

## South Sauty Embayment Guntersville Reservoir Intensive Basin Survey 2015 & 2018

Tennessee River Basin

**GUNM-6:** South Sauty Creek immediately upstream of Jackson County Rd 67 bridge (34.51917/-86.10389)

### 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, to 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 2017 Monitoring Strategy (ADEM 2017).

In 2015 and 2018, ADEM monitored the South Sauty Creek tributary embayment of Guntersville Reservoir as part of the intensive basin assessment of the Tennessee River under the RRMP (Figure 1). This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the South Sauty Creek embayment (GUNM-6) during the 2015 and 2018 growing seasons (Apr-Oct). These are the fourth and fifth intensive basin assessments 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)] were compared to ADEM’s historical data and established criteria.

### WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. South Sauty Creek is classified as a *Swimming/Fish & Wildlife (S/F&W)* waterbody located in the Sequatchie Valley ecoregion (68b). Based on the 2016 National Land Cover Dataset, land use within the 165 mi<sup>2</sup> watershed is predominantly pasture and forest (34%) (Figure 3). As of January 28, 2016, ADEM has issued a total of 78 NPDES permits within the watershed. One of those permits are located within 10 mi of the station (Figure 2).

### SITE DESCRIPTION

The South Sauty Creek embayment is located near Langston, AL. The headwaters of South Sauty originate near Henagar, AL, and wind down through Bucks Pocket State Park before flowing into the Tennessee River at river mile 372. South Sauty Creek has a mean bottom depth of 9.2 meters (Table 2) at the sampling location.



Figure 1. South Sauty Creek at GUNM-6.

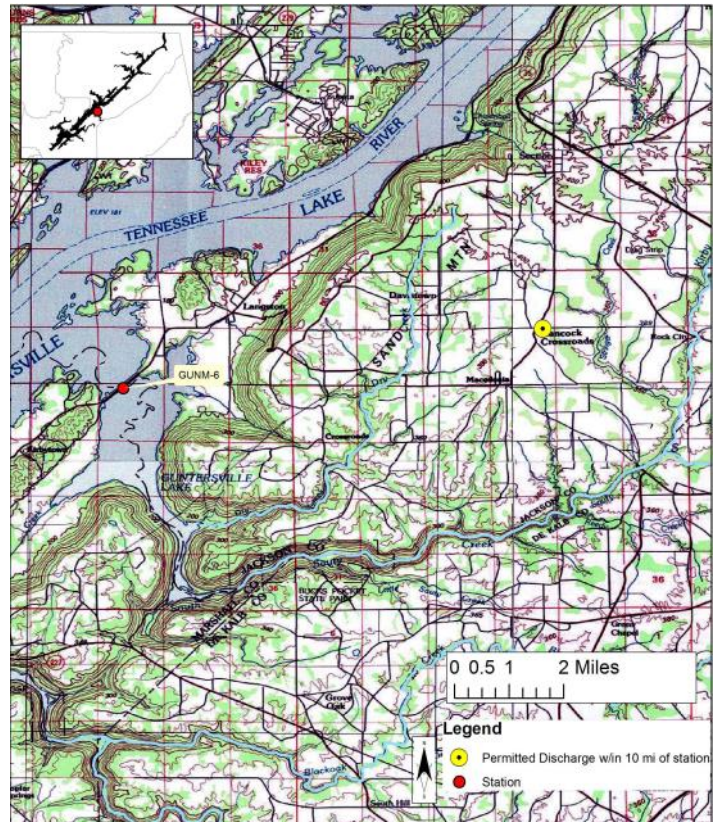


Figure 2. Map of the South Sauty Creek embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

## METHODS

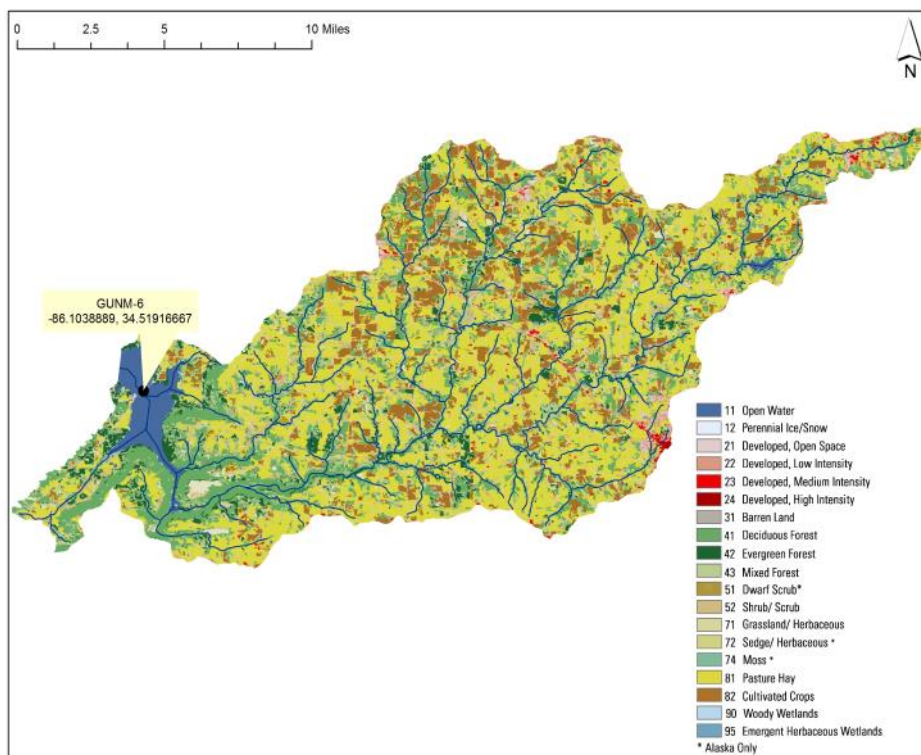
Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2018a), Surface Water Quality Assurance Project Plan (ADEM 2018b), and Quality Management Plan (ADEM 2018c).

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 in order to help interpret the results. Carlson's TSI was calculated from the corrected chl *a* concentrations (Carlson 1977).

Basin	Tennessee R	
Drainage Area (mi <sup>2</sup> )	165	
Ecoregion <sup>a</sup>	68b	
Assessment Unit	AL06030001-0505-111	
% Landuse		
Open Water	3%	
Developed	Open Space	4%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land	<1%	
Forest	Deciduous Forest	19%
	Evergreen Forest	5%
	Mixed Forest	10%
Shrub/Scrub	5%	
Herbaceous	2%	
Hay/Pasture	38%	
Cultivated Crops	12%	
Wetlands	Woody	0%
	Emergent Herb.	<1%
# NPDES outfalls <sup>b</sup>	TOTAL	78
	Construction Stormwater	13
	Mining	0
	Small Mining	3
	Industrial General	9
	Industrial Individual	50
	No Exposure	0
	Municipal	1
	Underground Injection Control	2

a. Sequatchie Valley

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.



**Figure 3.** Landuse within the South Sauty Creek watershed at GUNM-6.

## RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. A summary of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figures 4-6 were set to maximum values reservoir-wide so that all embayment reports on the same reservoir could be compared.

The mean growing season TN value increased 2003-2013 but decreased in 2015 and 2018 (Figure 4). Monthly TN concentrations were highest in April in both 2015 and 2018.

The mean growing season TP concentration decreased 2003-2018 (Figure 5). The highest monthly TP concentration was measured in August during 2015 and in April during 2018.

The mean growing season chl *a* value steadily declined from 2003-2015 but increased in 2018 (Figure 5). The highest monthly chl *a* concentration measured in 2015 was in September. The highest monthly concentration of 2018 was measured in October at 56.1 mg/L.

The mean TSI declined 2003-2015 but increased in 2018 (Figure 5). However, mean trophic conditions at GUNM-6 remained eutrophic over time. In 2015, monthly TSI in South Sauty Creek began as oligotrophic from April-June but increased to eutrophic in July. Monthly TSI remained eutrophic throughout most of the growing season in 2018, increasing to hypereutrophic in October.

Overall mean growing season TSS concentration decreased from 2003-2015 but increased in 2018 (Figure 5). Monthly TSS concentrations were highest in August and October during 2015 and in April in 2018.

AGPT results show that South Sauty Creek was co-limiting in 2003 and nitrogen limiting in 2009 and 2013 (Table 3). Raschke and Schultz (1987) found that maximum standing crop (MSC) values below 5.0 mg/L are considered to be protective of reservoir and lake systems. The most recent mean MSC measured in 2013 was 3.54 mg/L. All other AGPT results have also been less than 5 mg/L.

DO concentrations at the South Sauty Creek station were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) for all samples collected during 2015 and 2018. (ADEM Admin. Code R. 335-6-10-.09) (Figure 6).

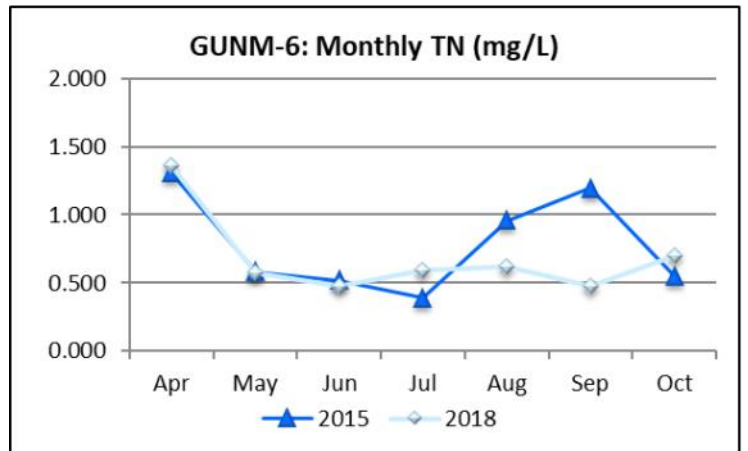
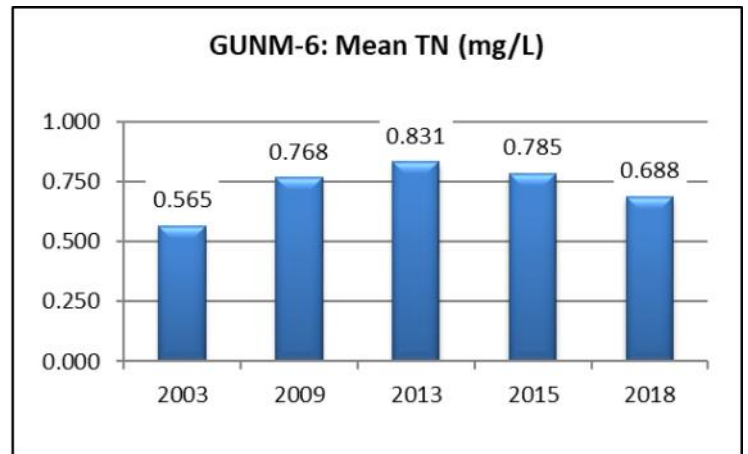
**Table 2.** Summary of water quality data collected April-October, 2015 and 2018. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), Mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

GUNM-6 2015	N	Min	Max	Med	Avg	SD
<b>Physical</b>						
Turbidity (NTU)	7	2.8	6.4	3.1	4.2	1.6
Total Dissolved Solids (mg/L)	7	< 1.0	105.0	95.0	82.6	37.5
Total Suspended Solids (mg/L)	7	1.0	8.0	3.0	3.7	3.0
Hardness (mg/L)	4	14.9	71.7	65.6	54.4	26.8
Alkalinity (mg/L)	7	24.2	57.3	46.3	44.4	10.8
Photic Zone (m)	7	2.48	4.48	3.54	3.55	0.76
Secchi (m)	7	0.98	2.30	1.62	1.58	0.47
Bottom Depth (m)	7	7.7	11.0	9.5	9.2	1.2
<b>Chemical</b>						
Ammonia Nitrogen (mg/L) <sup>J</sup>	7	< 0.007	0.117	0.004	0.022	0.042
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.002	0.852	0.048	0.200	0.318
Total Kjeldahl Nitrogen (mg/L) <sup>J</sup>	7	0.387	0.945	0.519	0.585	0.208
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.388	1.305	0.581	0.785	0.364
Dis Reactive Phosphorus (mg/L) <sup>J</sup>	7	< 0.005	0.009	0.004	0.005	0.002
Total Phosphorus (mg/L)	7	0.020	0.044	0.024	0.027	0.008
CBOD-5 (mg/L) <sup>J</sup>	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	4.6	7.1	6.1	6.1	0.9
<b>Biological</b>						
Chlorophyll a (mg/m <sup>3</sup> )	7	< 1.00	17.60	11.20	8.46	7.68
E. coli (MPN/DL)	3	< 1	1	1	1	0
<b>GUNM-6 2018</b>						
<b>Physical</b>						
Turbidity (NTU)	7	3.6	8.5	6.9	6.2	1.9
Total Dissolved Solids (mg/L)	7	66.0	92.0	83.0	83.4	9.2
Total Suspended Solids (mg/L) <sup>J</sup>	7	3.0	13.0	9.0	8.3	3.6
Hardness (mg/L)	4	56.5	59.1	58.1	58.0	1.1
Alkalinity (mg/L)	7	34.2	58.1	55.6	52.5	8.2
Photic Zone (m)	7	2.15	4.26	3.38	3.25	0.76
Secchi (m)	7	0.86	1.66	1.02	1.19	0.30
Bottom Depth (m)	7	8.1	10.8	9.2	9.2	1.0
<b>Chemical</b>						
Ammonia Nitrogen (mg/L) <sup>J</sup>	7	< 0.015	0.015	0.008	0.008	0.000
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.007	0.853	0.016	0.153	0.314
Total Kjeldahl Nitrogen (mg/L)	7	0.413	0.685	0.512	0.535	0.094
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.474	1.365	0.595	0.688	0.309
Dis Reactive Phosphorus (mg/L)	7	< 0.004	0.004	0.002	0.002	0.000
Total Phosphorus (mg/L) <sup>J</sup>	7	0.006	0.039	0.024	0.022	0.012
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	4.0	5.4	4.9	4.8	0.6
<b>Biological</b>						
Chlorophyll a (mg/m <sup>3</sup> )	7	8.54	56.10	18.20	23.05	15.71
E. coli (MPN/DL) <sup>J</sup>	4	< 1	1	1	1	0

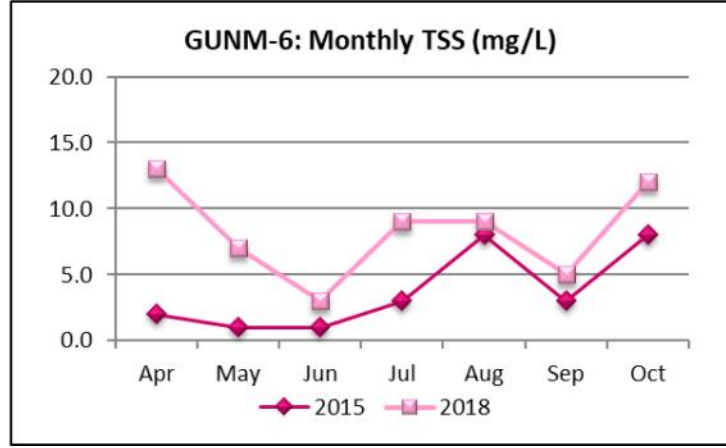
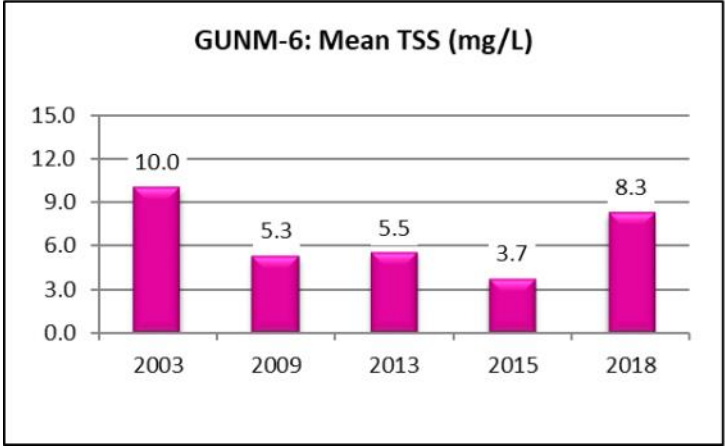
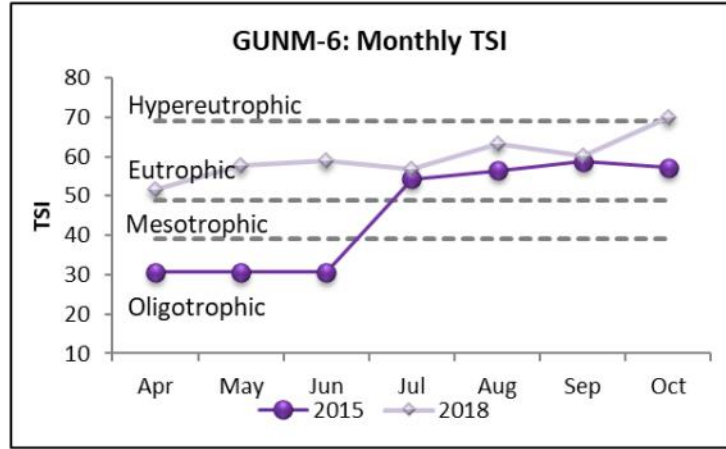
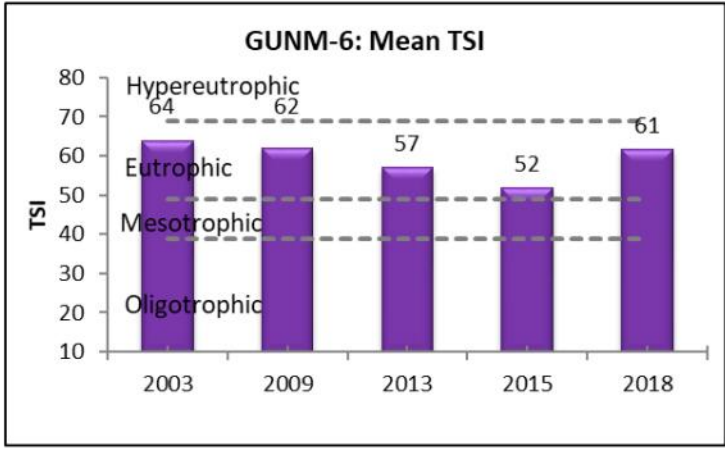
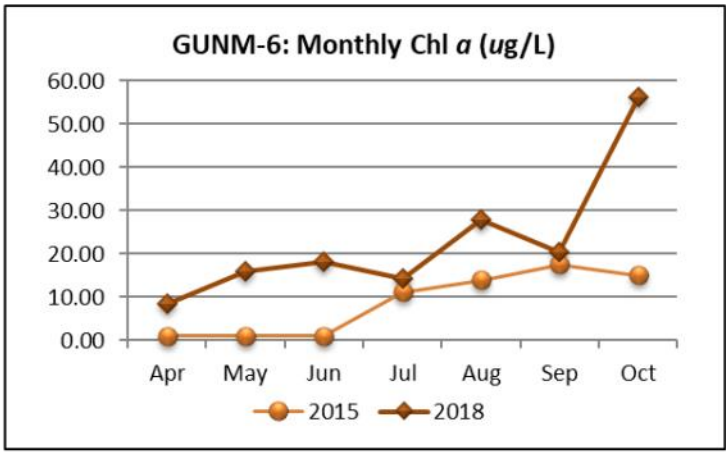
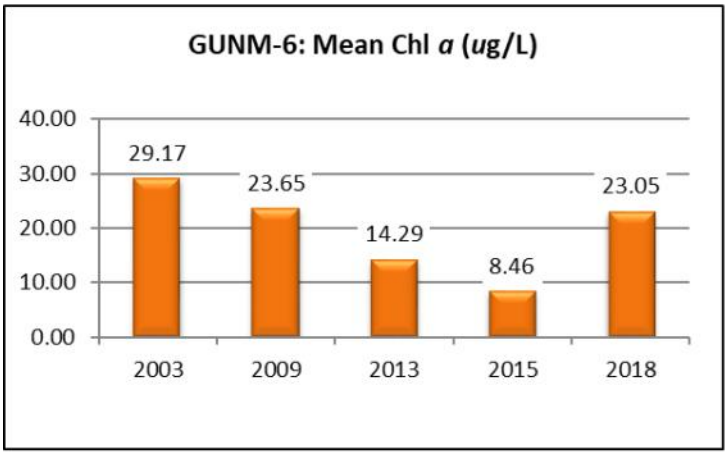
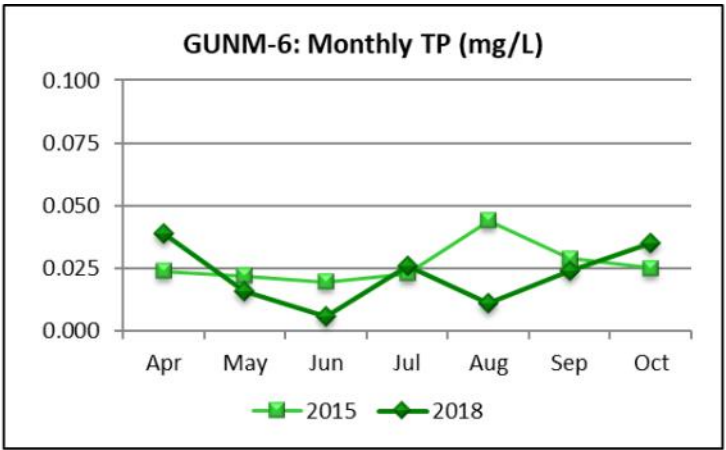
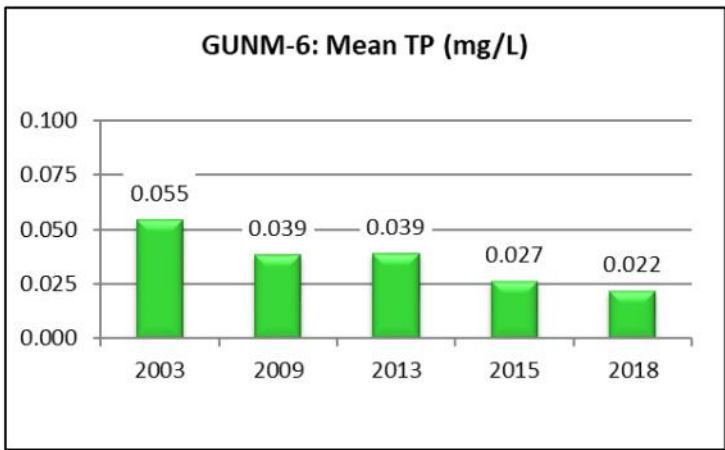
J= one or more of the values is an estimate; N= # samples.

**Table 3.** Algal growth potential test results (expressed as mean maximum standing crop (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).

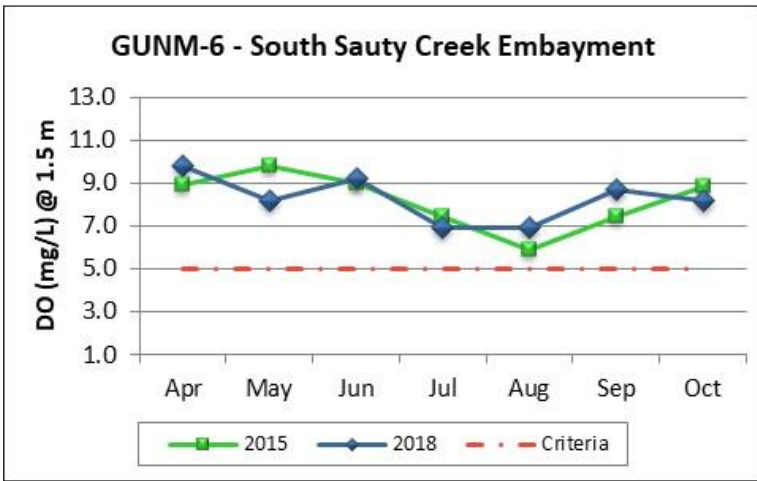
Year	Mean MSC	Limiting Nutrient
2003	2.93	Co-Limiting
2009	3.20	Nitrogen
2013	3.54	Nitrogen



**Figure 4.** Mean growing season (2003-2018) and monthly (April-October 2015 and 2018) TN measured in the South Sauty Creek embayment (GUNM-6) 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 (2003-2018) and monthly (April-October 2015 and 2018) TP, chl *a*, TSI, and TSS measured in the South Sauty Creek embayment (GUNM-6) of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for South Sauty Creek embayment station of Guntersville Reservoir collected April-October 2015 and 2018. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

## REFERENCES

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