Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

# Dry Creek Embayment
# Guntersville Reservoir
# Intensive Basin Survey 2013

**GUNM-4:** Dry Creek approximately 0.5 mi downstream of Jackson Co Park (Jackson Co 34.6323/-86.01811)

## 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 Dry 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 Dry Creek embayment (GUNM-4) 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.

**Figure 1**. Photo of Dry Ck at GUNM-4.

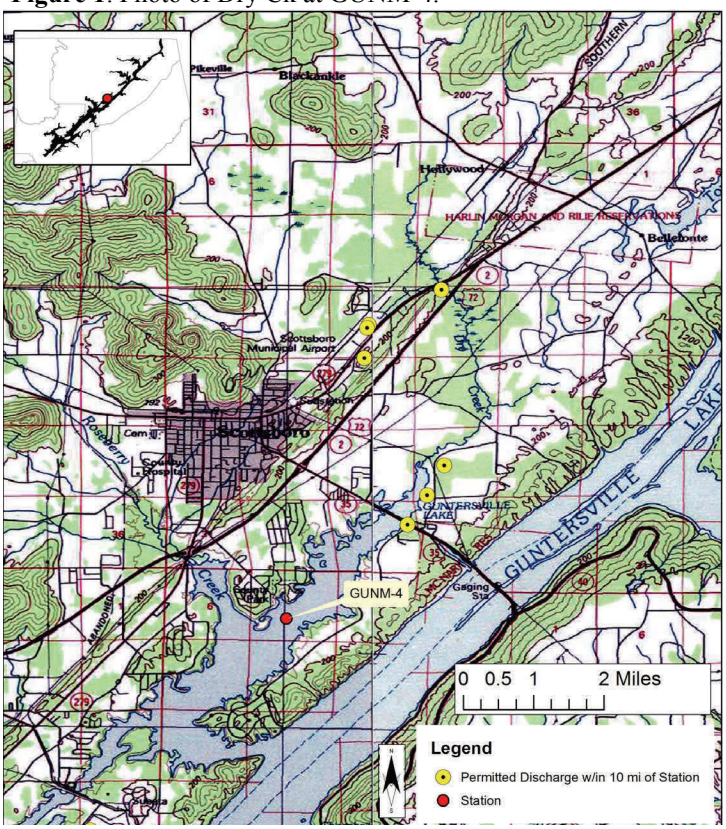



**Figure 2**. Map of Dry Ck embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

## WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Dry Creek is classified as a *Swimming/Fish & Wildlife (S/F&W)* stream located in the Sequatchie Valley ecoregion (68b). Based on the 2006 National Land Cover Dataset, land use within the 27 $mi^2$ watershed is variable (Fig. 3). As of October 1, 2013, ADEM has issued a total of 15 NPDES permits within the watershed. Seven of those permits are located within 10 mi upstream of the station (Fig. 2).

## SITE DESCRIPTION

The Dry Ck embayment at GUNM-4 is located just south of Scottsboro, AL. Dry Ck combines with Roseberry Ck before entering the Tennessee River near river mile 382. The sampling location is downstream of Jackson County Park. It's a fairly large but shallow embayment with a mean depth of 2.90m (Table 2).

## 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 ADEM's previously collected data to help interpret the 2013 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 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.

**Table 1:** Summary of Watershed **GUNM-4**

| Basin | | Tennessee R |
|---|---|---|
| Drainage Area ($mi^2$) | | 27 |
| 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 | 27% |
| | Evergreen Forest | 5% |
| | Mixed Forest | 6% |
| Shrub/Scrub | | 6% |
| Herbaceous | | 3% |
| Hay/Pasture | | 19% |
| Cultivated Crops | | 11% |
| Wetlands | Woody | 8% |
| | Emergent Herb. | <1% |
| #NPDES Permits[b] | **TOTAL** | 15 |
| Construction Stormwater | | 8 |
| Mining | | 2 |
| Small Mining | | 1 |
| Industrial General | | 4 |

a. Sequatchie Valley

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

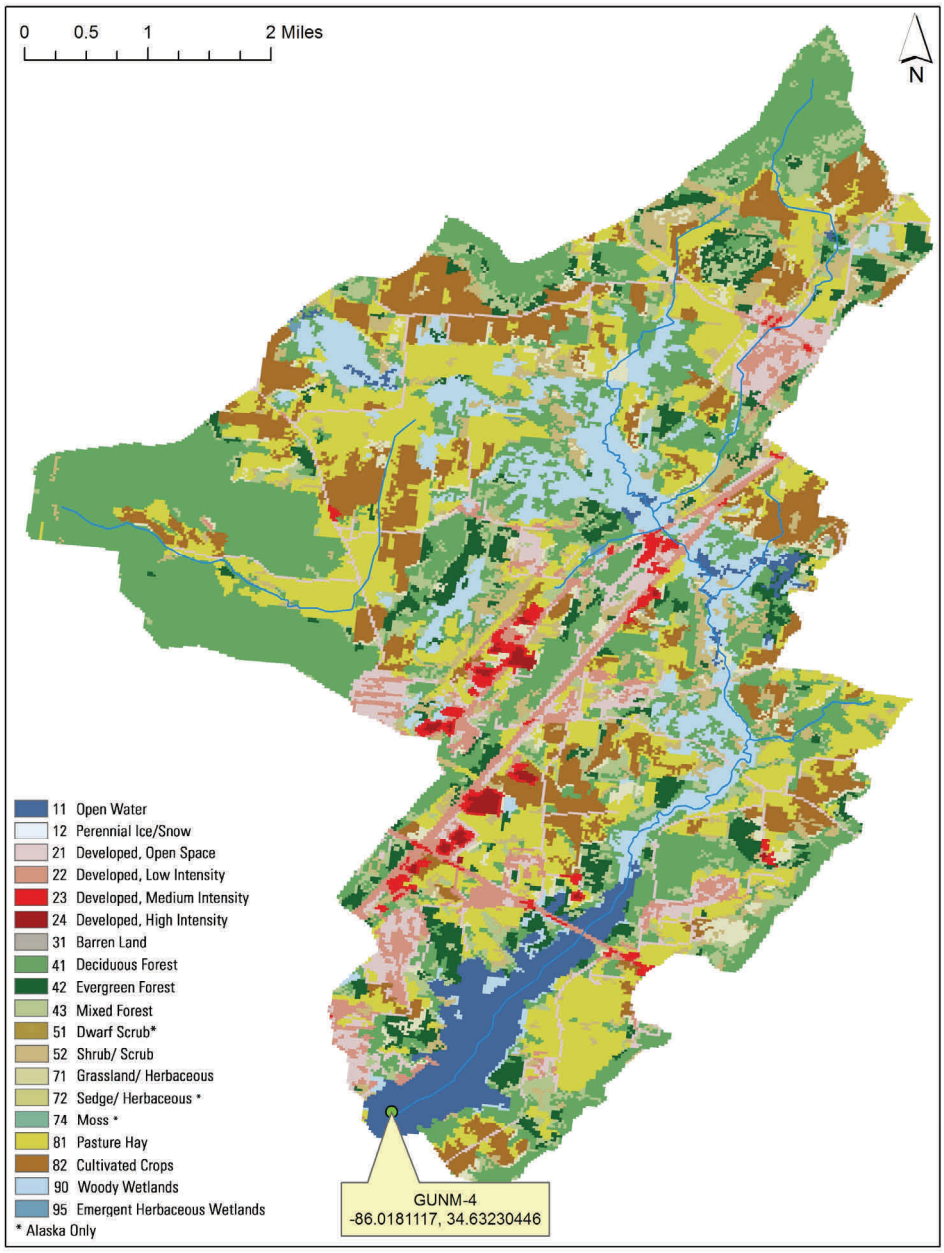



**Figure 3**. Land use within the Dry Creek watershed at GUNM-4.

The mean growing season TN value was higher in 2009 than in 2003 or 2013 (Fig. 4). Monthly TN concentrations increased from April through October.

Mean growing season TP concentrations have decreased since 2003 (Fig. 4). The highest monthly TP concentration was measured in May though concentrations were similar June through October.

In 2013, the growing season mean chl *a* value decreased from 2003-2013 (Fig. 4). Monthly chl *a* concentrations peaked in August and September and were considerably higher than other months.

Mean TSI remained eutrophic in 2013. Monthly TSI in Dry Ck was highly eutrophic August-September (Fig. 4).

Mean growing season TSS values decreased 2003-2013 (Fig. 5). Monthly TSS concentrations were highest in June and lowest in April and October.

AGPT results show that GUNM-4 was co-limited in 2013 (Table 3). The mean maximum standing crop (MSC) value was 3.29 mg/L, which was below the 5.0 m/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems. Previous MSC values for Dry Ck were 4.71 mg/L in 2003 and 1.90 in 2009.

The DO concentrations in Dry Ck were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) each time monitored in 2013 (ADEM Admin. Code R. 335-6-10-.09) (Fig.6).

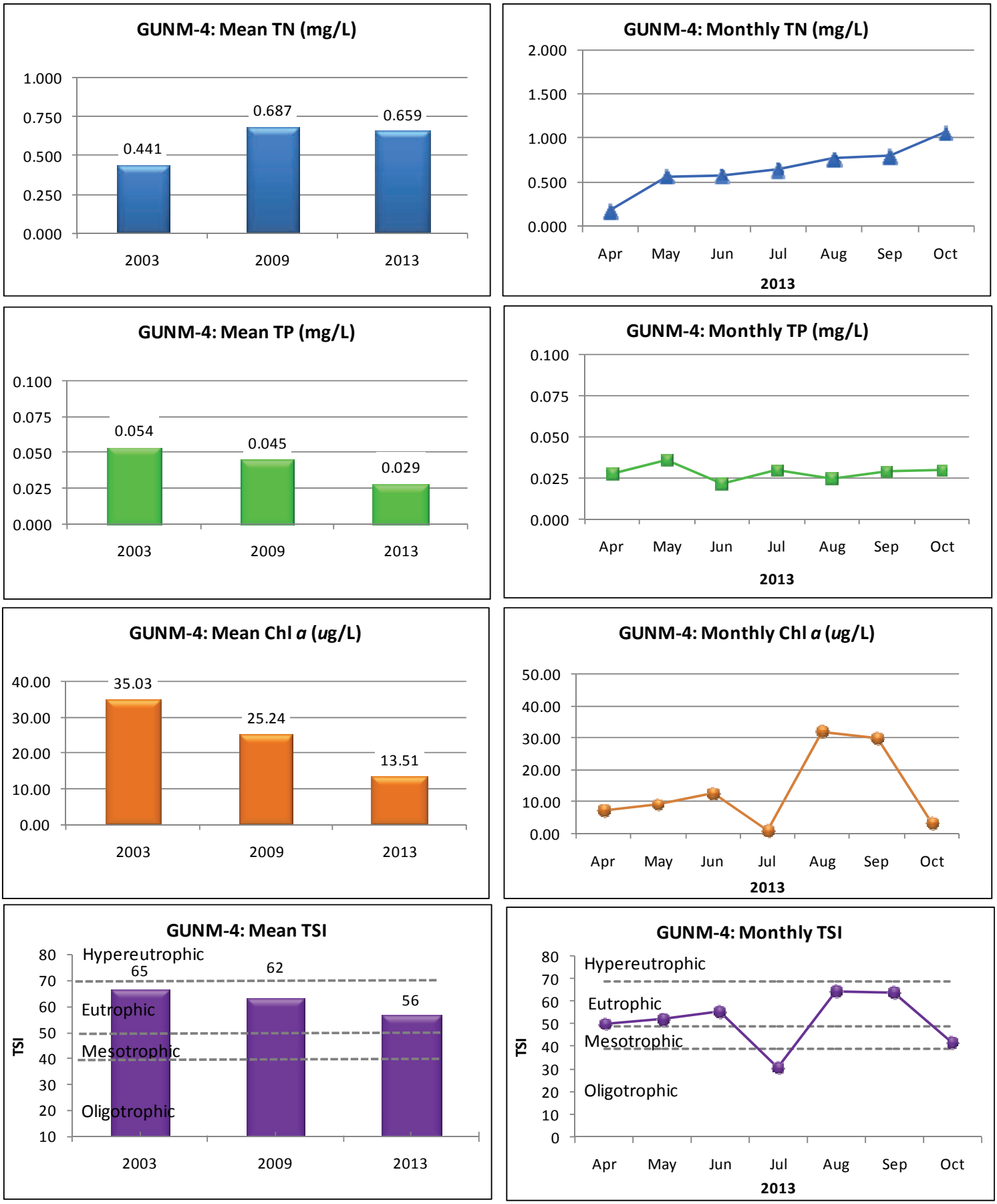
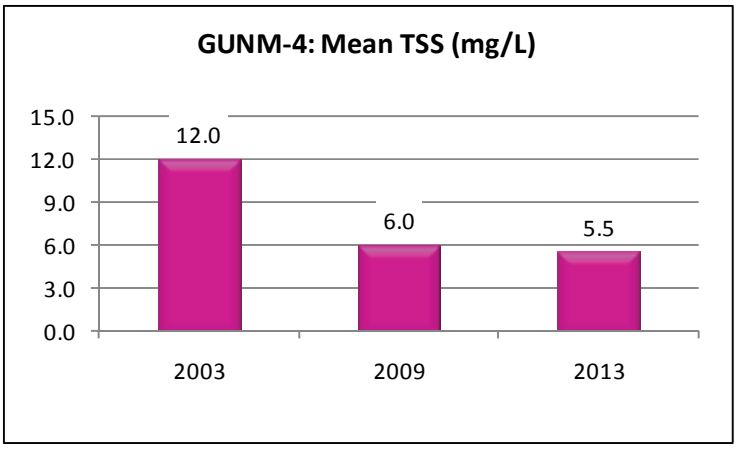



**Figure 4**. Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Dry Creek embayment of Guntersville Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



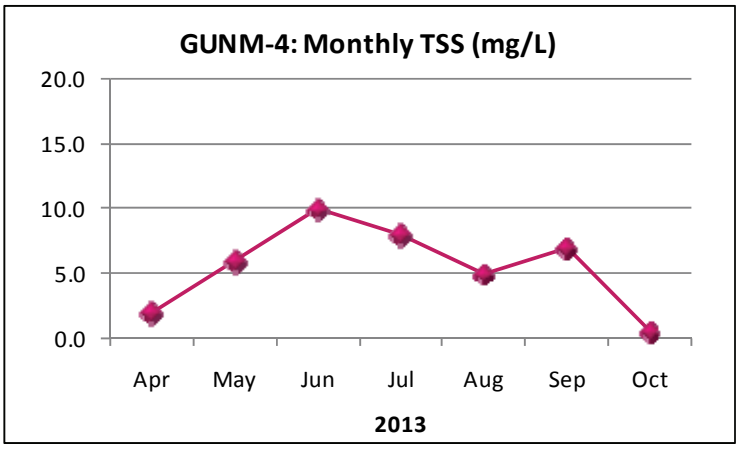




**Figure 5**. Mean growing season and monthly TSS measured in the Dry Creek embayment of Guntersville Reservoir.

**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-4 | N | | Min | Max | Med | Mean | SD |
|---|---|---|---|---|---|---|---|
| **Physical** | | | | | | | |
| Turbidity (NTU) | 7 | | 4.8 | 8.4 | 6.0 | 6.5 | 1.4 |
| Total Dissolved Solids (mg/L) | 7 | | 65.0 | 116.0 | 95.0 | 88.6 | 18.6 |
| Total Suspended Solids (mg/L)[J] | 7 | < | 1.0 | 10.0 | 6.0 | 5.5 | 3.3 |
| Hardness (mg/L) | 4 | | 67.6 | 83.7 | 69.0 | 72.3 | 7.6 |
| Alkalinity (mg/L) | 7 | | 66.1 | 88.8 | 69.7 | 74.6 | 9.4 |
| Photic Zone (m) | 7 | | 2.17 | 3.10 | 2.83 | 2.77 | 0.29 |
| Secchi (m) | 7 | | 0.94 | 1.52 | 1.02 | 1.08 | 0.20 |
| Bottom Depth (m) | 7 | | 2.90 | 3.10 | 2.90 | 2.90 | 0.13 |
| **Chemical** | | | | | | | |
| Ammonia Nitrogen (mg/L) | 7 | < | 0.004 | 0.018 | 0.009 | 0.007 | 0.003 |
| Nitrate+Nitrite Nitrogen (mg/L) | 7 | < | 0.002 | 0.004 | 0.002 | 0.002 | 0.000 |
| Total Kjeldahl Nitrogen (mg/L) | 7 | | 0.179 | 1.070 | 0.647 | 0.658 | 0.273 |
| Total Nitrogen (mg/L) | 7 | < | 0.181 | 1.071 | 0.649 | 0.659 | 0.272 |
| Dissolved Reactive Phosphorus (mg/L)[J] | 7 | < | 0.003 | 0.004 | 0.003 | 0.003 | 0.001 |
| Total Phosphorus (mg/L) | 7 | | 0.022 | 0.036 | 0.029 | 0.029 | 0.004 |
| CBOD-5 (mg/L) | 7 | < | 2.0 | 2.4 | 1.0 | 1.3 | 0.6 |
| Chlorides (mg/L) | 7 | | 2.8 | 5.0 | 3.5 | 3.6 | 0.8 |
| **Biological** | | | | | | | |
| Chlorophyll a (ug/L) | 7 | < | 0.10 | 32.04 | 9.08 | 13.51 | 12.62 |
| E. coli (col/100mL)[J] | 3 | < | 1 | 3 | 1 | 2 | 1 |

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 | 4.71 | CO-LIMITING |
| 2009 | 1.9 | NITROGEN |
| 2013 | 3.29 | CO-LIMITING |

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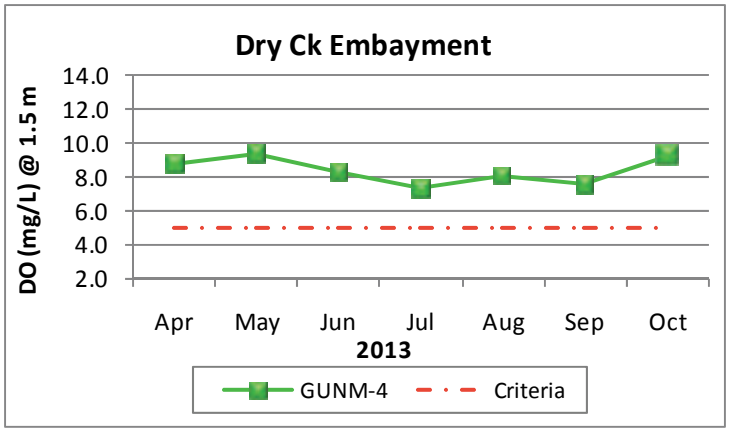


**Figure 6**. Monthly DO concentrations at 1.5 m (5 ft) for the Dry Ck embayment station of Guntersville Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

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