Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Crow Creek Embayment
Guntersville Reservoir
Intensive Basin Survey 2009

GUNM-1: Crow Creek approx. 1/2 mi downstream of US Hwy 72 (Jackson Co 34.83665/-85.82496)

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 Crow 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 Crow Ck embayment (GUNM-1) 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 [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. Crow 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 266 mi^2 watershed is predominantly forest (80%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 7 NPDES permits within the watershed. Two of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

Draining into Guntersville Reservoir near river mile 401, the Crow Ck embayment is located just south of Stevenson, AL. It is a shallow embayment with a median bottom depth of 3.4 m (Table 2) at the sampling location. Although the channel is clear, most of the embayment is covered with thick mats of aquatic vegetation.

Figure 1. Photo of Crow Ck at GUNM-1

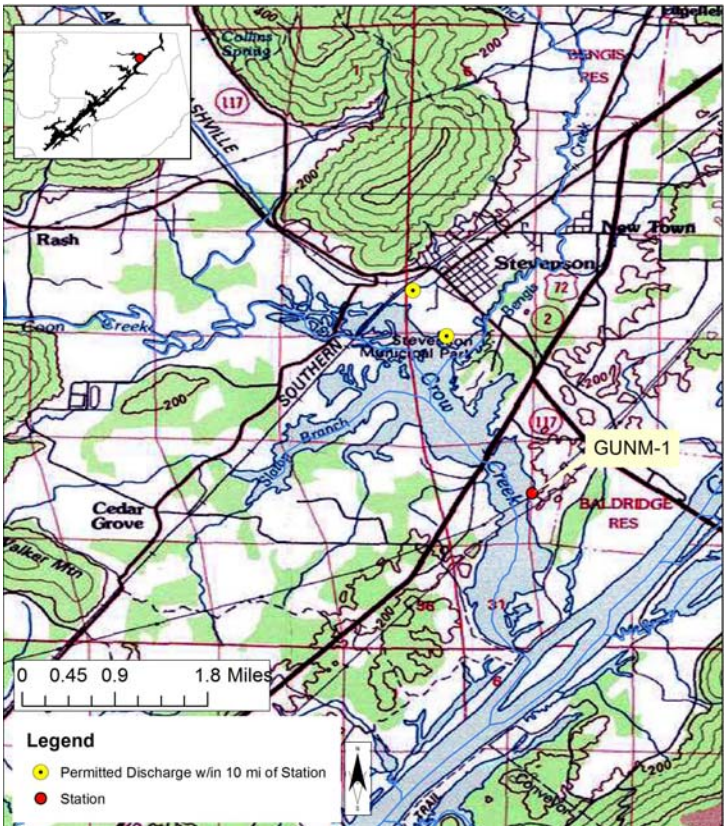


Figure 2. Map of Crow Ck Embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

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 discharge data, if available, and 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.

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

Basin		Tennessee R
Drainage Area (mi^2)		266
Ecoregion[a]		68b
% Landuse		
Open Water		1%
Developed	Open Space	2%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	75%
	Evergreen Forest	1%
	Mixed Forest	4%
Shrub/Scrub		3%
Herbaceous		2%
Hay/Pasture		7%
Cultivated Crops		3%
Wetlands	Woody	1%
	Emergent Herb.	<1%
# NPDES Permits	**TOTAL**	7
Construction Stormwater		4
Mining		1
Industrial General		1
Municipal Individual		1

a. Sequatchie Valley

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

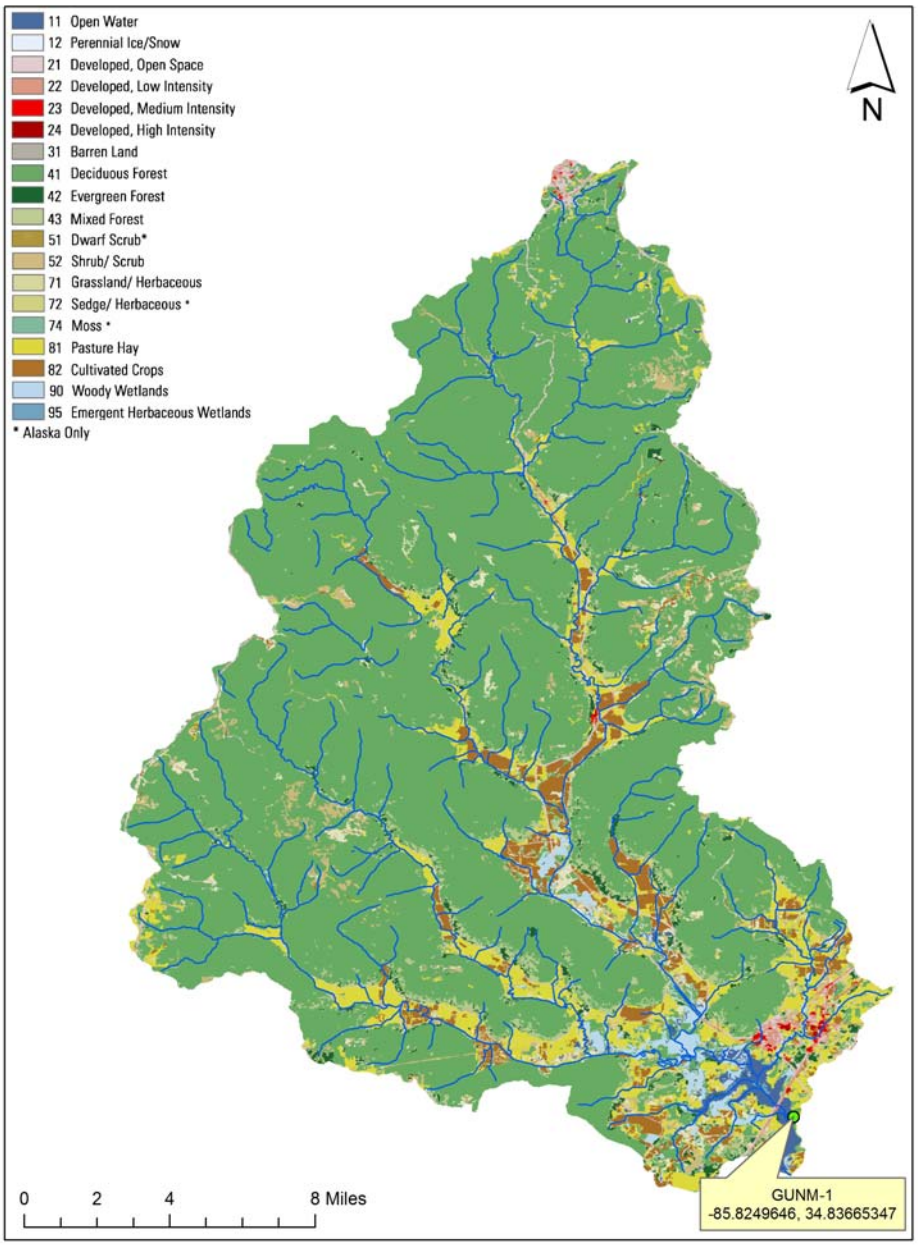


Figure 3. Landuse within the Crow Creek watershed at GUNM-1.

The mean growing season TN value was higher in 2009 than in 2003 (Fig. 4). Monthly TN concentrations were generally low and peaked in September.

Contrary to the mean TN concentration, the mean growing season TP concentration was lower in 2009 (Fig. 4). The highest monthly TP concentrations were measured in May and September.

In 2009, the growing season mean chl *a* value was lower than 2003 (Fig. 4). Monthly chl *a* concentrations peaked in August.

Mean TSI remained mesotrophic in 2009. Monthly TSI in Crow Ck was oligotrophic or mesotrophic in most months, but reached eutrophic levels in August (Fig. 4).

The mean growing season TSS value was lower in 2009 than 2003 (Fig. 5). Monthly TSS concentrations were highest in May and lowest in September.

AGPT results show that Crow Ck was phosphorus limited in both 2003 and 2009 (Table 3). The mean maximum standing crop (MSC) value was 1.33 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 Crow Ck was also below 5 mg/L.

The DO concentration at the Crow Ck station declined Apr-Aug and was below the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in August (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

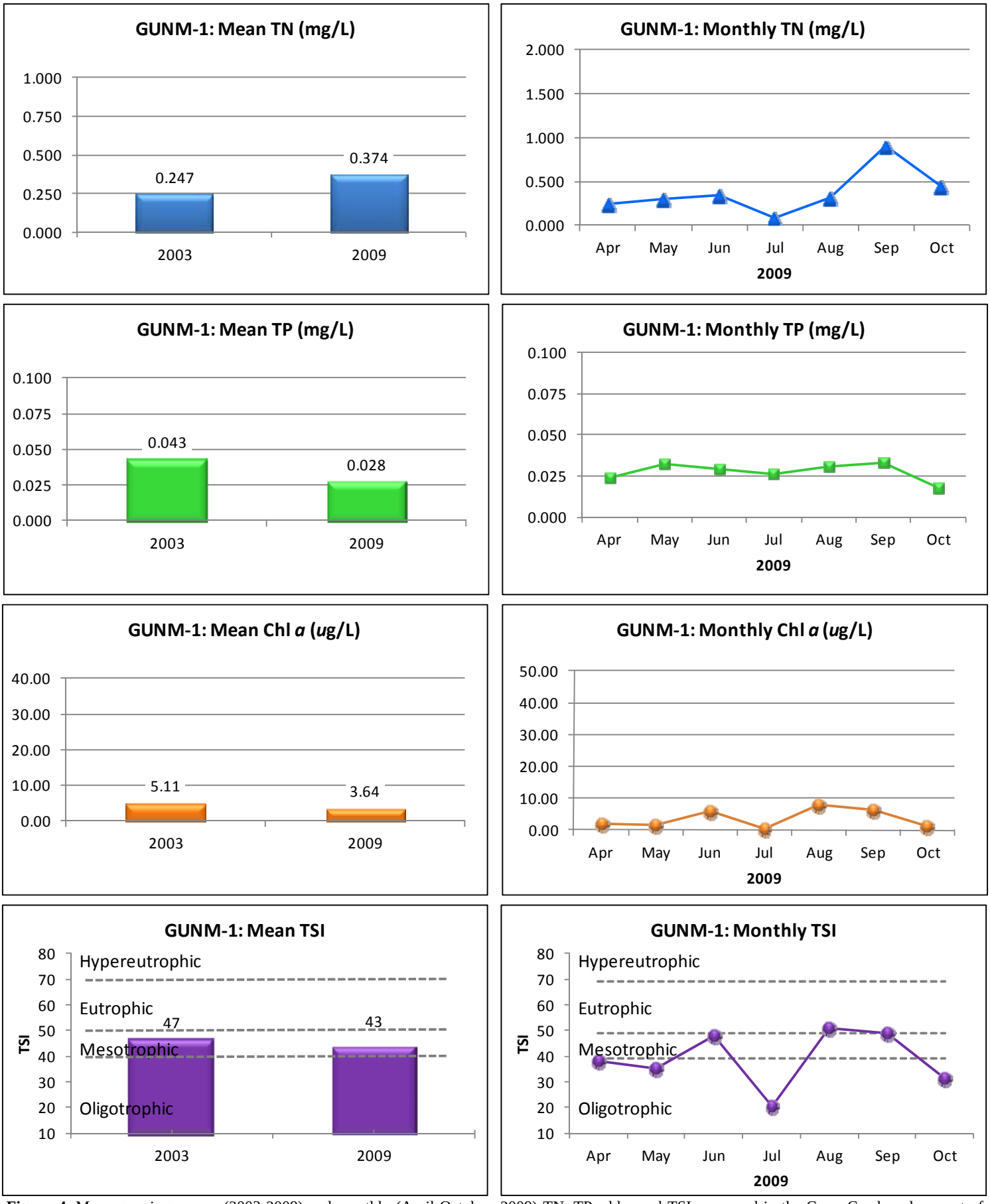
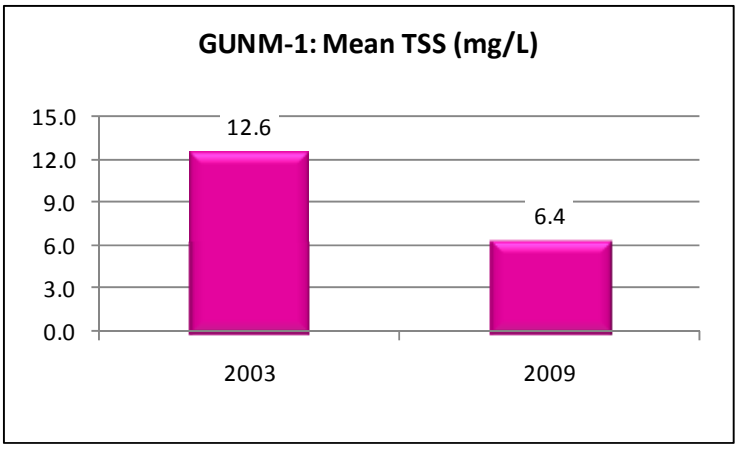


Figure 4. Mean growing season (2003-2009) and monthly (April-October, 2009) TN, TP, chl a and TSI measured in the Crow Creek embayment of Guntersville Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same



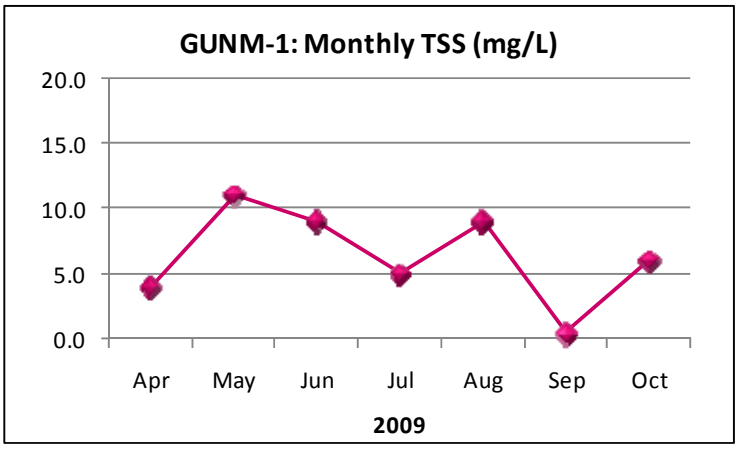


Figure 5. Mean growing season and monthly TSS measured in the Crow Creek embayment of Guntersville Reservoir**.**

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-1	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	7	8.1	15.1	9.9	10.7	2.4
Total Dissolved Solids (mg/L)[J]	7	60.0	142.0	114.0	107.1	32.9
Total Suspended Solids (mg/L)	7	< 1.0	11.0	6.0	6.4	3.6
Hardness (mg/L)	3	82.5	119.0	107.0	102.8	18.6
Alkalinity (mg/L)	7	75.7	115.0	102.0	99.3	12.2
Photic Zone (m)	7	2.64	3.14	2.96	2.98	0.17
Secchi (m)	7	0.73	1.42	0.98	0.99	0.21
Bottom Depth (m)	7	3.00	4.20	3.40	3.46	0.44
Chemical						
Ammonia Nitrogen (mg/L)	7	< 0.006	0.020	0.007	0.007	0.006
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	0.011	0.252	0.165	0.132	0.098
Total Kjeldahl Nitrogen (mg/L)	7	< 0.141	0.725	0.187	0.242	0.234
Total Nitrogen (mg/L)[J]	7	< 0.082	0.908	0.316	0.374	0.260
Dissolved Reactive Phosphorus (mg/L)[J]	7	0.005	0.012	0.008	0.008	0.002
Total Phosphorus (mg/L)	7	0.018	0.033	0.029	0.028	0.005
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	1.5	5.8	1.7	2.3	1.6
Biological						
Chlorophyll a (ug/L)	7	0.36	8.01	2.14	3.64	3.04
Fecal Coliform (col/100 mL)[J]	3	21	52	37	37	16

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
2003	0.98	Phosphorus
2009	1.33	Phosphorus

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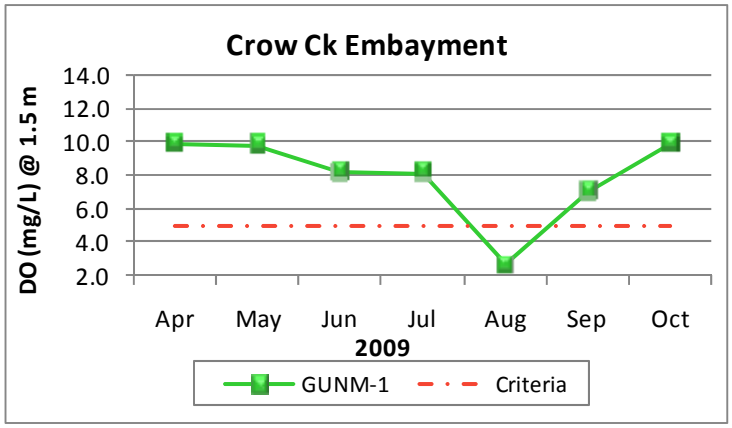

Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Crow Ck embayment station of Guntersville Reservoir collected April-October 2009. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth .

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