

WATER QUALITY AND FECAL COLIFORM MONITORING ON BIG CEDAR CREEK, A 303d LISTED STREAM

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Abstract. Big Cedar Creek in Putnam County has been listed as a 303d impaired stream due to excessive fecal coliform levels. The Big Cedar Creek Watershed above the highway 129 bridge is primarily a wildlife management area with minimal livestock or human impact. Since many 303d listed streams have questionable or limited data, further field sampling is required to verify existing data or generate data to make further assessments of water quality in the impaired portion of the stream. The objective of this study was to monitor fecal coliform levels in Big Cedar Creek to determine if streams are in compliance with EPA standards.

The uppermost sampling station in the National Forest contained a geometric mean for fecal coliform in excess of the 200 MPN/100 ml water quality criteria during March and June sampling periods. The sites at highway 129 bridge were above the geometric mean of 200 MPN standard during the June and September samplings. The fecal coliform geometric mean for all sites is below the guidelines of 500 MPN/100 ml in free flowing freshwater streams. Only one observation was above 4,000 MPN/100 ml (Site 7, October 10, 2002). This study provides a background estimate of fecal coliform levels in clean water streams of the lower Piedmont for future TMDL development. In addition, all P values were <0.06 mg/L, and conductivity ranged from 80 to 120 FS/cm.

INTRODUCTION

The State of Georgia is required to assess the water quality of all streams within the State. Reviewing the list of 303d impaired streams, it appears the fecal coliform level is the most frequently listed impairment. The use of fecal coliform is complicated by the fact that both human and non-human sources (warm-blooded animals) contribute to the fecal

coliform loading. Water quality criteria (Georgia EPD, 2002) for streams listed as fishing or human contact are:

- 1) Dissolved Oxygen must maintain a daily average of 6.0 mg/l and no less than 5.0 mg/l at all times for streams designated as trout streams. For waters supporting warm water species of fish the daily average of 5 mg/l and no less than 4.0 mg/l must be maintained at all times.
- 2) The pH must remain within the range of 6.0–8.5.
- 3) Bacteria: For the months of May through October, when water contact recreation activities are expected to occur, fecal coliform not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from non-human sources exceed 200/100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams. For the months of November through April, fecal coliform not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample. Thus there are two fecal coliform criteria levels used to assess stream water quality during the summer months, namely a geometric mean of 200 colonies/100 ml

for streams with known human sources and 500 per 100 ml in free flowing freshwater streams with non-human sources.

In the 1990's, the Georgia EPD conducted a water quality study on streams of the State. Cedar Creek in Putnam County has been listed as a 303d impaired stream due to excessive fecal coliform levels. The Big Cedar Creek Watershed above the highway 129 bridge is primarily a wildlife management area with minimal livestock or human impact. Big Cedar Creek, therefore, provides a study area with minimal human impact to determine potential wildlife background levels of fecal coliform for TMDL assessments in the Piedmont region. Since many 303d listed streams have questionable or limited data, further field sampling is required to verify existing data or generate data to make further assessments of water quality in the impaired portion of the stream. A year long water quality monitoring project was conducted on Big Cedar Creek to generate background water quality data for a lower Piedmont watershed with minimal development and human impacts.

The objective of this project is to:

- 1) Monitor fecal coliform levels in Big Cedar Creek to determine seasonal fluctuation in levels and determine if streams are in compliance with Georgia in-stream standards.
- 2) Collect water quality data to assess potential sources of fecal coliform.

MATERIALS AND METHODS

Big Cedar Creek is located in the rolling terrain of the Georgia Piedmont South of Eatonton, Georgia. Figure 1 presents a map of the study area. The headwaters of Big Cedar Creek lie in the Cedar Creek Wildlife Management area and the Oconee National Forest. Site 1 is located where U.S. Forest Service Road (Union Hill Church Road) crosses Big Cedar Creek above impacted stream segment. Site 2 is located below confluence of Cedar Creek and Hog Creek below a primitive camp location. Site 3 is 100 yards above highway 129 bridge with the Oconee National Forest (minimal impact from highway traffic and public fishing access). Site 4 is immediately downstream side of Highway 129 bridge which corresponds to the Georgia EPD sampling location for 303d list assessment. Site 5 is located downstream of a dry lot (low cattle density <1 cow/acre) dairy operation. Cattle have been fenced out of direct access to the

stream (>100 foot buffer). Site 6 is located on the downstream side of Highway 212 bridge where Big Cedar Creek enters Lake Sinclair (a Georgia Power hydroelectric impoundment). Direction of flow at sites 5 and 6 is influenced by power generation at Lakes Oconee and Sinclair. Stream loading at sites 5 and 6 may be diluted by Lake Sinclair. When power is being generated at Lake Oconee, stream flow direction appears to be reversed. Site 6 is the lower end of the impacted stream segment.

Stream segments were sampled weekly during September 2001 (9/11/2001-10/3/2001), December 2001 (12/5/2001-1/2/2002), March 2002 (3/7/2002-3/25/2002), June 2002 (6/6/2002-7/1/2002) and September 2002 (9/23/2002-10/17/2002) to generate a geometric mean of 4 samples for fecal coliform over a 30 day period for each season (quarter) of the year. Sampling occurred between 9 and 11 AM on each sampling date. Stream flow was estimated at Highway 129 Bridge. The following parameters were monitored onsite at each sampling event: dissolved oxygen, specific conductance, pH and temperature. Grab samples were collected for fecal coliform and mineral analysis.

RESULTS AND DISCUSSION

Dissolved oxygen levels were all within acceptable ranges for streams listed as fishing or human contact. With the exception of sites 3, 4 and 5 during June and September 2002, all dissolved oxygen levels were greater than 6.0. During the low flow conditions of June through September, the dissolved oxygen at sites 3, 4 and 5 were 5.2, 5.2 and 5.9, respectively. The water temperatures varied with seasons as expected. In general, however, temperatures at sites 5 and 6 (impacted by Lake Sinclair) tended to be 2°C higher than stream locations (Sites 1-4). The observed drop in dissolved oxygen is

due to elevated temperature and low flow conditions caused by the drought conditions.

Stream water pH values were within acceptable ranges of 6.0 to 8.5. Stream pH values tended to decrease when progressing from headwater Site 1 to the downstream-lake location Site 6: Site 1, pH 7.8-7.7; Site 2, pH 7.1-7.6; Site 3, pH 6.9-7.4; Site 4, pH 6.7-7.3; Site 5, pH 6.7-7.1; and Site 6, pH 6.8-7.4.

Other Water Quality Parameters measured were conductivity and P. Stream conductivity remained between 80-120 µg/cm at all 6 sampling sites through the year. Conductivity decreased from 100-120 µg/cm

Table 1. Analytical Parameters

Variable ¹	Analytical Method	Laboratory
pH	EPA 150.1	Field Measurement
Specific Conductance	EPA 120.1	Field Measurement
Total P	EPA Method 200.1 ICP (not official method)	UGA Ag Services Lab
Fecal Coliform	Standard Method 9221E2 fecal coliform by multitube fermentation	UGA Ag Services Lab

¹Dissolved Oxygen and temperature were determined using an YSI Model 95 handheld dissolved oxygen meter calibrated according to manufacturer's specifications. The pH and conductivity were determined using an Oyster[®] pH-Conductivity-Temperature Meter Model 34145A calibrated according to manufacturer's specifications.

during March due to increased spring stream flow. P levels were <0.06 ppm at all sampling periods and sites. The water temperatures varied with season as expected. In general, temperatures at sites 5 and 6 (impacted by Lake Sinclair) tended to be 2°C higher than the stream locations (Sites 1-4).

Fecal coliform levels (geometric mean) for the monitoring period are presented in Figure 2. The upstream location (Site 1) contained levels ranging from 108-278 MPN /100 ml with the highest level (278 MPN/100ml) occurring in March 2002. The mid-point sampling location (Site 2) contained fecal coliform levels < 200 colonies per 100 ml for all periods except September 2002 where the levels climbed to 438 colonies per 100 ml during the low flow conditions of September. Sampling sites at or above the highway 129 bridge contained fecal coliform levels of < 200 MPN per 100 ml for all sampling period except September. During the dry months of September 2001 and 2002, the fecal coliform levels spiked to 554 MPN/100 ml and 1118 MPN/100 ml for sites 3 and 4, respectively. The fecal coliform levels at the highway 129 bridge (Site 4) are higher than site 3 (100 yards upstream) suggesting a significant impact of public access at the bridge for fishing, camping, picnicking, wading, swimming and a possible wildlife contribution at the bridge (nesting swallows). All values at sites 5 and 6

were below 200 MPN / 100 ml except for September 2002 at the highway 212 bridge (Site 6) which peaked at 242 MPN / 100 ml. The only incidence of fecal coliform exceeding 4000 Colonies / 100 ml occurred at Site 2 on the October 7, 2002 sampling.

Excessive fecal coliform levels occurred during the dry hot weather months because of wildlife in areas in or near streams. This, in turn, leads to feces deposition in or adjacent to streams and to susceptibility to fecal coliform being moved into the stream during high intensity-short duration rain events. Since there are no human impact zones (municipal discharges, houses on the creek, cattle pastures, etc.) between Site 1, 2 and 3, the most likely source of the fecal coliform is wildlife. Thus the excessive fecal coliform levels at Sites 2-4 during September and the >4000 MPN / 100 ml is probably due to wildlife inputs and public access at road crossings.

In the initial assessment of Big Cedar Creek, a fecal coliform level of 200 MPN /100 ml was used as the standard due to the presence of one low density (<0.5 cows / acre) beef cattle operation and one abandoned chicken grow-out operation in the headwaters of Big Cedar Creek (upstream of Site 1). Since fecal coliform levels occasionally exceed the 200/100 ml standard primarily due to wildlife during the period from May to October, a more lenient standard of 300 in lakes and 500 in free flowing streams may be more appropriate. In this case only sites 2, 3 and 4 during the low flow conditions of September 2002 exceeded the standard.

CONCLUSIONS

Wildlife in forested watersheds contribute to fecal coliform loads that may exceed the current guideline of 200 MPN/100 mls. Dry lot dairy operations where cattle are fenced out of the stream do not produce elevated fecal coliform levels. A more lenient fecal coliform standard of 300 MPN/100 mls in lakes and 500 in free flowing streams is more appropriate for TMDL assessments.

LITERATURE CITED

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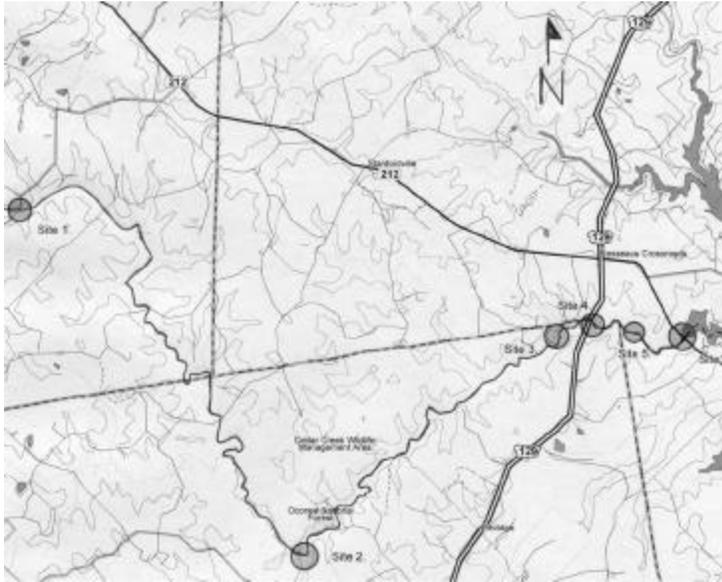


Figure 1. Site Locations on Big Cedar Creek, Putnam County, Georgia.

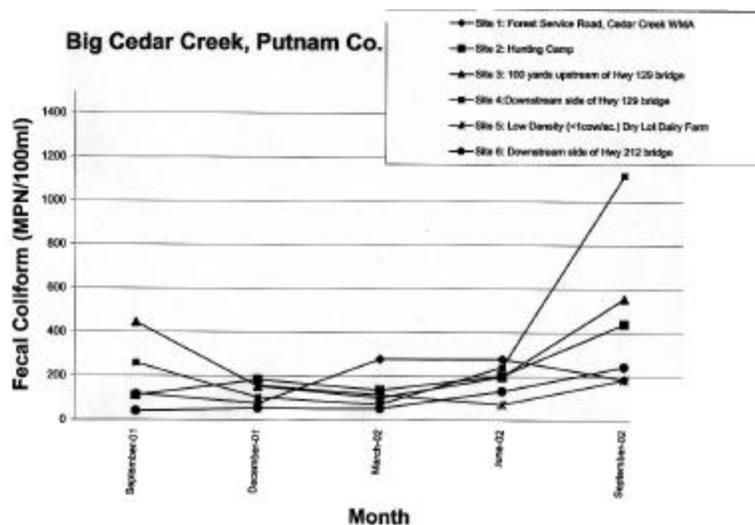


Figure 2: Results of fecal coliform monitoring on Big Cedar Creek, Putnam County, Georgia from September 2001 to September 2002. Fecal coliform levels are most probable number (MPN) by multiple fermentation.

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