

## Crow Creek Embayment Guntersville Reservoir Intensive Basin Survey 2015 & 2018

Tennessee River Basin

**GUNM-1:** Crow Creek approximately 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, 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 Crow 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 Crow Creek embayment (GUNM-1) 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. 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 2016 National Land Cover Dataset, land use within the 266 mi<sup>2</sup> watershed is predominantly forest (80%) (Figure 3). As of June 28, 2016, ADEM has issued a total of 55 NPDES outfalls within the watershed. Two of those permits are located within 10 mi of the station (Figure 2).



Figure 1. Crow Creek at GUNM-1.

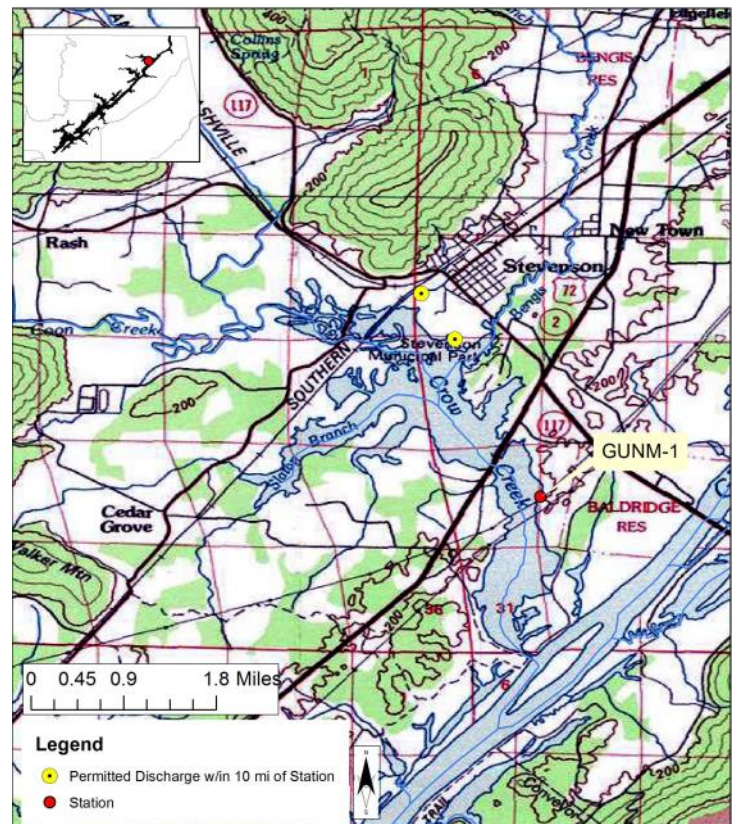


Figure 2. Map of the Crow Ck embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

Table 1. Summary of Watershed		GUNM-1
Basin		Tennessee R
Drainage Area (mi <sup>2</sup> )		266
Ecoregion <sup>a</sup>		68b
Assessment Unit		AL06030001-0307-111
% 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 outfalls <sup>b</sup>		TOTAL
Construction Stormwater		52
Mining		1
Small Mining		0
Industrial General		1
Industrial Individual		0
No Exposure		0
Municipal		1
Underground Injection Control		0

a. Sequatchie Valley

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

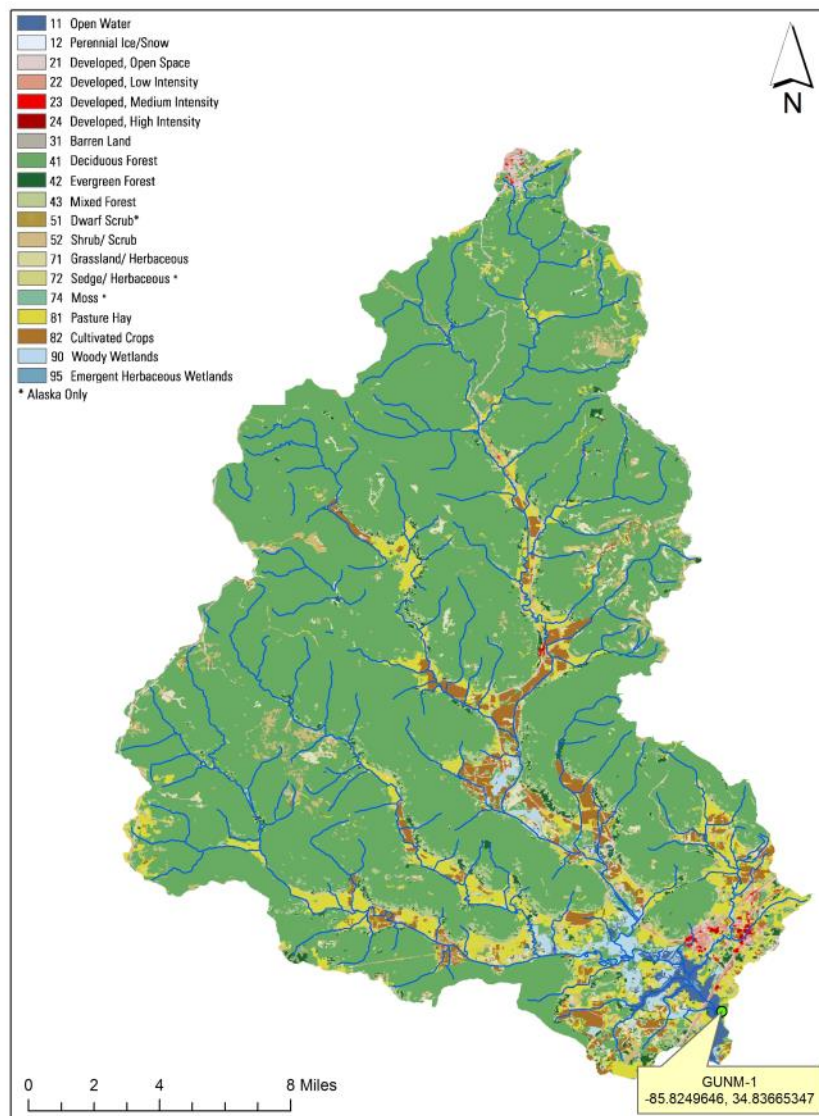


Figure 3. Land use within the Crow Creek watershed at GUNM-1.

## SITE DESCRIPTION

The Crow Creek embayment is located just south of Stevenson, AL, and flows into Guntersville Reservoir near river mile 401. It is a shallow embayment with a mean bottom depth of 4.1m (Table 2) at the sampling location. Although the channel is clear, most of the embayment is covered with thick mats of aquatic vegetation.

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

**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-1 2015	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	8	4.2	21.2	7.2	8.4	5.4
Total Dissolved Solids (mg/L)	8	86.0	155.0	137.0	130.2	21.8
Total Suspended Solids (mg/L)	8	4.0	10.0	6.5	6.9	2.2
Hardness (mg/L)	4	42.4	118.0	91.6	85.9	36.5
Alkalinity (mg/L)	8	35.2	118.0	92.0	87.7	24.6
Photic Zone (m)	8	2.18	4.26	3.54	3.42	0.65
Secchi (m)	8	0.65	1.85	1.39	1.38	0.40
Bottom Depth (m)	8	3.5	4.6	4.1	4.1	0.3
<b>Chemical</b>						
Ammonia Nitrogen (mg/L)	8	< 0.007	0.145	0.031	0.046	0.051
Nitrate+Nitrite Nitrogen (mg/L)	8	< 0.007	0.143	0.061	0.070	0.044
Total Kjeldahl Nitrogen (mg/L)	8	0.320	0.586	0.440	0.453	0.105
Total Nitrogen	8	< 0.375	0.652	0.537	0.523	0.110
Dis Reactive Phosphorus (mg/L)	8	< 0.006	0.013	0.007	0.007	0.003
Total Phosphorus (mg/L)	8	0.014	0.044	0.021	0.023	0.010
CBOD-5 (mg/L)	8	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	8	1.5	4.1	2.3	2.7	1.1
<b>Biological</b>						
Chlorophyll a (mg/m <sup>2</sup> )	7	< 1.00	3.74	1.07	1.59	1.36
E. coli (MPN/DL)	4	4	81	7	25	37
<b>GUNM-1 2018</b>						
<b>Physical</b>						
Turbidity (NTU)	7	1.6	15.7	5.6	6.4	4.6
Total Dissolved Solids (mg/L)	7	95.0	157.0	115.0	125.3	23.0
Total Suspended Solids (mg/L)	7	1.0	20.0	7.0	8.3	5.9
Hardness (mg/L)	4	81.3	128.0	113.5	109.1	22.6
Alkalinity (mg/L)	7	77.4	130.0	97.4	101.8	19.8
Photic Zone (m)	7	2.35	4.00	3.37	3.27	0.65
Secchi (m)	7	0.90	3.09	1.78	1.71	0.71
Bottom Depth (m)	7	3.0	4.3	4.0	4.0	0.4
<b>Chemical</b>						
Ammonia Nitrogen (mg/L) <sup>J</sup>	7	< 0.015	0.046	0.036	0.028	0.019
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.007	0.153	0.085	0.081	0.060
Total Kjeldahl Nitrogen (mg/L)	7	0.177	0.458	0.325	0.325	0.109
Total Nitrogen <sup>J</sup>	7	< 0.180	0.568	0.416	0.407	0.124
Dis Reactive Phosphorus (mg/L) <sup>J</sup>	7	< 0.004	0.011	0.005	0.005	0.003
Total Phosphorus (mg/L) <sup>J</sup>	7	0.006	0.026	0.015	0.016	0.007
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L) <sup>J</sup>	7	1.0	4.0	2.0	2.2	1.0
<b>Biological</b>						
Chlorophyll a (mg/m <sup>2</sup> )	7	1.60	10.10	6.94	5.83	3.32
E. coli (MPN/DL) <sup>J</sup>	4	2	53	6	17	24

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

## 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 2003-2015 and declined in 2018 (Figure 4). Monthly TN concentrations were highest in May in 2015 and October in 2018.

The mean growing season TP concentration decreased 2003-2018 (Figure 4). In general, monthly TP concentrations were higher in 2015 than in 2018. The highest monthly TP concentration was measured in May both years.

Mean growing season chl *a* declined 2003-2015 but increased in 2018 (Figure 4). In 2015, the highest monthly chl *a* concentration was measured in July. In 2018, the highest concentration was measured in May.

The mean TSI declined 2003-2015, reaching oligotrophic conditions in 2015, but returned to mesotrophic in 2018 (Figure 4). Monthly TSI in Crow Creek was oligotrophic or mesotrophic each month during 2015. During 2018, eutrophic conditions were measured during May, June, September, and October.

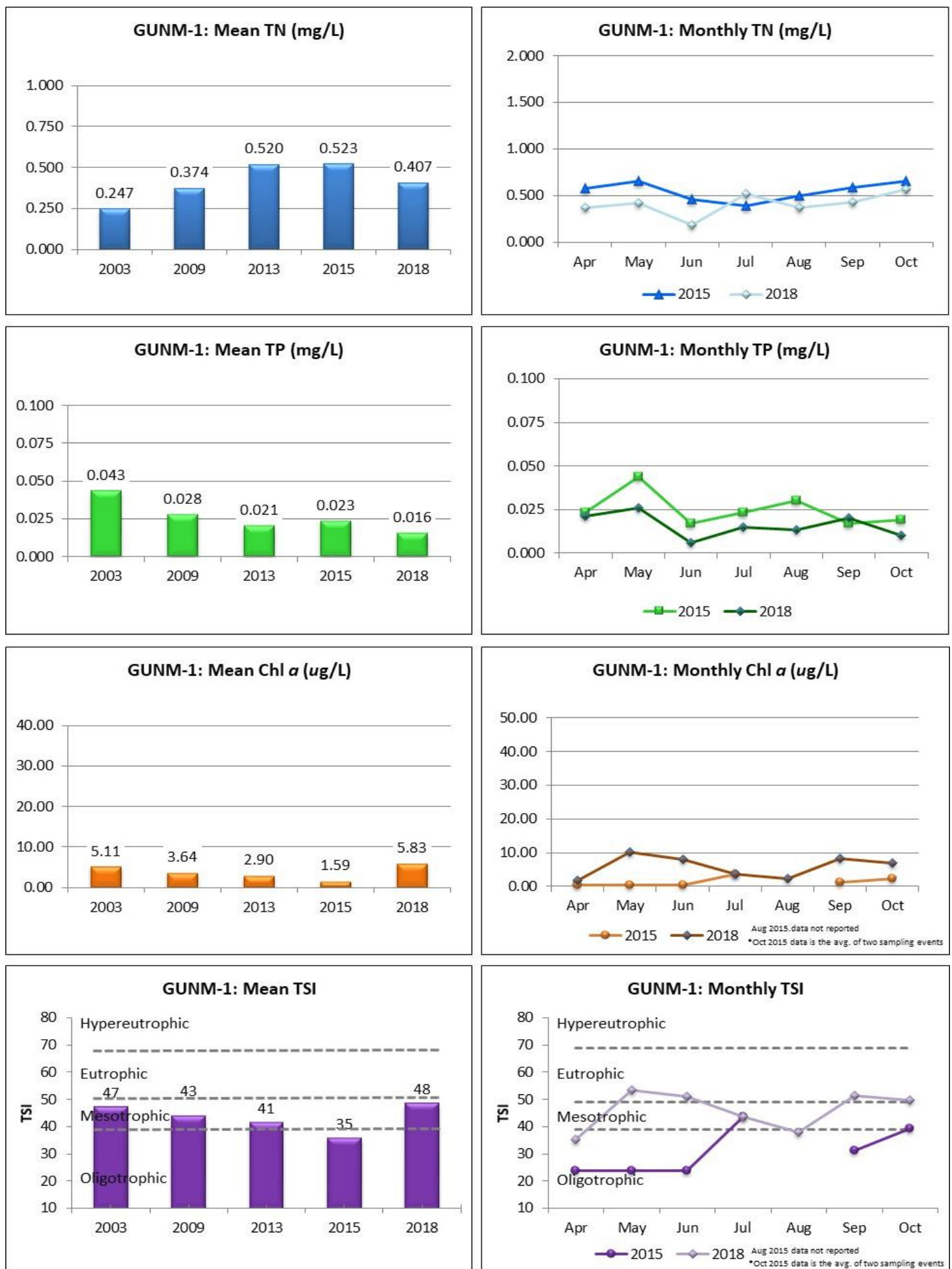
The mean growing season TSS value increased 2009-2018, but the values still remained lower than those measured in 2003 (Figure 5). Monthly TSS concentrations were highest in June and August in 2015 and in April in 2018.

AGPT results show that Crow Creek was phosphorus-limited 2003-2013 (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 2.12 mg/L.

The DO concentration at the Crow Creek station was below the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) July-October of 2015. In 2018, DO was below criteria from July-September, recovering to 5.9 mg/L in October. (ADEM Admin. Code R. 335-6-10-.09) (Figure 6).

**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	0.98	Phosphorus
2009	1.33	Phosphorus
2013	2.12	Phosphorus



**Figure 4.** Mean growing season (2003-2018) and monthly (April-October, 2015 & 2018) TN, TP, chl *a*, and TSI measured in the Crow Creek embayment (GUNM-1) of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

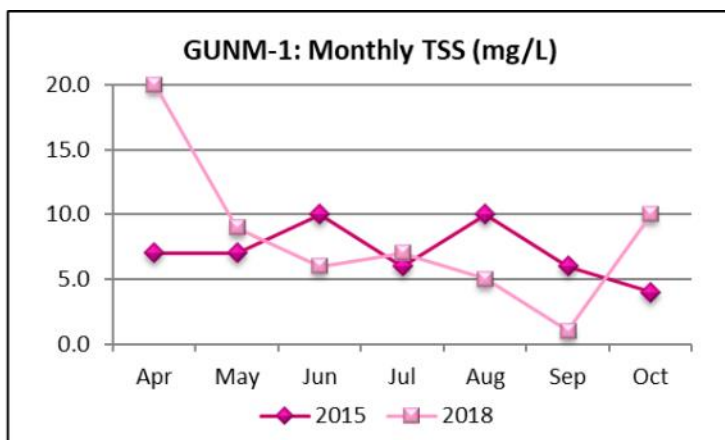
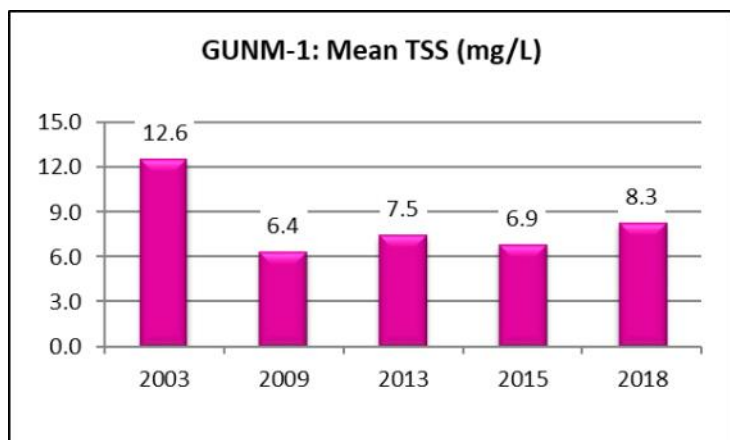


Figure 5. Mean growing season and monthly TSS measured in the Crow Creek embayment (GUNM-1) of Guntersville Reservoir.

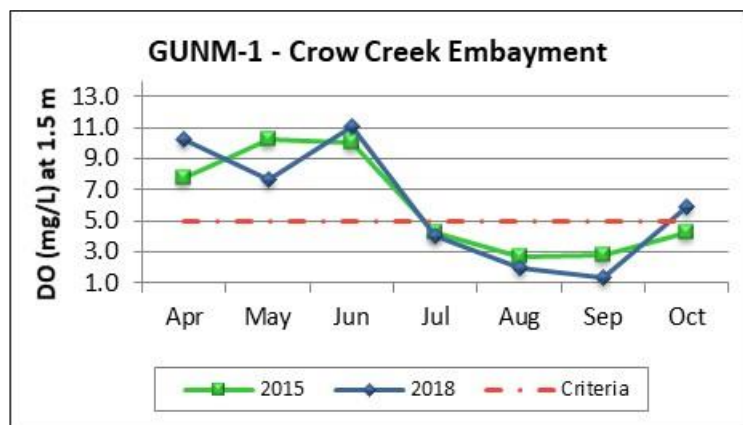


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Crow Creek embayment (GUNM-1) of Guntersville Reservoir collected April-October 2015 and 2018. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

## REFERENCES

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- ADEM. 2018a. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.
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- ADEM. 2018c. Quality Management Plan (QMP) for the Alabama Department of Environmental Management (ADEM) Rev 5.0, Montgomery, AL. 72 pp.
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