Total Maximum Daily Load

Evaluation

for the

Little River Embayment

in the

Coosa River Basin

for

Chlorophyll *a*

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

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

January 2004

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EXECUTIVE SUMMARY

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 with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. 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 (GA EPD, 2000-2001).

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.

The State of Georgia has identified a portion of one lake, the Little River Embayment of Lake Allatoona, located in the Coosa River Basin, as partially supporting its designated use due to chlorophyll *a*. This waterbody was included in the State's 2002 303(d) list. This report presents the chlorophyll *a* TMDL for this segment.

Part of the TMDL analysis is the identification of potential source. 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 the accumulation of nutrients on land surfaces that wash off as a result of storm events.

The process of developing the chlorophyll *a* TMDL for Little River Embayment included developing three computer models for the embayment. The models were run for the calendar years 2000, 2001, and 2002, when water quality data were collected in the Little River Embayment. A watershed model of the Little River Embayment was developed using the Loading Simulation Program in C++ (LSPC) that included all major point sources of nutrients. The watershed model simulates the effects of surface runoff on both water quality and flow and was calibrated to available data. The results of this model were used as tributary flow inputs to the hydrodynamic model, Environmental Fluid Dynamics Code (EFDC), which simulated the transport of water into and out of the embayment. The EPA Water Analysis Simulation Program (WASP) was used to simulate the fate and transport of nutrients into and out of the embayment and the uptake by phytoplankton, where the growth and death of phytoplankton is measured through a surrogate parameter called chlorophyll-a. The computer models used to develop this TMDL are described in the following sections.

Management practices may be used to help reduce and/or maintain the nutrient loads. These include:

- Compliance with the requirements of the NPDES permit program,
- Application of Best Management Practices (BMPs) appropriate to address nonpoint sources

The amount of nutrients delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these practices, their effects will improve stream water quality, and represent a beneficial measure of TMDL implementation.

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 with respect to designated uses: 1) supporting, 2) partially supporting, or 3) not supporting. 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 (GA EPD, 2000-2001).

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The State of Georgia has identified a portion of one lake, the Little River Embayment of Lake Allatoona, located in the Coosa River Basin, as partially supporting its designated use due to chlorophyll *a*. This waterbody was included in the State's 2002 303(d) list. This report presents the chlorophyll *a* TMDL for the listed segment in the Coosa River Basin identified in Table 1.

Table 1. Waterbody Listed For Chlorophyll *a* in the Coosa River Basin

Lake Name	Location	Acres Affected	Designated Use	Status
Allatoona	Little River Embayment	950	Fishing	Partially Support

1.2 Watershed Description

The Little River begins flowing in Forsyth County, just north of the Fulton County Line and approximately nine miles north of the Alpharetta city limits. The Little River flows southwest, where it converges with Mill Creek and Rubes Creek, which joins Little River just before it discharges in the Little River Embayment. Noonday Creek discharges into the Little River Embayment downstream from the confluence with the Little River. The Little River Embayment is part of Lake Allatoona, which is located in the Coosa River Basin approximately 30 miles north of Atlanta, Georgia. The Little River Watershed encompasses a total area of 214 mi^2 (554 km^2).

The USGS has divided the Coosa River Basin into five sub-basins, or Hydrologic Unit Codes (HUCs). Figure 1 shows the location of these sub-basins and the associated counties within

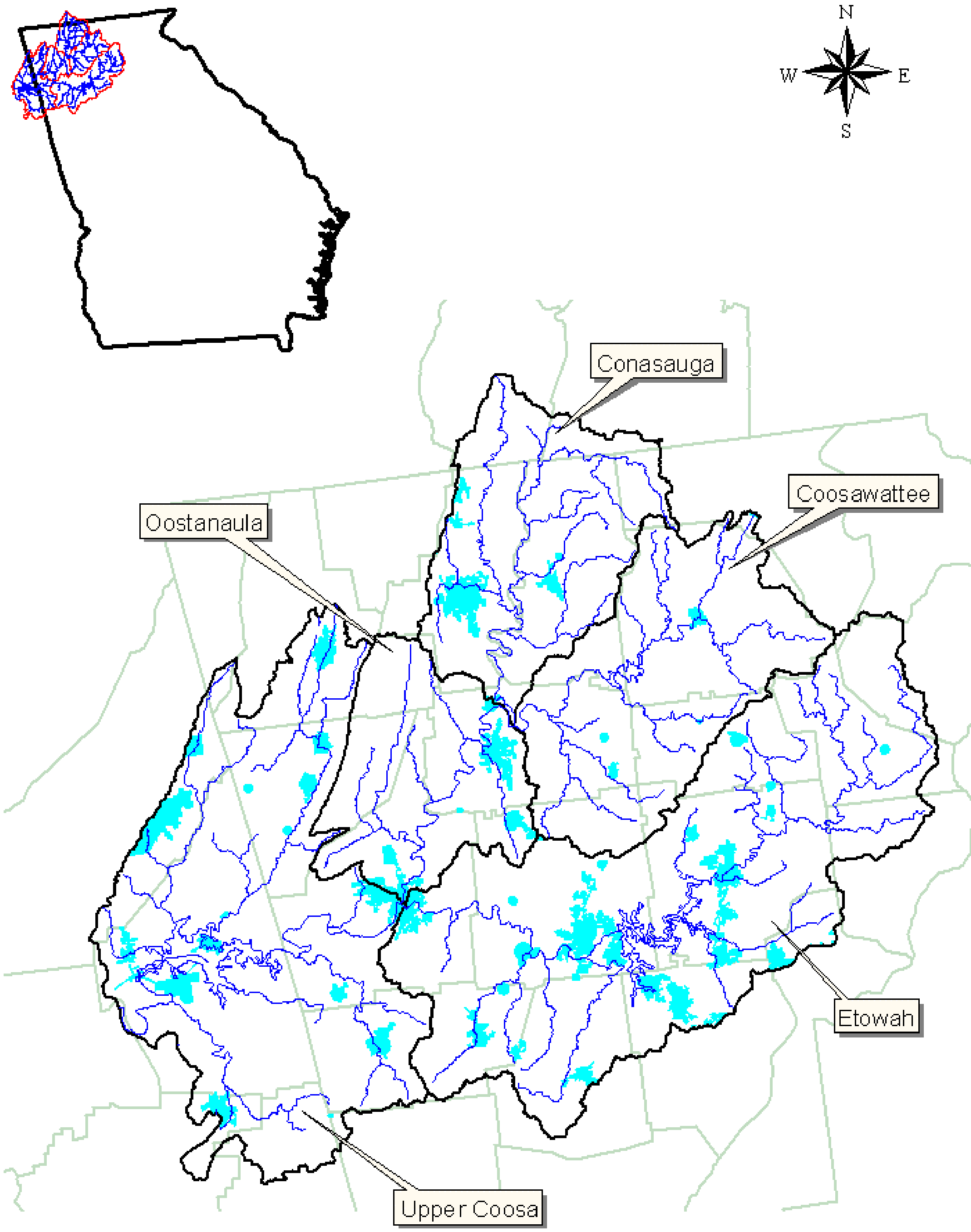

Figure 1. Location of the Coosa River Basin

each sub-basin. The Little River embayment is located in the Etowah (HUC 03150104). Figure 2 shows its location within the Coosa River Basin.

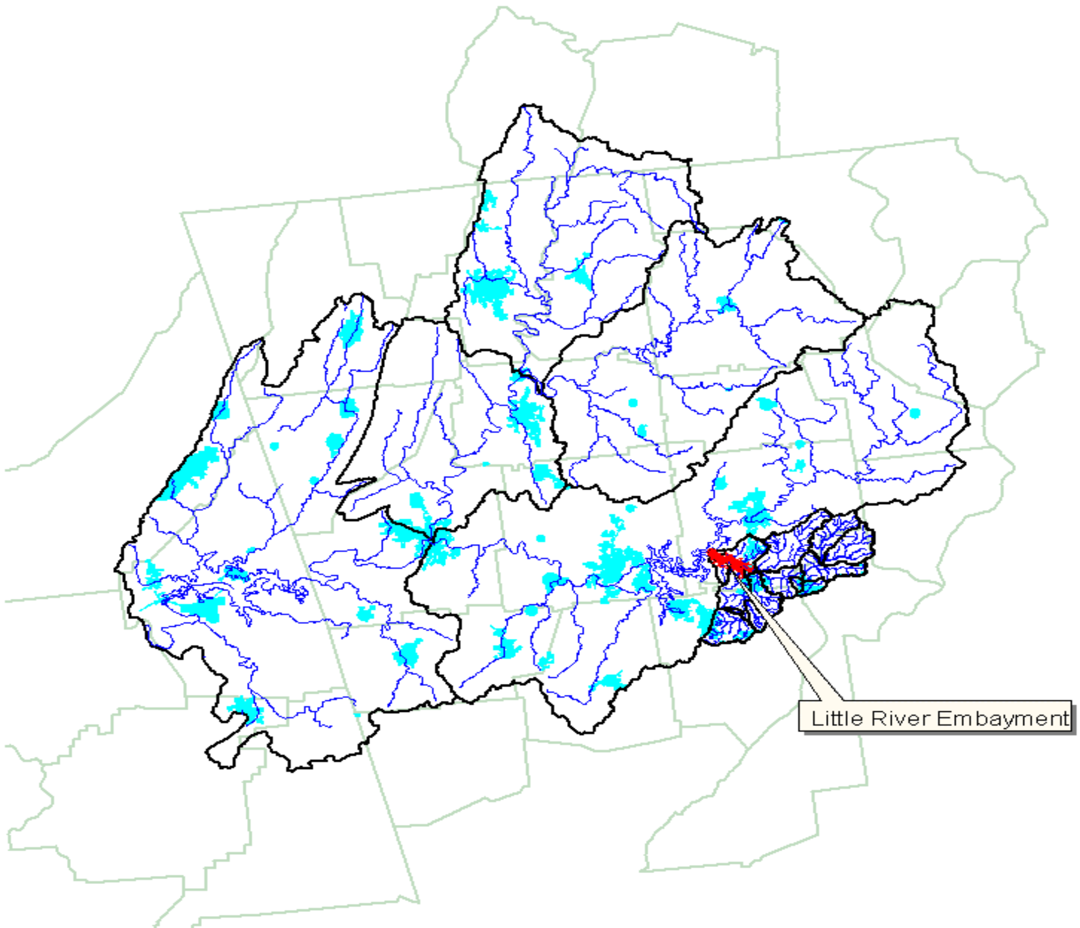

Figure 2. 303(d) Listed Segment for Chlorophyll *a* in the Coosa River Basin

The Little River embayment watershed is in the upper Piedmont physiographic province that extends throughout the southeastern United States.

The land use characteristics of the Little River embayment watershed were determined using data from the Atlanta Regional Commission (ARC) Landuse Coverage. This coverage is based on Landsat Thematic Mapper digital images developed in 2000. The classification is based on a modified Anderson level one and two system. Figure 3 shows the sub-basins in the Little River Embayment watershed and Table 2 lists the land cover distribution and associated percent land cover.

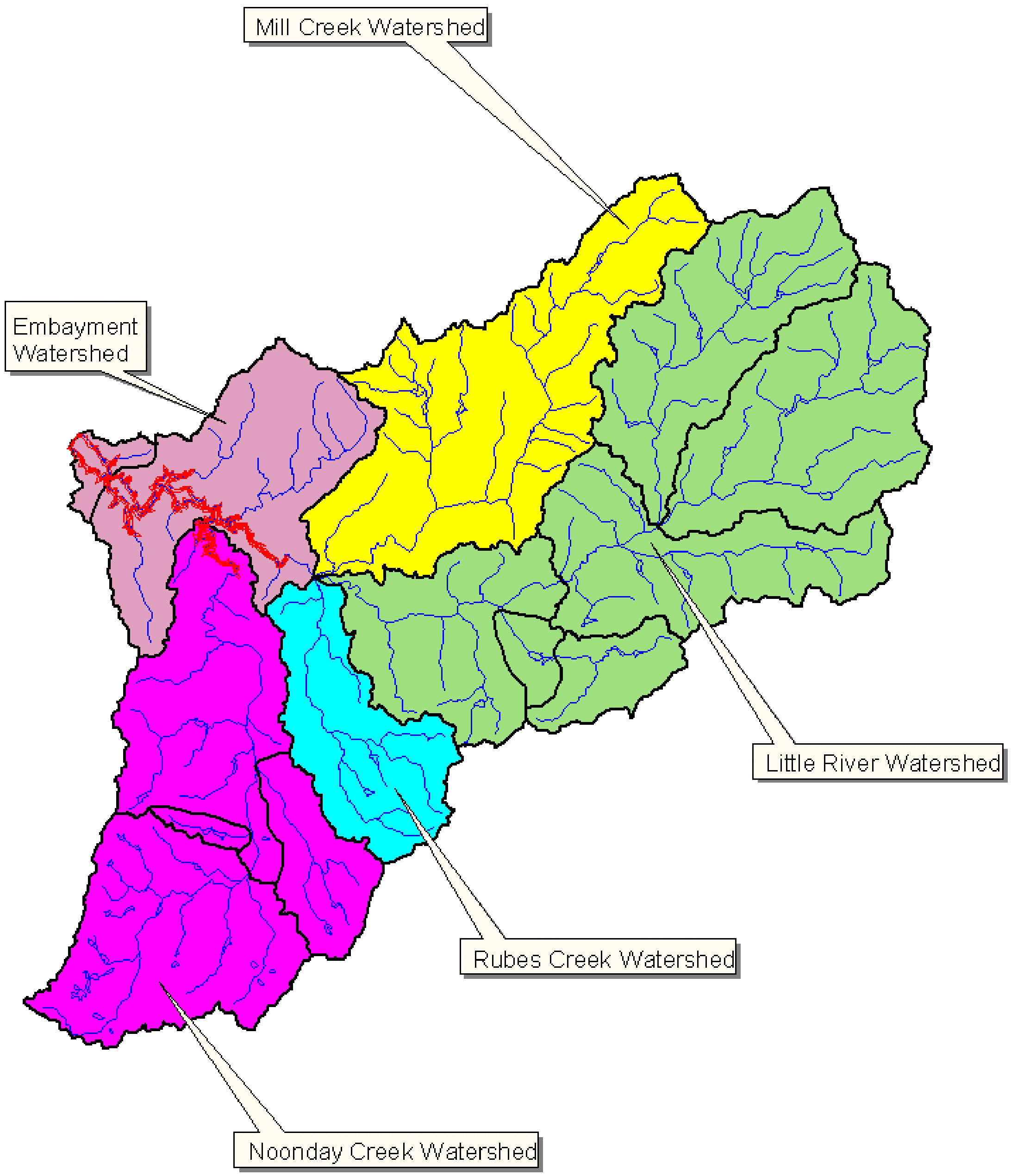

Figure 3. Little River Sub-Basins

Table 2. Land Cover Distribution Associated with the Little River Embayment Watershed

Sub-Basin	Land Cover in Acres (Percentage)								
	Open Water	Urban	Barren or Mining	Cropland	Pasture land	Forest	Grass	Wetlands	Total
Little River	458 (0.8)	24,020 (42.8)	0 (0.0)	11,288 (20.1)	40 (0.1)	18,668 (33.3)	1,362 (2.4)	290 (0.5)	56,123 (100.0)
Mill Creek	119 (0.5)	8,552 (36.3)	0 (0.0)	7,953 (33.8)	117 (0.5)	6,282 (26.7)	513 (2.2)	26 (0.1)	23,563 (100.0)
Noonday Creek	258 (0.8)	24,032 (74.4)	301 (0.9)	667 (2.1)	16 (0.0)	6,107 (18.9)	797 (2.5)	130 (0.4)	32,308 (100.0)
Rubes Creek	24 (0.2)	7,354 (76.1)	0 (0.0)	449 (4.6)	0 (0.0)	1,472 (15.2)	110 (1.1)	250 (2.6)	9,660 (100.0)
Embayment Area	786 (4.9)	8,761 (54.5)	0 (0.0)	780 (4.9)	5 (0.0)	5,506 (34.3)	227 (1.4)	4 (0.0)	16,068 (100.0)

1.3 Water Quality Standard

The water use classification for the Little River Embayment of Lake Allatoona is Drinking Water and Recreation. The criterion violated is listed as chlorophyll *a*. The potential causes listed are urban runoff and nonpoint source runoff. The specific criteria for chlorophyll *a* in Lake Allatoona, as stated in *Georgia's Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(17)(d) is:

> Cholorphyll a: For the months of April through October, the average of monthly mid-channel photic zone composite samples shall not exceed the chlorophyll *a* concentrations at the locations listed below:
>
> Upstream from the Allatoona Dam Forebay 10 μg /L
> Allatoona Creek upstream from I-75 10 μg /L
> Mid Lake downstream from Kellogg Creek 10 μg /L
> Little River upstream from Highway 205 15 μg/L
> Etowah River upstream from Sweetwater Creek 12 μg /L

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2.0 WATER QUALITY ASSESSMENT

During 2000 and 2001, the Georgia Environmental Protection Division (GA EPD) conducted water quality sampling in Lake Allatoona at five lake monitoring stations. These were upstream from the Allatoona Dam Forebay (GA EPD Station 14309001), Allatoona Creek upstream from I-75 GA EPD Station 14307501), Mid Lake downstream from Kellogg Creek (GA EPD Station 14305801), Little River upstream from Highway 205 (GA EPD Station 14304801), and Etowah River upstream from Sweetwater Creek (GA EPD Station 14302001). The lake sampling covered the growing season from April through October. Each chlorophyll *a* samples were a composite collected at each site in 2000 and 2001. The data are summarized in Table 3.

Table 3. Summary of the 2000-2001 Lake Allatoona Chlorophyll *a* Data

Date	Chlorophyll *a* (μg/L) Photic Zone Composite				
	Dam Forebay	**Allatoona Creek**	**Mid Lake**	**Little River**	**Etowah River**
	14309001	**14307501**	**14305801**	**14304801**	**14302001**
Standard	**10**	**10**	**10**	**15**	**12**
4/27/00	9.35	15.5	6.49	25.79	5.94
5/31/00	25.61	8.35	22.27	18.93	14.32
6/22/00	13.06	8.65	16.03	29.48	12.68
7/13/00	7.18	8.33	9.23	30.17	19.9
8/23/00	4.45	9.68	7.78	43.41	18.31
9/20/00	5.90	<1.0	9.08	12.58	17.69
10/17/00	5.64	14.6	11.16	25.92	14.15
2000 Growing Season Average	**10.2**	**9.4**	**11.7**	**26.6**	**14.7**
4/26/01	4.49	2.02	10.38	21.34	1.73
5/16/01	2.79	5.45	8.67	3.74	4.03
6/12/01	2.17	7.69	11.30	14.45	16.52
7/17/01	5.88	9.81	8.67	13.01	8.05
8/15/01	5.27	7.74	7.12	21.99	13.32
9/19/01	5.88	13.42	10.38	23.75	20.13
10/10/01	<1	3.10	1.55	14.87	2.79
2001 Growing Season Average	**3.9**	**7.0**	**8.3**	**16.2**	**9.5**

In 2000, the chlorophyll *a* standard was exceeded at the Dam Forebay, Mid Lake, Etowah River, and Little River monitoring sites. In 2001, only the Little River site exceeded its standard. Two consecutive years of chlorophyll *a* standard violations are required to list a lake on the 303(d) list.

All field data relevant to the Little River Basin were compiled by GA EPD and included in electronic database files. The data are managed in the Water Resources Data Base (WRDB), a software database that was developed by GA EPD. Project data file(s) contain the following information:

1. 2000 and 2001 GA EPD lake monitoring (see Figure 4)
2. 2000 and 2001 USGS water quality data (see Figure 5)
3. Cherokee County watershed assessment monitoring data (see Figure 6)
4. Cobb County watershed assessment monitoring data (see Figure 7)

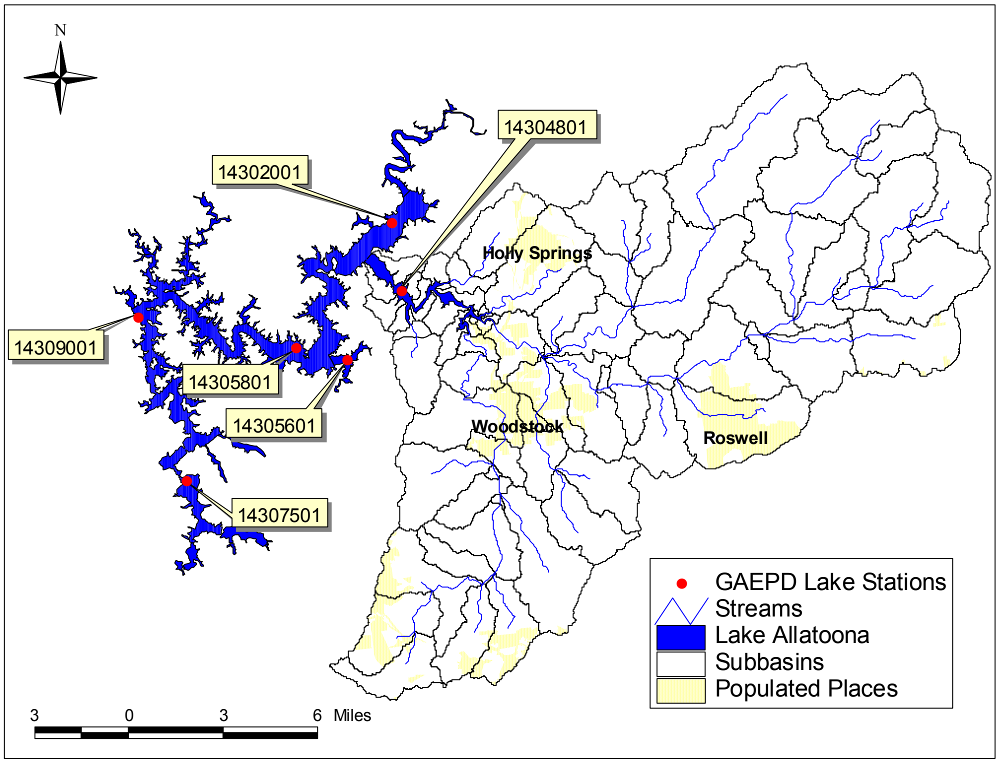

Figure 4. GA EPD Lake Monitoring Stations

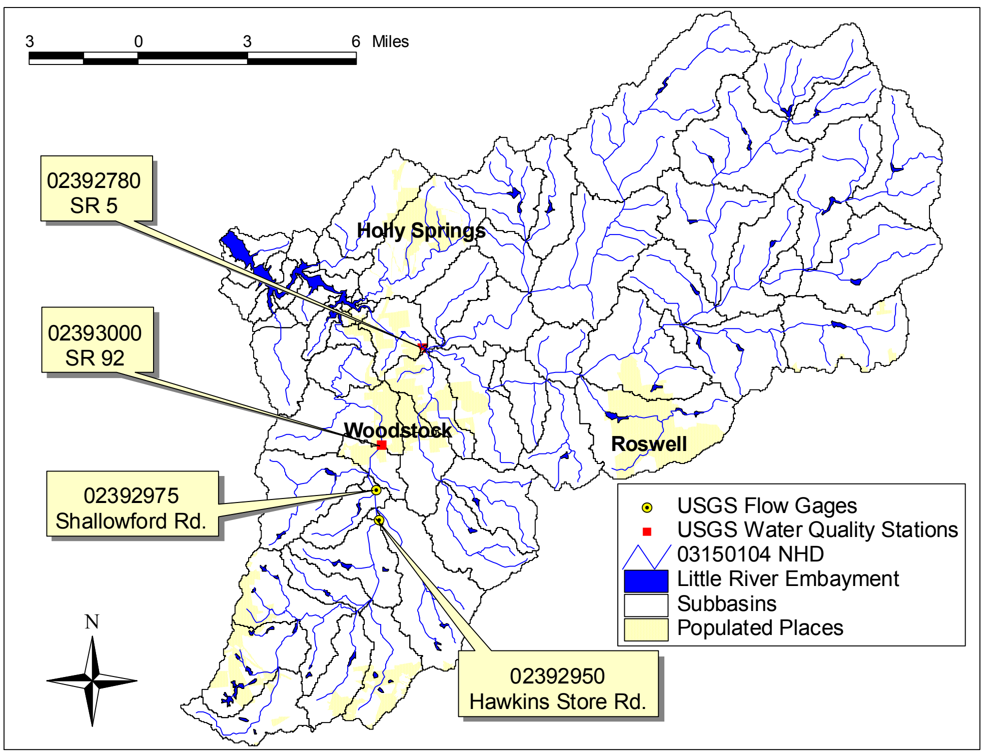

Figure 5. USGS Flow Gages and Water Quality Monitoring Stations

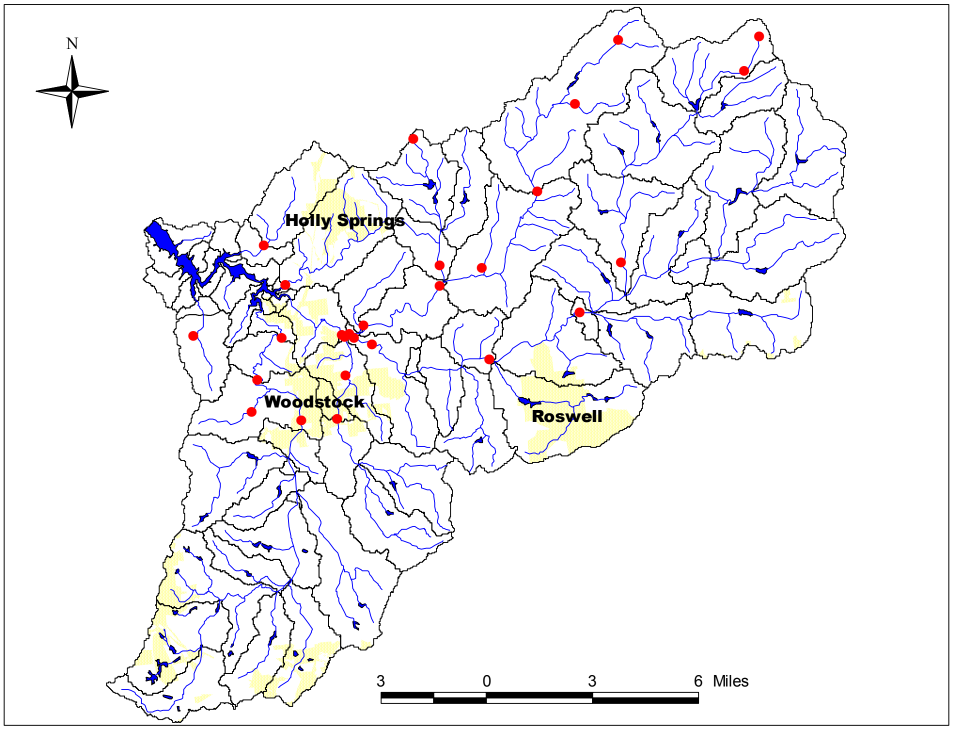

Figure 6. Cherokee County Water Quality Monitoring Stations

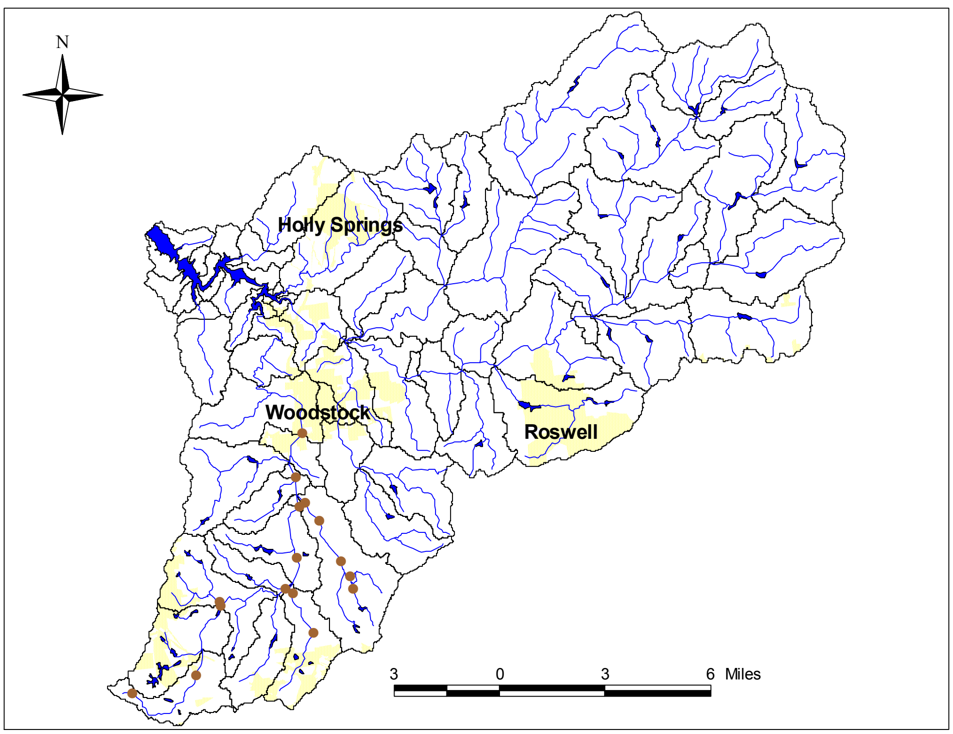

Figure 7. Cobb County Water Quality Monitoring Stations

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of potential sources. 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 nutrients 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. Basically, there are two 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, industrial and municipal 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 water quality standards (water quality-based limits).

EPA 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.

EPA 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.

Municipal and industrial wastewater treatment facilities' discharges may contribute oxygen-demanding substances to the receiving waters. There are four NPDES permitted discharges with effluent limits for nutrients identified in the Little River Watershed upstream from the listed segment. Three of these discharges are classified as major municipal facilities, with discharges of 1.0 million gallons per day (MGD) or more. One discharge is from an industrial facility. Table 4 provides the permitted flows, as well as the 5-day Biochemical Oxygen Demand (BOD_5), ammonia (NH_3), total phosphorus (Total P) and dissolved oxygen (DO) concentrations for the municipal and industrial treatment facilities. Figure 8 provides the locations of the point source discharges.

Table 4. NPDES Facilities in the Little River Basin

Facility Name	NPDES Permit No.	Date Issued	Receiving Stream	Average Monthly NPDES Permit Limits				
				Flow (MGD)	BOD_5 (mg/L)	NH_3 (mg/L)	Total P (mg/L)	Minimum DO (mg/L)
Little River								
Little River WPCP	GA0033251	1/7/98	Little River	1.0	8.5	1.7	0.9	6.0
Noonday Creek								
Noonday Creek WRF	GA0024988	4/6/01	Noonday Creek	12.0	10.0	2.0	1.0	6.0
Rubes Creek								
Woodstock WPCP	GA0026263	11/6/97[1]	Rubes Creek	0.5	15.0	4.0	1.0	6.0
Embayment Area								
Facility Name	**NPDES Permit No.**	**Date Issued**	**Receiving Stream**	**Average Daily NPDES Permit Limits**				
				Flow (MGD)	**BOD_5 (lbs/day)**	**NH_3 (lbs/day)**	**Total P (lbs/day)**	**Minimum DO (mg/L)**
ConAgra Poultry Plant	GA0001724	8/22/97	Blankets Creek	Monitor	135	55	NA	5.0
ConAgra Poultry Plant, B1	GA0001724	7/25/02	Blankets Creek	Monitor	135	55	Monitor	5.0
ConAgra Poultry Plant, B2	GA0001724	7/25/02	Blankets Creek	Monitor	135	May-Oct 25 Nov-Apr 55	13.7[2]	5.0

[1] Extended by letter 11/5/02, will be reissued in 2004

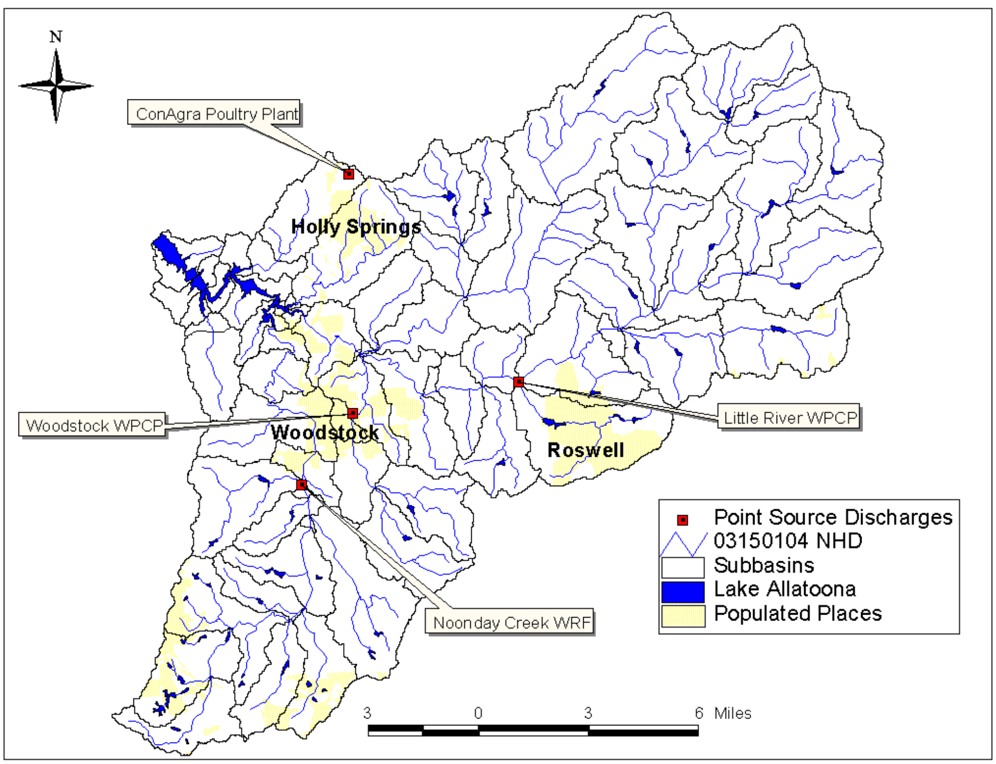

Figure 8. Location of Point Source Discharges

Combined sewer systems convey a mixture of raw sewage and storm water in the same conveyance structure to the 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 permitted CSO outfalls in the Little River Watershed.

3.1.2 Regulated Storm Water Discharges

Some storm water runoff is covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe limits, storm water NPDES permits establish controls "to the maximum extent practicable" (MEP). Currently, regulated storm water discharges that may contain nutrients consist of those associated with industrial activities including construction sites five acres or greater, and large and medium municipal separate storm sewer systems (MS4s) that serve populations of 100,000 or more.

Storm water discharges associated with industrial activities are currently covered under a General Storm Water NPDES permit. This permit requires visual monitoring of storm water discharges, site inspections, implementation of BMPs, and record keeping.

Storm water discharges from MS4s are very diverse in pollutant loadings and frequency of discharge. At present, all cities and counties within the state of Georgia that had a population of greater than 100,000, at the time of the 1990 Census, are permitted for their storm water discharge under Phase I. This includes 60 permittees, 45 of which are located in the greater Atlanta metro area (see Table 5).

Table 5. Phase I Permitted MS4s in Coosa River Basin

Name	Permit No.	Watershed
Acworth	GAS000101	Coosa
Cobb County	GAS000108	Coosa, Chattahoochee
Fulton County	GAS000117	Coosa, Chattahoochee, Ocmulgee, Flint
Forsyth County	GAS000300	Coosa, Chattahoochee
Kennesaw	GAS000121	Coosa

Source: Nonpoint Source Permitting Program, GA EPD, 2001

Phase I MS4 permits require 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, and 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.

In 2003, small MS4s serving urbanized areas were required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. It is estimated that 56 communities will be permitted under the Phase II regulations in Georgia. Table 6 lists those counties and communities located in the

Coosa River Basin that will be covered by the Phase II General Storm Water Permit, GAG610000.

Table 6. Phase II Permitted MS4s in Coosa River Basin

Name	Watershed
Bartow County	Coosa
Canton	Coosa
Cherokee County	Coosa
Dallas	Coosa
Dalton	Coosa
Emerson	Coosa
Floyd County	Coosa
Holly Springs	Coosa
Mountain Park	Coosa
Paulding County	Coosa, Tallapoosa, Chattahoochee
Rome	Coosa
Varnell	Coosa
Walker County	Coosa, Tennessee
Whitfield County	Coosa, Tennessee
Woodstock	Coosa

Source: Nonpoint Source Permitting Program, GA DNR, 2003

3.2 Nonpoint Source Assessment

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of nutrients come from materials being washed into the rivers and streams during storm events. In 2000 and 2001, many streams in the Little River Basin were dry, or had ponded areas and stagnant pools as a result of a four-year drought in Georgia. Due to the lack of rainfall during the summer of 2000-2001, stormwater did not contribute to significant wash off of materials into the streams. Constituents that may have washed off of land surfaces in previous months or years had either flushed out of the system along with the water column flow; or settled out and became part of the lake bottom.

In this manner, historic wash off of settleable material accumulates and may release nutrients into the water column over time. Constituents of concern from surface washoff include the fractions of phosphorus and nitrogen that become an integral part of channel bottom sediments, thus becoming a potential source of nutrients for algae. Table 2 provides the land cover distributions for the Coosa River sub-basins. These data show that the watersheds are predominately urban (approximately 57 percent, ranging from 36.3 to 76.1 percent). The predominant land cover is medium to high-density residential areas. These land uses can contribute considerable loadings of nitrogen and phosphorus from fertilizer applications to lawns. Forest is the next predominate land use (approximately 26 percent forested, ranging from 15.2 to 34.3 percent). Approximately 13 percent (ranging from 2.1 to 33.8 percent) of the landuse in these watersheds is row crops.

4.0 TECHNICAL APPROACH

The process of developing the chlorophyll *a* TMDL for Little River Embayment included developing three computer models for the embayment. The models were run for the calendar years 2000, 2001, and 2002, when water quality data were collected in the Little River Embayment. A watershed model of the Little River Embayment was developed using the Loading Simulation Program in C++ (LSPC) that included all major point sources of nutrients. The watershed model simulates the effects of surface runoff on both water quality and flow and was calibrated to available data. The results of this model were used as tributary flow inputs to the hydrodynamic model, Environmental Fluid Dynamics Code (EFDC), which simulated the transport of water into and out of the embayment. The EPA Water Analysis Simulation Program (WASP) was used to simulate the fate and transport of nutrients into and out of the embayment and the uptake by phytoplankton, where the growth and death of phytoplankton is measured through a surrogate parameter called chlorophyll-a. The computer models used to develop this TMDL are described in the following sections.

4.1 Watershed Modeling (LSPC)

LSPC is a system designed to support TMDL development for areas impacted by both point and nonpoint sources. It is capable of simulating land-to-stream transport of flow, sediment, metals, nutrients, and other conventional pollutants, as well as temperature and pH.
LSPC is a comprehensive data management and modeling system that simulates pollutant loading from nonpoint sources. LSPC utilizes the hydrologic core program of the Hydrological Simulation Program Fortran (HSPF, EPA 1996b), with a custom interface of the Mining Data Analysis System (MDAS), and modifications for non-mining applications such as nutrient and pathogen modeling. LSPC was developed by EPA Regions 3 and 4 for preparing TMDLs.

LSPC was used to calculate runoff and hydrologic transport of pollutants based on historic precipitation data. LSPC was configured for the Little River Watershed to simulate the watershed as a series of the hydrologically connected subwatersheds. Configuration of the model involved sub-dividing the Little River Watershed into 67 modeling subwatersheds. Potential pollutant loadings were determined from mass-balance predictions of available pollutants on the land surface for the land cover distribution in each subwatershed.

The Little River Watershed LSPC model performed a continuous simulation of flow and water quality for these subwatersheds using the following data:

- Meteorological data
- Land cover
- Soils
- Stream lengths and slopes
- Point source discharge data
- USGS flow data
- Water quality data

Meteorological Data

Nonpoint source loadings and hydrological conditions are dependent on weather conditions. Hourly data from weather stations within the boundaries of, or in close proximity to, the subwatersheds were applied to the watershed model. An ASCII file was generated for each meteorological station used in the hydrological evaluations in LSPC. Each meteorological file contains precipitation and potential evapotranspiration data used in modeling the hydrological processes. These data were used directly, or calculated from the observed data.

Precipitation for the Little River Watershed was gathered from three sources. The Little River Watershed was subdivided into Thiessen polygons, using the precipitation stations as centers, to determine the precipitation station that would be used for each subwatershed. The hourly NCDC precipitation station in Canton, GA was used for the northern part of the watershed. The daily rainfall measured at USGS station 02392975 was used for the western part of the watershed. The daily rainfall measured at the Little River (Fulton County) Water Pollution Control Plant was used for the eastern part of the watershed. Figure 9 shows the location of the meteorological stations used. The daily precipitation was fractionated into hourly precipitation based on the nearby NCDC hourly precipitation station in Canton, Georgia. If there was were data gaps at the NCDC station, then a six-hour synthetic rainfall was used to fraction daily data into hourly data.

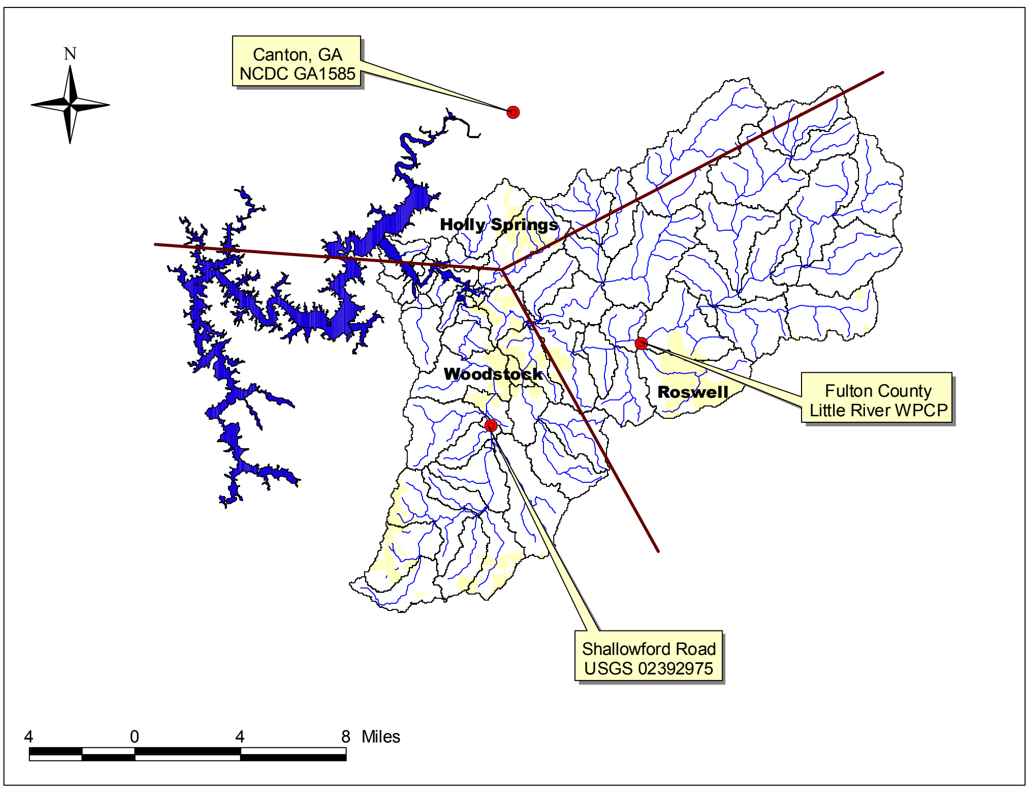

Figure 9. Precipitation Stations Used in the Little River Watershed Model

Potential evapotranspiration for the Little River Watershed was calculated from the maximum and minimum daily temperatures obtained from the Georgia Automated Environmental Monitoring Network (GAEMN) stations in Dunwoody and Duluth, Georgia. The College of Agriculture and Environmental Sciences of the University of Georgia established GAEMN in 1991. The Duluth station was used to fill in the missing data gaps at the Dunwoody station for the period of October 29, 1998, through December 31, 1999. The Hamon PET method was used to calculate hourly potential evapotranspiration. The Hamon PET method generates daily potential evapotranspiration using air temperature, a monthly variable coefficient, the number of hours of sunshine (based on latitude), and absolute humidity (computed from air temperature).

Land Cover

The watershed model uses land cover data as the basis for representing hydrology and nonpoint source loading. Land cover categories for modeling were selected based on the Atlanta Regional Commission (ARC) land use classification, and included open water, urban, barren or mining, cropland, pasture, forest, grassland, and wetlands. Figure 10 presents the distribution of land cover within the Little River Watershed.

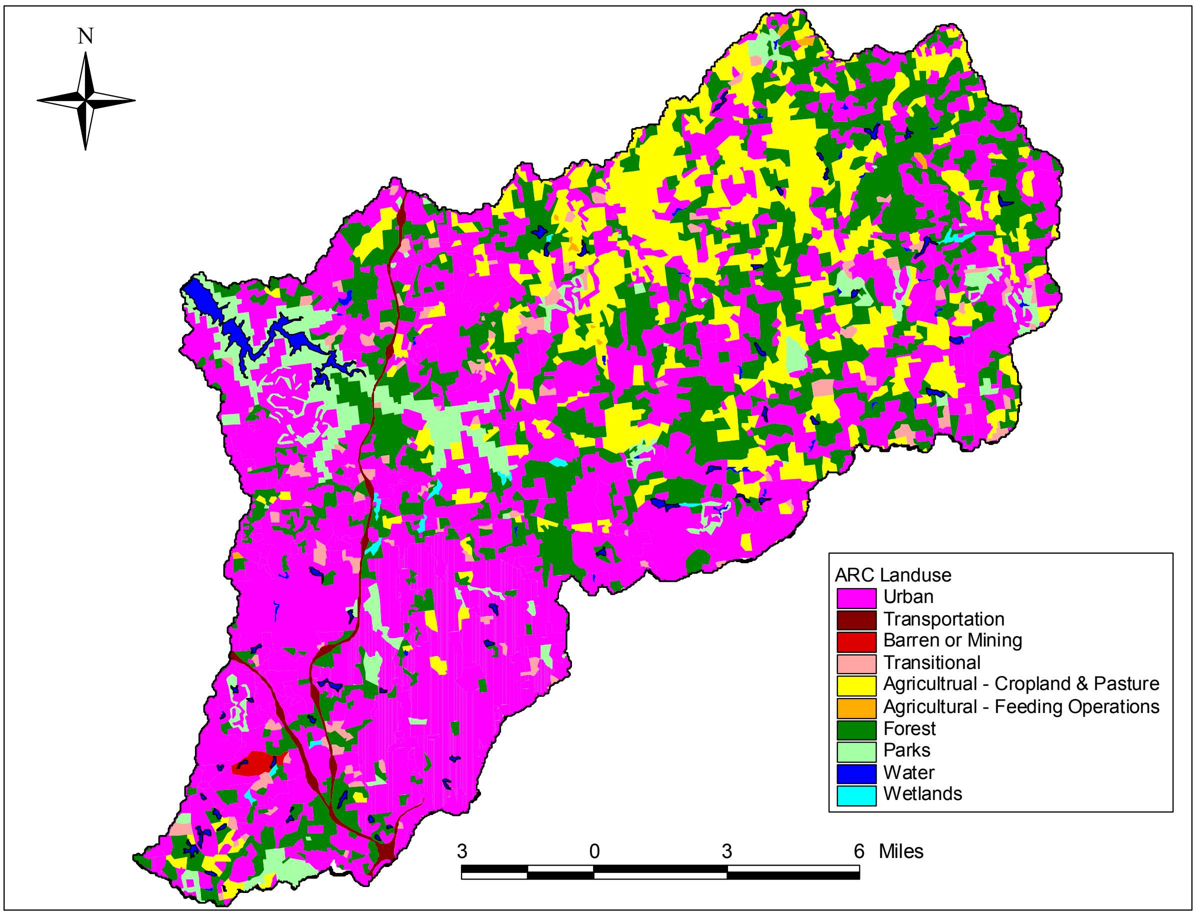

Figure 10. Little River Watershed 2000 Land Cover from ARC

The LSPC model requires division of land cover into pervious and impervious land units. For each land cover, this division can be made based on typical imperviousness percentages from individual land use categories, such as those used in the Soil Conservation Service's TR-55 method (see Table 7). For modeling purposes, the percent imperviousness of a given land category can be calculated as an area-weighted average of land use classes encompassing the modeling land category.

Table 7. Land Cover Percent Imperviousness

Land Categories Represented in the Model	ARC Land Use Code	ARC Land Use Classes	% Impervious
Water	53	Reservoirs	0
Forest	40	Forest	0
Strip Mining	75	Quarries	0
Wetlands	60	Wetlands	0
Cropland	21	Cropland and Pasture	0
	22	Orchard, Groves, Vineyards, Nurseries	0
Pasture	171	Golf Courses	0
	172	Cemeteries	0
	173	Parks	0
	175	Park Lands	0
	23	Confined Feeding Operations	0
Built-up	12	Commercial	80
	13	Industrial	72
	14	Transportation/Communications/Utilitie s	75
	15	Industrial/Commercial	78
	17	Urban Other	50
	76	Transitional	10
	111	Residential Low Density	10
	112	Residential Medium Density	20
	113	Residential High Density	50
	117	Residential Multifamily	40
	119	Residential Mobile Homes	40
	121	INST Intensive	60
	125	INST Extensive	60
	145	LTD Access	75

<u>Soils</u>

Soil data for the Little River Watershed were obtained from the State Soil Geographic Data Base (STATSGO). There are four main Hydrologic Soil Groups (Group A, B, C and D). The different soil groups range from soils that have a low runoff potential to soils that have a high runoff potential. The four soils groups are described below:

> <u>Group A Soils</u> Low runoff potential and high infiltration rates even when wet. They consist chiefly of sand and gravel and are well to excessively drained.
>
> <u>Group B Soils</u> Moderate infiltration rates when wet and consist chiefly of soils that are moderately deep to deep, moderately to well drained, and moderately to moderately course textures.

Group C Soils Low infiltration rates when wet and consist chiefly of soils having a layer that impedes downward movement of water with moderately fine to fine texture.

Group D Soils High runoff potential, very low infiltration rates and consist chiefly of clay soils.

The total area that each hydrologic soil group covered within each subwatershed was determined. The hydrologic soil group that had the highest percent of coverage within each subwatershed represented that subwatershed in LSPC. Figure 11 shows the soil groups coverage for the Little River Watershed.

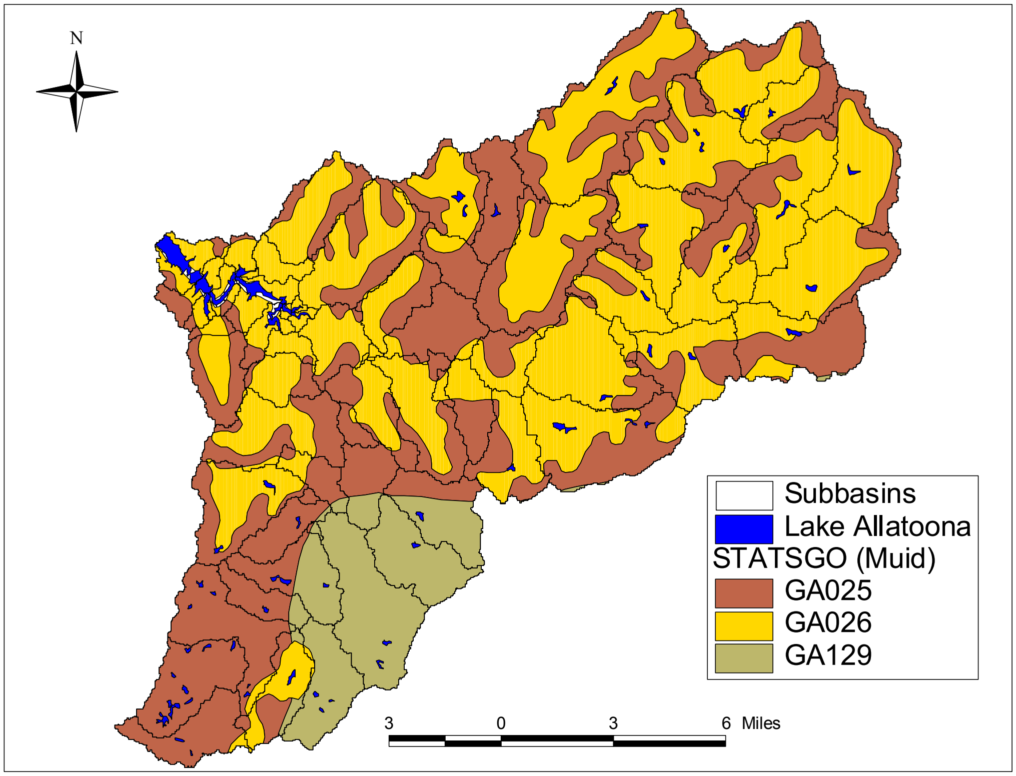

Figure 11. Little River Watershed Soil Hydrologic Group

Modeling Parameters

Pollutants simulated by LSPC were biochemical oxygen demand (BOD), total nitrogen (Total N), and total phosphorus (Total P). LSPC requires land cover specific accumulation and washoff rates for each of the modeled water quality parameters. Table 8 provides the rates developed during model calibration for BOD, total nitrogen, and total phosphorus for each land cover type.

Table 8. LSPC Modeling Parameters

Landuse	Water Quality Parameter	Rate of Accumulation (lb/acre/day)	Maximum Storage (lb/acre)	Rate Of Surface Runoff Which Will Remove 90% (in/hr)	Concentration In Interflow Outflow (mg/L)	Concentration In Active Groundwater Outflow (mg/L)
Cropland	BOD	0.050	0.300	1.500	1.500	0.100
	Total N	0.185	0.648	1.067	0.700	0.283
	Total P	0.005	0.038	0.800	0.020	0.010
Forest	BOD	0.050	0.300	1.500	0.200	0.100
	Total N	0.041	0.185	1.367	0.168	0.134
	Total P	0.001	0.007	1.00	0.020	0.010
Pasture	BOD	1.000	5.000	1.000	0.600	0.400
	Total N	0.260	1.300	1.033	1.217	0.440
	Total P	0.005	0.034	0.800	0.020	0.010
Strip Mining	BOD	0.010	0.050	0.500	0.200	0.100
	Total N	0.041	0.205	0.933	0.101	0.100
	Total P	0.001	0.007	0.400	0.020	0.010
Urban Pervious	BOD	0.05	0.080	1.000	0.500	0.300
	Total N	0.133	0.665	0.933	0.677	0.337
	Total P	0.002	0.017	0.500	0.020	0.010
Wetlands	BOD	0.080	0.400	2.500	0.200	0.100
	Total N	0.041	0.246	1.267	0.285	0.268
	Total P	0.001	0.007	1.400	0.020	0.010
Urban Impervious	BOD	0.040	080	0.800	0.500	0.300
	Total N	0.133	0.6665	0.933	0.692	0.342
	Total P	0.002	0.017	0.100	0.020	0.010

Model Calibration

As previously mentioned, to represent watershed loadings and resulting pollutant concentrations in individual stream segments, the Little River Watershed was divided into 67 subwatersheds. These subwatersheds, representing hydrologic boundaries, were defined by listed reaches, tributary confluences, and the locations of water-quality monitoring sites. Sub-basin delineations were based on elevation data (30 meter National Elevation Dataset from USGS), and stream connectivity from the National Hydrography Dataset. Delineation at water-quality monitoring sites allowed comparison of model output to measured data.

The Little River LSPC model was calibrated to discrete instream water quality data measured by USGS, Cobb County, and Cherokee County during 2000 and 2001. The water quality data included Total N, Total P, and BOD. Figure 12 shows the flow calibration for Noonday Creek at Shallowford Road during 2000 through 2001. Figure 13 shows the total phosphorus calibration for Noonday Creek at Highway 92 during 2000 through 2001.

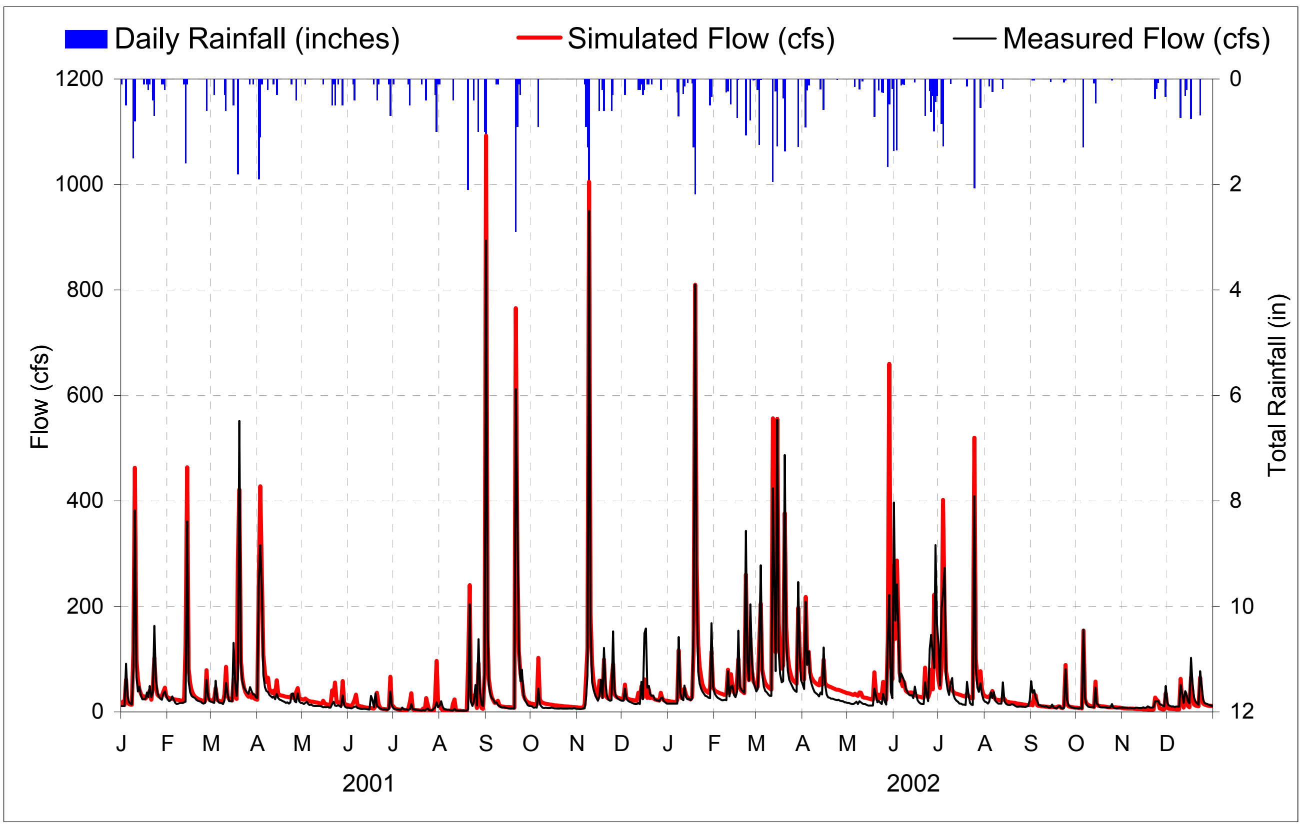

Figure 12. Flow Calibration for Noonday Creek at Shallowford Road from the LSPC Watershed Model for 2000-2001

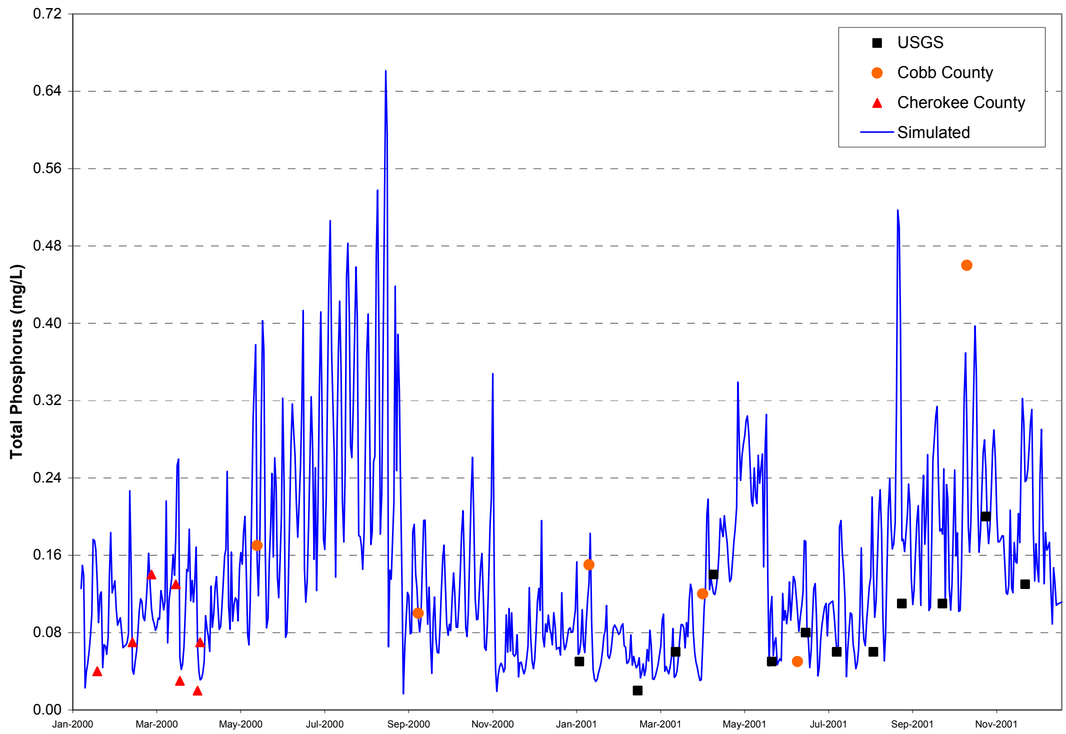

Figure 13. Total Phosphorus Calibration for Noonday Creek at Highway 92 from the LSPC Watershed Model for 2000-2001

4.2 Hydrodynamic Modeling (EFDC)

EFDC is a general purpose modeling package for simulating one, two, and three-dimensional flow and transport in surface water systems. These include rivers, lakes, estuaries, reservoirs, wetlands, and near shore to shelf-scale coastal regions. The EFDC model was originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications. It has been extensively tested and documented, and is considered public domain software.

EFDC was used to simulate the hydrologic transport within the embayment areas of the Little River Watershed. In EFDC, vertically hydrostatic equations of motion for turbulent flow are solved numerically to determine transport between cells, velocity, momentum, free surface elevation, and cell water volume.

Estimated bottom elevations and shoreline boundaries define the EFDC model grid. The shoreline boundary for Lake Allatoona, in the area of the Little River embayment, was used to create the semi-orthogonal grid shown in Figure 14. Bathymetric assumptions were derived from a cross-section taken at the Little River site designated GA EPD Little River site and from Lake Allatoona Atlantic Mapping bathymetry. The Little River site is documented as ALR3 in the *1992-1993 Lake Allatoona Phase 1 Diagnostic-Feasibility Study* (KSU, 1993). Downstream of this site, the depth from the cross section at GA EPD Etowah River site was examined to estimate the depth of the downstream extent of the grid. In addition, the CE-QUAL-W2 model previously developed for Lake Allatoona was examined to insure consistency.

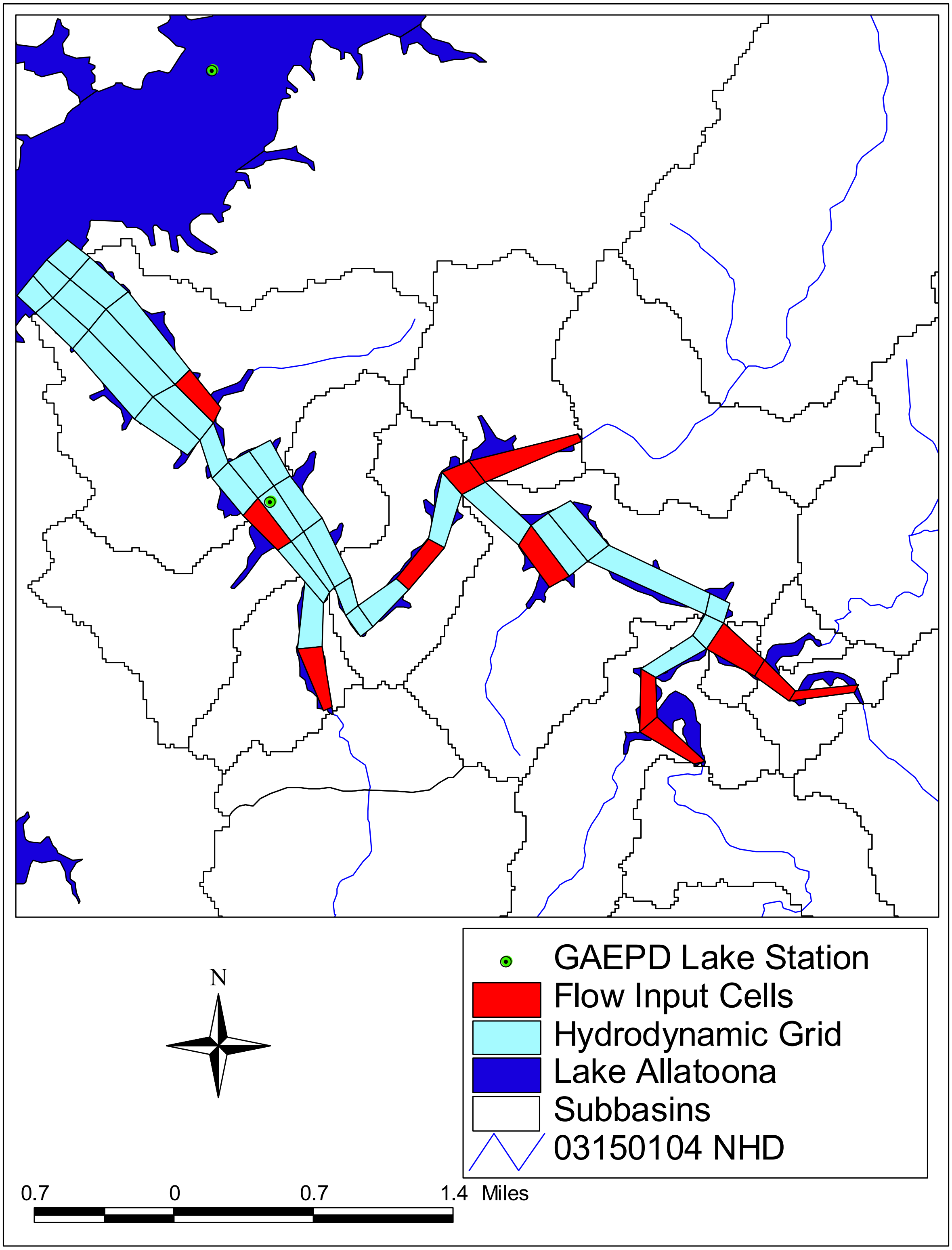

Figure 14. Model Grid for Little River Embayment, Showing the Location of Boundary Conditions and Tributary Inflows

EFDC requires boundary conditions to simulate circulation and transportation. These conditions include the water elevations at the downstream boundary, watershed inflows, and meteorological data.

The lake levels recorded at the Lake Allatoona dam define the water surface elevation at the downstream boundary of the embayment. The water surface elevation acts as a forcing function. Based on the change in lake levels, water in the downstream boundary cells flows either into or out of the embayment.

The hydrologic output from the LSPC watershed model was used as the watershed inflows to EFDC. Twelve watershed flows were distributed throughout the model grid as volume sources. The location of this inflow is shown on Figure 14. These include five tributaries (Blankets Creek, Toonigh Creek, Little River, Noonday Creek, and Rose Creek) and seven inflows from adjacent watersheds. Because of the watershed inflows, the net effect is that flow is usually out of the embayment, except when the lake is rising in the spring.

The meteorological data used included barometric pressure, air temperature, relative humidity, dew point, rainfall evaporations, wind speed, solar radiation, and cloud cover. These data came from the NCDC surface airways stations in Cartersville, Georgia. Data gaps were filled using data from Peachtree-DeKalb Airport.

Temperature is simulated in EFDC using solar radiation, atmospheric temperature, heat transfer at the water surface, and the temperature of the hydraulic inputs. The Little River EFDC model was calibrated to water temperature data for 2000 and 2001 measured by GA EPD at the Little River Embayment monitoring station. Figure 15 shows the temperature calibration at Bells Ferry Road, the Little River Embayment monitoring site, during 2000-2001.

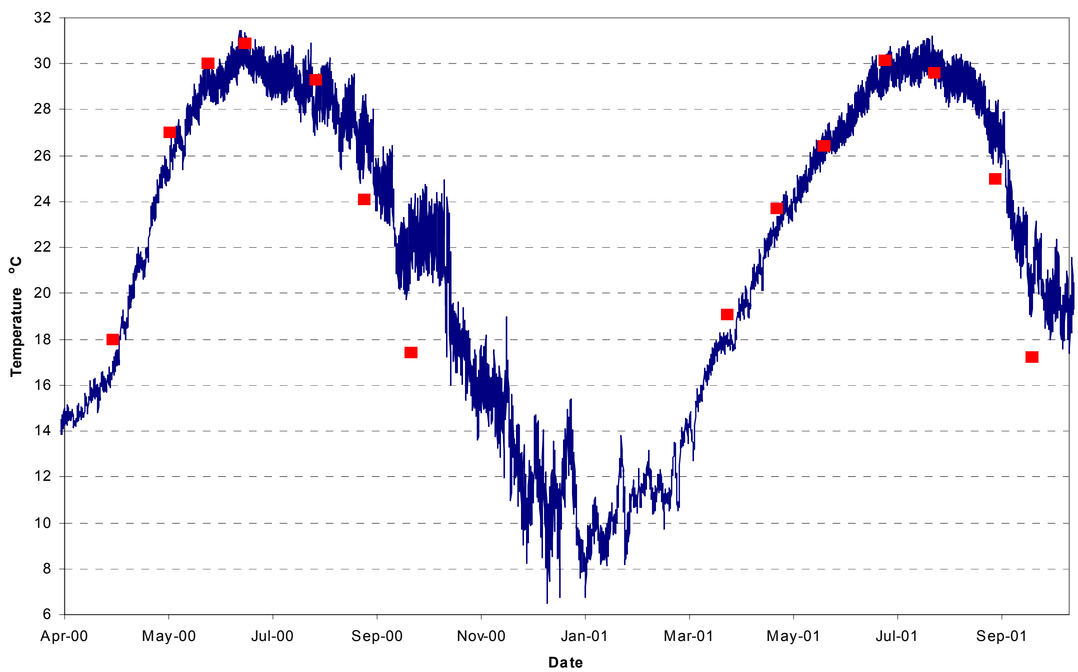

Figure 15. Temperature Calibration at Bells Ferry Road for 2000 and 2001

4.3 Water Quality Modeling (WASP)

The Water Quality Analysis Simulation Program (WASP) is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The program models the time varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange. WASP is a flexible model, allowing the modeler to structure one, two, and three-dimensional models. In addition, WASP allows the modeler tailored structuring of the kinetic processes (WASP User Manual). WASP has a library of special kinetic subroutines that the user can choose from. These include TOXI, which models toxicants, and EUTRO, which models conventional water quality parameters including algae.

WASP EUTRO calculates the interaction of eight water quality constituents based on interspecies kinetics and user-defined rates, as a function of water temperature (see Figure 16). The eight state-variables are:

- Organic nitrogen
- Ammonia
- Nitrate-Nitrite
- Organic phosphorus
- Orthophosphate
- Chlorophyll *a*
- Dissolved oxygen
- Biochemical oxygen demand (BOD)

WASP includes sediment oxygen demand (SOD) and reaeration. The eutrophication module was used in the Little River modeling scenarios to simulate the full nutrient dynamics and algal growth in the embayment.

The EFDC transport simulation record, or "hydro-file," was used as the input for the WASP dynamic water quality simulation. The flows and transport parameters calculated within EFDC drive the WASP water quality model and were applied to the same grid used in EFDC.

Inflow constituent concentrations of BOD, Total N, and Total P were determined from the calibrated LSPC model. LSPC predicts Total N and P loads for each modeled watershed, which included nutrient loads washed off land surfaces during storm events and loads from point source discharges. WASP, however, requires a fractionation of the nutrients into their constituents. Total phosphorus in fractioned into ortho phosphate and organic phosphorus. Total nitrogen includes organic nitrogen, ammonia, and nitrate-nitrite. The nitrogen and phosphorus loads were fractionated based on the results of water quality data collected by Cobb and Cherokee Counties.

4.4 Model Calibration and Verification

The model calibration period was determined from an examination of the GA EPD 2000 and 2001 water quality data for the listed lake segment. The data examined included chlorophyll *a*, nitrogen components, phosphorus components, dissolved oxygen profiles, and water temperature profiles. The calibration models were run using input data for this period, including boundary conditions and meteorological data. The data from 2002 were used to verify the model predictions.

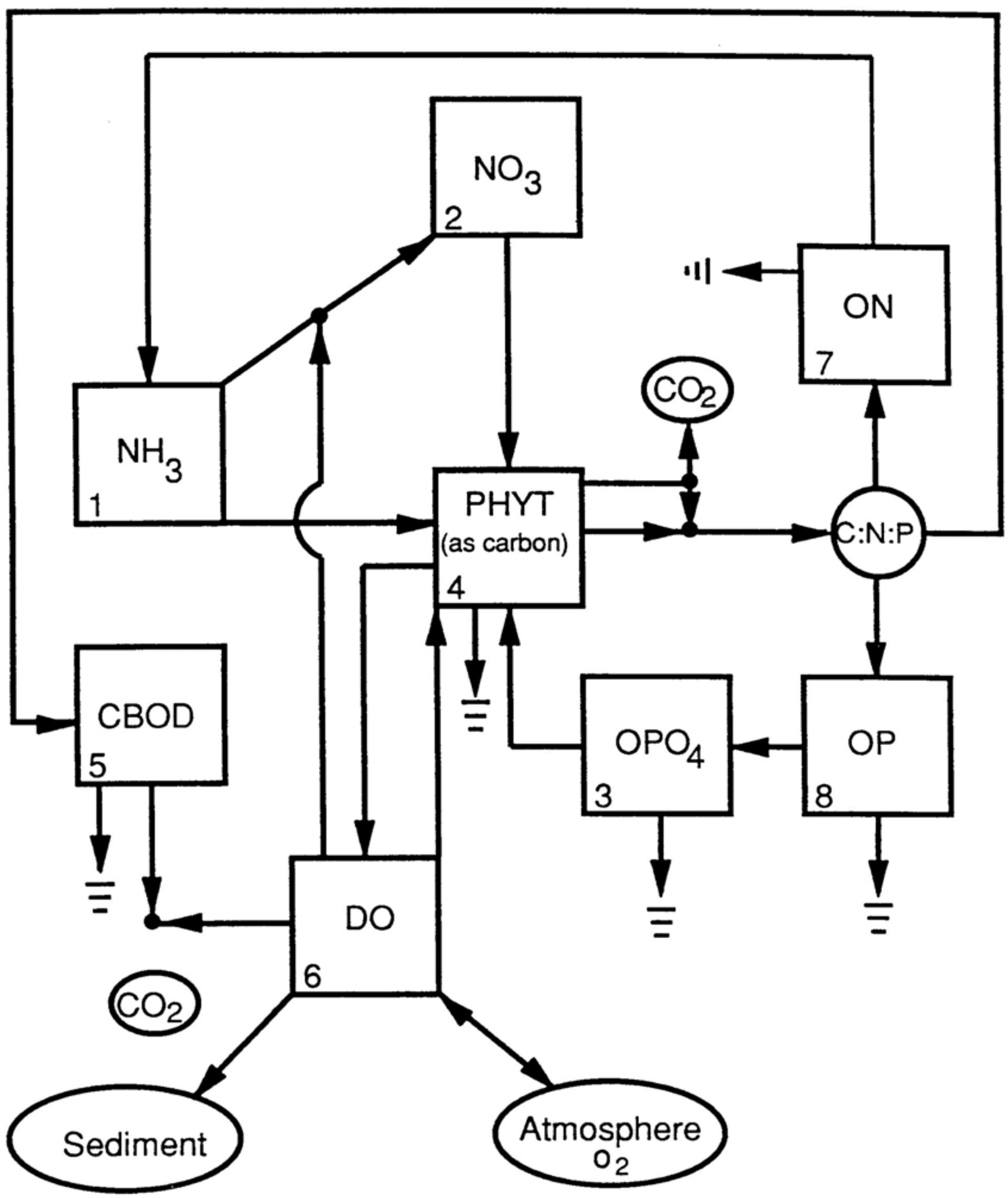

Figure 16. Schematic of Principal Kinetic Interactions for the Nutrient Cycling and Dissolved Oxygen that were Simulated in WASP

Daily discharge flows, BOD_5, NH_3 , Total P, and DO concentrations for the NPDES permitted discharges were obtained from 2000, 2001, and 2002 Operating Monitoring Reports (OMRs). These data were input into the calibration model. Table 9 is a summary of the actual discharges from these facilities for calendar years 2000 through 2002. During this period, ConAgra significantly reduced the average concentration of total phosphorus in its discharge from 15.5 mg/L in 2000 to 1.34 mg/L in 2002.

Table 9. Summary of NPDES Discharges during 2000-2002

Facility	NPDES Permit No.	Actual Discharge for Calendar Years 2000-2002				
		Average Flow (MGD)	Average NH_3		Average Total P	
			mg/L	lb/day	mg/L	lb/day
Little River WPCP	GA0033251	0.78	0.40	2.7	0.22	2.2
Noonday Creek WRF	GA0024988	8.99	0.20	16.5	0.30	22.5
Woodstock WPCP	GA0026263	0.44	0.9	3.3	0.46	1.7
ConAgra Poultry Plant	GA0001724	0.78	4.2	27.0	7.0	50.8

Table 10 provides the reaction rates and parameters developed during WASP model calibration. These parameters included the reaction rates for BOD, phosphorus, nitrogen, and SOD. The reactions rates used in the calibrated model either came from literature values or field data. SOD rates and benthic nutrient fluxes used in WASP were based on the SOD and nutrient exchange study conducted in the Little River Embayment in June 2001 (US EPA, 2001). Parameters are given by constituent.

EPA Region 4 Science and Ecosystem Support Division in Athens, Georgia performed a field survey during June 25-29, 2001. The results of the measurements are presented in the Lake Allatoona Nutrient Exchange and Sediment Oxygen Demand Study, Project #01-0698 (USEPA, 2001). Sediment Oxygen Demand (SOD) and nutrient flux measurements were performed at Station 3, just upstream of Bells Ferry Road. This site is nearby the GA EPD lake sampling stations were chlorophyll *a* was measured during 2000, 2001, and 2002.

Measured chlorophyll *a*, ortho phosphate, total phosphorus, total nitrogen, ammonia, and nitrate/nitrate data for the 2000 and 2001 growing seasons were used as instream targets to calibrate the model. The data from the 2002 growing season were used to verify the model. Figure 17 shows the chlorophyll *a* calibration and verification curve for the Little River Embayment at Bells Ferry Road (the compliance point) for 2000-2002.

Table 10. WASP Modeling Parameters

Definition and Units	Typical Range	Value
CBOD Deoxygenation Rate at 20C, 1/day	0.05 - 0.7	0.3
Nitrification Rate at 20 ^{o}C, 1/day	0.025 - 0.2	0.20
Denitrification Rate at 20 ^{o}C, 1/day	0 - 0.1	0.05
Reaeration Rate, 1/day	Model calculated	
Endogeneous Respiration Rate of Phytoplankton at 20 ^{o}C,1/day	0.05 - 0.15	0.15
Saturated Growth Rate of Phytoplankton, 1/day	1. - 3.	2.0
Non-Predatory Phytoplankton Death Rate, 1/day	0.01 - 0.1	0.05
Mineralization Rate of Dissolved Org N, 1/day	0.02 - 0.2	0.1
Mineralization Rate of Dissolved Org P, 1/day	0.02 - 0.22	0.1
Sediment Oxygen Demand, g/m^2-day	1.25 – 3.0	1.67
Ammonia Fluxes, mg NH_3/m^2/day	Field data	82.2
Ortho P Fluxes, mg Orho-P/m^2/day	Field data	8.1
Half-Saturation Constant for Nitrification-Oxygen Limitation, mgO_2/L	0.0 – 2.0	1.5
Nitrogen Half-Saturation Constant for Phytoplankton Growth	0.01 - 0.2	0.01
Phosphorous Half-Saturation Constant for Phytoplankton Growth	0.0005 - 0.03	0.001
Nitrogen/Carbon Ratio in Phytoplankton	0.15 - 0.25	0.176
Phosphorous/Carbon Ratio in Phytoplankton	0.015 - 0.025	0.025
Carbon/Chlorophyll Ratio	50 - 100	65
Saturation Light Intensity for Phytoplankton, Langley/day	200 - 500	300
Fraction of Dead Phytoplankton N Recycled to Org N, Default=1	0.5 - 1.0	0.85
Fraction of Dead Phytoplankton P Recycled to Org P, Default=1	0.5 - 1.0	0.85
Temperature Coefficient for CBOD Deoxygenation Rate 20 ^{o}C, Default=1.0	1.03 - 1.06	1.04
Temperature Coefficient for Nitrification Rate 20 ^{o}C, Default=1.0	1.0 - 1.08	1.07
Temperature Coefficient for Denitrification Rate 20 ^{o}C, C, Default=1.0	1.0 - 1.045	1.045
Temperature Coefficient for Respiration 20 ^{o}C, Default=1.0	1.0 - 1.08	1.08
Temperature Coefficient for Mineralization Rate of Dissolved Org N	1.02 - 1.08	1.08
Temperature Coefficient for Mineralization Rate of Dissolved Org P	1.02 - 1.08	1.08
Temperature Coefficient for SOD 20 ^{o}C, Default=1.0	1.0 - 1.08	1.06

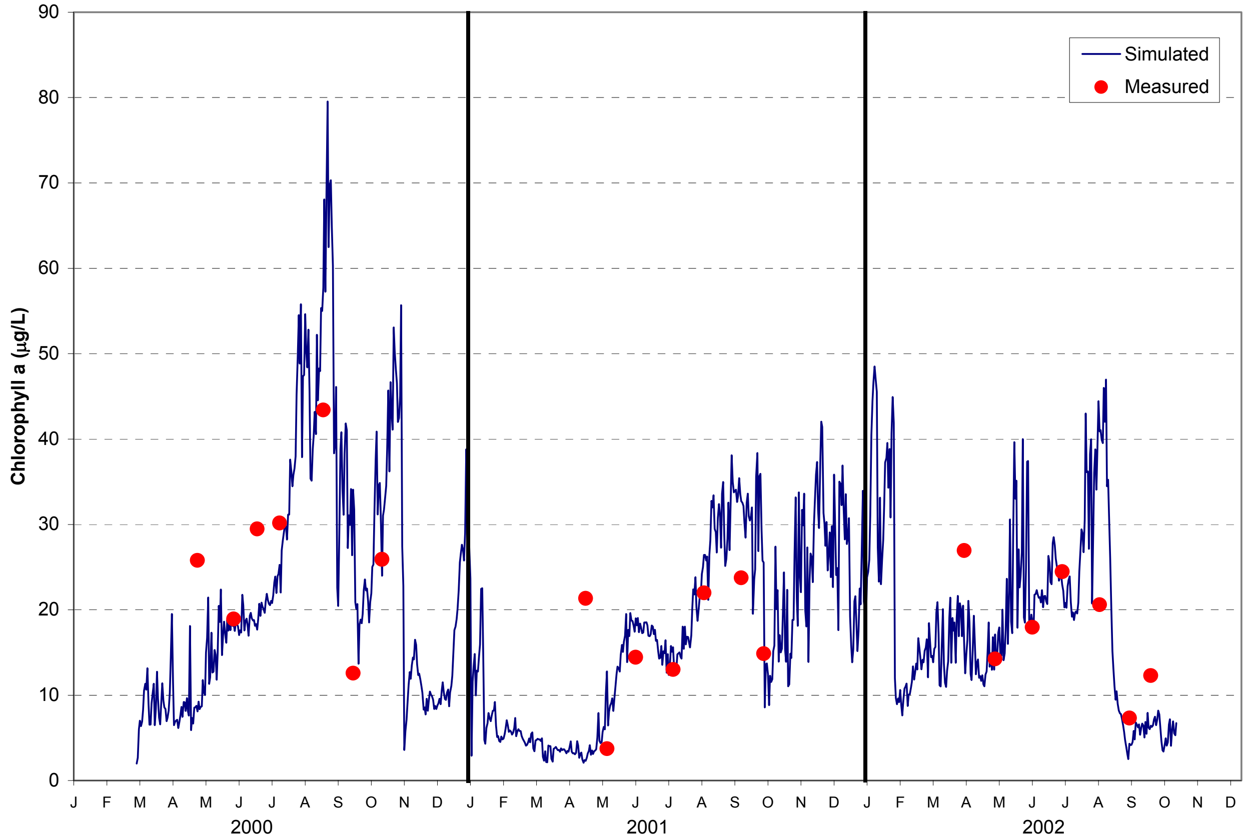

Figure 17. Chlorophyll *a* Calibration and Verification at Bells Ferry Road for 2000 – 2002

4.5 Critical Conditions Models

The critical conditions model were used to assess the nutrient loads and to determine if a problem exists requiring regulatory intervention. Model critical conditions were developed in accordance with GA EPD standard practices (GA EPD, 1978).

The complex dynamics simulated by the models demonstrated the critical conditions for nutrient uptake and the corresponding algal growth in the embayment. The critical conditions include:

- Meteorological conditions
- Available sunlight
- Watershed flows
- Retention time in embayment
- High water temperatures
- Watershed nutrient loads

The most critical time period for algal growth is during the summer when flows are low, thereby increasing the hydraulic retention time in the embayment. During the summer, rainfall is low and sunlight is not limited. Small amounts of nutrients during these low-flow, sunny periods, can cause algae to bloom and measured chlorophyll *a* levels can be above 15-20 µg/L.

Since drought conditions were experienced during 2000 through 2002, this simulation period exhibited low flows, high temperatures, and long retention times. Therefore, the critical condition models were run for this period.

The critical condition scenario was run with the NPDES point sources at the full permit loads and ConAgra discharging at their 2000, 2001, and 2002 levels. The permit limits are listed in Table 4. Figure 18 shows the chlorophyll *a* plot for the existing (same as calibration) conditions and for the critical conditions.

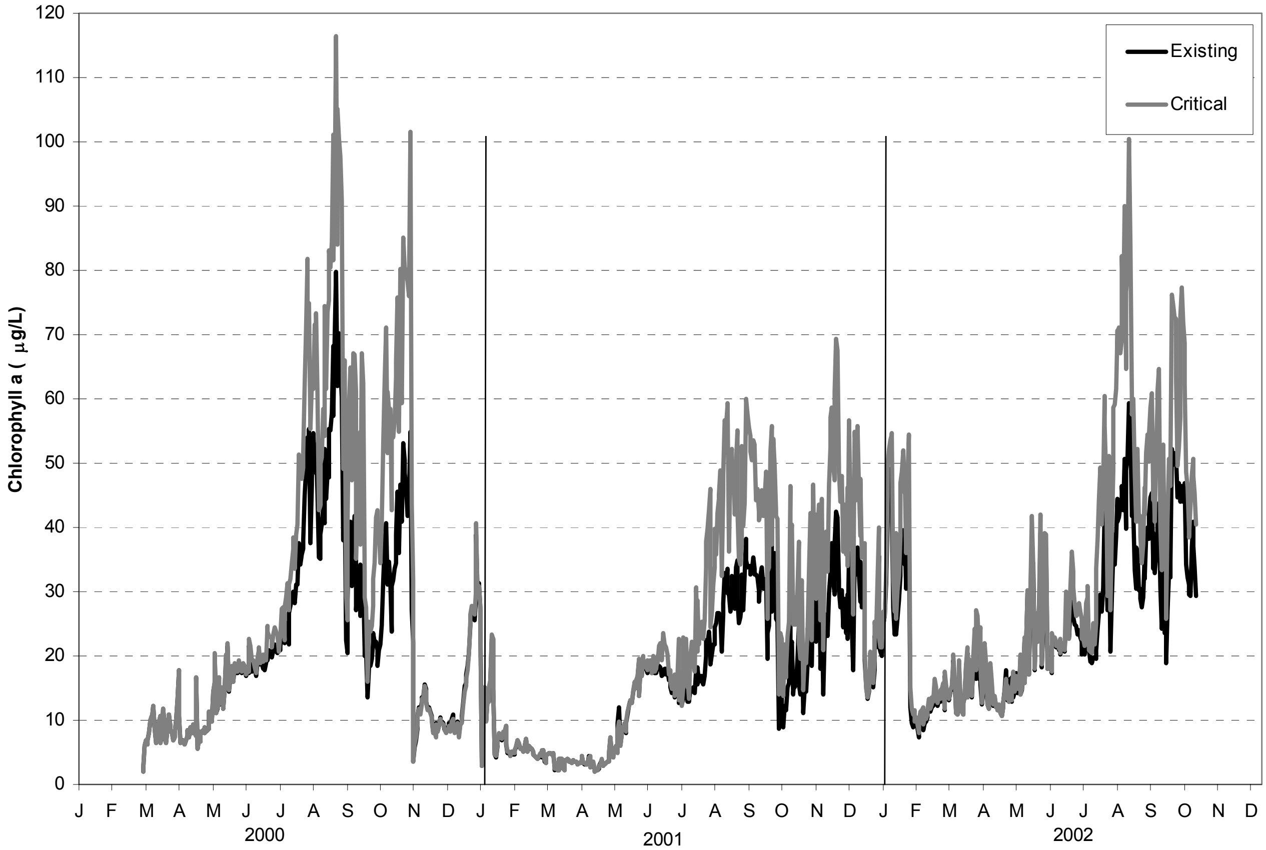

Figure 18. Chlorophyll *a* Existing and Critical Conditions at Bells Ferry Road for 2000-2002

5.0 TOTAL MAXIMUM DAILY LOADS

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality standard; in this case the growing season average chlorophyll *a* standard. A TMDL is the sum of the individual waste load allocations (WLAs) from point sources and load allocations (LAs) for nonpoint sources and natural background (40 CFR 130.2) for a given waterbody. The TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that 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 nutrients, the TMDLS are expressed as lbs/day.

A TMDL can be expressed as follows:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

This TMDL determines the allowable nutrient loads to the Little River Embayment. It is based on the assumption that a chlorophyll *a* standard of 15 μg/L is appropriate during critical conditions. The following sections describe the various TMDL components.

5.1 Waste Load and Load Allocations

The partitioning of allocations between point (WLA) and nonpoint (LA) sources is based on modeling results and professional judgment. The WLA is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. Waste load allocations are provided to the point sources from municipal and industrial wastewater treatment systems. There are four NPDES permitted facilities in the Coosa River watershed that effect instream chlorophyll *a*. Table 11 is a list of the WLAs required to meet the chlorophyll *a* TMDL. Table 12 provides the TMDL for the Little River Embayment and includes partition of WLA and LA. If necessary, GA EPD may modify the WLAs during the NPDES permitting process. In addition, the TMDL will be used to assess the permit renewals.

Table 11. Total Phosphorus WLAs for the Little River Embayment

Facility Name	Discharge Location	WLA (lbs/yr)
Little River WPCP	Little River	1530
Noonday Creek WRF	Noonday Creek	10,960
Woodstock WPCP	Rubes Creek	760
***ConAgra Poultry Plant**	Blankets Creek	5,000
Total WLA	Embayment	18,500

* This allocation will be reallocated when ConAgra relocates its discharge to Cherokee County Water and Sewerage Authority's Fitzgerald Creek WPCP.

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 entering the environment.

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 the 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 the storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

The nonpoint source loads for the existing LA and TMDL were computed from the LSPC results that were used as the WASP input. The LA load varies each year depending on the meteorological conditions

Table 12. Total Phosphorus Loads by Year for the Little River Embayment

Year	**2000**	**2001**
Existing Load (lbs/yr)	56,122	35,369
WLA (lbs/yr)	18,250	18,250
WLAsw (lbs/yr)	4,920	6,050
LA (lbs/yr)	4,230	5,200
MOS	implicit	implicit
TMDL(lbs/yr)	27,400	29,500

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

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.

For this TMDL, the MOS was implicitly incorporated in the use of the following conservative modeling assumptions:

- Critical low flows into the embayment
- Hot summer temperatures
- Critical meteorological conditions
- Long retention times
- Conservative reaction rates

6.0 RECOMMENDATIONS

6.1 Monitoring

GA EPD conducts annual sampling in those lakes that have specific criteria for lakes and major lake tributaries. In addition, water quality monitoring is conducted at a number of locations across the State each year. GA EPD 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 Coosa, Tallapoosa, and Tennessee River Basins were the basins of focused monitoring in 2001 and will again receive focused monitoring in 2006. In addition, GA EPD does annual monitoring of those lakes that have water quality standards, which includes Lake Allatoona and the Little River Embayment.

The three models used to simulate chlorophyll *a* in the Little River Embayment are very complex. All three models require significant amounts of input and calibration data. Continuous flow measurements from Little River would be useful in calibrating the LSPC model. Further bathymetric data, in the form of depth soundings or cross-sections within the Little River embayment, would be helpful to verify the grid used in EFDC and WASP models. In addition, data regarding the fractionation of the nutrients from the point sources would be useful in determining accurate input to the WASP model.

The TMDL Implementation Plan will outline an appropriate water quality-sampling program for the listed streams in the Coosa River Basin. The monitoring program will be developed to help identify the various nutrients sources. This will be especially valuable for those segments where no data or old data that resulted in the listing.

6.2 Reasonable Assurance

The GA 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 background nutrient concentrations. Permitted discharges will be regulated through the NPDES permitting process described in this report. The permittee may be required to perform nutrient monitoring upstream and downstream of the point source to verify the nutrient concentrations assumed in the model. 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, and the TMDL will be reallocated.

GA 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 thirty-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

GA EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. GA EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. GA 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 GA EPD and/or Regional Development Centers (RDCs), or other GA EPD contractors (hereinafter, "GA EPD Contractors"), will develop expanded plans (hereinafter, "Revised TMDL Implementation Plans").

This Initial TMDL Implementation Plan, written by GA EPD and for which GA EPD and/or the GA 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. GA EPD and the GA 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. GA 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 GA EPD Contractor and approved by GA 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 GA EPD approves. If for any reason the GA EPD Contractor does not complete the BMP demonstration project, GA EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the GA EPD brochure entitled "Watershed Wisdom -- Georgia's TMDL Program" will be distributed by GA EPD to the GA 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 GA EPD Contractor for its use in making presentations to appropriate stakeholders on TMDL Implementation Plan development.

4. If for any reason the GA EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, GA 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 December 2005.

6. The GA EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with GA 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 GA 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 GA EPD approves the Revised TMDL Implementation Plan.

Management Measure Selector Table

Land Use	Management Measures	*Fecal Coliform*	*Chlorophyll a*	*pH*	*Oxygen demanding substances*	*Temperature*	*Toxicity*	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	*PCBs, toxaphene*
Agriculture	1. Oxygen demanding substances & 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	_	_	_		_		_		

Land Use	**Management Measures**	***Fecal Coliform***	*Chlorophyll a*	***pH***	***Oxygen demanding substances***	***Temperature***	***Toxicity***	*Mercury*	*Metals (copper, lead, zinc, cadmium)*	*PCBs, toxaphene*
Urban	1. New Development	–	–		–	–			–	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Oxygen demanding substances 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	–	–			–			–	

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APPENDIX A

Little River Embayment Water Quality

2000 Water Quality Monitoring Data

Date	Chlorophyll *a* (mg/L)	Total N (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO2/NO3 (mg/L)	Total P (mg/L)	Ortho P (mg/L)	DO (mg/L)	Water Temp (deg C)
4/27/2000	25.79	1.1	0.61	0.05	0.49	0.05	<0.04	9.06	16.82
5/31/2000	18.93	0.67	0.5	<0.03	0.17	0.04	<0.04	9.08	26.57
6/22/2000	29.48	0.71	0.66	<0.03	0.05	0.04	<0.04	8.69	29.99
7/13/2000	30.17	0.83	0.77	0.04	0.06	0.04	<0.04	8.76	29.88
8/23/2000	43.41	1.28	0.82	0.04	0.46	0.03	<0.04	8.37	27.21
9/20/2000	12.58	2.63	0.63	0.07	2	0.11	<0.04	8.76	21.99
10/17/2000	25.92	2.43	0.63	0.05	1.8	0.06	0.05	9.86	16.93

2001 Water Quality Monitoring Data

Date	Chlorophyll *a* (mg/L)	Total N (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO2/NO3 (mg/L)	Total P (mg/L)	Ortho P (mg/L)	DO (mg/L)	Water Temp (deg C)
04/172001	21.34	1.01	0.48	<0.03	0.53	0.02	0.04	8.96	19.11
05/16/2001	3.74	0.85	0.18	<0.03	0.67	0.02	<0.04	8.92	23.39
06/12/2001	14.45	0.43	0.25	<0.03	0.18	<0.02	<0.04	9.46	26.44
07/17/2001	13.01	0.38	0.25	<0.03	0.13	0.03	<0.04	8.92	29.75
08/15/2001	21.99	0.56	0.42	<0.03	0.14	0.07	<0.04	9.41	29.44
09/19/2001	23.75	0.77	0.45	<0.03	0.32	0.03	<0.04	8.14	24.93
10/10/2001	14.87	3.22	0.42	<0.03	2.80	0.04	<0.04	7.97	17.30

2002 Water Quality Monitoring Data

Date	Chlorophyll *a* (mg/L)	Total N (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO2/NO3 (mg/L)	Total P (mg/L)	Ortho P (mg/L)	DO (mg/L)	Water Temp (deg C)
04/16/2002	26.95	1.16	0.40	<0.03	0.76	0.03	<0.04	11.21	19.87
05/15/2002	14.25	0.87	0.47	0.07	0.40	0.03	<0.04	7.06	21.85
06/19/2002	17.96	0.44	0.44	0.06	NM	0.03	<0.04	9.04	27.24
07/17/2002	24.47	0.75	0.51	0.05	0.24	0.06	<0.04	9.30	29.72
08/21/2002	20.61	1.26	0.72	0.13	0.54	0.06	<0.04	8.34	29.34

09/18/2002	7.33	2.40	1.00	0.27	1.40	0.23	0.11	4.33	22.69
10/08/2002	12.30	1.66	0.66	<0.03	1.00	0.09	<0.04	8.36	23.42

APPENDIX B

Total Maximum Daily Load Summary Memorandum

SUMMARY MEMORANDUM
Coosa River

1. 303(d) Listed Waterbody Information

State: Georgia
County: Cherokee

Major River Basin: Coosa
8-Digit Hydrologic Unit Code(s): 03150104

Waterbody Name: Lake Allatoona
Location: Little River Embayment
Affected Area: 950 acres
Ecoregion: Piedmont

Constituent(s) of Concern: Chlorophyll *a*

Designated Use: Recreation and Drinking Water
(Partially supporting designated use)

Applicable Water Quality Standard:
Chlorophyll a: For the months of April through October, the average monthly mid-channel photic zone composite samples shall not exceed the chlorophyll *a* concentrations of 15 μg/L.

2. TMDL Development

Analysis/Modeling:
LSPC – Watershed model
EFDC – 3-D Hydrodynamic model
WASP – 3-D Water quality model

Calibration Data: Lake Allatoona– 2000, 2001, and 2002 Water Quality Standards Assessment.

Critical Conditions:
1) Low watershed flows
2) High temperature
3) Point source discharges at permit.
4) SOD and nutrient fluxes based on measured field data
5) Kinetic rates, reaeration, and other model parameters as per the guidance provided in the WASP Users Manual.
5) Same metrological data as used in the calibrated models.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**18,250 lbs P/yr**	
(WLAsw):	**3,382 lbs P/yr (2000)**	**4,158 lbs P/yr (2001)**
Load Allocation (LA):	**5,768 lbs P/yr (2000)**	**7,092 lbs P/yr (2001)**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**

1) **Critical low flows into the embayment**
2) **Conservative reaction rates**
3) **Hot summer temperatures**
4) **Critical meteorological conditions**
5) **Long retention times**

TMDL: **27,400 lbs P/yr (2000)** **29,500 lbs P/yr (2001)**