Revised

Total Maximum Daily Load

Evaluation

for

Twenty-Three Stream Segments

in the

Ogeechee River Basin

for

Dissolved Oxygen

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

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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, 2002-2003).

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 in-stream 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 twenty-three (23) stream segments, located in the Ogeechee River Basin, as water quality limited due to dissolved oxygen (DO). These waterbodies were included in the State's 2002 303(d) list. This report presents the dissolved oxygen TMDLs for these segments.

Part of the TMDL analysis is the identification of potential source categories. 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 oxygen demanding substances on land surfaces that wash off as a result of storm events.

The process of developing the dissolved oxygen TMDL for the Ogeechee River Basin included developing computer models for the listed segments. Georgia DOSAG, a steady state water quality model developed by the Georgia Environmental Protection Division (GA EPD) was used for the freshwater segments. For the estuary segments that are influenced by tidal actions, Georgia ESTUARY was used. Georgia ESTUARY is a steady-state tidally averaged water quality model also developed by GA EPD. These models were calibrated to data collected in the Ogeechee River Basin in the summer of 2002.

Management practices may be used to help reduce and/or maintain the Ultimate Oxygen Demand (UOD) loads. These include:

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

The amount of oxygen demanding substances delivered to a stream is difficult to determine. However, by requiring and monitoring the implementation of these practices, such efforts 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, 2002-2003).

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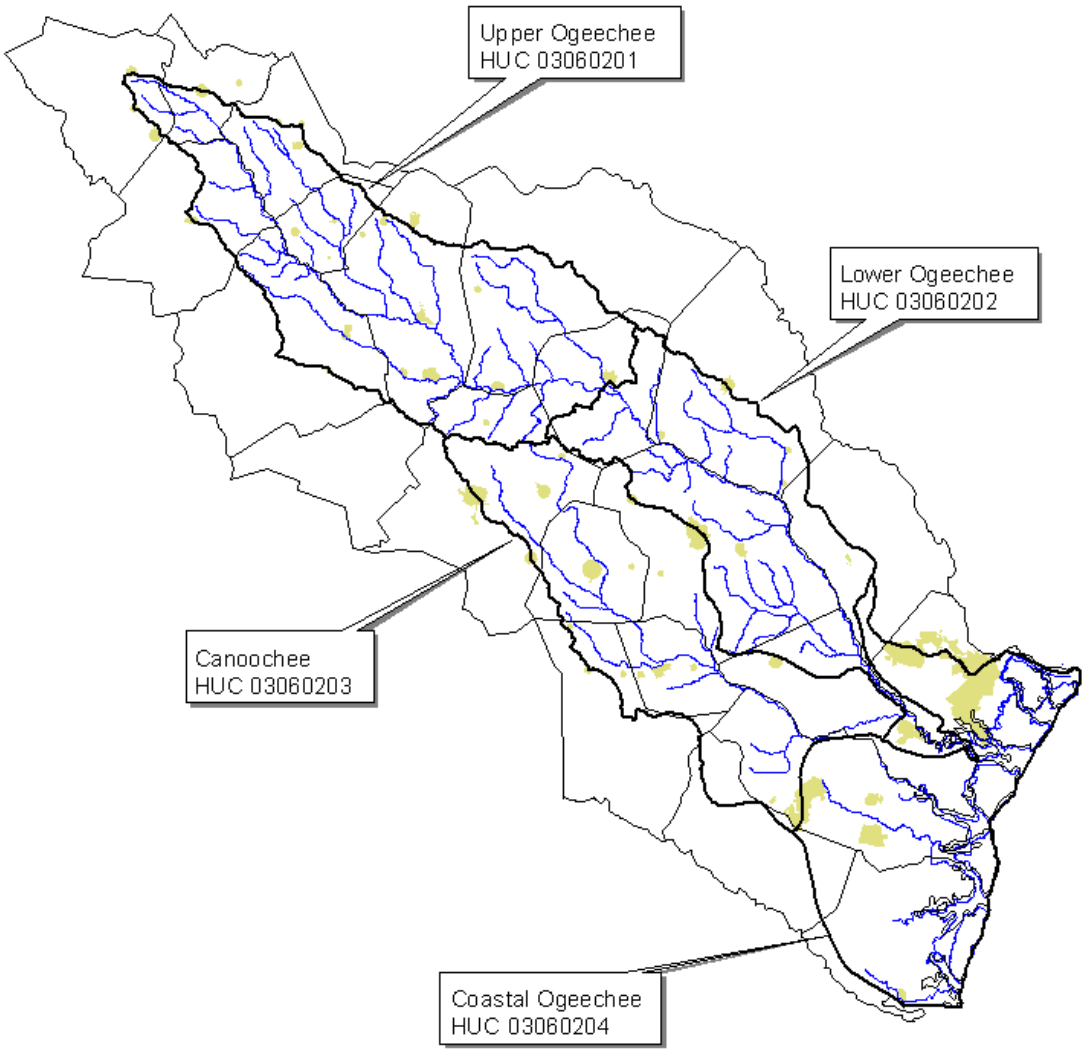
The State of Georgia has identified twenty-three (23) stream segments located in the Ogeechee River Basin as water quality limited due to dissolved oxygen (DO). These waterbodies were included in the State's 2002 303(d) list. This report presents the DO TMDLs for the listed segments in the Ogeechee River Basin identified in Table 1.

1.2 Watershed Description

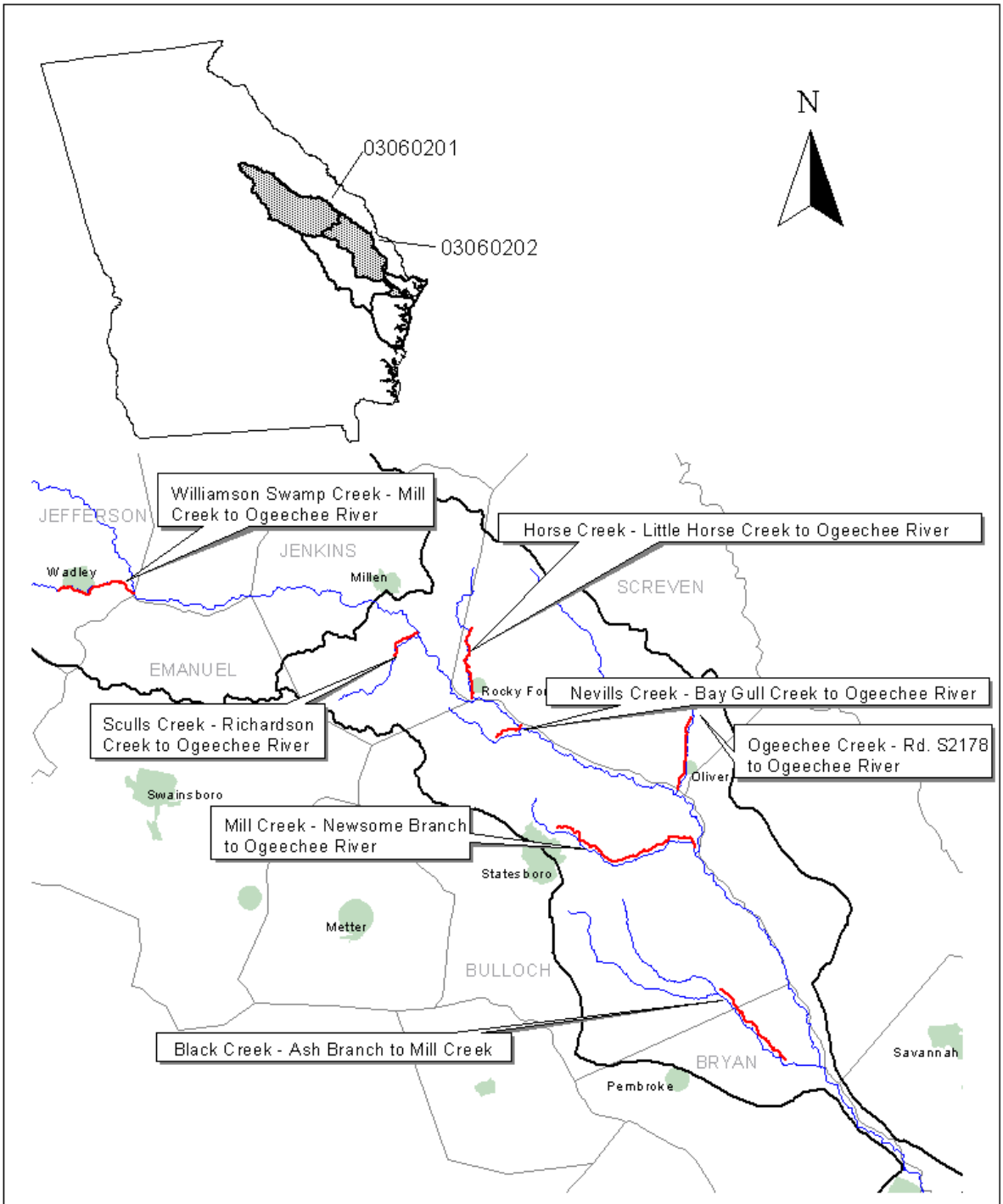
The Ogeechee River Basin is located in central to southeastern Georgia, encompassing approximately 5,540 square miles. The Ogeechee River Basin is bordered by the Oconee and Altamaha River Basins to the west and the Savannah River Basin to the east. The Ogeechee River originates in Greene County, in central Georgia. In the headwaters, the North and South Forks of the Ogeechee River join to form the Ogeechee River. The River then flows approximately 245 miles southeast toward the Atlantic Ocean. The Canoochee River originates in Emanuel County and flows southeast to join the Ogeechee River near Richmond Hill. The Ogeechee River Basin contains parts of the Piedmont and Coastal Plain physiographic provinces, which extend throughout the southeastern United States.

The USGS has divided the Ogeechee River Basin into four sub-basins, or Hydrologic Unit Codes (HUCs). Figure 1 shows the location of these sub-basins. Figures 2a, 2b, and 2c show the locations of the twenty-three listed dissolved oxygen segments in the Ogeechee River Basin and the associated counties.

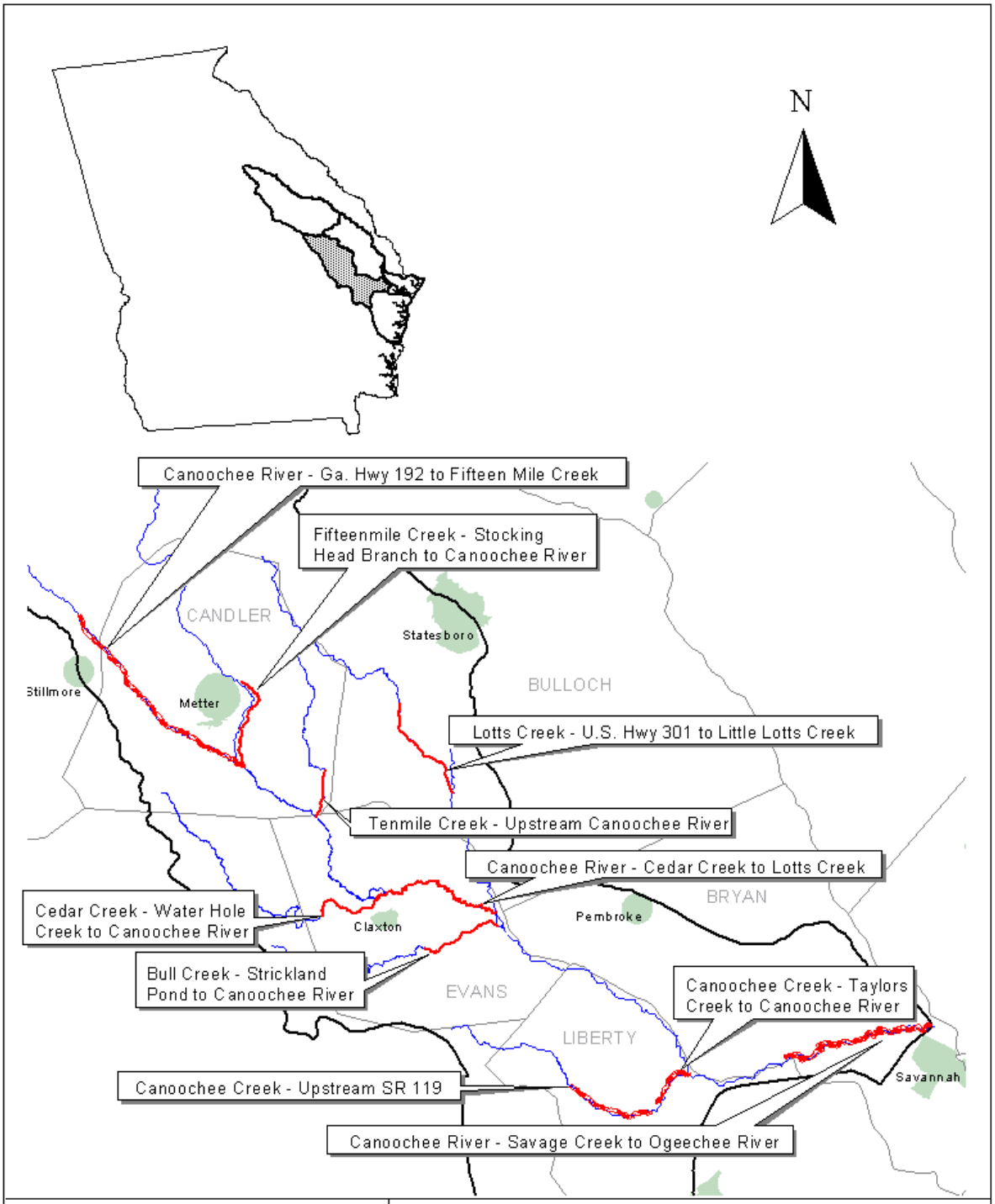
The land use characteristics of the Ogeechee River Basin watersheds were determined using data from the National Land Cover Dataset (NLCD) for Georgia. This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 2 lists the land cover distribution and associated percent land cover.



TMDL Evaluation - Dissolved Oxygen OgeecheeRiver Basin	Figure 1. Location of the Ogeechee River Basin

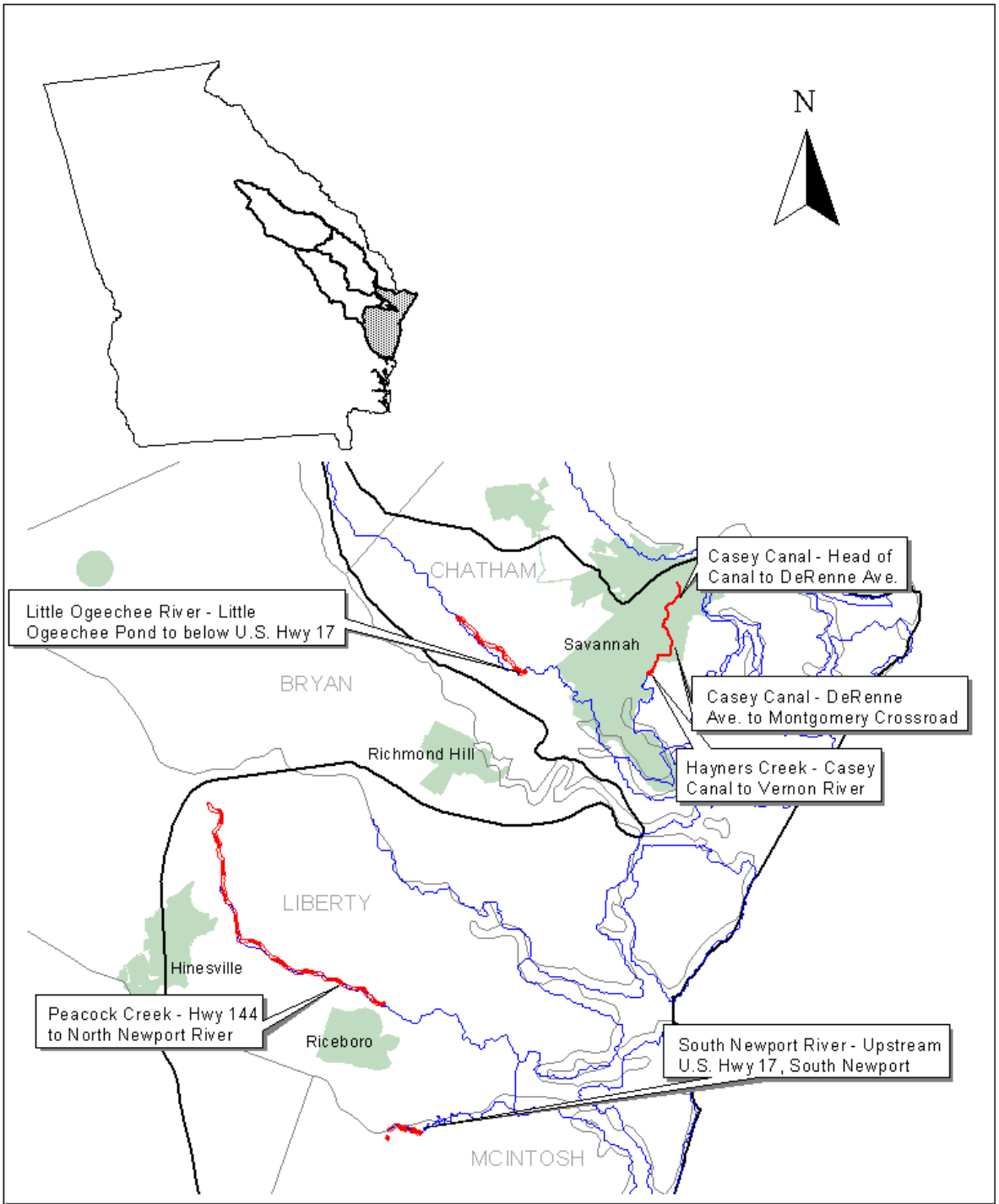


TMDL Evaluation - Dissolved Oxygen Ogeechee River Basin	Figure 2a. Impaired Stream Segments in HUCs 03060201 and 03060202



TMDL Evaluation - Dissolved Oxygen
Ogeechee River Basin

Figure 2b. Impaired Stream Segments in HUC 03060203



TMDL Evaluation - Dissolved Oxygen Ogeechee River Basin	Figure 2c. Impaired Stream Segments in HUC 03060204

Table 1. Waterbodies Listed For Dissolved Oxygen in the Ogeechee River Basin

Stream Segment	Location	Segment Length (miles)	Designated Use	Listing
Black Creek	Ash Branch to Mill Creek near Blitchton (Bulloch/Bryan Co)	11	Fishing	PS
Bull Creek	Strickland Pond to Canoochee River near Daisy (Evans Co)	6	Fishing	NS
Canoochee Creek	Upstream SR 119, Fort Stewart (Liberty Co)	7	Fishing	PS
Canoochee Creek	Taylors Creek to Canoochee River, Fort Stewart (Liberty Co)	4	Fishing	PS
Canoochee River	GA Hwy 192 to Fifteenmile Creek near Metter (Emanuel/Candler Co)	21	Fishing	PS
Canoochee River	Cedar Creek to Lotts Creek (Evans Co)	13	Fishing	NS
Canoochee River	Savage Creek to Ogeechee River (Liberty/Bryan Co)	18	Fishing	PS
Casey Canal	Head of Canal to DeRenne Ave., Savannah (Chatham Co)	3	Fishing	NS
Casey Canal	DeRenne Ave. to Montgomery Crossroad, Savannah (Chatham Co)	3	Fishing	NS
Cedar Creek	Water Hole Creek to Canoochee River, Claxton (Evans Co)	6	Fishing	NS
Fifteenmile Creek	Stocking Head Branch to Canoochee River near Metter (Chandler Co)	6	Fishing	NS
Hayners Creek	Casey Canal (Montgomery Crossroad) to Vernon River (Chatham Co)	2	Fishing	NS
Horse Creek	Little Horse Creek to Ogeechee River near Rocky Ford (Screven Co)	5	Fishing	NS
Little Ogeechee River	Little Ogeechee River Pond to below US Hwy 17 near Burroughs (Chatham Co)	6	Fishing	PS
Lotts Creek	US Hwy 301 to Little Lotts Creek near Register (Bulloch Co)	8	Fishing	NS
Mill Creek	Newsome Branch to Ogeechee River near Statesboro (Bulloch Co)	16	Fishing	NS
Nevills Creek	Bay Gull Creek to Ogeechee River near Rocky Ford (Bulloch Co)	3	Fishing	NS
Ogeechee Creek	Rd S2178 to Ogeechee River near Oliver (Screven Co)	7	Fishing	NS
Peacock Creek	Hwy 144 to North Newport River near McIntosh (Liberty Co)	17	Fishing	PS
Sculls Creek	Richardson Creek to Ogeechee River near Scarboro (Jenkins Co)	4	Fishing	NS
South Newport River	Upstream US Hwy 17, South Newport (Liberty/McIntosh Co)	3	Fishing	PS
Tenmile Creek	Upstream Canoochee River, Excelsior (Candler Co)	3	Fishing	NS
Williamson Swamp Creek	Mill Creek to Ogeechee River, Wadley (Jefferson Co)	9	Fishing	NS

Notes:
PS = Partially Supporting designated use
NS = Not Supporting designated use

1.3 Water Quality Standard

The water use classification for the listed stream segments in the Ogeechee River Basin is Fishing. No segments in the Ogeechee River Basin are classified as trout streams. The criterion violated is listed as dissolved oxygen. The potential cause listed includes municipal, urban, and nonpoint source runoff. The use classification water quality standards for dissolved oxygen, as stated in ***Georgia's*** *Rules and Regulations for Water Quality Control* (GA EPD, 2004), Chapter 391-3-6-.03(6)(c)(i) are:

> A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

Certain waters of the State may have conditions where dissolved oxygen is naturally lower than the numeric criteria specified above and therefore cannot meet these standards unless naturally occurring loads are reduced or streams are artificially or mechanically aerated. This is addressed in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03(7) (GA EPD, 2004):

> *Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.

EPA dissolved oxygen criteria are used to address these situations. Alternative EPA limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions (USEPA, 1986).

> Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria means or minima or both, the minimum acceptable concentration is 90 percent of the natural concentration.

Accordingly, if the naturally occurring DO exceeds GA EPD numeric limits at critical conditions, then the GA EPD numeric limits apply. If naturally occurring DO is lower than the GA EPD numeric limits, then 90% of the natural DO will become the minimum allowable.

Table 2. Ogeechee River Basin Land Coverage

Stream/Segment	Land use Categories - Acres (Percent)													
	Open Water	Residential	High Intensity Commercial, Industrial, Transportation	Bare Rock, Sand, Clay	Quarries, Strip Mines, Gravel Pits	Transitional	Forest	Row Crops	Pasture, Hay	Other Grasses (Urban, recreational; e.g. parks, lawns)	Woody Wetlands	Emergent Herbaceous Wetlands	Total	Land use Source
Black Creek	937	851	461	137	2	6,608	62,972	45,818	4,326	44	24,131	1,281	147,567	NLCD
	(0.6)	(0.6)	(0.3)	(0.1)	(0.0)	(4.5)	(42.7)	(31.0)	(2.9)	(0.0)	(16.4)	(0.9)		
Bull Creek	614	279	221	24	-	2,191	21,162	16,264	2,606	31	3,893	21	47,306	NLCD
	(1.3)	(0.6)	(0.5)	(0.1)	(0.0)	(4.6)	(44.7)	(34.4)	(5.5)	(0.1)	(8.2)	(0.0)		
Canoochee Creek	651	371	338	31	-	4,874	37,772	5,422	443	357	16,422	415	67,097	NLCD
Upstream SR 119, Fort Stewart	(1.0)	(0.6)	(0.5)	(0.0)	(0.0)	(7.3)	(56.3)	(8.1)	(0.7)	(0.5)	(24.5)	(0.6)		
Canoochee Creek	896	3,650	775	144	7	11,968	93,262	11,861	1,562	741	42,456	726	168,048	NLCD
Taylors Creek to Canoochee River	(1.0)	(0.6)	(0.5)	(0.0)	(0.0)	(7.3)	(56.3)	(8.1)	(0.7)	(0.5)	(24.5)	(0.6)		
Canoochee River	1,228	874	542	82	346	14,572	69,887	36,879	3,659	137	9,722	46	137,974	NLCD
GA Hwy 192 to Fifteenmile Creek near Metter	(0.9)	(0.6)	(0.4)	(0.1)	(0.3)	(10.6)	(50.7)	(26.7)	(2.7)	(0.1)	(7.0)	(0.0)		
Canoochee River	6,711	4,217	2,440	402	15,078	29,249	174,700	151,942	54,768	52,831	43,987	385	536,708	NLCD
Cedar Creek to Lotts Creek	(1.3)	(0.8)	(0.5)	(0.1)	(2.8)	(5.4)	(32.6)	(28.3)	(10.2)	(9.8)	(8.2)	(0.1)		
Canoochee River	8,008	7,931	175,505	152,109	54,777	70,441	127,462	15,180	17,097	30,070	102,731	2,367	763,678	NLCD
Savage Ck to Ogeechee River	(1.0)	(1.0)	(23.0)	(19.9)	(7.2)	(9.2)	(16.7)	(2.0)	(2.2)	(3.9)	(13.5)	(0.3)		
Casey Canal	5	2,760	783	10	-	238	382	96	24	54	161	1	4,513	NLCD
Head of Canal to DeRenne Ave., Savannah	(0.1)	(61.2)	(17.3)	(0.2)	(0.0)	(5.3)	(8.5)	(2.1)	(0.5)	(1.2)	(3.6)	(0.0)		
Casey Canal	125	4,433	1,607	27	-	576	1,358	456	43	422	555	18	9,618	NLCD
DeRenne Ave. to Montgomery Crossroad, Savannah	(1.3)	(46.1)	(16.7)	(0.3)	(0.0)	(6.0)	(14.1)	(4.7)	(0.4)	(4.4)	(5.8)	(0.2)		
Cedar Creek	482	278	97	32	-	2,267	14,471	16,166	2,806	28	3,168	14	39,808	NLCD
	(1.2)	(0.7)	(0.2)	(0.1)	(0.0)	(5.7)	(36.4)	(40.6)	(7.0)	(0.1)	(8.0)	(0.0)		
Fifteenmile Creek	1,162	394	377	45	1	5,981	37,621	38,626	4,240	87	7,727	9	96,270	NLCD
	(1.2)	(0.4)	(0.4)	(0.0)	(0.0)	(6.2)	(39.1)	(40.1)	(4.4)	(0.1)	(8.0)	(0.0)		
Hayners Creek (known upstream as Casey Canal)	144	4,630	1,631	27	-	593	1,490	458	43	429	559	87	10,092	NLCD
	(1.4)	(45.9)	(16.2)	(0.3)	(0.0)	(5.9)	(14.8)	(4.5)	(0.4)	(4.3)	(5.5)	(0.9)		
Horse Creek	218	10	3	16	-	2,679	27,066	14,771	1,437	1	3,326	139	49,666	NLCD

	(0.4)	(0.0)	(0.0)	(0.0)	(0.0)	(5.4)	(54.5)	(29.7)	(2.9)	(0.0)	(6.7)	(0.3)		

	Land use Categories - Acres (Percent)													
Stream/Segment	**Open Water**	**Residential**	**High Intensity Commercial, Industrial, Transportation**	**Bare Rock, Sand, Clay**	**Quarries, Strip Mines, Gravel Pits**	**Transitional**	**Forest**	**Row Crops**	**Pasture, Hay**	**Other Grasses (Urban, recreational; e.g. parks, lawns)**	**Woody Wetlands**	**Emergent Herbaceous Wetlands**	**Total**	**Land use Source**
Little Ogeechee River	296	468	259	30	79	1,657	17,215	2,143	425	33	12,092	187	34,884	NLCD
	(0.8)	(1.3)	(0.7)	(0.1)	(0.2)	(4.8)	(49.3)	(6.1)	(1.2)	(0.1)	(34.7)	(0.5)		
Lotts Creek	1,847	2,323	610	153	1	4,494	37,548	52,491	6,605	195	14,729	270	121,266	NLCD
	(1.5)	(1.9)	(0.5)	(0.1)	(0.0)	(3.7)	(31.0)	(43.3)	(5.4)	(0.2)	(12.1)	(0.2)		
Mill Creek	733	1,405	253	45	-	2,091	16,313	30,889	2,380	293	10,873	58	65,333	NLCD
	(1.1)	(2.2)	(0.4)	(0.1)	(0.0)	(3.2)	(25.0)	(47.3)	(3.6)	(0.4)	(16.6)	(0.1)		
Nevills Creek	275	7	2	16	1	2,255	13,622	13,264	1,129	-	3,493	18	34,082	NLCD
	(0.8)	(0.0)	(0.0)	(0.0)	(0.0)	(6.6)	(40.0)	(38.9)	(3.3)	(0.0)	(10.2)	(0.1)		
Ogeechee Creek	772	521	250	46	-	4,105	36,998	32,644	3,692	182	14,163	338	93,711	NLCD
	(0.8)	(0.6)	(0.3)	(0.0)	(0.0)	(4.4)	(39.5)	(34.8)	(3.9)	(0.2)	(15.1)	(0.4)		
Peacock Creek	120	1,906	564	25	46	1,477	15,496	695	131	437	10,290	514	31,701	NLCD
	(0.4)	(6.0)	(1.8)	(0.1)	(0.1)	(4.7)	(48.9)	(2.2)	(0.4)	(1.4)	(32.5)	(1.6)		
Sculls Creek	216	15	7	16	-	2,358	20,131	15,491	1,183	10	3,823	6	43,255	NLCD
	(0.5)	(0.0)	(0.0)	(0.0)	(0.0)	(5.5)	(46.5)	(35.8)	(2.7)	(0.0)	(8.8)	(0.0)		
South Newport River	71	297	66	10	2	5,196	46,824	2,348	536	20	26,453	532	82,354	NLCD
	(0.1)	(0.4)	(0.1)	(0.0)	(0.0)	(6.3)	(56.9)	(2.9)	(0.7)	(0.0)	(32.1)	(0.6)		
Tenmile Creek	530	34	238	23	-	1,149	9,806	14,296	1,510	3	2,544	34	30,166	NLCD
	(1.8)	(0.1)	(0.8)	(0.1)	(0.0)	(3.8)	(32.5)	(47.4)	(5.0)	(0.0)	(8.4)	(0.1)		
Williamson Swamp Creek	802	1,402	514	95	101	8,633	62,962	58,951	7,078	160	24,913	13	165,624	NLCD
	(0.5)	(0.8)	(0.3)	(0.1)	(0.1)	(5.2)	(38.0)	(35.6)	(4.3)	(0.1)	(15.0)	(0.0)		

2.0 WATER QUALITY ASSESSMENT

During 2002, the United States Geological Survey (USGS) collected water quality data at thirty-five USGS Stations in the Ogeechee River Basin. Figure 3 shows the GA EPD/USGS water quality and USGS flow stations that were sampled during 2002. Of these, a total of nineteen stations had DO standard violations in 2002. Appendix A provides the water quality data for these stations, and includes flow, DO, temperature, 5-day biochemical oxygen demand, and ammonia data. Several monitoring locations were used to list more than one stream segment.

In general, these data show that low dissolved oxygen values usually occurred during the summer months as shown in Figure 4. Furthermore, these values were usually limited to headwater streams where the drainage areas are relatively small and dry weather flows are low, intermittent, or zero. In larger watersheds where the flows are higher, the dissolved oxygen concentrations usually met the minimum standard of 4.0 mg/L and the daily average of 5.0 mg/L.

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

1. Historic trend monitoring data through 2002;
2. 2002 GA EPD/USGS water quality data;
3. Historic USGS daily average flow data through December 31, 2002;
4. Continuous monitoring data collected by the US Army at Fort Stewart; and
5. Monitoring data collected by the Canoochee Riverkeeper.

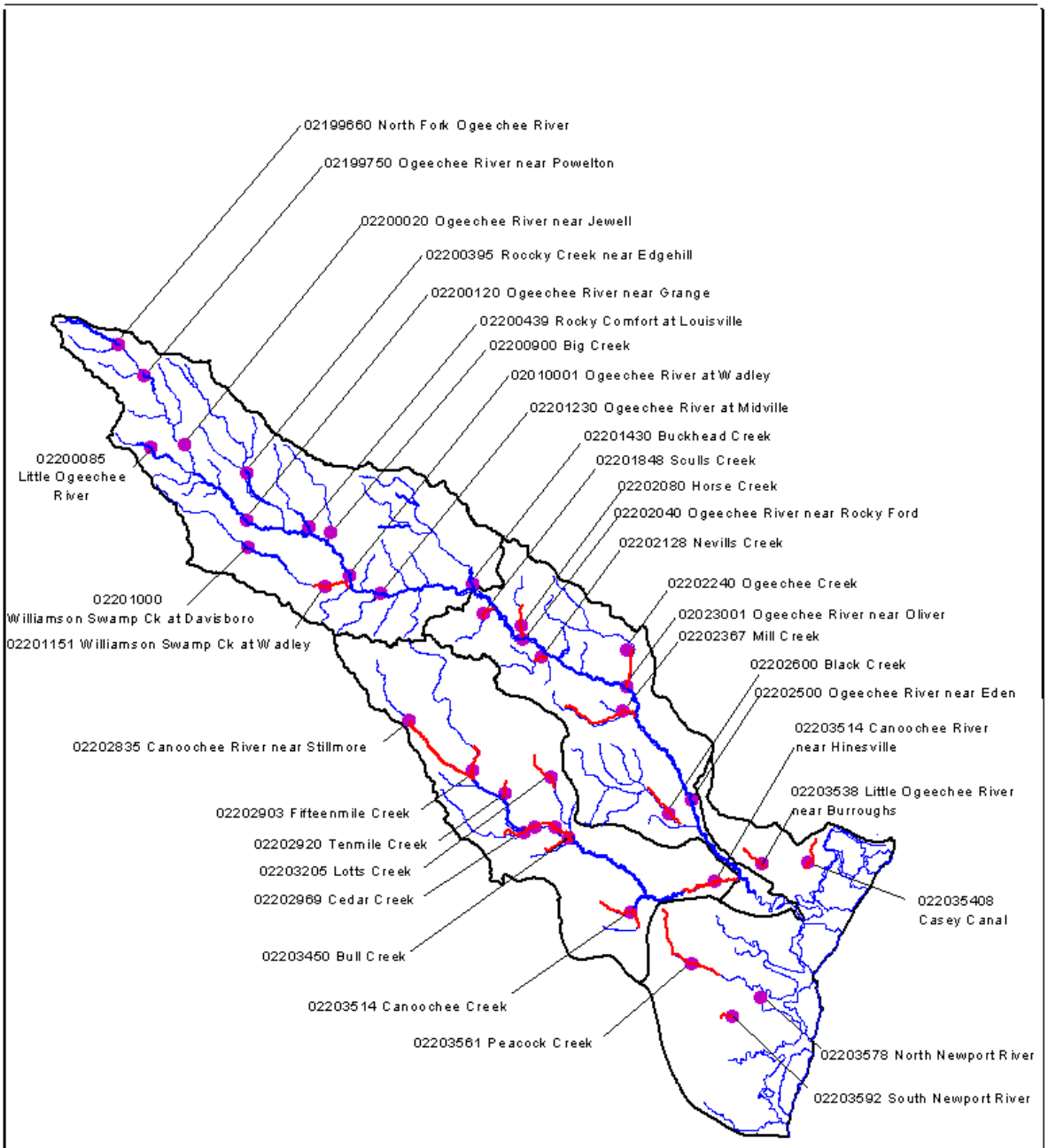


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Figure 3. 2002 USGS Water Quality Monitoring Stations Located in the Ogeechee River Basin

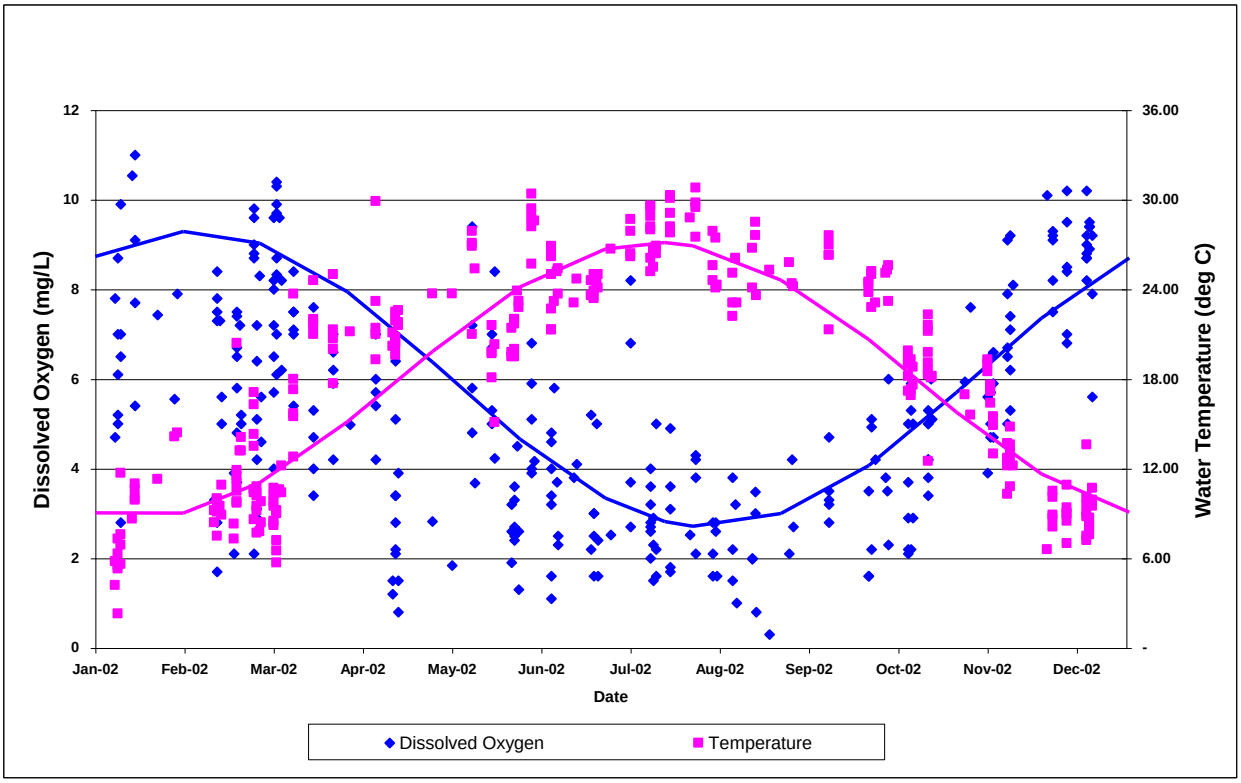


Figure 4. 2002 Dissolved Oxygen and Temperature Data for the Ogeechee River Basin Monitoring Stations

3.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of potential source categories. 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 oxygen demanding substances 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

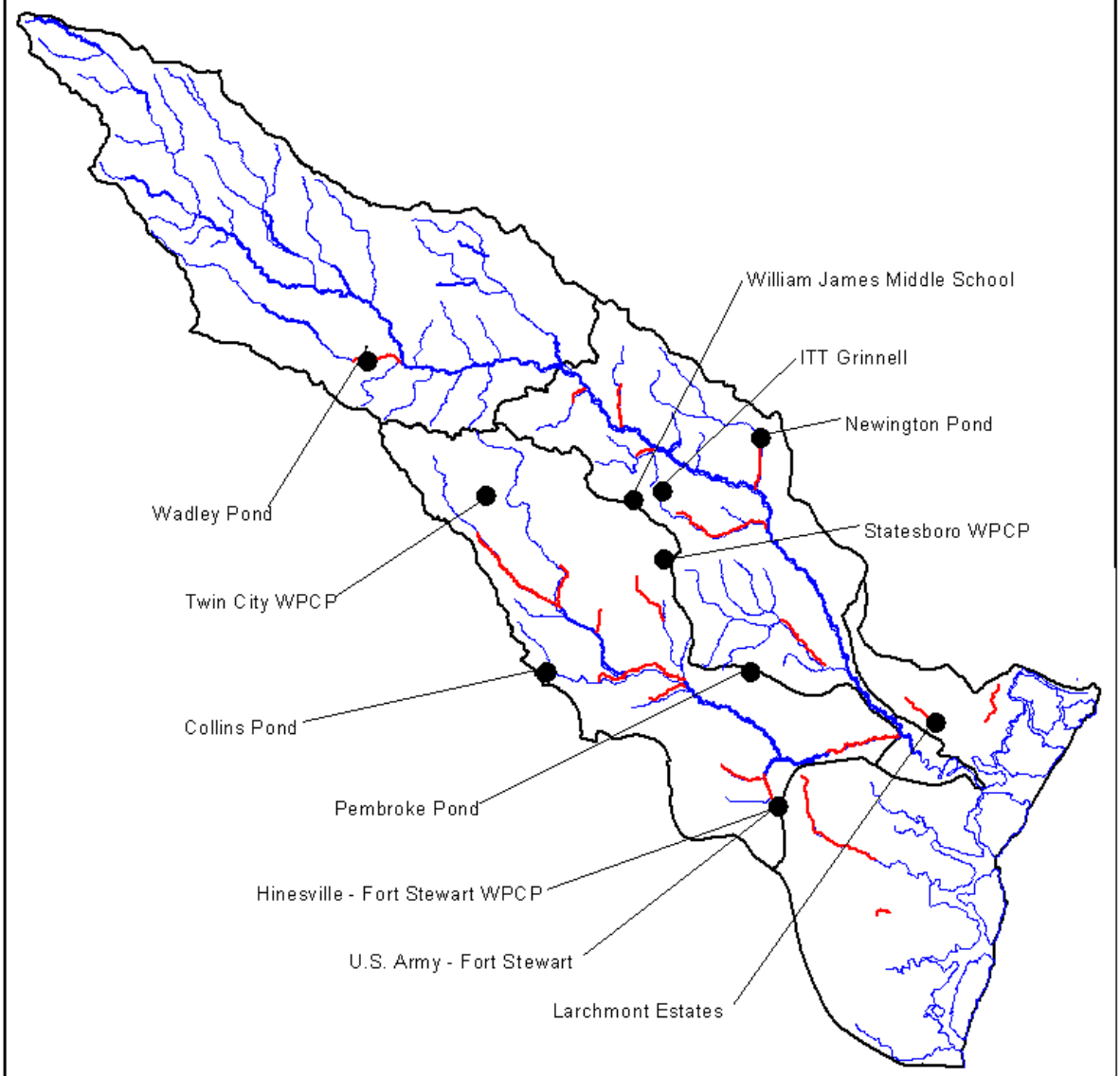
In general, industrial and municipal wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or water quality standards (water quality-based limits).

EPA has developed technology-based limits, 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 eleven (11) NPDES permitted discharges with effluent limits for oxygen consuming substances identified in the Ogeechee River Basin watershed upstream from the listed segments. Three of these discharges are classified as major, with discharges of 1.0 million gallons per day (MGD) or more. Figure 5 provides the locations of NPDES discharges and Table 3 provides the permitted flows, as well as the 5-day Biochemical Oxygen Demand (BOD_5), ammonia (NH_3), and DO concentrations for the municipal and industrial treatment facilities.

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 and storm water exceed 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 Ogeechee River Basin.



TMDL Evaluation - Dissolved Oxygen Ogeechee River Basin	Figure 5. Location of the NPDES Discharges in the Ogeechee River Basin

Table 3. NPDES Facilities in the Ogeechee River Basin

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits			
			Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)
Canoochee River Basin						
Twin City WPCP	GA0048666	Thick Creek	1	30	NA	2
Statesboro WPCP	GA0023108	Little Lotts Creek	10	10	2	6
Collins Pond	GA0021091	Tributary to Cedar Creek	0.06	30	NA	NA
Hinesville – Fort Stewart WPCP	GA0047180	Taylors Creek	7.15	10	2	6
US Army Fort Stewart- Outfall 001	GA0004308	Canoochee River	0.035	20	5	NA
Outfall 002		Canoochee River	0.035	20	5	NA
Outfall 003		Mill Creek – trib to Taylors Ck	0.5	20	NA	NA
Little Ogeechee Basin						
Larchmont Estates	GA0034819	Larchmont Canal	0.65	10	5	NA
Mill Creek Basin						
William James Middle School	GA0034061	Belcher Branch	0.2	30	NA	NA
ITT Grinnell	GA0003263	Mill Creek	0.019	30	NA	NA
Ogeechee Creek Basin						
Newington Pond	GA0050202	Ogeechee Creek	0.045	30	NA	NA
Williamson Swamp Creek Basin						
Wadley Pond	GA0021024	Williamson Swamp Creek	0.215	30	NA	5

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 oxygen demanding substances consist of those associated with industrial activities, including construction sites one acre or greater, and large, medium, and small municipal separate storm sewer systems (MS4s) that serve populations of 50,000 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, with about 45 located in the greater Atlanta metro area. Table 4 lists those counties and communities located in the Ogeechee River Basin that are covered by the Phase I General Storm Water Permits.

Table 4. Phase I Permitted MS4s in the Ogeechee River Basin

Name	Permit No.	Watershed
Chatham County	GAS000206	Ogeechee, Savannah
Garden City	GAS000208	Ogeechee, Savannah
Pooler	GAS000209	Ogeechee, Savannah
Savannah	GAS000205	Ogeechee, Savannah
Thunderbolt	GAS000211	Ogeechee
Tybee	GAS000212	Ogeechee, Savannah

Source: NonPoint Source Program, GA EPD, Atlanta, Georgia, 2003

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, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit.

As of March 10, 2003, small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an 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. Thirty counties and 56 communities within the state of Georgia are permitted under the Phase II regulations. Table 5 lists those counties and communities located in the Ogeechee River Basin that are covered by the Phase II General Storm Water Permit, GAG610000.

Table 5. Phase II Permitted MS4s in the Ogeechee River Basin

Permittee	Watershed
Allenhurst	Ogeechee
Fleming	Ogeechee
Hinesville	Ogeechee
Vernonburg	Ogeechee
Walthourville	Ogeechee

Source: NonPoint Source Program, GA EPD, Atlanta, Georgia, 2004

3.1.3 Confined Animal Feeding Operations

Confined livestock and confined animal feeding operations (CAFOs) are characterized by high animal densities. This results in large quantities of fecal material being contained in a limited area. Processed agricultural manure from confined hog, dairy cattle, and select poultry operations is generally collected in lagoons. It is then applied to pastureland and cropland as a fertilizer during the growing season, at rates that often vary monthly. Runoff during storm events may carry surface residual containing oxygen demanding substances to nearby surface waters.

In 1990, the State of Georgia began registering CAFOs. Many of the CAFOs were issued land application or NPDES permits for treatment of wastewaters generated from their operations. The type of permit issued depends on the operation size (i.e., number of animal units). Table 6 presents the swine and non-swine (primarily dairies) CAFOs located in the Ogeechee River Basin that are registered or have land application permits**.**

Table 6. Registered CAFOs in the Ogeechee River Basin

Name	City	County	Animal Type	Total No. of Animals	Permit No.
Bay Branch Farms	Claxton	Evans	Swine	2,495	GAU700000
Bell's Dairy	Greensboro	Greene	Dairy	200	GAU700000
Cabaniss Dairy L.L.C.	Maxeys	Oglethorpe	Dairy	1,200	GAG930006
C-M Farms/Orangeburg Foods, Inc.	Register	Candler	Swine	2,400	GAU700000
Drayben Dairy	White Plains	Taliaferro	Dairy	340	GAU700000
Dunn Sausage Company	Mitchell	Glascock	Swine		GAU700000
Eley Acres Farm	White Plains	Greene	Dairy	185	GAU700000
Franks' Farm	Waynesboro	Burke	Dairy	225	GAU700000
G & S Dairy	Warrenton	Warren	Dairy	260	GAU700000
J.B. Gay & Son Inc.	Garfield	Emanuel	Dairy	300	GAU700000
J.B. Gay & Son Inc.	Millen/Garfield	Jenkins	Swine	1,100	GAU700000
JAA Dunrovin Farm	Mitchell	Glascock	Swine	1,600	GAU700000
Larry Holdeman Dairy	Bartow	Jefferson	Dairy	170	GAU700000

Name	City	County	Animal Type	Total No. of Animals	Permit No.
Long Branch Dairy	White Plains	Taliaferro	Dairy	350	GAU700000
Pineland Dairy	Waynesboro	Burke	Dairy	699	GAU700000
Sandhill Farms (ex-Webb Brothers)	Twin City	Candler	Swine	6,400	GA0038261
Saxon Dairy	Perkins	Jenkins	Dairy	400	GAU700000
Scattered Acres Farm	Claxton	Evans	Swine	2,495	GAU700000
Smith-Healy Farms, Inc.	Statesboro	Bulloch	Swine	5,000	GA0038199
Visscher Dairy	Stapleton	Jefferson	Dairy	650	GAU700000
W. W. Ball Farms	Statesboro	Bulloch	Swine	2,000	GAU700000
Walnut Branch Farm	Davisboro	Washington	Dairy/Beef	673	GAU700000

Source: Permitting Compliance and Enforcement Program, GA EPD, Atlanta, Georgia, 2004

3.2 Nonpoint Source Assessments

In general, nonpoint sources cannot be identified as entering a waterbody through a discrete conveyance at a single location. Typical nonpoint sources of oxygen demanding substances come from materials being washed into the rivers and streams during storm events. In 2002, many streams in the Ogeechee River Basin were dry, or had ponded areas and stagnant pools as a result of a five-year drought in Georgia. Due to the lack of rainfall during the summer of 2002, 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: 1) flushed out of the system along with the water column flow; or 2) settled out and became part of the stream channel bottom.

In this manner, historic wash off of settleable materials accumulates and exerts sediment oxygen demand (SOD). Constituents of concern from surface washoff include the fractions of ammonia and BOD_5 that become an integral part of channel bottom sediments, thus becoming a potential source of SOD. Table 2 provides the land cover distributions for the listed Ogeechee River watersheds. These data show that the watersheds are predominately forested, with approximately 38.0 percent (ranging from 8.5 to 56.9 percent) of forest land use. Agriculture is the next predominate land use, with approximately 24.1 percent row crops (ranging from 2.0 to 47.4 percent). Approximately 14.2 percent (ranging from 3.6 to 34.7 percent) of the land use in these watersheds is woody wetlands. Urban land use makes up approximately 8.5 percent (ranging from 0.1 to 63.0 percent) of these watersheds.

In addition to nonpoint sources of SOD associated with land disturbing activities, most of the streams in the Ogeechee River Basin receive significant natural contributions of oxygen demanding organic materials from local wetlands and forested stream corridors. The following sources of naturally occurring organic materials have been identified:

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

Leaf litterfall is a major contributor to the amount of dissolved organic matter in the stream water column and the amount of SOD being exerted. Many streams in southern Georgia are also referred to as “blackwater” streams because of highly colored humic substances leached from

surrounding marshes and swamps. In addition, low dissolved oxygen in blackwater streams is very common in the summer months when the temperatures are high and the flows are low (Meyer, 1992). The oxygen demanding effects of leaf litterfall are reflected in two ways: 1) by lowering the DO saturation of water entering the channel from adjacent swampy areas caused by decaying vegetation; and 2) by increasing SOD associated with vegetation decaying on stream channel bottoms.

3.2.1 Land Application Systems

Many smaller communities use land application systems (LAS) for treatment of their sanitary wastewater. These facilities are required through LAS permits to treat all their wastewater by land application and are to be properly operated as non-discharging systems that contribute no runoff to nearby surface waters. However, runoff during storm events may carry surface residual containing oxygen demanding substances to nearby surface waters. Some of these facilities may also exceed the ground percolation rate when applying their wastewater, resulting in surface runoff. If not properly bermed, this runoff, which contains oxygen demanding substances, may discharge to nearby surface waters. In addition, water that percolates through the LAS and becomes groundwater that enters the stream as baseflow may contribute nutrient loads, which could promote the growth of aquatic plants in the stream. There are fifteen permitted LAS systems located in the Ogeechee River Basin (Table 7).

Table 7. Permitted Land Application Systems in the Ogeechee River Basin

LAS Name	County	Permit No.	Type	Flow (MGD)
Bartow LAS	Jefferson	GA02-215	Municipal	0.05
Chatham County Pine Barren	Chatham	GA02-285	Municipal	0.06
Chemtall Inc.	Liberty	GA01-403	Industrial	0.0383
Claxton LAS	Evans	GA02-111	Municipal	0.52
Claxton Poultry	Evans	GA01-415	Industrial	1.6
Claxton Poultry Farms Inc.	Evans	GA01-380	Industrial	1.15
Davisboro LAS	Washington	GA02-242	Municipal	0.3
Metter LAS	Candler	GA02-185	Municipal	1
Midway Industrial Park	Liberty	GA02-094	Municipal	0.05
Midway LAS	Liberty	GA02-131	Municipal	0.5
Sandhill Farms	Candler	GA01-355	Private	0.66
Skidaway Island Utilities	Chatham	GA03-941	Private	1.25
USA Army Fort Stewart/Camp Oliver	Evans	GA03-624	Federal	0.07
USA Army Fort Stewart/Wright Army Airfield	Liberty	GA03-834	Federal	0.0018
Waterford Landing Development	Bryan	GA03-768	Private	0.152

Source: Permitting Compliance and Enforcement Program, GA EPD, Atlanta, Georgia, 2004

The Claxton Poultry Company has experienced problems in the past with their Land Application System. The system was overloaded, causing ponding and discharges of nutrients and oxygen demanding materials to the Canoochee River. There may be continued groundwater sources of nutrients from water that percolates through the closed LAS. Claxton Poultry has since acquired a new 600-acre LAS site. This site is expected to provide the assimilative capacity to uptake the carbonaceous and nitrogenous BOD_5, as well as the hydraulic capacity to prevent the kind of runoff that results in the deterioration of water quality observed in 2002.

4.0 TECHNICAL APPROACH

The first step of the technical approach for these TMDLs was to select the models that can be effectively used to analyze the Ogeechee River DO resources. After appropriate models are selected, data is gathered to develop and calibrate the models. The calibrated models are then used to establish the TMDL during critical conditions. The modeling approach is described in the following sections.

4.1 Model Selection and Structure

Various analyses were performed to correlate the measured low DO concentrations to basic causes such as point and nonpoint contributions, flow conditions, stream and watershed characteristics, seasonal temperature effects, and others. From these analyses, the low DO values were found to coincide with low or zero flows, slow stream velocities, shallow water depths, and high temperatures. Inflows of very low DO waters from adjacent marshes and forested swamps compounded the situation. Since the impairments noted in 2002 occurred during sustained periods of low flows, a steady-state modeling approach was selected.

Further analyses of the listed segments revealed that two different water quality models were required based on the geographic, hydrologic, and water quality characteristics. It was determined that Georgia DOSAG would be used for freshwater streams and Georgia ESTUARY would be used for stream segments that are tidally influenced.

USGS quadrangle maps and navigational maps along with Arcview and MapInfo spatial graphics files were used to develop drainage areas, stream lengths, bed slopes, segment geometry, and other physical input data for each model. Appendix B provides a summary of each model structure.

4.1.1 Georgia DOSAG

Georgia DOSAG is a one-dimensional steady state water quality model that was developed by the GA EPD. The model was selected for the following reasons:

- It conforms to GA EPD standard practices for developing wasteload allocations;
- It works well for low flow and high temperature conditions;
- It can be developed with a limited dataset; and
- It is able to handle branching tributaries and both point and nonpoint source inputs.

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

Georgia DOSAG consists of a mainstem and may include up to six branches. DOSAG can also include tributaries, water intakes, and dams, as well as point sources. A total of ten DOSAG models were developed to represent the twenty freshwater listed segments in the Ogeechee River Basin. The models and the listed segments they include are as follows:

- Black Creek (1 segment)
- Canoochee River (10 segments)
    - Canoochee River - GA Hwy 192 to Fifteenmile Creek near Metter
    - Fifteenmile Creek
    - Tenmile Creek
    - Cedar Creek
    - Canoochee River – Cedar Creek to Lotts Creek
    - Lotts Creek
    - Bull Creek
    - Canoochee Creek – Upstream SR 119, Fort Stewart
    - Canoochee Creek - Taylors Creek to Canoochee River, Fort Stewart
    - Canoochee River - Savage Creek to Ogeechee River
- Casey Canal (2 segments)
    - Casey Canal - Head of Canal to DeRenne Ave., Savannah
    - Casey Canal - DeRenne Ave. to Montgomery Crossroad, Savannah
- Horse Creek (1 segment)
- Little Ogeechee River (1 segment)
- Mill Creek (1 segment)
- Nevills Creek (1 segment)
- Ogeechee Creek (1 segment)
- Sculls Creek (1 segment)
- Williamson Swamp Creek (1 segment)

4.1.2 Georgia ESTUARY

Georgia ESTUARY is a one-dimensional water quality model developed by GA EPD. This model may be used for saline estuaries, as well as non-saline tidal rivers where both freshwater flow and tidal mixing are significant mechanisms in the transport of wastes in the water. Georgia ESTUARY is a steady state tidally averaged water quality model. The concentrations in the estuary vary spatially, but are assumed to be constant in time. Because an estuary has cyclical tidal variations that effect depth, cross-sectional area, and volume, an average mean water model is developed that is the average of the high water and low water slack tides.

In Georgia estuaries, the natural DO can drop below the freshwater standard of 5 mg/L. The Coastal DO Criteria for fishing use classification is given in Table 8.

Table 8. Coastal DO Criteria for Fishing Use Classification

If the natural DO is		The Maximum Allowable DO Deficit (mg/L)
Greater than or equal to (mg/L)	But less than (mg/L)	
2.0	3.0	0.1
3.0	3.3	Never less than 3.0 mg/L
3.3	4.0	0.3
4.0	5.0	0.4
5.0	5.5	0.5
5.5	---	Never less than 5.0 mg/L

Georgia ESTUARY models are tidally averaged and cannot accept model segments lateral to the main channel. A total of three ESTUARY models were developed to represent the three tidally influenced listed segments in the Ogeechee River Basin. The models and the listed segments they include are as follows:

- Hayners Creek (1 segment)
- Peacock Creek (1 segment)
- South Newport River (1 segment)

4.2 Model Calibration

The model calibration period was determined from an examination of the USGS 2002 water quality data for the listed segments. The data examined included streamflow, DO, water temperature, BOD_5, and ammonia. The combination of the lowest flow, lowest DO, and highest water temperature defined the critical modeling period. For the listed segments, June through September was found to be the critical period. The calibration models were run to simulate an average DO from this period.

The average summer DO and average annual BOD_5 and ammonia values were extracted from the 2002 dataset for each sampling station. Table 9 provides a summary of the 2002 monitoring data used to develop data for the model calibration.

Table 9. Summary of the 2002 Monitoring Data for the Ogeechee River Basin

Monitoring Station	Avg Annual BOD_5 (mg/L)	Avg Annual NH_3 (mg/L)	Avg Summer Flow (cfs)	Avg Summer DO (mg/L)	Max Summer Temp (deg C)
Lower Ogeechee River Basin					
Williamson Swamp	1.3	0.12	16.05	5.02	25.6 (Jun)
Sculls Creek	3.0	0.05	0.10	3.73	25.2 (July)
Horse Creek	3.2	0.07	0.22	1.93	28.0 (July)
Nevills Creek	1.8	0.14	0.07	2.00	-
Ogeechee Creek	1.9	0.08	0.11	2.08	26.4 (July)
Mill Creek	1.4	0.09	4.40	3.85	28.5 (Aug)
Black Creek	1.5	0.07	5.70	1.86	26.9 (July)
Canoochee River Basin					
Canoochee River at Stillmore	1.5	0.03	-	3.35	-
Fifteenmile Creek	2.4	0.22	0.0	2.77	26.6 (July)
Tenmile Creek	1.9	0.08	-	2.64	25.7 (July)
Cedar Creek	3.0	0.17	0.0	1.60	27.9 (Aug)
Lotts Creek	1.5	0.10	17.50	2.60	26.0 (July)
Bull Creek	1.3	0.07	2.31	2.45	25.5 (July)
Canoochee Creek	2.2	0.08	0.05	2.90	27.8 (July)
Canoochee River At Hwy 67	-	-	-	2.91	28.8 (July)

Monitoring Station	Avg Annual BOD_5 (mg/L)	Avg Annual NH_3 (mg/L)	Avg Summer Flow (cfs)	Avg Summer DO (mg/L)	Max Summer Temp (deg C)
Coastal Ogeechee River Basin					
Casey Canal	3.0	0.27	-	4.00	30.4 (Jun)
Little Ogeechee River	1.9	0.16	-	3.41	29.8 (Aug)
Peacock Creek	1.6	0.05	-	4.46	28.2 (July)

Headwater and tributary water quality boundaries were developed from these instream field data, expected low DO saturation values (Meyer, 1992), and GA EPD standard modeling practices (GA EPD, 1978). BOD_5 was converted to Ultimate Carbonaceous Biochemical Oxygen Demand ($CBOD_U$) by multiplying by an f-ratio of 2.5 (GA EPD, 1978), and ammonia was converted to Ultimate Nitrogenous Biochemical Oxygen Demand ($NBOD_U$) by multiplying by the stoichiometric conversion factor of 4.57. Water temperatures were varied across the basin in accordance with the summer sampling data.

Average monthly discharge flows, BOD_5, NH_3, and DO concentrations for the discharges were obtained from 2002 Discharge Monitoring Reports (DMRs). These data were input into the calibration model. BOD_5 was converted to $CBOD_U$ by multiplying by an f-ratio of 2 if the BOD_5 is greater than 20 mg/L and an f-ration of 3 if the BOD_5 is 20 mg/L or less (GA EPD, 1978). Ammonia was converted to $NBOD_U$ by multiplying by 4.57. Table 10 is a summary of the actual discharges from these facilities for calendar year 2002.

Table 10. Summary of NPDES Discharges During 2002

Facility Name	NPDES Permit No.	Actual Discharge for Calendar Year 2002			
		Flow (MGD)	BOD_5 (mg/L)	NH_3 (mg/L)	DO (mg/L)
Twin City WPCP	GA0048666	0.25	26.5		4.84
Statesboro WPCP	GA0023108	3.22	1.07	0.09	6.35
Collins Pond	GA0021091	0.027	27.3		
Pembroke Pond	GA0033588	0.13	21.3		
Hinesville – Fort Stewart WPCP	GA0047180	5.13	4.98	0.97	7.38
US Army Fort Stewart – 001 002 003	GA0004308	0.005 0.021 0.122	6.25 16.2 11.71	0.66 0.835	
Larchmont Estates	GA0034819	0.24	10.0	0.18	
James Mitchell Middle School	GA0034061	0.0	-	-	-
ITT Grinnell	GA0003263	0.0116	7.0		
Newington Pond	GA0050202	0.0055	22.1		
Wadley Pond	GA0021024	0.19	25.6		5

* no permit limit or DMR data, assumed value

In shallow streams, SOD is an important part of the oxygen budget. However, there are no field SOD measurements in the Ogeechee River Basin. In the South 4 Basins, there are several SOD measurements that ranged from 0.9 to 1.9 $g/m^2/day$. An examination of South 4 SOD results was performed in order to develop realistic SOD values that could be applied to the Ogeechee DOSAG models.

Results from the 1998 South 4 calibrated models of existing conditions were compiled and summarized. An average value of existing SOD was determined to be 1.35 g/m^2/day. This represented 12 models that had mixed land uses and varying degrees of point source activity. When the same 12 models were analyzed under natural conditions (assuming zero point source discharges and completely forested watersheds), SOD averaged 1.25 g/m^2/day. These two values were adopted for the Ogeechee models to represent SOD for: 1) mixed land uses, including agriculture; and 2) natural or totally forested watersheds, respectively. From this, the anthropogenic nonpoint source contributions, those caused by land disturbing activities, are accounted for in the 0.1 g/m^2/day difference between the two adopted SOD values.

Stream velocities were calculated using the soil equation based on either the Atlantic Coastal Flatwoods or Southern Coast Plain soil provinces coefficients. The kinetic rates and input parameters developed during model calibration are provided in Table 11. These parameters include the carbonaceous BOD (CBOD) decay rate, nitrogenous BOD (NBOD) decay rate, SOD rate, and the Tsivoglou reaeration coefficient used to determine stream reaeration. In addition, GA Estuary requires a dispersion coefficient.

Table 11. Modeling Parameters

Parameter	DOSAG Values	GA ESTUARY Values
CBOD Decay Rate (1/day)	0.1	0.05-0.1
NBOD Decay Rate (1/day)	0.25	0.05-0.1
SOD (g/m^2/day)	1.25-1.35	0.75-2.0
Reaeration Coefficient	0.054	0.16-1.34
Dispersion Coefficient (mi^2/day)	NA	0.09-33.5

The Ogeechee River Basin DOSAG models were calibrated at locations where the USGS collected discrete water quality data during 2002. Appendix C provides the DO calibration curves plotted with the data from monitoring stations in the listed segments.

4.3 Critical Conditions Models

The critical conditions models were used to assess the dissolved oxygen standard and to determine if problems exist requiring regulatory intervention. Model critical conditions were developed in accordance with GA EPD standard practices (GA EPD, 1978).

For the twenty-three listed segments in the Ogeechee River Basin, only one segment, Black Creek, had both water quality and daily flow data for the year 2002. Since low flow data were limited at best, low flow analyses of the available Ogeechee River Basin flow data were performed. Data from the adjacent long-term USGS gages were analyzed to determine 7-day, 10-year minimum flows (7Q10s). Productivity factors, in cubic feet per second (cfs) per square mile, were computed by dividing the 7Q10s by the watershed areas at the gages. Table 12 summarizes the low-flow analyses and Figure 6 shows the proximity of these USGS long-term gages to the listed stream segments. The 7Q10 productivity factors developed from the USGS data were used to develop model input for the Ogeechee River Basin DOSAG models by multiplying them by the listed segment watershed drainage areas.

Table 12. Low-Flow Analysis Summary for the Ogeechee River Basin

DO TMDL Segment	7Q10 (cfs)	Drainage Area (sq. miles)	Productivity Factor (cfs/sq. mile)
UPPER OGEECHEE HUC 03060201			
South Fork Ogeechee River near Crawfordville 02199700	1.2	31	0.038
Ogeechee River near Jewell 02200000	4.8	242	0.020
Chew Mill Creek near Herndon 02201300	0.9	23	0.037
Ogeechee River near Louisville 02200500	91	800	0.114
Williamson Swamp Creek near Davisboro 02201000	12.0	94	0.127
LOWER OGEECHEE HUC 03060202			
Ogeechee River at Scarboro 02202000	180	1940	0.093
Ogeechee River near Eden 02202500	240	2650	0.091
Black Creek near Blitchton 02202600	0.2	227	0.001
CANOOCHEE HUC 03060203			
Canoochee River near Claxton 02202000	1.6	555	0.003
COASTAL OGEECHEE HUC 03060204			
Peacock Creek near McIntosh 02203559	0.5	33	0.016

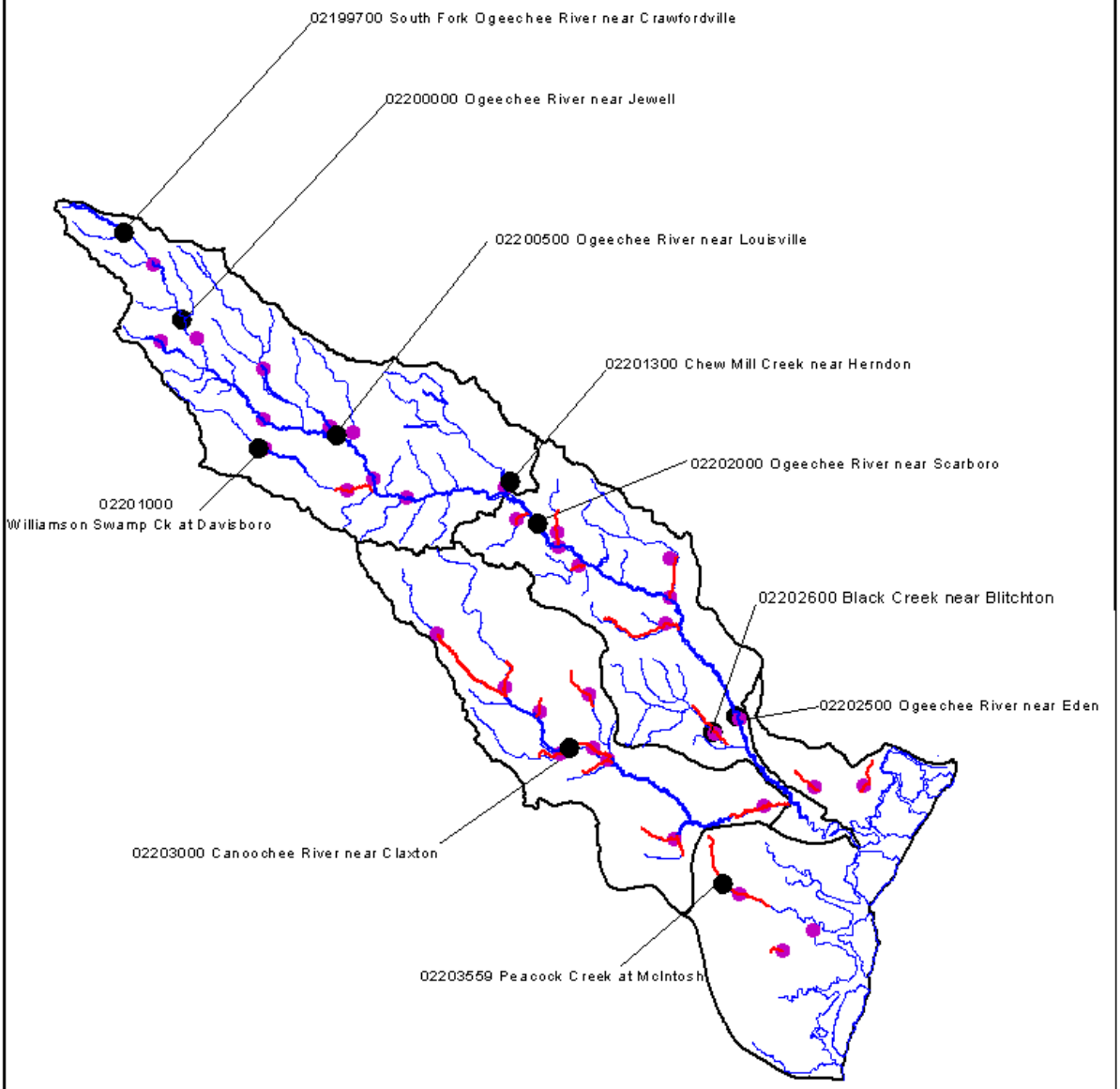
Source: Carter, R.F., E.H. Hopkins and H.A. Perlman, 1988
Carter, R. F. and S. A. Putnam, 1978

Critical water temperatures were determined by examining the 2002 water quality data and the long-term trend monitoring data. Harmonic sine functions were developed for the historical data from all of the long-term monitoring stations. The highest summer-time temperature from either the 2002 water quality data or the harmonic fit was used to represent each of the listed segments.

Point sources were incorporated into the critical conditions models at their current NPDES permit limits. For NPDES permits that do not have DO and/or ammonia limits, values of 2 mg/L and 17.4 mg/L were assumed, respectively. Water quality boundaries, the SOD rate, and all other modeling rates and constants were the same as those in the calibrated models.

4.4 Natural Conditions Models

For the natural conditions models, two changes were made to the critical conditions models. First, the SOD was changed from 1.35 g/m^2/ day to 1.25 g/m^2/day to reflect the change from mixed land uses to natural or completely forested land uses. Second, all point source discharges were completely removed from the model. All other model parameters remained the same. These models were used to determine the natural dissolved oxygen concentrations during critical conditions. These models predicted the natural dissolved oxygen concentrations, during the critical summer months, to be less than 5.0 mg/L. It is important to note: 1) even though DO was found to be low in the summer of 2002, the results are even lower at standard critical conditions; and 2) the summer of 2002 conditions are very close to critical conditions and compare favorably with the target of 90 percent of the natural DO standard. Results of natural conditions runs are plotted in the graphs in Appendix C along with the calibration, critical conditions and TMDL results for comparison.



TMDL Evaluation - Dissolved Oxygen
Ogeechee River Basin

Figure 6. Location of the USGS Low Flow Gaging Stations in the Ogeechee River Basin

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. A TMDL is the sum of the individual waste load allocations (WLAs) from point sources and load allocations (LAs) from nonpoint sources, as well as the 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 (USEPA, 1991). TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. For oxygen demanding substances, this TMDL is expressed in lbs/day.

Conceptually, a TMDL can be expressed as follows:

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

This TMDL determines the allowable oxygen demanding loads to the listed segments in the Ogeechee River Basin. The following sections describe the various oxygen demanding sources which may contribute loads to the TMDL components.

5.1 Waste Load and Load Allocations

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems, as well as permitted storm water discharges. There are eleven NPDES permitted facilities in the Ogeechee River watershed that effect instream dissolved oxygen. Waste load allocations are provided to the point sources from municipal and industrial wastewater treatment systems. Table 13 lists the WLAs required to meet the target DO standard.

The Georgia DOSAG and Georgia ESTUARY critical conditions models were used to determine the WLAs for the discharges upstream from or within the listed segments in order to meet the DO standards. Allocations are based on EPA Dissolved Oxygen Criteria, which states that if the natural dissolved oxygen is less than the standard, then only a 10 percent reduction in the natural condition is allowed. The target limits are defined as 90 percent of the naturally occurring dissolved oxygen concentration at critical conditions. Appendix C contains plots of the DO concentrations resulting from the TMDL loads versus the target DO Standard. Note that if the TMDL plot is higher than the target DO Standard plot, there is additional assimilative capacity in the stream available for future WLA.

When a wasteload allocation predicts the critical dissolved oxygen concentrations to be less 3.0 mg/L, the biological integrity of the stream will need to be evaluated. The biological evaluation should include a habitat assessment, aquatic macroinvertebrate community assessment, fish community assessment, and in-situ physical and chemical measurements. The most updated Standard Operating Procedures (SOP) should be used for the macroinvertebrate and fish assessments.

The TMDL will be used to assess permit renewals. If necessary, GA EPD may modify the WLAs during the NPDES permitting process. The assimilative capacity might not be fully allocated for all of the listed segments. Future wasteload allocations might be allowed if the discharge does not result in a concentration lower than 90 percent of the natural dissolved

Table 13. Ogeechee River Basin WLAs

Facility Name	NPDES Permit No.	Receiving Stream	NPDES Permit Limits			
			Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)
Canoochee River Basin						
Twin City WPCP	GA0048666	Thick Creek	0	-	-	-
Statesboro WPCP	GA0023108	Little Lotts Creek	10	5	1	6
Collins Pond	GA0021091	Canoochee River	0.027	5	1	6
Hinesville – Fort Stewart WPCP	GA0047180	Taylors Creek	7.15	5	1	6
US Army Fort Stewart - 001	GA0004308	Canoochee River	0.035	5	1	6
002		Canoochee River	0.035	5	1	6
003		Mill Creek	0.5	5	1	6
Little Ogeechee Basin						
Larchmont Estates	GA0034819	Larchmont Canal	0.65	5	1	6
Mill Creek Basin						
William James Middle School	GA0034061	Belcher Branch	0.2	5	1	6
ITT Grinnell	GA0003263	Mill Creek	0.019	5	1	6
Ogeechee Creek						
Newington Pond	GA0050202	Ogeechee Creek	0.045	5	1	6
Williamson Swamp Creek						
Wadley Pond	GA0021024	Williamson Swamp Creek	0.215	5	1	6

oxygen concentration during critical conditions. However, it should be noted that the SOD rates used in the TMDL allocation models were based on model predictions and may need to be verified before WLAs are implemented.

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 the various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and 4) they do not incorporate wastewater treatment plants that control specific pollutants to meet numeric 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 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 Georgia DOSAG and Georgia ESTUARY Ogeechee River Basin models were run under critical conditions, assuming 7Q10 flows and dry weather conditions. Because the critical conditions occur when there are no storm events, no numeric allocation is given to the waste load allocations from storm water discharges associated with MS4s (WLAsw).

The nonpoint source loads for the existing LA and TMDL were computed from the model boundary conditions, which include the stream, tributary, and headwater model boundaries under critical conditions. The partitioning of allocations between point (WLA) and nonpoint (LA) sources shown in Table 14 is based on modeling results and professional judgment.

Several streams (Canoochee, Cedar, Fifteenmile, Horse, and Sculls Creeks) have been found to have high background BOD_5 and ammonia levels. Additional monitoring should be conducted in these streams in order to determine the source of these elevated levels.

5.2 Seasonal Variation

The low flow, high temperature 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 7Q10 flows;
- Hot summer temperatures;
- Conservative reaction rates; and
- The assumption that all point sources continuously discharge at their NPDES permit limits for the same critical period.

Table 14. TMDL Loads for the Ogeechee River Basin under Critical Conditions

Stream Segment	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL (lbs/day)
Black Creek	-	NA	20.4	20.4
Bull Creek	-	NA	50.2	50.2
Canoochee Creek - US SR 119, Fort Stewart	-	NA	12.6	12.6
Canoochee Creek - Taylors Creek to Canoochee River	1,250.5	NA	24.3	1,274.8
Canoochee River - GA Hwy 192 to Fifteenmile Creek	-	NA	185.1	185.1
Canoochee River - Cedar Creek to Lotts Creek	-	NA	361.2	361.2
Canoochee River -Savage Creek to Ogeechee River	11.4	NA	952.0	963.4
Casey Canal -Head of Canal to DeRenne Ave., Savannah	-	NA	3.9	3.9
Casey Canal -DeRenne Ave. to Montgomery Crossroad	-	NA	5.9	5.9
Cedar Creek	9.8	NA	5.6	15.4
Fifteenmile Creek	-	NA	60.1	60.1
Hayners Creek	-	NA	8.0	8.0
Horse Creek	-	NA	24.8	24.8
Little Ogeechee River	106.3	NA	9.6	115.9
Lotts Creek	1,635	NA	294.5	1,929.5
Mill Creek	35.8	NA	98.1	133.9
Nevills Creek	-	NA	8.3	8.3
Ogeechee Creek	7.4	NA	21.2	28.6
Peacock Creek		NA	7.8	7.8
Sculls Creek	-	NA	6.3	6.3
South Newport River	-	NA	21.2	21.2
Tenmile Creek	-	NA	3.8	3.8
Williamson Swamp Creek	35.1	NA	613.5	648.6

Note: TMDL expressed as Ultimate Oxygen Demand (UOD), which includes the Carbonaceous Biochemical Oxygen Demand (CBOD) and the Nitrogenous Biochemical Oxygen Demand (NBOD).
NA = no storm water discharges associated with MS4s contributing to the listed segment during critical conditions

6.0 RECOMMENDATIONS

6.1 Monitoring

Water quality monitoring is conducted at a number of locations across the State each year. The 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 (GA EPD, 1996). The Ogeechee and Savannah River Basins were the basins of focused monitoring in 2002 and will again receive focused monitoring in 2007.

The revised TMDL Implementation Plans for the listed streams in the Ogeechee River Basin will include monitoring plans which describe pertinent current or impending water quality monitoring activities, recommended future monitoring activities, and suggest procedures for coordinating those activities.

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 conducted using a phased approach. Permitted discharges will be regulated through the NPDES permitting process described in this report. The permittee may be required to perform temperature and dissolved oxygen monitoring upstream and downstream of the point source. The target WLA reduction needed may not be implemented until sufficient data has been collected to verify the model assumptions. If it is determined that the model assumptions need to be modified, the target WLA reductions will be re-evaluated based on the new data collected during critical conditions, and the TMDL will be reallocated.

The 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 that 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 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 period is being provided for this TMDL. During that time, the availability of the TMDL will be publicly noticed, a copy of the TMDL will be provided upon request, and the public is 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. NPDES permit discharges are a primary source of excessive pollutant loading, where they are a factor. 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)]. Nonpoint sources are the secondary cause of excessive pollutant loading in most cases. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some BMPs. The "Management Measure Selector Table" shown below identifies these management strategies by source category and pollutant.

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. Revised TMDL Implementation Plans will be prepared or updated and accepted by EPD by the end of September 2007.

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 a 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 once GA EPD accepts the Revised TMDL Implementation Plan.

Management Measure Selector Table

Land Use	Management Measures	*Fecal Coliform*	*Dissolved Oxygen*	*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*	*Dissolved Oxygen*	*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

Water Quality Data

2002 Monitoring Water Quality Stations

Stream Segment	Location	USGS Monitoring Station No.	Monitoring Station Description
Black Creek	Ash Branch to Mill Creek near Blitchton (Bulloch/Bryan Co)	02202600	Black Creek at State Road 30 near Blichton, Georgia
Bull Creek	Strickland Pond to Canoochee River near Daisy (Evans Co)	02203450	Bull Creek at Road S2664 (Sunbury Road) near Daisy, Georgia
Canoochee Creek	Upstream SR 119, Fort Stewart (Liberty Co)	02203514	Canoochee Creek at State Road 119 near Hinesville, Georgia
Canoochee Creek	Taylors Creek to Canoochee River, Fort Stewart (Liberty Co)	02203514	Canoochee Creek at State Road 119 near Hinesville, Georgia
Canoochee River	GA Hwy 192 to Fifteenmile Creek near Metter (Emanuel/Candler Co)	02202835	Canoochee River at State Road 192 near Stillmore, Georgia
Canoochee River	Cedar Creek to Lotts Creek (Evans Co)	02203010	Canoochee River, Daisy Nevils Rd, near Daisy, Georgia
Canoochee River	Savage Creek to Ogeechee River (Liberty/Bryan Co)	02203519	Canoochee River - Hwy 67
Casey Canal	Head of Canal to DeRenne Ave., Savannah (Chatham Co)	022035408	Casey Canal South at Montgomery Cross Road at Savannah, Georgia
Casey Canal	DeRenne Ave. to Montgomery Crossroad, Savannah (Chatham Co)	022035408	Casey Canal South at Montgomery Cross Road at Savannah, Georgia
Cedar Creek	Water Hole Creek to Canoochee River, Claxton (Evans Co)	02202969	Cedar Creek at State Road 129 at Claxton, Georgia
Fifteenmile Creek	Stocking Head Branch to Canoochee River near Metter (Chandler Co)	02202903	Fifteenmile Creek at Candler County Road 28 near Metter, Georgia
Hayners Creek	Casey Canal (Montgomery Crossroad) to Vernon River (Chatham Co)	022035408	Casey Canal South at Montgomery Cross Road at Savannah, Georgia
Horse Creek	Little Horse Creek to Ogeechee River near Rocky Ford (Screven Co)	02202080	Horse Creek at State Road 17 near Rocky Ford, Georgia
Little Ogeechee River	Little Ogeechee River Pond to below US Hwy 17 near Burroughs (Chatham Co)	02203538	Little Ogeechee River at U.S. Highway 17 near Burroughs, Georgia
Lotts Creek	US Hwy 301 to Little Lotts Creek near Register (Bulloch Co)	02203205	Lotts Creek at State Road 250 (Nevils-Daisy Rd.) near Nevils, Georgia
Mill Creek	Newsome Branch to Ogeechee River near Statesboro (Bulloch Co)	02202367	Mill Creek at Bulloch Cnty Road 386 Old River Road near Brooklet, Georgia
Nevills Creek	Bay Gull Creek to Ogeechee River near Rocky Ford (Bulloch Co)	02202128	Nevills Creek at Bulloch County Road 578 near Rocky Ford, Georgia
Ogeechee Creek	Rd S2178 to Ogeechee River near Oliver (Screven Co)	02202240	Ogeechee Creek at State Road 17 at Oliver, Georgia
Peacock Creek	Hwy 144 to North Newport River near McIntosh (Liberty Co)	02203561	Peacock Creek at Lewis Fraser Road near Midway, Georgia
Sculls Creek	Richardson Creek to Ogeechee River near Scarboro (Jenkins Co)	02201848	Sculls Creek at Jenkins County Road 200 near Millen, Georgia
South Newport River	Upstream US Hwy 17, South Newport (Liberty/McIntosh Co)	02450001	South Newport River at U.S. Highway 17 at South Newport, Georgia
Tenmile Creek	Upstream Canoochee River, Excelsior (Candler Co)	02202920	Tenmile Creek at Road S2242 (Adabelle Road) near Excelsior, Georgia
Williamson Swamp Creek	Mill Creek to Ogeechee River, Wadley (Jefferson Co)	02201151	Williamson Swamp Creek at U.S. Highway 1 East at Wadley, Georgia

Figure A-1
Dissolved Oxygen and Instantaneous Flow Measurements
02202600 Black Creek at State Road 30 near Blichton, Georgia

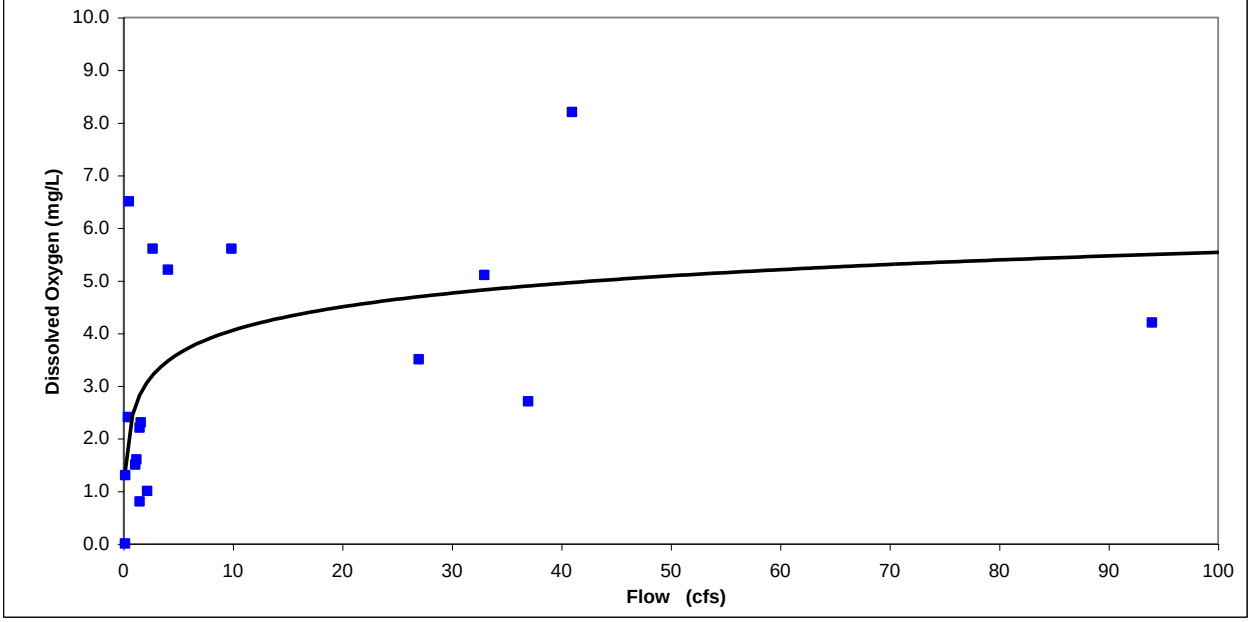


Table A-1. Data for Figure A-1

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Temp (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
10-Jan-02	0.52	6.5	11.7	8.2	1.2	0.05
14-Feb-02	9.90	5.6	10.9	2.8	1.3	<0.01
21-Feb-02	4.10	5.2	14.1			
28-Feb-02	2.70	5.6	9.8			
7-Mar-02	41.00	8.2	12.2	39.0	1.8	0.05
18-Apr-02	1.10	1.5	22.6	29.0	2.2	0.14
30-May-02	0.18	1.3	22.8	8.2	1.8	0.02
13-Jun-02	1.60	2.3	23.7			
20-Jun-02	0.16		22.9			
27-Jun-02	0.43	2.4	24.1	7.4	2.3	0.06
18-Jul-02	1.50	2.2	26.9	45.0	1.2	0.13
8-Aug-02	1.20	1.6	24.3	37.0	1.4	0.05
15-Aug-02	2.20	1.0	23.1			
22-Aug-02	1.50	0.8	23.6			
4-Sep-02	37.00	2.7	24.2	27.0	1.0	0.04
3-Oct-02	94.00	4.2	23.1	65.0	1.5	0.07
7-Oct-02	27.00	3.5	25.3			
16-Oct-02	117.00	5.0	18.8			
23-Oct-02	33.00	5.1	18.2			
14-Nov-02	708.00	5.9	15.5	52.0	1.5	<0.01
19-Dec-02	370.00	7.9	10.7	37.0	1.0	<0.01

Figure A-2
Dissolved Oxygen and Instantaneous Flow Measurements
02203450 Bull Creek at Road S2664 (Sunbury Road) near Daisy, Georgia

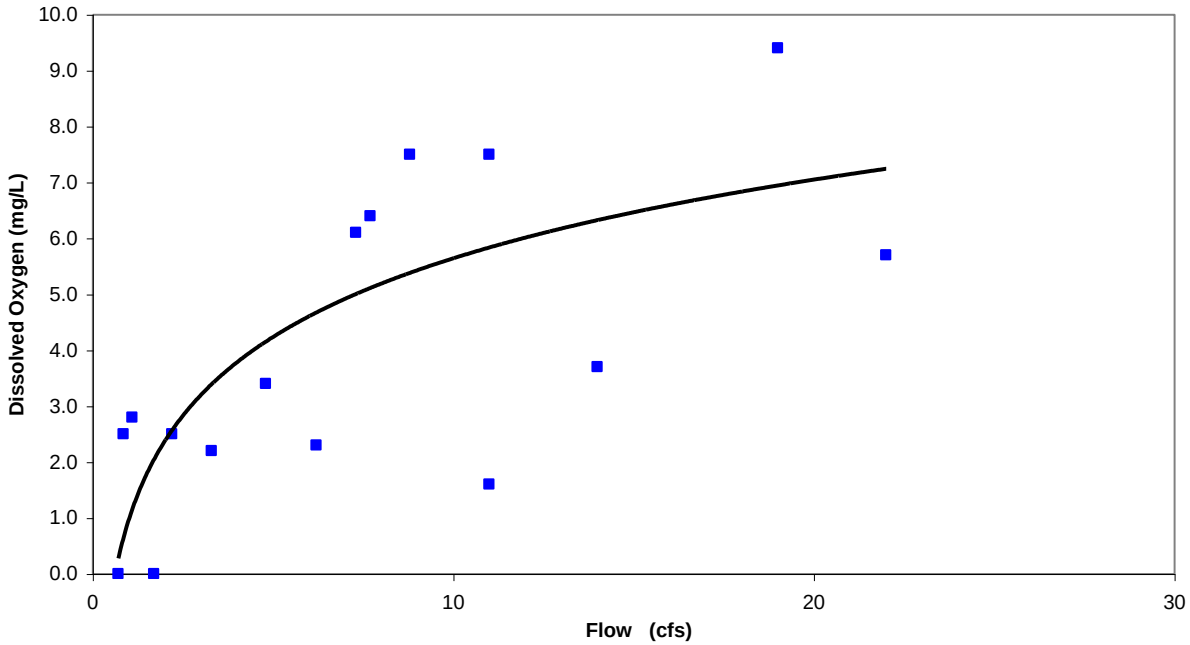


Table A-2. Data for Figure A-2

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
9-Jan-02	7.30	6.1	5.5	7.2	1.9	0.05
13-Feb-02	11.00	7.5	9.3	3.3	1.3	<0.01
20-Feb-02	8.80	7.5	9.7			
27-Feb-02	7.70	6.4	10.2			
6-Mar-02	22.00	10.3	9.2	18.0	0.6	0.02
17-Apr-02	4.80	3.4	20.2	20.0	0.7	0.17
29-May-02	2.20	2.5	19.5	14.0	1.1	0.11
12-Jun-02	1.70		21.4			
19-Jun-02	0.71		21.0			
26-Jun-02	0.85	2.5	23.4	8.2	1.5	0.14
17-Jul-02	6.20	2.3	25.5	12.0	1.3	0.09
7-Aug-02	1.10	2.8	24.6	8.1	1.0	0.04
14-Aug-02	3.30	2.2	22.2			
1-Oct-02	11.00	1.6	23.8	7.5	1.4	0.06
15-Oct-02	14.00	3.7	19.3			
13-Nov-02	22.00	5.7	17.6	24.0	2.1	0.02
18-Dec-02	19.00	9.4	8.6	18.0	1.2	0.03

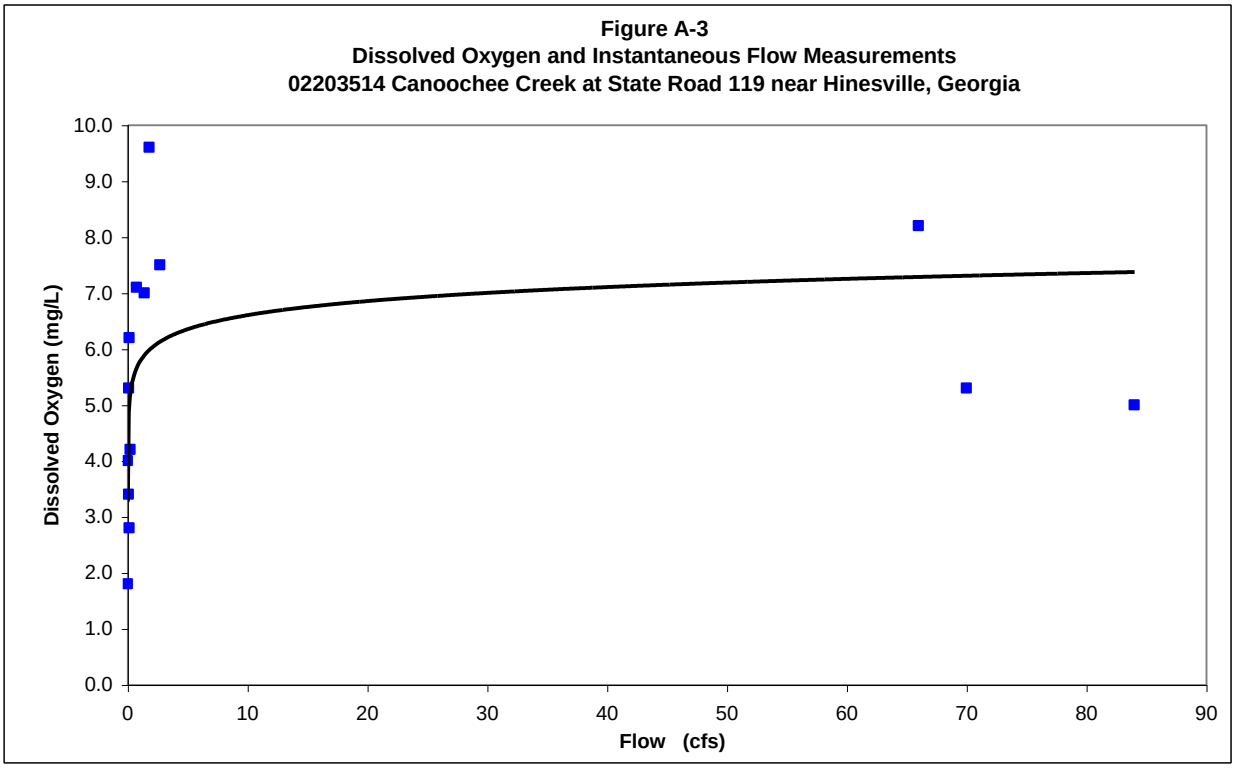


Table A-3. Data for Figure A-3

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
5-Mar-02	1.80	9.6	10.2			
12-Mar-02	0.76	7.1	23.7			
19-Mar-02	0.10	5.3	24.6	37.0	4.9	0.02
26-Mar-02	0.14	6.2	20.7			
10-Apr-02	0.23	4.2	29.9	46.0	2.1	0.14
16-Jul-02	0.00	4.0	26.1			
23-Jul-02	0.00	1.8	27.8			
17-Sep-02	0.14	2.8	21.3	51.0	1.0	0.11
22-Oct-02	0.08	3.4	12.5	48.0	1.8	0.06
19-Nov-02	84.00	5.0	12.6	55.0	1.9	0.07
20-Nov-02	70.00	5.3	13.6			
5-Dec-02	2.70	7.5	8.7			
10-Dec-02	1.40	7.0	9.0			
17-Dec-02	66.00	8.2	10.1	36.0	1.6	0.05

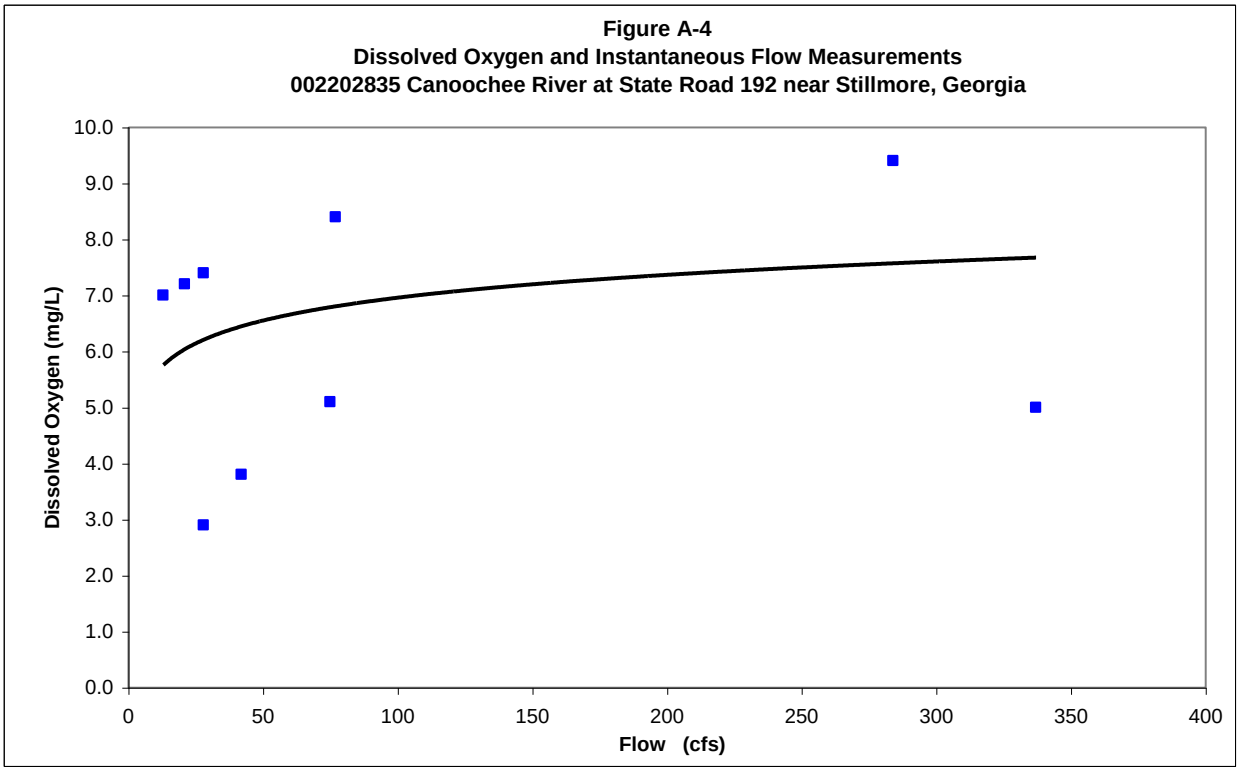


Table A-4. Data for Figure A-4

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
9-Jan-02	13.0	7.0	2.3	13.0	1.9	0.03
13-Feb-02	77.0	8.4	7.5	4.3	1.4	0.02
20-Feb-02	28.0	7.4	11.9			
27-Feb-02	21.0	7.2	7.7			
6-Mar-02	120.0	10.4	5.7	15.0	0.8	0.02
17-Apr-02	75.0	5.1	22.5	24.0	1.1	0.05
15-Oct-02	28.0	2.9	17.2			
22-Oct-02	42.0	3.8	18.3			
13-Nov-02	337.0	5.0	16.4	28.0	2.3	0.01
18-Dec-02	284.0	9.4	7.6	17.0	1.3	0.02

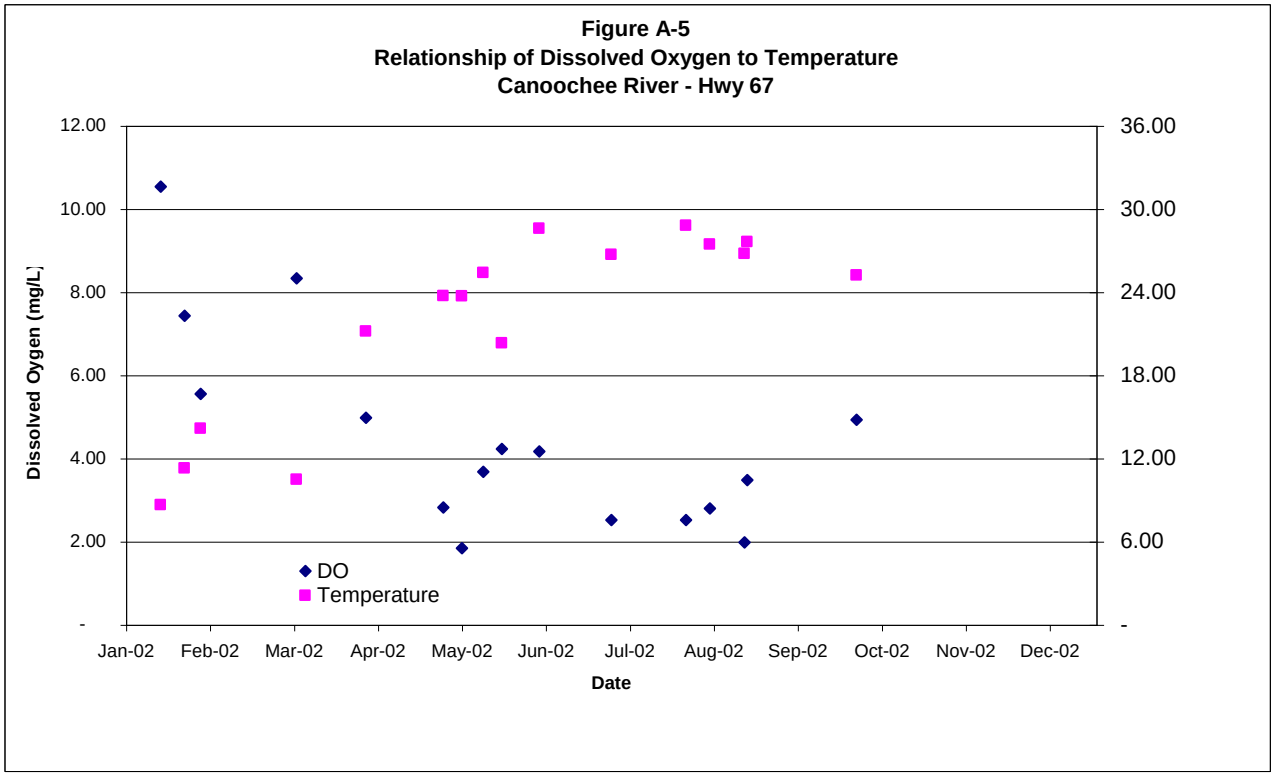


Table A-5. Data for Figure A-5

Date	Dissolved Oxygen (mg/L)	Water Temperature (deg C)
14-Jan-02	10.54	8.64
23-Jan-02	7.43	11.30
29-Jan-02	5.55	14.15
06-Mar-02	8.33	10.48
01-Apr-02	4.98	21.18
30-Apr-02	2.82	23.72
07-May-02	1.84	23.71
15-May-02	3.68	25.39
22-May-02	4.23	20.32
05-Jun-02	4.17	28.59
02-Jul-02	2.52	26.70
30-Jul-02	2.52	28.80
08-Aug-02	2.80	27.45
21-Aug-02	1.98	26.77
22-Aug-02	3.48	27.62
02-Oct-02	4.93	25.21

Figure A-6
Dissolved Oxygen and Gage Heights
022035408 Casey Canal South at Montgomery Crossroad at Savannah, Georgia

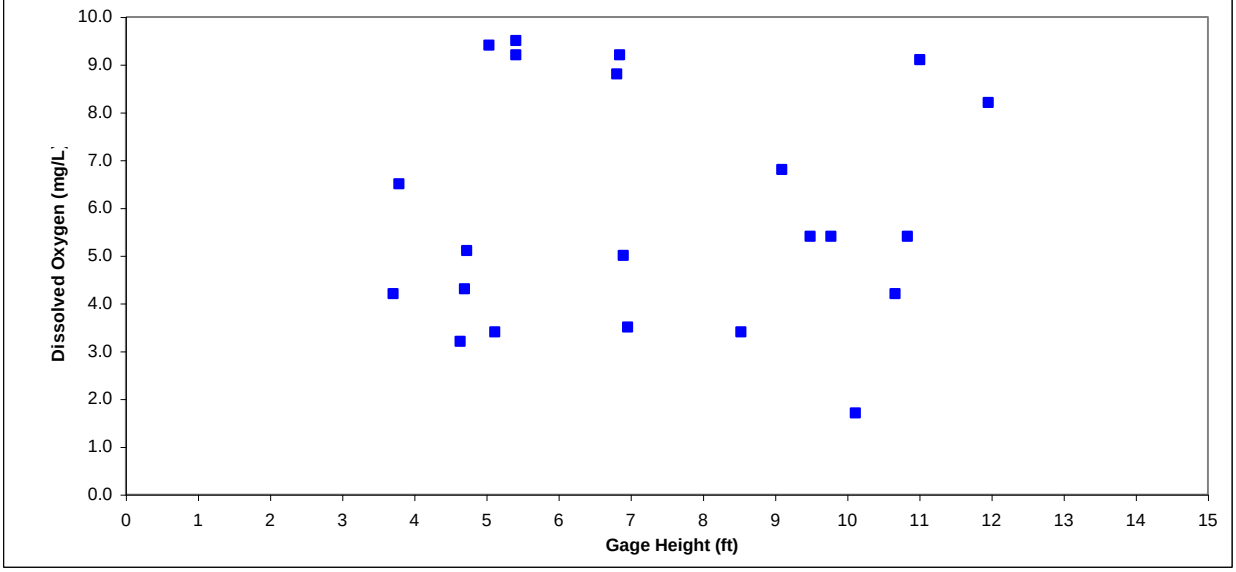


Table A-6. Data for Figure A-6

Date	Gage Height (ft)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
15-Jan-02	9.78	5.4	11.0	6.1	3.2	0.09
26-Feb-02	6.81	8.8	17.1	5.2	6.7	0.02
5-Mar-02	3.79	6.5	9.5			
12-Mar-02	10.84	5.4	18.0			
19-Mar-02	5.12	3.4	21.0	6.3	2.2	0.34
26-Mar-02	3.71	4.2	25.0			
10-Apr-02	9.49	5.4	23.2	5.8	3.0	0.19
14-May-02	5.04	9.4	27.9			
21-May-02	6.90	5.0	19.7	8.2	2.6	0.24
4-Jun-02	4.73	5.1	30.4			
11-Jun-02	8.53	3.4	26.9	8.4	2.7	
9-Jul-02	9.10	6.8	28.7	8.4	2.4	0.63
16-Jul-02	4.64	3.2	29.6			0.35
23-Jul-02	10.12	1.7	30.3			
1-Aug-02	4.70	4.3	29.5	7.4	4.4	
17-Sep-02	6.96	3.5	27.6	7.3	2.1	0.06
22-Oct-02	10.67	4.2	22.3	7.0	2.1	0.45
19-Nov-02	11.01	9.1	12.7	9.2	1.5	0.29
20-Nov-02	5.41	9.2	14.8			
5-Dec-02	11.96	8.2	10.1			
10-Dec-02	5.41	9.5	10.9			
17-Dec-02	6.85	9.2	13.6	7.0	3.2	0.28

Figure A-7
Dissolved Oxygen and Instantaneous Flow Measurements
02202969 Cedar Creek at State Road 129 at Claxton, Georgia

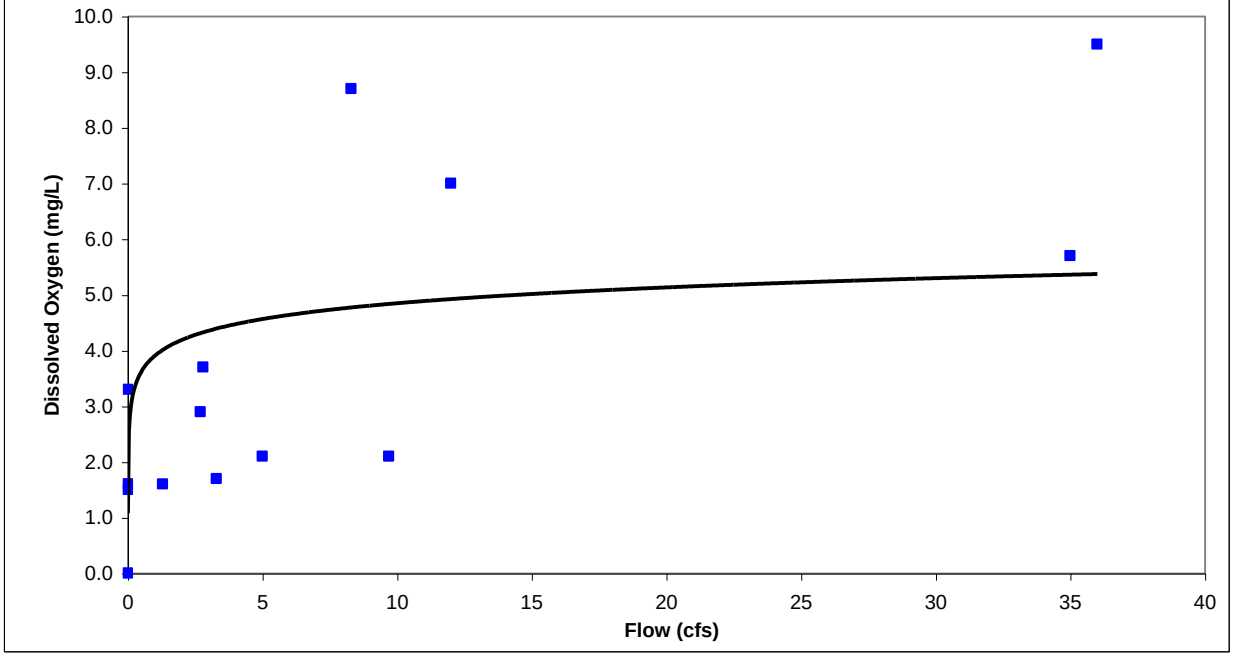


Table A-7. Data for Figure A-7

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
9-Jan-02	8.3	8.7	6.3	13.0	2.1	0.90
13-Feb-02	3.3	1.7	9.2	3.0	4.4	<0.01
20-Feb-02	2.8	3.7	9.8			
27-Feb-02	2.7	2.9	9.5			
6-Mar-02	12.0	7.0	10.4	18.0	1.5	0.04
17-Apr-02	9.7	2.1	20.5	32.0	3.1	0.05
29-May-02	0.0	3.3	22.0	21.0	8.5	<0.01
12-Jun-02	0.0		23.9			
19-Jun-02	0.0		23.2			
26-Jun-02	0.0	1.6	25.0	10.0	2.7	0.13
17-Jul-02	0.0	1.5	26.4	17.0	1.8	0.11
7-Aug-02	0.0	1.6	27.9	14.0	3.1	0.26
14-Aug-02	0.0	1.5	25.1			
1-Oct-02	1.3	1.6	24.5	14.0	1.9	0.06
15-Oct-02	5.0	2.1	19.9			
13-Nov-02	35.0	5.7	17.6	28.0	2.1	0.01
18-Dec-02	36.0	9.5	8.1	19.0	1.4	0.01

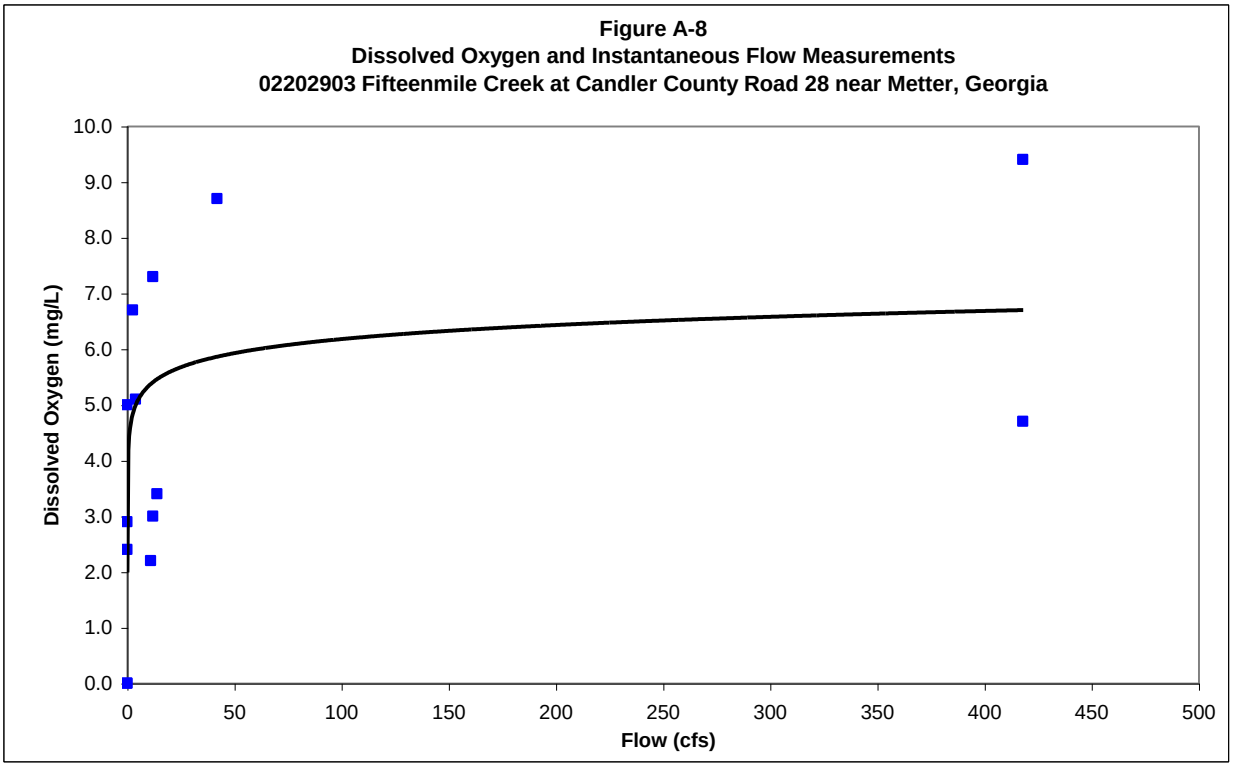


Table A-8. Data for Figure A-8

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
9-Jan-02	0.0	5.0	7.3	21.0	5.9	0.05
13-Feb-02	12.0	7.3	9.1	4.6	1.8	0.03
20-Feb-02	2.6	6.7	11.5			
27-Feb-02	4.0	5.1	9.2			
6-Mar-02	42.0	8.7	7.2	19.0	0.7	0.03
17-Apr-02	14.0	3.4	21.9	33.0	1.8	0.13
29-May-02	0.0	2.4	22.0	42.0	1.7	1.30
12-Jun-02	0.0		23.2			
19-Jun-02	0.0		22.9			
26-Jun-02	12.0	3.0	23.9	26.0	5.1	0.05
17-Jul-02	0.0	2.9	26.6	25.0	1.9	0.36
15-Oct-02	11.0	2.2	18.2			
13-Nov-02	418.0	4.7	17.2	29.0	1.9	0.02
18-Dec-02	418.0	9.4	8.1	17.0	1.1	0.01

Figure A-9
Dissolved Oxygen and Instaneous Flow Measurements
02202080 Horse Creek at State Road 17 near Rocky Ford, Georgia

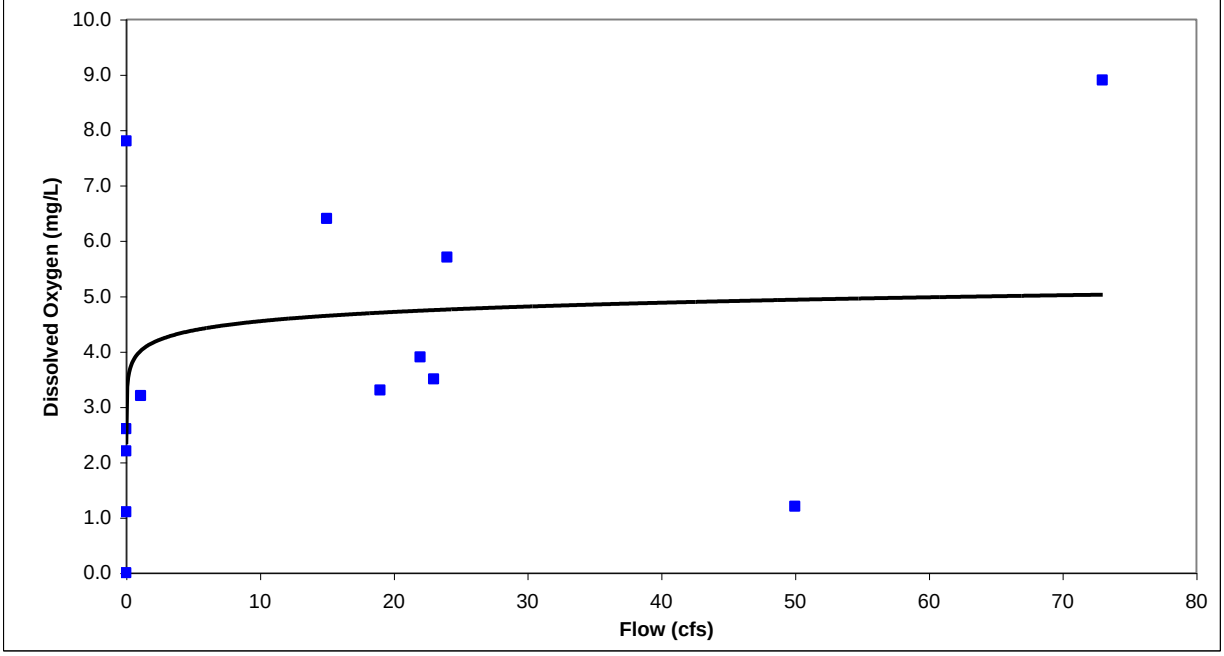


Table A-9. Data for Figure A-9

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
8-Jan-02	0.0	7.8	5.8	5.6	1.8	0.04
12-Feb-02	19.0	3.3	9.2	0.6	2.4	0.07
19-Feb-02	22.0	3.9	8.3			
26-Feb-02	23.0	3.5	10.6			
5-Mar-02	24.0	5.7	8.2	17.0	1.8	0.04
16-Apr-02	50.0	1.2	20.2	45.0	4.6	0.18
28-May-02	1.1	3.2	21.4	37.0	8.9	0.01
11-Jun-02	0.0	1.1	22.7			
18-Jun-02	0.0		23.7			
25-Jun-02	0.0	2.2	24.6	24.0	4.0	0.23
16-Jul-02	0.0	2.6	28.0	21.0	2.0	0.06
12-Nov-02	15.0	6.4	19.0	8.9	2.1	0.02
17-Dec-02	73.0	8.9	6.3	20.0	1.4	0.02

Figure A-10
Relationship of Dissolved Oxygen to Temperature
02203538 Little Ogeechee River at U.S. Highway 17 near Burroughs, Georgia

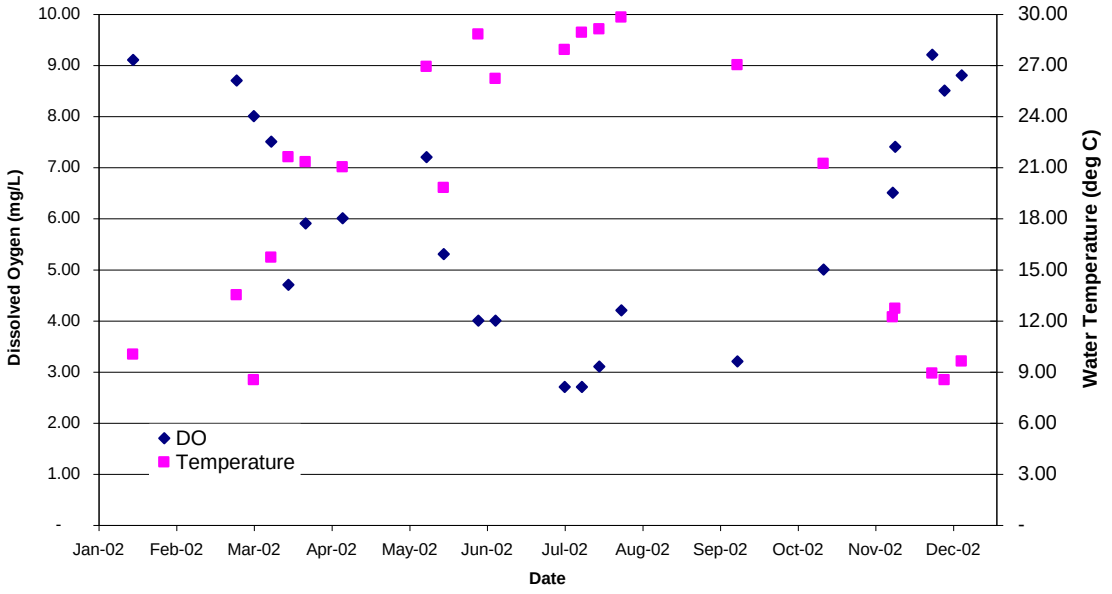


Table A-10. Data for Figure A-10

Date	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
15-Jan-02	9.10	10.00	11	1.7	0.26
26-Feb-02	8.70	13.50	6.5	2.1	0.02
5-Mar-02	8.00	8.50			
12-Mar-02	7.50	15.70			
19-Mar-02	4.70	21.60	12	2.5	0.17
26-Mar-02	5.90	21.30			
10-Apr-02	6.00	21.00	9.3	1.6	0.11
14-May-02	7.20	26.90			
21-May-02	5.30	19.80	13	1.8	0.14
4-Jun-02	4.00	28.80			
11-Jun-02	4.00	26.20	11	2.1	0.26
9-Jul-02	2.70	27.90	18	2	0.32
16-Jul-02	2.70	28.90			
23-Jul-02	3.10	29.10			
1-Aug-02	4.20	29.80	15	2.4	0.05
17-Sep-02	3.20	27.00	11	0.9	0.23
22-Oct-02	5.00	21.20	24	1.5	0.13
19-Nov-02	6.50	12.20	30	2	0.07
20-Nov-02	7.40	12.70			
5-Dec-02	9.20	8.90			
10-Dec-02	8.50	8.50			
17-Dec-02	8.80	9.60	39	1.6	0.04

Figure A-11
Dissolved Oxygen and Instantaneous Flow Measurements
02203205 Lotts Creek at State Road 250 (Nevils-Daisy Rd.) near Nevils, Georgia

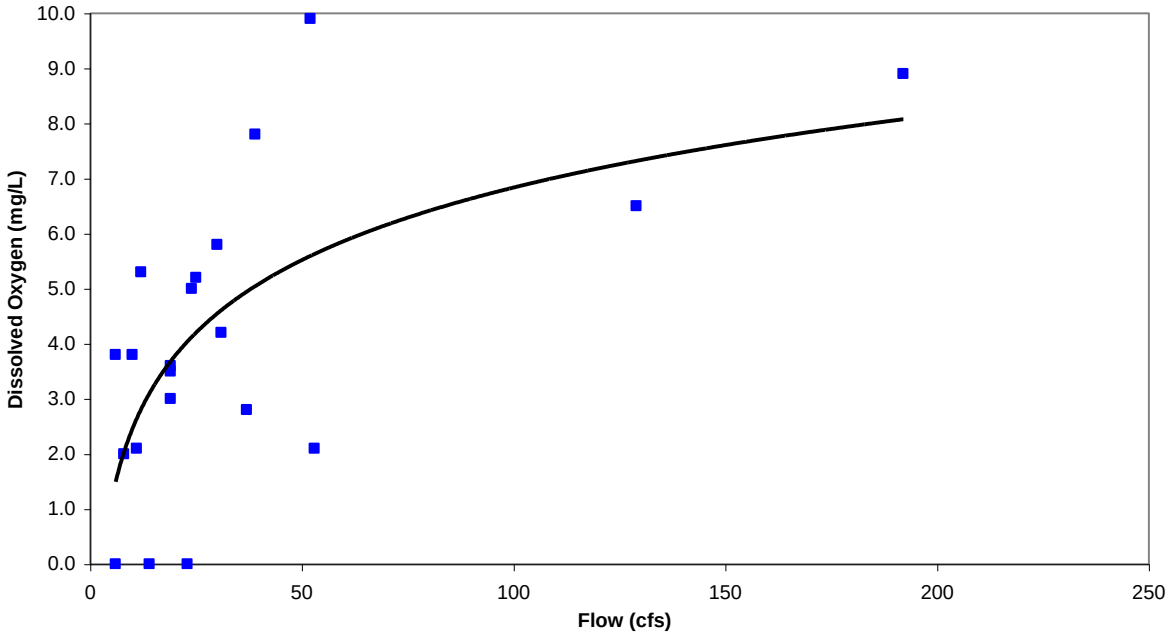


Table A-11. Data for Figure A-11

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
9-Jan-02	25.0	5.2	5.3	7.6	1.2	0.03
13-Feb-02	39.0	7.8	9.9	2.6	1.4	0.01
20-Feb-02	30.0	5.8	10.5			
27-Feb-02	31.0	4.2	10.8			
6-Mar-02	52.0	9.9	10.4	12.0	1.2	0.04
17-Apr-02	37.0	2.8	20.8	19.0	1.1	0.15
29-May-02	19.0	3.6	20.0	12.0	1.6	0.04
12-Jun-02	14.0		22.3			
19-Jun-02	6.0		21.9			
26-Jun-02	19.0	3.0	23.5	8.8	2.4	0.07
17-Jul-02	23.0		26.0	33.0	1.5	0.21
7-Aug-02	11.0	2.1	25.6	2.2	2.2	0.12
14-Aug-02	6.0	3.8	23.1			
21-Aug-02	8.0	2.0	24.1			
3-Sep-02	53.0	2.1	25.8	21.0	1.0	0.08
1-Oct-02	19.0	3.5	24.4	21.0	1.2	0.13
7-Oct-02	10.0	3.8	25.1			
15-Oct-02	24.0	5.0	19.0			
22-Oct-02	12.0	5.3	19.1			
13-Nov-02	129.0	6.5	17.2	16.0	1.2	0.10
18-Dec-02	192.0	8.9	8.7	26.0	1.4	0.20

Figure A-12
Dissolved Oxygen and Instantaneous Flow Measurements
02202367 Mill Creek at Bulloch Cnty Road 386 Old River Road near Brooklet, Georgia

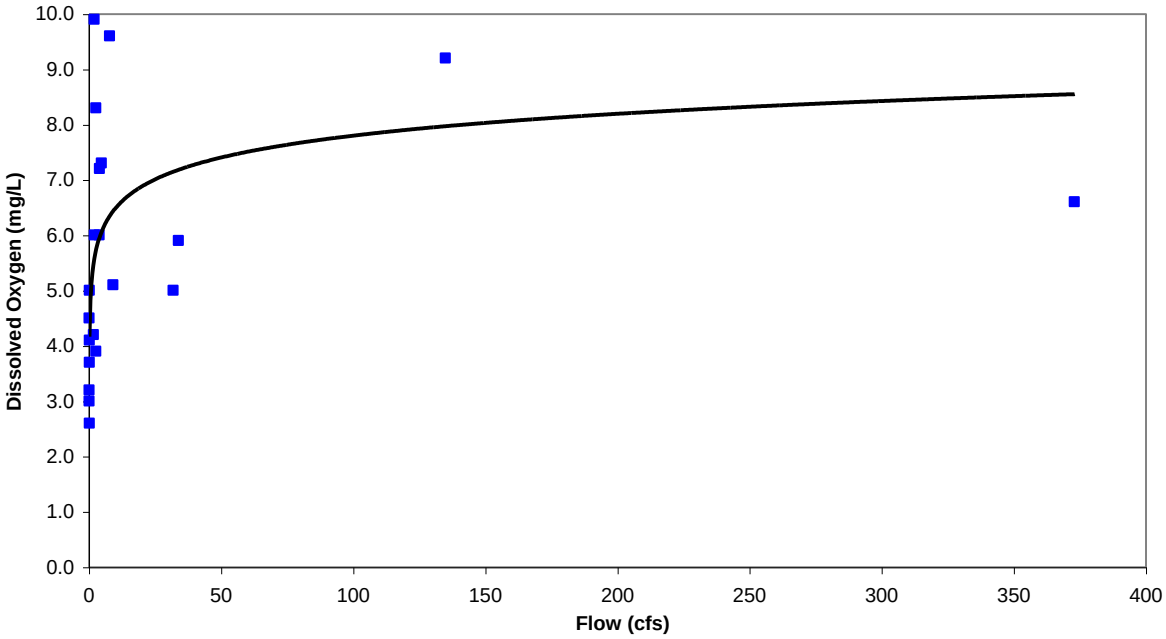


Table A-12. Data for Figure A-12

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
10-Jan-02	2.1	9.9	7.6	11.0	1.9	0.12
14-Feb-02	4.8	7.3	9.5	17.0	1.6	0.02
21-Feb-02	4.1	7.2	13.2			
28-Feb-02	2.7	8.3	7.8			
7-Mar-02	7.9	9.6	10.6	19.0	1.3	0.08
18-Apr-02	2.7	3.9	21.8	16.0	1.9	0.18
30-May-02	0.2	4.5	23.9	14.0	1.4	0.07
13-Jun-02	0.3	3.7	25.2			
20-Jun-02	0.3	4.1	24.7			
27-Jun-02	32.0	5.0	24.4	20.0	2.1	0.08
18-Jul-02	0.3	5.0	26.9	18.0	0.7	0.11
8-Aug-02	0.2	2.6	24.1	17.0	1.5	0.14
15-Aug-02	0.2	3.2	26.1			
22-Aug-02	0.2	3.0	28.5			
4-Sep-02	1.8	4.2	24.4	22.0	1.0	0.09
2-Oct-02	9.2	5.1	25.0	25.0	1.1	0.07
8-Oct-02	4.0	6.0	25.6			
16-Oct-02	34.0	5.9	19.3			
23-Oct-02	2.2	6.0	18.1			
14-Nov-02	373.0	6.6	14.9	29.0	1.9	0.01
19-Dec-02	135.0	9.2	9.5	19.0	0.9	<0.01

Figure A-13
Dissolved Oxygen and Instantaneous Flow Measurements
02202128 Nevills Creek at Bulloch County Road 578 near Rocky Ford, Georgia

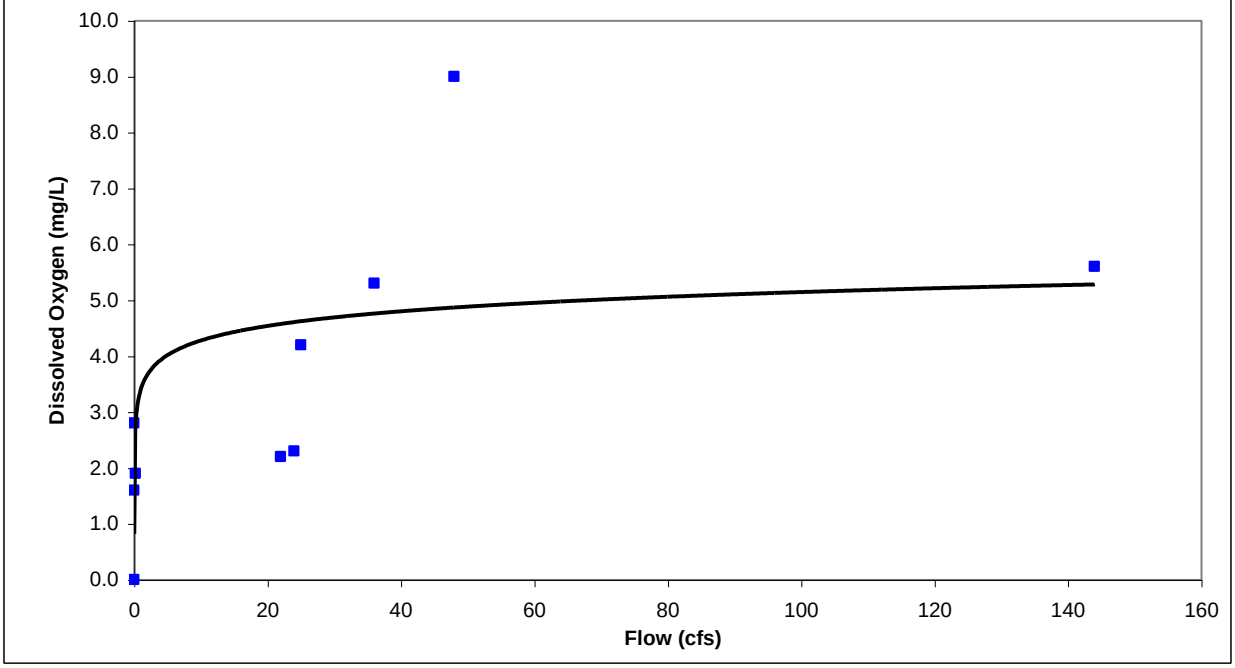


Table A-13. Data for Figure A-13

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
10-Jan-02	0.0	2.8	5.6	7.3	2.0	0.40
28-May-02	0.2	1.9	19.8	18.0	2.6	0.06
11-Jun-02	0.0	1.6	21.3			
18-Jun-02	0.0		21.8			
2-Oct-02	22.0	2.2	22.8	49.0	1.5	0.16
8-Oct-02	24.0	2.3	23.2			
16-Oct-02	36.0	5.3	17.3			
22-Oct-02	25.0	4.2	18.6			
12-Nov-02	144.0	5.6	19.3	33.0	1.9	0.01
17-Dec-02	48.0	9.0	7.2	23.0	1.0	0.05

Figure A-14
Dissolved Oxygen and Instantaneous Flow Measurements
02202240 Ogeechee Creek at State Road 17 at Oliver, Georgia

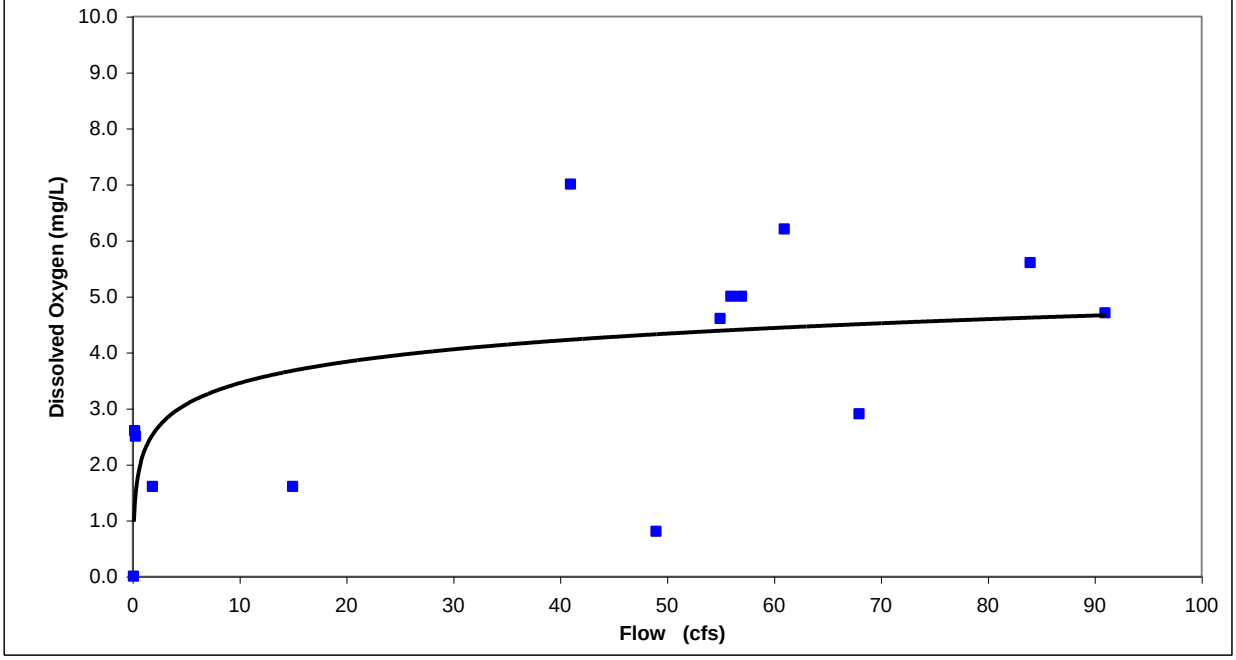


Table A-14. Data for Figure A-14

Date	Instantaneous Flow On Sample Day (cfs)	Dissolved Oxygen (mg/L)	Temp (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
10-Jan-02	41.0	7.0	6.9	13.0	1.0	0.04
14-Feb-02	56.0	5.0	8.9	22.0	0.8	<0.01
21-Feb-02	57.0	5.0	13.2			
28-Feb-02	55.0	4.6	8.4			
7-Mar-02	61.0	6.2	10.4	24.0	1.3	0.01
18-Apr-02	49.0	0.8	21.6	25.0	2.1	0.21
30-May-02	0.2	2.6	23.2	26.0	5.0	0.02
13-Jun-02	0.3	2.5	25.4			
20-Jun-02	0.1		24.3			
27-Jun-02	1.9	1.6	25.0	17.0	2.7	0.22
18-Jul-02	15.0	1.6	26.4	36.0	1.6	0.02
16-Oct-02	68.0	2.9	17.6			
14-Nov-02	91.0	4.7	13.0	38.0	2.1	0.02
19-Dec-02	84.0	5.6	9.9	23.0	0.8	<0.01

Figure A-15
Dissolved Oxygen and Instantaneous Flow Measurements
02203561 Peacock Creek at Lewis Fraser Road near Midway, Georgia

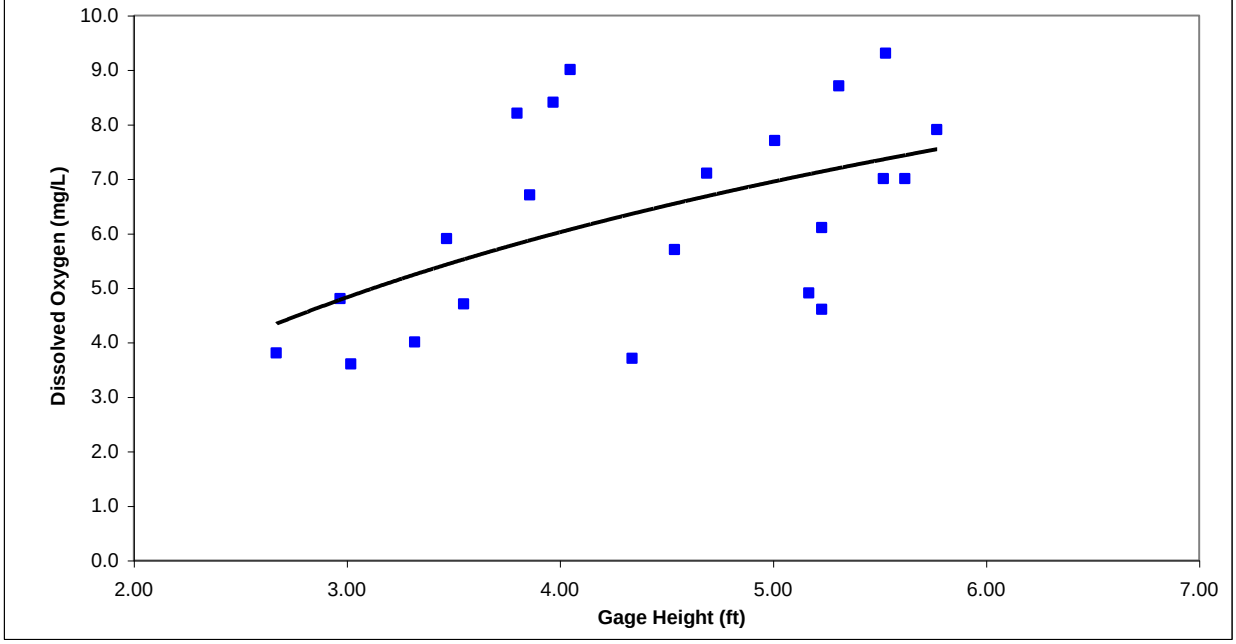


Table A-15. Data for Figure A-15

Date	Gage Height (ft)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
15-Jan-02	5.01	7.7	9.9	10.0	1.6	0.01
26-Feb-02	4.05	9.0	14.3	16.0	2.3	<0.01
5-Mar-02	3.80	8.2	9.8			
12-Mar-02	5.62	7.0	15.5			
19-Mar-02	3.32	4.0	22.0	18.0	1.8	0.02
26-Mar-02	5.52	7.0	17.7			
10-Apr-02	4.54	5.7	19.3	22.0	1.5	0.09
14-May-02	2.97	4.8	21.0			
21-May-02	3.86	6.7	18.1	8.7	1.5	0.04
4-Jun-02	3.47	5.9	28.2			
11-Jun-02	5.23	4.6	25.0	10.0	1.3	0.15
9-Jul-02	4.34	3.7	26.2	29.0	2.0	0.08
16-Jul-02	3.02	3.6	28.2			
23-Jul-02	5.17	4.9	28.2			
1-Aug-02	2.67	3.8	27.5	24.0	1.8	0.05
17-Sep-02	3.55	4.7	26.3	20.0	0.9	0.05
22-Oct-02	5.23	6.1	19.8	27.0	1.3	0.02
19-Nov-02	5.77	7.9	10.3	28.0	1.7	0.02
20-Nov-02	4.69	7.1	10.8			
5-Dec-02	5.53	9.3	8.1			
10-Dec-02	3.97	8.4	9.0			
17-Dec-02	5.31	8.7	8.8	26.0	1.6	0.01

Figure A-16
Dissolved Oxygen and Instantaneous Flow Measurements
02201848 Sculls Creek at Jenkins County Road 200 near Millen, Georgia

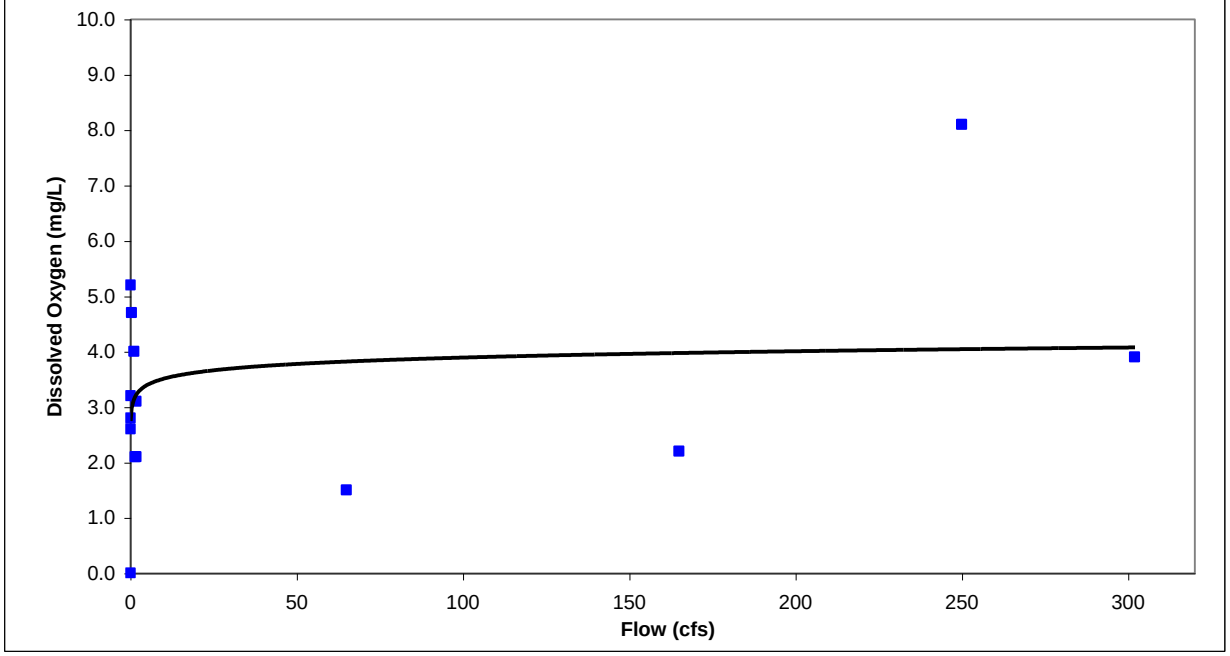


Table A-16. Data for Figure A-16

Date	Gage Height (ft)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
8-Jan-02	0.4	4.7	4.2	14.0	2.2	0.03
12-Feb-02	1.8	3.1	8.4	1.9	1.3	0.07
19-Feb-02	1.5	2.1	7.3			
26-Feb-02	1.8	2.1	8.6			
5-Mar-02	1.2	4.0	8.4	17.0	1.3	0.06
16-Apr-02	65.0	1.5	21.1	27.0	2.8	0.11
28-May-02	0.1	2.6	19.5	29.0	4.0	0.06
11-Jun-02	0.1	3.2	21.3			
18-Jun-02	0.1		21.9			
25-Jun-02	0.1	5.2	23.6	22.0	8.6	0.10
16-Jul-02	0.1	2.8	25.2	20.0	4.2	0.03
16-Oct-02	165.0	2.2	16.9			
12-Nov-02	302.0	3.9	18.5	19.0	1.2	0.01
17-Dec-02	250.0	8.1	7.4	15.0	1.0	0.02

Figure A-17
Dissolved Oxygen and Instaneous Flow Measurements
02450001 South Newport River at U.S. Highway 17 at South Newport, Georgia

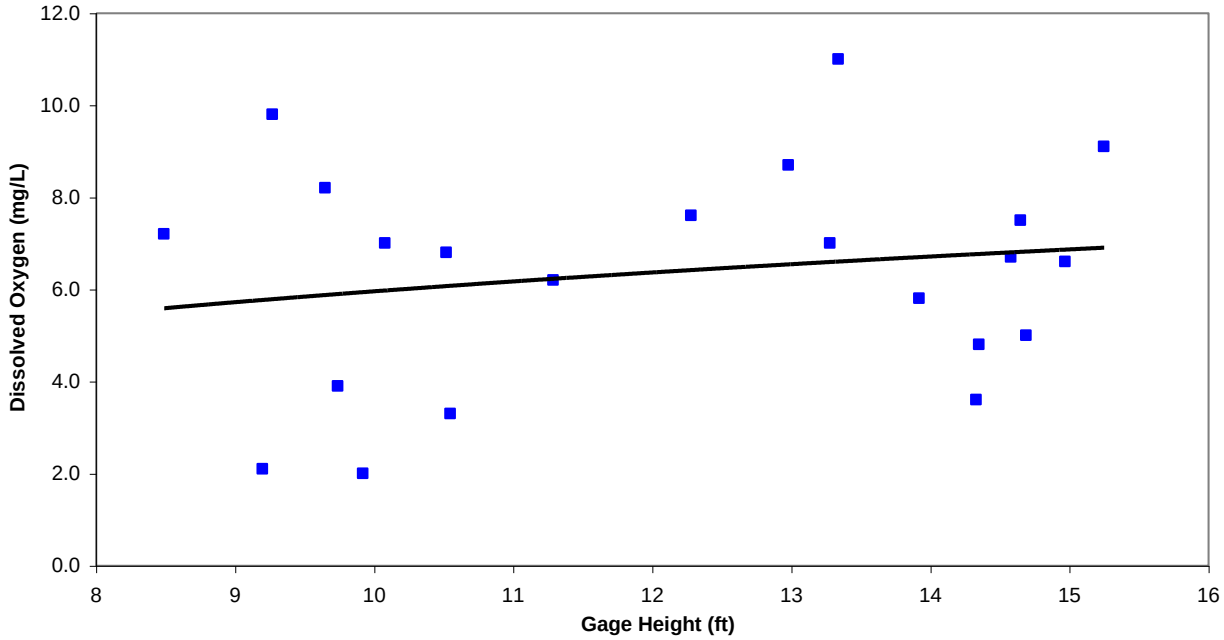


Table A-17. Data for Figure A-17

Date	Gage Height (ft)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD5 (mg/L)	Ammonia (mg/L)
15-Jan-02	13.34	11.0	10.6	8.7	2.2	0.02
26-Feb-02	9.27	9.8	16.3	16.0	2.1	0.04
5-Mar-02	8.49	7.2	10.7			
12-Mar-02	14.65	7.5	17.3			
19-Mar-02	12.28	7.6	21.8	6.3	1.5	0.08
26-Mar-02	14.97	6.6	20.0			
10-Apr-02	13.28	7.0	21.4	6.3	1.6	0.11
14-May-02	13.92	5.8	27.1			
21-May-02	10.08	7.0	21.6	12.0	1.9	0.14
4-Jun-02	9.74	3.9	29.4			
11-Jun-02	14.35	4.8	26.8	10.0	1.8	0.48
9-Jul-02	9.65	8.2	26.4	70.0	3.2	0.40
16-Jul-02	9.92	2.0	29.5			
23-Jul-02	14.33	3.6	30.1			
1-Aug-02	9.20	2.1	30.8	36.0	2.8	0.53
17-Sep-02	10.55	3.3	26.3	45.0	1.7	0.11
22-Oct-02	14.69	5.0	21.6	33.0	1.6	0.12
19-Nov-02	14.58	6.7	13.7	26.0	1.4	0.09
20-Nov-02	11.29	6.2	13.2			
5-Dec-02	15.25	9.1	10.5			
10-Dec-02	10.52	6.8	9.4			
17-Dec-02	12.98	8.7	9.0	29.0	1.5	0.04

Figure A-18
Dissolved Oxygen and Instantaneous Flow Measurements
02202920 Tenmile Creek at Road S2242 (Adabelle Road) near Excelsior, Georgia

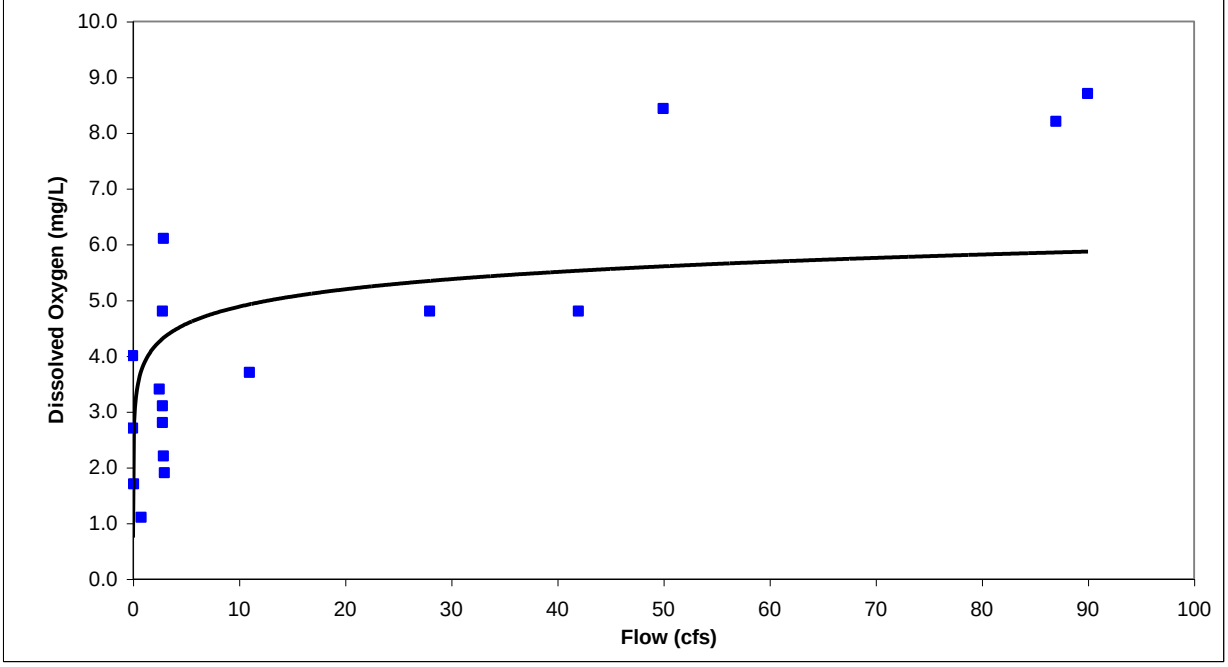


Table A-18. Data for Figure A-18

Date	Gage Height (ft)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
27-Jan-97	50.0	8.4	9.5		1.4	<0.01
28-Jul-97	0.8	1.1	25.7		1.4	0.14
11-Aug-97	28.0	4.8	23.6			
18-Aug-97	11.0	3.7	24.8			
25-Aug-97	3.0	1.9	21.2		0.8	0.05
29-Sep-97	0.1	1.7	20.7		2.2	0.03
6-Oct-97	0.0	4.0	21.3			
20-Oct-97	2.5	3.4	15.2			
27-Oct-97	42.0	4.8	19.1		2.0	0.01
17-Nov-97	90.0	8.7	8.8		1.4	0.03
22-Dec-97	87.0	8.2	12.0		1.0	0.02
13-Feb-02	2.8	2.8	10.0	2.7	2.8	<0.01
20-Feb-02	2.8	4.8	11.1			
27-Feb-02	2.8	3.1	10.4			
6-Mar-02	2.9	6.1	9.0	15.0	0.9	0.06
17-Apr-02	2.9	2.2	19.6	17.0	2.0	0.37
29-May-02	0.0	2.7	21.7	23.0	5.2	0.01

Figure A-19
Dissolved Oxygen and Instantaneous Flow Measurements
02201151 Williamson Swamp Creek at U.S. Highway 1 East at Wadley, Georgia

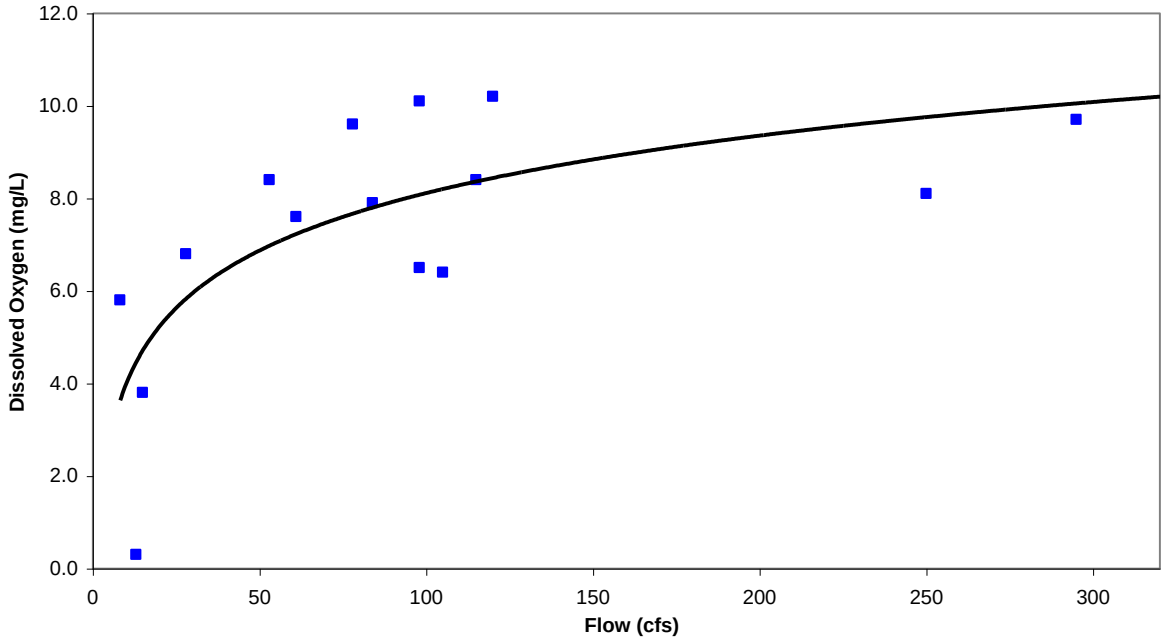


Table A-19. Data for Figure A-19

Date	Gage Height (ft)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	TOC (mg/L)	BOD_5 (mg/L)	Ammonia (mg/L)
30-Jan-02	84.0	7.9	14.4	5.6	0.6	0.02
26-Feb-02	78.0	9.6	10.4	6.0	1.3	0.03
6-Mar-02	295.0	9.7	6.5			
12-Mar-02	115.0	8.4	12.8			
20-Mar-02	98.0	6.5	20.4	7.4	1.0	0.09
17-Apr-02	105.0	6.4	20.4	8.1	0.1	0.09
22-May-02	53.0	8.4	15.1	6.8	1.9	0.06
4-Jun-02	28.0	6.8	25.7			
12-Jun-02	8.2	5.8	23.2			
19-Jun-02	15.0	3.8	23.1	7.9	5.3	0.74
27-Aug-02	13.0	0.3	25.3			
6-Nov-02	61.0	7.6	15.6	9.0	0.1	0.02
21-Nov-02	250.0	8.1	12.2	9.9	0.8	0.03
3-Dec-02	98.0	10.1	6.6			
10-Dec-02	120.0	10.2	7.0			
17-Dec-02	370.0	10.2	7.5	8.6	1.0	0.02

APPENDIX B

Model Structure

B-1. Black Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Upper Black Creek					
		Headwater		7.07	
1	S	Headwater to Unnamed Trib nr Doe Drive	1.81	4.31	19.7
2	T	Unnamed Tributary near Doe Drive	-	4.24	-
3	S	Unnamed Tributary 1 to Jeni-Wright Lane	2.04	9.85	13.1
4	S	Jeni-Wright Lane to U/S Arcola Road	1.63	6.23	7.4
5	S	U/S Arcola Road to RM 14.13	1.98	4.96	9
6	S	RM 14.13 to Iric Branch	1.48	2.79	5
7	B	Iric Branch	-	-	-
8	S	Iric Branch to Pole Branch	1.43	1.01	4.9
9	B	Pole Branch	-	-	-
10	S	Pole Branch to George Road	0.96	1.33	5.3
11	S	George Road to Lower Black Creek	0.85	1.21	4.6
12	B	Lower Black Creek	-	-	-
13	S	Lower Black Creek to SR 119 Caney Br	1.87	3.81	8.2
14	T	Caney Branch (SR 119)	-	13.78	-
15	S	SR 119 Caney Branch to nr Hardwood Tr	1.44	2.79	3.3
16	S	Near Hardwood Tr to near Caudill Road	1.85	2.98	4.6
17	S	Near Caudill Road to SR 30	1.34	4.99	2.6
18	S	SR 30 to RM 1.28	1.63	2.19	3.2
19	S	RM 1.28 to Mill Creek	1.28	1.01	2.5
Iric Branch					
		Headwater		13.63	
20	S	Headwater to near Mud Road	1.97	6.57	23
21	S	Near Mud Road to Black Creek	2.26	5.9	16.4
Pole Branch					
		Headwater		5.92	
22	S	Headwater to Mud Rd	1.78	7.7	9
23	S	Mud Rd to Black Creek	2.13	4.23	10.7
Lower Black Creek					
		Headwater		11.96	
24	S	Headwater to Woodstock Branch Trib	3.53	9.85	29.5
25	T	Woodstock Branch Trib	-	4.59	-
26	S	Woodstock Br Trib to nr Brooklet Denmark	1	1.86	9.8
27	S	Near Brooklet Denmark to Near Mud Rd	1.56	1.18	6.6
28	S	Near Mud Road to Near Old Happy Lane	1.22	4.02	9.8
29	S	Near Old Happy Lane to Luke Branch	1.4	1.09	9.8
30	B	Luke Branch	-	-	-
31	S	Luke Branch to near Hood Loop Road	1.87	7.71	6.6
32	S	Near Hood Loop Rd to nr D Hughs Lane	1.99	2.56	9.8
33	S	Near D Hughs Lane to Ash Branch	1.17	1.73	6.6
34	B	Ash Branch	-	-	-
35	S	Ash Branch to Black Creek	1.02	1.1	1.6
Luke Branch					
		Headwater		17.6	
36	S	Headwater to I-16 (unnamed trib 2)	1.79	5.98	9.8
37	T	Unnamed Tributary 2 (I-16)	-	8.42	-
38	S	I-16 (unnamed trib 2) to D/S SR 46	2	3.55	3.3
39	S	D/S SR 46 to Lower Black Creek	1.13	1.34	6.6

Ash Branch					
		Headwater		18.57	
40	S	Headwater to Coursey Road	2.28	4.98	6.6
41	S	Coursey Road to Lower Black Creek	1.8	3.46	13.1

Note: S: Stream
T: Tributary
B: Branch
D: Discharge

B-2. Canoochee Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Canoochee River					
		Headwater		35.1	
1	S	Headwater to Hughes Prong	6	15	22.8
2	T	Hughes Prong (Swainsboro City)	-	-	-
3	S	Hughes Prong to Little Canoochee River	7.2	21.9	20
4	T	Little Canoochee River	-	38.3	-
5	S	Little Canoochee River to Proposed Twin City Discharge	0.5	0.3	1
6	D	Proposed Twin City Discharge	-	-	-
7	S	Proposed Twin City Disch to Thick Creek	0.1	1	0.4
8	T	Thick Creek	-	12.9	-
9	S	Thick Creek to Trib. from Stillmore	4.3	18.7	12.6
10	S	Trib. from Stillmore to Sams Creek	7.7	31	21.3
11	S	Sams Creek to Fifteenmile Creek	5.3	26	8.7
12	B	Fifteenmile Creek	-	-	-
13	S	Fifteenmile Cr. to Tenmile Creek	6.4	11.4	36
14	B	Tenmile Creek	-	-	-
15	S	Tenmile Creek to Dry Creek	3.7	9.5	10
16	T	Dry Creek	-	20.4	-
17	S	Dry Creek to Cedar Creek	5.7	8.8	10
18	B	Cedar Creek	-	-	-
19	S	Cedar Creek to SR 301	2.5	7.7	3
20	D	Claxton Poultry LAS (SR 301)	-	-	-
21	S	SR 301 to 80ft Contour	3.6	9.8	7
22	S	80ft Contour to USGS gage	2.4	4	5
23	S	USGS gage to 70ft Contour	2.5	5.2	5
24	S	70ft Contour to Lotts Creek	2.8	2.6	3
25	B	Lotts Creek	-	-	-
26	S	Lotts Creek to Bull Creek	1.2	0.7	4
27	B	Bull Creek	-	-	-
28	S	Bull Creek to 1st Trib. (001)	11.3	38.5	12.2
29	D	Fort Stewart 001	-	-	-
30	S	1st trib. (001) to 2nd trib. from Reserve	4.7	27.9	6.7
31	S	2nd trib. from Reserve to Canoochee Ck	8.4	15.8	11.6
32	B	Canoochee Creek	-	-	-
33	S	Canoochee Creek to Fort Stewart 002	6.79	12.5	10
34	D	Fort Stewart Discharge 002	-	-	-
35	S	Fort Stewart 002 to Savage Creek	3.91	3.5	3.5
36	T	Savage Creek	-	56.6	-
37	S	Savage Creek to Ogeechee River	22.7	70.3	9.5
Fifteenmile Creek					
		Headwater (above Nathan Creek)		37.6	
38	S	Nathan Creek to Candler County Line	3.6	28.5	9.4
39	S	Candler County Line to Stocking Head Ck	5.8	29.8	13
40	S	Stocking Head Creek to Canoochee Riv	7.4	22.3	19.3

Tenmile Creek					
		Headwaters		18.7	
41	S	Headwater to Trib. from Atwood Pond	1.3	1	11.8
42	T	Tributary from Atwood Pond	-	14	-
43	S	Trib. from Atwood Pond to Canoochee River	3.3	13.5	20
Cedar Creek					
		Headwaters		7	
44	D	Collins Pond WPCP	-	-	-
45	S	Collins Pond to Cedar Creek	2.85	4.2	34
46	T	Cedar Creek	-	28.4	-
47	S	Cedar Creek to Waterhole Creek	6.7	9.6	19.5
48	S	Waterhole Creek to 100' contour	3.1	4.1	15
49	S	100' contour to Canoochee River	2.8	4.4	10
Lotts Creek					
		Headwater		9	
50	D	Statesboro WPCP	-	-	-
51	S	Statesboro WPCP to SR233	0.12	0.1	3
52	S	SR233 to County Rd Crossing	2.78	10.7	21
53	S	County Road Crossing to SR 252	1.83	3.25	8
54	S	SR 252 to SR 46	1.86	5.05	10
55	S	SR 46 to I-16	1.38	5.27	19
56	S	I-16 to Lotts Creek	1.38	0.88	9
57	T	Lotts Creek	-	155.7	-
58	S	Lotts Creek to Scott Creek	4.3	14.2	10
59	T	Scott Creek	-	23.3	-
60	S	Scott Creek to Canoochee River	6	28.8	25.5
Bull Creek					
		Headwater		2.1	
61	S	Ennis Branch to Bull Creek	2.18	2.38	22
62	T	Bull Creek to Proposed Discharge #2	-	37.82	-
63	D	Proposed Discharge #2	-	-	-
64	S	Proposed Discharge #2 to SR 129	3	10.6	23
65	S	SR 129 to Canoochee River	8	30	17
Canoochee Creek					
		Headwater		1	
66	D	Hinesville – Fort Stewart WPCP	-	-	-
67	S	Fort Stewart WPCP to SR 44	1.3	1.3	6
68	S	SR 44 to Taylor's Creek	0.6	0.3	3
69	T	Taylor's Creek (Fort Stewart 003)	-	96	-
70	D	Ft. Stewart WPCP 003	-	-	-
71	S	Taylor's Creek to Survey Sta. T7	1.4	2.4	3.9
72	S	Survey Sta. T7 to Survey Sta. 8	1	1.3	2.8
73	S	Survey Sta. T8 to Canoochee Creek	1.5	10.1	4.3
74	T	Canoochee Creek	-	134	-
75	S	Canoochee Creek to Canoochee River	4.2	10.9	10

B-3. Casey Canal Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Casey Canal					
		Headwater		0.9	
1	S	Headwater to Victory Drive	0.6	2.5	0.4
2	S	Victory Drive to Delesseps Ave.	1.1	2.1	0.8
3	S	Delesseps Ave. to DeRenne Ave.	1.0	1.6	0.7
4	S	DeRenne Ave. to Hammond Tributary	1.1	1.2	0.7
5	T	Hammond Tributary	-	3.0	-
6	S	Hammond Tributary to Sallie Moode Dr.	1.1	1.8	0.8
7	S	Sallie Moode Dr. to Montgomery X-Rd	0.9	2.0	0.6

B-4. Horse Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Horse Creek					
		Headwaters		10.98	
1	S	Headwater to Buttermilk Road	2.56	2.16	13.2
2	S	Buttermilk Road to Middle Prong	1.95	6.67	10
3	T	Middle Prong	-	8.53	-
4	S	Middle Prong to SR 21 @ Unnamed Trib	1.27	1.41	6.5
5	T	Unnamed Trib 1 (SR 21)	-	1.41	-
6	S	SR 21 @ Unnamed Trib to Billy Branch	1.85	1.85	7
7	T	Billy Branch	0	7.82	0
8	S	Billy Branch to Harrison Road	2.15	5.17	8.1
9	S	Harrison Road to Little Horse Creek	2.2	2.95	8.3
10	B	Little Horse Creek	-	-	-
11	S	Little Horse Creek to Flat Branch	2.16	4.52	12
12	B	Flat Branch	-	-	-
13	S	Flat Branch to RM 3.55	0.73	1.84	4
14	S	RM 3.55 to SR 17	1.19	1.86	6.7
15	S	SR 17 to RM 1.44	0.92	1.34	5.2
16	S	RM 1.44 to Ogeechee River	1.44	0.86	8.1
Little Horse Creek					
		Headwater		2.12	
17	S	Headwaters to Little Horse Creek Rd	1.26	1.38	23
18	S	Little Horse Creek Rd to Unnamed Trib 2	1.36	1.31	26
19	T	Unnamed Trib 2	-	1.71	-
20	S	Unnamed Trib 2 to Crooked Creek	0.35	0.12	3.4
21	T	Crooked Creek	-	5.31	-
22	S	Crooked Creek to Horse Creek	0.43	0.3	3.6
Flat Branch					
		Headwaters		2.84	
23	S	Headwater to RM 6.71	1.77	1.91	26
24	S	RM 6.71 to Horse Creek	2.43	1.19	23

B-5. Little Ogeechee River Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change (ft)
Little Ogeechee River					
		Headwater		45.7	
1	S	Headwaters to RM 3.4	1.71	5.98	6.6
2	S	RM 3.4 to RM 2.66	0.74	1.18	1.5
3	S	RM 2.66 to Unnamed Trib 1	0.85	0.89	1.7
4	T	Unnamed Trib 1	-	2.844	-
5	S	Unnamed Trib 1 to Larchmont Estates	0.89	0.72	1.5
6	D	Larchmont Estates PS	-	-	-
7	S	Larchmont Estates to Unnamed Trib 2	0.57	0.92	1.8
8	T	Unnamed Trib 2	-	2.924	-
9	S	Unnamed Trib 2 to Vernon River	0.35	0.09	1.1

B-6. Mill Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Mill Creek					
		Headwater		4.42	
1	S	Headwater to RM 26	0.96	3.76	9.84
2	S	RM 26 to US HWY 25	2.02	4.77	13.12
3	S	US HWY 25 to Friendship Church Rd	2.06	4.63	13.12
4	S	Friendship Church Rd to RM 20	2.2	3.91	6.56
5	S	RM 20 to RM 19	0.73	3.36	6.56
6	S	RM 19 to Belcher Branch Conf	3.15	6.85	22.97
7	D	ITT Grinnell & James Mitchell Mid School	-	0	-
8	T	Unnamed Trib 1	-	4.27	-
9	S	Belcher Branch to Unnamed Trib 2	1.57	2.6	6.56
10	T	Unnamed Trib 2	-	2.79	-
11	S	Unnamed Trib 2 to GA Hwy 24	2.21	8.71	9.84
12	S	GA HWY 24 to Bragg Chester Rd Trib 3	1.25	6.47	9.84
13	T	Bragg Chester Rd Trib 3	-	4.59	-
14	S	Bragg Chester Rd Trib 3 - Unnamed Trib 4	2.08	4.83	9.84
15	T	Unnamed Trib 4	-	4	-
16	S	Unnamed Trib 4 to Clito Rd	2.19	5.41	9.84
17	S	Clito Rd to Stilson-Leefield Rd	1.57	5.96	13.12
18	S	Stilson-Leefield Rd to Old River Rd South Spring Ck	2.23	3.65	13.12
19	T	Old River Rd South Spring Ck	-	12	-
20	S	Old River Rd South Spring Ck to RM 1.3	1.41	1.42	13.12
21	S	RM 1.3 to Ogeechee River	1.31	3.61	3.28

B-7. Nevills Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Nevills Creek					
		Headwater		3.59	
1	S	US Hwy 25 to Bay Gull Creek	2.81	2.42	26.1
2	T	Bay Gull Creek	-	4.49	-
3	S	Bay Gull Creek to County Line	1.49	1.51	13.8
4	S	County Line to Rocky Ford Rd	1.74	3.39	16.1
5	S	Rocky Ford Rd to E Hendrix Rd	1.65	3.89	13.8
6	S	E Hendrix Rd to Wyatt Creek	1.95	3.31	16.3
7	B	Wyatt Creek	-	-	-
8	S	Wyatt Creek to 1/4 mile D/S	0.27	0.12	1.2
9	S	1/4 mi D/S to 3/4 mi U/S USGS Station	0.73	0.78	3.3
10	S	3/4 mi U/S USGS to Old River N Rd	0.84	1.36	3.8
11	S	Old River N Rd to 1/2 mi D/S Old River N Rd	0.61	0.39	2.7
12	S	1/2 mi D/S Old River N Rd to unnamed Trib	0.49	0.14	2.2
13	T	Unnamed Trib	-	1.46	-
14	S	Unnamed Trib of Ogeechee River	0.63	0.44	2.8
Wyatt Creek					
		Headwater		2.60	
15	S	Headwater to Rattlesnake Creek	2.13	4.11	26
16	S	Rattlesnake Creek to Sweet Branch	3.14	2.29	33
17	T	Sweet Branch and Banks Creek	-	6.67	-
18	S	Banks Creek to Spring Branch	0.86	4.25	2
19	S	Spring Branch to D/S UT	0.55	3.40	2
20	S	D/S UT to Nevills Creek	2.23	2.65	13

B-8. Ogeechee Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Ogeechee Creek					
		Headwater		9.27	
1	S	Headwater to RM 27	2.79	6.44	19.7
2	S	RM 27 to RM 24.5	2.65	4.7	19.7
3	S	RM 24.5 to Unnamed Trib 1	2.63	5.63	16.4
4	T	Unnamed Trib 1	-	3.4	-
5	S	Unnamed Trib 1 to RM 20.6	1.29	4.85	5.4
6	S	RM 20.6 to RM 19.6	0.95	2.74	3.9
7	S	RM 19.6 to RM 18.6	0.99	1.17	4.1
8	S	RM 18.6 to S Fork OgeecheeCk	1.52	1.43	6.3
9	B	S Fork OgeecheeCreek	-	-	-
10	S	S Fork Ogeechee to Robbins Branch	2.48	6.19	8.1
11	T	Robbins Branch	0	9.93	0
12	S	Robbins Branch to RM 12	2.67	6.54	8.8
13	S	RM 12 to RM 10.4	1.53	7.17	5
14	S	RM 10.4 to RM 9	1.34	5.94	4.4
15	S	RM 9 to Newington Pond	1.98	8.47	6.5
16	D	Newington Pond GA0050202	-	-	-
17	S	Newington Pond to RM 5.5	1.57	4.77	6
18	S	RM 5.5 to RM 4	1.43	11.06	5
19	S	RM 4 to SR 17	1.83	11.62	7
20	S	SR 17 to Ogeechee River	2.27	3.12	9
South Fork Ogeechee Creek					
		Headwater	2.12	2.31	19.7
21	S	Headwaters to Elv 207 NGVD	1.93	1.87	19.7
22	S	Elv 207 NGVD to D/S Stoopto Rd	2.08	3.64	19.7
23	S	D/S Stoopto Rd to Hen Coop Branch	-	7.23	-
24	T	Hen Coop Branch	3.09	3.36	6.6
25	S	Hen Coop Branch to unnamed Trib 2	-	3.51	0
26	T	Unnamed Trib 2	2.4	5.13	26.2
27	S	Unnamed Trib 2 to Ogeechee River	2.12	2.31	19.7

B-9. Peacock Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi2)	Elevation Change(ft)
Peacock Creek					
		Headwater		14.68	
1	T	Headwater to RM 11.28	1.12	1.98	3.28
2	S	RM 11.28 to Unnamed Branch	1.73	1.94	3.28
3	T	Unnamed Branch	0	0	0
4	S	Unnamed Branch to Holmestown Rd	1.4	1.46	1.64
5	S	Holmestown Rd to Unnamed Trib	0	3.52	0
6	T	Unnamed Trib	0.62	2.45	1.64
7	S	Unnamed Trib to Lewis Frasier Rd	1.84	3.95	1.64
8	T	Lewis Frasier Rd to RM 4.7	1.04	2.12	1.64
9	B	RM 4.7 to S Coastal Hwy	1.98	2.87	1.64
10	S	S Coastal Hwy to RM 1.5	1.22	1.87	1.64
11	S	RM 1.5 to RM 0.7	0.71	0.74	1.64
12	S	RM 0.7 to N Newport R EOM	0.74	0.52	1.64
Unnamed Branch					
		Headwater		2.37	
13	S	Headwaters to RM 12	0.74	0.52	1.64
14	S	RM 12 to RM 11	1.17	2.84	3.28
15	S	RM 11 to Peacock Creek	1.47	2.84	1.64

B-10. Sculls Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Sculls Creek					
		Headwater		6.36	
1	T	Unnamed Tributary 1	-	6.14	-
2	S	Headwater to Sandy Hill Branch	1.41	1.98	13
3	T	Sandy Hill Branch	-	5.26	-
4	S	Sandy Hill Br. to u/s Elam (Fields) Rd	0.88	0.74	10
5	S	U/s Elam (Fields) Road to unnamed Trib 2	1.28	2.08	9
6	T	Unnamed Tributary 2	-	2.61	-
7	S	Unnamed Trib. 2 to nr Newton Ag Road	1.09	1.26	8
8	T	Nr Newton Ag Rd to Richardson Creek	0.78	1.57	5
9	B	Richardson Creek	-	-	-
10	S	Richardson Ck to 2 miles u/s of Old Savan.	0.37	0.26	3
11	S	2 mi U/s Old Savannah to Old Savannah	0.57	0.28	3
12	S	Old Savannah to RM 2.2	0.8	0.36	3
13	S	RM 2.2 to RM 1.59	0.61	0.40	3
14	S	RM 1.59 to RM 0.79	0.8	0.51	3
15	S	RM 0.79 to Ogeechee River	0.79	0.19	3
Richardson Creek					
		Headwater		8.62	
16	S	B/w Johnson Rd to Edgar Lane Trib 3	2.14	7.19	10
17	T	Edgar Lane Trib 3	-	8.63	-
18	S	Edgar Lane Trib 3 to Mill Branch	3.41	4.87	32.44
19	T	Mill Branch	-	5.34	-
20	S	Mill Branch to Sculls Creek	2.91	2.90	13

B-11. Williamson Swamp Creek Model Structure – Watershed Designation

Reach Type		Reach Name	Reach Length (mile)	Drainage Area (mi^2)	Elevation Change(ft)
Williamson Swamp Creek					
		Headwater		3.01	
1	S	RM 39 to RM 37	1.7	2.41	19.7
2	S	RM 37 to RM 35	1.92	2.53	19.7
3	S	RM 35 to RM 33	1.96	3.56	13.1
4	S	RM 35 to RM 31	1.68	3.6	16.4
5	S	RM 39 to RM 37	2.5	4.27	32.8
6	S	RM 37 to Kittrell Creek	1.86	2.41	13.1
7	B	Kittrell Creek	-	-	-
8	S	Kittrell Creek to Jordan Mill Pond Rd	0.86	1.13	6.6
9	S	Jordan Mill Pond Rd to Inman Branch	2.79	4.63	16.4
10	B	Inman Branch	-	-	-
11	S	Inman Branch to Sun Hill Creek	1.66	2.52	13.1
12	B	Sun Hill Creek	-	-	-
13	S	Sun Hill Creek to Steel Creek	1.65	2.19	9.8
14	T	Steel Creek	-	6.55	-
15	S	Steel Creek Conf to RM 21	1.34	2.45	9.8
16	S	RM 21 to Unnamed Trib 1	0.8	2.98	1.6
17	T	Unnamed Trib 1	-	4.23	-
18	S	Unnamed Trib 1 to RM 19	1.13	3.51	1.6
19	S	RM 19 to Unnamed Trib 2	1.38	2.21	6.6
20	T	Unnamed Trib 2	-	2.75	0
21	S	Unnamed Trib 2 Conf to RM 16	1.4	2.78	9.8
22	S	RM 16 to RM 15	0.96	5.72	1.6
23	S	RM 15 to Limestone Creek	1.13	3.36	8.2
24	B	Limestone Creek	-	-	-
25	S	Limestone Creek to RM 11	2.56	12.15	1.6
26	S	RM 11 to RM 8.6	2.78	15	11.5
27	S	RM 8.6 to Mill Creek	0.76	8.99	1.6
28	B	Mill Creek	-	-	-
29	S	Mill Creek to RM 6.4	1.39	2.77	4.9
30	S	RM 6.4 to US Hwy 1 Wadley Pond	1	3.09	3.3
31	D	Wadley Pond GA0021024 (US Hwy 1)	-	-	-
32	S	US Hwy 1 Wadely Pond to Boggy Creek	1.48	3.55	6.6
33	T	Boggy Creek	0	11.57	0
34	S	Boggy Creek to RM 2.2	1.7	5.02	6.6
35	S	RM 2.2 to RM 1	1.14	2.65	3.3
36	S	RM 1 to Rocky Creek	1.07	1.2	9.8
37	B	Rocky Creek	-	-	-
38	S	Rocky Creek to Ogeechee River	0.3	0.07	2
Kittrell Creek					
		Headwater (above Nathan Creek)		2.2	
39	S	HW to Unnamed Trib 3	2.37	3.27	29.5
40	T	Unnamed Trib 3	-	4.91	-
41	S	Unnamed Trib 3 to RM 33	1.6	6.01	19.7
42	S	RM 33 to Williamson Swamp Ck	1.85	3.13	16.4

Inman Branch					
		Headwaters		6.63	
43	S	Headwater to Williamson Swamp Creek	2.38	3.97	45.9
Sun Hill Creek					
		Headwaters		5.86	
44	S	Headwater to Unnamed Trib 3	1.65	5.5	42.7
45	T	Unnamed Trib 3	-	8.04	-
46	S	Unnamed Trib 3 to RM 33	1.7	4.79	16.4
47	S	RM 33 to McCoy Pond Rd trib	1.98	5.6	13.1
48	T	McCoy Pond Rd trib (Unnamed Trib 4)	-	9.18	-
49	S	McCoy Pond Rd trib to Elv 88 NGVD	1.37	4.97	19.7
50	S	Elv 88 NGVD to Williamson Swamp Creek	1.81	4.05	9.8
Limestone Creek					
		Headwater		6.18	
51	D	Headwater to RM 23.7	4.24	10.81	42.7
52	S	RM 23.7 to Lewis Lake Rd	0.91	8.73	6.6
53	S	Lewis Lake Rd to Williamson Swamp Ck	1.61	3.09	19.7
Mill Creek					
		Headwater		10.87	
54	S	Headwater to Williamson Swamp Creek	3.92	6.1	19.7
Rocky Creek					
		Headwater		8.97	
55	S	Headwater to RM 3	2.5	5.32	19.7
56	T	RM 3 to Meadows Rd	1.35	4.75	9.8
57	S	Meadows Rd to RM 2	0.95	3.6	9.8
58	T	RM 2 to Williamson Swamp Creek	1.78	2.63	13.1

B-12. Hayners Creek Estuary Model Structure

Segment	Segment Name	Reach Length (mile)	Volume (million gallons)	Depth (ft)
1	RM 4.5 (Montgomery Crossroad, Sta. 2)	0.5	5.5	4.0
2	RM 4.0	0.3	7.8	6.0
3	RM 3.7 (Savannah Sta. 3)	0.7	27.2	7.5
4	RM 3.0	0.5	17.3	5.7
5	RM 2.5 (Savannah Sta. 4)	0.5	15.2	4.4
6	RM 2.0	0.5	47.6	4.8
7	RM 1.5 (Savannah Sta. 5)	0.5	133.5	10.8
8	RM 1.0	0.5	211.1	20.8
9	RM 0.5	0.5	250.2	14.8
10	RM 0 (Savannah Sta. 6)	-	-	-

B-13. Peacock Creek Estuary Model Structure

Segment	Segment Name	Reach Length (feet)	Volume (million gallons)	Depth (ft)
1	Peacock at RM 33	5280	3.55	2
2	Peacock at RM 32	5280	3.55	2
3	Peacock at RM 31	2640	2.07	2
4	Peacock at RM 30.5	5280	4.74	2
5	Peacock at RM 29.5	5280	9.48	2
6	Peacock at RM 28.5	2640	7.94	6
7	Peacock at RM 28.0	2640	13.27	7.4
8	Peacock at RM 27.5	2640	18.8	7.8
9	Peacock at RM 27 & STA R1 (Peacock Cr)	2640	28.6	8.6
10	Peacock at RM 26.5 current discharge	2640	40.5	10.2
11	Peacock at RM 26.0 (Cay Cr.)	2640	56.3	12.9
12	Peacock at RM 25.5	2640	77	12.2
13	Peacock at RM 25.0 & STA NN3	2640	93.8	12.1
14	Peacock at RM 24.5	2640	108.6	15.4
15	Peacock at RM 24.0	2640	114.5	18.5
16	Peacock at RM 23.5	2640	113.6	16.3
17	Peacock at RM 23.0 & STA NN8	5280	209.3	16.6
18	Peacock at RM 22.0	5280	223.1	15.6
19	Peacock at RM 21.0	5280	312	18.4
20	Peacock at RM 20.0 & NN7 (Payne Cr.)	5280	400.9	16.8
21	Peacock at RM 19.0	5280	472	17.7
22	Peacock at RM 18.0	5280	558.8	17.2
23	Peacock at RM 17.0 & STA NN6	5280	529.2	19.2
24	Peacock at RM 16.0	5280	517.4	19.3
25	Peacock at RM 15.0	5280	602.3	17.4
26	Peacock at RM 14.0 & STA NN5	5280	3.55	2
27	STA NN5	-	-	-

B-14. South Newport River Estuary Model Structure

Segment	Segment Name	Reach Length (mile)	Volume (million gallons)	Depth (ft)
1	RM 13.5	1.0	3.2	2.1
2	RM 12.5	1.0	3.4	2.2
3	RM 11.5	1.0	3.6	2.3
4	RM 10.5	0.5	1.9	2.4
5	RM 10	0.5	1.9	2.5
6	RM 9.5	0.5	2.0	2.6
7	RM 9	0.5	2.4	2.7
8	RM 8.5	0.5	3.0	2.8
9	RM 8	0.5	3.4	2.9
10	RM 7.5	0.5	3.5	3.0
11	RM 7	0.5	4.5	3.1
12	RM 6.5	0.5	8.8	3.2
13	RM 6	0.5	11.5	3.3
14	RM 5.5	0.5	11.9	3.4
15	RM 5	0.5	18.1	3.5
16	RM 4.5	0.5	17.1	3.5
17	RM 4	0.5	10.1	3.7
18	RM 3.5	0.5	14.7	4.4
19	RM 3	0.5	26.3	5.3
20	RM 2.5	0.5	42.6	5.8
21	RM 2	0.5	50.0	5.8
22	RM 1.5	0.5	76.0	5.8
23	RM 1	0.5	119.6	6.3
24	RM 0.5	0.5	153.6	6.2
25	RM 0	-	-	-

APPENDIX C

Calibration, Natural Conditions, and TMDL Model Curves

Figure C-1
DOSAG Model Results
Black Creek

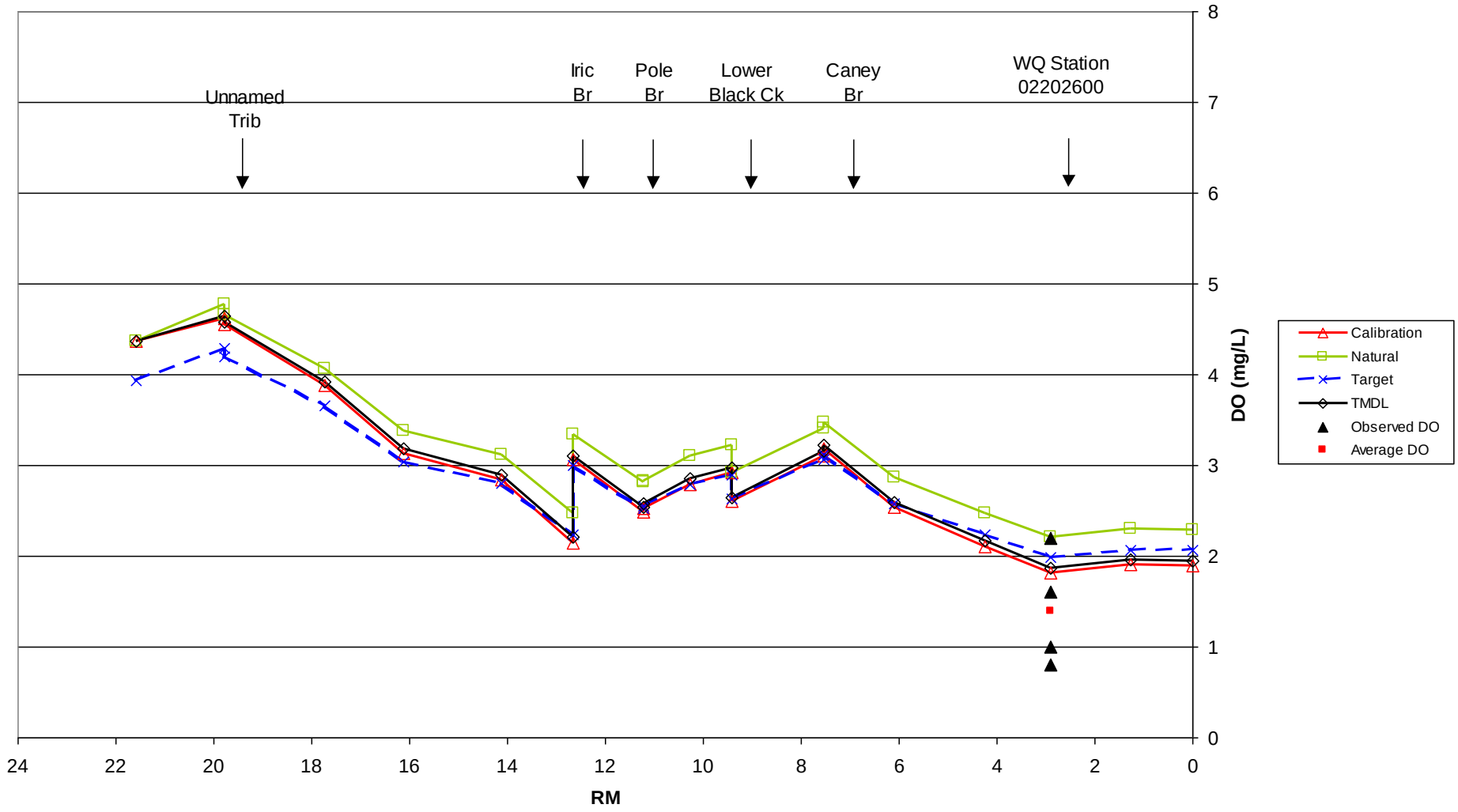


Figure C-2a
DOSAG Model Results
Canoochee River

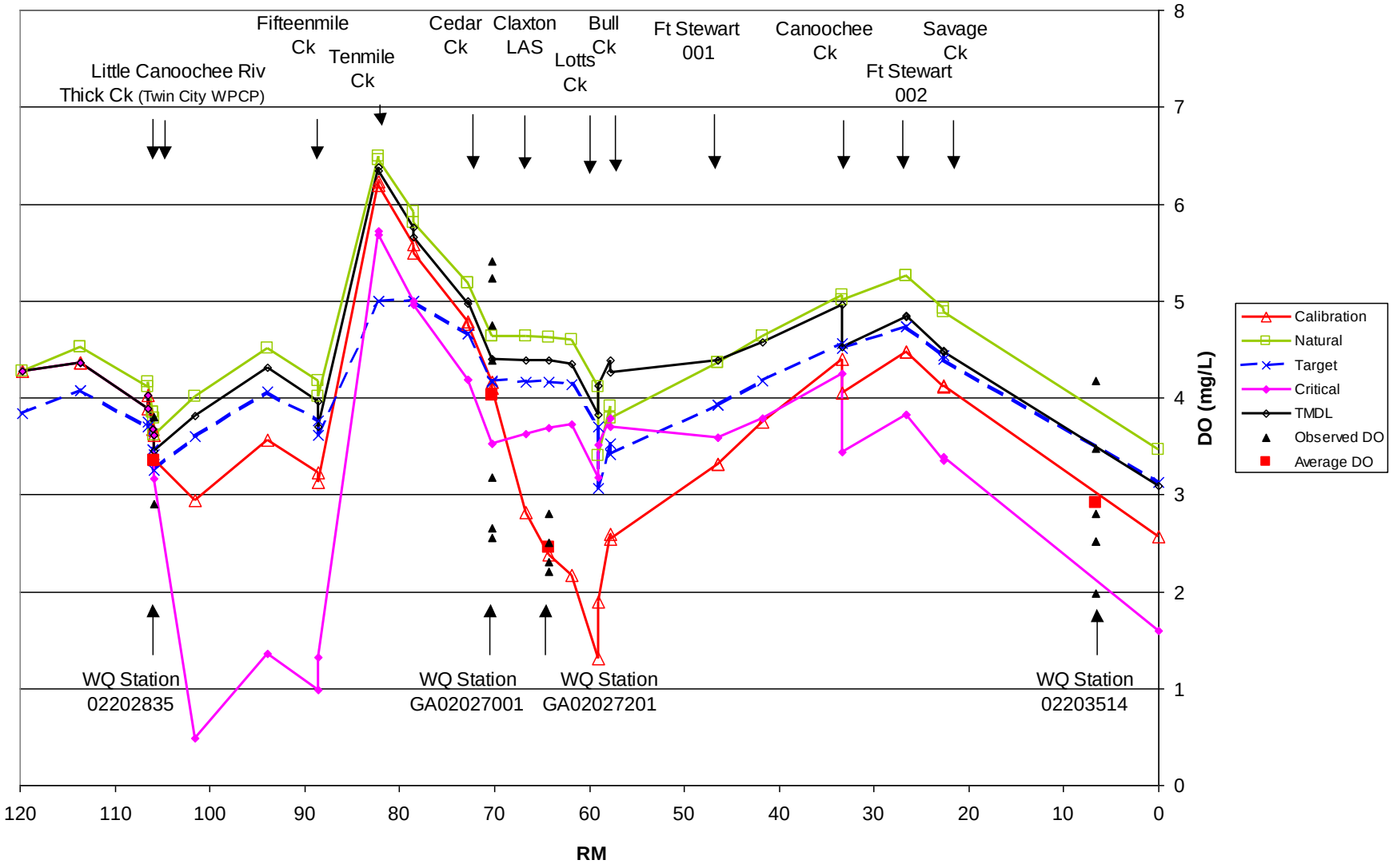


Figure C-2b
DOSAG Model Results
Fifteenmile Creek

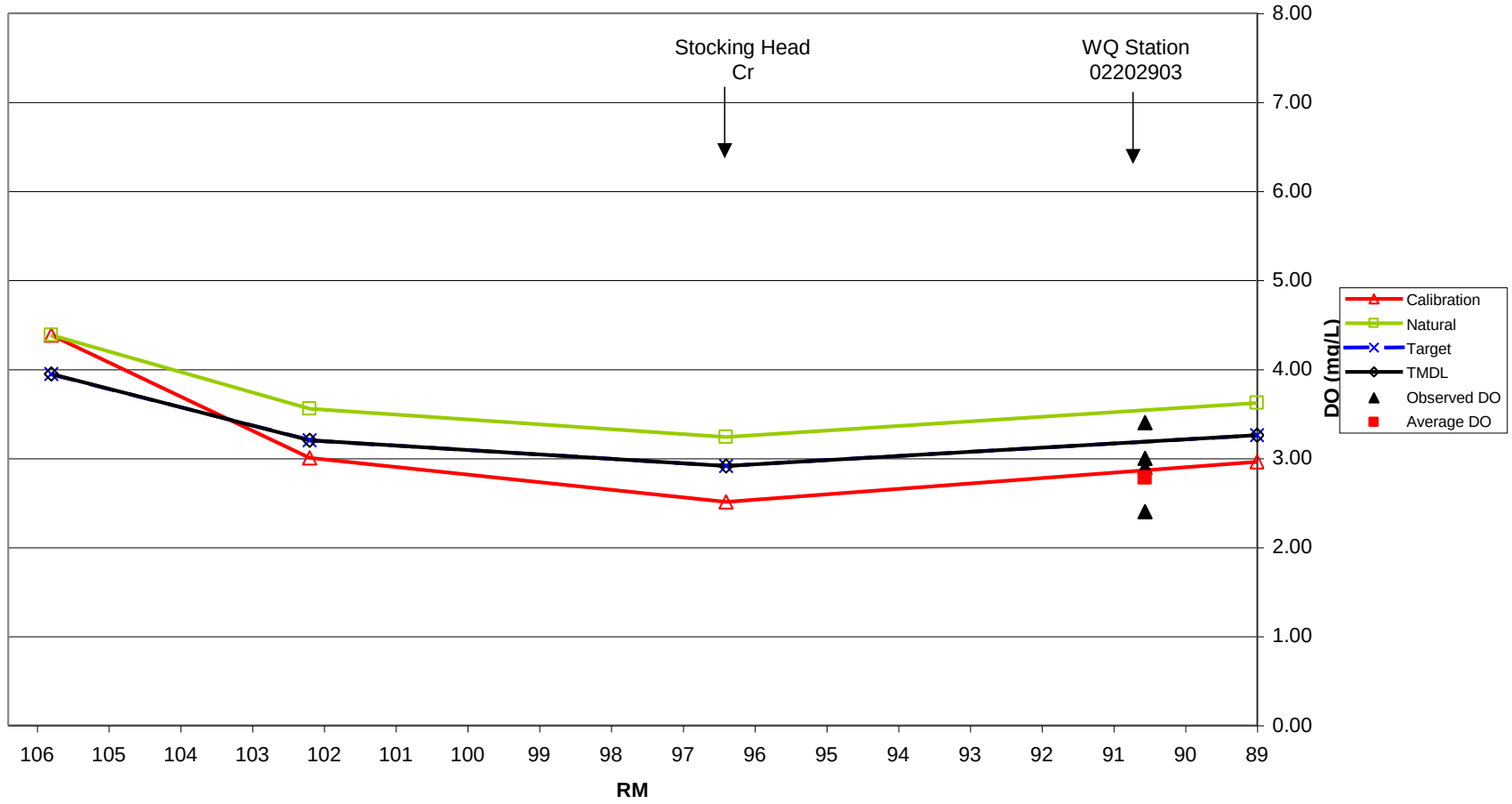


Figure C-2c
DOSAG Model Results
Tenmile Creek

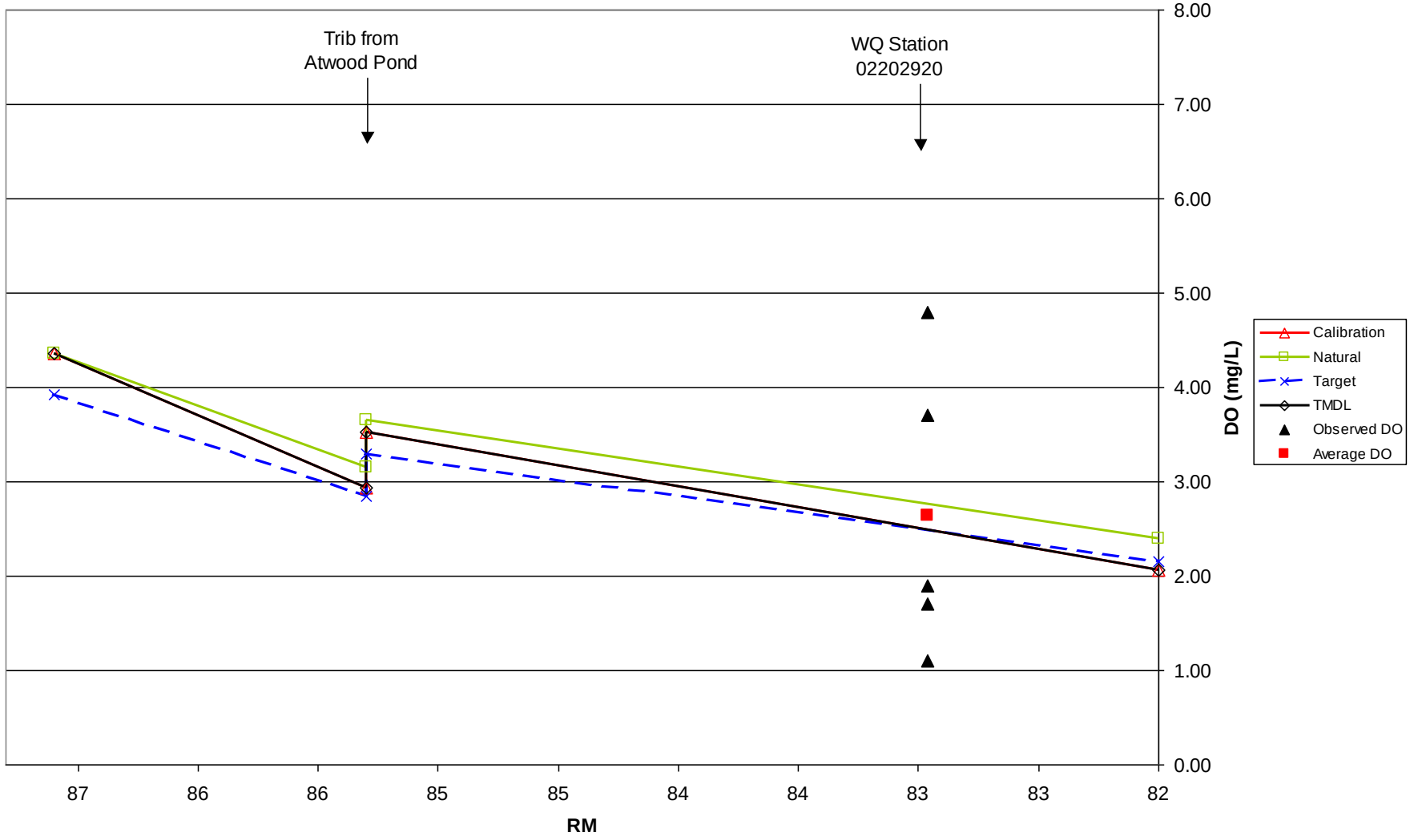


Figure C-2d
DOSAG Model Results
Cedar Creek

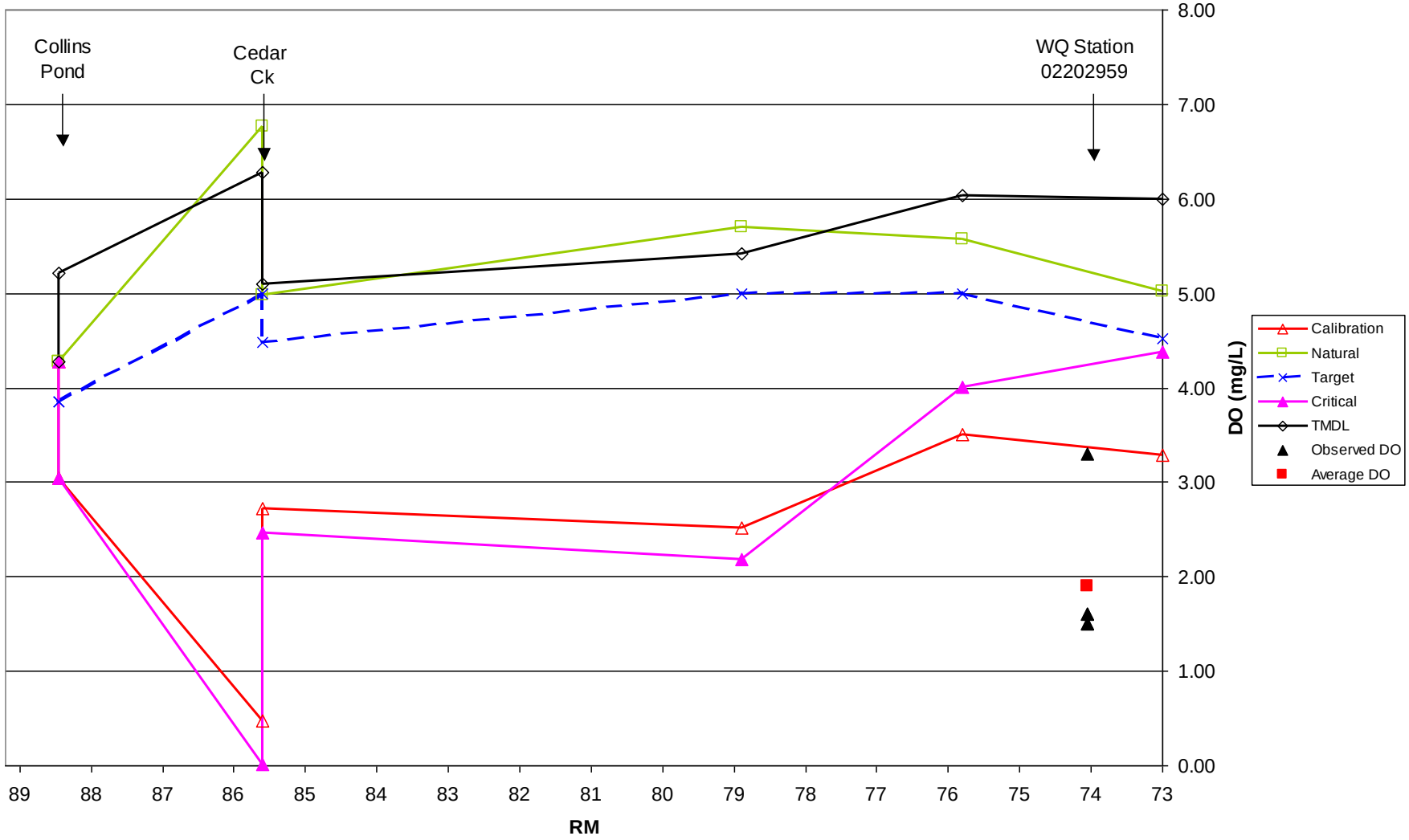


Figure C-2e
DOSAG Model Results
Lotts Creek

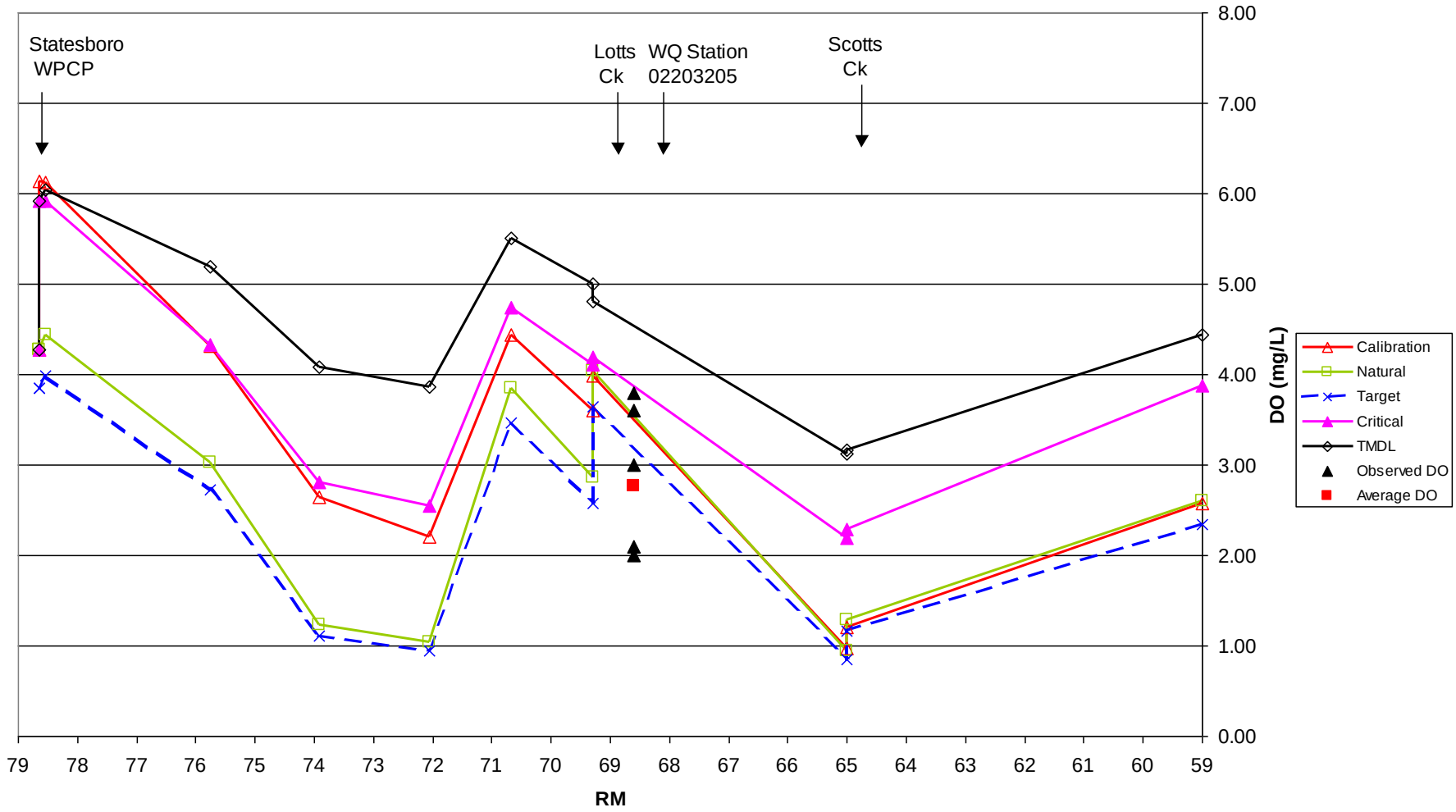


Figure C-2f
DOSAG Model Results
Bull Creek

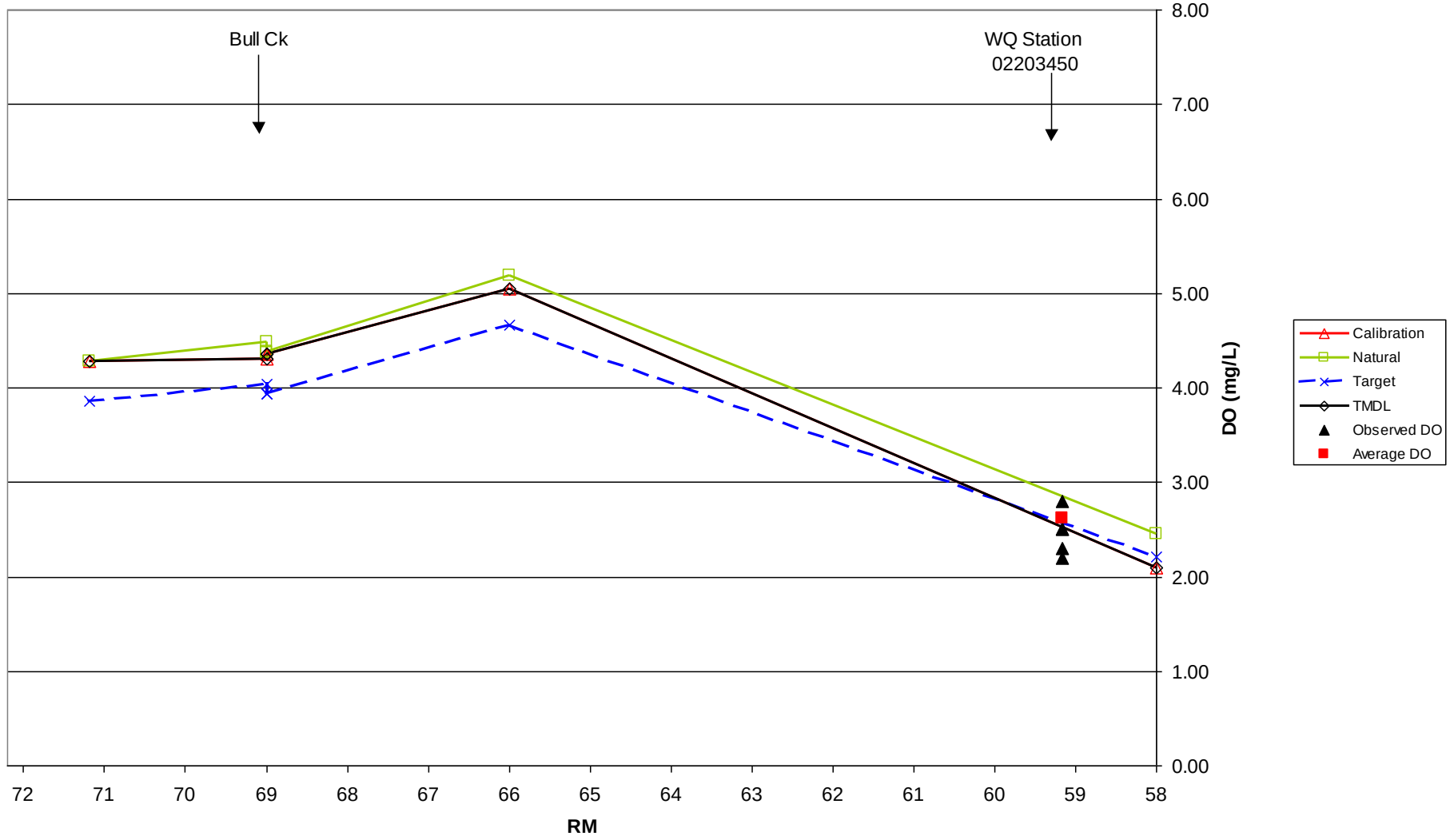


Figure C-2g
DOSAG Model Results
Canoochee Creek

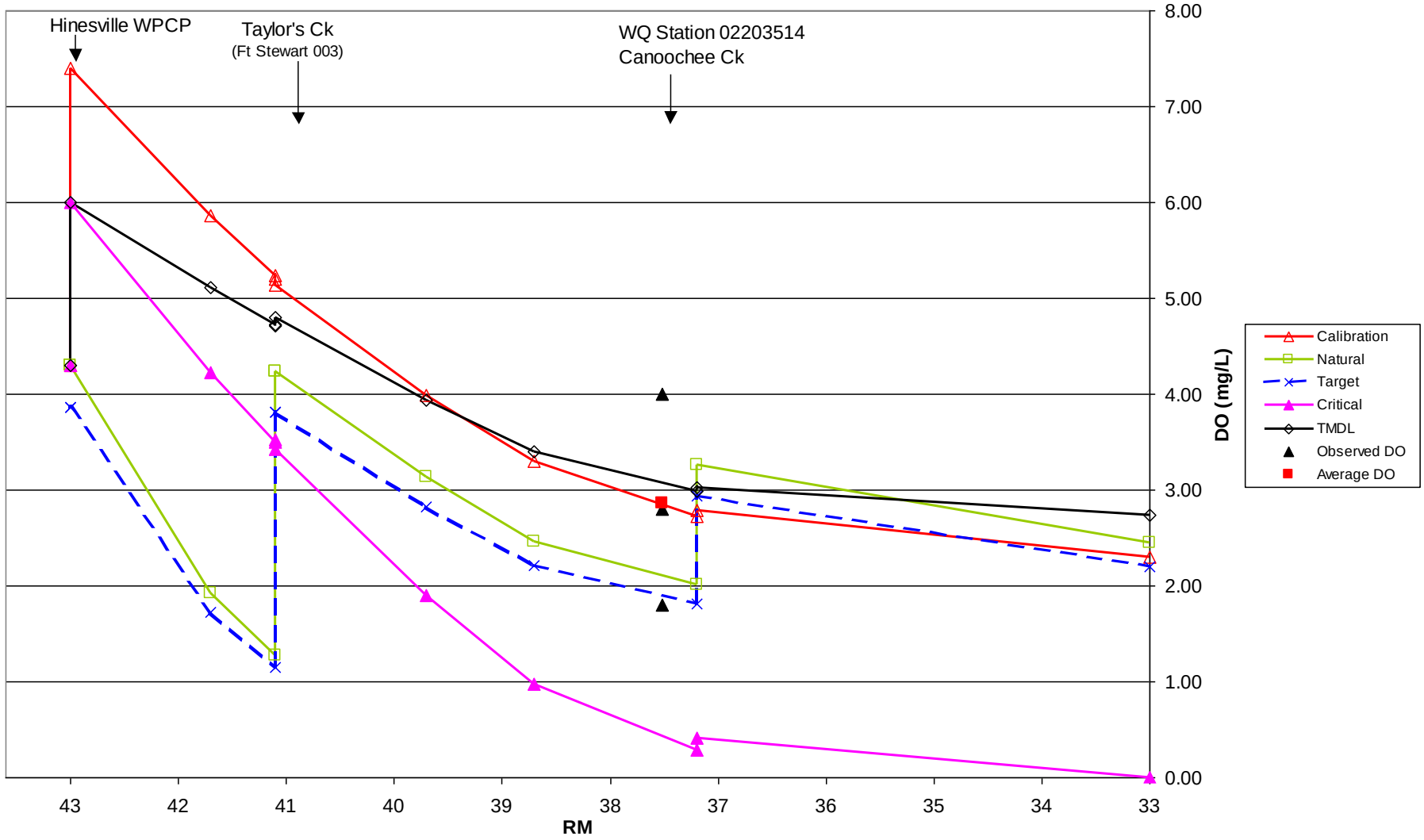


Figure C-3
DOSAG Model Results
Casey Canal

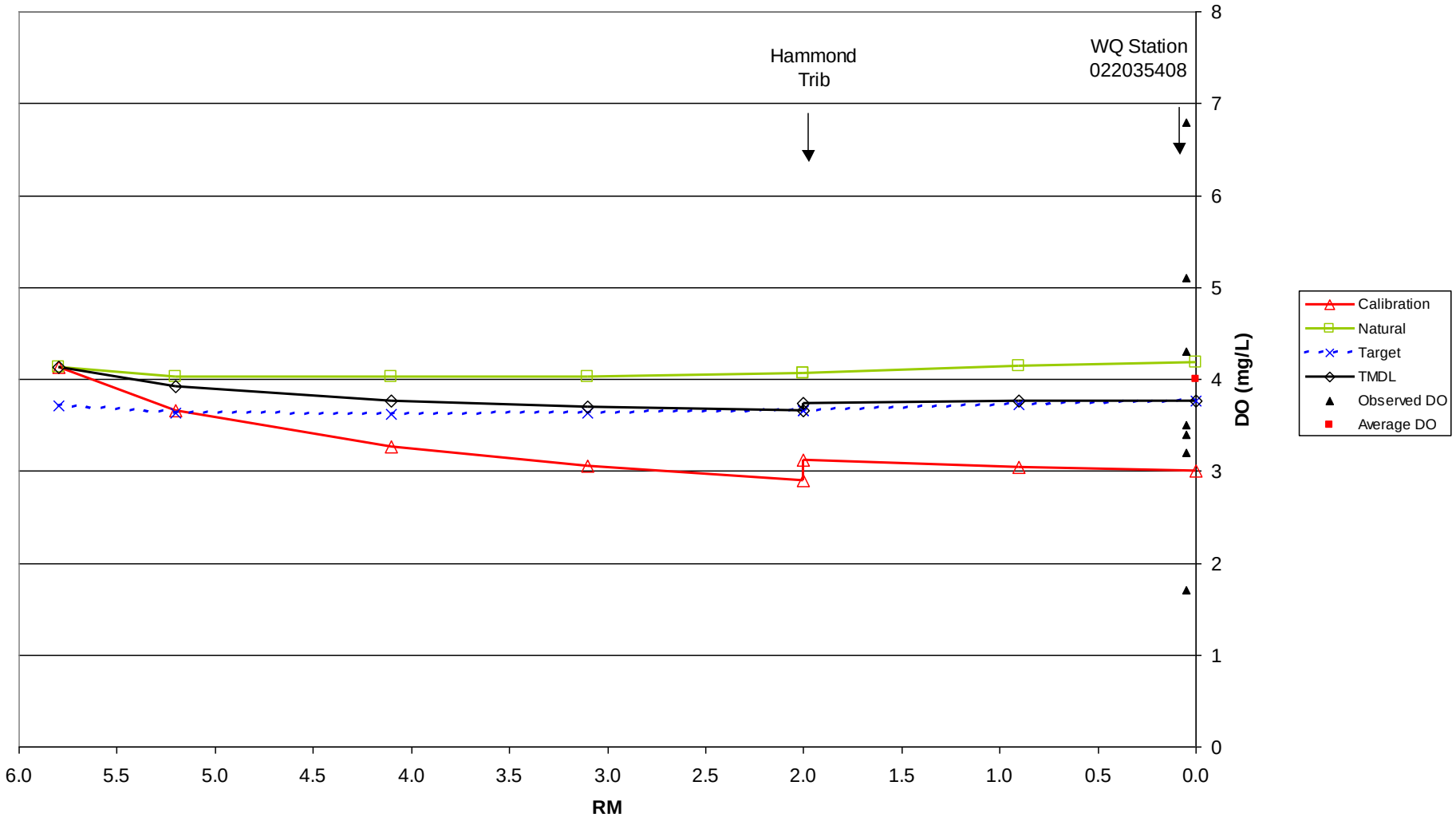


Figure C-4
DOSAG Model Results
Horse Creek

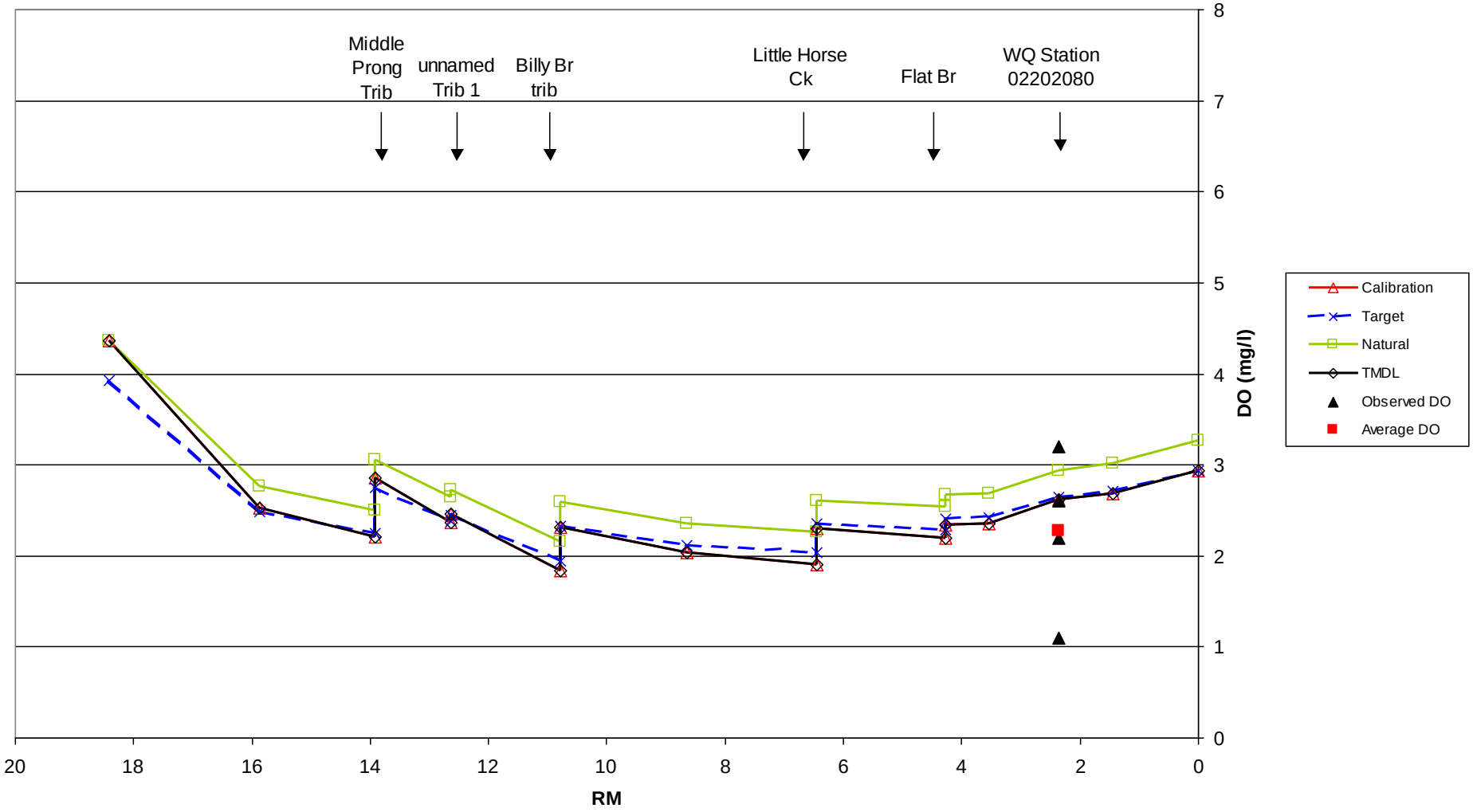


Figure C-5
Little Ogeechee River
DOSAG Modeling Results

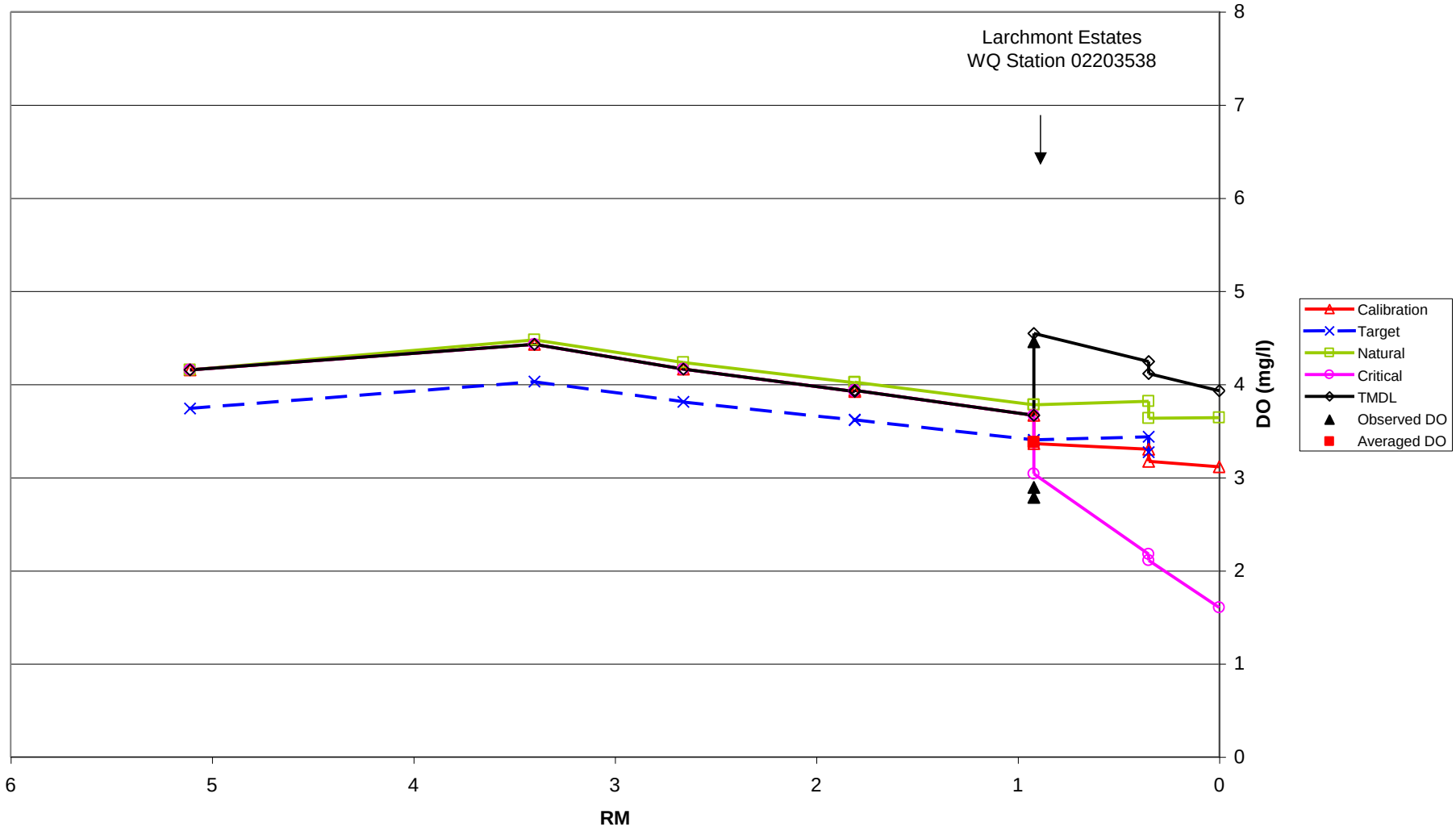


Figure C-6
DOSAG Model Results
Mill Creek

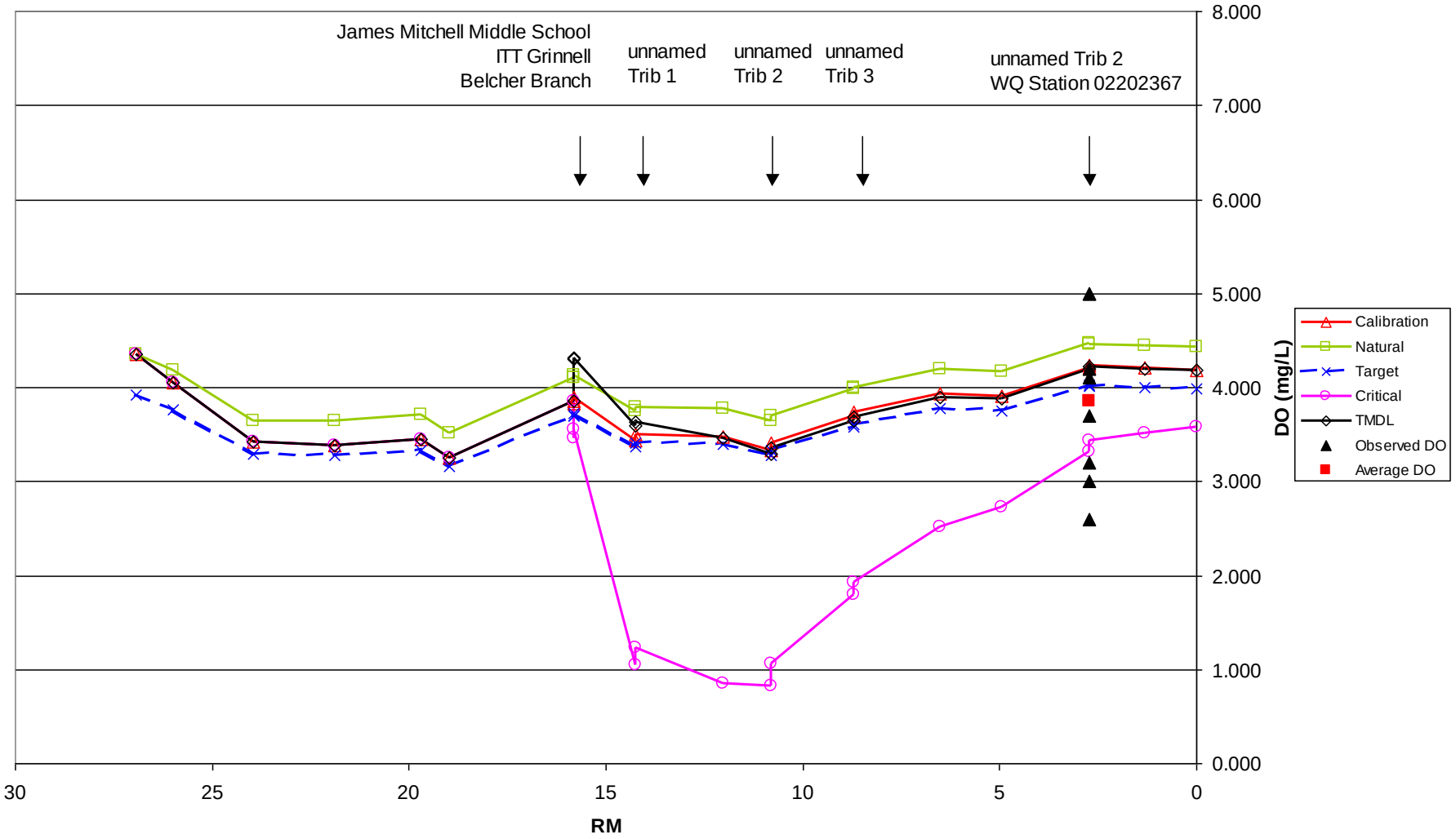


Figure C-7
DOSAG Model Results
Nevills Creek

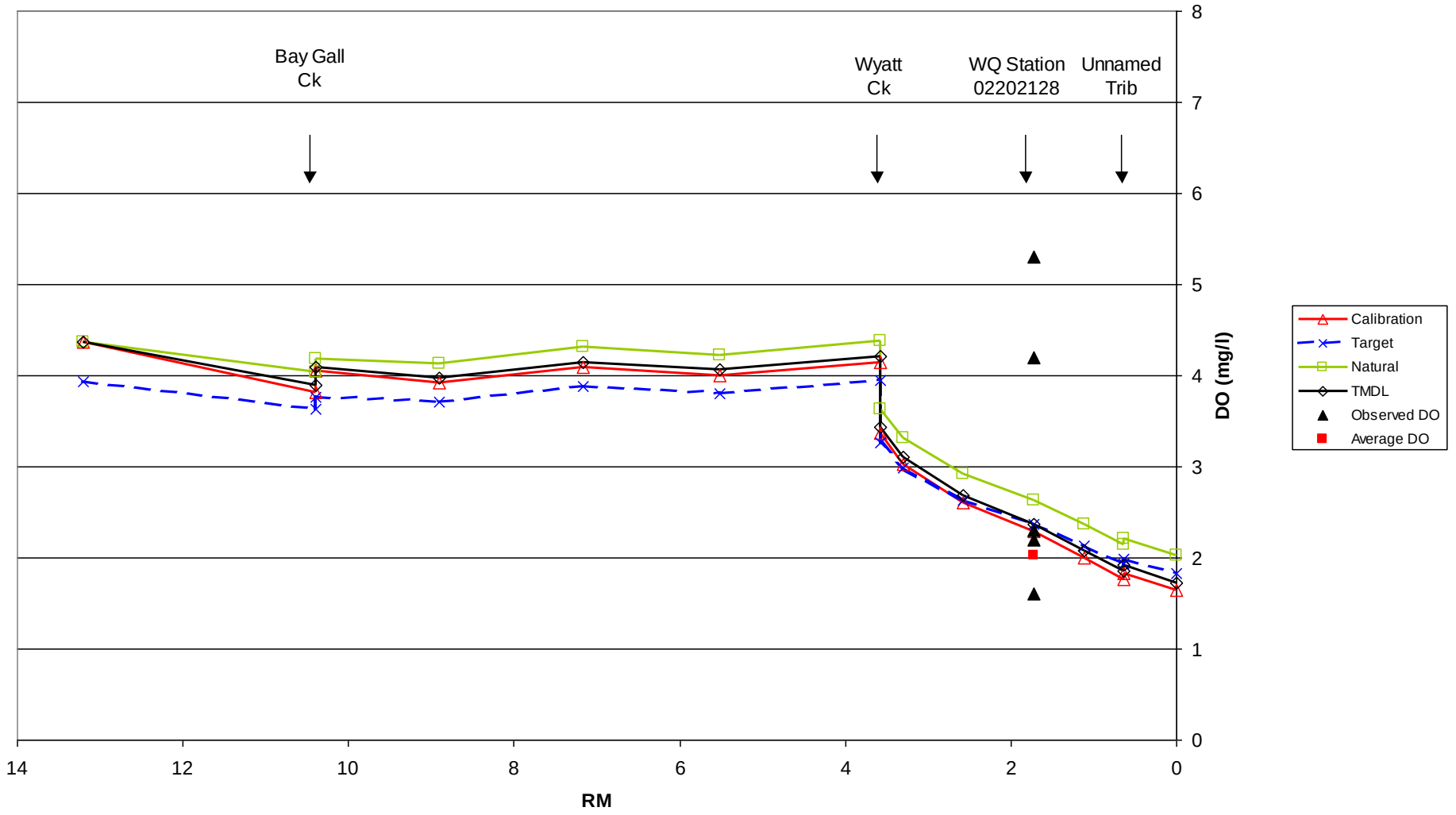


Figure C-8
DOSAG Model Results
Ogeechee Creek

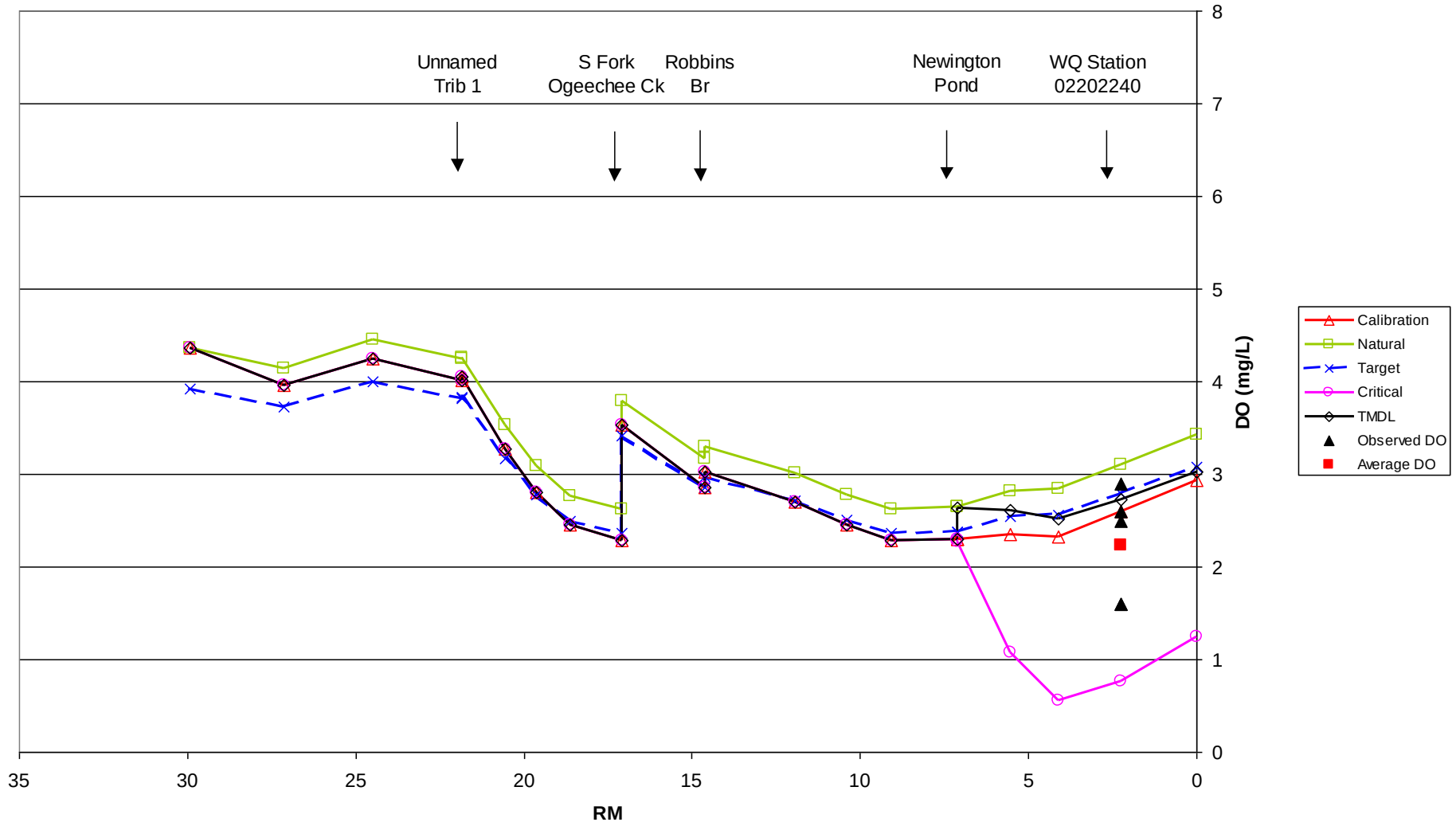


Figure C-9
DOSAG Model Results
Peacock Creek

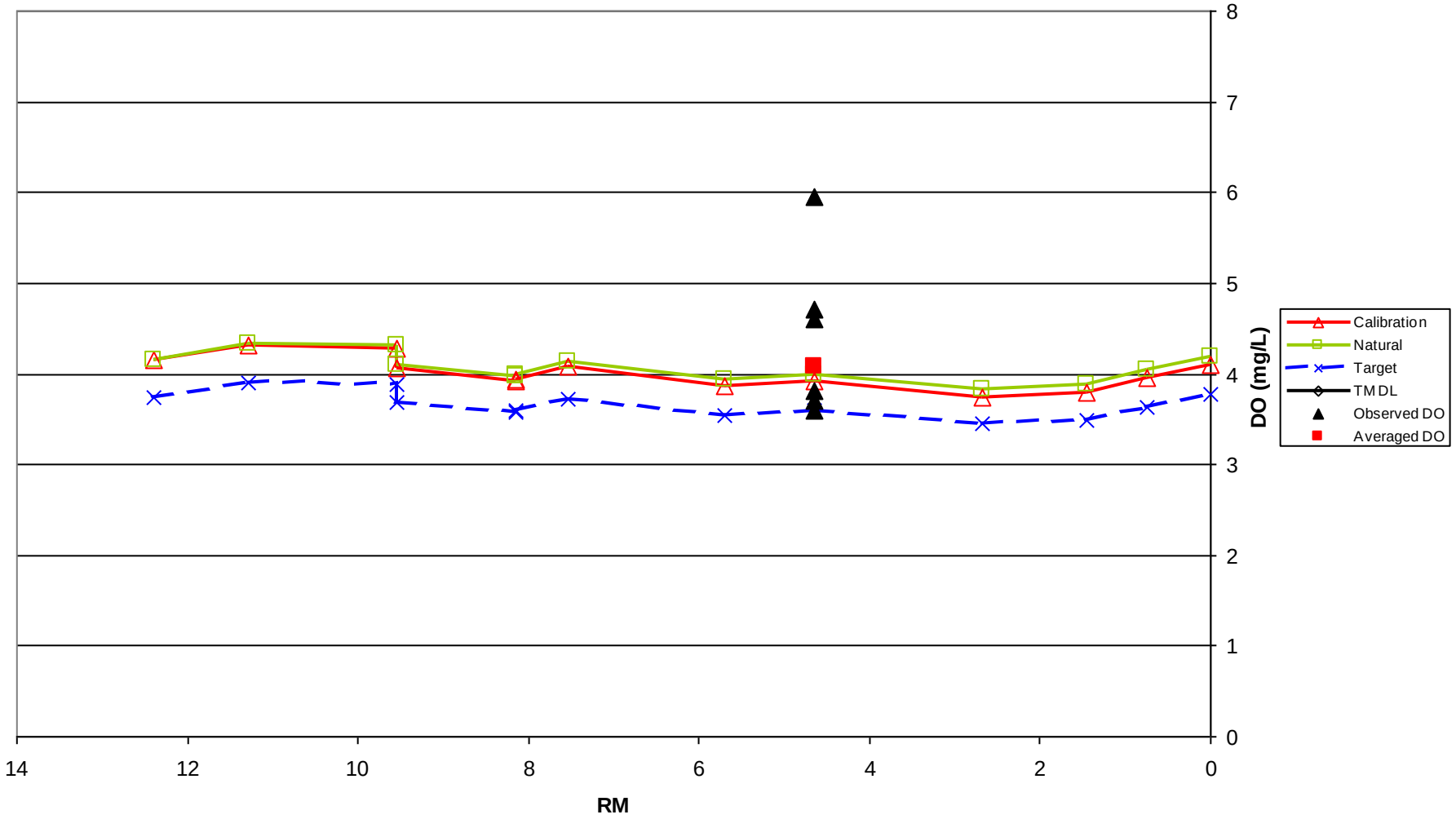


Figure C-10
DOSAG Model Results
Sculls Creek

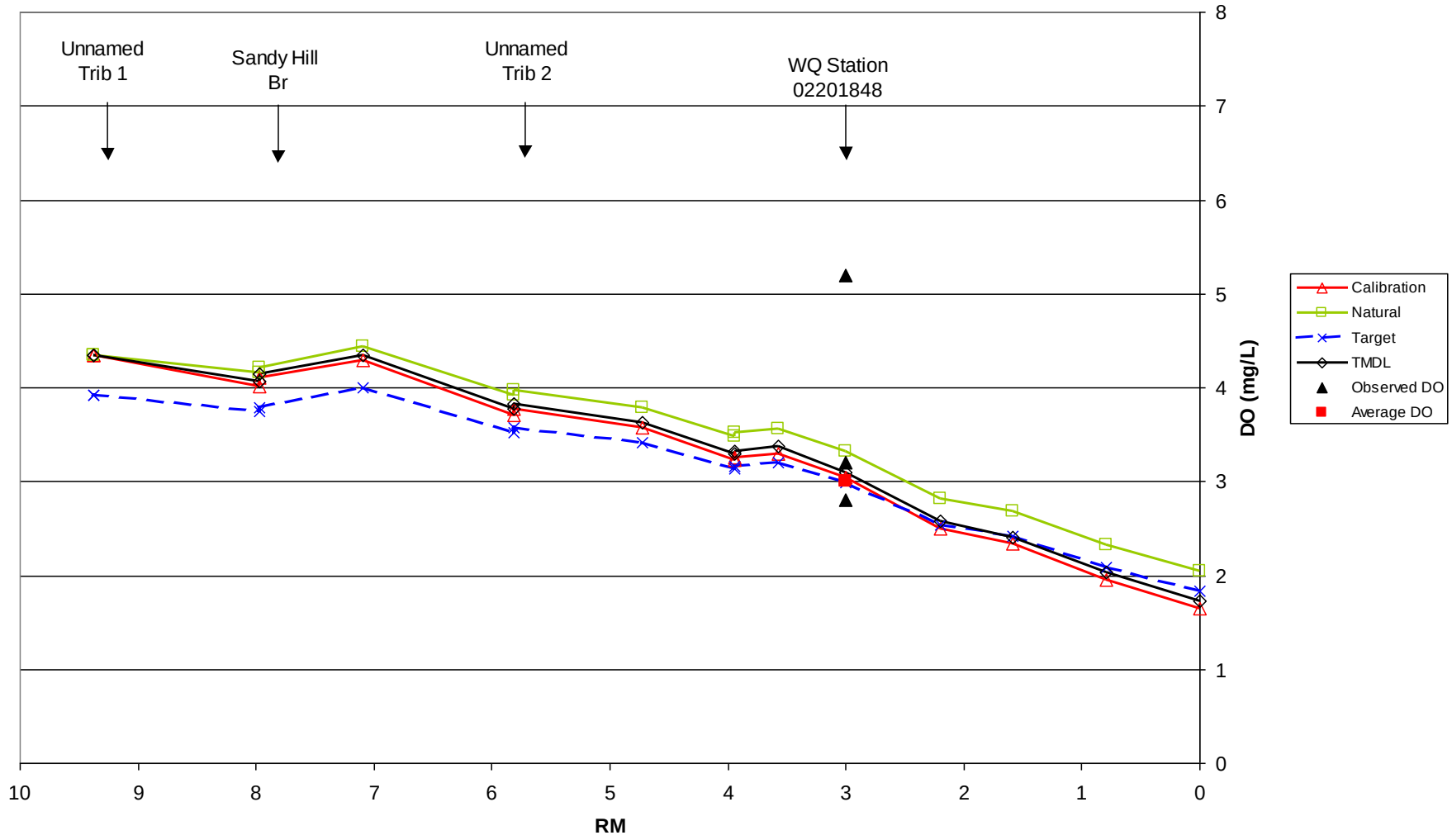


Figure C-11
DOSAG Model Results
Williamson Swamp Creek

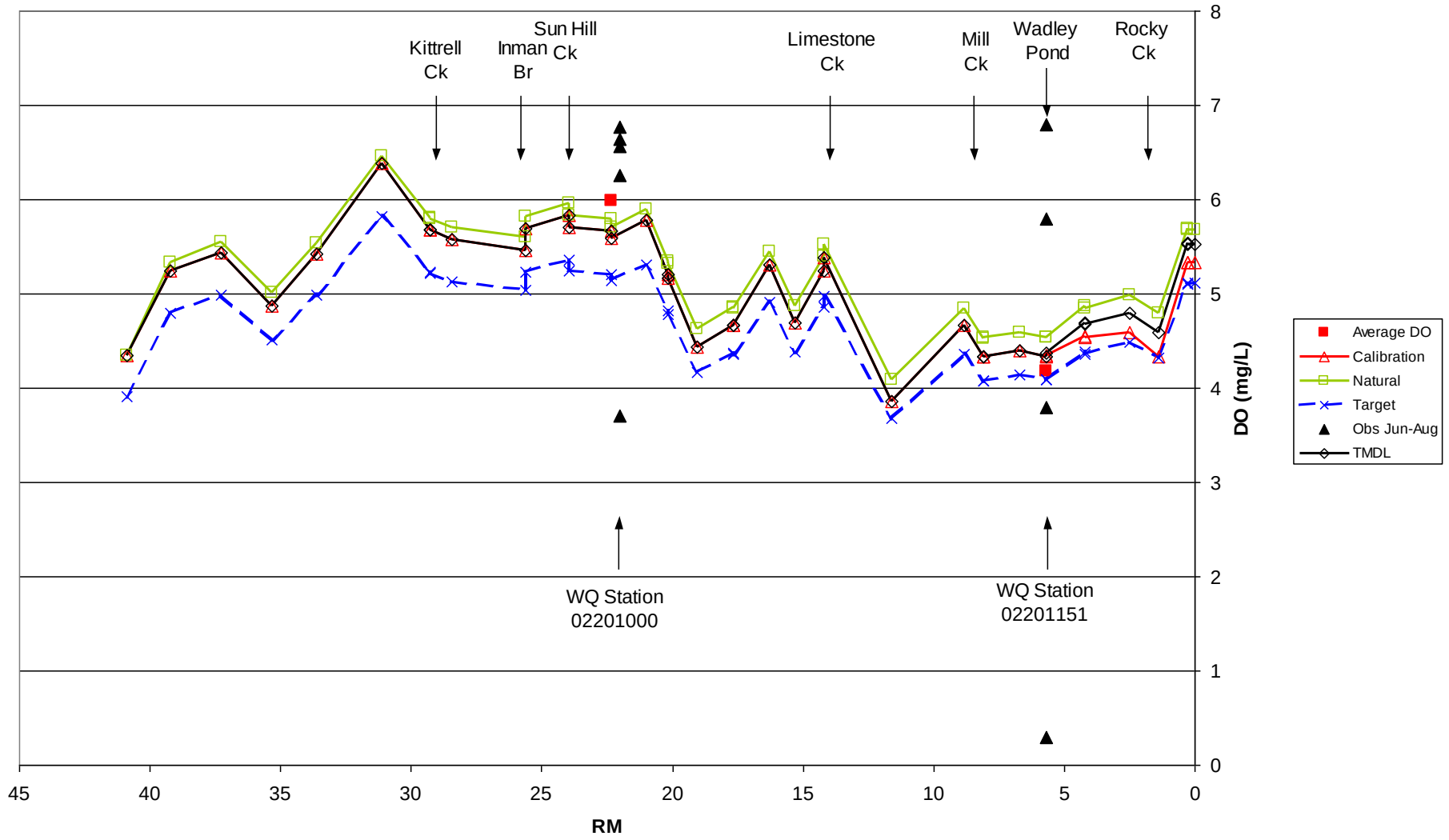


Figure C-12
ESTUARY Model Results
Hayners Creek

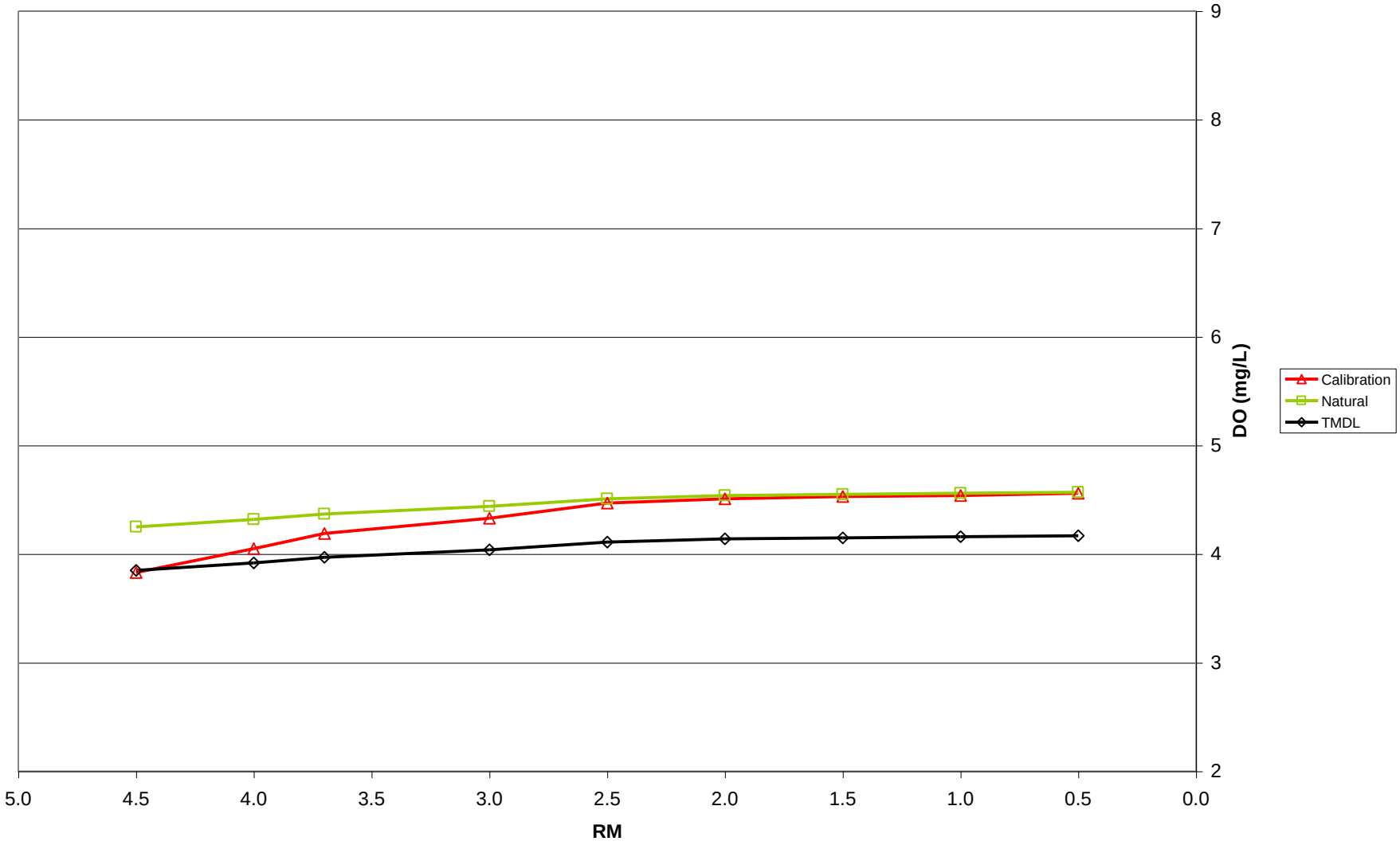


Figure C-13
ESTUARY Model Results
Peacock Creek

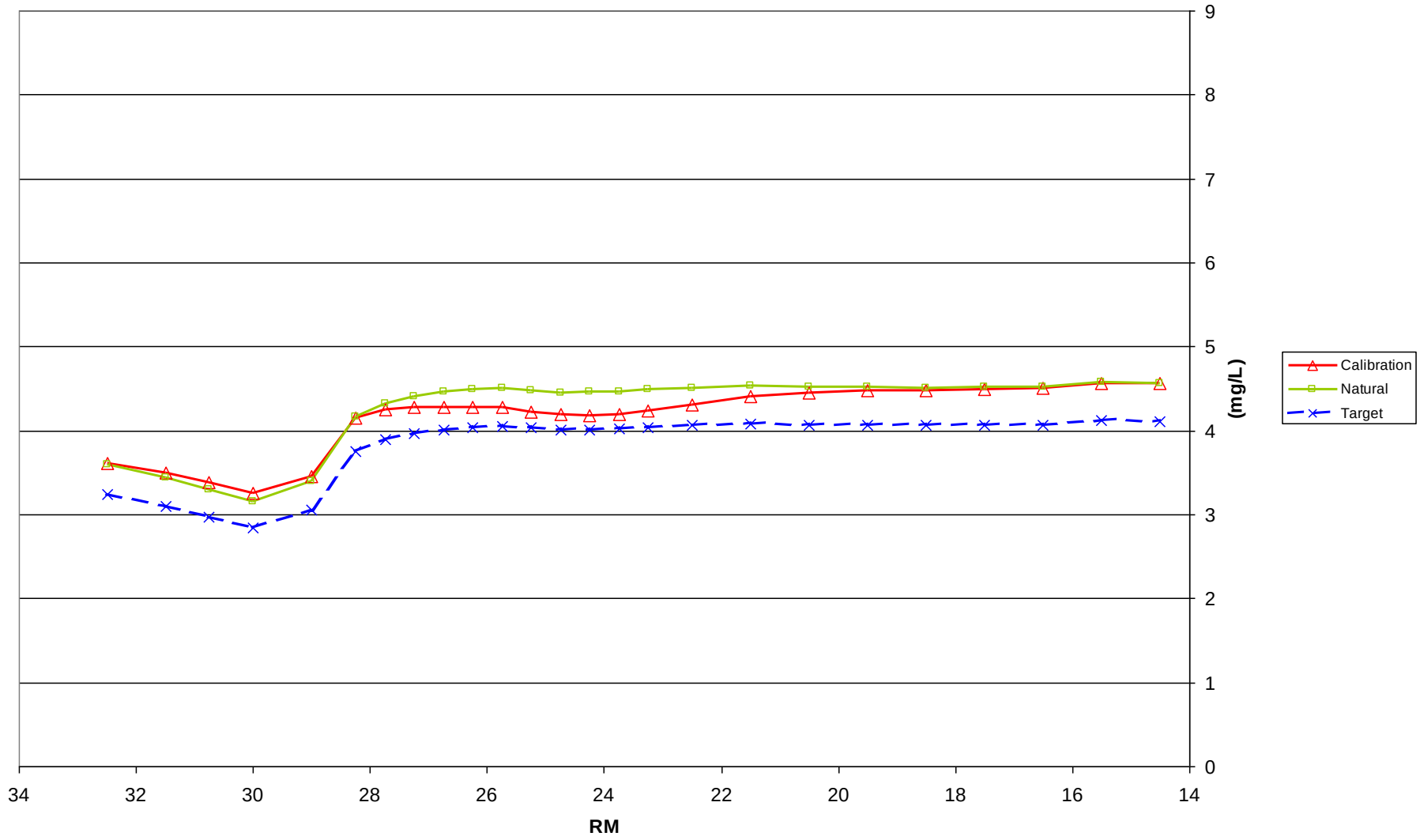
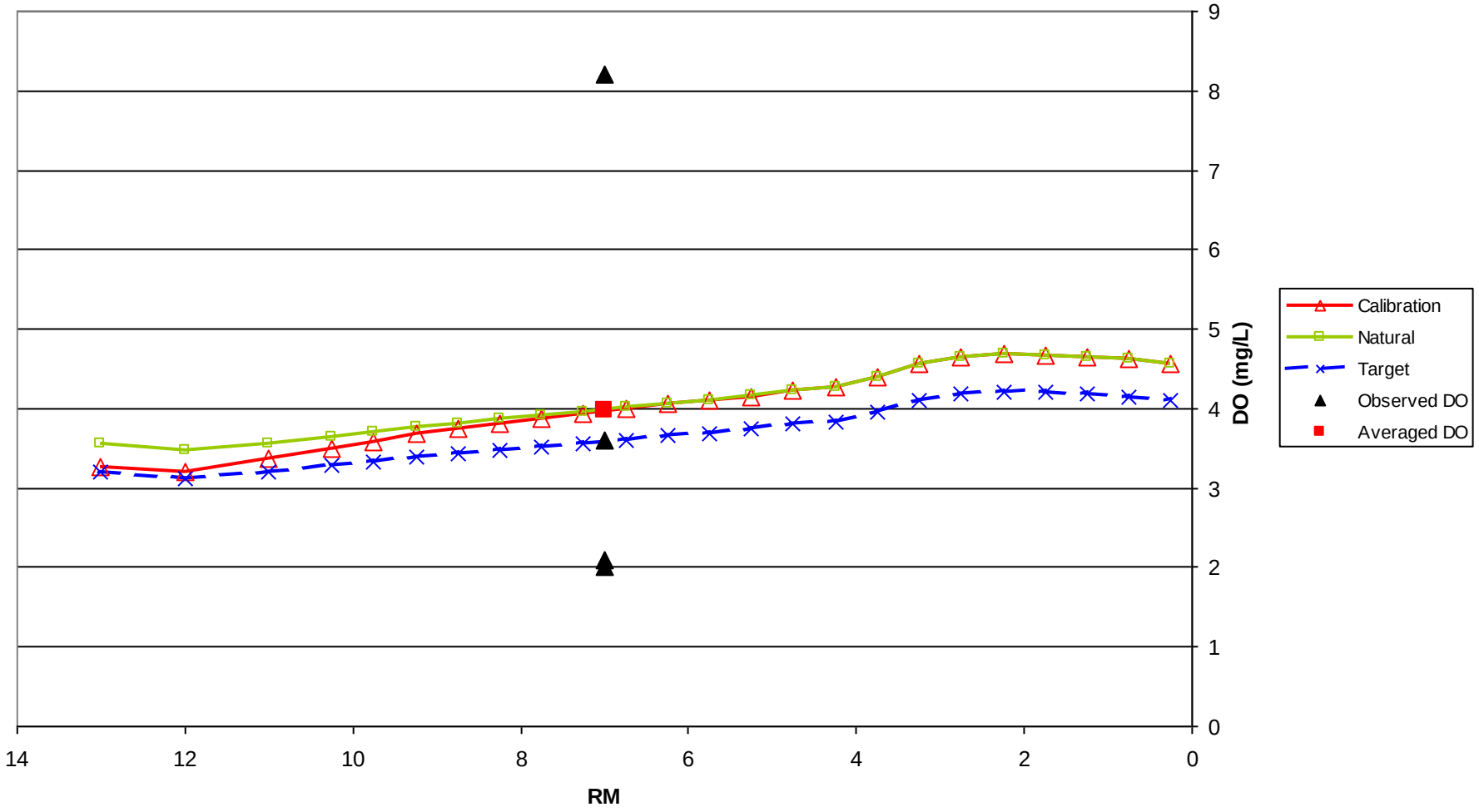


Figure C-14
ESTUARY Model Results
South Newport River



APPENDIX D

Daily Oxygen Demanding Substances Load Summary Memorandum

SUMMARY MEMORANDUM

Average Annual Oxygen Demanding Substances Load
Black Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Bulloch and Bryan**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060202**
Waterbody Name:	**Black Creek**
Location:	**Ash Branch to Mill Creek near Blitchton**
Stream Length:	**11 miles**
Watershed Area:	**230 square miles**
Tributary to:	**Ogeechee River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**20.4 lbs/day**
TMDL	**20.4 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Bull Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Evans

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Bull Creek
Location: Strickland Pond to Canoochee River near Daisy
Stream Length: 6 miles
Watershed Area: 74 square miles
Tributary to: Canoochee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**50.2 lbs/day**
TMDL	**50.2 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Canoochee Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Liberty**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060203**
Waterbody Name:	**Canoochee Creek**
Location:	**US SR 119, Ft Stewart**
Stream Length:	**7 miles**
Watershed Area:	**105 square miles**
Tributary to:	**Canoochee River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**12.6 lbs/day**
TMDL	**12.6 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Canoochee Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Liberty**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060203**
Waterbody Name:	**Canoochee Creek**
Location:	**Taylors Creek to Canoochee River, Fort Stewart**
Stream Length:	**4 miles**
Watershed Area:	**263 square miles**
Tributary to:	**Canoochee River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):
Hinesville-Fort Stewart 1,168.8 lbs/day
Fort Stewart 003 81.7 lbs/day
Wasteload Allocations (WLAsw): NA

Load Allocation (LA): 24.3 lbs/day

TMDL 1,274.8 lbs/day

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Canoochee River

1. 303(d) Listed Waterbody Information

State: Georgia
County: Emanuel and Candler

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Canoochee River
Location: GA Hwy 192 to Fifteen Mile Creek near Metter
Stream Length: 21 miles
Watershed Area: 216 square miles
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**185.1 lbs/day**
TMDL	**185.1 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Canoochee River

1. 303(d) Listed Waterbody Information

State: Georgia
County: Evans

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Canoochee River
Location: Cedar Creek to Lotts Creek
Stream Length: 13 miles
Watershed Area: 839 square miles
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions: (1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**361.2 lbs/day**
TMDL	**361.2 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Canoochee River

1. 303(d) Listed Waterbody Information

State: Georgia
County: Liberty and Bryan

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Canoochee River
Location: Savage Creek to Ogeechee River
Stream Length: 18 miles
Watershed Area: 1,193 square miles
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions: (1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
Fort Stewart 001	**5.7 lbs/day**
Fort Stewart 002	**5.7 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**952.0 lbs/day**
TMDL	**963.4 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Casey Canal

1. 303(d) Listed Waterbody Information

State: Georgia
County: Chatham

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060204

Waterbody Name: Casey Canal
Location: Head of Canal to DeRenne Ave., Savannah
Stream Length: 3 miles
Watershed Area: 7 square miles
Tributary to: Vernon River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**3.9 lbs/day**
TMDL	**3.9 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Casey Canal

1. 303(d) Listed Waterbody Information

State: Georgia
County: Chatham

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060204

Waterbody Name: Casey Canal
Location: DeRenne Ave to Montgomery Crossroad, Savannah
Stream Length: 3 miles
Watershed Area: 15 square miles
Tributary to: Vernon River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**5.9 lbs/day**
TMDL	**5.9 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Cedar Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Evans

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Cedar Creek
Location: Water Hole Creek to Canoochee River Claxton
Stream Length: 6 miles
Watershed Area: 62 square miles
Tributary to: Canoochee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
Collins Pond WPCP	**9.8 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**5.6 lbs/day**
TMDL	**15.4 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Fifteenmile Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Chandler

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Fifteenmile Creek
Location: Stocking Head Branch to Canoochee River near Metter
Stream Length: 6 miles
Watershed Area: 150 square miles
Tributary to: Canoochee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**60.1 lbs/day**
TMDL	**60.1 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Hayners Creek (known upstream as Casey Canal)

1. 303(d) Listed Waterbody Information

State: Georgia
County: Chatham

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060204

Waterbody Name: Hayners Creek
Location: Casey Canal (Montgomery Crossroad) to Vernon River
Stream Length: 2 miles
Watershed Area: 16 square miles
Tributary to: Vernon River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**8.0 lbs/day**
TMDL	**8.0 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Horse Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Screven

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060202

Waterbody Name: Horse Creek
Location: Little Horse Creek to Ogeechee River near Rocky Ford
Stream Length: 5 miles
Watershed Area: 78 square miles
Tributary to: Vernon River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**24.8 lbs/day**
TMDL	**24.8 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Little Ogeechee River

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Chatham**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060204**
Waterbody Name:	**Little Ogeechee River**
Location:	**Little Ogeechee Pond to below U.S. Hwy 17 near Burroughs**
Stream Length:	**6 miles**
Watershed Area:	**55 square miles**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
Larchmont Estates	**106.3 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**9.6 lbs/day**
TMDL	**115.9 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Lotts Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Bulloch**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060203**
Waterbody Name:	**Lotts Creek**
Location:	**US Hwy 301 to Little Lotts Creek near Register**
Stream Length:	**8 miles**
Watershed Area:	**189 square miles**
Tributary to:	**Canoochee River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
Statesboro WPCP	**1,635 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**294.5 lbs/day**
TMDL	**1,929.5 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Mill Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Bulloch**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060202**
Waterbody Name:	**Mill Creek**
Location:	**Newsome Branch to Ogeechee River near Statesboro**
Stream Length:	**16 miles**
Watershed Area:	**102 square miles**
Tributary to:	**Ogeechee River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
William James Middle School	**32.7 lbs/day**
ITT Grinnell	**3.1 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**98.1 lbs/day**
TMDL	**133.9 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Nevills Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Bulloch

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060202

Waterbody Name: Nevills Creek
Location: Bay Gull Creek to Ogeechee River near Rocky Ford
Stream Length: 3 miles
Watershed Area: 53 square miles
Tributary to: Ogeechee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**8.3 lbs/day**
TMDL	**8.3 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Ogeechee Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Screven

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060202

Waterbody Name: Ogeechee Creek
Location: Rd S2178 to Ogeechee River near Oliver
Stream Length: 7 miles
Watershed Area: 146 square miles
Tributary to: Ogeechee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
Newington Pond	**7.4 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**21.2 lbs/day**
TMDL	**28.6 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Peacock Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Liberty

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060204

Waterbody Name: Peacock Creek
Location: Hwy 144 to North Newport River near McIntosh
Stream Length: 17 miles
Watershed Area: 50 square miles
Tributary to: North Newport River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**7.8 lbs/day**
TMDL	**7.8 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Sculls Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Jenkins

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060202

Waterbody Name: Sculls Creek
Location: Richardson Creek to Ogeechee River near Scarboro
Stream Length: 4 miles
Watershed Area: 68 square miles
Tributary to: Ogeechee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**6.3 lbs/day**
TMDL	**6.3 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
South Newport River

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Liberty and McIntosh**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060204**
Waterbody Name:	**South Newport River**
Location:	**Upstream US Hwy 17, South Newport**
Stream Length:	**3 miles**
Watershed Area:	**129 square miles**
Tributary to:	**North Newport River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**21.2 lbs/day**
TMDL	**21.2 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Tenmile Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Candler

Major River Basin: Ogeechee
8-Digit Hydrologic Unit Code(s): 03060203

Waterbody Name: Tenmile Creek
Location: Upstream Canoochee River, Excelsior
Stream Length: 3 miles
Watershed Area: 47 square miles
Tributary to: Canoochee River
Ecoregion: Southern Coastal Plain

Constituent(s) of Concern: Dissolved Oxygen

Designated Use: Fishing (not supporting designated use)

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling: Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.

Calibration Data: USGS field data from summer 2002.

Critical Conditions:
(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.
(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*
(3) No point source discharges at current conditions.
(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	**NA**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**3.8 lbs/day**
TMDL	**3.8 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

SUMMARY MEMORANDUM
Average Annual Oxygen Demanding Substances Load
Williamson Swamp Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Jefferson**
Major River Basin:	**Ogeechee**
8-Digit Hydrologic Unit Code(s):	**03060201**
Waterbody Name:	**Williamson Swamp Creek**
Location:	**Mill Creek to Ogeechee River, Wadley**
Stream Length:	**9 miles**
Watershed Area:	**259 square miles**
Tributary to:	**Ogeechee River**
Ecoregion:	**Southern Coastal Plain**
Constituent(s) of Concern:	**Dissolved Oxygen**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standards:

A daily average of 6.0 mg/L and no less than 5.0 mg/L at all times for waters designated as trout streams by the Wildlife Resources Division. A daily average of 5.0 mg/L and no less than 4.0 mg/L at all times for waters supporting warm water species of fish.

***Natural Water Quality*. It is recognized that certain natural waters of the State may have a quality that will not be within the general or specific requirements contained herein. These circumstances do not constitute violations of water quality standards. This is especially the case for the criteria for dissolved oxygen, temperature, pH and fecal coliform. NPDES permits and Best Management Practices will be the primary mechanisms for ensuring that the discharges will not create a harmful situation.**

2. TMDL Development

Analysis/Modeling:	**Georgia DOSAG – Steady state water quality model developed by Georgia Environmental Protection Division.**
Calibration Data:	**USGS field data from summer 2002.**
Critical Conditions:	**(1) 7Q10 flows based on low-flow analysis of available data from the Ogeechee River Basin.** **(2) Temperatures were derived from historic trend monitoring data in *Stream-Temperature Characteristics in Georgia (USGS, 1997).*** **(3) No point source discharges at current conditions.** **(4) Velocities, kinetic rates, reaeration rates, and boundary conditions as per the guidance provided in the Georgia DOSAG Modeling Procedures Manual.**

(5) Same depths, velocities, kinetic rates, reaeration rates, and boundary conditions as calibration conditions.

3. Allocation Watershed/Stream Reach:

Wasteload Allocations (WLA):	
Wadley Pond	**35.1 lbs/day**
Wasteload Allocations (WLAsw):	**NA**
Load Allocation (LA):	**613.5 lbs/day**
TMDL	**648.6 lbs/day**

*** TMDL expressed as Ultimate Oxygen Demand (UOD), which includes Carbonaceous Biochemical Oxygen Demand (CBOD) and Nitrogenous Biochemical Oxygen Demand (NBOD).**

Margin of Safety (MOS): **Implicit, based on the following conservative assumptions:**
(1) Drought streamflows persist through the critical summer months at monthly 7Q10 flow values.
(2) Hot summer temperatures, based on the historical record, persist for the same critical period.
(3) DO saturation, for all flows entering the system, equal those measured during the low DO period in the summer of 2002.
(4) Water depths are shallow, generally one foot, which increases the effect of SOD.
(5) Water velocities are sluggish, which intensifies the effect of BOD decay.
(6) All point sources discharge continuously at their NPDES permit limits for the same critical period.

APPENDIX E

Assimilative Capacity Updates

Addendum 01 – Williamson Swamp Creek (GAR030602010501) – Public Notice by EPD on 3/31/2021. Approved by EPA Region IV on 7/6/2021

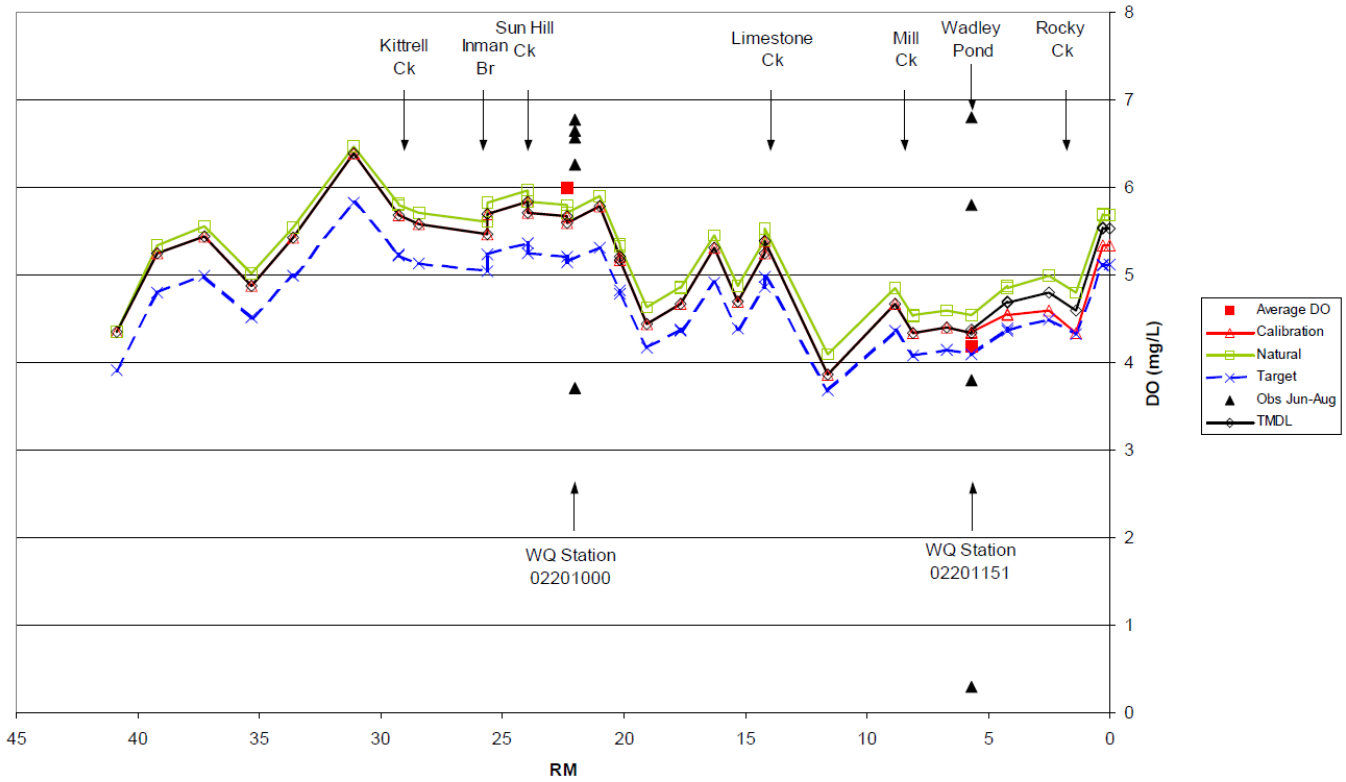
Addendum 01 – Assimilative Capacity Updates
Williamson Swamp Creek

TMDL Action ID: GAR4_21_02_01

Georgia EPD originally developed the Ogeechee River Basin DO TMDL for a segment of Williamson Swamp Creek, from Mill Creek to the Ogeechee River in 2007. The Assessment Unit ID for this segment, defined after the TMDL was developed, is GAR030602010501. The TMDL for Ultimate Oxygen Demand (UOD) for the listed segment was determined to be 648.6 pounds/day. The load allocation to Williamson Swamp Creek was calculated to be 613.5 lbs UOD/day. The TMDL assigned Waste Load Allocations (WLAs) for BOD_5, NH_3 and DO of 5 mg/L, 1 mg/L and 6 mg/L, respectively for all affected facilities in the basin. The Wadley Pond was given a WLA of 35.1 lbs UOD/day.

Section 5.1 of the TMDL states that future WLAs might be allowed if the discharge does not result in an instream DO concentration lower than 90% of the natural DO concentrations during critical conditions. Figure C-11 of the TMDL shows there is additional assimilative capacity in William Swamp Creek available for future WLAs since the target DO curve, representing 90% of the natural modeled DO, is lower than the predicted DO curve for the TMDL.

Figure C-11
DOSAG Model Results
Williamson Swamp Creek



As indicated in the TMDL, the TMDL will be used to assess permit renewals. Because the assimilative capacity might not be fully allocated for all of the listed segments, EPD may modify the WLAs during the NPDES permitting process to make permit modifications or issue new permits, if necessary. Future WLAs would be allowed if the discharge does not result in a concentration lower than 90% of the natural dissolved oxygen concentration during critical conditions.

The Georgia Dissolved Oxygen Sag (GaDOSAG) TMDL model was used to determine the additional assimilative capacity in Williamson Swamp Creek. The additional available assimilative capacity is dependent on the location of the discharge and the DO target. For the upper reaches of the Williamson Swamp Creek around Davisboro (RM 33 to RM 20), the daily average DO standard of 5.0 mg/L is the recommended target. For the lower reaches of the Williamson Swamp Creek (RM 21 to RM 0), 90% of the natural DO is the target. The additional available assimilative capacity is also dependent on the allocation of the discharge as BOD_5 and NH_3 because the CBODu and NBODu decay rates are different.

Modeling shows assimilative capacity of 120.8 lbs UOD/day is available for the Davisboro discharge located at RM 22.3. The DO sag due to the Davisboro discharge occurs at RM 20.2, approximately 2.1 miles downstream of the discharge, and the sag totally recovers before it reaches Mill Creek. Additional assimilative capacity of 249.5±25 lbs UOD/day is available for the Wadley Pond discharge located at RM 5.7. This results in a total WLA for Wadley Pond of approximately 284.6±25 lbs UOD/day, dependent on the allocation between BOD_5 and NH_3. These additional WLAs result in a revised TMDL of 1018.9±25 lbs UOD/day. The revised TMDL for Williamson Swamp Creek is given in Table 1, and Figure 1 shows the new predicted DO levels.

Stream Segment	Segment Description	WLA (lbs/day)	WLAsw (lbs/day)	LA (lbs/day)	TMDL (lbs/day)
Williamson Swamp Creek	Mill Creek to Ogeechee River, Wadley	405.4±25	NA	613.5	1018.9±25

Table 1. TMDL Loads for the Ogeechee River Basin under Critical Conditions

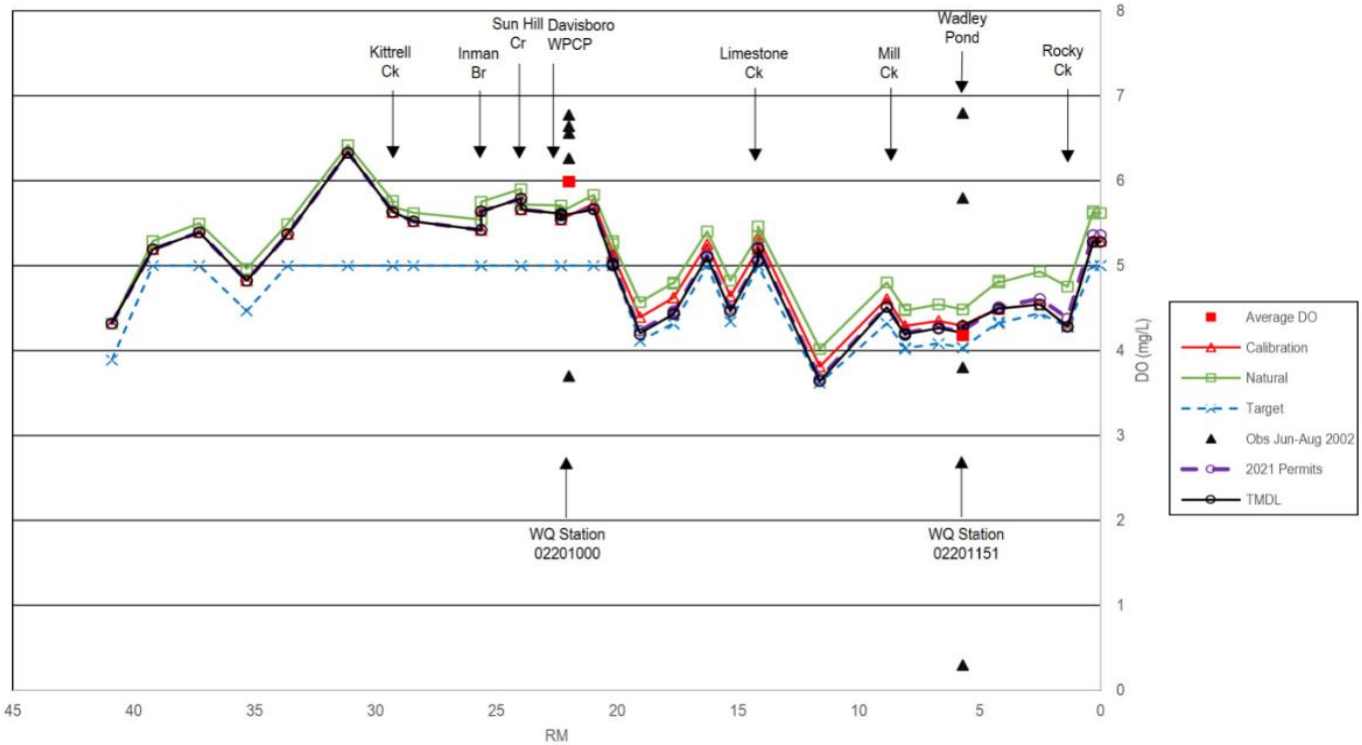


Figure 1. DOSAG Modeling Results – Updated WLAs Williamson Swamp Creek

The revised WLAs for Williamson Swamp Creek are given in Table 2. Davisboro has been allocated 100.7 lbs UOD/day, and Wadley Pond has been allocated 148.6 lbs UOD/day.

Facility	NPDES Permit No.	Average Monthly Flow (MGD)	Average Monthly BOD_5 (mg/L)	Average Monthly NH_3 (mg/L)	Minimum DO (mg/L)	WLA (lbs/day)
Davisboro	GA0050291	0.5	5	2	6	100.7
Wadley Pond	GA0021024	0.215	20	5	5	148.6

Table 2. Williamson Swamp Creek WLAs.

Future wasteload allocations will be allowed if there are expansions of the Davisboro or Wadley facilities and the WLAs do not exceed those given above. However, other WLAs cannot be provided at this time because the amount of allowable UOD is dependent on the location of the discharge and the parameterization between BOD_5 and NH_3. The TMDL model will be used to assess any new WLA and assign any available assimilative capacity.