Chattahoochee River Basin Dissolved Oxygen TMDLs

Cedar Creek, Partially Supporting, Coweta County
Clear Creek, Partially Supporting, Fulton County
Ollie Creek, Partially Supporting, Meriwether County

Submitted to:

U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:

Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

January 2003

Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

Basin Name: **Chattahoochee River**

Table ES-1 2002-303(d) Listed Segments for Dissolved Oxygen in the Chattahoochee River Basin

SEGMENT NUMBER	STREAM	SEGMENT LENGTH (Miles)	2000 MONITORING STATION	12 DIGIT HUC ID
1	Cedar Creek	6	12148001	0313000020402
2	Clear Creek	3	Historical Listing	031300011204
3	Ollie Creek	1	Historical Listing	031300020705

Description of Analysis

USGS water quality data collected in 2000 identified low dissolved oxygen (DO) concentrations in Cedar Creek in the Chattahoochee River Basin. The data indicated that this occurred during, and were limited to, summer months, low flow and high temperature conditions. Clear Creek and Ollie Creek were listed from historical DO data. Stream flows during the period of the low DOs for these segments, were at, or below, the minimum 7-day average flow that occurs once in 10 years on the average (7Q10). This is consistent with the 3-year drought experienced in Georgia from 1998 to 2000. Since the observed DO concentrations were driven by low flows and high temperatures, occurring over several summer months, a steady state modeling approach was adopted as appropriate for DO TMDL analysis.

Applicable Water Quality Standards

The applicable dissolved oxygen water quality standards for waters in the Chattahoochee River Basin are as follows:

> *Numeric - GAEPD.* A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish. 391-3-6-.03 (c) (I). (GAEPD, 2002)
>
> *Natural Water Quality – GAEPD.* It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation. 391-3-6-.03 (7). (GAEPD, 2000)
>
> *Natural Water Quality – EPA*. Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration. (USEPA, 1986).

Due to naturally occurring low dissolved oxygen in the listed segments, the EPA natural water quality policy was appropriate to support the proposed allocations. That is, if a model result showed a natural dissolved oxygen less than 5.0 mg/L, the model result would define the natural DO standard to be applied. In this case, the standard would become 90 percent of the computed natural DO.

Technical Approach

Model Adopted: Georgia DOSAG – steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data:
Cedar Creek - USGS field data from June 2000.
Clear Creek – CRMP Data from 1991.
Ollie Creek – biological monitoring during May-September, 1992.

Calibration Conditions:
(1) USGS flows measured in June 2000.
(2) USGS temperatures measured in June 2000.
(3) Point source DMR data for June 2000.
(4) SOD values for 'mixed land uses' based on year-2000 TMDLs for the South 4 Basins.
(5) Depths, velocities, kinetic rates, reaeration, and boundary conditions based on 2000 USGS field data and/or GAEPD standard modeling practices.

Critical Conditions:
(1) 7Q10 flows recomputed to include data through 2000.
(2) Temperatures derived from historic trend monitoring data.
(3) Point source discharges at current permit limits.
(4) Same SOD for 'mixed land uses' as calibration conditions.
(5) Same depths, velocities, kinetic rates, reaeration, and boundary conditions as calibration conditions.

Natural Conditions:
(1) Same flows as critical conditions.
(2) Same temperatures as critical conditions.
(3) All point sources completely removed.
(4) SOD for natural (i.e., fully forested) land use based on year-2000 TMDLs for the South 4 Basins.
(5) Same depths, velocities, kinetic rates, reaeration, and boundary conditions as calibration conditions.

Margin Of Safety: Implicit, based on the following conservative assumptions:
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) All point sources discharge continuously at their NPDES permit limits for the same critical period.
(4) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2000.
(5) Water depths are shallow, generally less than one foot, which aggravates the effect of SOD.
(6) Water velocities are sluggish, generally 0.5 fps or less, which intensifies the effect of BOD decay.

Seasonality: Dissolved oxygen data showed no impairments outside of the high-temperature, low-flow conditions, which occur during the summer months.

Monitoring: Follow-up monitoring according to the River Basin Planning 5-year cycle (Georgia EPD, 1996)

Approach: NPDES permits for point sources; Best Management Practices for nonpoint sources.

Date Submitted: Draft June 2002, Final January 2003.

Table ES-2 Summary of TMDLs for Dissolved Oxygen Listed Segments in the Chattahoochee River Basin

SEGMENT NUMBER	STREAM	TMDL * (lbs/day)
1	Cedar Creek	479
2	Clear Creek **	278
3	Ollie Creek	126

NOTE: * TMDL expressed as Ultimate Oxygen Demand (UOD) which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).
** City of Atlanta Clear Creek CSO was not discharging in the critical time period (June 2000) and therefore is not considered in the TMDL analysis. Further studies and monitoring will occur to quantify impacts on DO.

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 three categories, supporting, partially supporting, or not supporting their designated uses, 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* every two years.

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

Water quality data collected by the United States Geological Survey (USGS) in 2000 and historical data indicate that three waterbodies in the Chattahoochee River Basin did not achieve water quality standards for dissolved oxygen (DO). These waterbodies were included in the state's 2002-303(d) list. This report presents the dissolved oxygen TMDLs for the listed segments in the Chattahoochee River basin identified in Table 1-1.

Table 1-1 Waterbodies Listed For Dissolved Oxygen in the Chattahoochee River Basin

LISTED STREAM	LOCATION	SEGMENT LENGTH (Miles)	STATUS
Cedar Creek	Near Whitesburg (Coweta County)	6	Partially Support
Clear Creek	In Atlanta (Fulton County)	3	Partially Support
Ollie Creek	Near Hogansville (Meriwether County)	1	Partially Support

1.2 Watershed Description

The Chattahoochee River originates in the southeast corner of Union County, in north Georgia, within the Blue Ridge Mountains. The river flows southwest to Lake Sidney Lanier (Lake Lanier), then through the Atlanta metropolitan area to West Point Lake on the Alabama border. At this point, the Chattahoochee forms the border between Georgia and Alabama. It continues flowing south through Walter F. George Reservoir and converges with the Flint River in Lake Seminole, at the Georgia-Florida border. The outflow from Lake Seminole forms the Apalachicola River in Florida, which ultimately discharges to the Gulf of Mexico. The Chattahoochee River Basin contains parts of the Blue Ridge, Piedmont, and Coastal Plain physiographic provinces that extend throughout the southeastern United States.

Table 1-2 shows that there are four 8-digit Hydrologic Unit Codes (HUCs) within the Chattahoochee River Basin. Figure 1-1 shows the location of these HUCs. Figure 1-2 shows the listed segments for dissolved oxygen in the Chattahoochee River Basin.

Table 1-2 Summary of the Chattahoochee and Flint Dissolved Oxygen TMDLs

River Basin	Drainage Area (square miles)	Listed Segments	2000 WQ Stations	8-digit Hydrologic Unit Codes
Chattahoochee	8,742	3	60	• Upper Chattahoochee (HUC 03130001) • Middle Chattahoochee – Lake Harding (HUC 03130002) • Middle Chattahoochee – WF George Reservoir (HUC 03130003) • Lower Chattahoochee (HUC 03130004)
Flint	8,447	8	62	• Upper Flint (HUC 03130005) • Middle Flint (HUC 03130006) • Kinchafoonee-Muckalee (HUC 03130007) • Lower Flint (HUC 03130008) • Ichawaynochaway (HUC 03130009) • Spring (HUC 03130010)

The land use characteristics of the Chattahoochee River Basin watersheds were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage was produced from Landsat Thematic Mapper digital images developed in 1995. For the thirteen metro Atlanta counties, the Atlanta Regional Commission (ARC) Landuse Coverage was used. The ARC landuse was derived from digital images developed in 2000. Landuse classification is based on a modified Anderson level one and two system. Table 1-3 lists the land use distribution of the eight watersheds on the 303(d) list. Detailed information on each of the watersheds is provided in Appendix A.

Table 1-3 Land Uses Associated with Listed Segments in the Chattahoochee River Basin

Seg. #	Stream	Total Contributing Area (acres)	Cropland (%)	Pasture (%)	Forest (%)	Wetland (%)	Built-Up Impervious (%)	Built-Up Pervious (%)
1	Cedar Creek	30,311	16.7	0.0	56.2	6.2	19.4	1.5
2	Clear Creek	4,648	0.0	0.0	3.2	0.3	92.6	4.0
3	Ollie Creek	2,201	2.7	5.3	86.4	4.5	0.2	1.0

1.3 Water Quality Standards

The three listed segments in the Chattahoochee River Basin have been assigned a water use classification of Fishing. Georgia's water quality standards specify the following DO criteria for this use classification:

Numeric. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish*. A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resource Division. (*There are no designated trout streams in the Chattahoochee River Basin).

Georgia EPD, 2000

Certain waters of the state may have conditions where dissolved oxygen is naturally lower than the numeric criteria specified above and therefore cannot meet these standards unless naturally occurring loads are reduced or streams are artificially or mechanically aerated.

Natural Water Quality. "It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation." 391-3-6-.03(7)

Georgia EPD, 2000

EPA Dissolved Oxygen Criteria were used to address these situations. Alternative EPA limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions.

"Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration." Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater), EPA440/5-86-003, April 1986.

US EPA, 1986

Accordingly, if the naturally occurring dissolved oxygen exceeds GAEPD numeric limits at critical conditions then the GAEPD numeric limits apply. If naturally occurring DO is lower than the GAEPD numeric limits then 90 percent of the natural DO will become the minimum allowable.

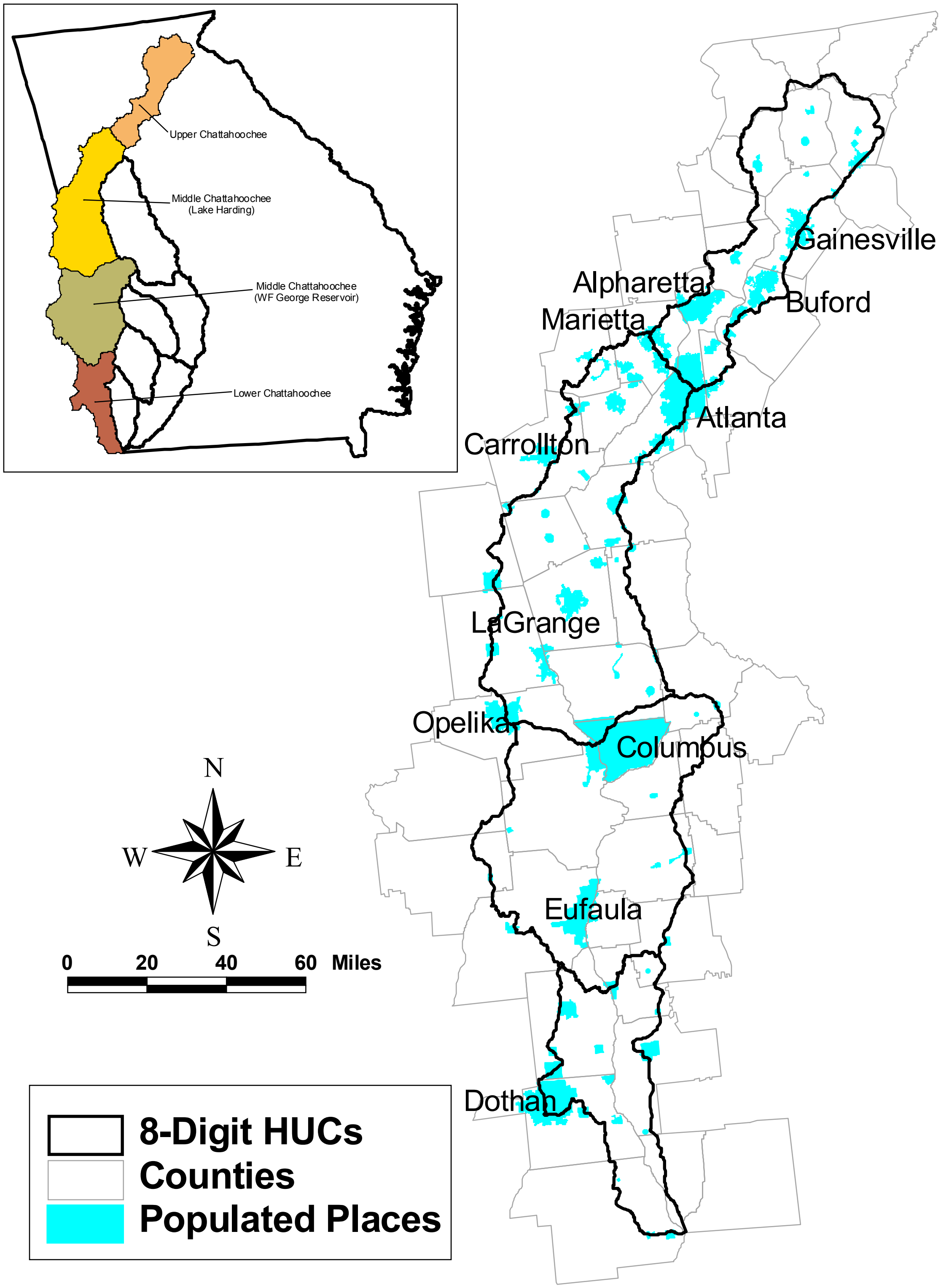

Figure 1-1 Location of the Chattahoochee River Basin

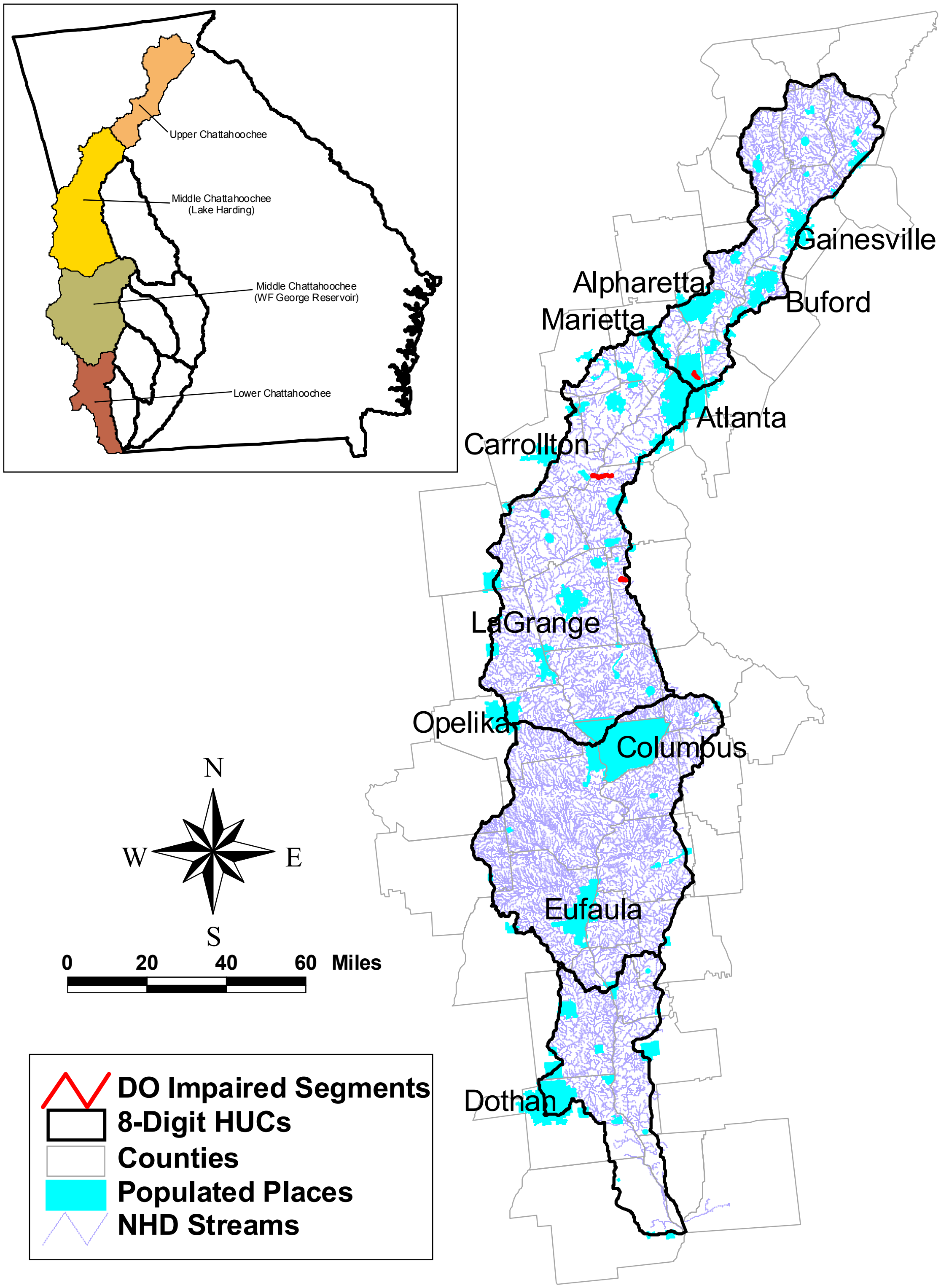

Figure 1-2 303(d) Listed Segments for Dissolved Oxygen in the Chattahoochee River Basin

2.0 WATER QUALITY ASSESSMENT

USGS collected water quality data in Georgia during 2000. There were a total of 122 stations in the Chattahoochee and Flint River basins. There were 62 water quality stations in the Chattahoochee River Basin for 2000. Figure 2-1 shows the USGS/GAEPD water quality and USGS flow stations that were sampled during 2000. Data collected at Cedar Creek are provided in Appendix B.

These data show that low dissolved oxygen values usually occurred during the summer months. Furthermore, these were limited to headwater streams where the drainage areas are relatively small and dry weather flows are low, intermittent, or zero. In larger watersheds where the flows are higher, the dissolved oxygen concentrations always met the minimum standard of 4.0 mg/L and the daily average of 5.0 mg/L. Figure 2-2 is a graph of the dissolved oxygen versus flow in Cedar Creek during 2000. The plot shows that dissolved oxygen values below 5.0 mg/L typically occur at flows less than 10 cfs. The computed 7Q10 for Cedar Creek is 8.26 cfs.

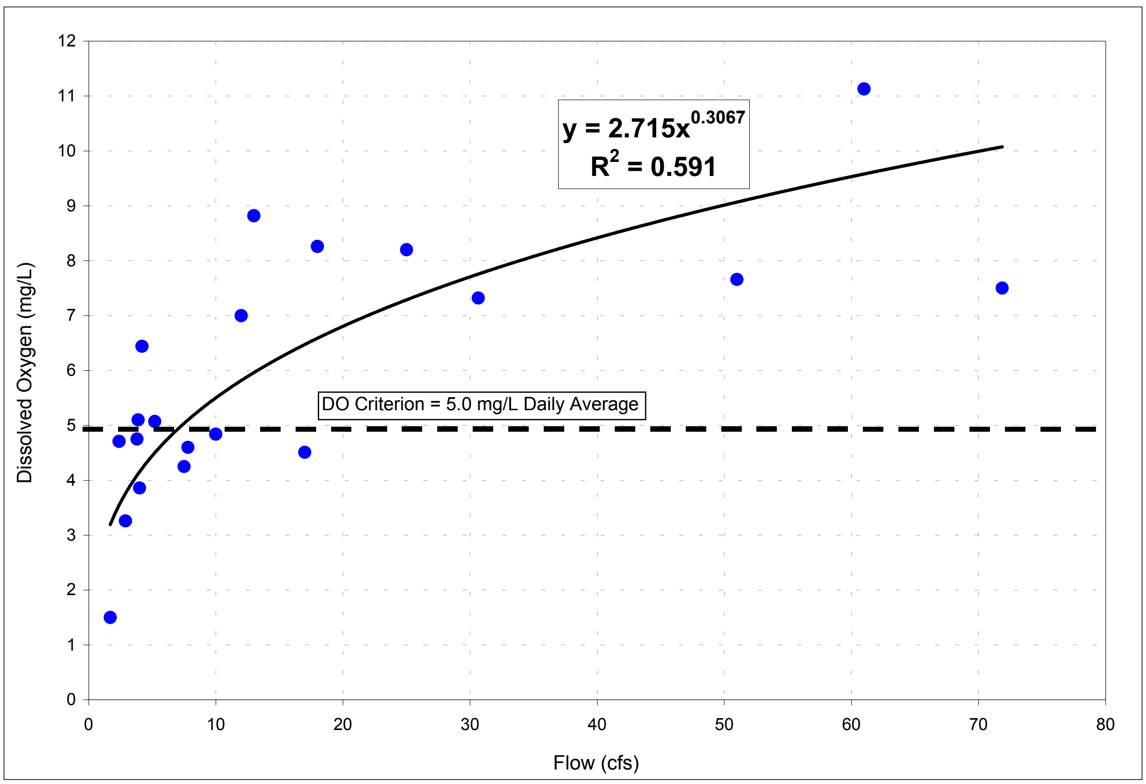

Figure 2-2 Dissolved Oxygen Versus Flow at #12148001 – Cedar Creek at Brimer Road Near Roscoe, GA

All field data relevant to the Chattahoochee and Flint River Basins were compiled by GAEPD and included in electronic database files. The data are managed in the Water Resources Data Base (WRDB), a software database that was developed by GAEPD. Project data file(s) contain the following information comprising over a half million records:

1. Historic trend monitoring data through 1999,
2. 2000 GAEPD/USGS water quality data, and
3. Historic USGS daily average flow data through December 31, 2000

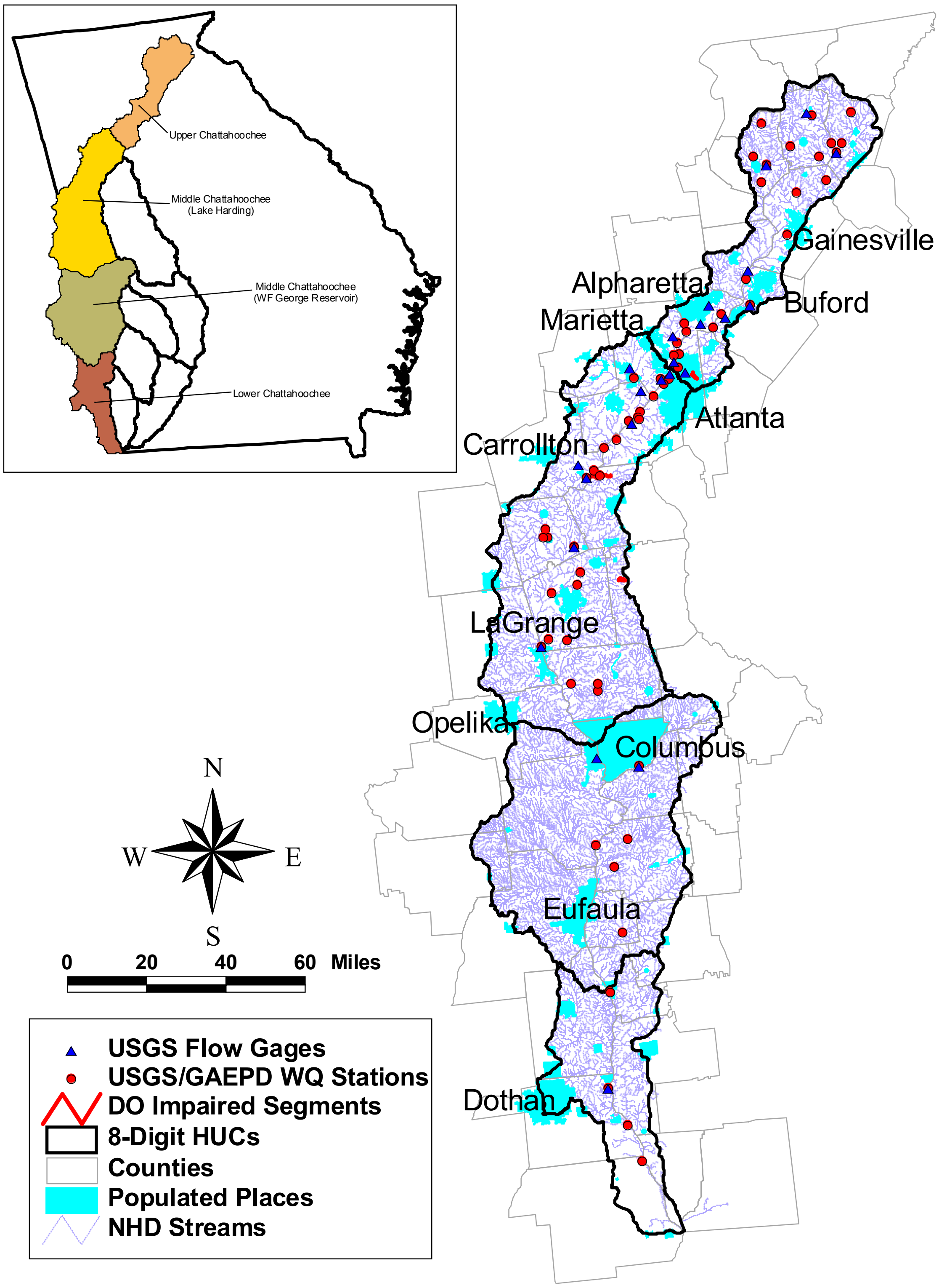

Figure 2-1 2000 USGS Water Quality Stations in the Chattahoochee River Basin

3.0 SOURCE ASSESSMENT

3.1 Point Sources

GAEPD maintains a database of current NPDES permits and GIS files that locate each permitted outfall. Monthly Discharge Monitoring Reports (DMRs) for 2000 were downloaded from the Permit Compliance System (PCS). Table 3-1 shows the point source in the Chattahoochee River Basin that discharge into or upstream of a DO listed segments. The permit for the City of Atlanta's Clear Creek Combine Sewer Overflow (CSO) does not contain any limits for dissolved oxygen related parameters.

Table 3-1 Contributing Point Sources in the Chattahoochee River Basin

NPDES Permit	Facility Name	Receiving Water	8-Digit HUC	County
GA0036871	Atlanta Clear Creek CSO	Clear Creek	Upper Chattahoochee (HUC 03130001)	Fulton
GAS000117	Fulton County MS4	Many	Upper Chattahoochee (HUC 03130001)	Fulton

3.2 Nonpoint Sources – Surface Washoff and Leaf Litter Decay

In 2000, many streams in the basin were dry or had ponded areas and stagnant pools as a result of a 3-year drought in Georgia. Due to the absence of rainfall during the summer months of 2000, the critical time period, stormwater did not contribute any washoff of materials into the streams. Any constituents that may have washed off of disturbed land surfaces in previous months or years have either: (1) already flushed out of the system along with the water column flow; or, (2) a portion may have settled out to become a part of the stream channel bottom. In this manner, the historic washoff of settleable material could accumulate and exert an additional sediment oxygen demand (SOD) attributable to man's land disturbing activities. The constituents of concern from surface washoff include the fraction of ammonia and 5-day Biochemical Oxygen Demand (BOD_5) that become an integral part of channel bottom sediments and thus become a potential source of sediment oxygen demand.

Table 1-3 describes the land use distributions for each DO listed stream. Note the relatively high percentages of forested and wetland land uses and the low percentages of built up areas in cedar and Ollie Creeks.

In addition to nonpoint sources of sediment oxygen demand associated with man's land disturbing activities, Cedar and Ollie Creeks receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors. The following sources of naturally occurring organic materials have been identified:

- Adjacent wetlands and swamps with organically rich bottom sediments; and,
- Direct leaf litterfall onto water surfaces and adjacent floodplains from overhanging trees and vegetation.

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of sediment oxygen demand being exerted. In addition, low dissolved oxygen in streams is very common in the summer months when the temperatures are high and the flows are low (Meyer, 1992). The oxygen demanding effects of leaf litterfall were reflected here in two ways: (1) by lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and, (2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

4.0 TECHNICAL APPROACH

The technical approach is described in the steps below:

- Model Selection and Setup,
- Low-Flow Analysis,
- Calibration Data,
- SOD Representation,
- Calibration Conditions,
- Critical Conditions,
- Natural Conditions, and
- Allocations

Model Selection and Setup
Initially, an analysis was performed to correlate indicated low DO values to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and others. From this analysis, low DOs were found to coincide with low or zero flows, slow stream velocities, shallow water depths, and high temperatures. Inflows of very low dissolved oxygen waters from adjacent marshes and forested swamps compounded the situation. Since all of the impairments noted in 2000 occurred during sustained periods of low flows, a steady-state modeling approach was chosen. The steady-state Georgia DOSAG, developed by the Georgia Environmental Protection Division, was selected for the following reasons:

- It is simple, without unnecessary complexity.
- It conforms to GAEPD standard practices for developing wasteload allocations.
- It works well for low flow and high temperature conditions.
- It can be developed with a limited dataset.
- It is able to handle branching tributaries and both point and nonpoint source inputs.

Georgia DOSAG computes dissolved oxygen using an enhanced form of the Streeter-Phelps equation (Thomann and Mueller, 1987). The model applies the equation to each stream reach over small incremental distance intervals. The model also provides a complete spatial view of a system, upstream to downstream. This allows the modeler to understand the important differences in stream behavior at various locations throughout a basin.

A total of three DOSAG models developed to represent the three listed segments in the Chattahoochee River Basin. USGS quadrangle maps along with Arcview and MapInfo spatial graphics files were used to develop drainage areas, stream lengths, bed slopes, and other physical input data for each model.

Low-Flow Analysis
For the three listed segments in the Chattahoochee River basin, only one segment had 2000 water quality and flow data. Cedar Creek was sampled throughout the year 2000 and two flow measurements were recorded on June 19 and August 1, 2000. Since the flow data were limited at best, an analysis was performed to examine the adjacent long-term USGS gages to develop a representative flow during June 2000. Table 4-1 lists the USGS long-term gages that were selected to represent a low flow for modeling purposes for each of the listed segments.

Table 4-1 Low-Flow Analysis Summary for the Chattahoochee River Listed Segments

DO TMDL Segment	Drainage Area to bottom of listed segment (sq. miles)	Nearest USGS Gage	Drainage Area of Gage (sq. miles)	7Q10 of USGS Gage	June 2000 Average Flow (cfs)	Productivity Factor of 7Q10 (cfs/sq. mile)	Weighted 7Q10 for Modeling (cfs)
Cedar Creek	47.35	02337500	35.5	6.19	6.93	0.1744	8.26
Clear Creek	7.26	02336300	86.8	10.03	3.59	0.1156	0.84
Ollie Creek	3.44	02338660	2,680	1.63	0.0	0.0006	0.002

A productivity factor was computed by dividing the 7Q10 by the watershed area of the USGS gage. The units of the productivity factor are cfs per square mile. A weighting 7Q10 was then computed by multiplying the listed segment watershed drainage area by the calculated productivity factor. The proximity of the USGS long-term gages is shown in Appendix A (Figures A-1, A-2, and A–3).

Calibration Data

The model calibration period was determined from an examination of the USGS 2000 water quality data for each station located on the listed segment. The data examined included streamflow, dissolved oxygen, water temperature, BOD_5, and ammonia. The combination of the lowest, steady flow period with the lowest dissolved oxygen, and highest BOD concentrations, defined the critical modeling period. For all three of the listed segments, June 2000 was found to be the critical period.

SOD Representation

SOD is an important part of the oxygen budget in these shallow streams. There are no field sediment oxygen demand measurements in the Chattahoochee River basin. However, there were several SOD measurements from the South 4 Basins. The values ranged from 0.9 to 1.9 $g/m^2/day$. It is necessary to be realistic in the development and application of SOD values in the Chattahoochee models, and to be consistent with the findings from the South 4 Basins. For this reason, an examination of South 4 SOD results was performed.

The results from all calibrated models of existing conditions in June 1998 were compiled and summarized. An average value of existing SOD was determined to be 1.35 $g/m^2/day$. This represented 12 models that had mixed land uses and varying degrees of point source activity. When the same 12 models were re-run under natural conditions (assuming zero point source discharges and completely forested watersheds), SOD averaged 1.25 $g/m^2/day$. These two values were adopted for the Chattahoochee models to represent SOD for: (1) mixed land uses, including agriculture; and, (2) natural or totally forested watersheds, respectively. From this, the anthropogenic nonpoint source contributions, those caused by man's land disturbing activities, are accounted for in the 0.1 $g/m^2/day$ difference between the two adopted SOD values.

Calibration Conditions

Monthly average values of DO, Ultimate Carboneous Biochemical Oxygen Demand ($CBOD_U$), and Ultimate Nitrogenous Biochemical Oxygen Demand ($NBOD_U$) for June 2000 were used as instream targets to calibrate the models. June 2000 water temperatures were varied across the basin in accordance with the sampling data. Point source discharges were put into the model at their June 2000 DMR values for DO, BOD_5, NH_3, and flow. Headwater and tributary water quality boundaries were developed from instream field data, expected low DO saturation values (Meyer, 1992), and GAEPD standard modeling practices. SOD was set to 1.35 g/m^2/day to reflect mixed land uses. Figure 4-1 depicts a longitudinal dissolved oxygen calibration curve for the mainstem of the Cedar Creek developed using this approach.

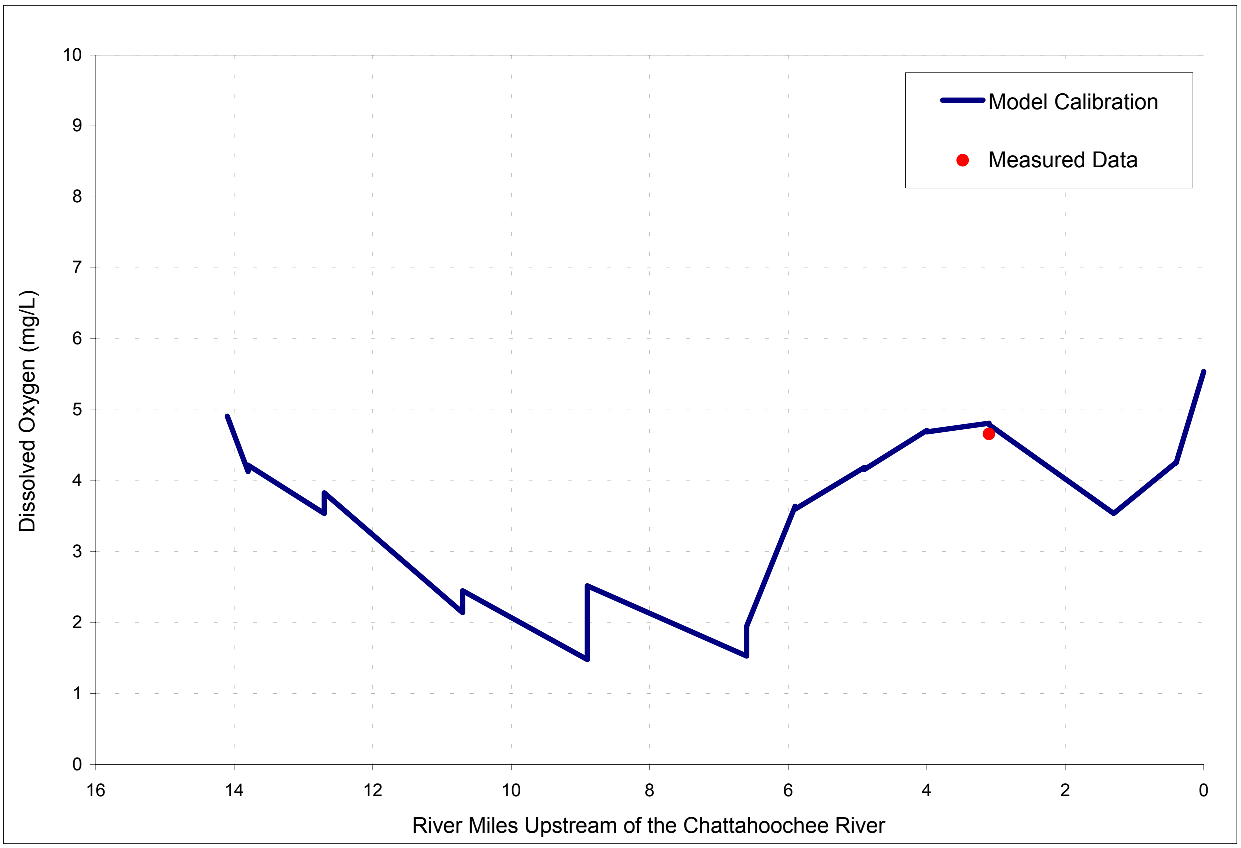

Figure 4-1 Dissolved Oxygen Calibration for Cedar Creek

Critical Conditions

Model critical conditions were developed, in accordance with GAEPD standard practices. Critical conditions are used to assess dissolved oxygen standards, to determine if a problem exists requiring regulatory intervention, and to establish a level of protection if necessary. To do this, each calibrated model was modified in the following manner: 1) For flows, a 7Q10 was used. This is consistent with provisions in Georgia's Water Quality Regulations. Older published 7Q10 values in the USGS report (Carter and Fanning, 1982) only considered data through 1979. To account for the droughts in the late 1980s and 1990s, new monthly 7Q10 values were calculated and an average of the June through September 7Q10 was adopted. Productivity factors were then calculated from the revised 7Q10 values and applied uniformly throughout the basin. 2) For temperature, critical water temperatures were developed by examining the long-term trend monitoring data and fitting a harmonic sine function to all of the historical data at a given station. The June through August average temperature from the harmonic fit was used to represent each trend station. Critical temperatures in other locations in the basin were adjusted on the basis of June 2000 field data. Point sources were incorporated into the critical conditions models at their current NPDES permit limits. Water quality boundaries, the SOD rate, and all other modeling rates and constants were the same as those in the calibrated models.

Natural Conditions

For the natural conditions runs, the SOD term in the model was changed from 1.35 g/m^2/ day to 1.25 g/m^2/day to reflect the change from mixed land uses to natural or completely forested land uses. All other model parameters remained the same. The results of the natural conditions runs are plotted in Figure 4-2 along with the June 2000, and critical conditions results for comparison. It is important to note: (1) even though field DO measurements were found to be low in the summer of 2000, the results are even lower at standard critical conditions; (2) June 2000 conditions are very close to natural conditions and compare favorably with the 90 percent of natural DO standard.

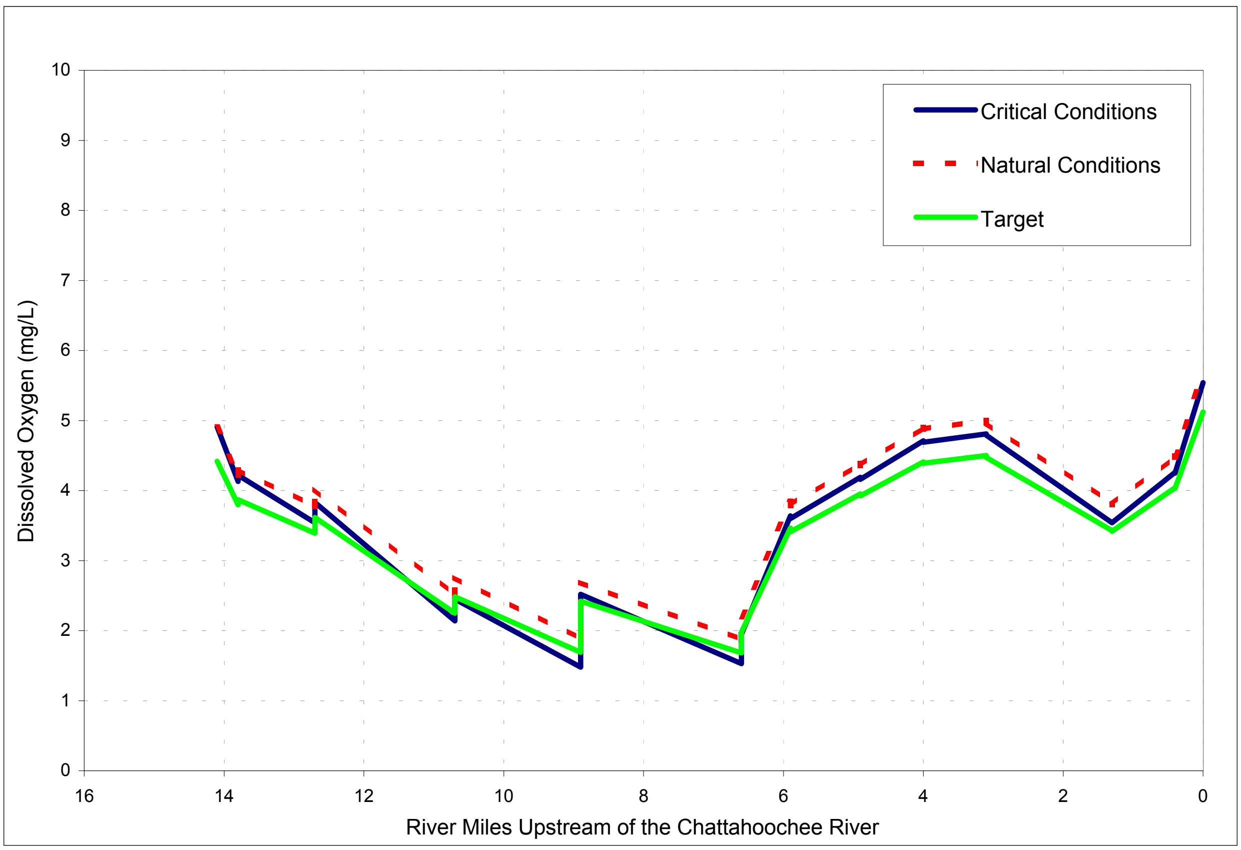

Figure 4-2 Critical, Natural, and Target Conditions for Cedar Creek

Allocations

Allocations are based on EPA Dissolved Oxygen Criteria that states if the natural dissolved oxygen is less than the standard, then only a 10 percent reduction in the natural condition is allowed. The target limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions.

The Ollie Creek and Cedar Creek models simulated a natural condition below the daily average of 5.0 mg/L. Therefore, these models were used to establish targets at 90% of the natural condition run. All of the nonpoint source loadings remained within the 10% margin to meet the target dissolved oxygen value. No allocations were made to the nonpoint sources.

The Clear Creek segment did not have dissolved oxygen measurements for any time period. A steady-state model was setup for June 2000 using the downstream Peachtree Creek gage and background concentrations for $CBOD_U$ and $NBOD_U$. The model showed no impact during dry weather critical conditions. It is not clear whether a dissolved oxygen impairment currently exists and what the potential sources might be in the watershed.

5.0 ALLOCATION

The first step in the process was to determine naturally occurring dissolved oxygen concentrations for the listed segments. By doing so, the applicable water quality standard used for TMDL development can be determined.

To determine naturally occurring dissolved oxygen concentrations, the steady-state DOSAG models were run with 1) critical conditions, 2) zero point source inputs and 3) nonpoint source inputs representing forested or wetland conditions free from man's influences. According to EPA Dissolved Oxygen Criteria, the target limits were identified as 90 percent of the naturally occurring concentration.

After identifying the dissolved oxygen target limits, the models were run to determine the loading capacity of the waterbody. This was accomplished through a series of simulations aimed at meeting the dissolved oxygen target limit by varying source contributions. The final acceptable scenario represented the TMDL (and loading capacity of the waterbody).

5.1 Waste Load and Load Allocations

Two critical components of the TMDL are the Waste Load Allocations (WLAs) and the Load Allocations (LAs). The WLAs represent the allocations to point source facilities contributing to listed waterbodies, while the LAs represent allocations to the nonpoint source contributions.

The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 5-1 is based on modeling results and professional judgment. The existing WLA is separated into 'Direct' and 'Upstream' contributions. The 'Direct' loads are the point source loads discharging directly into the listed stream segment. The 'Upstream' load is one that discharges in an upstream segment and is transported downstream into the listed segment. The model was used to account for instream kinetic processes that would occur from the discharge point to the upstream boundary of the listed segment. The WLAs may be modified by GAEPD during the NPDES permitting process. The TMDLs will be used to assess the permit renewals. The nonpoint source loads for the existing LA and TMDL were computed from the model boundary conditions, which include the stream, tributary, and headwater model boundaries.

Table 5-1 Existing and TMDL Loads for Listed Segments in the Chattahoochee River Basin

Segment Number	Stream	Existing Direct WLA (lbs/day)	Existing Upstream WLA (lbs/day)	Existing LA (lbs/day)	Total Existing Load (lbs/day)	TMDL* (lbs/day)	Reduction WLA	Reduction LA
1	Cedar Creek	None	None	479	479	479	NA	0%
2	Clear Creek **	None	None	278	278	278	NA	0%
3	Ollie Creek	None	None	126	126	126	NA	0%

NOTE: * TMDL expressed as Ultimate Oxygen Demand (UOD) which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).
** City of Atlanta Clear Creek CSO was not discharging in the critical time period (June 2000) and therefore not considered in the TMDL analysis. Further studies and monitoring will occur to quantify impacts on DO.
None = No permitted point source contributing to listed segment (see note below on Clear Creek).
NA = Since there is not a permitted point source, a percent reduction is not applicable.

5.2 Seasonal Variation

The low flow critical conditions incorporated in this TMDL are assumed to represent the most critical design conditions and to provide year-round protection of water quality. This TMDL is expressed as a total load during the critical low flow period.

5.3 Margin of Safety (MOS)

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.

MOS was incorporated implicitly in this dissolved oxygen TMDL development based on the following conservative assumptions:

- Drought streamflows that persist through the critical summer months at monthly 7Q10 flow values.
- Hot summer temperatures, based on the historical record, that persist for the same critical period.
- All point sources discharge continuously at their NPDES permit limits for the same critical period.
- DO saturation, for all flows entering the system, equal to those measured during the low DO period in the summer of 2000.
- Shallow water depths, generally less than one foot, which aggravates the effect of SOD.
- Slow water velocities, generally 0.5 fps or less, which intensifies the effect of BOD decay.

6.0 RECOMMENDATIONS

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the State each year. GAEPD has adopted a basin approach to water quality management that divides Georgia's major river basins into five groups. This approach provides for additional sampling work to be focused on one of the five basin groups each year and offers a five-year planning and assessment cycle. The Chattahoochee and Flint River Basins were the subjects of focused monitoring in 2000 and will again receive focused monitoring in 2005.

The TMDL Implementation Plan will outline an appropriate water quality-sampling program for the listed streams in the Chattahoochee River Basin. The monitoring program will be developed to help identify the various oxygen demanding sources. The sampling program will be used to verify the 303(d) stream segment listings. This will be especially valuable for those segments where no data or old data that resulted in the listing.

6.2 Reasonable Assurance

The Georgia EPD is responsible for administering and enforcing laws to protect the waters of the State. The TMDL implementation will be done using a phased approach due to the insufficient data available on the natural background dissolved oxygen concentrations. Permitted discharges will be regulated through the NPDES permitting process d1escribed in this report. The permittee may be required to perform dissolved oxygen monitoring upstream and downstream of the point source to verify the natural dissolved oxygen concentrations assumed in the model. The target WLA reduction will not be implemented until sufficient data has been collected to verify the model assumptions. If it is determined that the model assumptions need to be updated, the target WLA reductions will be re-evaluated based on the new data collected during critical conditions, and the TMDL will be reallocated.

EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities that have a bearing on nonpoint source pollution include establishing water quality standards and use classifications, assessing and reporting water quality conditions, and regulating land-use activities, which may affect water quality. 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 Best Management Practices (BMPs) that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality.

6.3 Public Participation

A 30-day public notice will be provided for this TMDL. During this time, the availability of the TMDL will be public noticed, a copy of the TMDL will be provided as requested, and the public will be invited to provide comments on the TMDL.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of BMPs and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL, while State and/or local agencies work with local stakeholders to develop a revised TMDL implementation plan. It also includes a process whereby EPD and/or Regional Development Centers (RDCs), or other EPD contractors (hereinafter, “EPD Contractors”), will develop expanded plans (hereinafter, “Revised TMDL Implementation Plans”).

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some Best Management Practices. The “Management Measure Selector Table” shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. [See 40 C.F.R. § 122.44(d)(1)(vii)(B)]. NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

2. EPD and the EPD Contractor will select and implement one or more BMP demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major pollutant categories of concern for the respective River Basin as identified in the TMDLs. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA’s “Best Management Practices Handbook,” the “NRCS National Handbook of Conservation Practices,” or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled “Watershed Wisdom -- Georgia’s TMDL Program” will be distributed by EPD to the EPD Contractor for use with appropriate stakeholders for this TMDL. Also, a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders on TMDL Implementation Plan development.

4. If for any reason the EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan is the end of August 2004.

6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:

   A. Generally characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate, (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

Table 7-1 Management Measure Selector Table

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	Toxicity	Mercury	Metals (copper, lead, zinc, cadmium)	PCBs, Toxaphene
Agriculture	1. Sediment & Erosion Control	_	_		_	_				
	2. Confined Animal Facilities	_	_							
	3. Nutrient Management	_	_							
	4. Pesticide Management		_							
	5. Livestock Grazing	_	_		_	_				
	6. Irrigation		_		_	_				
Forestry	1. Preharvest Planning				_	_				
	2. Streamside Management Areas	_	_		_	_				
	3. Road Construction &Reconstruction		_		_	_				
	4. Road Management		_		_	_				
	5. Timber Harvesting		_		_	_				
	6. Site Preparation & Forest Regeneration		_		_	_				
	7. Fire Management	_	_	_	_	_				
	8. Revegetation of Disturbed Areas	_	_	_	_	_				
	9. Forest Chemical Management		_			_				
	10. Wetlands Forest Management	_	_	_		_		_		
Urban	1. New Development	_	_		_	_			_	
	2. Watershed Protection & Site Development	_	_		_	_		_	_	

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	Toxicity	Mercury	Metals (copper, lead, zinc, cadmium)	PCBs, Toxaphene
	3. Construction Site Erosion and Sediment Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	–	–		–	–			–	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance-Roads, Highways and Bridges	–	–			–			–	

#202082

REFERENCES

Carter, R.F. and J.D. Fanning, 1982. Monthly Low-Flow Characteristics of Georgia Streams. United States Geological Survey prepared in cooperation with the Georgia Department on Natural Resources Environmental Protection Division, Open-File Report 82-560.

Dyar, T.R. and S.J. Alhadeff, 1997. Stream-Temperature Characteristics in Georgia. United States Geological Survey prepared in cooperation with the Georgia Department on Natural Resources Environmental Protection Division, Water-Resources Investigations Report 96-4203.

Edwards, R.T. and J.L. Meyer, 1987. Metabolism of a subtropical low gradient blackwater river." *Freshwater Biology*, 17:251-263.

Georgia EPD, 1978. Modeling Procedures Manual. Prepared for Georgia Department of Natural Resources, Environmental Protection Division by Larry A. Roesner and Robert P. Shubinski.

Georgia EPD, 1996. Georgia's Watershed Protection Approach: River Basin Management Planning, Draft Program Description. February 1996.

Georgia EPD, 2000. *Rules and Regulations for Water Quality Control. Chapter 391-3-6.* Revised – July 2000. Georgia Department of Natural Resources. Environmental Protection Division. Atlanta, GA.

Meyer, J.L., 1992. Seasonal patterns of water quality in blackwater rivers of the Coastal Plain, Southeastern United States. *Water Quality in North American River Systems,* Battelle Press, Columbus, Ohio, pages 249-276.

Meyer et al., 1997. Organic matter dynamics in the Ogeechee River, a blackwater river in Georgia, USA. *Journal of the North American Benthological Society*, 16(1):1.

Sierra Club v. Hankinson. Civil Action File No. 1: 94-CV-2501-MHS. Consent decree signed on July 15, 1997.

Thomann, R.V. and J.A. Mueller, 1987. Principles of surface water quality modeling and control. Harper Collins Publishers Inc., New York.

Tsivoglou, C. and L.A. Neal, 1976. Tracer measurement of reaeration: III. Predicting the reaeration capacity of inland streams, *Journal of Water Pollution Control Facilities,* December, pages 2669-2689.

USEPA, 1991. *Guidance for Water Quality Based Decisions: The TMDL Process*. EPA 440/4-91-001. U.S. Environmental Protection Agency; Assessment and Watershed Protection Division, Washington, DC.

USEPA, 1986. Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater). Office of Water Regulations and Standards Criteria and Standards Division, EPA440/5-86-003.

Wharton, C. H. and M. M. Brinson, 1979. Characteristics of southeastern river systems. Pages 32-40 in R. R. Johnson and J. F. McCormick, editors. Strategies for protection and management of floodplain wetlands and other riparian ecosystems. U. S. Forest Service General Technical Report WO-12. National Technical Information Service, Springfield, VA.

Appendix A – Data Used in TMDL Analysis

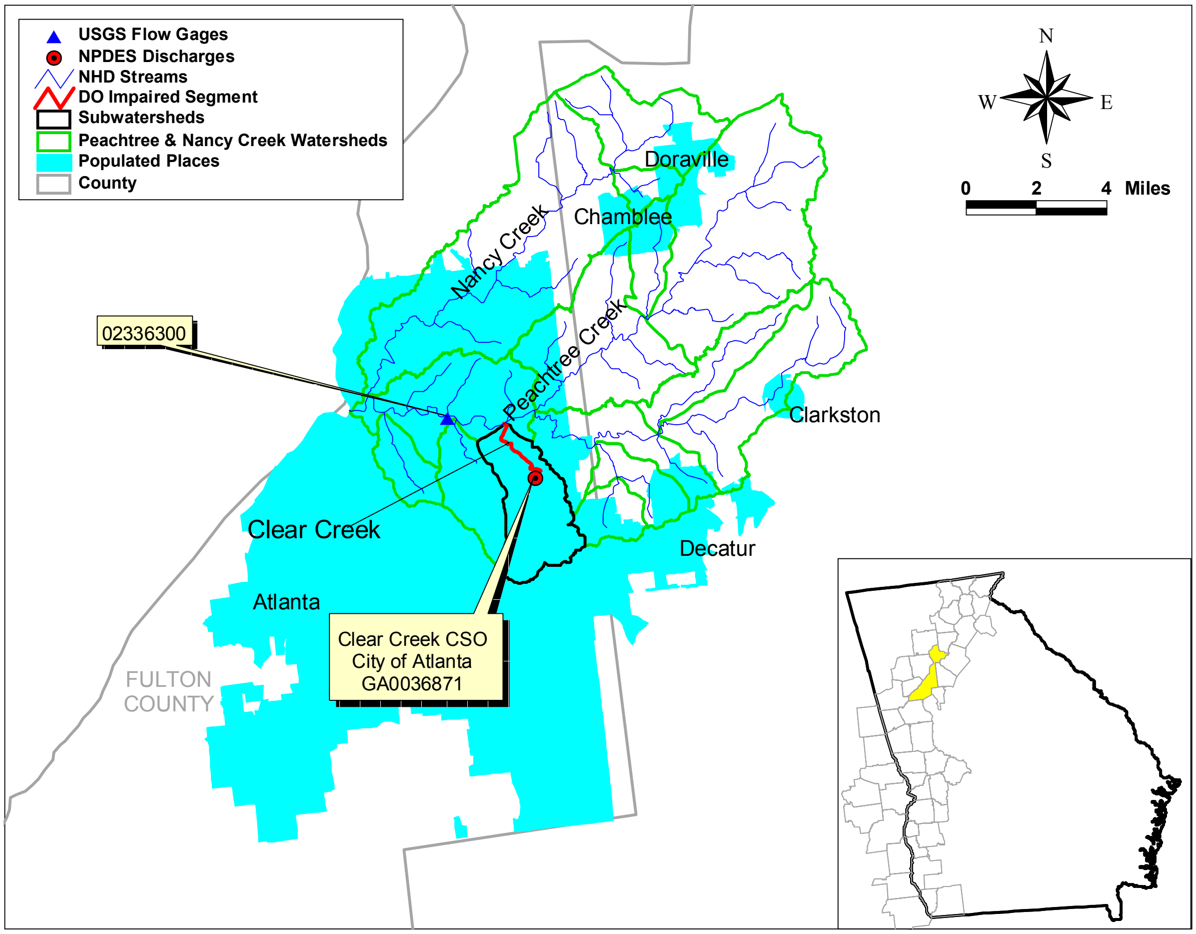

Figure A-1 Location of Point Sources and Data Stations in the Contributing Clear Creek Watershed

Table A-1 Summary of Source Assessment for the Cedar Creek Watershed

Impaired Segment: Cedar Creek
Miles of Impairment: 6
8-Digit HUC: 03130002
12-Digit HUC: 031300020402B
County: Carroll, Fulton, Coweta
Cities: Palmetto and Whitesburg
Reason for Listing: Fish IBI
USGS/GAEPD WQ Station ID: 12148001
DO Violations (Year of data): 3 of 22 (2000)
USGS Station ID: near 02337500 (Snake Creek near Whitesburg, GA), DA = 35.5 sq. miles
NPDES Facilities: none
Landfills: none
CAFOs: none
Land Applications: none
Water Withdrawals: (2 withdrawals) 060-1218-01 City of Palmetto
Area of Watershed (sq. miles): 47.35
Area of Watershed (acres): 30,306

	MRLC			ARC		
Landuse (acres/percent)	sq. meters	acres	% of Total	sq. meters	acres	% of Total
Open Water	3,180,829	786	2.6%	3,358,891	830	2.7%
Low Intensity Residential	0	0	0.0%	23,386,783	5,779	19.1%
High Intensity Residential	392,545	97	0.3%	0	0	0.0%
High Intensity Commercial/Industrial/Transportatio	384,451	95	0.3%	396,592	98	0.3%
Bare Rock/Sand/Clay	0	0	0.0%	0	0	0.0%
Quarries/Strip Mines/Gravel Pits	0	0	0.0%	60,703	15	0.0%
Transitional	384,451	95	0.3%	914,590	226	0.7%
Forest	96,918,164	23,949	79.0%	68,966,527	17,042	56.2%
Row Crops	5,475,397	1,353	4.5%	20,505,421	5,067	16.7%
Pasture/Hay	9,704,362	2,398	7.9%	0	0	0.0%
Other Grasses (Urban/Recreational;e.g.parks/lawns)	372,311	92	0.3%	805,324	199	0.7%
Woody Wetlands	5,600,849	1,384	4.6%	4,269,434	1,055	3.5%
Emergent Herbaceous Wetlands	230,671	57	0.2%	0	0	0.0%
Total	122,644,031	30,306	100%	122,664,265	30,311	100%

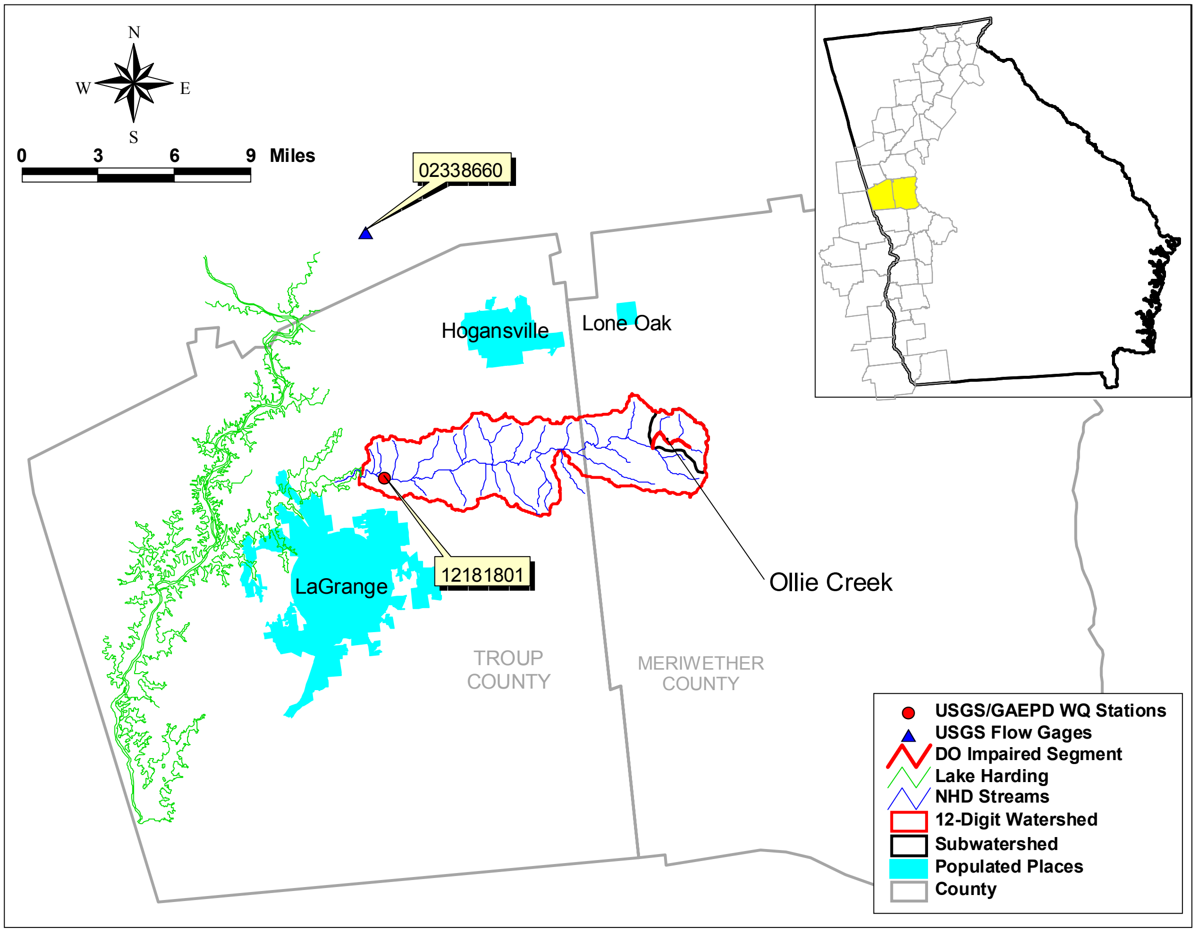

Figure A-2 Location of Point Sources and Data Stations in the Contributing Ollie Creek Watershed

Table A-2 Summary of Source Assessment for the Clear Creek Watershed

Impaired Segment:	Clear Creek
Miles of Impairment:	3
8-Digit HUC:	03130001
12-Digit HUC:	031300011204D
County:	Fulton
Cities:	Atlanta, Decatur, Clarkston
Reason for Listing:	EPD - Mun. Engineering Program - old or no data
USGS/GAEPD WQ Station ID:	none
DO Violations (Year of data):	none
USGS Station ID:	upstream of 02336300 (Peachtree Creek at Atlanta, GA), DA = 86.8 sq. miles
NPDES Facilities:	GA0036871 - Altanta Clear Creek CSO
Landfills:	none
CAFOs:	none
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	7.26
Area of Watershed (acres):	4,647

	MRLC			ARC		
Landuse (acres/percent)	sq. meters	acres	% of Total	sq. meters	acres	% of Total
Open Water	48,562	12	0%	56,656	14	0%
Low Intensity Residential	0	0	0%	3,383,172	836	18%
High Intensity Residential	10,509,686	2597	56%	5,390,413	1332	29%
High Intensity Commercial/Industrial/Transportatio	4,046,856	1000	22%	8,635,992	2134	46%
Bare Rock/Sand/Clay	8,094	2	0%	0	0	0%
Quarries/Strip Mines/Gravel Pits	0	0	0%	0	0	0%
Transitional	0	0	0%	182,109	45	1%
Forest	3,630,030	897	19%	598,935	148	3%
Row Crops	0	0	0%	0	0	0%
Pasture/Hay	0	0	0%	0	0	0%
Other Grasses (Urban/Recreational;e.g.parks/lawns)	562,513	139	3%	562,513	139	3%
Woody Wetlands	0	0	0%	0	0	0%
Emergent Herbaceous Wetlands	0	0	0%	0	0	0%
Total	18,805,742	4,647	100%	18,809,789	4,648	100%

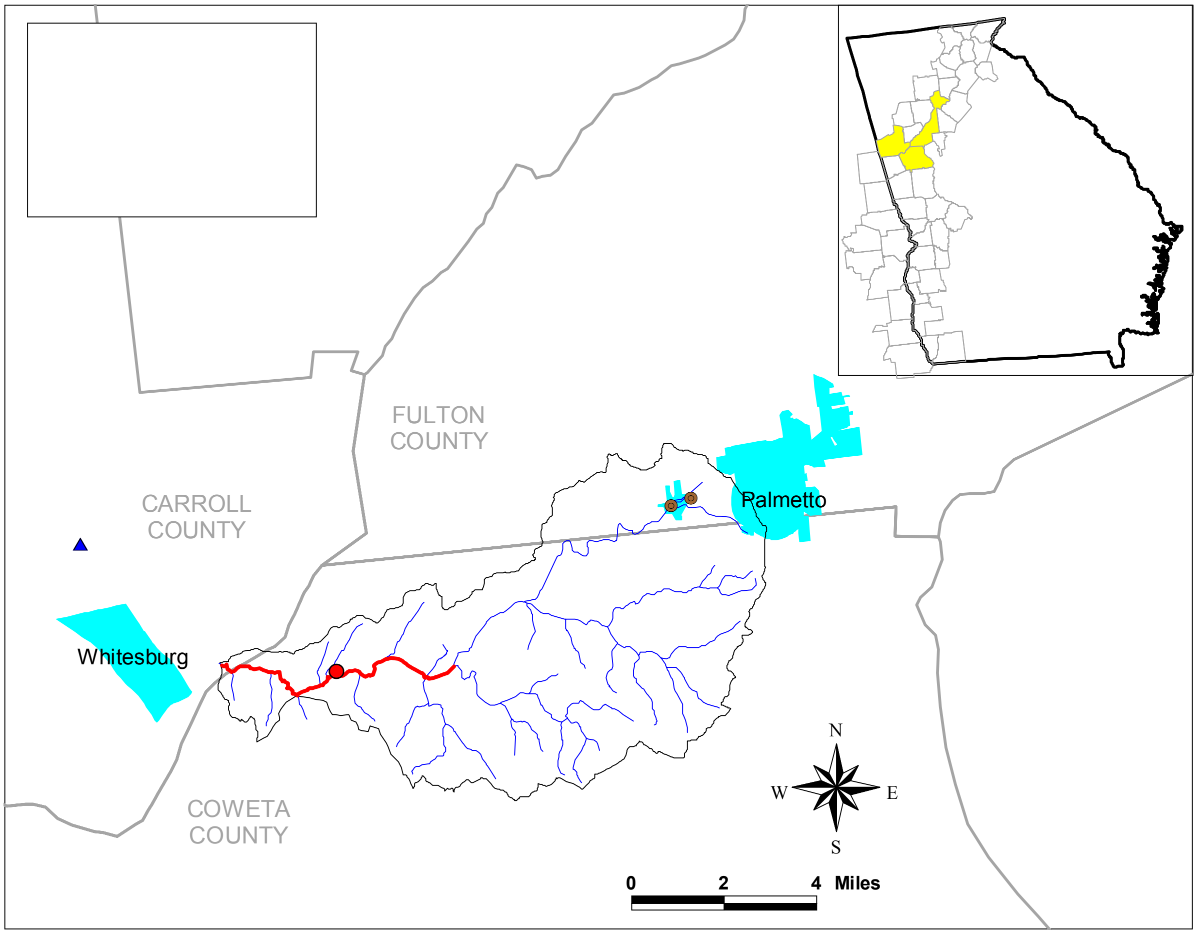

Figure A-3 Location of Point Sources and Data Stations in the Contributing Cedar Creek Watershed

Table A-3 Summary of Source Assessment for the Ollie Creek Watershed

Impaired Segment:	Ollie Creek
Miles of Impairment:	1
8-Digit HUC:	03130002
12-Digit HUC:	031300020705
County:	Troup and Meriwether
Cities:	near LaGrange, Hogansville, and Lone Oak
Reason for Listing:	Fish IBI
USGS/GAEPD WQ Station ID:	none, upstream of 12181801 (Beech Creek near LaGrange, GA)
DO Violations (Year of data):	4.3 mg/L (May - Sept 1992)
USGS Station ID:	near 02338660 (New River near Corinth, GA), DA = 2,680 sq. miles
NPDES Facilities:	none
Landfills:	none
CAFOs:	none
Land Applications:	none
Water Withdrawals:	none
Area of Watershed (sq. miles):	3.44
Area of Watershed (acres):	2,200.60

Landuse (acres/percent)	sq. meters	acres	% of Total
Open Water	31,500	7.78	0%
ntensity Commercial/Industrial/Transpor	16,200	4.00	0%
Transitional	86,400	21.35	1%
Deciduous Forest	2,406,600	594.68	27%
Evergreen Forest	3,405,600	841.54	38%
Mixed Forest	1,883,700	465.47	21%
Pasture/Hay	469,800	116.09	5%
Row Crops	240,300	59.38	3%
Woody Wetlands	340,200	84.07	4%
Emergent Herbaceous Wetlands	25,200	6.23	0%
Total	8,905,500	2,201	100%

Appendix B – Water Quality Data

Table B-1 2000 Water Quality Data Collected in Cedar Creek

Date	Time	BOD_5 (mg/L)	Discharge (cfs)	DO (mg/L)	% Saturation	Gage Height (feet)	NH_3 (mg/L)	NO_2-NO_3 (mg/L)	pH	TP (mg/L)	Water Temp (deg C)	TOC (mg/L)	Turbidity (NTU)
01/24/2000	12:45	1.1		11.13	90	1.99	0.06	0.14	6.84	0.03	5.1	2.2	13
02/28/2000	12:30	0.5		8.2	77	1.8	0.06	0.11	7.18	<0.02	12	2	5.5
03/15/2000	08:35			8.26	77	1.9			7.16		12		
03/22/2000	11:15	0.7		7.66	74	2.05	0.04	0.07	6.93	<0.02	13.4	3	10
03/29/2000	08:00			7.32	74	1.85			6.88		14.9		
04/05/2000	10:30	2.4		7.5	68	2.04	0.08	0.06	6.95	0.02	10.6	3	13
05/25/2000	08:15	3.3		4.51	54	1.86	0.08	0.06	6.81	<0.02	23.4	2.4	6.5
06/08/2000	09:00			4.84	53	1.6			7.01		19.7		
06/15/2000	07:45			4.25	50	-1.3			6.84		23		
06/19/2000	10:50	0.6	0.54	4.6	56	-3.21	0.38	0.06	7.16	<0.02	24.5	2.2	21
07/10/2000	08:15	1.5		4.71	57	-3.3	0.39	0.03	6.81	<0.02	24.2	2.1	36
07/17/2000	06:45			1.5	18	-3.41			6.54		22.3		
07/24/2000	06:55			3.26	39	-2.7			6.72		23.3		
08/01/2000	09:30	1.3	0.06	5.1	62	-1.79	0.18	0.13	7.09	<0.02	24.3	2.6	7.2
09/28/2000	10:00	1.6		5.07	53	1.3	0.1	0.03	7.03	<0.02	17.5	6.1	13
10/11/2000	09:10			6.44	59	0.82			6.78		11.3		
10/18/2000	07:20			4.75	46	-1.72			6.64		13.6		
10/24/2000	08:10	5.7		3.86	39	-1.87	0.08	0.04	6.52	<0.02	15.7	5.7	12
11/15/2000	10:45	0.6		7	63	1.68	0.1	0.05	6.73	<0.02	10	3.5	8.7
12/13/2000	11:45	0.6		8.82	72	1.77	0.06	0.05	7.26	<0.02	6.5	2.6	5.6

Appendix C – Low-Flow Analysis

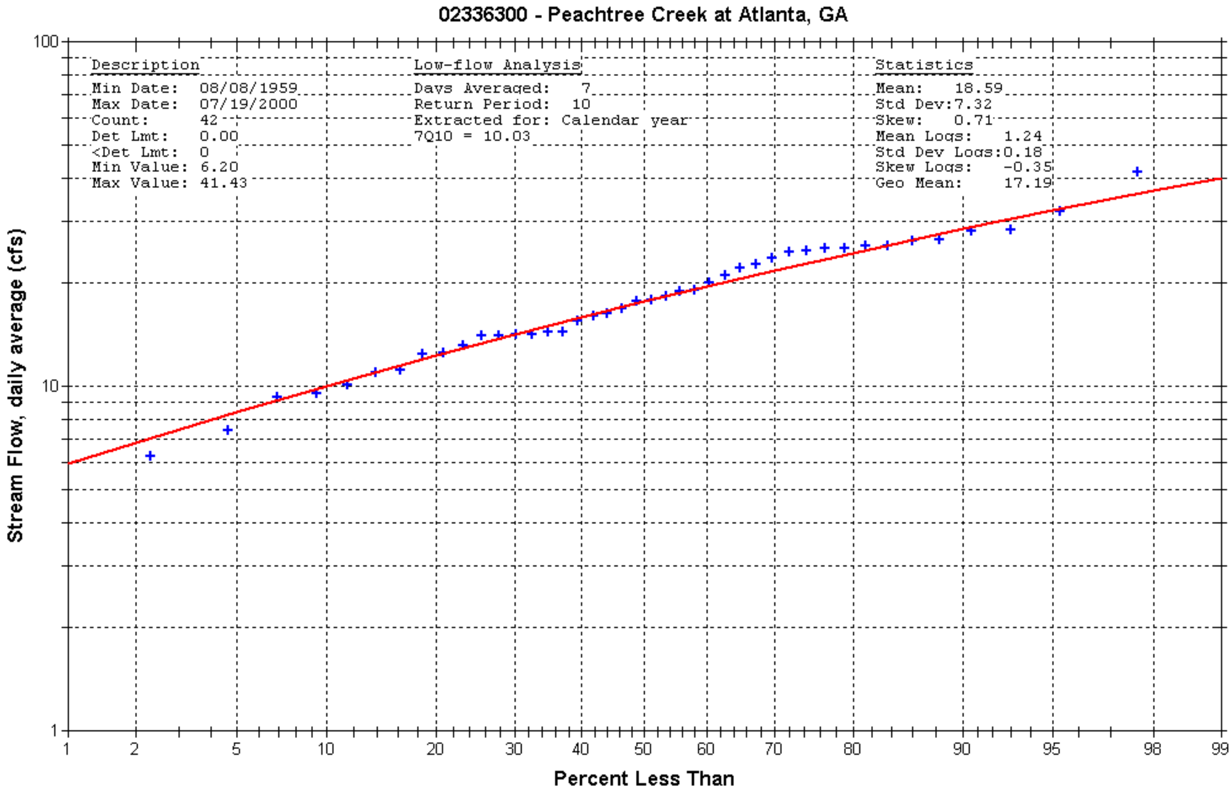

Figure C-1 Low-Flow Analysis at USGS 02336300 (Peachtree Creek at Atlanta, GA), Drainage Area Equals 86.8 square miles

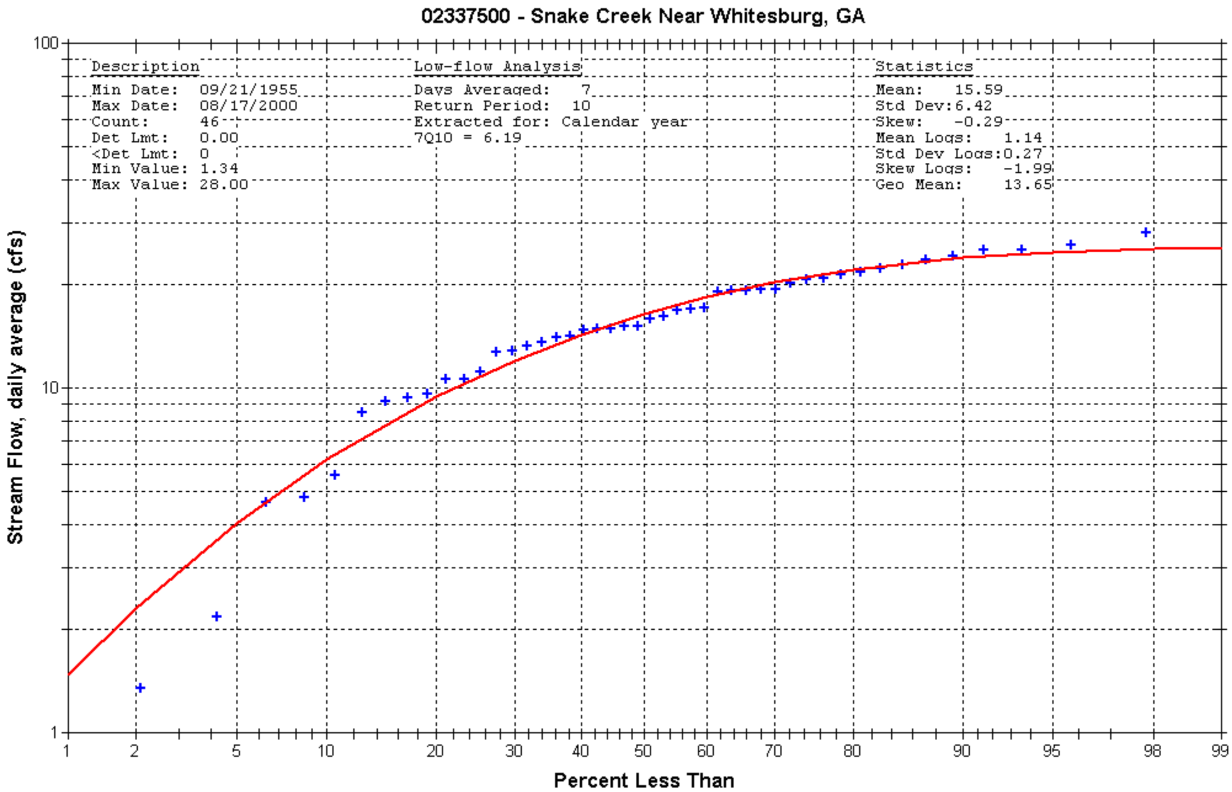

Figure C-2 Low-Flow Analysis at USGS 02337500 (Snake Creek near Whitesburg, GA), Drainage Area Equals 35.5 square miles

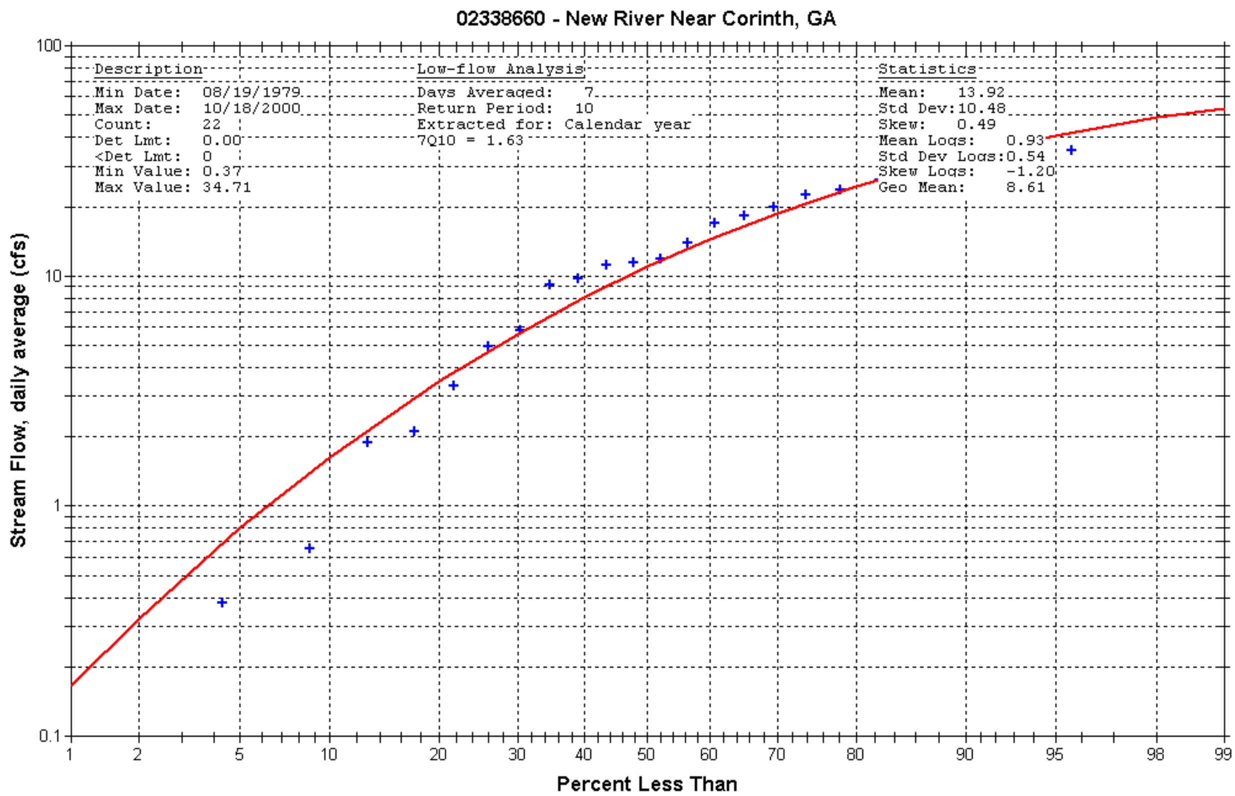

Figure C-3 Low-Flow Analysis at USGS 02338660 (New River near Corinth, GA), Drainage Area Equals 2,680 square miles