

Dry Creek Embayment Guntersville Reservoir Intensive Basin Survey 2015 & 2018

Tennessee River Basin

GUNM-4: Dry Creek approximately 0.5 mi downstream of Jackson Co Park (Jackson Co 34.6323/-86.0181)

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 Dry 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 Dry Creek embayment (GUNM-4) 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.

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 2016 National Land Cover Dataset, land use within the 27 mi² watershed is mostly forested (38%) with some hay/pasture (Figure 3). As of January 28, 2016, ADEM has issued a total of 21 NPDES permits within the watershed. Seven of those permits are located within 10 mi upstream of the station (Figure 2).

SITE DESCRIPTION

The Dry Creek embayment at GUNM-4 is located just south of Scottsboro, AL. Dry Creek combines with Roseberry Creek before entering the Tennessee River near river mile 382. The sampling location is downstream of Jackson County Park. It is a fairly large but shallow embayment with a mean depth of about 3 meters (Table 2).



Figure 1. Dry Creek at GUNM-4.

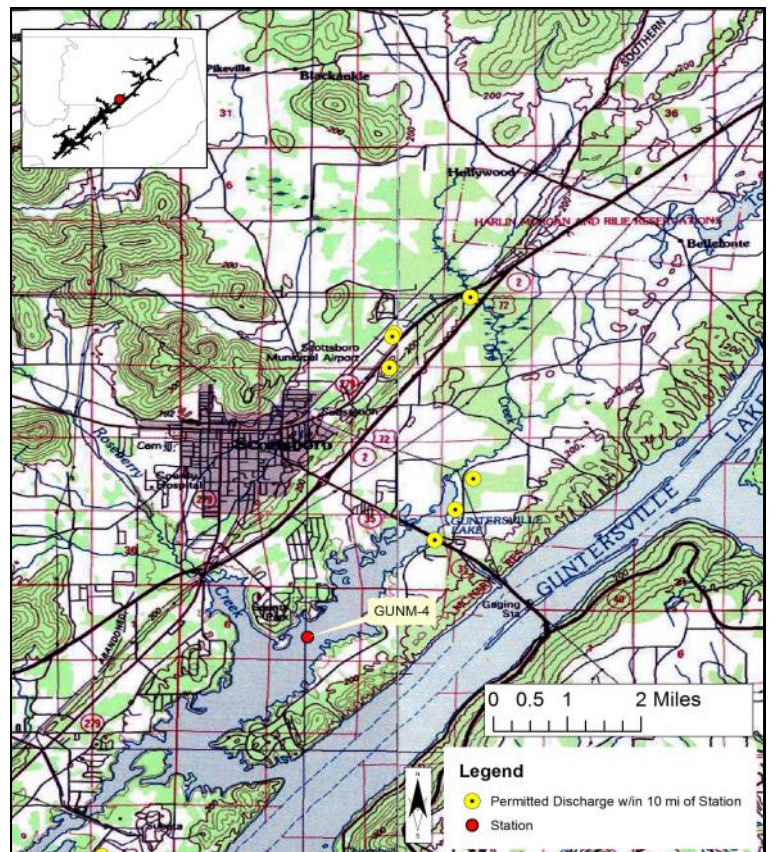


Figure 2. Map of the Dry Creek embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

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

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

Basin	Tennessee R		
Drainage Area (mi ²)	27		
Ecoregion ^a	68b		
Assessment Unit	AL06030001-0603-111		
% 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 outfalls ^b	TOTAL	21	
	Construction Stormwater	8	
	Mining	6	
	Small Mining	2	
	Industrial General	5	
	Industrial Individual	0	
	No Exposure	0	
	Municipal	0	
	Underground Injection Control	0	

a. Sequatchie Valley

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

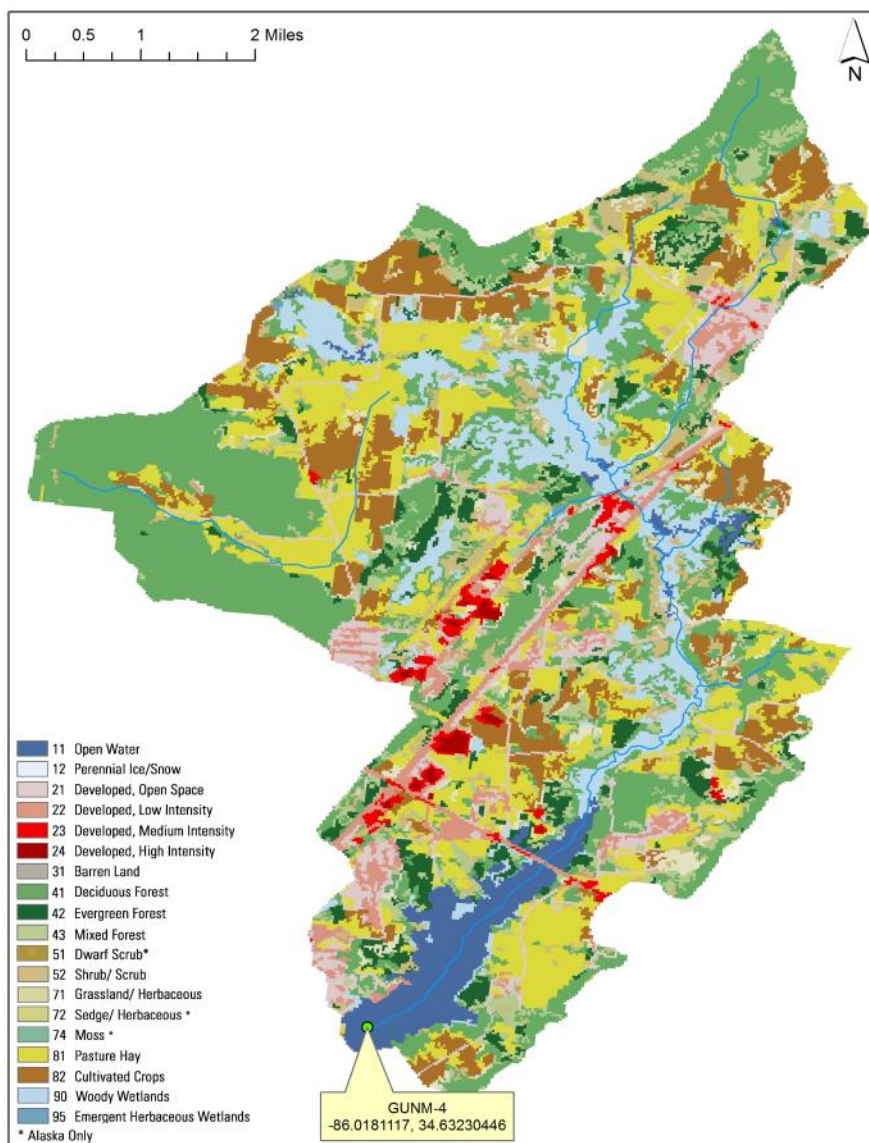


Figure 3. Land use within the Dry Creek watershed at GUNM-4.

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 from 2013 to 2015, but then declined in 2018 (Figure 4). Monthly TN concentrations were highest in September of 2015 and in May of 2018.

After steadily decreasing 2003-2013, the mean growing season TP concentration increased in 2015, but then declined in 2018 to the lowest mean recorded for Dry Creek (Figure 5). The highest monthly TP concentration was measured in August of 2015 and in April of 2018.

The mean growing season chl *a* value declined 2003-2013, but increased in 2015 (Figure 5). In both 2015 and 2018, the highest monthly chl *a* concentration was measured in August.

The mean TSI increased from 2013 to 2015, but conditions in Dry Creek have been eutrophic for all years sampled (Figure 5). In 2015, monthly TSI was oligotrophic April-June, increasing to hypereutrophic by August, and decreasing to eutrophic the rest of the growing season. In 2018, eutrophic conditions were measured the entire sampling season.

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-4 2015	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	7	4.5	12.1	7.5	8.0	3.2
Total Dissolved Solids (mg/L)	7	117.0	134.0	124.0	124.4	6.0
Total Suspended Solids (mg/L)	7	4.0	12.0	7.0	8.0	3.3
Hardness (mg/L)	4	39.4	96.2	91.4	79.6	27.1
Alkalinity (mg/L)	7	58.6	94.2	67.4	72.1	11.8
Photic Zone (m)	7	1.69	3.06	2.60	2.44	0.59
Secchi (m)	7	0.58	1.48	1.00	1.00	0.34
Bottom Depth (m)	7	2.9	3.1	3.0	3.0	0.1
Chemical						
Ammonia Nitrogen (mg/L) ^J	7	< 0.007	0.102	0.004	0.029	0.044
Nitrate+Nitrite Nitrogen (mg/L) ^J	7	< 0.001	0.048	0.015	0.018	0.018
Total Kjeldahl Nitrogen (mg/L) ^J	7	0.572	1.560	0.832	0.926	0.376
Total Nitrogen (mg/L) ^J	7	< 1.761	4.752	0.880	0.944	0.374
Dis Reactive Phosphorus (mg/L) ^J	7	< 0.004	0.010	0.004	0.004	0.002
Total Phosphorus (mg/L)	7	0.019	0.090	0.027	0.037	0.026
CBOD-5 (mg/L) ^J	7	< 2.0	4.6	1.0	1.9	1.4
Chlorides (mg/L)	7	3.3	7.0	4.9	5.0	1.3
Biological						
Chlorophyll a (mg/m ³)	7	< 1.00	53.40	12.30	19.30	23.46
E. coli (MPN/DL)	3	1	2	1	1	1
GUNM-4 2018						
Physical						
Turbidity (NTU)	7	3.3	9.9	6.6	7.2	2.3
Total Dissolved Solids (mg/L)	7	102.0	113.0	108.0	107.6	3.3
Total Suspended Solids (mg/L)	7	3.0	12.0	9.0	8.7	2.9
Hardness (mg/L)	4	73.0	82.9	78.2	78.1	4.1
Alkalinity (mg/L)	7	73.0	91.0	75.0	78.5	6.4
Photic Zone (m)	7	2.00	2.94	2.46	2.46	0.35
Secchi (m)	7	0.83	1.90	1.02	1.16	0.38
Bottom Depth (m)	7	2.9	3.4	3.0	3.1	0.2
Chemical						
Ammonia Nitrogen (mg/L) ^J	7	< 0.015	0.049	0.008	0.015	0.016
Nitrate+Nitrite Nitrogen (mg/L) ^J	7	< 0.007	0.123	0.004	0.021	0.045
Total Kjeldahl Nitrogen (mg/L)	7	0.400	1.210	0.753	0.768	0.248
Total Nitrogen (mg/L) ^J	7	< 1.210	3.640	0.756	0.789	0.262
Dis Reactive Phosphorus (mg/L) ^J	7	< 0.004	0.005	0.002	0.003	0.001
Total Phosphorus (mg/L) ^J	7	0.009	0.040	0.013	0.018	0.011
CBOD-5 (mg/L) ^J	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.1	5.1	4.1	4.2	0.8
Biological						
Chlorophyll a (mg/m ³)	7	10.70	31.00	16.00	18.54	7.21
E. coli (MPN/DL) ^J	4	1	3	2	2	1

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

RESULTS (con't)

The mean growing season TSS concentration decreased 2003-2013, but then increased 2015-2018 (Figure 5). Monthly TSS concentrations were highest in August and September of 2015 and in April of 2018.

AGPT results show that GUNM-4 was co-limiting in 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. In 2013, the MSC value was 3.29 mg/L. MSC values measured in previous years were also less than 5.0 mg/L. No AGPT samples were collected at Dry Creek during the 2015 or 2018 sampling seasons.

The DO concentrations in Dry Creek were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) for all months sampled in 2015 and in 2018 (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	4.71	CO-LIMITING
2009	1.9	NITROGEN
2013	3.29	CO-LIMITING

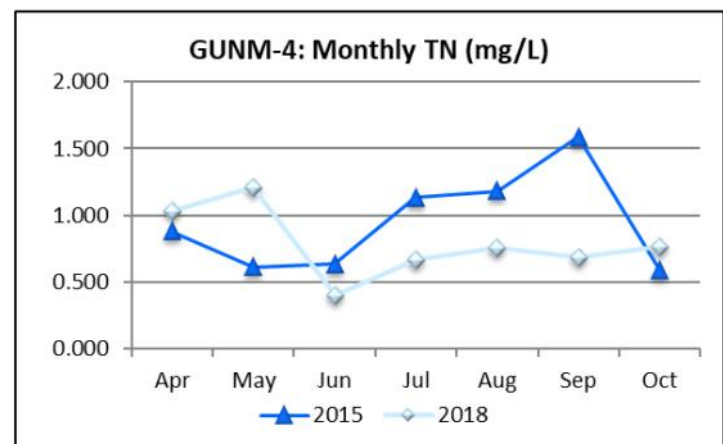
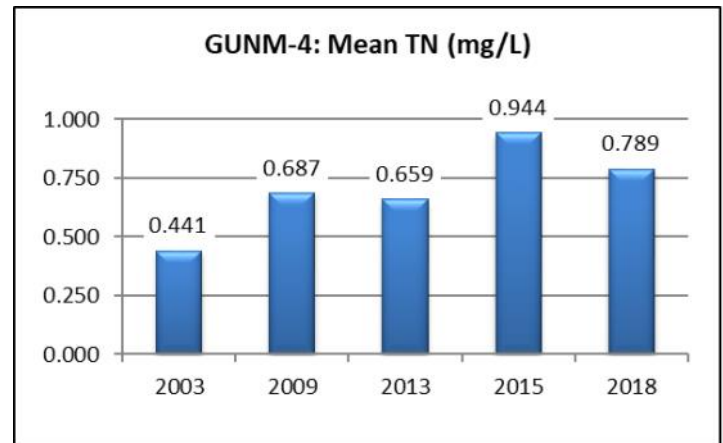


Figure 4. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TN measured in the Dry Creek embayment (GUNM-4) of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

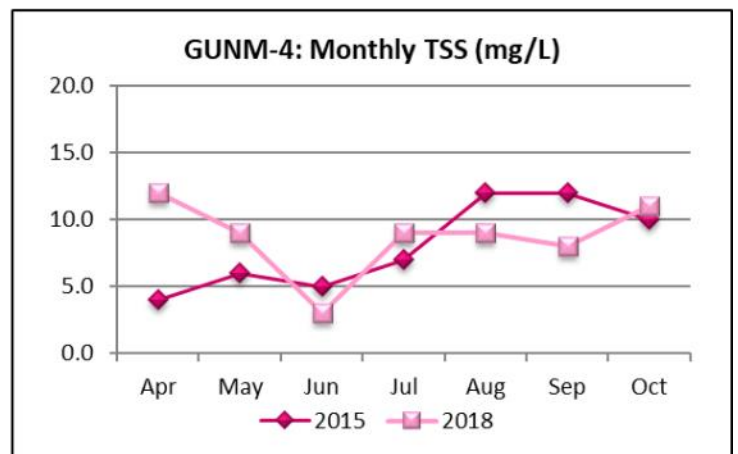
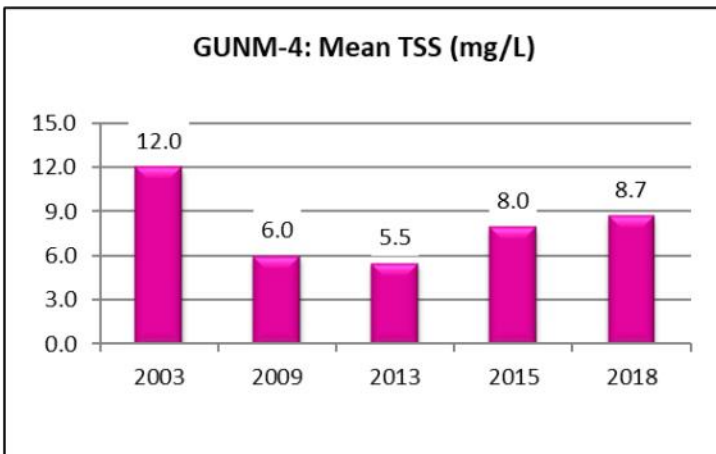
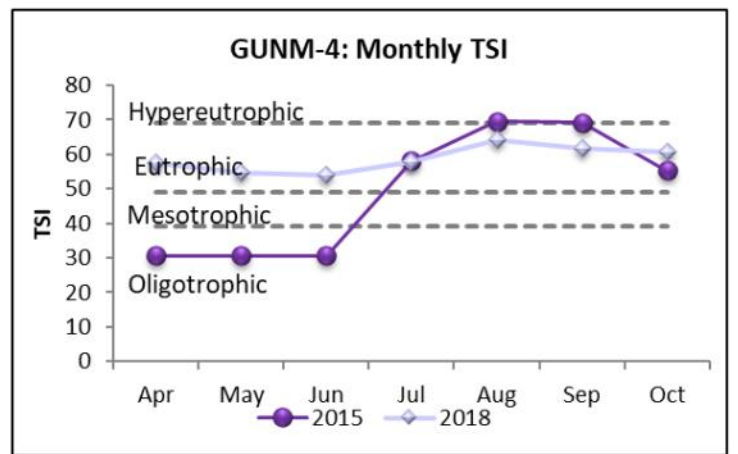
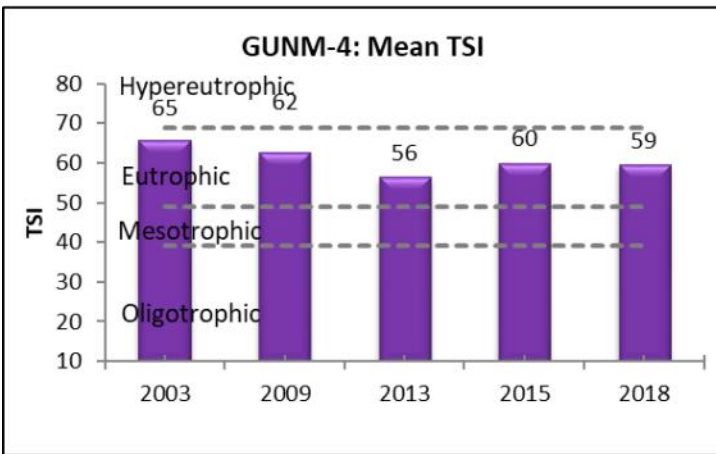
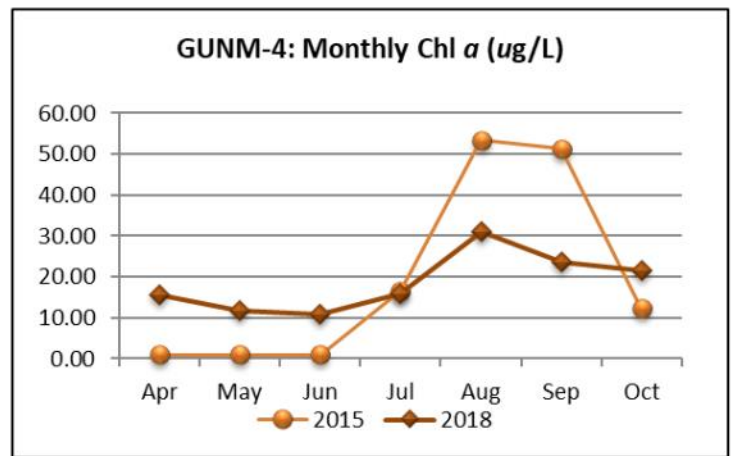
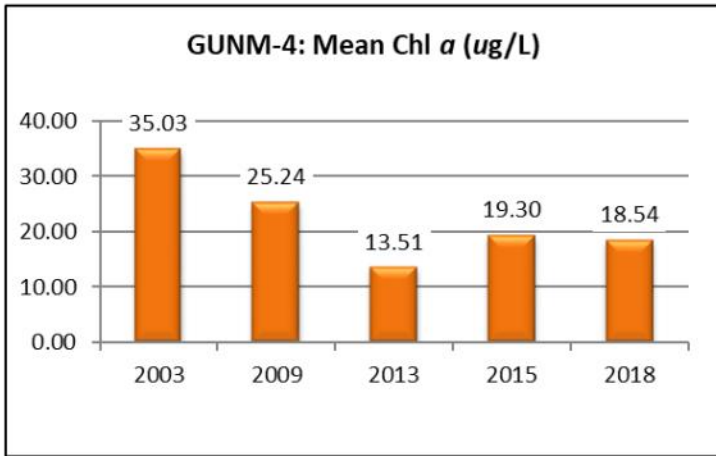
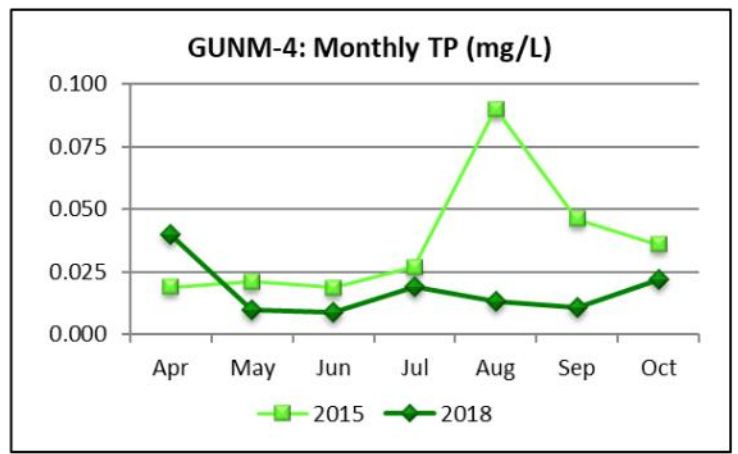
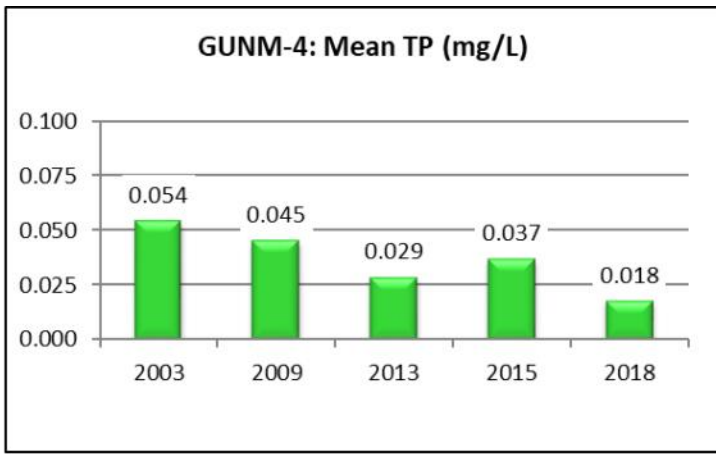


Figure 5. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TP, chl *a*, TSI, and TSS measured in the Dry Creek embayment (GUNM-4) of Gunterville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

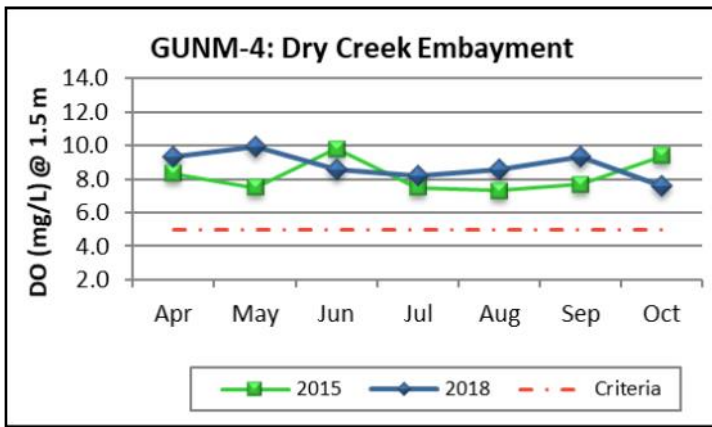


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for the Dry Creek embayment station (GUNM-4) of Guntersville Reservoir collected (April-October, 2015 and 2018). ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

REFERENCES

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