Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Short Creek Embayment Guntersville Reservoir Intensive Basin Survey 2015 & 2018

GUNM-8: Short Creek immediately upstream of AL Hwy 227 bridge (Jackson Co 34.36454/-86.21693)

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 Short 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 Short Creek embayment (GUNM-8) during the 2015 and 2018 growing seasons (Apr-Oct). This is the fourth and fifth 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)] were compared to ADEM's historical data and established criteria.

Figure 1. Short Creek at GUNM-8.

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 2016 National Land Cover Dataset, land use within the 224 mi^2 watershed is predominantly agriculture [hay/pasture (45%) and cultivated crops (9%)] (Figure 3). As of January 28, 2016, ADEM has issued a total of 115 NPDES permits within the watershed. Thirteen of those permits are located within 10 mi of the station (Figure 2).

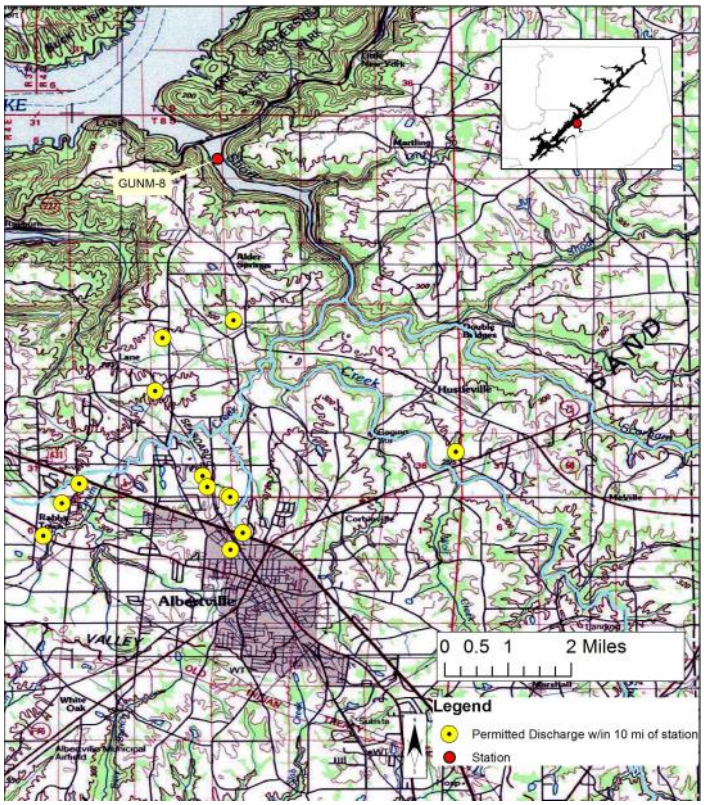


Figure 2. Map of the Short Creek embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

SITE DESCRIPTION

The Short Creek embayment at GUNM-8 is located northeast of Guntersville, AL. This watershed receives 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 Creek has a mean bottom depth of about 4.3 meters at the sampling location (Table 2).

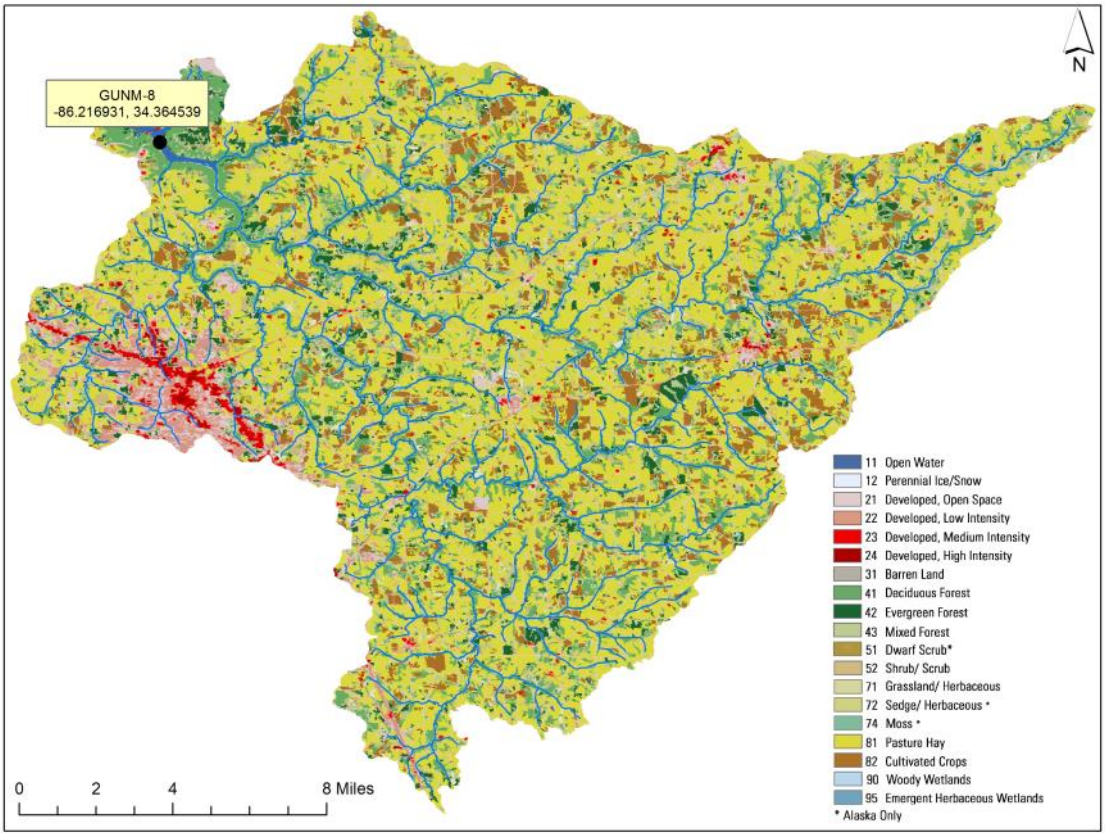


Figure 3. Land use within the Short Creek watershed at GUNM-8.

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).

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 and declined 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 from 2003-2018 (Figure 5). The highest monthly TP concentration was measured in April during 2015 and 2018.

The mean growing season chl *a* value increased from 2009 to 2018 (Figure 5). The highest monthly chl *a* concentrations were measured in July in 2015 and in September in 2018.

The mean TSI increased from 2009 to 2018 (Figure 5). However, mean TSI remained eutrophic all years sampled. In 2015, monthly TSI in Short Creek began as oligotrophic in April and May, quickly increasing to hypereutrophic by July, before decreasing at the end of the growing season. In 2018, monthly TSI remained eutrophic all months sampled except September, which was hypereutrophic.

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

Basin		Tennessee R
Drainage Area (mi^2)		224
Ecoregion[a]		68d
Assessment Unit		AL06030001-0807-111
% 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		%
Wetlands	Woody	0%
	Emergent Herb.	<1%
# NPDES outfalls[b]	TOTAL	115
Construction Stormwater		51
Industrial General		43
Industrial Individual		5
Municipal		3
Underground Injection Control		13

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

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-8 2015	N		Min	Max	Med	Avg	SD
Physical							
Turbidity (NTU)	7		5.6	13.6	6.8	7.6	2.7
Total Dissolved Solids (mg/L)	7		56.0	119.0	100.0	90.7	21.4
Total Suspended Solids (mg/L)	7		2.0	11.0	8.0	7.3	3.2
Hardness (mg/L)	4		24.9	82.5	68.6	61.1	25.3
Alkalinity (mg/L)	7		14.6	76.5	64.4	57.9	20.2
Photic Zone (m)	7		2.12	2.64	2.42	2.42	0.22
Secchi (m)	7		0.65	1.35	1.19	1.08	0.25
Bottom Depth (m)	7		3.6	4.6	4.4	4.2	0.4
Chemical							
Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.072	0.005	0.025	0.032
Nitrate+Nitrite Nitrogen (mg/L)	7		0.035	1.498	0.088	0.316	0.530
Total Kjeldahl Nitrogen (mg/L)[J]	7		0.293	1.320	0.733	0.770	0.395
Total Nitrogen (mg/L)[J]	7		0.470	2.103	0.890	1.086	0.558
Dis Reactive Phosphorus (mg/L)[J]	7		0.003	0.022	0.006	0.008	0.006
Total Phosphorus (mg/L)	7		0.032	0.066	0.045	0.047	0.012
CBOD-5 (mg/L)[J]	7	<	2.0	2.4	1.0	1.2	0.5
Chlorides (mg/L)	7		4.0	10.9	9.4	8.7	2.5
Biological							
Chlorophyll a (mg/m³)	7		1.20	63.40	5.34	21.01	24.26
E. coli (MPN/DL)[J]	3	<	1	1	1	1	0

GUNM-8 2018	N		Min	Max	Med	Avg	SD
Physical							
Turbidity (NTU)	7		3.4	19.1	6.0	7.7	5.2
Total Dissolved Solids (mg/L)	7		53.0	106.0	95.0	90.1	17.6
Total Suspended Solids (mg/L)	7		2.0	19.0	9.0	9.0	5.1
Hardness (mg/L)	4		58.4	74.0	59.0	62.6	7.6
Alkalinity (mg/L)	7		13.8	71.2	58.8	53.5	18.4
Photic Zone (m)	7		1.60	4.75	2.70	2.72	1.07
Secchi (m)	7		0.52	1.67	0.86	0.92	0.38
Bottom Depth (m)	7		3.6	7.4	4.2	4.5	1.4
Chemical							
Ammonia Nitrogen (mg/L)[J]	7	<	0.015	0.111	0.008	0.030	0.038
Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.007	1.350	0.032	0.321	0.494
Total Kjeldahl Nitrogen (mg/L)	7		0.256	1.080	0.814	0.751	0.274
Total Nitrogen (mg/L)	7	<	0.260	2.234	1.004	1.071	0.590
Dis Reactive Phosphorus (mg/L)[J]	7	<	0.004	0.038	0.006	0.011	0.013
Total Phosphorus (mg/L)	7		0.014	0.126	0.038	0.047	0.036
CBOD-5 (mg/L)	7	<	2.0	2.6	1.0	1.2	0.6
Chlorides (mg/L)[J]	7		3.4	10.1	5.6	6.2	2.1
Biological							
Chlorophyll a (mg/m³)	7		6.41	64.10	16.60	23.89	19.17
E. coli (MPN/DL)	4	<	1	3	1	1	1

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

RESULTS (con't)

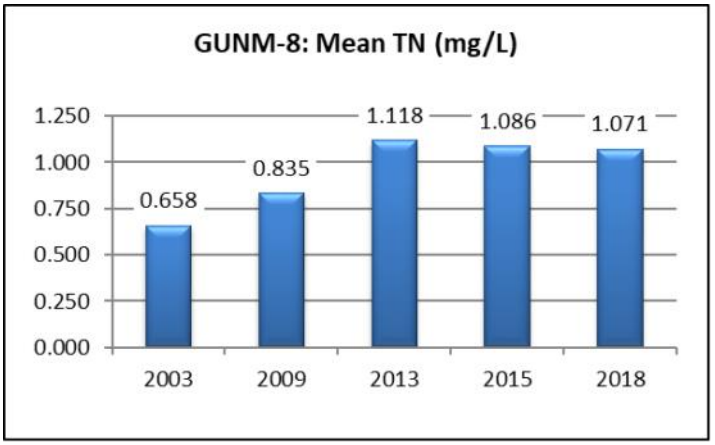
The mean growing season TSS value increased from 2013 to 2018 (Figure 5). Monthly TSS concentrations were highest in July in 2015 and in April in 2018.

AGPT results show that Short Creek was nitrogen limiting in 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 2013 mean maximum standing crop (MSC) value was 17.82 mg/L. Previous MSC values at Short Creek were also >5.0 mg/L.

DO concentrations at the sampling location were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) for all samples collected during the 2015 and 2018 growing seasons (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
8/20/2003	9.32	NITROGEN
8/18/2009	8.19	NITROGEN
8/21/2013	17.82	NITROGEN



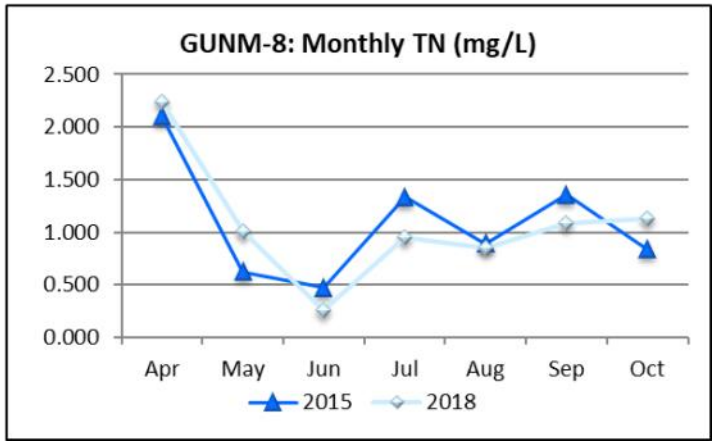
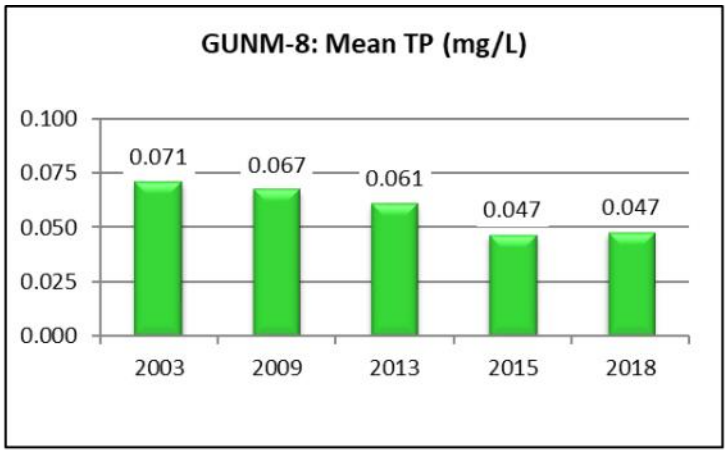
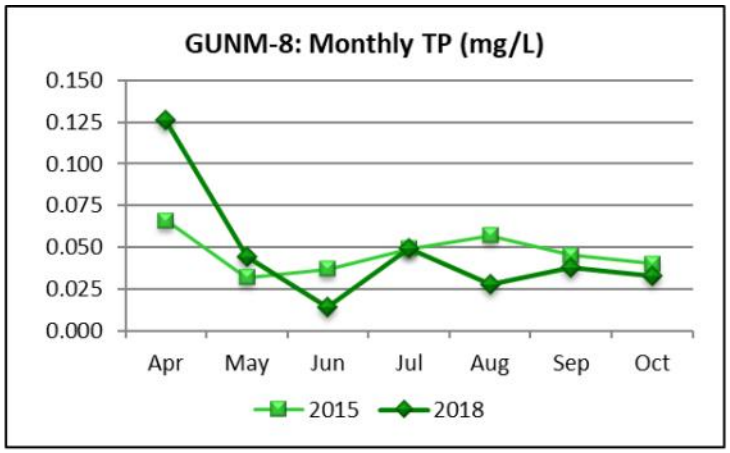
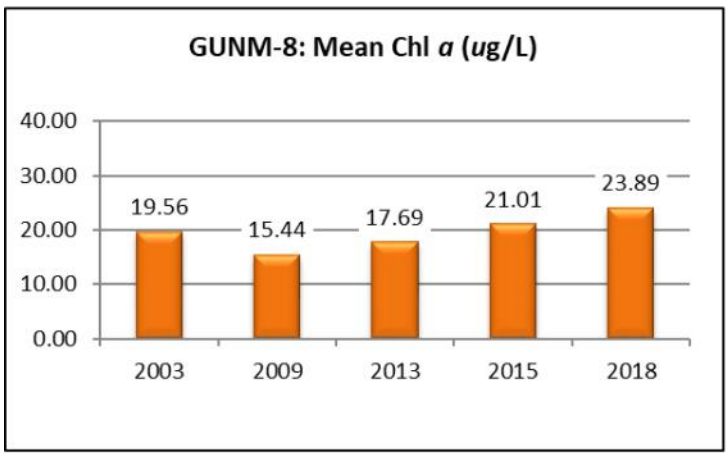
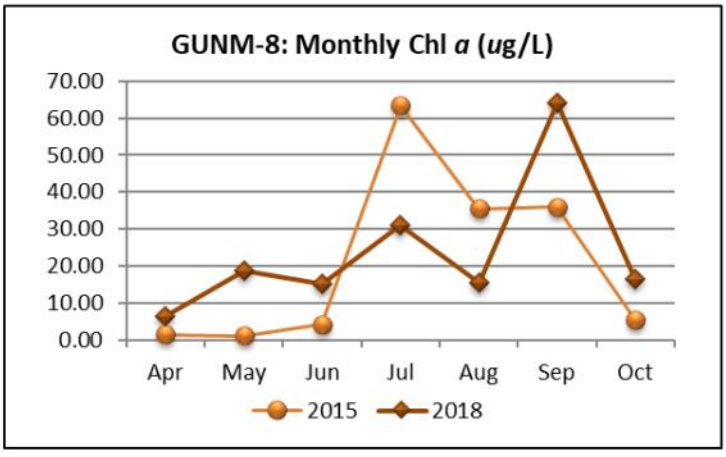


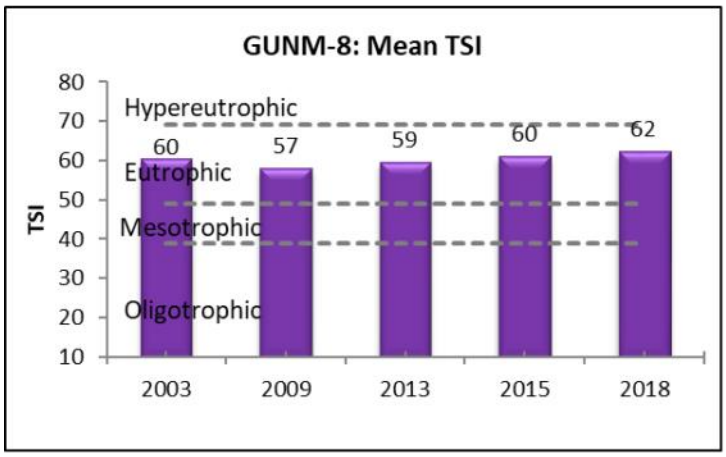
Figure 4. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TN measured in the Short Creek embayment (GUNM-8) of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

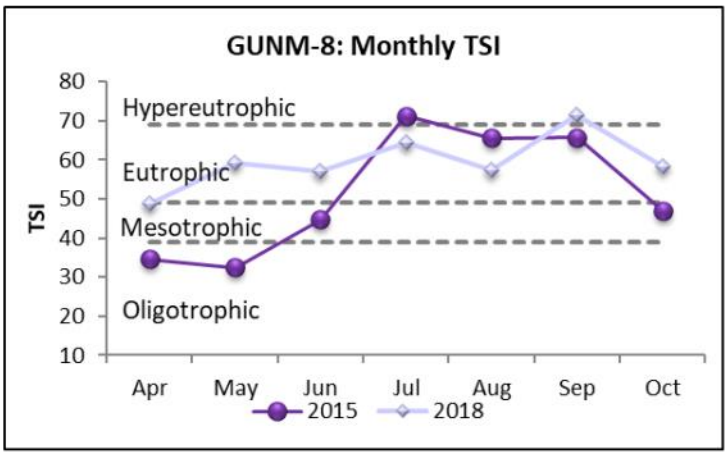


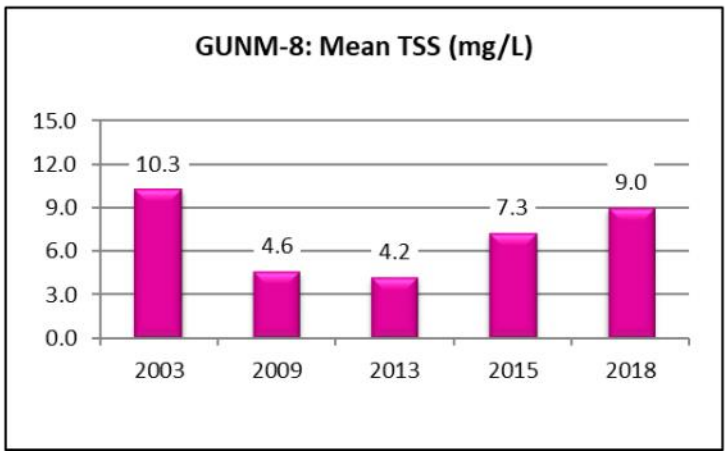












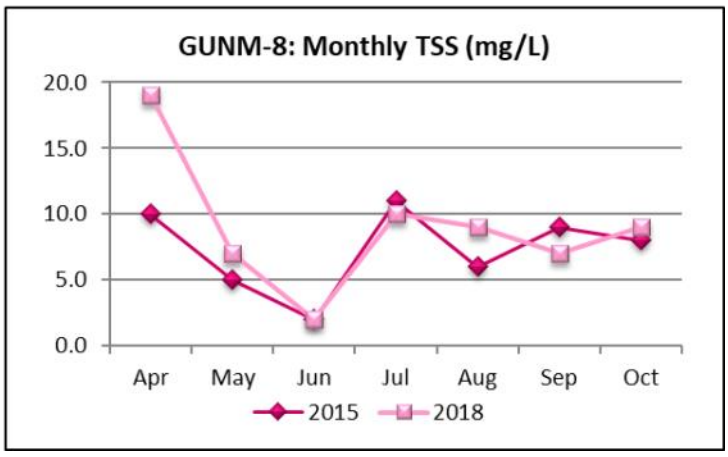


Figure 5. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TP, chl *a,* TSI, and TSS measured in the Short Creek embayment (GUNM-8) of Guntersville Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

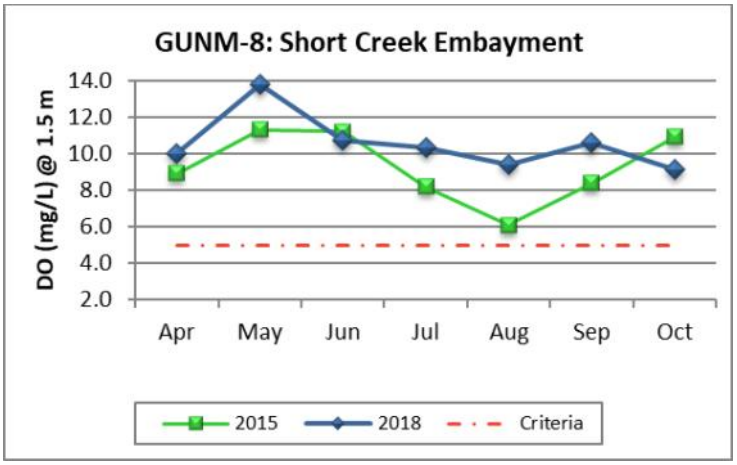


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Short Creek embayment station (GUNM-8) of Guntersville Reservoir collected April-October 2015 and 2018. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

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