Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Big Spring Creek Embayment
Guntersville Reservoir
Intensive Basin Survey 2009

GUNM-9: Big Spring Creek immediately upstream of AL Hwy 227 bridge (Marshall Co 34.3452/-86.29182)

BACKGROUND

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program (now known as the Rivers and Reservoirs Monitoring Program (RRMP) was initiated by ADEM.

The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM's 2012 Monitoring Strategy (ADEM 2012).

In 2009, ADEM monitored the Big Spring Creek tributary embayment of Guntersville Reservoir as part of the intensive basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Big Spring Ck embayment (GUNM-9) during the 2009 growing season (Apr-Oct). This is the second intensive basin assessment of the Tennessee River since ADEM began sampling on a basin rotation. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/ productivity [chlorophyll *a* (chl *a)*; algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson's trophic state index (TSI)] from 2009 were compared to ADEM's 2003 data and established criteria.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Big Spring Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/ S/F&W)* stream located in the Sequatchie Valley ecoregion (68b). Based on the 2006 National Land Cover Dataset, land use within the 69 mi^2 watershed is mixed between forest (41%) and agriculture (35%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 32 NPDES permits within the watershed. Six of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Big Spring Ck embayment at GUNM-9 is located near Guntersville, AL. It is a large embayment with a fairly deep channel and flows into the Tennessee River near the US 431 bridge crossing. Big Spring Ck has a median bottom depth of 7.65 m (Table 2) at the sampling location.

Figure 1. Photo of Big Spring Ck at GUNM-9

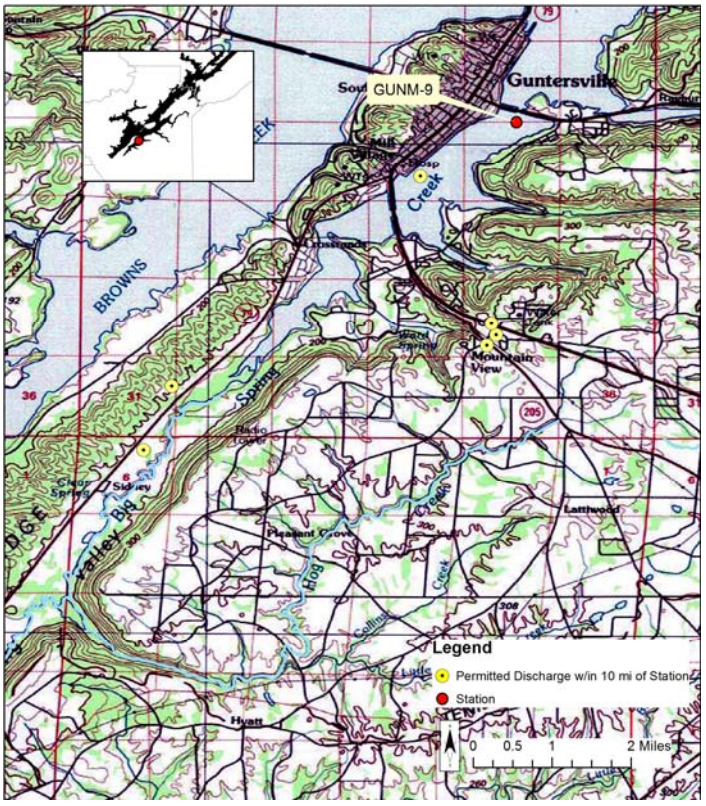


Figure 2. Map of Big Spring Ck Embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

METHODS

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2009), Surface Water Quality Assurance Project Plan (ADEM 2008a), and Quality Management Plan (ADEM 2008b).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2009 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis of the graphs in Fig. 4 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

The mean growing season TN value was higher in 2009 than in 2003 (Fig. 4). Monthly TN concentrations fluctuated throughout the year, peaking in Apr, Jul, and Oct.

Contrary to mean TN concentration, the mean growing season TP concentration was slightly lower in 2009 (Fig. 4). Monthly TP concentrations gradually increased throughout the season with the highest values in September.

In 2009, the growing season mean chl *a* value was slightly lower than 2003 (Fig. 4). Monthly chl *a* concentrations were quite variable month to month, with an increasing trend through the season. Concentrations peaked in September.

Mean TSI remained eutrophic in 2009. Monthly TSI in Big Spring Ck was eutrophic April-October, reaching near hypereutrophic conditions in September (Fig. 4).

Table 1: Summary of Watershed **GUNM-9**

Basin		Tennessee R
Drainage Area (mi^2)		69
Ecoregion[a]		68b
% Landuse		
Open Water		4%
Developed	Open Space	6%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	30%
	Evergreen Forest	4%
	Mixed Forest	7%
Shrub/Scrub		5%
Herbaceous		3%
Hay/Pasture		30%
Cultivated Crops		5%
Wetlands	Woody	1%
	Emergent Herb.	<1%
# NPDES Permits[b]	TOTAL	32
401 Water Quality Certification		2
Construction Stormwater		8
Mining		1
Industrial General		16
Industrial Individual		2
Municipal Individual		2
Underground Injection Control		1

a. Sequatchie Valley

b. # NPDES permits downloaded from ADEM's NPDES Management System database, Oct 1, 2013.

The mean growing season TSS value was lower in 2009 than 2003 (Fig. 5). With the exception of May, all monthly TSS concentrations were at or below 5.0 mg/L.

AGPT results show that GUNM-9 was nitrogen limited in 2009, opposite of the 2003 results (Table 3). The mean maximum standing crop (MSC) value was 3.01 mg/L, which is below the 5.0 m/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems. The previous MSC value for Big Spring Ck was also below 5 mg/L.

The DO concentration in the GUNM-9 station was above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months though concentrations declined sharply in August (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

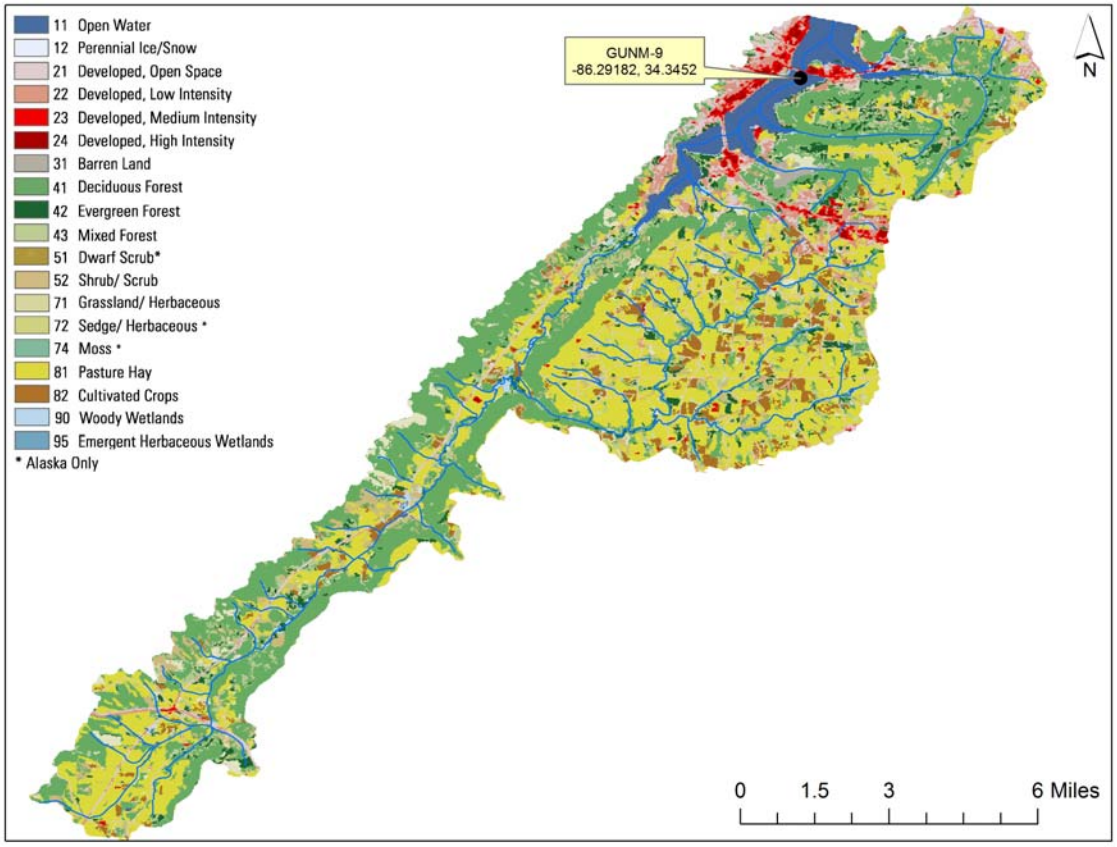
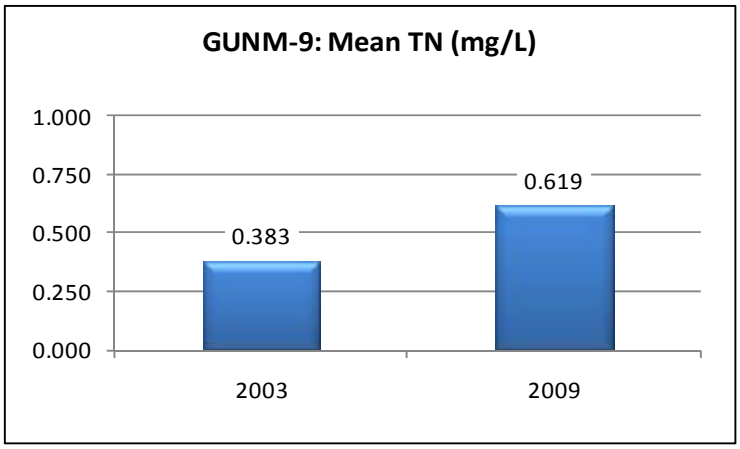
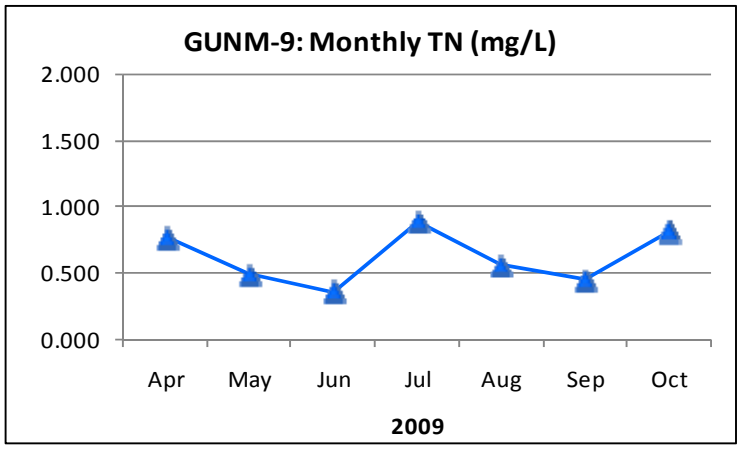
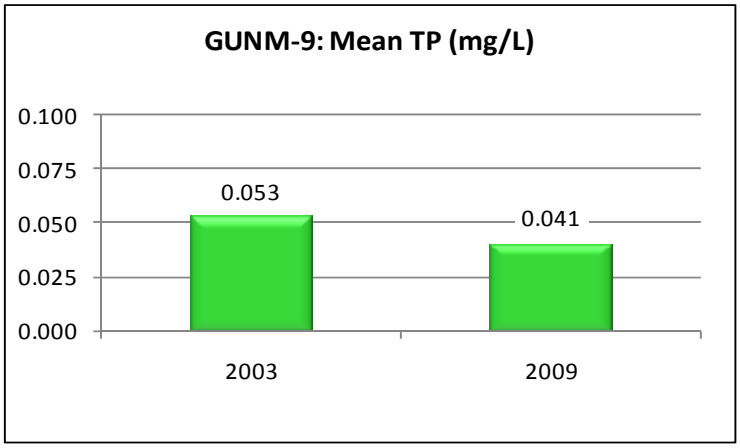
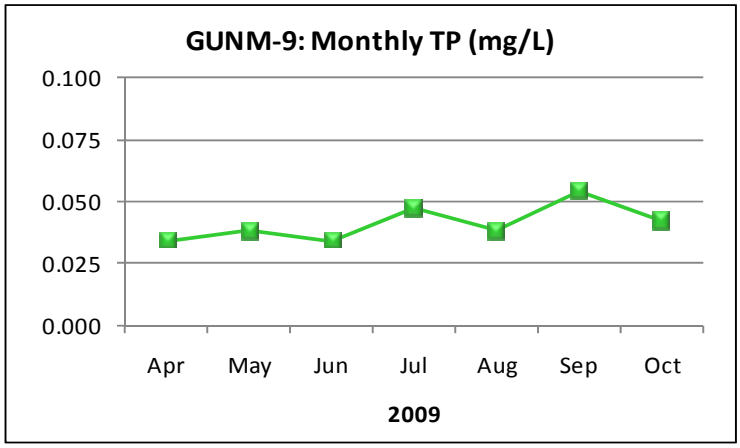


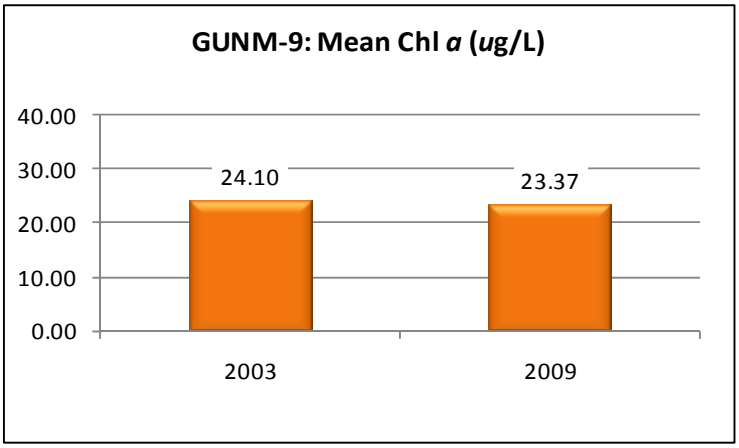
Figure 3. Landuse within the Big Spring Creek watershed at GUNM-9.

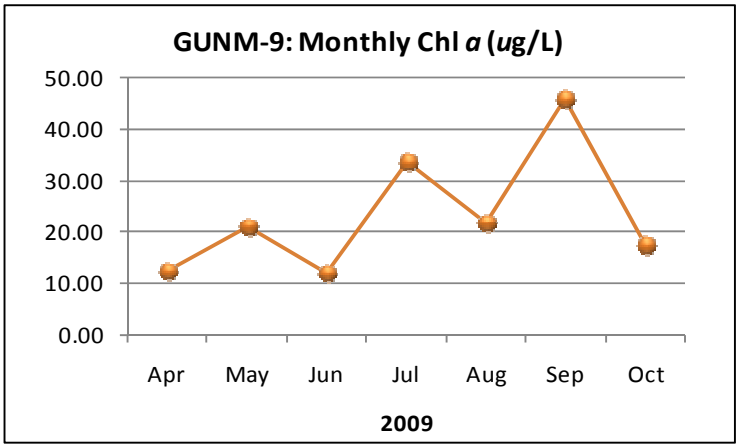


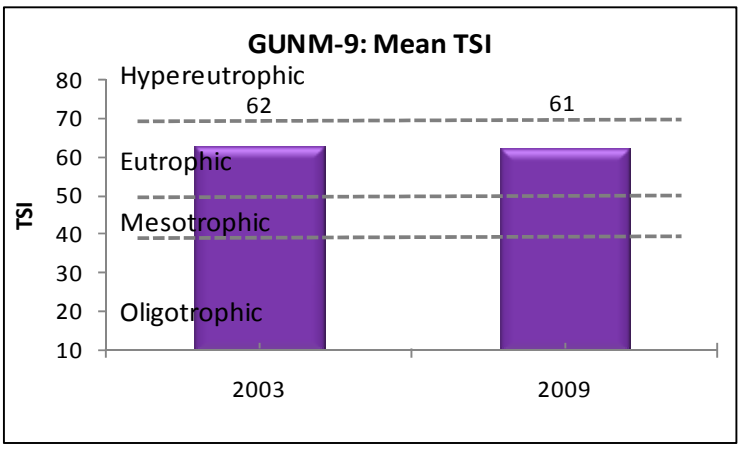












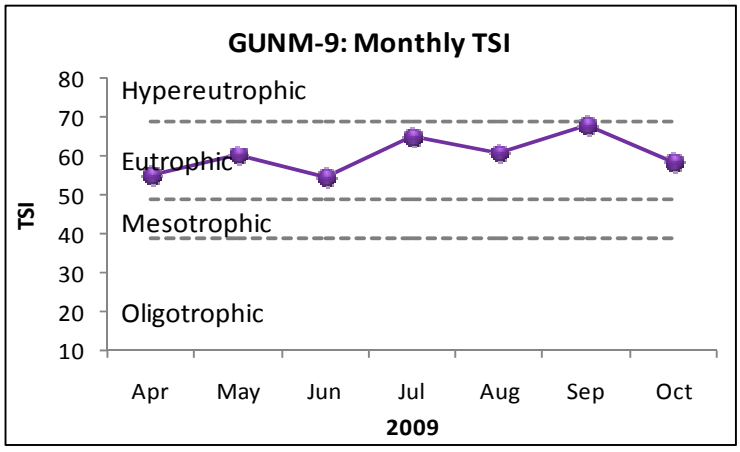
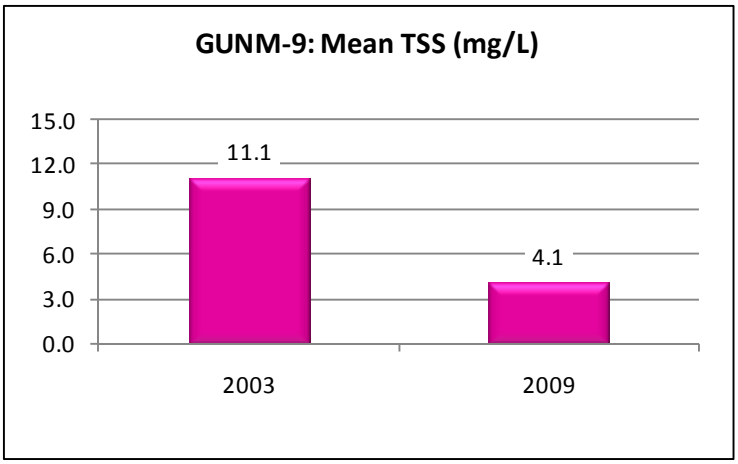


Figure 4. Mean growing season (2003-2009) and monthly (April-October, 2009) TN, TP, chl a and TSI measured in the Big Spring Creek embayment of Guntersville Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



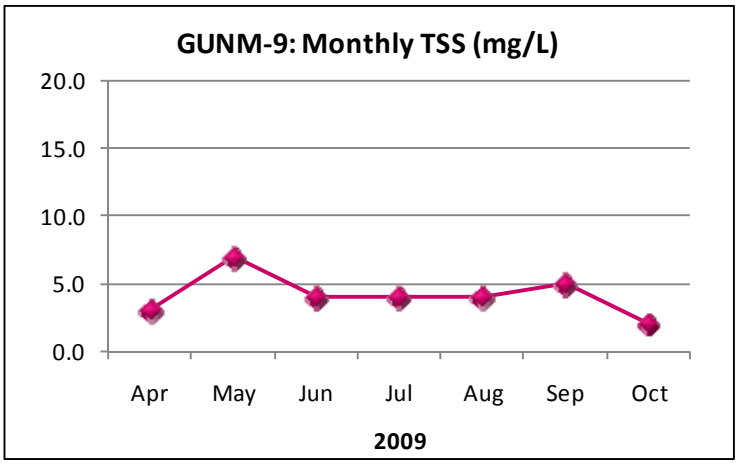


Figure 5. Mean growing season and monthly TSS measured in the Big Spring Creek embayment of Guntersville Reservoir**.**

Table 2. Summary of water quality data collected April-October, 2009. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), average (Avg), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

GUNM-9	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	7	3.8	6.4	4.6	4.8	0.9
Total Dissolved Solids (mg/L)[J]	7	18.0	144.0	112.0	99.7	40.8
Total Suspended Solids (mg/L)	7	2.0	7.0	4.0	4.1	1.6
Hardness (mg/L)	3	57.0	74.1	73.3	68.1	9.6
Alkalinity (mg/L)	7	25.5	75.7	68.2	61.0	17.4
Photic Zone (m)	7	3.04	4.07	3.52	3.47	0.34
Secchi (m)	7	1.11	1.43	1.21	1.22	0.11
Bottom Depth (m)	8	7.00	9.00	7.65	7.78	0.52
Chemical						
Ammonia Nitrogen (mg/L)	7	< 0.006	0.076	0.007	0.016	0.027
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	< 0.002	0.331	0.013	0.116	0.142
Total Kjeldahl Nitrogen (mg/L)	7	0.230	0.888	0.440	0.503	0.214
Total Nitrogen (mg/L)[J]	7	< 0.359	0.890	0.561	0.619	0.205
Dissolved Reactive Phosphorus (mg/L)[J]	7	< 0.004	0.013	0.005	0.006	0.004
Total Phosphorus (mg/L)	7	0.034	0.054	0.038	0.041	0.007
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.8	7.1	5.5	5.5	1.2
Biological						
Chlorophyll a (ug/L)	7	11.75	45.92	21.00	23.37	12.38
Fecal Coliform (col/100 mL)[J]	3	< 1	100	20	40	53

J= one or more of the values is an estimate; N= # samples.

Table 3. Algal growth potential test results (expressed as mean MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
8/20/2003	4.23	PHOSPHORUS
8/18/2009	3.01	NITROGEN

FOR MORE INFORMATION, CONTACT:
Gina Curvin, ADEM Environmental Indicators Section
1350 Coliseum Boulevard, Montgomery, AL 36110
(334) 260-2783, gcurvin@adem.state.al.us

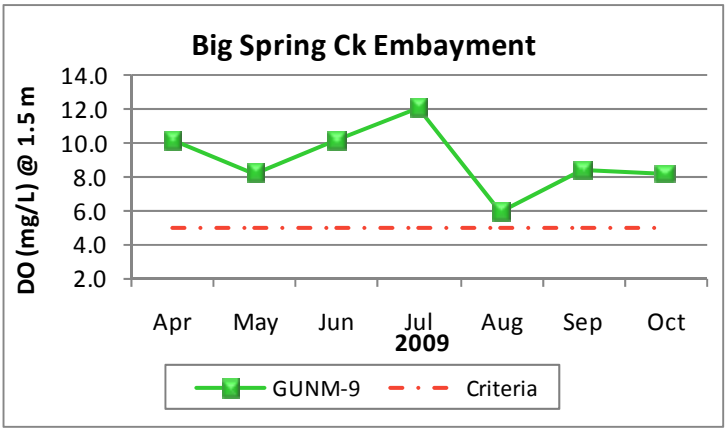


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Big Spring Ck embayment station of Guntersville Reservoir collected April-October 2009. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth .

REFERENCES

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