Total Maximum Daily Load

Evaluation

for

Beaverdam Creek

Submitted to:

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

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
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EXECUTIVE SUMMARY

The State of Georgia assesses its waters for compliance with water quality standards established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed waters are placed into three categories, supporting, partially supporting, or not supporting their designated uses depending on water quality data assessment results. These waters are referred to as 305(b) waters after the section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years. A subset of the 305(b) partially and not supporting waters is assigned to the 303(d) list, also named after the section of the CWA. In accordance with U.S. Environmental Protection Agency (USEPA) guidelines, waters are placed on the 303(d) list if actions to achieve water quality standards will take more than two years to implement.

Waters on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for that water quality constituent in violation of the water quality standard. The implementation of a TMDL is one tool for addressing water quality limited waters, and is based on the relationship between pollution sources and in-stream water quality conditions. The TMDL establishes the allowable loadings or percent reductions to the stream, thereby providing the basis for addressing the water quality impairment.

The State of Georgia has identified a segment of Beaverdam Creek downstream from the City of Commerce, Georgia, as a 305(b) partially supporting stream segment, and has placed the stream segment on the 303(d) list of waters. Beaverdam Creek is an approximately 12 square mile watershed located in the headwaters of the Broad River watershed of the northern Savannah River basin. Beaverdam Creek is a tributary to Grove Creek which drains into the Hudson River. The Hudson River flows into the Broad River which is a tributary to the Savannah River. A portion of the City of Commerce is located in the headwaters of Beaverdam Creek. The one mile segment of Beaverdam Creek identified on the 303(d) list is located downstream from the City of Commerce North Plant wastewater treatment facility. This segment has a water use classification of fishing and a daily average dissolved oxygen concentration standard of 5.0 milligrams per liter (mg/l) and no less than 4.0 mg/l at all times.

The Beaverdam Creek segment was identified as potentially partially supporting water quality standards during the permit reissuance process in 1992. This segment was listed based on water quality modeling results, and not for measured dissolved oxygen concentrations below the water quality standard. Just prior to 1992, Georgia adopted a new annual low flow value for Beaverdam Creek based on new streamflow statistics for the Savannah River basin developed by the U.S. Geological Survey. The revised low flow was approximately 50 percent lower than the low flow previously used. Using the revised low flow, the updated water quality model predicted a dissolved oxygen concentration below water quality standards due to the City of Commerce North Plant. discharge. At that time, the National Pollutant Discharge Elimination System (NPDES) permit was reissued with a clause regarding a stream study for model calibration and a clause to reopen the permit to require more stringent limitations as appropriate based

on the calibrated model. It should be noted that there has been no documented violation of the dissolved oxygen concentration standard in Beaverdam Creek.

The potential dissolved oxygen concentration standard violation shown by the water quality modeling was attributed to the permitted discharge from the City of Commerce North Plant. The facility was permitted for a monthly average flow of 1.05 million gallons per day (MGD) and effluent limits for BOD_5, ammonia, and dissolved oxygen of 20, 15, and 5 mg/l, respectively. The primary constituents responsible for lowering the instream dissolved oxygen concentration are ultimate carbonaceous biochemical oxygen demand ($CBOD_u$) and ultimate nitrogenous oxygen demand ($NBOD_u$). The nitrogenous oxygen demand is represented by ammonia. Other sources of these constituents are nonpoint sources such as background stream concentrations.

Model calibration field studies were performed in 1994-1996 to collect data for Beaverdam Creek and improve the defensibility of the water quality model. Using the model calibration results, a critical conditions water quality model was developed to determine the effluent limits for the City of Commerce North Plant that would be protective of the dissolved oxygen concentration standard. The critical conditions model incorporates those severe hydrologic and meteorologic conditions in which the water quality standard would be protected. Revised effluent limits for BOD_5, ammonia, and dissolved oxygen of 10, 2, and 6 mg/l, respectively, were developed and required in the City of Commerce North Plant's NPDES permit in May 1998. The average monthly flow rate remains the same, 1.05 MGD. These effluent limits represent a 70 percent reduction in the oxygen demanding constituents permitted to be discharged from the plant. TMDLs for $CBOD_u$ and $NBOD_u$ for the Beaverdam Creek watershed were developed based on the critical conditions water quality modeling results.

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its waters for compliance with water quality standards established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed waters are placed into three categories, supporting, partially supporting, or not supporting their designated uses depending on water quality data assessment results. These waters are referred to as 305(b) waters after the section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* every two years. A subset of the 305(b) partially and not supporting waters is assigned to the 303(d) list, also named after the section of the CWA. In accordance with U.S. Environmental Protection Agency (USEPA) guidelines, waters are placed on the 303(d) list if actions to achieve water quality standards will take more than two years to implement.

Waters on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for that water quality constituent in violation of the water quality standard. The implementation of a TMDL is one tool for addressing water quality limited waters, and is based on the relationship between pollution sources and in-stream water quality conditions. The TMDL establishes the allowable loadings or percent reductions to the stream, thereby providing the basis for addressing the water quality impairment.

The State of Georgia has identified a segment of Beaverdam Creek downstream from the City of Commerce, Georgia, as a 305(b) partially supporting stream segment, and has placed the stream segment on the 303(d) list of waters. A portion of the City of Commerce is located in the headwaters of Beaverdam Creek. The one mile segment of Beaverdam Creek identified on the 303(d) list is located downstream from the City of Commerce North Plant wastewater treatment facility. This segment has a water use classification of fishing and a daily average dissolved oxygen concentration standard of 5.0 milligrams per liter (mg/l) and no less than 4.0 mg/l at all times. This document describes the analyses used to develop the TMDL(s) and the resulting wastewater treatment permit limits that will be protective of the dissolved oxygen concentration standard.

1.2 Watershed Description

Beaverdam Creek is located in the Broad River watershed of the northern Savannah River basin, U.S. Geological Survey (USGS) hydrologic unit code 03060104. Beaverdam Creek is a tributary to Grove Creek which drains into the Hudson River. The Hudson River flows into the Broad River which is a tributary to the Savannah River (see Figure 1). The one mile segment of Beaverdam Creek identified on the 303(d) list is located downstream from the City of Commerce North Plant wastewater treatment facility (see Figure 2).

The Beaverdam Creek watershed (to its confluence with Grove Creek) is a 11.7 square mile (sqmi) watershed composed of two headwater streams that join together to form

Beaverdam Creek (see Figure 2). Both of these headwater streams drain areas of the City of Commerce which is located on the watershed divide between the Oconee and Savannah River basins. The northern headwater watershed has an area of 3.3 sqmi and the southern headwater watershed has an area of 2.8 sqmi. Other than the City of Commerce, there is little development in the remainder of the Beaverdam Creek watershed. Other areas of the watershed are either forested or open land.

1.3 Water Quality Standards

As described in section 1.1 the water quality standard for dissolved oxygen concentration in Beaverdam Creek is a daily average of 5.0 mg/l and no less than 4.0 mg/l at all times. This standard will be used to determine the TMDL for Beaverdam Creek. An explicit TMDL for dissolved oxygen was not developed since it is not a pollutant, but rather an indicator of water quality. Therefore, TMDLs were developed for those constituents responsible for depleting dissolved oxygen.

2.0 WATER QUALITY ASSESSMENT

There are very little water quality monitoring data available for this stream segment. The data that are available were collected during the calibration field studies. Table 1 shows water quality monitoring data from the field studies. Figures 3, 4, 5, and 6 show instream continuous monitoring data. None of the data collected during these surveys indicated water quality standards violations.

3.0 SOURCE ASSESSMENT

3.1 Point Source Assessment

There is one National Pollutant Discharge Elimination System (NPDES) permitted wastewater treatment facility discharging to the Beaverdam Creek watershed. The City of Commerce operates its North Plant wastewater treatment facility (NPDES permit number GA0026247).

The one mile segment of Beaverdam Creek was identified as potentially partially supporting water quality standards during the permit reissuance process in 1992. Just prior to 1992, Georgia adopted a new 7-day average low flow with a recurrence interval of 10 years (7Q10) for the Bear Creek watershed. The new low flow was based on streamflow statistics developed by the USGS (USGS 1988). The new low flow yield of 0.14 cubic feet per square mile (cfs/sqmi) is more than 50 percent less than the previously used low flow yield of 0.30 cfs/sqmi. Using the revised low flow, the updated water quality model predicted a dissolved oxygen sag concentration below water quality standards due to the Commerce North Plant discharge. At that time, the NPDES permit was reissued with a clause regarding a model calibration stream study, and a clause to reopen the permit to require more stringent limitations based on the water quality modeling results.

The Commerce North Plant discharge is located approximately 200 feet upstream from the confluence of the two headwater streams of Beaverdam Creek (see Figure 2). The Commerce North Plant was previously permitted for a monthly average flow of 1.05 million gallons per day (MGD) and effluent limits for BOD_5, ammonia, and dissolved oxygen of 20, 15, and 5 mg/l, respectively. These effluent limits were later revised to 10, 2, and 6 mg/l as a result of the revised water quality model. The primary constituents responsible for lowering the instream dissolved oxygen concentration are ultimate carbonaceous biochemical oxygen demand ($CBOD_u$) and ultimate nitrogenous oxygen demand ($NBOD_u$). These effluent limits represent a 70 percent reduction in the oxygen demanding constituents permitted to be discharged from the plant. Other sources of these constituents are nonpoint sources such as background stream concentrations which are discussed in the following section.

3.2 Nonpoint Source Assessment

Other pollutant loadings include nonpoint source loads representing background streamflow concentrations. These are represented in the water quality model as headwaters, tributary inflows, and lateral inflows. Water quality data used in the water quality model were derived from the field study data.

4.0 MODELING APPROACH

4.1 Model Selection

Water quality modeling was used to assess the cause and effect relationship between pollutant sources and stream water quality. A one-dimensional steady-state conventional pollutant water quality model was applied to Beaverdam Creek. This modeling approach was chosen based on the nature of the waterbody, pollutant sources and constituents, critical conditions, and the water quality standard involved. The Georgia DOSAG conventional pollutant and dissolved oxygen computer model was chosen to develop the Beaverdam Creek TMDL for dissolved oxygen. The following sections describe the justification for using this modeling approach.

4.1.1 Waterbody

Beaverdam Creek is a small headwater stream in which the one-dimensional assumption is valid. The stream segment to be modeled is approximately 4.6 miles long and only has one significant tributary flowing into it. The DOSAG model is well suited for modeling streams of this type.

4.1.2 Pollutant Sources and Constituents

The primary pollutant source is the City of Commerce North Plant. The primary pollutants affecting the dissolved oxygen concentrations in Beaverdam Creek are the oxygen demanding constituents in the facility's effluent and local streamflows. These include the carbonaceous biochemical oxygen demanding materials ($CBOD_u$) and the nitrogenous oxygen demanding materials ($NBOD_u$). The DOSAG model simulates the dissolved oxygen kinetics of both $CBOD_u$ and $NBOD_u$.

4.1.3 Critical Conditions

The steady-state critical conditions selected for developing the TMDL for Beaverdam Creek are low-flow and high temperature conditions in which the primary pollutant source, the discharge from the wastewater treatment facility, has a more severe impact on the stream's dissolved oxygen concentration. Low-flow conditions are defined by streamflows equivalent to the estimated 7-day average low flow with a 10 year recurrence interval, referred to as the 7Q10. Dilution of the wastewater is at a minimum during low flow conditions, and higher water temperatures reduce dissolved oxygen solubility. These are severe environmental conditions affecting the dissolved oxygen concentration. The potential minimum instream dissolved oxygen concentration can be determined using these critical conditions along with the allowable wastewater treatment facility effluent limits. The DOSAG model is capable of simulating these steady-state critical conditions.

4.1.4 Water Quality Standard

The DOSAG model computes dissolved oxygen concentrations using the dissolved oxygen kinetics of $CBOD_u$ and $NBOD_u$ and other processes. An explicit TMDL for dissolved oxygen will not be determined, but rather TMDLs for oxygen consuming substances, $CBOD_u$ and $NBOD_u$, will be determined. Consequently, DOSAG will be used to predict dissolved oxygen concentrations and the TMDLs will be developed from the corresponding loadings used in the model.

4.2 Calibration Model

Field studies were conducted in 1993, 1994, and 1996, to collect data and information to calibrate the water quality model. These field studies collected data including streamflow, instream constituent concentrations, time of travel, and wastewater effluent flow and constituent concentrations. The 1994 data set was used for model calibration. Section 4.4 describes the model setup in more detail and Appendix A contains the DOSAG model input and results for the 1994 calibration model.

4.3 Critical Conditions Model

The critical conditions model was developed from the calibration model by modifying the model input parameters to represent the selected critical conditions. The model parameters modified to represent the critical conditions are those involving streamflow, temperature, and wastewater treatment facility limits. Section 4.4 describes the model setup in more detail and Appendix B contains the DOSAG model input and results for the critical conditions model.

4.4 Model Setup

4.4.1 General

The Beaverdam Creek water quality model consists of one branch with seven stream reaches. Stream reaches were chosen based on features such as roads, tributary confluences, point source discharges, and county boundaries. The model included one wastewater treatment facility and one tributary.

4.4.2 Point Source Representation

The City of Commerce North Plant was represented in the critical conditions model as a point source with effluent limits for BOD_5, ammonia, and dissolved oxygen of 10, 2, and 6 mg/l, respectively. A $CBOD_u$ to BOD_5 f-ratio of 2.0 was applied to the wastewater treatment facility BOD_5 effluent limit concentration in both the calibration and critical conditions model.

4.4.3 Nonpoint Source Representation

The water quality associated with headwaters, tributaries, and lateral inflows was generally determined from the 1994 measured water quality data. A dissolved oxygen concentration equal to 75 percent of saturation was used for headwaters, tributaries, and lateral inflows. A $CBOD_u$ to BOD_5 f-ratio of 3.0 was applied to the measured BOD_5 concentrations.

4.4.4 Stream Characteristics

Streamflows in the critical conditions model were determined using the 7Q10 streamflow yield factor of 0.14 cfs/sqmi. Time of travel studies yielded inconclusive streamflow velocity results insufficient to develop a relationship between streamflow and velocity. As a result, a streamflow velocity of 0.2 feet per second was used based on gaged streamflow data and time of travel data considered to be reliable.

The *water temperature* throughout the critical conditions model was set to 23 degrees Celsius based on U.S. Geological Survey water temperature estimates for this area. This is the expected highest water temperature for this area.

Kinetic rates for $CBOD_u$ and $NBOD_u$ are used in the DOSAG model to compute the decay of these substances and the corresponding oxygen consumption. Nitrogen was modeled as $NBOD_u$ with a first-order decay rate. The decomposition of $CBOD_u$ and $NBOD_u$ was modeled using a first-order decay rate. Literature values were first used in the calibration model and then adjusted to improve model calibration. The final rates were used in the critical conditions model. The kinetic rates at 20 degrees Celsius for $CBOD_u$ ranged from 0.25 to 0.5 per day, and the rate used for $NBOD_u$ was 0.3 per day. These kinetic rates were temperature adjusted in the model.

Reaeration was computed using the Tsivoglou reaeration formulation with escape coefficients of 0.02 to 0.03. These coefficients were determined during model calibration and used in the critical conditions model.

Photosynthesis/respiration and sediment oxygen demand were not considered significant components of the dissolved oxygen deficit and were not represented in the water quality model.

5.0 MODEL RESULTS

Model input and results for both the calibration model and the critical conditions model are contained in Appendix A and B.

5.1 Calibration Model

The calibration model (see Appendix A) was developed using data from the June 20, 1994, field survey. Data from this survey were also used to compare with model results to calibrate the water quality model. Figures 7 through 10 compare the measured field data to the model results for $CBOD_u$, $NBOD_u$, ammonia, and dissolved oxygen. The $CBOD_u$ model results compare well with the measured data (see Figure 7). Calibration results for $NBOD_u$ and ammonia are not as good (see Figures 8 and 9). Figure 10 shows the dissolved oxygen calibration results. During the calibration process it was not possible to match the most downstream dissolved oxygen calibration point. Examination of field data from the September 12, 1996, survey in which conditions were very similar to the June 20, 1994, survey, showed a relatively constant dissolved oxygen concentration in Beaverdam Creek. Considering this circumstance, the water quality model calibration was considered adequate.

5.2 Critical Conditions Model

The critical conditions model (see Appendix B) was developed using parameters from the calibration model, and streamflow and water temperature representing the critical condition. High temperature and low-flow conditions represent the selected critical or design condition for protecting the dissolved oxygen standard, and is considered the condition in which the treatment facility will have a severe impact. The resulting dissolved oxygen concentration profile is shown in Figure 11. The results show a minimum dissolved oxygen concentration in Beaverdam Creek of 5.2 mg/l that occurs near the Grove Creek confluence. The loadings in the critical conditions model will be used as the basis for determining the TMDLs for the various constituents.

6.0 ALLOCATION

6.1 Total Maximum Daily Load

A TMDL is the sum of the individual wasteload allocations (WLA) for point sources and load allocations (LA) for nonpoint sources and natural background (40 CFR 130.2). The sum of these components may not result in an exceedence of water quality standards for that waterbody. To protect against exceedences, the TMDL must 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 of the receiving waterbody. Conceptually, a TMDL can be expressed as follows:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while maintaining water quality standards. TMDLs establish allowable waterbody loadings that are less than or equal to the TMDL and thereby provide the basis to establish water quality based controls. For some pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For dissolved oxygen the TMDLs for the oxygen consuming constituents $CBOD_u$ and $NBOD_u$ are expressed as mass loading rates.

The total maximum daily loads of oxygen demanding constituents was determined by adding the WLA and the LA. The MOS (as described in Section 4.5) was implicitly included in the TMDL analysis and does not factor directly in the TMDL equation as shown above. Tables 2 and 3 show the computation of the total maximum daily load using the WLAs and the LAs for the critical condition. The TMDL for $CBOD_u$ and $NBOD_u$ is 198 and 84 pounds, respectively, and were determined by rounding the computed results.

6.2 Wasteload Allocations

The only permitted point source discharge in the Beaverdam Creek watershed is the City of Commerce North Plant. The critical conditions model was used to set the wasteload allocation for this plant that protects the dissolved oxygen standard. At a flow rate of 1.05 MGD (1.62 cfs), the plant's effluent limits for BOD_5, ammonia, and dissolved oxygen must be 10, 2, and 6 mg/l, respectively, to protect the downstream dissolved oxygen concentration standard. Using a $CBOD_u/BOD_5$ f-ratio of 2.0 and an ammonia to $NBOD_u$ conversion factor of 4.57, the corresponding loadings for $CBOD_u$ and $NBOD_u$ are 175 and 80 pounds per day, respectively. These are the allowable waste loadings for the Commerce North Plant for the critical conditions and are shown in Tables 2 and 3. These revised limits represent a 70 percent reduction in the permitted ultimate oxygen demanding substance loading to Beaverdam Creek (see Table 4).

6.3 Load Allocations

Load allocations include constituents originating from nonpoint sources and natural background levels for the watershed and were included in the critical conditions model to determine the TMDLs. For the Beaverdam Creek steady-state low flow critical condition, these load allocations (LA) represent the background levels for the watershed and were included in the water quality model. Background concentrations were determined from the 1994 measured field data. Background tributary concentrations of $CBOD_u$ and $NBOD_u$ are estimated at 3.0 mg/l and 0.4 mg/l, respectively.

The loadings from the headwaters, tributaries, and local inflows were computed to determine the load allocation for background loadings. Tables 2 and 3 show the background loadings by headwater and stream reach. The total load allocation was computed by adding all the loads associated with background concentrations upstream from the dissolved oxygen sag point, which was located just upstream from the Grove Creek confluence. The sag point was chosen rather than the plant discharge point because the water quality standards violation occurs downstream from the plant discharge and not at the plant discharge. Therefore, loads downstream from the discharge point, but upstream from the point of impairment contribute to the water quality standards violation.

The resulting load allocation for the Beaverdam Creek watershed upstream from the Grove Creek confluence was 23 pounds per day of $CBOD_u$ and 4 pounds per day of $NBOD_u$. These load allocations were computed based on the low flow critical conditions. Therefore, it should be recognized that during wet weather and other higher streamflow conditions these load allocations could be exceeded. However, these conditions are not considered critical to the dissolved oxygen concentration.

6.4 Seasonal Variation

The high temperature and low-flow conditions represent the selected design condition for protecting the dissolved oxygen standard, and is considered the condition in which the treatment facility will have the greatest impact. This design condition is expected to occur during the summer/fall seasons of the year when low streamflows and higher ambient water temperatures would be expected to occur. Other times of the year are expected to be less severe with higher streamflows and lower temperatures.

To demonstrate this conclusion, an analysis of minimum dissolved oxygen concentration changes with changing streamflows and water temperature was performed. The analysis used average monthly 7Q10 streamflows (USGS 1982) and computed monthly water temperatures (USGS 1996) based on historic measured data.

Minimum (7Q10) streamflows for Beaverdam Creek were based on the USGS average monthly minimum streamflow data for the Hudson River near Homer (02191200). Minimum streamflow yield for the Hudson River gage watershed was computed by dividing the minimum streamflow rate by the gaged watershed area (see Table 5). The average monthly minimum streamflow yield for Beaverdam Creek was computed using

the ratio of the annual 7Q10 streamflow rates for Beaverdam Creek and the Hudson River (0.14 [USGS 88] and 0.45 [USGS 77], respectively) multiplied by the average monthly minimum streamflow yield for the Hudson River (see Table 5). The table shows that the minimum streamflow yield is 0.16 cfs/sqmi, slightly higher than the 0.14 used in the water quality critical conditions model. This minimum streamflow yield occurred during the months of July, August, and September.

These monthly minimum streamflows and water temperatures were used in individual model simulations to compute the resulting minimum dissolved oxygen concentrations for each month (see Table 5). The results show that the minimum dissolved oxygen concentration is affected more by water temperature than minimum instream flow. Minimum dissolved oxygen concentrations for all months were greater than the minimum dissolved oxygen concentration computed in the critical conditions model. This supports the use of the selected critical conditions.

6.5 Margin of Safety

The MOS is part of the TMDL development process and there are two basic methods for incorporating the MOS:

- Implicitly incorporate the MOS using conservative model assumptions to develop allocations, or

- Explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations.

A combination of these two MOS approaches was used in developing the TMDL for dissolved oxygen for Bear Creek. First, the MOS is implicitly incorporated into the modeling process by selecting critical conditions of combined high temperature and low streamflow with a low recurrence interval. Secondly, the minimum dissolved oxygen concentration was maintained at 5.2 mg/l which is above the 4.0 and 5.0 mg/l standard concentrations in order to provide another margin of safety in the analysis.

6.6 Monitoring Recommendations

It is recommended that the City of Commerce conduct monitoring of dissolved oxygen concentration and water temperature both upstream and downstream from the wastewater treatment facility discharge once per week. Monitoring downstream from the facility discharge should be performed at the first road crossing upstream from Grove Creek.

REFERENCES

USGS 1977, Low-Flow Frequency of Georgia Streams, U.S. Geological Survey Water Resources Investigations Open File Report 77-127, Carter R.F., Putnam S.A.

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USGS 1988, Low-Flow Profiles of the Upper Savannah and Ogeechee Rivers and Tributaries in Georgia, U.S. Geological Survey Water Resources Investigations Open File Report 88-4047, Carter R.F., Hopkins E.H., and Perlman H.A.

USGS 1996, Stream Temperature Characteristics, U.S. Geological Survey Water Resources Investigations Report 96-4203, Dyar T.R., Alhadeff S.J.

Table 1: Water Quality Data from Field Calibration Studies

June 20, 1994 Field Survey

	Location	Date	Time	Flow (mgd)	Flow (cfs)	Temperature (C)	DO (mg/l)	Ammonia (mg/l)	BOD (mg/l)
BD-1	Beaverdam Creek at W.E. King Road	06/20/1994	13:30		2.8	18.5	8.1	0.08	1.0
	Commerce Northside WPCP Effluent	06/20/1994	13:50	0.57	0.88	23.5	6.7	0.25	5.4
BD-3	Beaverdam Creek Upstream Unnamed Tributary	06/20/1994	13:12			20.0	7.6	0.08	1.9
TB-1	Unnamed Tributary	06/20/1994	13:11		3.0	19.5	7.7	0.10	0.8
BD-4	Beaverdam Creek at Brown Bridge Road	06/20/1994	12:36		7.6	25.0	7.0	0.06	0.8

September 12, 1996 Field Survey

	Location	Date	Time	Flow (mgd)	Flow (cfs)	Temperature (C)	DO (mg/l)	Ammonia (mg/l)	BOD (mg/l)
BD-1	Beaverdam Creek at W.E. King Road	09/12/1996	10:10		2.0	19.5	7.8	0.04	0.5
	Commerce Northside WPCP Effluent	09/12/1996	10:43	0.69	1.07	23.5	7.3	0.09	1.0
BD-3	Beaverdam Creek Upstream Unnamed Tributary	09/12/1996	11:37			21.0	7.7	0.05	0.5
TB-1	Unnamed Tributary	09/12/1996	11:55		2.1	20.0	7.7	0.06	0.5
BD-4	Beaverdam Creek at Brown Bridge Road	09/12/1996	14:10		7.3	23.0	7.6	0.015	0.5

September 16, 1996 Field Survey

	Location	Date	Time	Flow (mgd)	Flow (cfs)	Temperature (C)	DO (mg/l)	Ammonia (mg/l)	BOD (mg/l)
BD-1	Beaverdam Creek at W.E. King Road	09/16/1996	19:20		9.7	20.5	6.7	0.08	4.3
	Commerce Northside WPCP Effluent	09/16/1996	18:50	1.70	2.63	22.0	7.0	0.63	5.0
BD-3	Beaverdam Creek Upstream Unnamed Tributary	09/16/1996	20:18			20.5	7.0	0.13	4.0
TB-1	Unnamed Tributary	09/16/1996	20:25			20.0	7.0	0.05	3.4
BD-4	Beaverdam Creek at Brown Bridge Road	09/16/1996	22:35			20.0	6.6	0.015	1.7

Table 2: CBODu Load Allocation

Reach/Headwater	Wasteload Allocation Flow (cfs)	Concentration (mg/l)	Load (lbs/day)	Load Allocation Flow (cfs)	Concentration (mg/l)	Load (lbs/day)
Headwater				0.46	3.0	7.4
W.E. King Road to Commerce WPCP				0.01	3.0	0.2
Commerce Northside WPCP	1.62	20	175.1			
WPCP to Unnamed Tributary				0.01	3.0	0.2
Unnamed Tributary				0.39	2.4	5.0
Unnamed Tributary to Banks County Line				0.07	2.4	0.9
Banks County Line to Highway 227				0.60	2.4	7.8
Highway 227 to Grove Creek				0.11	2.4	1.4
Total:	1.62		175	1.65		23

Total Maximum Daily Load: 198 pounds

Table 3: NBODu Load Allocation

Reach/Headwater	Wasteload Allocation Flow (cfs)	Concentration (mg/l)	Load (lbs/day)	Load Allocation Flow (cfs)	Concentration (mg/l)	Load (lbs/day)
Headwater				0.46	0.4	1.0
W.E. King Road to Commerce WPCP				0.01	0.4	0.0
Commerce Northside WPCP	1.62	9.1	79.7			
WPCP to Unnamed Tributary				0.01	0.4	0.0
Unnamed Tributary				0.39	0.5	1.1
Unnamed Tributary to Banks County Line				0.07	0.4	0.2
Banks County Line to Highway 227				0.60	0.4	1.3
Highway 227 to Grove Creek				0.11	0.4	0.2
Total:			80	1.65		4

Total Maximum Daily Load: 84 pounds

Table 4: Percent Permitted Load Reduction for City of Commerce North Plant

f-Ratio(1):	1.5							
f-Ratio(2):	2.0							
NBODu Stoichiometric Constant:	4.57							
	Flow (MGD)	Flow (cfs)	BOD5 (mg/l)	BODu (mg/l)	Load (lbs/day)	Ammonia (mg/l)	NBODu (mg/l)	Load (lbs/day)
Previous Effluent Limits	1.05	1.62	20	30	263	15	69	600
Revised Effluent Limits	1.05	1.62	10	20	175	2	9	80
			BODu percent reduction:		33%	NBODu percent reduction:		87%
Total Reduction:	70%							

Note: To compute BODu f-ratio(1) was used for previous effluent limits and f-ratio(2) was used for revised effluent limits.

Table 5: Seasonal Dissolved Oxygen Analysis Data and Results

Month	(1) Average Monthly Minimum Discharge (cfs)	Average Monthly Minimum Discharge Yield (Hudson River) (cfs/sqmi)	(2) Average Monthly Minimum Discharge Yield (Beaverdam Cr.) (cfs/sqmi)	Monthly Temperature (Celsius)	Dissolved Oxygen Concentration (mg/l)
January	56	0.92	0.29	6	7.37
February	65	1.06	0.33	8	7.30
March	67	1.10	0.34	12	7.00
April	65	1.06	0.33	16	6.70
May	64	1.05	0.33	20	6.32
June	44	0.72	0.22	23	5.57
July	31	0.51	0.16	23	5.27
August	31	0.51	0.16	21	5.63
September	32	0.52	0.16	18	6.18
October	34	0.56	0.17	13	6.58
November	44	0.72	0.22	9	6.94
December	43	0.70	0.22	7	7.07

(1) Monthly 7 consecutive day average low flow with 10 year recurrence interval (7Q10) based on U.S. Geological Survey streamflow gage Hudson River at Homer, Georgia (02191200).

(2) Average monthly minimum (7Q10) discharge yield for Beaverdam Creek is computed using the ratio of the annual 7Q10 values for Beaverdam Creek and the Hudson River (0.14 and 0.45 respectively) multiplied by the average monthly minimum discharge yield for the Hudson River.

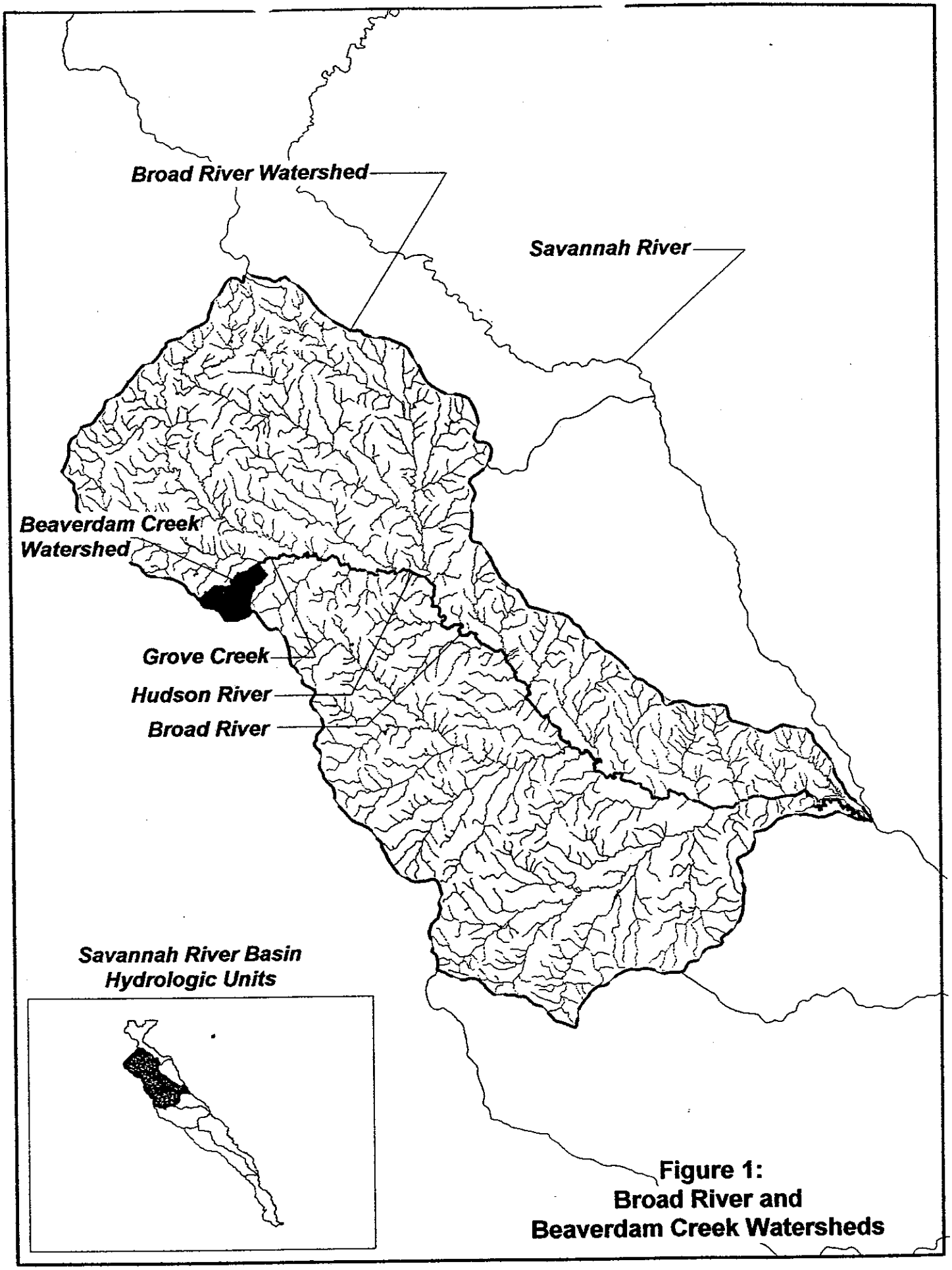


Figure 1:
Broad River and Beaverdam Creek Watersheds

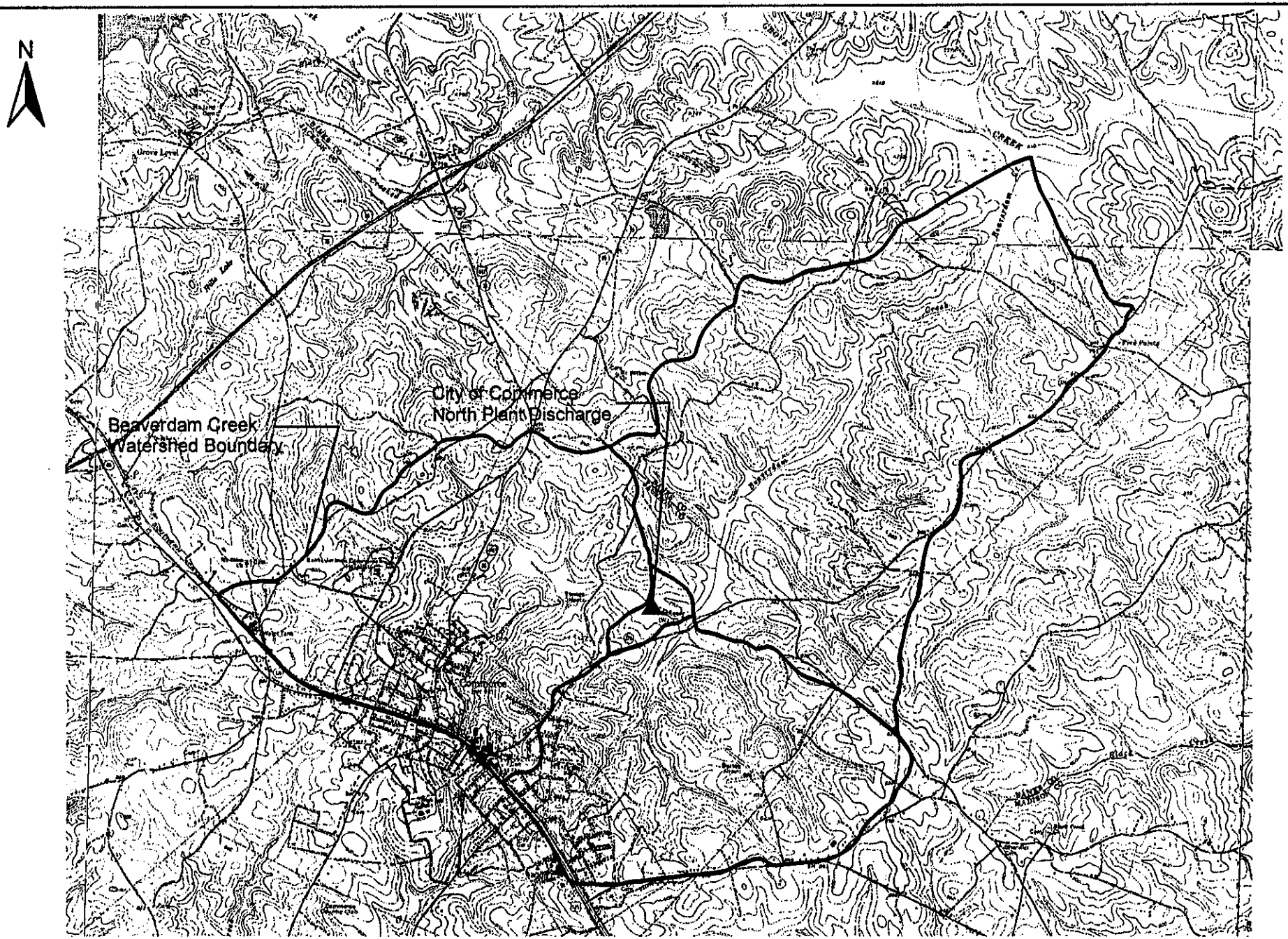
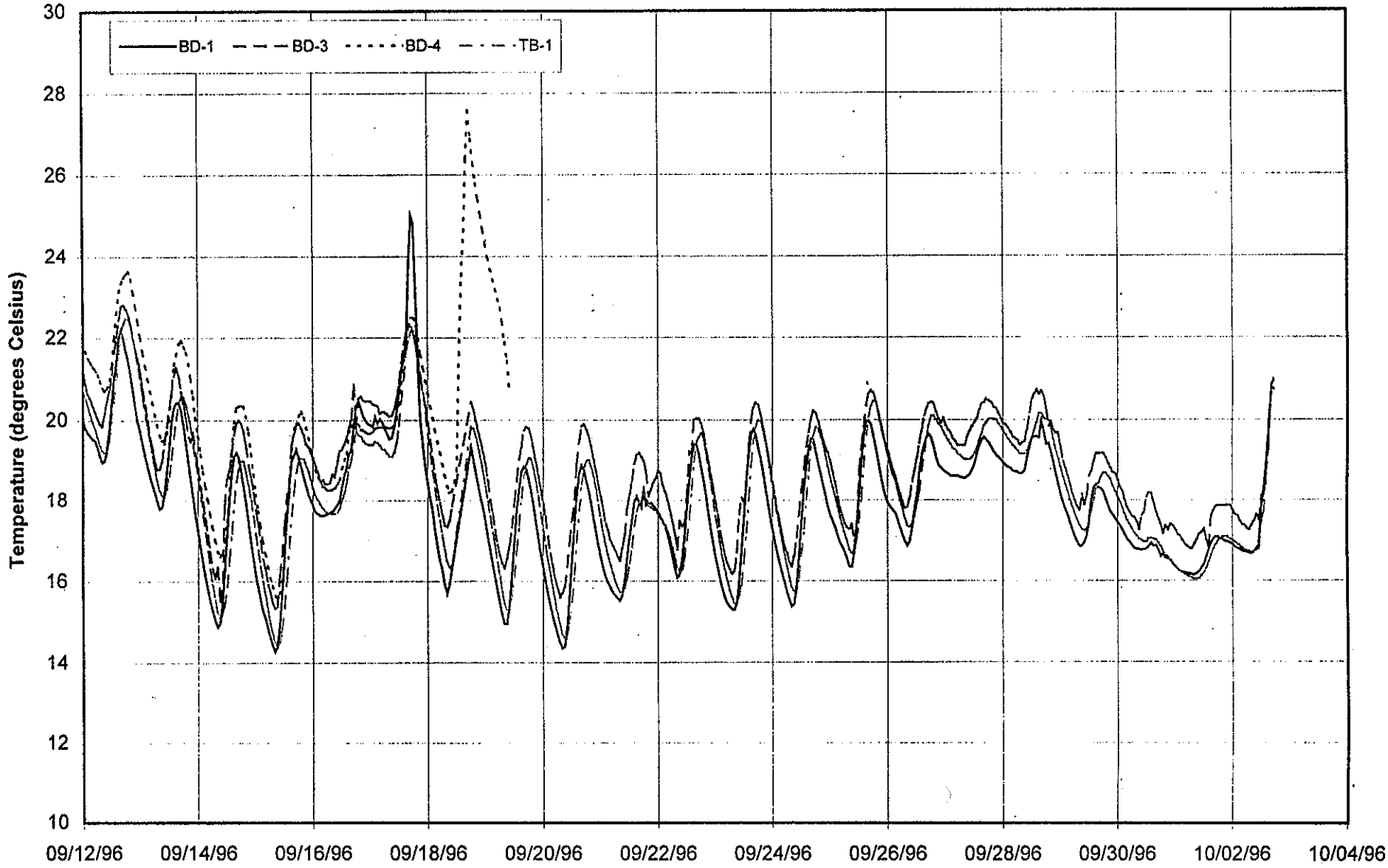


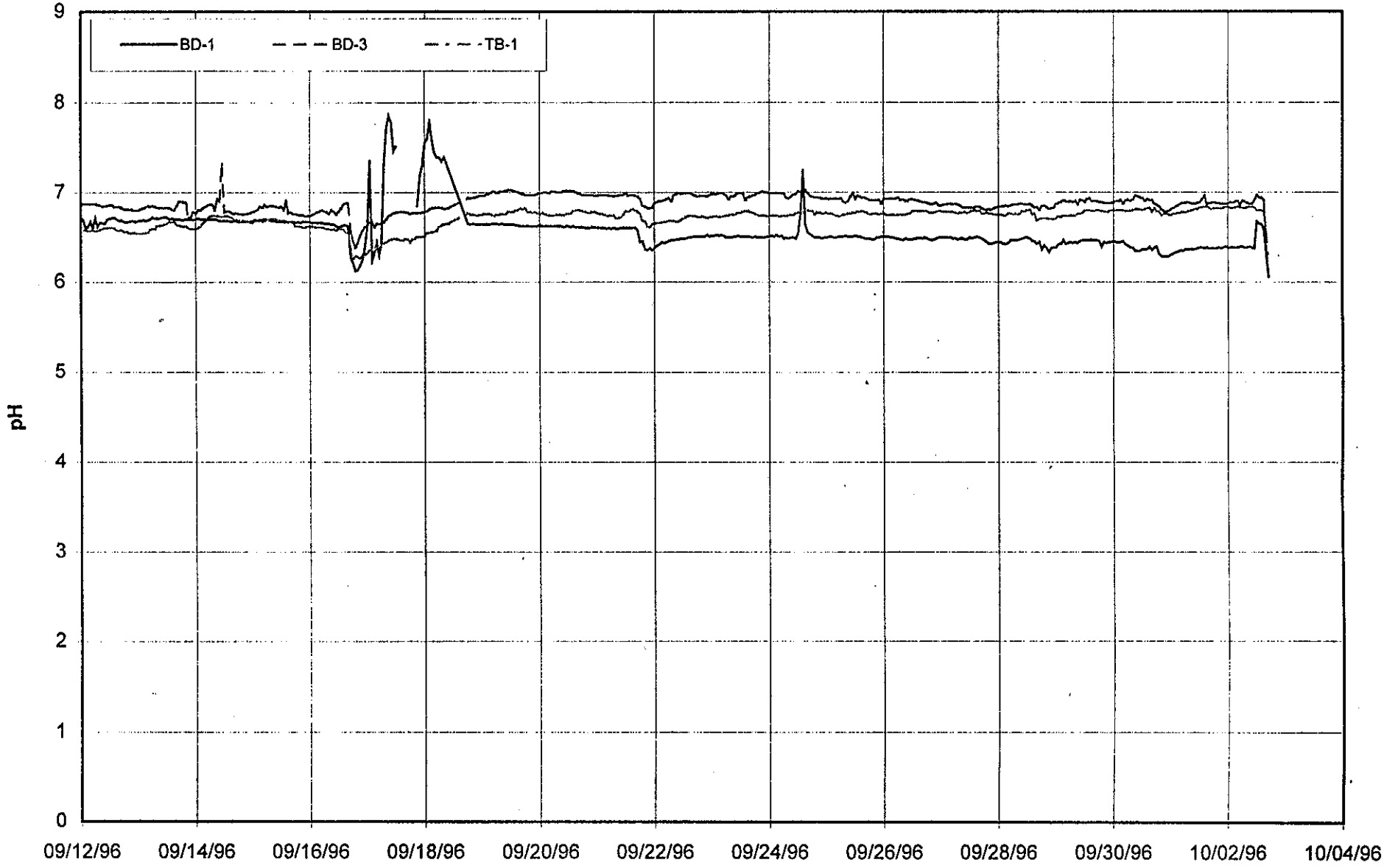
Figure 2:
Beaverdam Creek
Watershed Features Map

Georgia Environmental Protection Division
Atlanta, Georgia



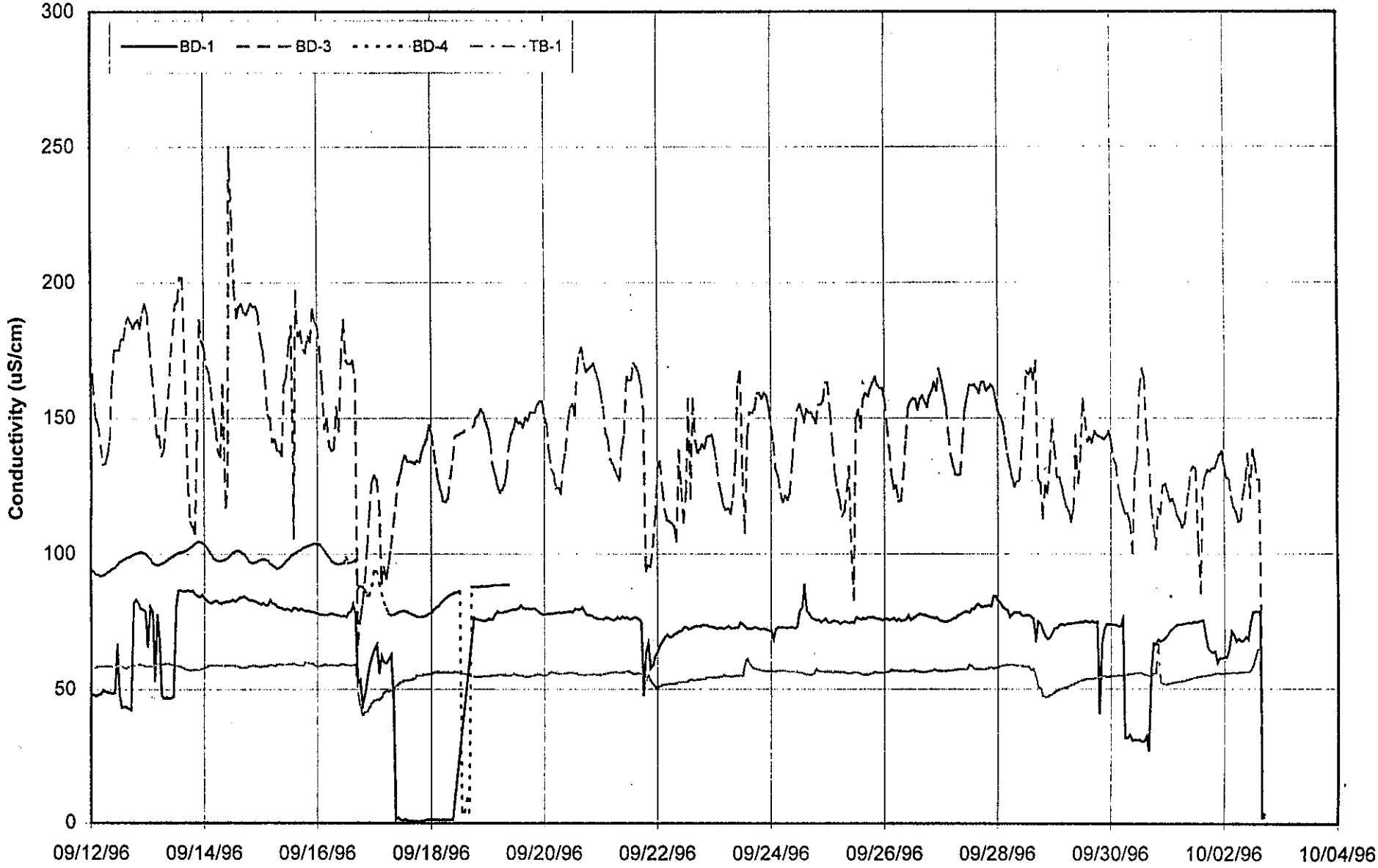
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 3:
Beaverdam Creek Water Temperature
Continuous Monitoring Data



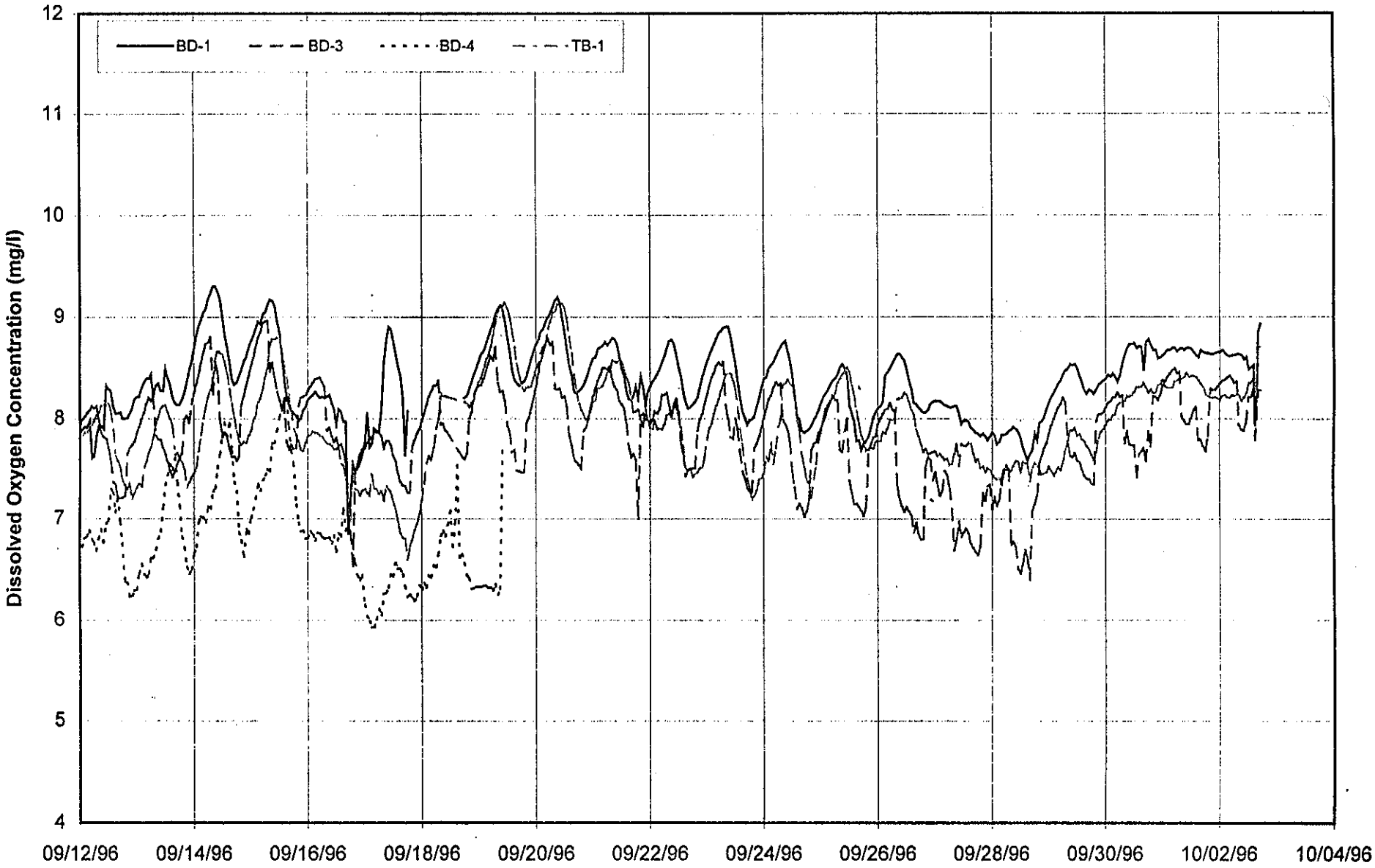
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 4:
Beaverdam Creek pH
Continuous Monitoring Data



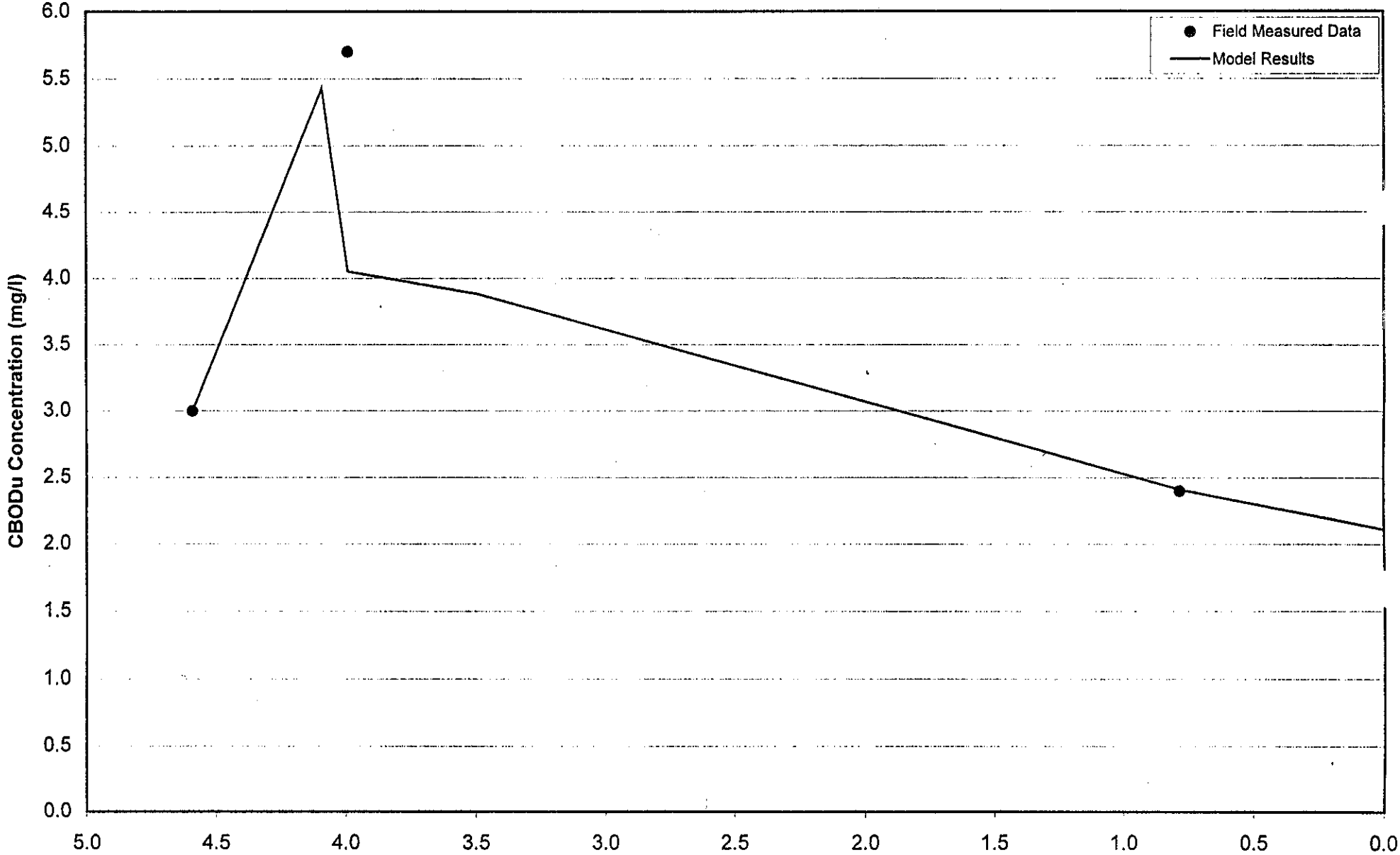
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 5:
Beaverdam Creek Conductivity
Continuous Monitoring Data



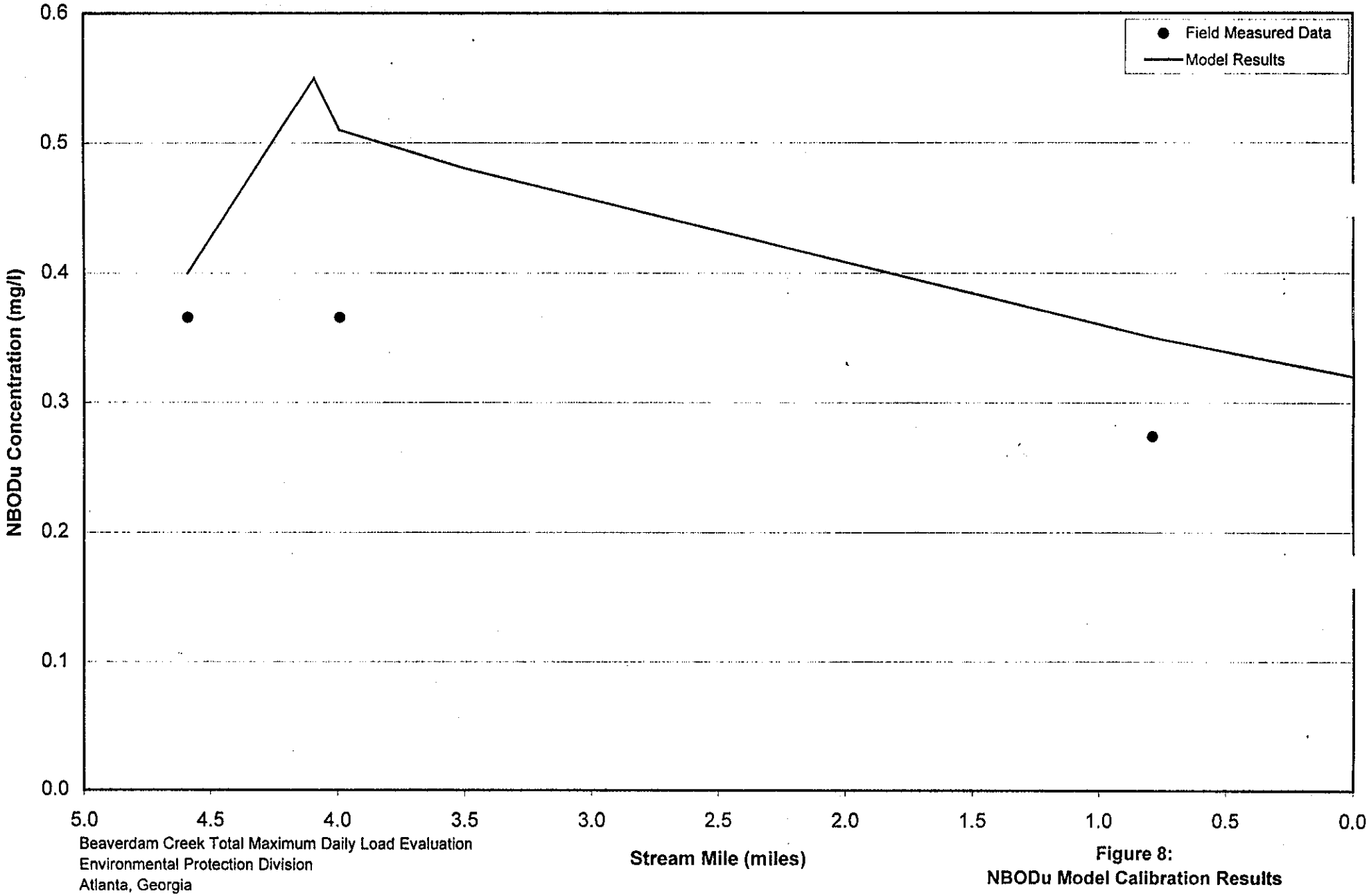
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 6:
Beaverdam Creek Dissolved Oxygen Continuous Monitoring Data



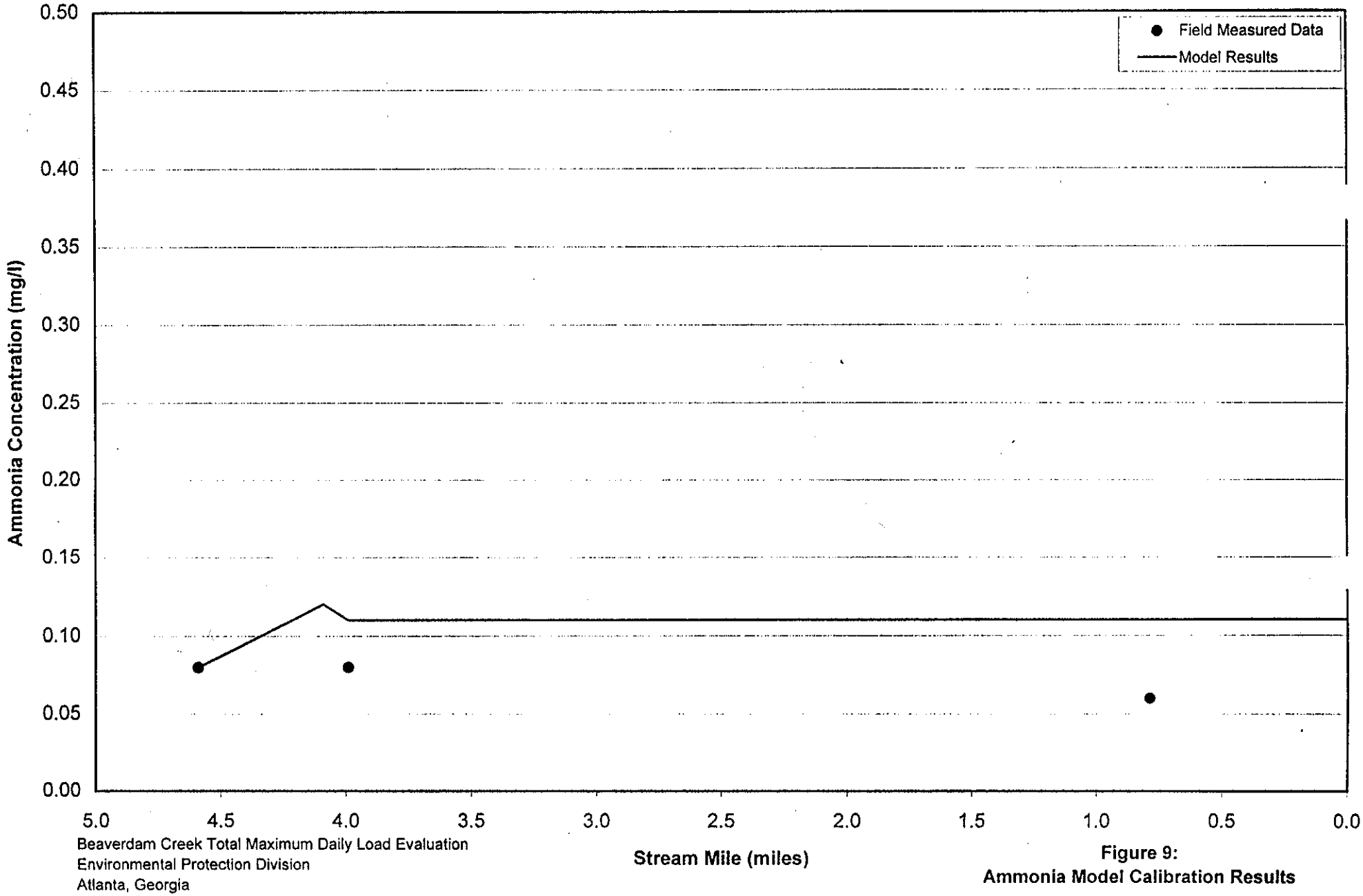
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 7:
CBODu Model Calibration Results



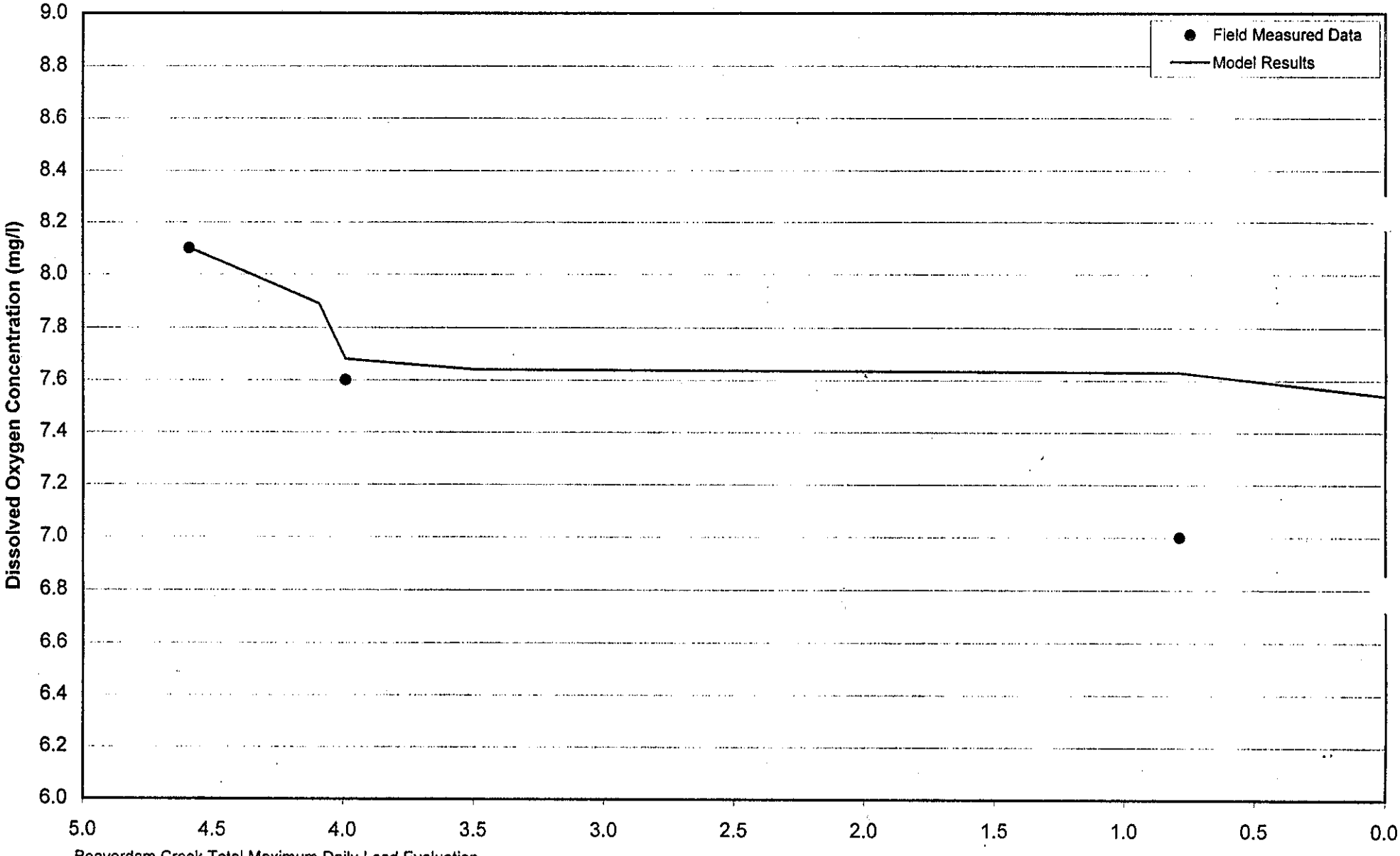
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 8:
NBODu Model Calibration Results



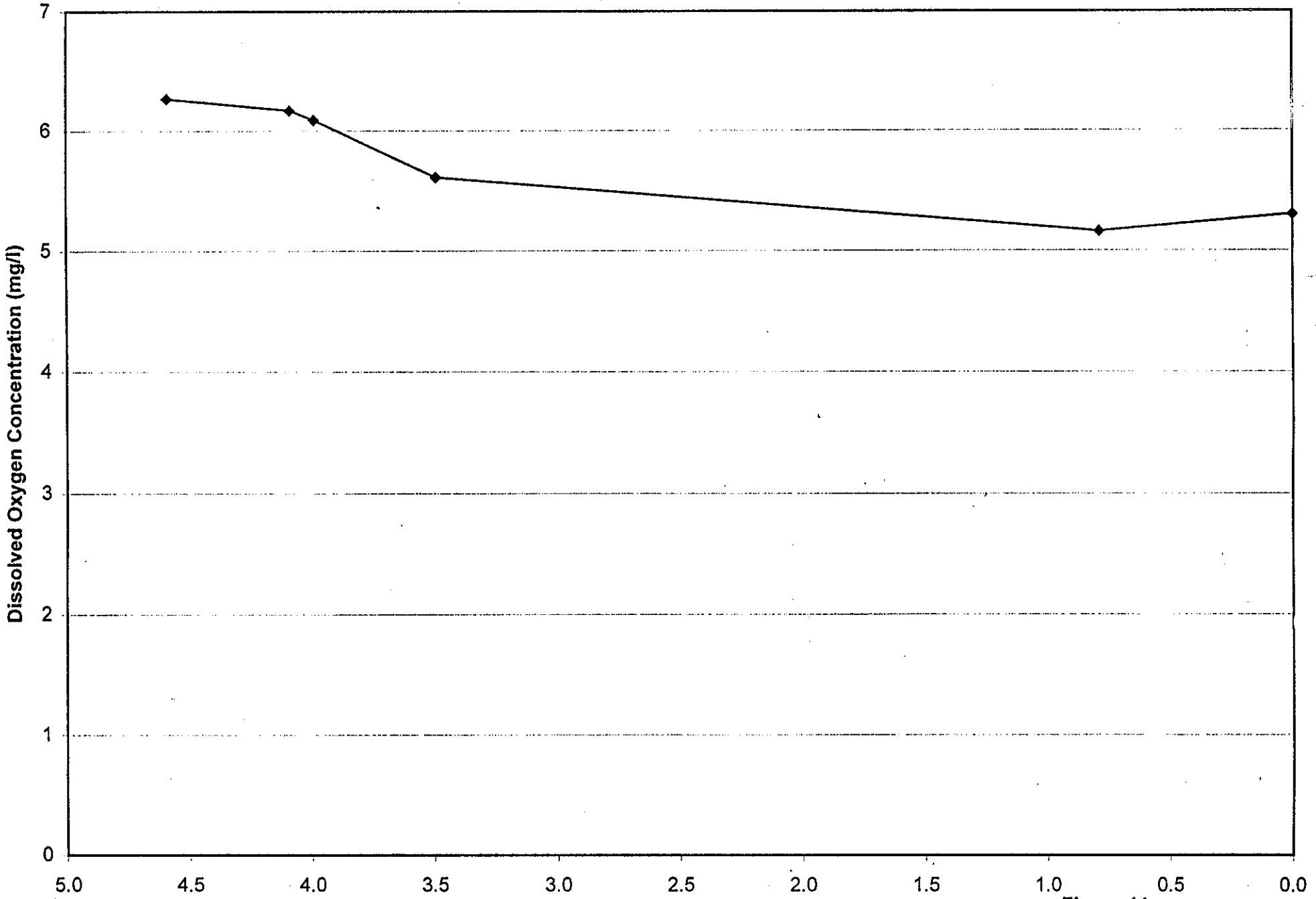
Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 9:
Ammonia Model Calibration Results



Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 10:
Dissolved Oxygen
Model Calibration Results



Beaverdam Creek Total Maximum Daily Load Evaluation
Environmental Protection Division
Atlanta, Georgia

Figure 11:
Critical Conditions Dissolved Oxygen Concentration Profile

APPENDIX A

Calibration Model

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * SYSTEM DATA AND SELECTED RUN PARAMETERS * * *

PROJ:	Beaverdam Cr./Commerce WT	Reaches	= 7	Ints =	0
Date:	03-15-1999.....	Branches	= 0	Wtfs =	1
File:	BDCCAL94.....	Sub-Branches	= 0	Dams =	0

SOD Variable: ON. Net P/R Variable: OFF.
Substance No. 1: ON --> TNH3 expressed in mg/l
Substance No. 2: OFF --> Sub#2 expressed in ---

Georgia Soil Type --> No. 4: Southern Piedmont
Soil Vel Eqn = 0.137*(Q^ 0.522)*(S^ 0.264)*(A^-0.333)*(L^ 0.348)

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * BRANCH OPTIONS AND SELECTED HEADWATER DATA * * *

********** BRANCH DESCRIPTIONS **********			<---- CALC OPTIONS ---->		
No.	Type	Name	Depth	Vel	Reaer
1	MAIN STEM	Beaverdam Creek.....	ON	v=c*Q^n	Tsivoglou

BRAN	***** HEADWATER GEOMETRY ****			<------ FLOW PARAMETERS ------->			
No.	Rch	RivMile	Elev	drAREA	Fixed	Opt	Prod	Used
1	1	4.59	708.5	3.300	2.80	INPUT	0.150	2.80

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * HEADWATERS DATA AND SELECTED BRANCH RESULTS * * *

BRAN No.	CBODu mg/l	NBODu mg/l	<------ DO PARAMETERS ------> Fixed	Opt	%Sat	DoSat	Used	TNH3 mg/l	Sub#2 ---
1	3.0	0.4	8.1	INPUT	75.0	9.13	8.10	0.1	0.000E+00

BRANCH No.	hwTEMP degC	********** Reach	END-OF-BRANCH RESULTS ********** RivMile	Elev	SumArea	SumFlow	SumTOT
1	18.5	EOM	0.00	635.5	11.680	7.74	1.403

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * REACH FLOW AND VELOCITY DATA * * *

03-17-1999 11:19 am

RCH #	<---- FLOW PARAMETERS ----> fixed	Prod	Opt	used	<--- VELOCITY PARAMETERS ---> fixed	coeff	exp	Opt	used
-(br 1)	MAIN STEM: Beaverdam Creek								
1	0.00	0.150	C	0.01	0.20	0.000	0.000	I	0.200
2	Dischg	--		--	--	--	--		--
3	0.00	0.150	C	0.00	0.20	0.000	0.000	I	0.200
4	3.00	0.000	I	3.00	--	----trib----			--
5	0.00	0.150	C	0.07	0.20	0.000	0.000	I	0.200
6	0.00	0.200	C	0.86	0.20	0.000	0.000	I	0.200
7	0.00	0.150	C	0.12	0.20	0.000	0.000	I	0.200
SF =	---	1.00		1.00	--	1.00	1.00		1.00

NOTE: 'used' - shows the Value actually 'used' in calculations.
'fixed' - identifies the Value fixed-by-user Input.
I or C - Value 'used' is INPUT (I), or CALCULATED (C).
S or Q - Velocity from Soil (S), or V=c*Q^n (Q) equation.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * RATES: BOD, TNH3, Sub#2 (Base e @ 20 Deg.C) * *

03-17-1999 11:19 am

RCH #	TEMP degC	Kr,CBOD /day	Kd,CBOD /day	Kd,NBOD /day	Kx,TNH3 /day	Kz,Sub#2 /day
-(br 1) MAIN STEM: Beaverdam Creek						
1	18.5	0.250	0.250	0.300	0.000	0.000
2	Dischg	--	--	--	--	--
3	19.7	0.250	0.250	0.300	0.000	0.000
4	-trib-	--	--	--	--	--
5	20.0	0.250	0.250	0.300	0.000	0.000
6	21.0	0.500	0.250	0.300	0.000	0.000
7	22.0	0.500	0.250	0.300	0.000	0.000
SF =	0.0	1.00	1.00	1.00	1.00	1.00
Current Variable Status -->					ON	OFF

TNH3 and Sub#2 are independent AND have no effect on DO.
CAUTION: Kd for CBOD should NEVER exceed Kr for CBOD.
NOTE: Nitrification Inhibition switch now turned OFF, thus Kd,NBOD rates are NOT inhibited in the Calculations.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * RATES: REAER, SOD, P/R (Base e @ 20 Deg.C) * * *

03-17-1999 11:19 am

RCH #	BOTTOM fract	SOD gsmd	nP/R mgld	<-------- REAERATION PARAMETERS ---------> fixed	ESC	dE/TOT	Depth	Opt	-used
-(br 1)	MAIN STEM:		Beaverdam Creek						
1	1.00	0.00	0.0	0.000	0.030	69.38	-on-	T	2.081
2	Dischg	--	-	--	--	--			---
3	1.00	0.00	0.0	0.000	0.030	49.09	-on-	T	1.473
4	-trib-	--	-	--	--	--			---
5	1.00	0.00	0.0	0.000	0.020	52.04	-on-	T	1.041
6	1.00	0.00	0.0	0.000	0.020	49.58	-on-	T	0.992
7	1.00	0.00	0.0	0.000	0.020	50.13	-on-	T	1.003
SF =	1.00	1.00	1.00	---	1.00	--			1.00
STATUS -->		ON	OFF						

NOTE: 'used' - shows the Value actually 'used' in calculations.
'fixed' - identifies the K2 value fixed-by-user Input.
I - means K2 'used' is INPUT (I), fixed by user.
T or O - K2 is CALCULATED, Tsivoglou (T) or O'Connor (O).
*T - O'Connor selected, DEPTH disabled, Tsivoglou used.

Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * REACH WATER QUALITY INPUT DATA * * *

03-17-1999 11:19 am

RCH #	TEMP degC	CBODu mg/l	NBODu mg/l	<---- DO PARAMS ----> fixed	%Sat	Opt	*pH -used		TNH3 mg/l	Sub#2 ---
-(br 1) MAIN STEM: Beaverdam Creek										
1	18.5	3.0	0.2	0.00	75.0	C	6.85	7.0	0.10	0.000E+00
2	Dischg	--	--	--	--		--	-	--	---
3	19.7	3.0	0.2	0.00	75.0	C	6.69	7.0	0.10	0.000E+00
4	19.5	2.4	0.5	7.70	0.0	I	7.70	trib	0.10	0.000E+00
5	20.0	2.4	0.2	0.00	75.0	C	6.65	7.0	0.10	0.000E+00
6	21.0	2.4	0.2	0.00	75.0	C	6.53	7.0	0.10	0.000E+00
7	22.0	2.4	0.2	0.00	75.0	C	6.41	7.0	0.10	0.000E+00
SF = 0.0		1.00	1.00	--	1.00		1.00	1.00	1.00	1.00
Current Variable Status -->									ON	OFF

TNH3 and Sub#2 are independent AND have no effect on DO.
*pH is SET-by-user, ONLY used for Ammonia Toxicity calculations.
DO Saturation is based on the STANDARD METHODS equation.
Elevation Correction for DO Saturation has been turned ON.
NOTE: 'used' - shows the Value actually 'used' in calculations.
'fixed' - identifies the DO value fixed-by-user Input.
I or C - reach DO 'used' is INPUT (I), or CALCULATED (C).
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * WATER INTAKE, WASTE DISCHARGE SUMMARY * * *

03-17-1999 11:19 am

RCH #	STREAM Mile	FLOW MGD	CBODu mg/l	NBODu mg/l	DO mg/l	TNH3 mg/l	Sub#2 ---
-(br 1) MAIN STEM: Beaverdam Creek							
2	Dischg Name: Commerce Northside WPCP						
	4.09	0.57	13.50	1.1	6.7	0.25	0.000E+00

NOTE: Discharge DO less than zero will become IOD (mg/l).
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * FIELD CALIBRATION DATA * * *

03-17-1999 11:19 am

RCH #	RIVER Mile	CBODu mg/l	NBODu mg/l	DoDEF mg/l	DO mg/l	TNH3 mg/l	Sub#2 ---
-(br 1)	MAIN STEM:	Beaverdam Creek					
1	4.59	1.50	0.36	-1.00x	8.10	0.08	-1.000E+00x
4	3.99	2.85	0.36	-1.00x	7.60	0.08	-1.000E+00x
7	0.79	1.20	0.27	-1.00x	7.00	0.06	-1.000E+00x

Current Variable Status --> ON OFF
NOTE: Field Data MUST represent 'Head-of-Reach' RiverMiles.
(-1.00x) means 'No Field Data' for that location.
Calibration File Name: CAL94
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * CALCULATED REACH RESULTS * * *

03-17-1999 11:19 am

RCH #	TYPE	CBODu mg/l	NBODu mg/l	DO mg/l	***DO MIN**** mg/l	RM	TNH3 mg/l	Sub#2 ---
-(br 1) MAIN STEM: Beaverdam Creek								
1	stream	3.0	0.4	8.10	8.10	4.59	0.08	0.000E+00
2	Dischg	2.9	0.4	8.27	7.89	4.09	0.08	0.000E+00
3	stream	5.4	0.6	7.89	7.68	4.09	0.12	0.000E+00
4	-trib-	5.4	0.5	7.69	7.68	3.99	0.12	0.000E+00
5	stream	4.0	0.5	7.68	7.61	3.99	0.11	0.000E+00
6	stream	3.9	0.5	7.64	7.37	3.49	0.11	0.000E+00
7	stream	2.4	0.3	7.63	7.45	0.79	0.11	0.000E+00
eBr	----	2.1	0.3	7.54	--	--	0.11	0.000E+00

Current Variable Status --> ON OFF
TNH3 and Sub#2 are independent AND have no effect on DO.
All Results (except DO Min) represent the 'Head-of-Reach'.
DO Saturation is based on the STANDARD METHODS equation.
Elevation Correction for DO Saturation has been turned ON.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * MODEL REACH STRUCTURE * * *

03-17-1999 11:19 am

RCH #	RIVER Mile	ELEV ft	REACH Type	REACH DESCRIPTION
-(br 1)	MAIN STEM:		Beaverdam Creek	
1	4.59	708.5	stream	W.E. King Rd. to Commerce WPCP.....
2	4.09	698.0	Dischg	Commerce Northside WPCP.....
3	4.09	698.0	stream	WPCP to Unnamed Tributary.....
4	3.99	696.5	-trib-	Unnamed Tributary.....
5	3.99	696.5	stream	Unnamed Tributary to Banks Co. Line
6	3.49	688.5	stream	Banks County Line to Highway 227...
7	0.79	647.6	stream	Highway 227 to Grove Creek.....
DS =	0.00	635.5	----	DISCHARGES 1; INTAKES 0; DAMS 0

RiverMiles and Elevations represent 'Head-of-Reach' Values.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * STREAM DEPTH & REACH PHYSICAL DATA * * *

03-17-1999 11:19 am

RCH #	LENGTH mi	dELEV ft	SLOPE ft/mi	drAREA mi2	<----- DEPTH PARAMETERS -----> fixed	coeff	exp	Opt	-used
-(br 1) MAIN STEM: Beaverdam Creek									
1	0.500	10.60	21.200	0.060	0.3	0.000	0.000	I	0.3
2	Dischg	--	--	--	-	--	--		-
3	0.100	1.50	15.000	0.020	0.3	0.000	0.000	I	0.3
4	-trib-	--	--	2.760	-	--	--		-
5	0.500	7.95	15.900	0.490	1.2	0.000	0.000	I	1.2
6	2.700	40.90	15.148	4.280	1.2	0.000	0.000	I	1.2
7	0.790	12.10	15.316	0.770	1.2	0.000	0.000	I	1.2
SF =	--	1.00	1.00	1.00	--	---	---		1.00

(*) means Depth variable has been turned OFF for THAT Branch.
NOTE: 'used' - shows the Depth value 'used' in calculations.
'fixed' - identifies the Depth value fixed-by-user Input.
I or C - Depth 'used' is INPUT (I), or CALCULATED (C).
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * PROCESSED REACH DATA * * *

03-17-1999 11:19 am

RCH #	RIVER Mile	WIDTH ft	CUM Flow	VEL fps	TOT days	K2@T /day	TEMP degC	rDO mg/l
-(br 1) MAIN STEM: Beaverdam Creek								
1	4.59	46.7	2.80	0.20	0.153	2.009	18.5	6.85
2	Dischg	-	2.81	--	--	--	--	--
3	4.09	61.5	3.69	0.20	0.031	1.462	19.7	6.69
4	-trib-	-	3.69	--	--	--	19.5	7.70
5	3.99	28.0	6.69	0.20	0.153	1.041	20.0	6.65
6	3.49	30.0	6.77	0.20	0.825	1.015	21.0	6.53
7	0.79	32.0	7.62	0.20	0.241	1.051	22.0	6.41
eBr	0.00	-	7.74	--	1.403	--	--	--
SF =	--	---	--	1.00	---	1.00	0.0	1.00

(?) - means Width cannot be calculated (Depth turned OFF).
Cumulative FLOW represents the inflow to 'Head-of-Reach'.
rDO is the DO concentration of Reach Incremental Flows.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * RATES: BOD, TNH3, Sub#2 (Base e @ T Deg.C) * * *
03-17-1999 11:19 am

RCH #	TEMP degC	Kr,CBOD /day	Kd,CBOD /day	INHIB Factor	Kd,NBOD /day	K,TNH3 /day	K,Sub#2 /day
-(br 1) MAIN STEM: Beaverdam Creek							
1	18.5	0.233	0.233	1.000	0.267	0.000	0.000
2	Dischg	--	--	--	--	--	--
3	19.7	0.247	0.247	1.000	0.293	0.000	0.000
4	-trib-	--	--	--	--	--	--
5	20.0	0.250	0.250	1.000	0.300	0.000	0.000
6	21.0	0.524	0.262	1.000	0.324	0.000	0.000
7	22.0	0.548	0.274	1.000	0.350	0.000	0.000
SF =	0.0	1.00	1.00	---	1.00	1.00	1.00
Current Variable Status -->						ON	OFF

TNH3 and Sub#2 are independent AND have no effect on DO.
CAUTION: Kd for CBOD should NEVER exceed Kr for CBOD.
NOTE: Nitrification Inhibition switch now turned OFF, thus Kd,NBOD rates are NOT inhibited in the Calculations.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * RATES: REAER, SOD, P/R (Base e @ T Deg.C) * * *
03-17-1999 11:19 am

RCH #	TEMP degC	nP/R mgld	BOTTOM fract	SOD gsmd	DEPTH m	rSOD mg/l	K2,REAERATION Opt	/day
-(br 1) MAIN STEM: Beaverdam Creek								
1	18.5	0.00	1.00	0.00	0.09	0.00	T	2.009
2	Dischg	--	--	--	--	--		--
3	19.7	0.00	1.00	0.00	0.09	0.00	T	1.462
4	-trib-	--	--	--	--	--		--
5	20.0	0.00	1.00	0.00	0.37	0.00	T	1.041
6	21.0	0.00	1.00	0.00	0.37	0.00	T	1.015
7	22.0	0.00	1.00	0.00	0.37	0.00	T	1.051
SF =	0.0	1.00	1.00	1.00	---	---		1.00
STATUS -->		OFF		ON		ON		

rSOD = 'Reach SOD', the value actually used in DOsag calcs.
NOTE: I - means Reaeration is INPUT (I), fixed-by-user.
T or O - K2 is CALCULATED, Tsivoglou (T) or O'Connor (O).
*T - O'Connor chosen, Depth disabled, Tsivoglou used.
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * BOD CALIBRATION SUMMARY * * *

03-17-1999 11:19 am

RCH #	RIVER Mile	<---- CBODu, mg/l ----> Calc.	Field =	Diff	<---- NBODu, mg/l ----> Calc.	Field =	Diff
-(br 1) MAIN STEM: Beaverdam Creek							
1	4.6	3.00	1.50	1.50	0.40	0.36	0.04
2	Dischg	2.89	--	--	0.38	--	--
3	4.1	5.43	--	--	0.55	--	--
4	-trib-	5.39	2.85	2.54	0.55	0.36	0.19
5	4.0	4.05	--	--	0.51	--	--
6	3.5	3.88	--	--	0.48	--	--
7	0.8	2.41	1.20	1.21	0.35	0.27	0.08
eBr	0.0	2.11	--	--	0.32	--	--

NOTE: RiverMiles are 'Head-of-Reach' values, thus 'Field' data MUST correspond to Head-of-Reach RiverMiles.
Calibration File Name: CAL94
Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * TNH3, Sub#2 CALIBRATION SUMMARY * * *

03-17-1999 11:19 am

RCH #	RIVER Mile	<---TNH3 , mg/l --> Calc	- Field	= Diff	<-------- Sub#2, --- Calc.	- Field	= Diff
-(br 1)	MAIN STEM:	Beaverdam Creek					
1	4.6	0.08	0.08	0.00	0.000E+00	--	--
2	Dischg	0.08	--	--	0.000E+00	--	--
3	4.1	0.12	--	--	0.000E+00	--	--
4	-trib-	0.12	0.08	0.04	0.000E+00	--	--
5	4.0	0.11	--	--	0.000E+00	--	--
6	3.5	0.11	--	--	0.000E+00	--	--
7	0.8	0.11	0.06	0.05	0.000E+00	--	--
eBr	0.0	0.11	--	--	0.000E+00	--	--

Status --> ON OFF

NOTE: RiverMiles are 'Head-of-Reach' values, thus 'Field' data MUST correspond to Head-of-Reach RiverMiles.

Calibration File Name: CAL94

Model File Name: BDCCAL94

1994 Calibration Model (Paul Lamarre 3/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * DO RESULTS & CALIBRATION SUMMARY * * *

03-17-1999 11:20 am

RCH #	RIVER Mile	DoSat River	%SAT River	DoSTD mg/l	<--- DO, mg/l ----> Calc	Field	Diff	DoDEF mg/l
-(br 1)	MAIN STEM:	Beaverdam Creek						
1	4.6	9.13	88.7	5.00	8.10	8.10	0.00	1.03
2	Dischg	9.14	90.5	5.00	8.27	--	--	0.87
3	4.1	9.14	86.4	5.00	7.89	--	--	1.24
4	-trib-	8.92	86.2	5.00	7.69	7.60	0.09	1.23
5	4.0	8.92	86.1	5.00	7.68	--	--	1.24
6	3.5	8.87	86.1	5.00	7.64	--	--	1.23
7	0.8	8.70	87.6	5.00	7.63	7.00	0.63	1.08
eBr	0.0	8.54	88.3	--	7.54	--	--	1.00

NOTE: RiverMiles are 'Head-of-Reach' values, thus 'Field' data MUST correspond to Head-of-Reach RiverMiles.
DO Saturation is based on the STANDARD METHODS equation.
Elevation Correction for DO Saturation has been turned ON.
The DO Standard is a FIXED Minimum value.
Calibration File Name: CAL94
Model File Name: BDCCAL94

APPENDIX B

Critical Conditions Model

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * SYSTEM DATA AND SELECTED RUN PARAMETERS * * *

==========

PROJ:	Beaverdam Cr./Commerce WT	Reaches	= 7	Ints =	0
Date:	05-05-1999.....	Branches	= 0	Wtfs =	1
File:	BDCCRIT.....	Sub-Branches	= 0	Dams =	0

SOD Variable: ON. Net P/R Variable: OFF.
Substance No. 1: ON --> TNH3 expressed in mg/l
Substance No. 2: OFF --> Sub#2 expressed in ---

Georgia Soil Type --> No. 4: Southern Piedmont
Soil Vel Eqn = 0.137*(Q^ 0.522)*(S^ 0.264)*(A^-0.333)*(L^ 0.348)

==========

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * BRANCH OPTIONS AND SELECTED HEADWATER DATA * * *

********** BRANCH DESCRIPTIONS **********			<---- CALC OPTIONS ---->		
No.	Type	Name	Depth	Vel	Reaer
1	MAIN STEM	Beaverdam Creek.....	OFF	v=c*Q^n	Tsivoglou

BRAN ***** HEADWATER GEOMETRY ****				<------ FLOW PARAMETERS ------->			
No.	Rch	RivMile	Elev	drAREA	Fixed	Opt	Prod	Used
1	1	4.59	708.5	3.300	0.00	CALC	0.140	0.46

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * HEADWATERS DATA AND SELECTED BRANCH RESULTS * * *

BRAN No.	CBODu mg/l	NBODu mg/l	<------ DO PARAMETERS -------> Fixed	Opt	%Sat	DoSat	Used	TNH3 mg/l	Sub#2 ---
1	3.0	0.4	0.0	CALC	75.0	8.36	6.27	0.1	0.000E+00

BRANCH No.	hwTEMP degC	********** Reach	END-OF-BRANCH RESULTS ********** RivMile	Elev	SumArea	SumFlow	SumTOT
1	23.0	EOM	0.00	635.5	11.680	3.26	1.403

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * MODEL REACH STRUCTURE * * *

05-05-1999 10:08 am

RCH #	RIVER Mile	ELEV ft	REACH Type	REACH DESCRIPTION
-(br 1)	MAIN STEM:	Beaverdam Creek		
1	4.59	708.5	stream	W.E. King Rd. to Commerce WPCP.....
2	4.09	698.0	Dischg	Commerce Northside WPCP.....
3	4.09	698.0	stream	WPCP to Unnamed Tributary.....
4	3.99	696.5	-trib-	Unnamed Tributary.....
5	3.99	696.5	stream	Unnamed Tributary to Banks Co. Line
6	3.49	688.5	stream	Banks County Line to Highway 227...
7	0.79	647.6	stream	Highway 227 to Grove Creek.....
DS =	0.00	635.5	----	DISCHARGES 1; INTAKES 0; DAMS 0

RiverMiles and Elevations represent 'Head-of-Reach' Values.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * STREAM DEPTH & REACH PHYSICAL DATA * * *

05-05-1999 10:08 am

RCH #	LENGTH mi	dELEV ft	SLOPE ft/mi	drAREA mi2	<----- DEPTH PARAMETERS fixed	coeff	exp	Opt	-----> -used
-(br 1) MAIN STEM: Beaverdam Creek									
1	0.500	10.60	21.200	0.060	0.0	0.000	0.000	I	0.0*
2	Dischg	--	--	--	-	--	--		-
3	0.100	1.50	15.000	0.020	0.0	0.000	0.000	I	0.0*
4	-trib-	--	--	2.760	-	--	--		-
5	0.500	7.95	15.900	0.490	0.0	0.000	0.000	I	0.0*
6	2.700	40.90	15.148	4.280	0.0	0.000	0.000	I	0.0*
7	0.790	12.10	15.316	0.770	0.0	0.000	0.000	I	0.0*
SF =	--	1.00	1.00	1.00	--	---	---		1.00

(*) means Depth variable has been turned OFF for THAT Branch.
NOTE: 'used' - shows the Depth value 'used' in calculations.
'fixed' - identifies the Depth value fixed-by-user Input.
I or C - Depth 'used' is INPUT (I), or CALCULATED (C).
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * REACH FLOW AND VELOCITY DATA * * *

05-05-1999 10:08 am

RCH #	<---- FLOW PARAMETERS ----> fixed	Prod	Opt	used	<--- VELOCITY PARAMETERS ---> fixed	coeff	exp	Opt	used
-(br 1)	MAIN STEM: Beaverdam Creek								
1	0.00	0.140	C	0.01	0.20	1.627	0.300	I	0.200
2	Dischg	--		--	--	--	--		--
3	0.00	0.140	C	0.00	0.20	1.627	0.300	I	0.200
4	0.00	0.140	C	0.39	--	----trib----			--
5	0.00	0.140	C	0.07	0.20	0.000	7.810	I	0.200
6	0.00	0.140	C	0.60	0.20	0.000	7.810	I	0.200
7	0.00	0.140	C	0.11	0.20	0.000	7.810	I	0.200
SF =	---	1.00		1.00	--	1.00	1.00		1.00

NOTE: 'used' - shows the Value actually 'used' in calculations.
'fixed' - identifies the Value fixed-by-user Input.
I or C - Value 'used' is INPUT (I), or CALCULATED (C).
S or Q - Velocity from Soil (S), or V=c*Q^n (Q) equation.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * RATES: BOD, TNH3, Sub#2 (Base e @ 20 Deg.C) * *
05-05-1999 10:08 am

RCH #	TEMP degC	Kr,CBOD /day	Kd,CBOD /day	Kd,NBOD /day	Kx,TNH3 /day	Kz,Sub#2 /day
-(br 1) MAIN STEM: Beaverdam Creek						
1	23.0	0.250	0.250	0.300	0.000	0.000
2	Dischg	--	--	--	--	--
3	23.0	0.250	0.250	0.300	0.000	0.000
4	-trib-	--	--	--	--	--
5	23.0	0.250	0.250	0.300	0.000	0.000
6	23.0	0.500	0.250	0.300	0.000	0.000
7	23.0	0.500	0.250	0.300	0.000	0.000
SF =	0.0	1.00	1.00	1.00	1.00	1.00
Current Variable Status -->					ON	OFF

TNH3 and Sub#2 are independent AND have no effect on DO.
CAUTION: Kd for CBOD should NEVER exceed Kr for CBOD.
NOTE: Nitrification Inhibition switch now turned OFF, thus Kd,NBOD rates are NOT inhibited in the Calculations.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * RATES: REAER, SOD, P/R (Base e @ 20 Deg.C) * * *

05-05-1999 10:08 am

RCH #	BOTTOM fract	SOD gsmd	nP/R mgld	REAERATION PARAMETERS fixed	ESC	dE/TOT	Depth	Opt	-used
-(br 1)	MAIN STEM:		Beaverdam Creek						
1	1.00	0.00	0.0	0.000	0.030	69.38	-off	T	2.081
2	Dischg	--	-	--	--	--			---
3	1.00	0.00	0.0	0.000	0.030	49.09	-off	T	1.473
4	-trib-	--	-	--	--	--			---
5	1.00	0.00	0.0	0.000	0.020	52.04	-off	T	1.041
6	1.00	0.00	0.0	0.000	0.020	49.58	-off	T	0.992
7	1.00	0.00	0.0	0.000	0.020	50.13	-off	T	1.003
SF =	1.00	1.00	1.00	---	1.00	--			1.00
STATUS -->		ON	OFF						

NOTE: 'used' - shows the Value actually 'used' in calculations.
'fixed' - identifies the K2 value fixed-by-user Input.
I - means K2 'used' is INPUT (I), fixed by user.
T or O - K2 is CALCULATED, Tsivoglou (T) or O'Connor (O).
*T - O'Connor selected, DEPTH disabled, Tsivoglou used.

Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * REACH WATER QUALITY INPUT DATA * * *

05-05-1999 10:08 am

RCH #	TEMP degC	CBODu mg/l	NBODu mg/l	<---- DO PARAMS ----> fixed	%Sat	Opt	*pH -used		TNH3 mg/l	Sub#2 ---
-(br 1) MAIN STEM: Beaverdam Creek										
1	23.0	3.0	0.4	0.00	75.0	C	6.27	7.0	0.10	0.000E+00
2	Dischg	--	--	--	--		--	-	--	---
3	23.0	3.0	0.4	0.00	75.0	C	6.27	7.0	0.10	0.000E+00
4	23.0	2.4	0.5	0.00	75.0	C	6.27	trib	0.10	0.000E+00
5	23.0	2.4	0.4	0.00	75.0	C	6.27	7.0	0.10	0.000E+00
6	23.0	2.4	0.4	0.00	75.0	C	6.28	7.0	0.10	0.000E+00
7	23.0	2.4	0.4	0.00	75.0	C	6.29	7.0	0.10	0.000E+00
SF = 0.0		1.00	1.00	--	1.00		1.00	1.00	1.00	1.00
Current Variable Status -->									ON	OFF

TNH3 and Sub#2 are independent AND have no effect on DO.
*pH is SET-by-user, ONLY used for Ammonia Toxicity calculations.
DO Saturation is based on the STANDARD METHODS equation.
Elevation Correction for DO Saturation has been turned ON.
NOTE: 'used' - shows the Value actually 'used' in calculations.
'fixed' - identifies the DO value fixed-by-user Input.
I or C - reach DO 'used' is INPUT (I), or CALCULATED (C).
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * WATER INTAKE, WASTE DISCHARGE SUMMARY * * *

05-05-1999 10:09 am

RCH #	STREAM Mile	FLOW MGD	CBODu mg/l	NBODu mg/l	DO mg/l	TNH3 mg/l	Sub#2 ---
-(br 1) MAIN STEM: Beaverdam Creek							
2	Dischg Name: Commerce Northside WPCP						
	4.09	1.05	20.00	9.1	6.0	2.00	0.000E+00

NOTE: Discharge DO less than zero will become IOD (mg/l).
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * CALCULATED REACH RESULTS * * *

05-05-1999 10:09 am

RCH #	TYPE	CBODu mg/l	NBODu mg/l	DO mg/l	***DO MIN**** mg/l	RM	TNH3 mg/l	Sub#2 ---
-(br 1)	MAIN STEM:	Beaverdam Creek						
1	stream	3.0	0.4	6.27	6.27	4.59	0.08	0.000E+00
2	Dischg	2.9	0.4	6.75	6.17	4.09	0.08	0.000E+00
3	stream	16.2	7.2	6.17	6.05	3.99	1.57	0.000E+00
4	-trib-	16.0	7.1	6.05	6.05	3.99	1.57	0.000E+00
5	stream	13.9	6.1	6.09	5.61	3.49	1.34	0.000E+00
6	stream	13.0	5.6	5.61	5.14	1.21	1.31	0.000E+00
7	stream	6.8	3.4	5.15	5.15	0.79	1.08	0.000E+00
eBr	----	5.8	3.0	5.30	--	--	1.04	0.000E+00

Current Variable Status --> ON OFF
TNH3 and Sub#2 are independent AND have no effect on DO.
All Results (except DO Min) represent the 'Head-of-Reach'.
DO Saturation is based on the STANDARD METHODS equation.
Elevation Correction for DO Saturation has been turned ON.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * PROCESSED REACH DATA * * *

05-05-1999 10:09 am

RCH #	RIVER Mile	WIDTH ft	CUM Flow	VEL fps	TOT days	K2@T /day	TEMP degC	rDO mg/l
-(br 1) MAIN STEM: Beaverdam Creek								
1	4.59	(?)	0.46	0.20	0.153	2.235	23.0	6.27
2	Dischg	-	0.47	--	--	--	--	--
3	4.09	(?)	2.10	0.20	0.031	1.581	23.0	6.27
4	-trib-	-	2.10	--	--	--	23.0	6.27
5	3.99	(?)	2.48	0.20	0.153	1.117	23.0	6.27
6	3.49	(?)	2.55	0.20	0.825	1.065	23.0	6.28
7	0.79	(?)	3.15	0.20	0.241	1.076	23.0	6.29
eBr	0.00	-	3.26	--	1.403	--	--	--
SF =	--	---	--	1.00	---	1.00	0.0	1.00

(?) - means Width cannot be calculated (Depth turned OFF).
Cumulative FLOW represents the inflow to 'Head-of-Reach'.
rDO is the DO concentration of Reach Incremental Flows.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * RATES: BOD, TNH3, Sub#2 (Base e @ T Deg.C) * * *

05-05-1999 10:09 am

RCH #	TEMP degC	Kr,CBOD /day	Kd,CBOD /day	INHIB Factor	Kd,NBOD /day	K,TNH3 /day	K,Sub#2 /day
-(br 1) MAIN STEM: Beaverdam Creek							
1	23.0	0.287	0.287	1.000	0.378	0.000	0.000
2	Dischg	--	--	--	--	--	--
3	23.0	0.287	0.287	1.000	0.378	0.000	0.000
4	-trib-	--	--	--	--	--	--
5	23.0	0.287	0.287	1.000	0.378	0.000	0.000
6	23.0	0.574	0.287	1.000	0.378	0.000	0.000
7	23.0	0.574	0.287	1.000	0.378	0.000	0.000
SF =	0.0	1.00	1.00	---	1.00	1.00	1.00
Current Variable Status -->						ON	OFF

TNH3 and Sub#2 are independent AND have no effect on DO.
CAUTION: Kd for CBOD should NEVER exceed Kr for CBOD.
NOTE: Nitrification Inhibition switch now turned OFF, thus Kd,NBOD rates are NOT inhibited in the Calculations.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * RATES: REAER, SOD, P/R (Base e @ T Deg.C) * * *

05-05-1999 10:09 am

RCH #	TEMP degC	nP/R mgld	BOTTOM fract	SOD gsmd	DEPTH m	rSOD mg/l	K2,REAERATION Opt	/day
-(br 1) MAIN STEM: Beaverdam Creek								
1	23.0	0.00	1.00	0.00	-off	-off	T	2.235
2	Dischg	--	--	--	--	--		--
3	23.0	0.00	1.00	0.00	-off	-off	T	1.581
4	-trib-	--	--	--	--	--		--
5	23.0	0.00	1.00	0.00	-off	-off	T	1.117
6	23.0	0.00	1.00	0.00	-off	-off	T	1.065
7	23.0	0.00	1.00	0.00	-off	-off	T	1.076
SF =	0.0	1.00	1.00	1.00	---	---		1.00
STATUS -->		OFF		ON		ON		

rSOD = 'Reach SOD', the value actually used in DOsag calcs.
NOTE: I - means Reaeration is INPUT (I), fixed-by-user.
T or O - K2 is CALCULATED, Tsivoglou (T) or O'Connor (O).
*T - O'Connor chosen, Depth disabled, Tsivoglou used.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * AMMONIA TOXICITY RESULTS * * *

05-05-1999 10:09 am

Rch #.	pH	TEMP degC	TNH3-N mg/l	un-NH3 mg/l	**COLD-WATER** acute	**COLD-WATER** chronic	**WARM-WATER** acute	**WARM-WATER** chronic
-(br 1) MAIN STEM: Beaverdam Creek								
1	7.0	23.0	0.08	0.000	0.093	0.007	0.114	0.010
2	Dischg	--	--	---	---	---	---	---
3	7.0	23.0	1.57	0.009	0.093	0.007	0.114	0.010
4	-trib-	--	--	---	---	---	---	---
5	7.0	23.0	1.34	0.008	0.093	0.007	0.114	0.010
6	7.0	23.0	1.31	0.008	0.093	0.007	0.114	0.010
7	7.0	23.0	1.08	0.006	0.093	0.007	0.114	0.010
eBr	-	--	1.04	---	---	---	---	---

SF = 1.00 0.0
BASIS FOR LIMITS: USEPA Revision (30 July 1992) to 1985 Criteria.
NOTE: Valid pH should lie between 6.5 and 9; accordingly,
(#) means that pH is out-of-bounds for that Reach.
Valid Temperature should lie between 0 and 30 degC;
likewise, (*) means that Temp is out-of-bounds.
Model File Name: BDCCRIT

Critical Conditions Model (Paul Lamarre 5/99)
Commerce Northside WPCP
Beaverdam Creek, WQMU 0106
From WE King Road to Grove Creek

* * * DO RESULTS & CALIBRATION SUMMARY * * *

05-05-1999 10:09 am

RCH #	RIVER Mile	DoSat River	%SAT River	DoSTD mg/l	<--- DO, mg/l ----> Calc - Field = Diff			DoDEF mg/l
-(br 1) MAIN STEM: Beaverdam Creek								
1	4.6	8.36	75.0	5.00	6.27	--	--	2.09
2	Dischg	8.36	80.7	5.00	6.75	--	--	1.61
3	4.1	8.36	73.7	5.00	6.17	--	--	2.20
4	-trib-	8.37	72.4	5.00	6.05	--	--	2.31
5	4.0	8.37	72.8	5.00	6.09	--	--	2.28
6	3.5	8.37	67.1	5.00	5.61	--	--	2.75
7	0.8	8.37	61.5	5.00	5.15	--	--	3.22
eBr	0.0	8.38	63.2	--	5.30	--	--	3.09

NOTE: RiverMiles are 'Head-of-Reach' values, thus 'Field' data MUST correspond to Head-of-Reach RiverMiles.
DO Saturation is based on the STANDARD METHODS equation.
Elevation Correction for DO Saturation has been turned ON.
The DO Standard is a FIXED Minimum value.
Calibration File Name: NoCal
Model File Name: BDCCRIT

APPENDIX C

Total Maximum Daily Load Summary Memorandum

SUMMARY MEMORANDUM
Total Maximum Daily Load (TMDL)
Beaverdam Creek

1. State Contact

Name: Paul Lamarre
Agency: Georgia Environmental Protection Division
Water Protection Branch
Watershed Planning and Monitoring Program
Address: 4220 International Parkway-Suite 101
Atlanta, Georgia 30354

Telephone: (404) 675-1672
Facsimile: (404) 675-6244
E-Mail: paul_lamarre@mail.dnr.state.ga.us

2. Waterbody Information

State:	Georgia
County:	Banks and Jackson
City/Town:	Commerce
Major River Basin:	Savannah
8-Digit Hydrologic Unit Code:	Broad River (03060104)
10-Digit Hydrologic Unit Code:	Hudson River (0306010402)
Waterbody Name:	Beaverdam Creek
Stream Length:	4.6 miles
Watershed Area:	11.7 square miles
Tributary to:	Grove Creek
Constituents of Concern:	Dissolved Oxygen (DO) Carbonaceous Biochemical Oxygen Demand (CBOD) Ammonia (NBOD)
Designated Use:	Fishing
Applicable Water Quality Standard:	Daily average dissolved oxygen concentration standard 5.0 milligrams per liter (mg/l) and no less than 4.0 mg/l at all times.

3. TMDL Development

Constituents: Carbonaceous Biochemical Oxygen Demand (CBOD)
Ammonia (NBOD)

Analysis/Modeling: ☒ Steady State ☐ Dynamic ☐ Watershed
☐ Other:

Describe: A steady state and conventional pollutant modeling approach was used.

Critical Conditions: ☒ Low Flow ☒ High Temperature ☐ Other:

Seasonal Variation: ☒ Considered
☐ Not Considered

Discuss: A seasonal 7Q10 analysis showed that seasonal variation in minimum flows and water temperatures was not critical to protecting the dissolved oxygen water quality standard in Beaverdam Creek.

Allocation Watershed/Stream Reach:

The watershed/stream reach covered by this TMDL includes Beaverdam Creek from its headwaters to Grove Creek.

Wasteload Allocations (WLA) (by constituent):

Ultimate CBOD

NPDES Number	Facility Name	Wasteload Allocation (pounds/day)
GA0026247	Commerce North Plant	175
	Total:	175

Ultimate NBOD

NPDES Number	Facility Name	Wasteload Allocation (pounds/day)
GA0026247	Commerce North Plant	80
	Total:	80

Load Allocations (LA) (by constituent):

Ultimate CBOD

Stream	Load Allocation (pounds/day)
Beaverdam Creek	23
Total:	23

Ultimate NBOD

Stream	Load Allocation (pounds/day)
Beaverdam Creek	4
Total:	4

Margin of Safety (MOS): ☐ Explicit ☒ Implicit

Explain: First, the MOS is implicitly incorporated into the modeling process by selecting critical conditions of combined high temperature and low streamflow with a low recurrence interval. Secondly, the minimum dissolved oxygen concentration was maintained at 5.2 mg/l which is above the 4.0 and 5.0 mg/l standard concentrations in order to provide another margin of safety in the analysis.