µg/L, and the calculated dissolved concentration of 0.67 µg/L exceeded the instream chronic criteria by 1.5 times. During the same time samples taken from the BASF Gordon facility Outfall 001 and the BASF McIntyre Outfall 005 showed cadmium levels to be below reportable detection limits (Table 6).

A second round of samples were collected on October 19, 2011, at three locations on Little Commissioner Creek, approximately three weeks after the fish kill was reported. The total recoverable cadmium concentrations at the upstream sample sites at US Highway 18 and Owens-Sheppard Road were below the reportable detection limits. However, at Claymont Road the total cadmium concentration had increased to 11.0 µg/L, more than three times what was observed 3 weeks prior. The calculated dissolved cadmium concentration of 2.55 µg/L exceeded the cadmium acute criteria by 2 times and the chronic criteria by nearly 5 times.

In summary, the water samples collected by EPD from Little Commissioner Creek over the time period from September 29 to October 19, 2011 showed exceedances of both the acute and chronic instream water quality standards for cadmium. All of the exceedances of the cadmium standards occurred downstream from the kaolin mining and processing industries. These exceedances of the cadmium standards resulted in these stream segments being placed on Georgia's 2014 303(d) list of impaired streams.

Table 6. EPD Sample Results: Total Cadmium Concentrations for Water Samples Collected from Little Commissioner Creek

Little Commissioner Creek Sample Sites				
Sample Site	**Sample Site Description**	**Sample Date**	**Total Cadmium (µg/L)**	**Dissolved Cadmium (µg/L) (1)**
Fall Line Road	Farthest upstream site, approximately 3 miles upstream from BASF Gordon Plant	9/30/2011	<0.7	<0.7
BASF Gordon Outfall 001	1 mile upstream from Owens-Sheppard Road	9/30/2011	<0.7	<0.7
Owens-Sheppard Road	Approximately 1 mile downstream from BASF Gordon Plant main outfall.	9/30/2011	2.4	0.80
Claymont Road	6 miles downstream from BASF Gordon Plant, 4 miles downstream from Active Minerals International, 0.6 miles upstream from BASF McIntyre Mine, 1.1 mile upstream from BASF Brannon Outfall 005.	9/29/2011	3.1	0.67
BASF McIntyre Outfall 005	1.1 mile downstream from Claymont Road	9/30/2011	<0.7	<0.7
SR 18	Immediately south and adjacent to BASF Gordon Plant, upstream from Outfall 001	10/19/2011	<0.7	<0.7
Owens-Sheppard Road	Approximately 1 mile downstream from BASF Gordon Plant main outfall.	10/19/2011	<0.7	<0.7
Claymont Road	6 miles downstream from BASF Gordon Plant, 4 miles downstream from Active Minerals International, 0.6 miles upstream from BASF McIntyre Mine, 1.1 mile upstream from BASF Brannon Outfall 005.	10/19/2011	11.0	2.55

(1) Calculated based on measured hardness and total suspended solids

3.3.2 Georgia Mining Association Studies

Under a Memorandum of Agreement (MOA) between the Georgia Mining Association (GMA) and EPD, a study is currently being conducted by the GMA to characterize the discharges and receiving streams for several kaolin operations located in the region. With respect to facilities located within the Little Commissioner Creek watershed, the study included the BASF Gordon processing facility and the BASF McIntyre Mine (GMA, 2016, Nutter & Associates, Inc., 2015a, Nutter & Associates, Inc., 2015b; Nutter & Associates, Inc., 2016a; Nutter & Associates, Inc., 2016b). A kaolin processing plant owned and operated by Active Minerals International that is located near an unnamed tributary to Little Commissioner Creek downstream from the BASF Gordon Plant, was not considered in the study. The GMA study has included developing background levels of chemical constituents in the water and sediments of reference streams for the region, chemical analyses of the water and sediments at several locations along the 303(d) listed segment of Little Commissioner Creek, and characterizing the permitted outfalls of kaolin mines and processing facilities discharging to the listed segment.

3.3.2.1 Stream and Sediment Study

During the initial phase of the study, water and sediment samples were collected at six reference sites from streams located in the Gordon-McIntyre area to establish background levels of constituents. The reference sites included:

- Little Black Creek at U.S. Highway 441 (site SSR05)
- Maiden Creek at U.S. Highway 441 (site SSR06)
- Cedar Creek at U.S. Highway 441 (site SSR07)
- Sandy Hill Creek at SR 272 (site SSR08)
- Black Creek at Mt. Pleasant Church Road (site SSR11)
- Little Sandy Creek at Baker Road (site SSR13)

Four to six water quality samples were collected on separate dates from each reference site. All water samples collected at the reference sites, totaling 28 samples, showed total cadmium concentrations to be below the method detection limit of 5 µg/L. It should be pointed out that this particular method detection limit for cadmium is quite high. When translated to dissolved cadmium based on the observed TSS and total hardness at the reference sites, the detection limit was nearly always greater than the acute criteria for cadmium, and was always greater than the chronic cadmium criteria. Therefore, based on the analytical methods used by the GMA, it could not be determined if cadmium levels ever exceeded the water quality criteria at the reference sites. The median concentration of total recoverable cadmium in the sediments at all of the reference sites were below either the method detection limit or the method reporting limit.

The GMA collected sediment samples at sites along Little Commissioner Creek. The locations and descriptions of these sites relative to the kaolin mining and processing facilities, along with sample results are presented in Table 7.

Table 7. GMA Sample Results: Total Cadmium Concentrations in Sediments from Little Commissioner Creek, September 17, 2014

Sample Site ID	Sample Site Description	Total Cadmium (mg/kg)
LCC01	At SR18, immediately south and adjacent to BASF Gordon Plant, upstream from Outfall 001.	0.76
LCC02	Owens-Sheppard Rd., approximately 1 mile downstream from BASF Gordon Plant main outfall.	0.06 (1)
LCC03	At RR crossing #1, two miles downstream from LCC02, downstream from Active Minerals International.	0.03 (1)
LCC04	At RR crossing #2, 1.5 miles downstream from LLC03.	0.66
LCC05	Claymont Road, 2 miles downstream from LLC04, 0.6 miles upstream from BASF McIntyre Mine, 1.1 mile upstream from BASF Brannon Outfall 005.	0.06 (1)
LCC06	Sheppard Bridge Rd, 2 miles downstream from LLC05, adjacent to BASF McIntyre Mine, downstream from BASF Brannon Outfall 005, upstream from BASF Vinson Outfall 004.	0.64

(1) Below the Method Reporting Limit

Cadmium concentrations measured in the Little Commissioner Creek sediments varied considerably (Table 7). The furthest upstream sample site, LCC01, located near the BASF Gordon facility, had a median total recoverable cadmium of 0.76 mg/kg. Downstream at LCC02 and LCC03, the total cadmium in the sediments dropped below the method reporting limit. At LCC04, the sediment cadmium concentration was 0.66 mg/kg, dropping to below the reporting limit at site LCC05. At LCC06, the furthest downstream site, total cadmium increased again to 0.64 mg/kg.. It appears that in Little Commissioner Creek sediments containing cadmium accumulated in “pockets” in areas adjacent to or downstream from the kaolin facilities. At LCC01, LCC04, and LCC06 cadmium concentrations were greater than at reference sites. At the remaining sites concentrations were below the method reporting limit. The established EPA sediment screening level of 0.99 mg/kg was not exceeded at any site.

Sediments which have been deposited in stream beds may remain for long periods of time. Thus, the cadmium-laden sediments in Little Commissioner Creek may be due in part to legacy depositional processes. The observed increase in cadmium concentrations in the water column following some storm events may be the result of both freshly-deposited cadmium-laden sediments and the re-suspension of previously deposited sediments.

Water quality samples were collected from Little Commissioner Creek for both a dry-weather sampling event and a wet-weather sampling event. These samples were taken at the same locations used for sediment sampling. In addition, samples were taken at the BASF Gordon Plant Outfall 001 and the BASF McIntyre Mine Brannon Outfall 005 during the dry-weather and wet-weather sampling events. Both outfalls discharge to Little Commissioner Creek. The dry-weather sampling event was conducted on September 17, 2014. The recorded average daily flow for Commissioner Creek at the USGS gage at Highway 441 in McIntyre was 56 cfs. The calculated average daily flow for Little Commissioner Creek was 17.6 cfs. The USGS weather station near Irwinton, GA., located approximately 3 miles south of McIntyre, showed the most recent recorded rainfall to be 0.33 inches four days prior to the dry-weather sampling event. The wet-weather sampling event took place on November 18, 2014, one day after a storm event totaling 1.33 inches. The average daily flow in Commissioner Creek rose from 56 cfs on the previous day to 138 cfs on the day of the sampling event. The calculated average daily flow for Little Commissioner Creek rose from 17.6 cfs to 43.3 cfs.

Tables 8 and 9 present the GMA sampling results for both baseflow and storm flow conditions. These tables also present the TSS and hardness values obtained for each sample site. The calculated dissolved cadmium is presented along with the calculated acute and chronic cadmium criteria based on conditions at each site.

The sample results for the baseflow sampling event (Table 8) showed total cadmium concentrations to be below the method reporting limit of 5.0 µg/L at all sample sites on Little Commissioner Creek. Cadmium levels in the effluents for the BASF Gordon Plant Outfall 001 and the BASF McIntyre Mine Outfall 005 were also below the method detection limit. The same results were observed for the samples collected as part of the storm flow sampling event (Table 9). Total cadmium levels at all sample sites on Little Commissioner Creek were below the method reporting limit of 5.0 µg/L, and were also below the method reporting limit in the effluents for the BASF Gordon Plant and the BASF McIntyre Mine. When the total cadmium reporting limit of 5.0 µg/L was translated to the equivalent dissolved cadmium concentration for each site, in nearly every instance, the resulting dissolved cadmium reporting limit was greater than both the acute and chronic criteria. This indicates that the method reporting limit was too reporting limit of 5.0 µg/L was translated to the equivalent dissolved cadmium concentration for each site, in nearly every instance, the resulting dissolved cadmium reporting limit was greater than both the acute and chronic criteria. This indicates that the method reporting limit was too

Table 8. GMA Sample Results: Total Cadmium Concentrations for Water Samples Collected from Little Commissioner Creek during Baseflow Conditions

Sample Site ID	Sample Site Description	TSS (µg/l)	Total Hardness (mg L as $CaCO_3$)	Total Cadmium (µg/l)	Dissolved Cadmium (µg/l)	Acute Criterion (µg/l)	Chronic Criterion (µg/l)
LCC01	At SR18, immediately south and adjacent to BASF Gordon Plant, upstream from Outfall 001.	8.0	23.1	<5.0 (1)	<1.24	0.46	0.24
BASF Gordon Outfall	1 mile upstream from Owens-Sheppard Rd	13.0	41.6	<5.0	<1.30	0.79	0.37
LCC02	Owens-Sheppard Rd, 1 mile downstream from BASF Gordon Plant main outfall.	7.0	32.4	<5.0	<1.23	0.63	0.31
LCC03	At RR crossing #1, two miles downstream from LCC02, downstream from Active Minerals International.	6.0	31.7	<5.0	<1.20	0.61	0.30
LCC04	At RR crossing #2, 1.5 miles downstream from LLC03.	11.0	30.5	<5.0	<1.27	0.59	0.29
LCC05	Claymont Road, 2 miles downstream from LLC04, 0.6 miles upstream from BASF McIntyre Mine, 1.1 mile upstream from Brannon Outfall 005.	9.5	30.2	<5.0	<1.25	0.59	0.29
BASF McIntyre Outfall	1.1 mile downstream from Claymont Road	5.5	243	<5.0	<1.19	4.11	1.40
LCC06	Sheppard Bridge Rd, 2 miles downstream from LLC05, adjacent to BASF McIntyre Mine, downstream from BASF Brannon Outfall 005, upstream from BASF Vinson Outfall 004.	18.5	115	<5.0	<1.34	2.04	0.80

(1) The less than "<" symbol indicates the analytical result to be below the Method Reporting Limit

reporting limit of 5.0 µg/L was translated to the equivalent dissolved cadmium concentration for each site, in nearly every instance, the resulting dissolved cadmium reporting limit was greater than both the acute and chronic criteria. This indicates that the method reporting limit was too high and the sampling results cannot be used to determine if exceedances of the cadmium criteria occurred. The BASF McIntyre outfall presented an exception, whereby the highly elevated total hardness of the effluent results in higher acute and chronic criteria that are greater than the method reporting limit. In this case, results show that the cadmium criteria are not exceeded. This increase in hardness carried down to site LCC06, which resulted in the dissolved cadmium reporting limit being less than the acute criteria, but it still exceeded the chronic criteria (Table 9). In this case, it is shown that the cadmium acute criteria were not exceeded. It cannot be determined if exceedances of the chronic criteria occurred.

Table 9. GMA Sample Results: Total Cadmium Concentrations for Water Samples Collected from Commissioner Creek During Storm Flow Conditions

Sample Site ID	Sample Site Description	TSS (µg/l)	Total Hardness (mg L as $CaCO_3$)	Total Cadmium (µg/l)	Dissolved Cadmium (µg/l)	Acute Criterion (µg/l)	Chronic Criterion (µg/l)
LCC01	At SR18, immediately south and adjacent to BASF Gordon Plant, upstream from Outfall 001.	13.0	17.6	<5.0 (1)	<1.30	0.35	0.19
BASF Gordon Outfall	1 mile upstream from Owens-Sheppard Rd	57.0	36.8	<5.0	<1.49	0.70	0.34
LCC02	Owens-Sheppard Rd, 1 mile downstream from BASF Gordon Plant main outfall.	23.5	21.0	<5.0	<1.37	0.42	0.22
LCC03	At RR crossing #1, two miles downstream from LCC02, downstream from Active Minerals International.	44.0	30.3	<5.0	<1.45	0.59	0.29
LCC04	At RR crossing #2, 1.5 miles downstream from LLC03.	25.0	32.8	<5.0	<1.38	0.63	0.31
LCC05	Claymont Road, 2 miles downstream from LLC04, 0.6 miles upstream from BASF McIntyre Mine, 1.1 mile upstream from Brannon Outfall 005.	24..0	33.3	<5.0	<1.37	0.64	0.31
BASF McIntyre Outfall	1.1 mile downstream from Claymont Road	<5.0	231	<5.0	<1.18	3.92	1.35
LCC06	Sheppard Bridge Rd, 2 miles downstream from LLC05, adjacent to BASF McIntyre Mine, downstream from BASF Brannon Outfall 005, upstream from BASF Vinson Outfall 004.	14.0	70.0	<5.0	<1.30	1.29	0.55

(1) The less than "<" symbol indicates the analytical result to be below the Method Reporting Limit

To summarize, for both the baseflow and storm flow sampling events, total cadmium levels were below the method detection limit at all stream sites and at the BASF Gordon Plant and BASF McIntyre Mine outfalls. However, due to the high detection limit for the analytical method used by the GMA, the resulting equivalent dissolved cadmium detection limits for the Little Commissioner Creek sample sites and the BASF Gordon Plant outfall were nearly always greater than the acute and chronic cadmium criteria. Therefore, the majority of the data collected cannot be used to determine if exceedances of the acute and chronic criteria occurred in Little Commissioner Creek or at the BASF Gordon Plant outfall for either the base-flow or storm-flow sampling events.

3.3.2.1 Kaolin Mines Outfalls Characterization Studies

The GMA study has included a sampling program of the permitted outfalls for kaolin facilities that discharge into the 303(d) listed segment of Little Commissioner Creek. The purpose of the program has been to characterize the outfalls with respect to several parameters including cadmium.

Tables 10 through 12 present sample results for the BASF Gordon Plant Main Outfall 001, the BASF McIntyre Mine's Brannon Outfall 005 and Vinson Outfall 004, and results for samples collected upstream and downstream from each outfall. The Gordon Plant outfall is the furthest upstream on Little Commissioner Creek, located immediately downstream from the City of Gordon. The McIntyre Mine Brannan outfall is located approximately 7 miles downstream from the Gordon Plant outfall. The McIntyre Mine Vinson outfall is approximately 2 miles downstream from the Brannon outfall.

Table 10. GMA Sample Results: BASF Gordon Main Plant Outfall 001

Date	TSS (mg/L)	Hardness (mg/L as $CaCO_3$)	Outfall Total Cadmium (µg/L)	Outfall Dissolved Cadmium (µg/L)	Acute Criteria (µg/L)	Chronic Criteria (µg/L)
Outfall						
06/24/2014	16.5	39.6	<5.0	<1.33	0.75	0.36
07/14/2014	8.0	39.6	<5.0	<1.24	0.75	0.36
07/28/2014	11.0	38.1	<5.0	<1.27	0.73	0.35
08/11/2014	14.5	38.6	<5.0	<1.31	0.74	0.35
08/26/2014	8.0	37.6	<5.0	<1.24	0.72	0.34
09/17/2014	13.0	41.6	<5.0	<1.29	0.79	0.37
09/29/2014	15.5	39.0	<5.0	<1.32	0.74	0.35
10/01/2014	17.0	40.7	<5.0	<1.33	0.77	0.37
10/03/2014	10.5	40.9	<5.0	<1.27	0.78	0.37
10/13/2014	8.0	39.3	<5.0	<1.24	0.75	0.36
Upstream from Outfall						
06/24/2014	27.0	25.2	<5.0	<1.39	0.49	0.25
07/14/2014	8.0	23.7	<5.0	<1.24	0.47	0.24
07/28/2014	8.0	24.1	<5.0	<1.24	0.47	0.25
08/11/2014	15.0	21.6	<5.0	<1.31	0.43	0.23
08/26/2014	33.5	23.1	<5.0	<1.42	0.46	0.24
09/17/2014	12.0	23.7	<5.0	<1.29	0.47	0.24
09/29/2014	29.5	21.5	<5.0	<1.40	0.43	0.23
10/01/2014	17.0	21.9	<5.0	<1.33	0.43	0.23
10/03/2014	18.0	21.1	<5.0	<1.34	0.42	0.22
10/13/2014	14.0	20.9	<5.0	<1.30	0.41	0.22
Downstream from Outfall						
06/24/2014	22.5	28.7	<5.0	<1.37	0.56	0.28
07/14/2014	11.5	28.4	<5.0	<1.23	0.55	0.29
07/28/2014	10.0	28.6	<5.0	<1.26	0.56	0.28
08/11/2014	17.5	25.3	<5.0	<1.33	0.50	0.26
08/26/2014	35.5	29.2	<5.0	<1.43	0.57	0.28
09/17/2014	7.0	32.4	<5.0	<1.22	0.63	0.31
09/29/2014	24.0	27.0	<5.0	<1.37	0.53	0.27
10/01/2014	18.5	28.2	<5.0	<1.34	0.55	0.28
10/03/2014	19.0	29.2	<5.0	<1.34	0.57	0.28
10/13/2014	17.0	29.7	<5.0	<1.33	0.57	0.29

(1) The less than "<" symbol indicates the analytical result to be below the Method Reporting Limit

The BASF Gordon Outfall 001 and the BASF McIntyre Outfall 005 were sampled during the same time period in 2014 (Table 11). The cadmium levels in all samples taken from both outfalls were below the method reporting limit of 5 µg/L (Table 10 and 11). The cadmium levels in Little Commissioner Creek upstream and downstream from both outfalls were also below the method reporting limit. The total cadmium reporting limit was translated to the equivalent dissolved cadmium reporting limits for samples from both outfalls and the upstream and downstream samples. The total hardness values associated with the Gordon Plant outfall and the upstream and downstream sites resulted in acute and chronic criteria that are lower than the method reporting limits (Table 10). Therefore, it could not be determined from these results if the acute and chronic criteria were ever exceeded.

The effluents from the Brannon outfall exhibited extremely high hardness values, which resulted in acute and chronic criteria that were greater than the dissolved cadmium reporting limits (Table 11). The cadmium criteria were never exceeded in the Brannon outfall. Upstream from the outfall the lower hardness of Little Commissioner Creek resulted in acute and chronic criteria

Table 11. GMA Sample Results: BASF McIntyre Mine – Brannan Outfall 005

Date	TSS (mg/L)	Hardness (mg/L as $CaCO_3$)	Outfall Total Cadmium (µg/L)	Outfall Dissolved Cadmium (µg/L)	Acute Criteria (µg/L)	Chronic Criteria (µg/L)
Outfall						
06/23/2014	<5.0	187	<5.0	<1.18	3.22	1.15
07/14/2014	<5.0	209	<5.0	<1.18	3.57	1.23
07/28/2014	5.0	219	<5.0	<1.18	3.73	1.23
08/11/2014	<5.0	243	<5.0	<1.18	4.11	1.40
08/26/2014	6.5	234	<5.0	<1.21	3.97	1.36
09/17/2014	5.5	243	<5.0	<1.19	4.11	1.40
09/29/2014	10.5	215	<5.0	<1.27	3.67	1.28
10/01/2014	<5.0	224	<5.0	<1.18	3.81	1.32
10/03/2014	5.0	222	<5.0	<1.18	3.78	1.31
10/13/2014	<5.0	218	<5.0	<1.18	3.71	1.29
Upstream from Outfall						
06/23/2014	9.5	26.8	<5.0	<1.23	0.52	0.27
07/14/2014	10.5	26.6	<5.0	<1.27	0.52	0.27
07/28/2014	15.5	25.3	<5.0	<1.32	0.50	0.26
08/11/2014	10.5	24.7	<5.0	<1.27	0.49	0.25
08/26/2014	5.0	27.1	<5.0	<1.18	0.53	0.27
09/17/2014	9.5	30.2	<5.0	<1.26	0.59	0.29
09/29/2014	5.5	25.6	<5.0	<1.19	0.50	0.26
10/01/2014	11.5	26.5	<5.0	<1.28	0.52	0.26
10/03/2014	8.5	26.2	<5.0	<1.24	0.51	0.26
10/13/2014	5.5	26.4	<5.0	<1.19	0.52	0.26
Downstream from Outfall						
06/23/2014	10.0	67.8	<5.0	<1.26	1.25	0.54
07/14/2014	17.0	71.6	<5.0	<1.33	1.31	0.56
07/28/2014	14.5	64.8	<5.0	<1.31	1.20	0.52
08/11/2014	17.5	75.2	<5.0	<1.33	1.37	0.58
08/26/2014	18.5	91.0	<5.0	<1.34	1.65	0.67
09/17/2014	18.5	115	<5.0	<1.34	2.04	0.80
09/29/2014	18.5	100	<5.0	<1.34	1.79	0.72
10/01/2014	17.5	112	<5.0	<1.33	1.99	0.78
10/03/2014	17.0	112	<5.0	<1.33	1.99	0.78
10/13/2014	19.5	95.5	<5.0	<1.35	1.72	0.69

(1) The less than "<" symbol indicates the analytical result to be below the Method Reporting Limit

for cadmium that were lower than the reporting limits, and it could not be determined if exceedances of the criteria occurred upstream from the outfall. The high hardness from the Brannon outfall artificially raised the hardness levels downstream in Little Commissioner Creek, which led to higher acute and chronic criteria. In some instances the acute criteria were greater than the method reporting limit and it could be confirmed that cadmium levels did not exceed this criteria. However, in many cases the reporting limit was higher than the acute criteria, and it was always higher than the chronic criteria. In these instances, it could not be determined if the acute and chronic criteria for cadmium were exceeded downstream from the outfall.

The characterization study for the BASF McIntyre Mine Vinson outfall was conducted in 2015 and 2016. In all instances, cadmium levels were below either the method detection limit or method reporting limit in the outfall samples, and the upstream and downstream samples (Table 12). There were no exceedances of the acute and chronic criteria for cadmium.

Table 12. GMA Sample Results: BASF McIntyre Mine - Vinson Outfall 004

Date	TSS (mg/L)	Hardness (mg/L as $CaCO_3$)	Outfall Total Cadmium (µg/L)	Outfall Dissolved Cadmium (µg/L)	Acute Criteria (µg/L)	Chronic Criteria (µg/L)
Outfall						
02/27/2015	<5.0	169	<0.20 (1)	<0.05	2.93	1.07
01/26/2016	<5.0	149	<0.10	<0.02	2.60	0.97
02/12/2016	<5.0	145	<0.10	<0.02	2.54	0.95
04/17/2016	<5.0	139	<0.10	<0.02	2.44	0.92
Upstream from Outfall						
02/27/2015	20.0	29.6	0.13 (2)	0.04 (2)	0.57	0.29
01/26/2016	<5.0	40.5	<0.10	<0.02	0.77	0.36
02/12/2016	<5.0	52.1	0.10	<0.02	0.98	0.44
04/17/2016	22.0	18.2	<0.10	<0.02	0.36	0.20
Downstream from Outfall						
02/27/2015	21.5	28.8	0.13 (2)	0.04 (2)	0.56	0.28
01/26/2016	5.5	39.4	<0.10	<0.02	0.75	0.36
02/12/2016	8.5	35.8	<0.10	<0.02	0.69	0.33
04/17/2016	17.0	17.8	<0.10	<0.03	0.36	0.20

(1) The less than “<” symbol indicates the analytical result to be below the Method Detection Limit
(2) Result is below the Method Reporting Limit

3.3.3 Spills, Bypasses, Unpermitted Discharges, and Permit Sampling/Reporting Deficiencies

A network of pipelines carries raw (or minimally processed) mined kaolin between various mine sites and the processing facilities. Through a process called “blunging” kaolin is mixed with water and chemical dispersants to create a milk-shake-like slurry. Slurry is simply the water and dispersed clay mixture, which puts the clay particles in suspension. The slurried kaolin is usually transported through pipelines to degritting facilities, where sand, mica and other impurities are extracted with the help of gravity (“Georgia’s Best Management Practices For Mining“, 2008). Pipes also carry treated process wastewater from processing facilities to permitted outfalls that discharge into surface waters. Additionally, there are usually impoundments associated with mine sites and processing facilities. At the mine sites there may be active “pits” or other types of impoundments that retain storm water and groundwater until it can be transferred to other impoundments or discharged through permitted outfalls. Managing wastewater and collected storm water from kaolin processing facilities is an on-going activity (“Georgia’s Best Management Practices For Mining“, 2008).

There have been occasional pipeline breaks and ruptures reported within the Little Commissioner Creek watershed. While these breaks do not always result in unpermitted discharges to state waters, in July 2012 and April 2014 there were two reported breaks or ruptures in pipelines resulting in kaolin slurry or low-solids wastewater reaching Little Commissioner Creek. The July 9, 2012 pipeline leak resulted in approximately 2,000 gallons of kaolin slurry flowing to a nearby storm water ditch and into Little Commissioner Creek (EPD, 2014a). The April 17, 2014 pipeline break resulted in approximately 500 gallons of low-solids wastewater (<4% solids) flowing into Little Commissioner Creek (EPD, 2014a).

All permitted facilities, whether point source dischargers with NPDES or MS4 permits or facilities covered under Industrial General Storm Water NPDES Permits, are required to sample and report various sampling results as detailed in their permits. As mentioned in Section 3.1.2.1, benchmark monitoring for pollutants of concern is required for certain facilities covered under Appendix C of the Industrial General Permit for storm water.

It is important for facilities that discharge pollutants to periodically evaluate their compliance with the effluent limitations established in their permits and provide the results to the permitting authority. Industrial material pipeline breaks or leaks, and unpermitted discharges from process wastewater treatment or storage ponds, are potential nonpoint sources of pollution.

3.4 Additional Potential Sources

A wide range of products that contain cadmium are produced and commonly used in our modern society. Some of the more familiar examples include:

- Nickel-cadmium batteries
- Paint pigments
- Metal coatings
- Plastic stabilizers
- Specialized uses (e.g., photovoltaic cells, color displays)

This presents a number of opportunities for the introduction of cadmium into the aquatic environment, beginning with extracting cadmium from mined materials, manufacturing of cadmium-containing products, the use of these products and chemicals, and disposal of these products at the end of their life.

3.5 Source Assessment Summary

An important part of the TMDL analysis is the identification of potential sources of pollutants. Under the CWA requirement to develop TMDLs for waters on the 303(d) list that are not supporting their designated uses, point source and nonpoint source inputs are considered when developing water-quality based controls to reduce pollution and restore and maintain water quality. Sections 3.1 through 3.3 describe point and nonpoint assessments, with a specific section on kaolin mining and processing operations due to the widespread nature of their operations in the Little Commissioner Creek watershed and the significant water quality and sediment data provided from studies conducted by the industry.

Within the point source assessment findings, two municipal wastewater treatment facilities with NPDES permits discharge within the impaired segment watersheds. None of these facilities monitor for cadmium in their discharges or have permit limits that include cadmium or cadmium compounds. There are three industrial wastewater treatment facilities with NPDES permits in the subject watersheds. There is only one MS4 permitee (Phase 2) that discharges to the impaired segment watersheds and the Little Commissioner Creek drainage does not contain any areas defined as urbanized.

Nonpoint source assessment findings include possible sources documented in the Toxic Release Inventory (TRI), those identified as CERCLA sites, sites on the Hazardous Site Index (HSI), Brownfields, solid waste disposal facilities, and spills, leaks and other sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. Within the subject impaired stream segment watersheds:

- No TRI sites have reported releases of cadmium or cadmium compounds above established reportable levels
- There are no CERCLA sites known to have uncontrolled cadmium or cadmium compounds present or to have had releases of these compounds into the environment.
- There are no HSI sites known to have released cadmium or cadmium compounds above reportable quantities
- There are no brownfields
- There are three known landfills, one of which is active and the remaining two are closed.
- Two spills, bypasses, or unpermitted discharges associated with kaolin mining and processing facilities from pipelines and wastewater treatment processes were documented as being reported during 2014.
- One kaolin processing facility with coverage under the Industrial General Storm Water Permit has failed to consistently submit annual reports or submit benchmark sampling data reports.

4.0 TMDL DEVELOPMENT APPROACH

An important component of TMDL development is to establish relationships between source loadings and in-stream water quality. In this section, the mathematical modeling techniques used to develop the TMDL are discussed. The process of developing the cadmium TMDL for the Oconee River Basin listed segment includes the determination of the following:

- The current critical cadmium load to the stream under existing conditions;
- The TMDL for similar conditions under which the current load was determined; and
- The percent reduction in the current critical cadmium load necessary to achieve the TMDL.

4.1 Steady-State Approach

Steady-state models are applied for "critical" environmental conditions that represent extremely low assimilative capacity. Critical environmental conditions correspond to drought flows. The assumption behind steady-state modeling is that point and nonpoint source discharge concentrations that protect water quality during low-flow critical conditions will be protective for the large majority of environmental conditions that occur. Mass balance equations are used to model the critical conditions and calculate allocations.

4.2 Critical Conditions

The critical flow conditions for this TMDL occur when the ratio of effluent or contaminated storm water to stream flow is the greatest. The TMDL is presented in two ways: first, as total daily mass loads for the low flow conditions; and second, loads as a function of the total flow at any given time.

In the first case, total daily mass loads for the 1-day, 10-year minimum (1Q10), and 7-day, 10-year minimum (7Q10) low flow conditions are given. These are the assumed critical conditions for aquatic life. The 1Q10 and the acute criteria provide protection of the acute standard, and the 7Q10 and chronic criteria provide protection of the chronic standard.

Available flow data for the impaired stream segment is limited. Therefore, the 1Q10 and 7Q10 critical flows were developed using 1Q10 and 7Q10 flow data determined by the USGS for a nearby stream (Gotvald, 2016). This stream had relatively similar watershed characteristics, including land use, slope, and drainage area. The critical stream flows for the impaired stream segment were estimated by calculating the average productivity values (i.e., ratio of flow and drainage area) for the 1Q10 and 7Q10 flows of the nearby streams and multiplying these values by the impaired stream segment drainage area. These calculations are presented in Appendix A. Table 13 provides the 1Q10 and 7Q10 statistical flow values associated with this segment.

Table 13. Minimum Flows Associated with Cadmium Impaired Segments in the Oconee River Basin

Stream Segment	1Q10		7Q10	
	cfs	MGD	cfs	MGD
Little Commissioner Creek	4.8	3.10	5.32	3.44

For the second case, the TMDL is expressed as equations that show the loads as a function of the total flow at any given time. Since instantaneous samples are used to evaluate compliance with the standards, as well as the need for a TMDL, this flow dependent load, or concentration approach, is more meaningful. This approach takes into account seasonal variability and makes it easier to evaluate compliance with the TMDL.

The acute and chronic criteria for metals are expressed as the dissolved fraction. The criteria are calculated based on the hardness of the receiving stream (see Section 1.3 for equations). A lower hardness results in a higher proportion of metal in the dissolved form, resulting in a more conservative criterion.

Results for sample analyses of metals are commonly reported as a total (or total recoverable) concentration. Because the criteria are for the dissolved fraction of the metals, Georgia Regulation 391-3-6-.03(5)(e)(ii) (EPD, 2015) allows USEPA's "Guidance Document of Dynamic Modeling and Translators, August 1993" (USEPA, 1994) to be used for "translating" the total recoverable concentration to the dissolved form. In addition, Georgia Regulation 391-3-6-.06(4)(d)5.(ii)(b)(2) allows methods from this EPA guidance document to be used to translate dissolved criteria concentrations into total recoverable permit limits. Metals effluent permit limitations are required to be expressed as total recoverable metal per 40 CFR §122.45(c).

The translator is dependent on the instream TSS concentration. As the TSS concentration increases, a smaller percent of the metal is in the dissolved form. The equations used to calculate the translator are taken from EPA guidance (USEPA, 1994; USEPA, 1996). The ratio of the total measured metal concentration (C_t) to the calculated dissolved concentration (C_d) is the translator. The equations are provided below for reference.

$$C_t/C_d = 1 + K_d \text{ x TSS x } (10^{-6} \text{ kg/mg})$$

Where: K_d = partition coefficient for cadmium (L/kg)
TSS = total suspended solids concentration (mg/L)

The partition coefficient for cadmium:

$$K_d = K_{po} \text{ x TSS}^a$$

Where: K_{po} * = 4.00 x 10^6
a * = -1.1307

* Note: It is important to note that the authors of EPA's "*Technical Guidance Manual*" derived the above values for the 'K_{po}' coefficient and the 'a' exponent based on the statistical analysis of 2,253 data records collected from rivers and streams distributed throughout the United States.

Instream TSS data are also available for the listed segments. Table 14 shows the average TSS and corresponding translator, average hardness, and dissolved acute and chronic criterion for the impaired stream segment.

Table 14. Instream Dissolved Acute and Chronic Cadmium Criteria for the Impaired Stream Segment in the Oconee River Basin

Stream Segment	TSS (mg/L)	Translator	Total Hardness (mg/L as $CaCO_3$)	Dissolved Cadmium Acute Criterion (µg/L)	Dissolved Cadmium Chronic Criterion (µg/L)
Little Commissioner Creek	9.2 (1)	0.2504	46	0.87	0.40

(1) This average did not include the sample collected 9/30/2016. The TSS value was an extreme outlier.

5.0 ALLOCATIONS

A TMDL is the amount of a pollutant that can be assimilated by the receiving water body without exceeding the applicable water quality standard. The TMDLs for cadmium are based on the acute and chronic instream standards for this metal. A TMDL is the sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources, as well as natural background (40 CFR 130.2) for a given water body. The TMDL must also include a margin of safety (MOS), either implicitly or explicitly, which accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For cadmium the TMDLs are expressed as mass per day and as a concentration. A TMDL is expressed as:

$$\text{TMDL} = \Sigma\text{WLAs} + \Sigma\text{LAs} + \text{MOS}$$

The TMDL calculates the WLAs and LAs with margins of safety to meet the stream's water quality standards. The allocations are based on estimates that use the best available data and provide the basis to establish or modify existing controls so that water quality standards can be achieved. In developing a TMDL, it is important to consider whether adequate data exists to identify the sources, fate, and transport of the pollutant to be controlled.

TMDLs may be developed using a phased approach. Under a phased approach, the TMDL includes: 1) WLAs that confirm existing limits and controls or result in new limits, and 2) LAs that confirm existing controls or include implementing new controls (USEPA, 1991). A phased TMDL requires that additional data be collected to determine if load reductions required by the TMDL are leading to the attainment of water quality standards.

The TMDL Implementation Plan establishes a schedule or timetable for the installation and evaluation of point and nonpoint source control measures, data collection, assessment of water quality standard attainment, and if needed, additional modeling. Future monitoring of the listed segment's water quality will then be used to evaluate this phase of the TMDL, and if necessary, to reallocate the loads.

5.1 Waste Load Allocations

5.1.1 Wastewater Treatment Facilities

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources represented by municipal and industrial wastewater treatment systems that have NPDES effluent limits. Currently, there are no NPDES-permitted wastewater treatment facilities that are known to discharge cadmium into the impaired streams. In the future, if any wastewater treatment facilities are permitted to discharge cadmium to the impaired stream segments in the Oconee River Basin, the WLA loads will be calculated using the effluent design flow. Since some NPDES permits do not have a flow limitation, a TMDL expressed only in mass per day is not appropriate. It is more accurate and conservative to assign a waste load allocation as a concentration. The mass limit for any value of flow (Q) will then be calculated by multiplying flow times concentration. The WLA requires that the effluent concentration from each point source not exceed the allowable instream metal concentration at the end of pipe without any dilution. The WLA is represented by the equation:

$$\text{WLA} = \Sigma Q_{WLA} \times \text{metal criterion (acute or chronic)}$$

where: ΣQ_{WLA} = sum of all current, potential, and future NPDES permitted wastewater treatment discharges

5.1.2 Regulated Storm Water Discharges

State and Federal Rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects: 1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and 4) they do not have wastewater treatment plants that control specific pollutants to meet numerical limits.

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to try to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce pollutants from entering the environment.

Waste Load Allocations for storm water discharges associated with industrial activities, covered under Georgia's General Industrial Storm Water NPDES Permit, are represented by the equation:

$$WLA_{SW} = Q_{WLASW} \times \text{metal criterion (acute or chronic)}$$

Where: WLA_{SW} = Wasteload Allocation for permitted storm water runoff from all industrial areas
Q_{WLASW} = permitted storm water runoff from all industrial areas

The waste load allocations from storm water discharges associated with MS4s (WLAsw) are estimated based on the percentage of urban area in each watershed covered by the MS4 storm water permit. At this time, the portion of each watershed that goes directly to a permitted storm sewer and that which goes through non-permitted point sources, or is sheet flow or agricultural runoff, has not been clearly defined. Thus, it is assumed that approximately 70 percent of storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems. This can be represented by the following equation:

$$Q_{WLASW} = \Sigma Q_{urban} \times 0.7$$

$$WLA_{SW} = Q_{WLASW} \times \text{metal criterion (acute or chronic)}$$

where: WLA_{SW} = Wasteload Allocation for permitted storm water runoff from all MS4 urban areas
Q_{WLASW} = runoff from all MS4 urban areas conveyed through permitted storm water structures
ΣQ_{urban} = sum of all storm water runoff from all MS4 urban areas

For storm water permits, compliance with the terms and conditions of the permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP), and demonstrates consistency with the assumptions and requirements of the TMDL. EPD acknowledges that progress with the assumptions and requirements of the TMDL by storm water permittees may take one or more permit iterations. Achieving the TMDL reductions may constitute compliance with a storm water management plan (SWMP) or a storm water pollution prevention plan (SWPPP), provided the MEP definition is met, even where the numeric percent reduction may not be achieved so long as reasonable progress is made toward attainment of water quality standards using an iterative BMP process.

There are no facilities in the Little Commissioner Creek watershed covered under the Industrial General Permit that are considered to have the potential for discharging cadmium based on their SIC Codes, Sector designation, and required benchmark monitoring.
There are no areas within the Little Commissioner Creek watershed defined as urbanized with regulated storm sewer systems.

5.2 Load Allocations

The load allocation (LA) is the portion of the receiving water's loading capacity that is attributed to existing or future nonpoint sources or to natural background sources. Nonpoint sources are identified in 40 CFR 130.6 as follows:

- Residual waste
- Land disposal
- Agricultural and silvicultural
- Mines
- Construction
- Saltwater intrusion
- Urban storm water (non-permitted)

It is not known how much of the cadmium contributions to the impaired stream segments are from nonpoint sources. Generally, there are two types of load allocations in the creek: 1) loads associated with the accumulation of metals on land surfaces that are washed off during storm events, and; 2) loads independent of precipitation, such as seepage of contaminated groundwater, leachate from landfills, failing septic systems, leaking sewer system collection lines, and background loads. Available data suggests that cadmium introduced to the impaired stream segments are both from storm water runoff and from other sources not related to storm events. At this time, it is not possible to partition the various sources of load allocations. In the future, after additional data has been collected, it may be possible to partition the load allocation by source.

The instream concentrations of hardness used to determine the cadmium criteria, along with historical low-flow data, are used to determine the load allocations for the impaired stream segments under critical conditions. The load allocations during 1Q10 and 7Q10 flow conditions are calculated as follows:

To protect against the acute effects of dissolved metals:

allowable loading (kg/d) = dissolved acute criterion (μg/L) x 1Q10 (MGD) x units conversion

where: units conversion = 3.785 L/gallon x 10^{-9} kg/μg

$$\text{dissolved acute criteria} = (e^{(0.9789[\ln(\text{hardness})] - 3.866)})(1.136672 - [\ln \text{hardness})(0.041838)])\ \mu g/L$$

To protect against the chronic effects of dissolved metals:

allowable loading (kg/d) = dissolved chronic criterion (μg/L) x 7Q10 (MGD) x units conversion

where: units conversion = 3.785 L/gallon x 10^{-9} kg/μg

$$\text{dissolved chronic criteria} = (e^{(0.7977[\ln(\text{hardness})] - 3.909)})(1.101672 - [\ln \text{hardness})(0.041838)])\ \mu g/L$$

The critical conditions load allocations for cadmium, using the representative instream hardness shown in Table 14 are presented in Table 15.

Table 15. Load Allocations (LA) for Dissolved Cadmium under Critical Conditions for the Impaired Stream Segment in the Oconee River Basin

Stream Segment	Criteria	Dissolved Cadmium Concentration (µg/L)	Critical Flow (MGD)	Allowable Load Allocation (kg/day)
Little Commissioner Creek	Acute	0.87	3.10	1.02×10^{-2}
	Chronic	0.4	3.44	5.21×10^{-3}

5.3 Seasonal Variation

The low flow critical conditions incorporated in this TMDL are assumed to represent the most critical design conditions and provide year-round protection of water quality. The base flow of a stream will generally range from low flows during critical conditions to higher flows at other times. Runoff from storm events will contribute additional flow to the stream. Seasonal variability in flow is addressed by expressing the TMDL as a concentration, as well as a load associated with different flows. The LA for all flows and conditions can be described by the following equation:

$$LA = Q_{LA} \text{ x metal criterion (acute or chronic)}$$

$$Q_{LA} = [Q_{Total} - (\Sigma Q_{WLA} + \Sigma Q_{WLASW})]$$

where:
- LA = load allocation
- Q_{LA} = flow from all nonpoint sources
- Q_{Total} = total flow in the creek
- ΣQ_{WLA} = sum of all current, potential, and future NPDES permitted wastewater treatment discharges
- ΣQ_{WLASW} = sum of all permitted storm water runoff from MS4 urban areas

5.4 Margin of Safety

The MOS is a required component of TMDL development. As specified by section 303(d) of the CWA, the margin of safety must account for any lack of knowledge concerning the relationship between effluent limitations and water quality. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations.

The MOS was implicitly incorporated into the TMDLs through the use of the critical conditions established in Section 4.2 of this report. Through the use of low flow conditions and conservative hardness values the margin of safety for these TMDLs adequately accounts for the lack of knowledge concerning the relationship between effluent limitations and water quality.

5.5 TMDL Results

The TMDL for any condition will be based on the flow of creek, instream hardness, as well as the discharge flow of a permitted discharger. The TMDLs for cadmium are summarized in Table 16.

Table 16. Total Dissolved Cadmium TMDL Summary for the Impaired Stream Segment in the Oconee River Basin

Stream Segment	Criteria	Current Load	WLA	WLA_{SW}	LA	MOS	TMDL	Reduction
Little Commissioner Creek	Acute	Q x 2.55 µg/L	-	-	1.02×10^{-2} kg/day for the 1Q10 ΣQ_{LA} x 0.87 µg/L for all conditions and flows	Implicit	1.02×10^{-2} kg/day + WLA for the 1Q10 Q_{total} x 0.87 µg/L for all conditions and flows	65.9%
	Chronic	Q x 2.55 µg/L	-	-	5.21×10^{-3} kg/day for the 7Q10 ΣQ_{LA} x 0.4 µg/L for all conditions and flows	Implicit	5.21×10^{-3} kg/day + WLA for the 7Q10 Q_{total} x 0.4 µg/L for all conditions and flows	84.3%

6.0 RECOMMENDATIONS

The TMDL process consists of an evaluation of the sub-watersheds for each 303(d) listed stream segment to identify, as best as possible, the sources of cadmium causing the stream to exceed instream standards. The TMDL analysis was performed using the best available data to specify WLAs and LAs that will meet cadmium water quality criteria so as to support the use classification specified for each listed segment.

This TMDL represents part of a long-term process to reduce loading of cadmium to meet water quality standards in the Oconee River Basin. Implementation strategies will be reviewed and the TMDLs will be refined as necessary. The phased approach will support progress toward water quality standards attainment in the future. In accordance with USEPA TMDL guidance, these TMDLs may be revised based on the results of future monitoring and source characterization data efforts. The following recommendations emphasize further source identification and involve the collection of data to support the current allocations and subsequent source reductions.

6.1 Monitoring

EPD collected water quality samples during September-October 2011 at sites on Little Commissioner Creek following a series of small storm events. The samples were taken upstream at Fall Line Freeway and US Highway 18 near the City of Gordon, Georgia. Samples were taken downstream at Owens-Sheppard Road near Gordon, and further downstream at Claymont Road near the confluence of Little Commissioner Creek and Commissioner Creek.

At the upstream-most sample site at Fall Line Road, cadmium levels were below detection limits. The sample collected at Claymont Road on September 29, 2011 showed an exceedance of the chronic criterion for cadmium. The sample collected at Claymont Road on October 19, 2011 showed exceedances of both the acute and chronic cadmium criteria. As a result, Little Commissioner from SR 18 down to its confluence with Commissioner Creek was placed on the 303(d) list.

It is recommended that further water-quality sampling be conducted on Little Commissioner Creek to monitor cadmium concentrations. This should include both dry-weather and wet-weather sampling events. If exceedances of the cadmium criteria continue, then the sources should be determined and corrective actions may be needed. In the case where a watershed based plan has been developed for a listed stream segment, an appropriate water quality monitoring program will be outlined. The monitoring program will be developed to help identify the various cadmium sources. The monitoring program may be used to verify the 303(d) stream segment listings. This will be especially valuable for those segments where limited data resulted in the listing.

6.2 Management Practices

Based on findings of the source assessment, there are currently no known point source loads of cadmium to the impaired stream segment. Characterization studies for NPDES permitted outfalls from kaolin mining and processing facilities were inconclusive, and therefore these outfalls cannot be ruled out as potential point sources. The studies are discussed in more detail in Section 3. Potential nonpoint sources include non-permitted storm runoff from industrial sites, runoff from improper disposal of waste materials, illicit discharges into storm sewer systems, leachate from open and closed landfills, leakage or overflows from sanitary sewer lines, leakage or overflows from industrial material and process wastewater pipelines, and contributions from failing septic systems.

Management practices are recommended to reduce cadmium source loads to the impaired stream segment, with the result of achieving the instream standard criteria for these metals. These recommended management practices include:

- Compliance with future NPDES treated wastewater permit requirements;
- Compliance with NPDES MS4 permit requirements;
- Implementation of recommended Water Quality management practices in the *Upper Oconee Regional Water Plan* (2011);
- Compliance with NPDES Industrial General Permit requirements, including where applicable, achieving benchmarks for monitored constituents;
- Adherence to the Surface Mining Land Use Plan prepared as part of the Surface Mining Permit Application;
- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2014)
- Application of Best Management Practices (BMPs) appropriate to both urban and rural land uses, where applicable.

6.2.1 Point Source Approaches

Point sources are defined as discharges of treated wastewater or storm water into rivers and streams at discrete locations. The NPDES permit program provides a basis for municipal, industrial, and storm water permits, monitoring and compliance with permit limitations, and appropriate enforcement actions for violations. In accordance with EPD rules and regulations, all discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times.

For storm water permits, compliance with the terms and conditions of the permit is effective implementation of the WLA to the Maximum Extent Practicable (MEP), and demonstrates consistency with the assumptions and requirements of the TMDL. EPD acknowledges that progress with the assumptions and requirements of the TMDL by storm water permittees may take one or more permit iterations. Achieving the TMDL reductions may constitute compliance with a storm water management plan (SWMP) or a storm water pollution prevention plan (SWPPP), provided the MEP definition is met, even where the numeric percent reduction may not be achieved so long as reasonable progress is made toward attainment of water quality standards using an iterative BMP process.

As previously noted, there are currently no known NPDES permitted wastewater treatment facilities discharging to the impaired stream segment watersheds that are considered potential sources of cadmium. The upper portion of the Little Commissioner Creek watershed lies within the boundaries of an MS4 Phase 2 permittee. However, there are no areas within its watershed that are defined as urbanized with regulated storm sewer systems (see Section 3.1.2.2 MS4 NPDES Permits). Storm water discharges from industrial sites are covered under the Industrial General Permit. Under this permit implementation of BMPs are required. Storm water from industrial sites that discharge within one linear mile of a 303(d) listed stream and that potentially might contain the listed constituent must be monitored to determine that benchmarks are met.

The current NPDES wastewater discharge permits for the mining facilities located in the Little Commissioner Creek watershed require monitoring of flow and turbidity. It is recommended that additional characterization studies for the outfalls of these facilities be conducted to determine if cadmium is present in the effluents. The laboratory analytical procedures used should have method detection limits and reporting limits that are capable of determining the actual or calculated dissolved cadmium concentrations at least down to the acute and chronic cadmium criteria based on the total hardness of Little Commissioner Creek at the outfall locations. If the presence of cadmium in the effluents has been confirmed, then it is recommended that total recoverable cadmium and hardness be added as required parameters to monitor with numerical effluent limits established so the permitted discharges will not cause violations of the acute and chronic standards for cadmium, based on the measured hardness.

The storm water discharges from kaolin mines and processing facilities (SIC Code 1455) are covered under the Georgia NPDES Industrial General Storm Water Permit (GAR050000). Currently, these facilities are not required to do benchmark monitoring of the storm water discharges for cadmium. Kaolin ores typically contain small amounts of cadmium. Because of this, and based on water quality sampling results conducted by the EPD, it has been determined that storm water runoff from kaolin mining operations and processing facilities has the potential of containing cadmium. It is, therefore, recommended that the kaolin mining and processing facilities located within the Little Commissioner Creek watershed be required to do benchmark monitoring of their storm water for turbidity, hardness, and total recoverable cadmium.

6.2.2 Nonpoint Source Approaches

The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." In general, all generators, transporters, treaters, storers, and disposers of hazardous waste are required to provide information about their activities to state environmental agencies. These agencies, in turn pass on the information to regional and national EPA offices. In 1984, RCRA was amended by the Federal Hazardous and Solid Waste Amendments (HSWA). These amendments focused on waste minimization and phasing out land disposal of hazardous waste as well as corrective action for releases. Some of the other mandates of this law include increased enforcement authority for EPA. EPA maintains the Toxics Release Inventory, a database of industrial facilities that have had releases of hazardous chemicals at reportable quantities (TSI). There are no facilities included on the TRI that have had reported releases of cadmium or cadmium compounds above established reportable levels within the Little Commissioner Creek drainage area. However, in the future if facilities located within the watershed of the impaired stream segment do have reportable releases, they will be monitored under these programs.

EPD is the lead agency for implementing the State’s Nonpoint Source Management Program, as described in Georgia’s *Statewide Nonpoint Source Management Plan* (EPD, 2014b). The *Statewide Nonpoint Source Management Plan* combines regulatory and nonregulatory approaches, in cooperation with other State and Federal agencies, local and regional governments, State colleges and universities, businesses and industries, nonprofit organizations, and individual citizens. Regulatory responsibilities include establishing water quality criteria and use classifications, assessing and reporting water quality conditions, issuing point source permits, issuing water withdrawal and ground water permits, and regulating land-disturbing activities. Georgia is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of BMPs that address nonpoint source pollution. The following sections describe programs in place and recommendations which should minimize the potential for nonpoint source loads of cadmium and cadmium compounds in Georgia's surface waters.

6.2.2.1 Waste Management

The Land Protection Branch (LPB) of EPD manages the disposal and treatment of solid waste through the permitting of municipal and industrial solid waste landfills, and oversees surface mining permitting and reclamation. Government and businesses that generate or store hazardous waste are regulated through the Hazardous Waste Management Programs of the LPB.

The Industrial and Municipal Solid Waste Unit of the LPB is responsible for the permitting, review of site suitability reports, construction, and closure of all publicly and privately owned solid waste handling facilities. It also reviews spill investigations and corrective action plans. Owners and/or operators of municipal solid waste landfills must conduct groundwater monitoring and evaluate the data to determine if established standards have been exceeded. All exceedances must be reported to EPD. The monitoring reports must be accompanied by a statement certifying that constituents which have established standards have been complied with or are non-compliant. It is recommended that monitoring of the groundwater continues to include periodic analysis for the presence of metals including cadmium.

Government and businesses that generate or store hazardous waste are regulated by the Hazardous Waste Management Programs of the LPB. These Programs also investigate spills and releases involving hazardous waste and determine the impact to soil and water. Industrial sites within impaired stream segment watersheds are placed on the Georgia Hazardous Site Inventory as a result of releases of regulated substances in reportable quantities considered hazardous to human health and the environment. EPD's Response and Remediation Program works with the owners towards cleanup of the sites, and implementing BMPs that will minimize these releases.

6.2.2.2 Mining Operations

The Georgia Surface Mining Act of 1968 provides for the issuance of mining permits. EPD's Surface Mining Unit reviews applications and approves surface mining land use plans, issues surface mining permits, conducts compliance evaluations of surface mining operations, and ensures reclamation of completed mining operations. The permit application must include a Surface Mining Land Use Plan, which specifies activities prior to, during, and following mining to dispose of refuse and control erosion and sedimentation. The regional EPD offices monitor and inspect surface mining sites to assess permit compliance.

The Georgia Mining Association (GMA) is an informal trade association of the mining industry. It educates miners about laws and regulations that affect them. The mining industry has developed industry-wide standards for BMPs to prevent and reduce nonpoint source pollution. These BMPs described in "Georgia's Best Management Practices For Mining"(2008), are referenced in the NPDES permits issued to mining operations. The following general mining BMPs to prevent and reduce nonpoint source pollution are of specific relevance in the Little Commissioner Creek watershed due to the prevalence of kaolin mining and processing operations:

Managing Wastewater

Managing wastewater and collected storm water from kaolin processing facilities is an on-going activity. Many of the BMPs for kaolin processing facilities are similar to those associated with managing pit pumpout and storm water management at mining operations and include the following:

- Design the drainage for the milling and processing operation to ensure that wastewater and/or collected storm water is transferred to a wastewater treatment system which has an NPDES permit that includes storm water and industrial wastewater.

- For any discharges which are intended to leave the kaolin processing site, ensure that the final destination for any process wastewater and mixed storm water is to a permitted NPDES outfall.

Pipeline Installation and Repair

- Use corrosion and wear resistant pipe materials such as poly pipe or heavy walled plastic coated steel pipe.

- Use anode bags or cathodic protection to prevent corrosion failures.

- Clean out pipeline periodically using a “pig”, which is a mechanical device pumped through the line to scrape the internal surfaces.

- Inspect pipeline right-of-ways periodically to look for leaks.

- Protect stream crossings and other sensitive areas such as wetlands by installing double-wall pipe, pipe casings and extra heavy wall pipe.

- Mark the pipeline with signs or concrete markers to prevent mechanical damage from digging in the area.

- Provide local spill responders and local emergency management agencies with emergency contact information and with a diagram locating all pipelines, including buried waste lines and slurry lines.

- In the event of a pipeline leak: (1) Stop the flow as soon as possible; (2) Divert the spill away from streams by creating temporary earthen catch basins and ditches; and (3) Repair pipeline with appropriate equipment.

It is recommended that special attention be given to those facilities located in not supporting watersheds. The implementation and maintenance of BMPs used for fugitive dust control and to control erosion should be reviewed during the site inspections.

In addition to the generalized BMPs mentioned above in this section, the kaolin industry undertook specific actions in the Little Commissioner watershed including:

- Replacement of the entire length of the 8-mile Gordon pipeline in 2013 (which had a leak in 2012, as discussed in Section 3.3.3)

- Inspections of kaolin pipelines by riding the pipeline right of way once per week and flying the pipelines twice per month (or other frequency that is equally protective based on circumstances of a particular pipeline or a portion thereof)

6.2.2.3 Urban Sources

Nonpoint sources of cadmium and cadmium compounds can be significant in the Oconee River Basin urban areas. Urban sources can best be addressed using a strategy that involves public participation and intergovernmental coordination to reduce the discharge of pollutants to the maximum extent practicable. Management practices, control techniques, public education, and other appropriate methods and provisions may be employed. In addition to water quality monitoring programs, discussed in Section 6.1, the following activities and programs conducted by cities, counties, and State agencies are recommended:

- Uphold requirements that all new and replacement sanitary sewage systems be designed to minimize discharges into storm sewer systems;

- Further develop and streamline mechanisms for reporting and correcting illicit connections, breaks, surcharges, and general sanitary sewer system problems;

- Continue efforts to increase public awareness and education towards the impact of human activities in urban settings on water quality, ranging from the consequences of industrial and municipal discharges to the activities of individuals in residential neighborhoods.

6.2.3 Summary of Source Management Practices

As indicated by the summary of land uses in Section 1 (Table 2), the Little Commissioner Creek watershed is primarily rural in nature. However, some small size urban areas are present. The watershed contains some commercial and industrial properties. Mining operations make up only two to three percent of the overall land uses in the watershed, but may have significant environmental consequences. Both rural and urban sources can best be addressed using a strategy that involves public participation and intergovernmental coordination to reduce the discharge of pollutants to the maximum extent practicable. Management practices, control techniques, public education, and other appropriate methods and provisions may be employed. In addition to water quality monitoring programs, discussed in Section 6.1, the following activities and programs conducted by cities, counties, and state agencies are recommended:

- Sustain compliance with storm water NPDES MS4 and Industrial General Permit for Storm Water requirements. Require that outfall discharges from industrial NPDES permitted wastewater treatment facilities be characterized to confirm the presence of cadmium, and to determine if cadmium limits should be included as part of the permit in the future.

- Implementation of recommended Water Quality management practices in the *Upper Oconee Regional Water Plan* (2011);

- Ensure that storm water management plans are in place and being implemented by the local governments, and by the industrial facilities located in the watershed.

These Plans are designed to control storm water runoff and to identify and implement BMPs to reduce the discharge of pollutants associated with storm water;

- EPD should continue working with federal, state, and local agencies and owners of sites where cleanup measures are necessary, and in developing control measures to prevent future releases of the metals of concern.

- Further develop and streamline mechanisms for reporting and correcting illicit discharges, breaks, surcharges, and general sanitary sewer system problems;

- Uphold requirements that all new and replacement sanitary sewage systems be designed to minimize discharges into storm sewer systems;

- Continue efforts to increase public awareness and education towards the impact of human activities in urban settings on water quality, ranging from the consequences of industrial and municipal discharges to the activities of individuals in residential neighborhoods.

6.3 Reasonable Assurance

Currently, there are no NPDES permitted wastewater treatment facilities with permit limits that include cadmium or cadmium compounds discharging in the impaired stream segment watershed. Should there, in the future, be applicants for discharge permits, EPD will determine whether the applicants have a reasonable potential of discharging cadmium levels equal to or greater than the allocated loads. The results of this reasonable potential analysis will determine the specific type of requirements in an individual facility's NPDES permit. As part of its analysis, EPD will use its EPA approved 2003 NPDES Reasonable Potential Procedures to determine whether monitoring requirements or effluent limitations are necessary.

If effluent limitations are determined to be necessary, they should be established in accordance with *Georgia Rules and Regulations for Water Quality Control*, Section 391-3-6-.06(4)(d)5.(ii)(b)(2) (EPD, 2015), to protect against chronic and acute effects.

All industrial sites that have a storm water discharge associated with their primary industrial activity are required to submit a Notice of Intent under the NPDES General Industrial Permit. This authorizes them to discharge storm water in accordance with the conditions and monitoring requirements established in the Industrial General Permit. Storm water from industrial sites that discharge within one linear mile of a 303(d) listed stream and that potentially might contain the listed constituent must be monitored to determine that benchmarks are met. Also, this permit requires implementation of BMPs.

A portion of the Little Commissioner Creek watershed occurs within the boundaries of an NPDES MS4 Phase 2 permittee. However, there are currently no areas within its watershed that are defined as urbanized with regulated storm sewer systems. Future growth within the watershed may result in the appearance of urbanized areas with associated storm sewer systems that are regulated under the NPDES MS4 Phase 2 Permit. These permits prohibit illicit discharges into storm sewer system, and require that BMPs be put in place to reduce the discharge of pollutants to the maximum extent possible.

EPD is working with local governments to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

6.4 Public Participation

A thirty day public notice was provided for this TMDL. During this time, the availability of the TMDL was public noticed, a copy of the TMDL was provided on request, and the public was invited to provide comments on the TMDL.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

7.1 Initial TMDL Implementation Plan

This plan identifies applicable state-wide programs and activities that may be employed to manage point and nonpoint sources of cadmium loads for the impaired stream segments in the Oconee River Basin. Local watershed planning and management initiatives will be fostered, supported, or developed through a variety of mechanisms. Implementation may be addressed by watershed improvement projects, assessments for Section 319 (h) grants, the local development of watershed protection plans, or "Targeted Outreach" initiated by EPD. These initiatives will supplement or possibly replace this initial implementation plan. Implementation actions should also be guided by the recommended management practices and actions contained within each applicable Regional Water Plan developed as part of Georgia's Comprehensive State-wide Water Management Plan implementation (Georgia Water Council, 2008).

7.2 Impaired Segments

This initial plan is applicable to the cadmium impaired stream segments in the Oconee River Basin, which were added to Georgia's 303(d) list available on EPD's website (www.gaepd.org). The following table summarizes the descriptive information provided in the 303(d) list.

Water Body Listed for Cadmium in the Oconee River Basin

Reach ID	Water body	Segment	County	Segment Length (miles)	Designated Use
R030701020503	Little Commissioner Creek	Ga. Hwy. 18 to Commissioner Creek	Wilkinson	9	Fishing

The current water quality standard [*State of Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(6)(c)(iii) (EPD, 2015) states that instream concentrations shall not exceed the acute criteria under 1-day, 10-year minimum flow (1Q10) or higher stream flow conditions, and shall not exceed the chronic criteria under 7-day, 10-year minimum flow (7Q10) or higher stream flow conditions. The acute and chronic cadmium criteria are determined using the following equations:

acute criteria dissolved cadmium = $(e^{(0.9789[\ln(\text{hardness})] - 3.866)})(1.136672 - [\ln \text{hardness})(0.041838)])$ µg/L

chronic criteria dissolved cadmium = $(e^{(0.7977[\ln(\text{hardness})] - 3.909)})(1.101672 - [\ln \text{hardness})(0.041838)])$ µg/L

These criteria are expressed in terms of the dissolved fraction in the water column and are a function of total hardness. Exceedances of these criteria are violations of the water quality standards for these metals, and are the basis for adding a stream segment to the 303(d) listing.

7.3 Potential Sources

An important part of the TMDL analysis is the identification of potential source categories. A source assessment characterizes the known and suspected sources for cadmium in the watershed. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from that pollutants are or may be discharged to surface waters. Point sources of cadmium may include discharges from wastewater treatment facilities and include storm water discharges through permitted storm water systems. Nonpoint sources of these metals are diffuse and cannot be identified as entering the water body at a single location. These sources generally involve land use activities that contribute the metals to streams during rainfall events. However, other potential nonpoint sources exist such as deposition of particulates from air emissions, and seepage of contaminated groundwater.

Currently, there are no NPDES permitted wastewater treatment facilities with permit limits that include cadmium or cadmium compounds discharging in the impaired stream segment watershed. Characterization studies for NPDES permitted outfalls from kaolin mining and processing facilities were inconclusive, and therefore these outfalls cannot be ruled out as potential point sources. Potential nonpoint sources for cadmium include: non-permitted storm runoff from industrial sites, runoff from improper disposal of waste materials, illicit discharges into storm sewer systems, leachate from operating and closed landfills, overflows from sanitary sewer lines, and leaking septic systems.

7.4 Management Practices and Activities

The NPDES permit program provides a basis for municipal, industrial, and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations. In accordance with EPD rules and regulations, all discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times.

EPD is responsible for administering and enforcing laws to protect the waters of the state and is the lead agency for implementing the state's Nonpoint Source Management Program. Georgia is working with federal, county, and local governments, and other state and county agencies to foster implementation of BMPs that address nonpoint source pollution. The following management practices are recommended to reduce cadmium loads to the impaired stream segments:

- Sustain compliance with the Industrial General Storm Water Permit requirements. Require that outfall discharges from industrial NPDES permitted wastewater treatment facilities be characterized to confirm the presence of cadmium, and to determine if cadmium limits should be included as part of the permit in the future. . Kaolin ores typically contain small amounts of cadmium. Because of this, and based on water quality sampling results conducted by the EPD, it has been determined that storm water runoff from kaolin mining operations and processing facilities has the potential of containing cadmium. It is, therefore, recommended that the kaolin mining and processing facilities located within the Little Commissioner Creek watershed be required to do benchmark monitoring of their storm water for turbidity, hardness, and total recoverable cadmium.

- Implementation of recommended Water Quality management practices in the *Upper Oconee Regional Water Plan* (2011);

- Ensure that storm water management plans are in place and being implemented by the local governments, and by the industrial facilities located in the watershed. These Plans are designed to control storm water runoff and to identify and implement BMPs to reduce the discharge of pollutants associated with storm water;

- EPD should continue working with federal, state, and local agencies and owners of sites where further cleanup measures are necessary, and in developing control measures to prevent future releases of the cadmium or cadmium compounds.

- Further develop and streamline mechanisms for reporting and correcting illicit discharges, breaks, surcharges, and general sanitary sewer system problems;

- Uphold requirements that all new and replacement sanitary sewage systems be designed to minimize discharges into storm sewer systems;

- Adoption of local ordinances (i.e. septic tanks, storm water, etc.) that address local water quality;

- Continue efforts to increase public awareness and education towards the impact of human activities in urban settings on water quality, ranging from the consequences of industrial and municipal discharges to the activities of individuals in residential neighborhoods.

Public education efforts target individual stakeholders to provide information regarding the use of BMPs to protect water quality. EPD will continue efforts to increase awareness and educate the public about the impact of human activities on water quality.

7.5 Monitoring

EPD encourages local governments and municipalities to develop water quality monitoring programs. These programs can help pinpoint various pollutant sources, as well as verify the 303(d) stream segment listings. EPD recommends that monitoring of cadmium, total hardness, and TSS be continued for Little Commissioner Creek to determine if implementation of BMPs results in the improvement of water quality over time. EPD is available to assist in completing a monitoring plan, preparing a Sampling Quality Assurance Plan (SQAP), and/or providing necessary training as needed.

7.6 Future Action

This Initial TMDL Implementation Plan includes a general approach to pollutant source identification, as well as management practices to address pollutants. In the future, EPD will continue to determine and assess the appropriate point and non-point source management measures needed to achieve the TMDLs and also to protect and restore water quality in impaired water bodies.

For point sources, any waste load allocations for wastewater treatment plant facilities will be implemented in the form of water-quality based effluent limitations in NPDES permits. Any wasteload allocations for regulated storm water will be implemented in the form of best management practices in the NPDES permits. Contributions of cadmium from regulated communities may also be managed using permit requirements such as watershed assessments, watershed protection plans, and long term monitoring. These measures will be directed through current point source management programs.

EPD will work to support watershed improvement projects that address non-point source pollution. This is a process whereby EPD and/or Regional Commissions or other agencies or local governments, under a contract with EPD, will develop a Watershed Management Plan intended to address water quality at the small watershed level (HUC 10 or smaller). These plans will be developed as resources and willing partners become available. The development of these plans may be funded via several grant sources, including but not limited to, Clean Water Act Section 319(h), Section 604(b), and/or Section 106 grant funds. These plans are intended for implementation upon completion.

Any Watershed Management Plan that specifically address water bodies contained within this TMDL will supersede the Initial TMDL Implementation Plan once EPD accepts the plan. Future Watershed Management Plans intended to address this TMDL and other water quality concerns, written by EPD and for which EPD and/or the EPD Contractor are responsible, will contain at a minimum the USEPA's 9 Elements of Watershed Planning:

1) An identification of the sources or groups of similar sources contributing to nonpoint source pollution to be controlled to implement load allocations or achieve water quality standards. Sources should be identified at the subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers industrial sites needing upgrading, Y acres of contaminated soils needing remediation, or Z linear miles of eroded stream bank needing restoration);

2) An estimate of the load reductions expected for the management measures;

3) A description of 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) An estimate of the sources of funding needed, and/or authorities that will be relied upon, to implement the plan;

5) An information/education component that will be used to enhance public understanding of and participation in implementing the plan;

6) A schedule for implementing the management measures that is reasonably expeditious;

7) A description of interim, measurable milestones (e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

8) A set of criteria that can be used to determine whether substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised; and;

9) A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item 8.

The public will be provided an opportunity to participate in the development of Watershed Management Plans that address impaired waters and to comment on them before they are finalized.

EPD will continue to offer technical and financial assistance (when and where available) to complete Watershed Management Plans that address the impaired water bodies listed in this and other TMDL documents. Assistance may include but will not be limited to:

- Assessments of pollutant sources within watersheds;
- Determinations of appropriate management practices to address impairments;
- Identification of potential stakeholders and other partners;
- Developing a plan for outreach to the general public and other groups;
- Assessing the resources needed to implement the plan upon completion; and
- Other needs determined by the lead organization responsible for plan development.

EPD will also make this same assistance available, if needed, to proactively address water quality concerns. This assistance may be in the way of financial, technical, or other aid and may be requested and provided outside of the TMDL process or schedule.

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Appendix A

Estimation of 1Q10 and 7Q10 Flows for Little Commissioner Creek

Calculation of Average 1Q10 and 7Q10 Estimates for Streams in the Oconee River Basin

Source: Anthony J. Gotvald, 2016, Provisional Draft Selected Low-Flow Frequency Statistics for Continuous- Record Stream Gages in Georgia, 2013, Scientific Investigations Report 2016-####, U.S. Geological Survey, Reston, Virginia

Stream	Gage No	Drainage Area (sq miles)	1Q10 (cfs)	Productivity Factor (cfs/sq miles)	7Q10 (cfs)	Productivity Factor (cfs/sq miles)
Big Sandy Creek near Jeffersonville	02223300	33.5	3.28	0.10	3.64	0.11
Little Commissioner Creek (1)	-	49.0	4.80	-	5.32	-

(1) Using the reported 1Q10 and 7Q10 for Big Sandy Creek gage to calculate the 1Q10 and 7Q10 of the 303(d) listed segment of Little Commissioner Creek using productivity factors.