

Short Creek Embayment  
Guntersville Reservoir  
Intensive Basin Survey 2013

Tennessee River Basin

**GUNM-8:** Short Creek immediately upstream of AL Hwy 227 bridge (Marshall Co 34.3645/-86.2169)

**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 2013, ADEM monitored the Short 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 Short Ck embayment (GUNM-8) during the 2013 growing season (Apr-Oct). This is the third 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 2013 were compared to ADEM’s historical data and established criteria.

**WATERSHED CHARACTERISTICS**

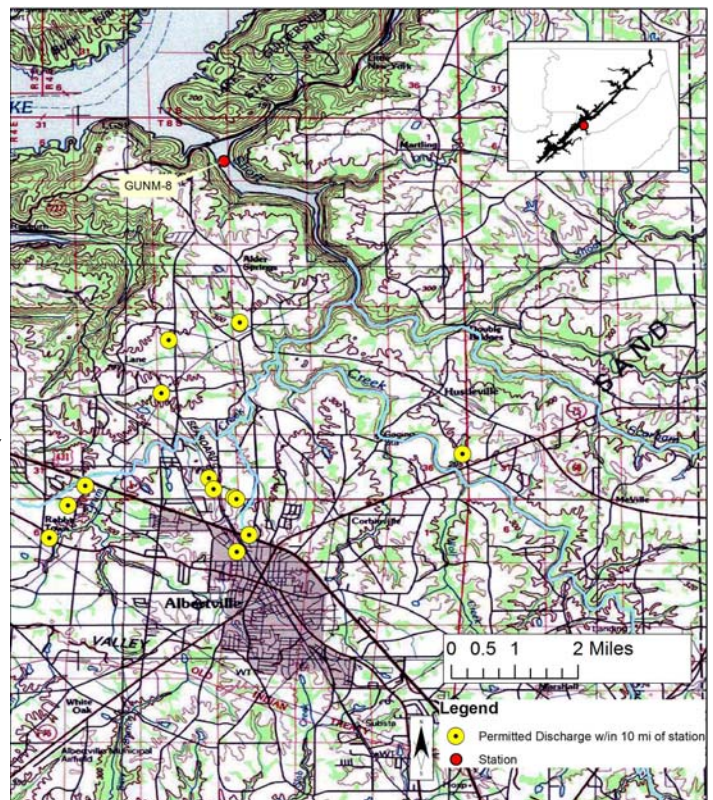
Watershed land uses are summarized in Table 1. Short Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Southern Table Plateaus ecoregion (68d). Based on the 2006 National Land Cover Dataset, land use within the 224 mi<sup>2</sup> watershed is predominantly agriculture [hay/pasture (45%) and cultivated crops (9%)](Fig. 3). As of October 1, 2013, ADEM has issued a total of 52 NPDES permits within the watershed. Thirteen of those permits are located within 10 mi of the station (Fig. 2).

**SITE DESCRIPTION**

The Short Ck embayment at GUNM-8 is located northeast of Guntersville, AL. This watershed handles all of the runoff and discharges from the city of Albertville. It is a fairly large embayment flowing into the Tennessee River near Guntersville State Park at river mile 361. Short Ck has a mean bottom depth of 4.37 m (Table 2) at the sampling location.



**Figure 1.** Photo of Short Ck at GUNM-8.

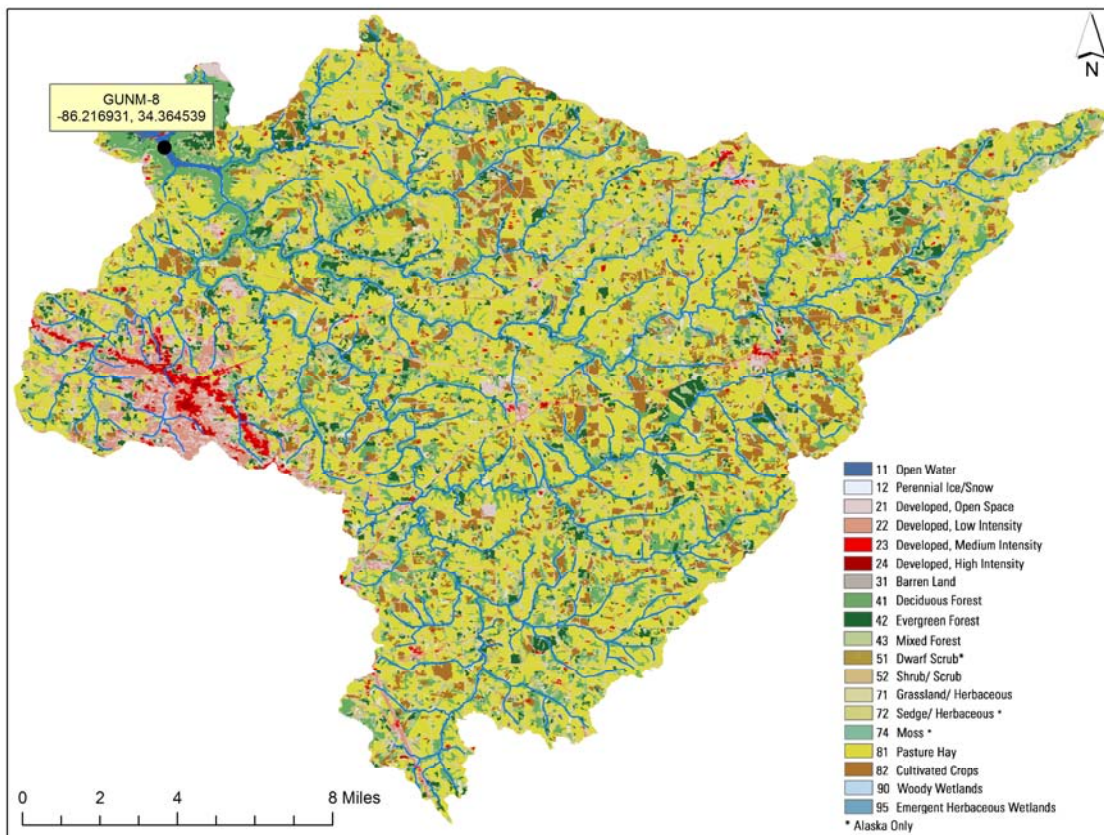


**Figure 2.** Map of Short Ck embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

## 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 2013b), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013a).

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 2013 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.



**Figure 3.** Landuse within the Short Creek watershed at GUNM-8.

## 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 ranges of the graphs in Figs. 4-6 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

The mean growing season TN value increased 2003-2013 (Fig. 4). Monthly TN concentrations were highest in May.

Mean growing season TP concentrations decreased 2003-2013 (Fig. 4). Monthly TP concentrations varied during the sampling season.

In 2013, the growing season mean chl *a* value was higher than in 2009 (Fig. 4). Monthly chl *a* concentrations were highest in October.

Mean TSI remained eutrophic in 2013 (Fig. 4). Monthly TSI in Short Ck was mesotrophic in April and May, eutrophic June-October, and reached near hypereutrophic conditions in October.

The mean growing season TSS value decreased 2003-2013 (Fig. 5). Monthly TSS concentrations peaked in September.

AGPT results show that GUNM-8 was nitrogen limited 2003-2013 (Table 3). The mean maximum standing crop (MSC) value was 17.82 mg/L, which is above the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems. The previous MSC value for Short Ck was also above 5 mg/L.

The DO concentrations in the GUNM-8 station were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in all months sampled (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

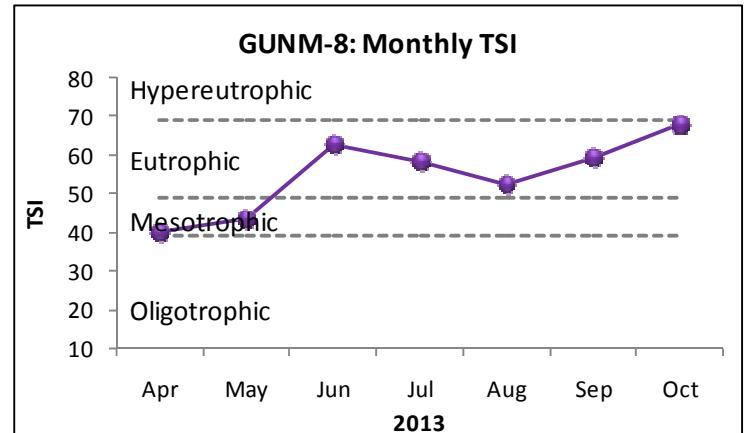
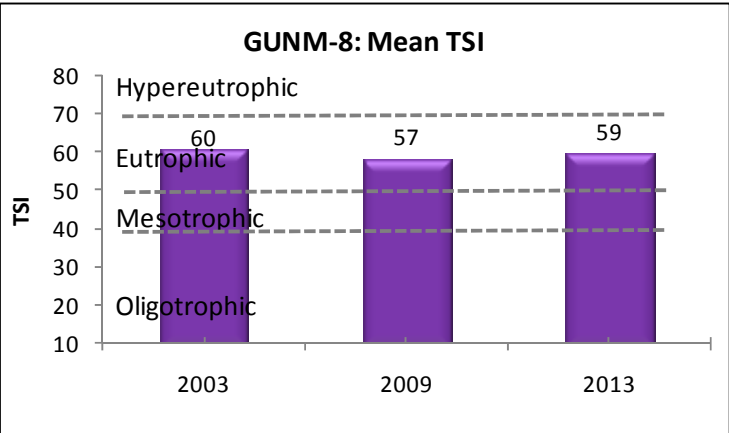
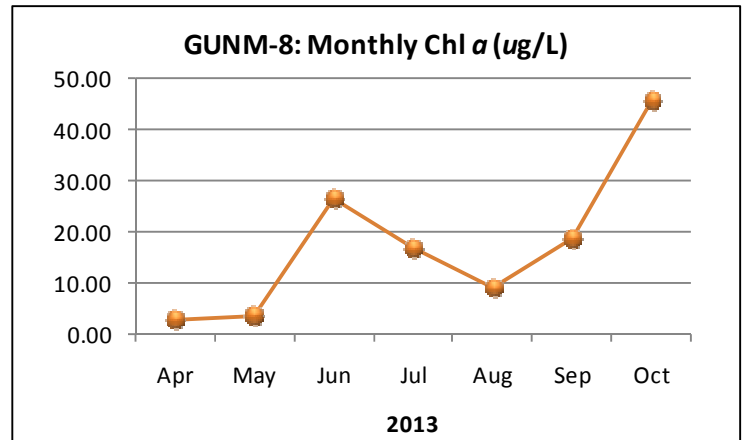
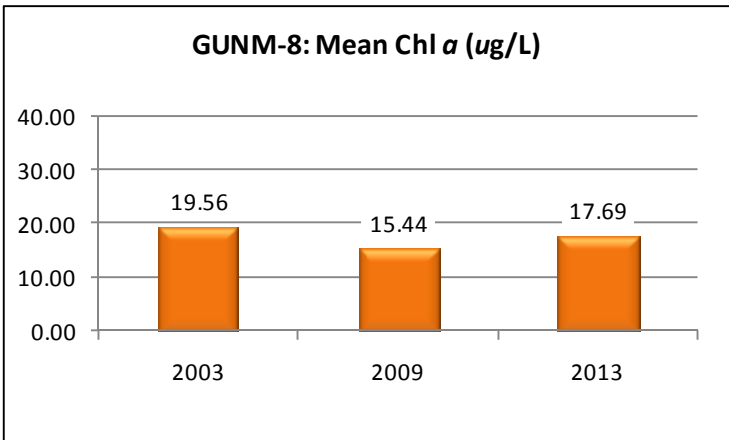
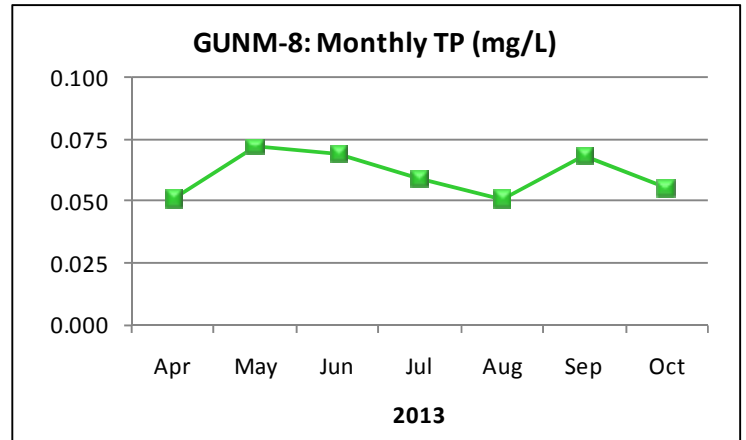
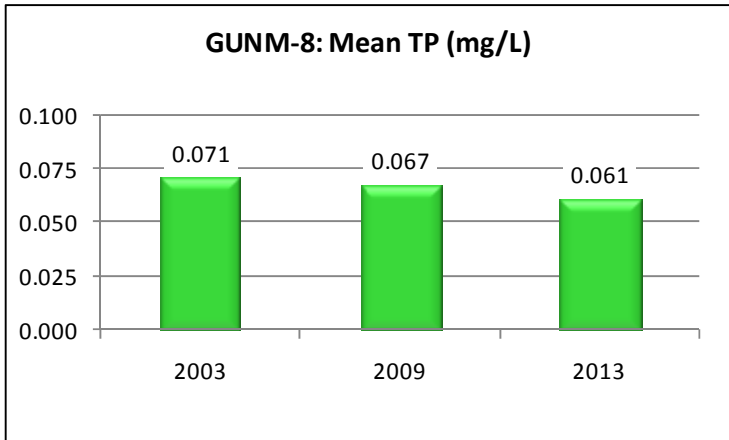
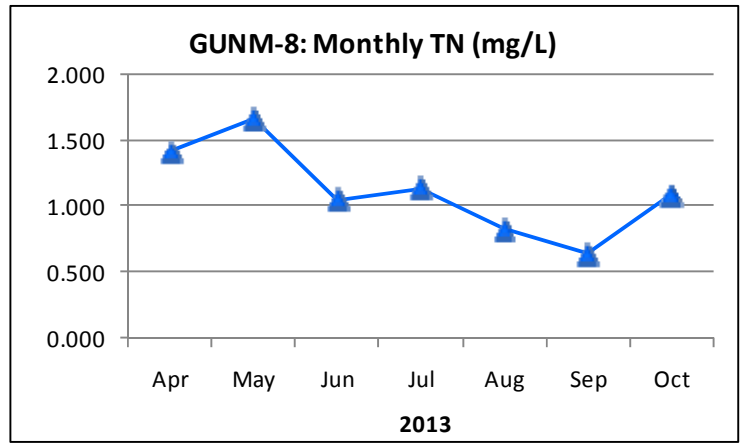
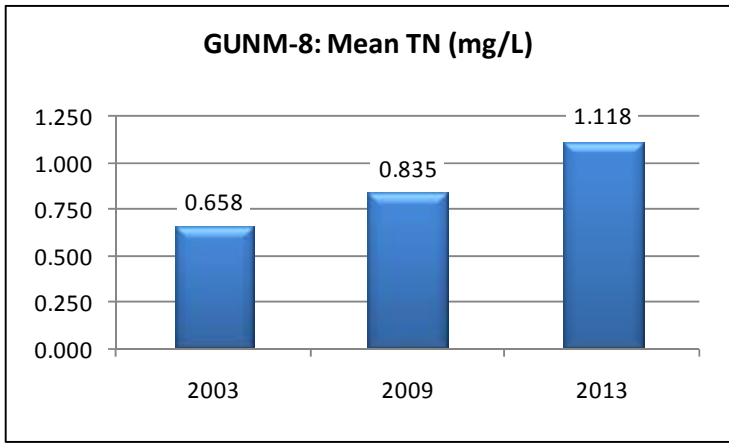
**Table 1:** Summary of Watershed **GUNM-8**

| Basin                              | Tennessee R |
|------------------------------------|-------------|
| Drainage Area (mi <sup>2</sup> )   | 224         |
| Ecoregion <sup>a</sup>             | 68d         |
| % Landuse                          |             |
| Open Water                         | 1%          |
| Developed Open Space               | 7%          |
| Low Intensity                      | <1%         |
| Medium Intensity                   | <1%         |
| High Intensity                     | <1%         |
| Barren Land                        | <1%         |
| Forest Deciduous Forest            | 14%         |
| Evergreen Forest                   | 5%          |
| Mixed Forest                       | 10%         |
| Shrub/Scrub                        | 3%          |
| Herbaceous                         | 1%          |
| Hay/Pasture                        | 45%         |
| Cultivated Crops                   | 9%          |
| Wetlands Woody                     | 0%          |
| Emergent Herb.                     | <1%         |
| # NPDES Permits <sup>b</sup> TOTAL | 52          |
| Construction Stormwater            | 16          |
| Industrial General                 | 26          |
| Industrial Individual              | 1           |
| Municipal Individual               | 4           |
| Underground Injection Control      | 5           |

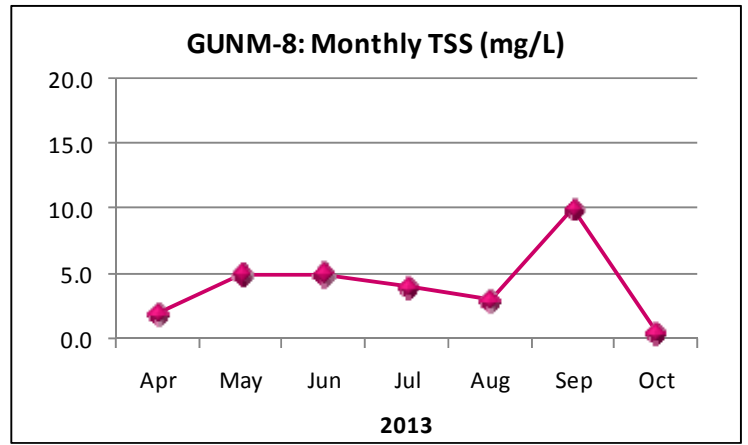
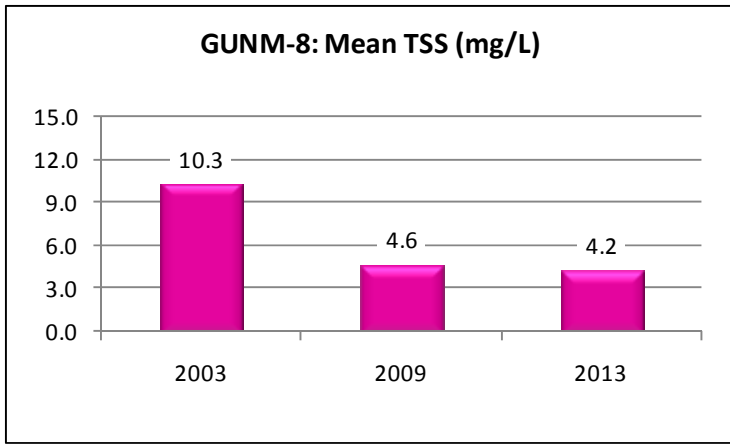
a. Southern Table Plateaus

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





**Figure 4.** Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Short Creek embayment of Gunter'sville 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 Short Creek embayment of Guntersville Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2013. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

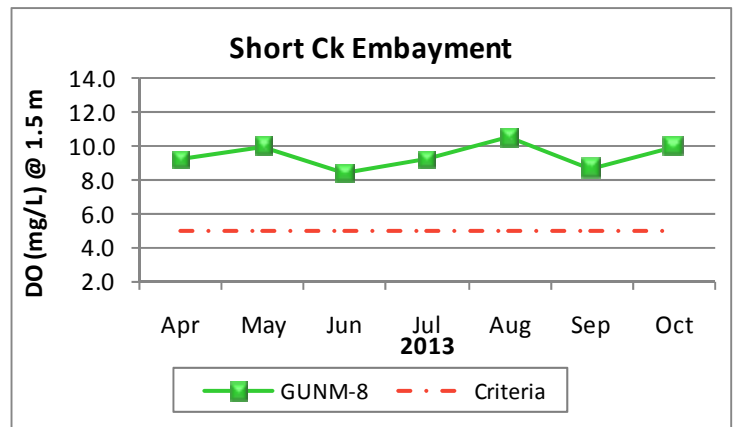
| GUNM-8  | N | Min     | Max   | Med   | Mean  | SD    |
|---|---|---------|-------|-------|-------|-------|
| <b>Physical</b>                                   |   |         |       |       |       |       |
| Turbidity (NTU)                                   | 7 | 4.0     | 8.1   | 5.4   | 6.1   | 1.6   |
| Total Dissolved Solids (mg/L)                     | 7 | 47.0    | 94.0  | 78.0  | 73.3  | 16.8  |
| Total Suspended Solids (mg/L)                     | 7 | < 1.0   | 10.0  | 4.0   | 4.2   | 3.0   |
| Hardness (mg/L)                                   | 4 | 23.4    | 66.8  | 46.6  | 45.8  | 18.1  |
| Alkalinity (mg/L)                                 | 7 | 16.9    | 65.2  | 43.8  | 41.8  | 17.4  |
| Photic Zone (m)                                   | 7 | 2.25    | 4.15  | 2.39  | 2.84  | 0.71  |
| Secchi (m)  | 7 | 0.88    | 1.98  | 0.96  | 1.15  | 0.41  |
| Bottom Depth (m)                                  | 7 | 3.90    | 4.80  | 4.50  | 4.37  | 0.42  |
| <b>Chemical</b>                                   |   |         |       |       |       |       |
| Ammonia Nitrogen (mg/L)                           | 7 | < 0.004 | 0.076 | 0.009 | 0.018 | 0.026 |
| Nitrate+Nitrite Nitrogen (mg/L)                   | 7 | 0.041   | 1.068 | 0.329 | 0.478 | 0.411 |
| Total Kjeldahl Nitrogen (mg/L)                    | 7 | 0.351   | 0.828 | 0.628 | 0.640 | 0.152 |
| Total Nitrogen (mg/L)                             | 7 | 0.640   | 1.666 | 1.086 | 1.118 | 0.344 |
| Dissolved Reactive Phosphorus (mg/L) <sup>J</sup> | 7 | 0.004   | 0.033 | 0.021 | 0.018 | 0.011 |
| Total Phosphorus (mg/L)                           | 7 | 0.051   | 0.072 | 0.059 | 0.061 | 0.009 |
| CBOD-5 (mg/L)                                     | 7 | < 2.0   | 2.3   | 1.0   | 1.2   | 0.5   |
| Chlorides (mg/L)                                  | 7 | 4.3     | 9.7   | 5.2   | 5.9   | 1.9   |
| <b>Biological</b>                                 |   |         |       |       |       |       |
| Chlorophyll a (ug/L)                              | 7 | 2.67    | 45.77 | 17.09 | 17.69 | 15.08 |
| E. coli (col/100mL) <sup>J</sup>                  | 3 | < 1     | 75    | 15    | 30    | 40    |

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 | 9.32     | NITROGEN          |
| 8/18/2009 | 8.19     | NITROGEN          |
| 8/21/2013 | 17.82    | NITROGEN          |

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Short Ck embayment station of Guntersville Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.

ADEM. 2013a. Quality Management Plan (QMP) for the Alabama Department of Environmental Management, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.

ADEM. 2013b. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp. <http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy>

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2010. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.

Carlson, R.E. 1977. A trophic state index. *Limnology and Oceanography*. 22(2):361-369.

Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. *Journal of Water Pollution Control Federation* 59(4):222-227.