

**TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT**

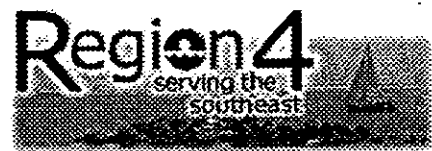
*For TOXICITY in the*

**CRAWFORD CREEK WATERSHED**

**In the Savannah River Basin**

(HUC 03060106)

Columbia County, Crawford Creek, Georgia



## APPROVAL PAGE

for CRAWFORD CREEK TMDL in

the Savannah River Basin, GA

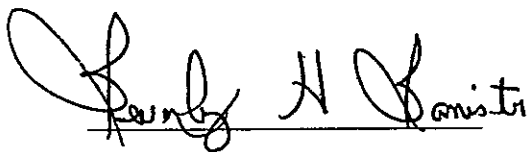
Georgia's final 1998 303(d) list identified Crawford Creek in Columbia County, GA as partially supporting its designated use, with the parameter of concern being toxicity. This Total Maximum Daily Load (TMDL) is being established pursuant to the 1998 Georgia 303(d) list and the Consent Decree in the Georgia TMDL Lawsuit.

The Total Maximum Daily Load for Crawford Creek is given below.

$$\text{TMDL} = 1.009 \text{ TU}_c$$

In order to meet this TMDL, the Columbia County Crawford Creek Water Pollution Control Plant should not exhibit chronic toxicity greater than  $1.009 \text{ TU}_c$ .

APPROVED BY:



Robert F. McGhee, Director  
Water Management Division  
EPA-Region 4

3/1/00

Date

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## Introduction

Section 303(d) of the Clean Water Act (CWA) as Amended by the Water Quality Act of 1987, Public Law 100-4, and the United States Environmental Protection Agency's (USEPA/EPA) Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulation (40 CFR), Part 130] require each State to identify those waters within its boundaries not meeting water quality standards applicable to the waters' designated uses. Total maximum daily loads (TMDLs) for all pollutants violating or causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with consideration given to seasonal variations and margins of safety. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991a).

## Problem Definition

Georgia's final 1998 Section 303(d) list identified two miles of Crawford Creek, downstream of the Columbia County Water Pollution Control Plant (WPCP) (NPDES #GA0031984), as partially supporting its designated use as a fishing water, with toxicity identified as the criterion violated. This listing decision was influenced by total residual chlorine (TRC) measurements taken from the Columbia County-Crawford Creek WPCP which discharges into Crawford Creek. The discharger, which was under a permitting schedule to meet TRC limits by July 1999, has recently installed dechlorination equipment and has met permitted TRC limits since February 1999. The facility conducted and passed a whole effluent toxicity (WET) test in October, 1996, and there are no WET test requirements in the current permit.

## Target Identification

Protection against toxic releases is called for under the CWA Section 101(a)(3), which states that "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." In addition, CWA Section 303(c) requires States to develop water quality standards to protect the public health or welfare, enhance the quality of water, and serve the purposes of the CWA. In turn, water quality standards are composed of the designated use of the receiving water, water quality criteria (numeric or narrative) to protect the designated use, and an antidegradation statement.

Georgia's narrative criterion for toxicity is established for all waters and is deemed to be necessary and applicable to all waters of the State. Georgia's Water Quality Standard for toxicity is expressed in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6, Revised July 6, 1999. Georgia regulations state that "All waters shall be free from toxic, corrosive, acidic and caustic substances discharged from municipalities, industries or other sources, such as nonpoint sources, in amounts, concentrations or combinations which are harmful to humans, animals or aquatic life."

For an effluent dominated stream such as the water quality limited segment of Crawford Creek, protection against chronic toxicity will inherently provide protection against acute toxicity. In accordance with EPA's Technical Support Document For Water Quality-based Toxics Control (TSD), an instream chronic toxicity not exceeding 1.0 chronic toxic units (TU<sub>c</sub>) is representative of no chronic toxic effects (USEPA, 1991b). Therefore, this TMDL is being developed such that the chronic toxicity of Crawford Creek does not exceed 1.0 TU<sub>c</sub> during critical conditions.

## Background

The segment of Crawford Creek listed as impaired flows from the Columbia County Crawford Creek WPCP discharge to Crawford Creek's confluence with Tudor Branch. Tudor Branch is a tributary to Utchee Creek (drainage basin equal to 64 square miles) which flows into the Savannah River between Thurmond Dam and the urban setting of Augusta, Georgia. This 2-mile segment of Crawford Creek is on the State of Georgia's §303 (d) list for violating toxicity standards for the State

of Georgia. The Columbia County Crawford Creek WPCP conducted and passed a whole effluent toxicity test in 1996, and has since installed de-chlorination equipment to reduce or eliminate total residual chlorine in their effluent. Monthly grab samples in 1999 have either contained zero or non-detect levels of TRC since February 1999 when the TRC value was 0.4 mg/l. The plant is permitted for TRC maximum at 0.011 mg/l.

## Numeric Targets and Sources - Model Development

For TMDL purposes, steady-state models are applied for "critical" environmental conditions that represent extremely low assimilative capacity. For effluent-dominated riverine systems where there are no known sources of nonpoint source pollution, critical environmental conditions correspond to drought upstream flows. The assumption behind steady-state modeling is that permit limits that protect water quality during critical conditions will be protective for the large majority of environmental conditions that occur.

EPA's TSD defines the  $TU_c$  associated with an effluent discharge as being equal to 100 divided by the No Observed Effect Concentration (NOEC). For example, an effluent discharge with a NOEC of 50% reflects a  $TU_c$  of 2.0. In addition, EPA's TSD suggests that the  $TU_c$  associated with a stream that exhibits no toxicity before it receives any wastewater is equal to zero (i.e.,  $TU_c = 0$ ). Therefore, a simple mass-balance equation reflecting critical flow conditions can be used for the TMDL development.

## Critical Condition Determination

The most critical condition for this segment of Crawford Creek will be used to determine the TMDL. For the Crawford Creek segment, the critical flow will be considered 0.023 cubic feet per second (cfs) or 0.00065 cubic meters per second (cms). This flow represents the lowest 7-day average flow which is expected during a 10-year interval (7Q10) for Crawford Creek at the point of discharge. 7Q10 low flow characteristics of Crawford Creek were estimated from the USGS water resources investigation

report 88-4047, Low-Flow Profiles of the Upper Savannah and Ogeechee Rivers and Tributaries in Georgia, (USGS, 1988). Drainage basin area relationships were developed to estimate the 7Q10 flow for Crawford Creek based on published values for Tudor Branch.

## Total Maximum Daily Load (TMDL)

A TMDL is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels for a given watershed. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while achieving water quality standards.

For some pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). In accordance with 40 CFR Part 130.2(i), "TMDLs can be expressed in terms of ... mass per time, toxicity, or other appropriate measure(s)." In addition, NPDES permitting regulations in 40 CFR 122.45(f) state that "All pollutants limited in permits shall have limitations...expressed in terms of mass except...pollutants which cannot appropriately be expressed by mass." For the toxicity TMDL for Crawford Creek, the Total Maximum Daily Load is expressed in terms of chronic toxicity units (TU<sub>c</sub>s).

### ***Margin of Safety***

The margin of safety (MOS) is part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991a):

- Implicitly incorporating the MOS using conservative model assumptions to develop allocations, or
- Explicitly specifying a portion of the total TMDL as the MOS; using the remainder for

allocations.

The MOS is incorporated implicitly into this modeling process by selecting the critical low flow from the previous 20 years.

### ***TMDL Calculation***

The TMDL calculation will utilize the conservation of mass principle, where the load can be calculated by using the following relationship:

Concentration = Load / Flow

The receiving water concentration for chronic toxicity is calculated using a mass-balance equation:

$$C = \frac{(C_{\text{eff}} \times Q_{\text{eff}}) + (C_{\text{amb}} \times Q_{\text{rec}})}{Q_{\text{eff}} + Q_{\text{rec}}}$$

Whereby,

- C = receiving water concentration after mixing in TU<sub>c</sub>
- C<sub>eff</sub> = effluent concentration in TU<sub>c</sub>
- Q<sub>eff</sub> = effluent discharge at design capacity
- C<sub>amb</sub> = ambient instream concentration in TU<sub>c</sub>
- Q<sub>rec</sub> = receiving stream 7Q10 flow

As the Georgia Environmental Protection Division documented in its 1998 §303(d) list, the potential cause of toxicity impairment to Crawford Creek is the effluent from the Columbia County Crawford Creek WPCP. Therefore, the existing toxicity contribution to Crawford Creek from nonpoint sources is assumed to be 0.0 TU<sub>c</sub>. Since the wasteload allocation will use all of the assimilative capacity of Crawford Creek during critical conditions, the allocation to the nonpoint sources (i.e., the load allocation) is set equal to the existing toxicity contribution of 0.0 TU<sub>c</sub>.

For the TMDL calculation: C<sub>amb</sub> = 0 TU<sub>c</sub>; Q<sub>rec</sub> = 7Q10 flow = 0.00065 cms; C = 1.0 TU<sub>c</sub> per EPA's TSD; Q<sub>eff</sub> = 1.5 million gallons per day (MGD) or 0.0725 cms. To meet the target for chronic toxicity, the effluent concentration is solved for:



$$\text{Effluent Concentration, } C_{\text{eff}} = \frac{C \times (Q_{\text{eff}} + Q_{\text{rec}})}{Q_{\text{eff}}} = 1.009 \text{ TU}_c$$

The toxicity TMDL for the §303(d) listed segment of Crawford Creek is summarized below.

**Table 1. TMDL Calculation**

Pollutant	TMDL (TU <sub>c</sub> )	WLA (TU <sub>c</sub> )	LA (TU <sub>c</sub> )	MOS
Toxicity	1.009	1.009	0.0	Implicit

### ***Seasonal Variation***

The low flow condition represents the most critical design condition and will provide year round protection of water quality.

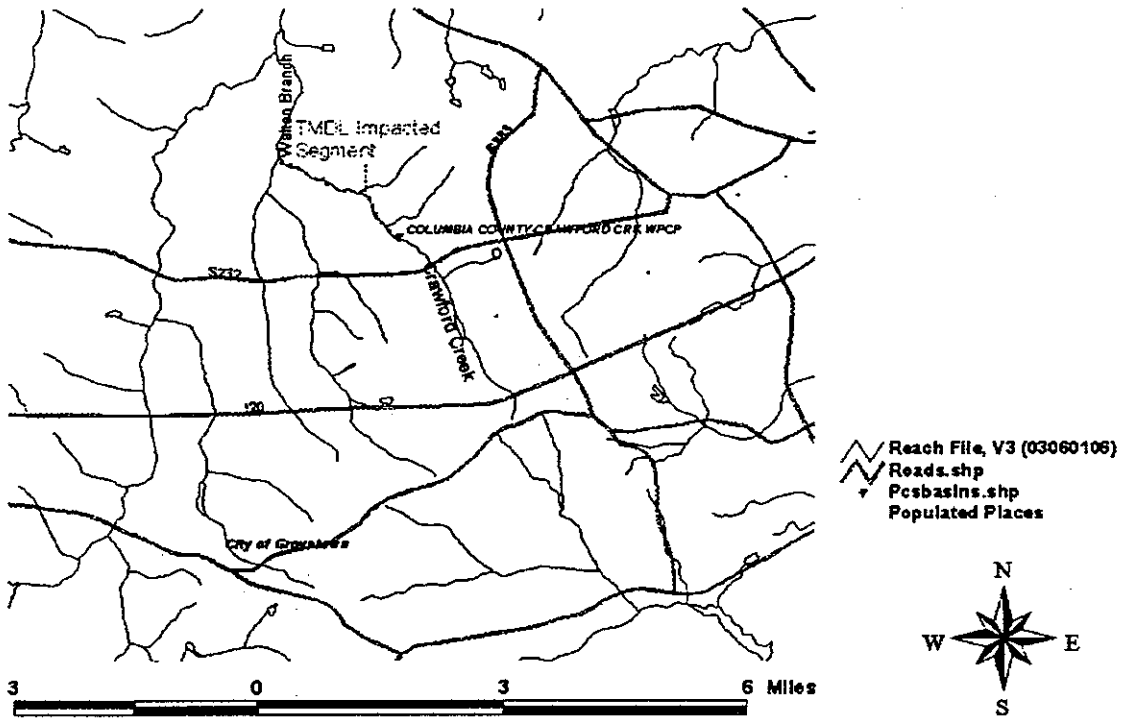
### ***Allocation of Responsibility and Recommendations***

The allocation for toxicity to this segment of Crawford Creek is given in Table 1. Consistent with the TMDL of 1.009 TU<sub>c</sub>, the NOEC shall be no less than the instream waste concentration (IWC) of 99.1%. Therefore, NPDES permit requirements for the Columbia County Crawford Creek WPCP should be consistent with this TMDL and GAEPD's EPA-approved NPDES Reasonable Potential Procedures.

For a potential future point or nonpoint source of toxicity introduced into the system, the total of the WLA (wasteload allocations for point source loadings) and LA (load allocation for nonpoint source loadings) shall not exceed this TMDL.

# Appendix A – Site Map

## Crawford Creek TMDL Site Location Map



## Appendix B – Units Conversion Table

From	To	Multiply by:
Million Gallons per Day (MGD)	Cubic Meters per Second (cms)	0.04381
Cubic Feet per Second (cfs)	Cubic Meters per Second (cms)	0.02832

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## Administrative Record Index

1. EarthJustice Legal Defense Fund. Letter from Eric E. Huber to EPA Region 4. December 7, 1999.
2. Environmental Protection Division of the Georgia Department of Natural Resources. Compilation of Georgia's Current Modeling Guidelines for the Development of Wasteload Allocations and NPDES Permit Limitations. January 1991.
3. Environmental Protection Division of the Georgia Department of Natural Resources. NPDES Reasonable Potential Procedures. January 1995.
4. Environmental Protection Division of the Georgia Department of Natural Resources. Final version of the Georgia 1998 303(d) list. December 22, 1998.
5. Environmental Protection Division of the Georgia Department of Natural Resources. Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards, July 1999.
6. Environmental Protection Division of the Georgia Department of Natural Resources. Printout of Discharge Monitoring Report data from 1999 for the NPDES Permit for Columbia County-Crawford Creek (GA0031984). Undated.
7. Environmental Protection Division of the Georgia Department of Natural Resources. 303(d) List for EPA: More Information. Received by EPA Region 4 on October 5, 1999.
8. Environmental Protection Division of the Georgia Department of Natural Resources. National Pollutant Discharge Elimination System Permit for Columbia County-Crawford Creek (GA0031984). November 8, 1999.
9. Environmental Protection Division of the Georgia Department of Natural Resources. National Pollutant Discharge Elimination System Permit for Columbia County-Crawford Creek (GA0031984). November 8, 1999.
10. ETT Environmental Inc. 7 Day Chronic Definitive Survival and Growth Bioassay for Crawford Creek WTP Effluent. October 22, 1996.
11. Georgia Legal Watch. Letter from Douglas P. Haines to EPA Region 4. December 22, 1999.
12. Sierra Club v. EPA & Hankinson USDC-ND-GA Atlanta Div. #1: 94-CV-2501-MHS
13. USEPA. Guidance for Water Quality-based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA-440/4-91-001, April 1991.

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14. USEPA. Technical Support Document For Water Quality-based Toxics Control. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA/505/2-90-001. March 1991.
  15. USEPA. Photocopied tables and charts from (USGS 1988 Low-Flow profiles) with 7Q10 estimation and calculations for Crawford Creek. U.S. Environmental Protection Agency, Region 4, Water Management Division. October 28, 1999 (estimated date).
  16. USEPA. Proposed Total Maximum Daily Load (TMDL) Development for Toxicity in the Crawford Creek Watershed. U.S. Environmental Protection Agency, Region 4, Water Management Division. October 28, 1999.
  17. USGS. Water Resources Investigation Report 88-4047: Low-Flow Profiles of the Upper Savannah and Ogeechee Rivers and Tributaries in Georgia. 1988.

## Response to Public Comment on the Proposed TMDL

### *COMMENT*

It is not apparent if the chlorine permit limit for the Columbia County Water Pollution Control Plant is consistent with the wasteload allocation of the proposed TMDL. If not, the permit limit needs to be reduced accordingly.

Mr. Eric E. Huber, EarthJustice Legal Defense Fund, 400 Magazine Street, Suite 401, New Orleans, Louisiana 70130-2453, December 7, 1999

### *RESPONSE*

The total residual chlorine (TRC) permit limit for the Columbia County Water Pollution Control Plant is equal to 0.011 mg/l. This concentration is protective of instream chronic effects of TRC, and therefore is anticipated to be consistent with the wasteload allocation.

### *COMMENT*

The draft TMDL uses 7Q10 as the basis for toxicity calculations. However, it is unclear, from the Georgia toxicity criteria, if the chronic and acute criteria are to be based on this flow. The use of this flow for an implicit margin of safety is questioned, especially where the low flow is zero. While both acute and chronic criterion are given, the TMDL calculations are only done for chronic. If this also assures compliance with acute, it needs to be justified.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

### *RESPONSE*

For an effluent dominated stream such as the water quality limited segment of Crawford Creek, protection against chronic toxicity during 7Q10 conditions will inherently provide protection against acute toxicity. Unnecessary references to acute toxicity criteria in the proposed TMDL report have been removed from the final TMDL report. The margin of safety for this TMDL is implicit through the use of the 7Q10 value, which is greater than zero.

**COMMENT**

In this case, the toxicity problem is specifically attributed to chlorine. It is understood that the 303(d) list includes toxicity as the criterion at issue, however it also states in the "Actions to Alleviate" column that chlorine is the problem. Therefore it would be more useful to determine the allowable daily load of chlorine, perhaps along with TU if it is felt that this is required. This would make the TMDL more accessible to the public and get at the heart of the issue in a more useable form.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

**RESPONSE**

Georgia's 1998 §303(d) list includes Crawford Creek as a water quality limited segment partially supporting its designated uses. The criterion violated was identified as toxicity. Therefore, this TMDL has been established to protect against toxicity in Crawford Creek. If the criterion violated for a particular 303(d) listed water was identified as total residual chlorine, then a TMDL for total residual chlorine would need to be developed.

**COMMENT**

It is stated that the discharger installed dechlorination equipment last February. It is not clear if there are data showing all toxicity problems have been resolved at the end of the pipe and in the stream. This is particularly of interest since it is stated that the permit does not have toxicity limits. Since the facility caused the toxicity listing, the permit should contain toxicity limits.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

**RESPONSE**

The following language has been added to the final TMDL report:

"Consistent with the TMDL of 1.01 TU<sub>c</sub>, the No Observable Effect Concentration (NOEC) shall be no less than the instream waste concentration (IWC) of 99%. Therefore, NPDES permit requirements for the Columbia County Crawford Creek WPCP should be consistent with this TMDL and GAEPD's EPA-approved NPDES Reasonable Potential Procedures."

**COMMENT**

On page 3 in the Background section of the TMDL, it is stated that the water passed a 1996 toxicity test. It seems that this test would have failed since there was no dechlorination, and since the stream was being added to the 303(d) list. Perhaps this is a typo or needs more explanation.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

**RESPONSE**

A 7-day chronic definitive survival and growth bioassay was conducted on the Crawford Creek Water Pollution Control Plant effluent on October 22, 1996 using the test organism, *Pimephales promelas*. The test results indicated that the No Observed Effect Concentration (NOEC) was greater than 100%.

**COMMENT**

It is stated that the maximum permit limit for TRC is 0.011 mg/l. Where can the State's standard for chlorine be found in the regulations? The State regulations may need to be updated to be more specific for toxicity and TRC.

Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street, Athens, Georgia 30601, December 22, 1999

**RESPONSE**

The State does not have a specific standard for chlorine. In accordance with Georgia Regulation 391-3-6-.01(5), any interested persons shall have the right to participate in the promulgation of rules associated with the Georgia Water Quality Control Act. EPA encourages the commenter and any interested persons to contact the Georgia Environmental Protection Division to obtain more information regarding participation in this process.

**COMMENT**

In the TMDL Calculation section of the TMDL, it looks like the equation at the bottom of page 6 should have a denominator of  $Q_{rec} + Q_{eff}$ , instead of  $Q_{rec} + Q_{amb}$  to match the term definitions.



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Mr. Douglas P. Haines, Executive Director, Georgia Legal Watch, 264 North Jackson Street,  
Athens, Georgia 30601, December 22, 1999

*RESPONSE*

The denominator of this equation has been changed to  $Q_{\text{eff}} + Q_{\text{rec}}$  in order to be consistent with the term definitions.

## References:

- Environmental Protection Division of the Georgia Department of Natural Resources. 1998. Final version of the Georgia 1998 303(d) list. Atlanta, Georgia. December 22, 1998.
- Environmental Protection Division of the Georgia Department of Natural Resources. 1999. *Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards*, Revised July 6, 1999. Atlanta, Georgia. July 6, 1999.
- Sierra Club v. EPA & Hankinson. 1998. USDC-ND-GA Atlanta Div. #1: 94-CV-2501-MHS.
- USEPA. 1991a. Guidance for Water Quality-based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.
- USEPA. 1991b. Technical Support Document for Water Quality Based Toxics Control. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-505/2-90-001, March 1991.
- USGS. 1988. Water Resources Investigation Report 88-4047, Low-Flow Profiles of the Upper Savannah and Ogeechee Rivers and Tributaries in Georgia. Doraville, Georgia. 1988.