Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Town Creek Embayment
Wilson Reservoir
Intensive Basin Survey 2018 & 2020

WILL-3: Town Creek approx. 1 mile downstream of CR 314 bridge (Colbert Co 34.77306/-87.43028)

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 2018 and 2020, ADEM monitored the Town Creek (Wilson Lake) tributary embayment 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 Town Creek (Wilson Lake) embayment (WILL-3) during the 2018 and 2020 growing seasons (Apr-Oct). These are the fifth and sixth 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.

Figure 1. Town Creek (Wilson Lake) at WILL-3.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Town Creek (Wilson Lake) embayment is classified *Fish & Wildlife (F&W)* and located in the Eastern Highland Rim ecoregion (71g). Based on the 2021 National Land Cover Dataset, land use within the 235 mi^2 watershed is predominantly pastureland with some forest (26%) and cropland (Figure 3). As of February 13, 2024, ADEM has issued permits for 17 NPDES outfalls within the watershed (Figure 2).

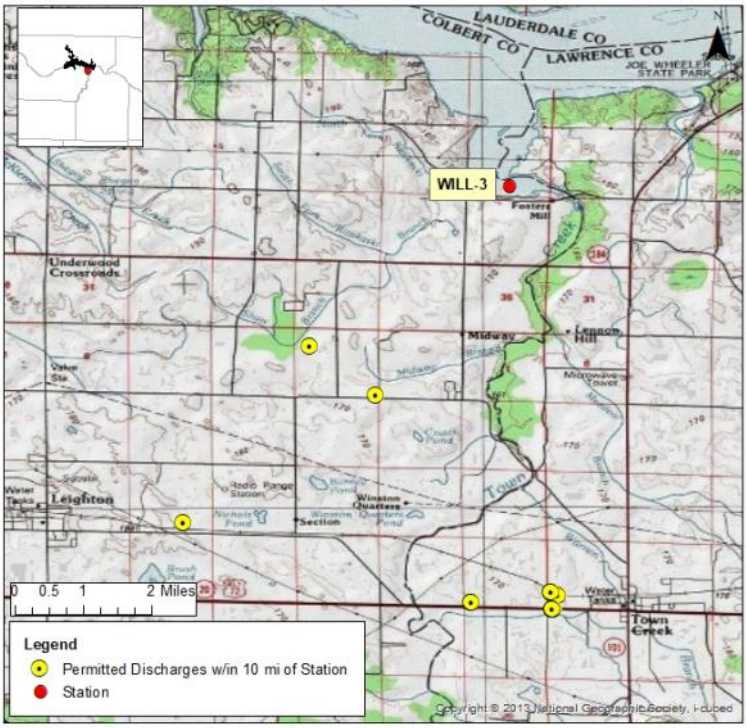


Figure 2. Map of the Town Creek (Wilson Lake) embayment. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

Table 1. Summary of Watershed **WILL-3**

Basin		Tennessee R
Assessment Unit		AL06030005-0304-111
Drainage Area (mi^2)		235
Ecoregion[a]		71g
% Landuse		
Open Water		<1%
Developed	Open Space	3%
	Low Intensity	1%
	Medium Intensity	1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	18%
	Evergreen Forest	5%
	Mixed Forest	3%
Shrub/Scrub		1%
Herbaceous		1%
Hay/Pasture		31%
Cultivated Crops		21%
Wetlands	Woody	14%
	Emergent Herb.	1%
# NPDES outfalls[b]	TOTAL	17
Mining		4
Industrial General		11
Municipal		2

a. Eastern Highland Rim
b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Feb 13, 2024.

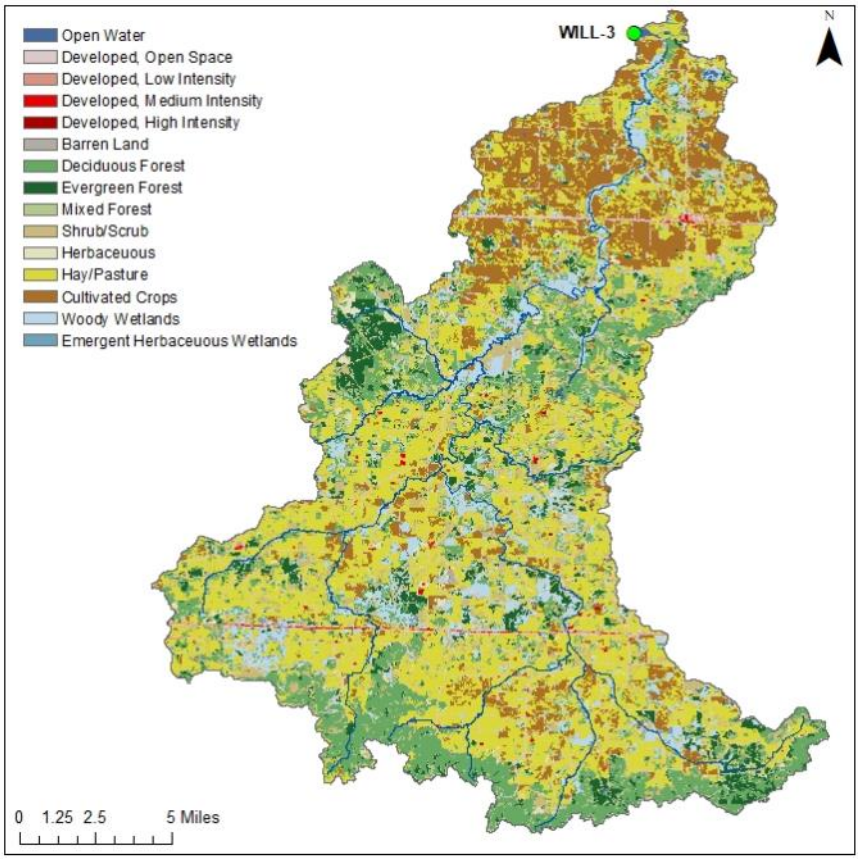


Figure 3. Land use within the Town Creek (Wilson Lake) watershed at WILL-3.

SITE DESCRIPTION

The Town Creek (Wilson Lake) embayment at WILL-3 is located east of Muscle Shoals, AL, near the Doublehead Resort. It is a fairly wide embayment at the sampling location with emergent vegetation in the shallow areas along the bank. Town Creek (Wilson Lake) flows into the Tennessee River at river mile 273.The embayment had a mean bottom depth of 3.2m in 2018 and 2.3m in 2020 (Table 2) at the sampling location.

METHODS

Water quality assessments were conducted at monthly intervals, April-October in 2018. The 2020 sampling schedule was modified to accommodate Departmental precautions related to COVD-19 that occurred early in the sampling season. As a result, no water quality samples were collected in April and two samples were collected in October to account for the missed sampling event early in the season. In 2020, the early October chl *a* and TN samples were lost by the lab, so the 2020 means for these parameters are calculated from six monthly samples, not seven as is standard for all other growing season means. These modifications are noted in related graphs. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2020), Surface Water Quality Assurance Project Plan (ADEM 2018a), and Quality Management Plan (ADEM 2018b).

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 2018 and 2020 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 4-7 were set to maximum values reservoir-wide so that all embayment reports on the same reservoir could be compared.

Mean growing season TN values have remained stable since 2009 (Figure 4). Monthly TN concentrations were highest in June in 2018 and in May in 2020 (Figure 5).

Table 2. Summary of water quality data collected April-October, 2018 and 2020. 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.

WILL-3 2018	N		Min		Max	Med	Avg	SD
Physical								
Turbidity (NTU)	6		6.0		16.2	8.0	9.6	3.9
Total Dissolved Solids (mg/L)	7		106.0		141.0	124.0	125.0	12.4
Total Suspended Solids (mg/L)	7		4.0		13.0	6.0	7.9	3.6
Hardness (mg/L)	4		96.0		116.0	103.8	104.9	9.0
Alkalinity (mg/L)	7		87.5		115.0	99.2	101.1	9.2
Photic Zone (m)	7		2.33		3.40	2.90	2.94	0.40
Secchi (m)	7		0.63		1.36	0.94	0.95	0.25
Bottom Depth (m)	7		2.9		3.4	3.3	3.2	0.2
Chemical								
Ammonia Nitrogen (mg/L)[J]	7	<	0.007		0.036	0.004	0.010	0.012
Nitrate+Nitrite Nitrogen (mg/L)	7		0.541		1.880	0.926	1.158	0.594
Total Kjeldahl Nitrogen (mg/L)	7		0.349		0.756	0.407	0.504	0.168
Total Nitrogen (mg/L)	7		2.739		6.837	1.610	1.662	0.579
Dis Reactive Phosphorus (mg/L)[J]	7		0.007		0.050	0.015	0.021	0.015
Total Phosphorus (mg/L)	7		0.035		0.076	0.051	0.049	0.014
CBOD-5 (mg/L)	7	<	2.0		2.8	1.0	1.2	0.7
Chlorides (mg/L)	7		3.3		6.5	5.7	5.5	1.1
Biological								
Chlorophyll a (mg/m³)	7		1.07		16.00	5.34	6.29	5.38
E. coli (MPN/DL)[J]	4	<	1		3	1	1	0
WILL-3 2020	**N**		**Min**		**Max**	**Med**	**Avg**	**SD**
Physical								
Turbidity (NTU)	7		2.5		31.1	3.2	7.6	10.4
Total Dissolved Solids (mg/L)[J]	7		112.0		152.0	124.0	130.0	15.9
Total Suspended Solids (mg/L)[J]	7		2.0		22.0	4.0	6.1	7.1
Hardness (mg/L)	4		92.5		158.0	104.2	114.8	30.6
Alkalinity (mg/L)[J]	7		52.9		124.0	98.9	96.9	24.1
Photic Zone (m)	7		0.82		2.64	2.16	2.04	0.62
Secchi (m)	7		0.51		2.41	1.43	1.50	0.61
Bottom Depth (m)	7		1.9		2.9	2.2	2.3	0.4
Chemical								
Ammonia Nitrogen (mg/L)	7	<	0.044	<	0.044	0.022	0.022	0.000
Nitrate+Nitrite Nitrogen (mg/L)[J]	7		0.204		2.530	1.270	1.264	0.768
Total Kjeldahl Nitrogen (mg/L)[J]	6	<	0.120		1.100	0.385	0.468	0.354
Total Nitrogen (mg/L)[J]	6	<	3.387		7.770	1.582	1.686	0.581
Total Phosphorus (mg/L)[J]	7	<	0.028		0.354	0.035	0.087	0.121
Chlorides (mg/L)[J]	7		2.9		5.8	4.5	4.4	1.0
Biological								
Chlorophyll a (mg/m³)[J]	6	<	1.00		14.40	3.07	5.37	5.60
E. coli (MPN/DL)[J]	4	<	1		40	3	11	19

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

RESULTS (con't)

While mean growing season TP concentrations decreased 2009 to 2013 and have remained stable since then, the 2020 mean was slightly higher than those calculated in previous years (Figure 4). In 2018, all monthly TP concentrations were <0.100 mg/L throughout the growing season (Figure 5). In 2020, the highest monthly TP concentration was observed in late October with a value of 0.354 mg/L.

The mean growing season chl *a* concentrations calculated for 2018 and 2020 were lower than those in previous sampling years (Figure 4). Monthly chl *a* concentrations were highest in August in both 2018 and 2020 (Figure 5).

According to mean annual TSI, the Town Creek (Wilson Lake) embayment was eutrophic 2003 to 2015 and mesotrophic in 2018 and 2020 (Figure 4). In 2018, monthly TSI calculations indicated eutrophic conditions in August and September (Figure 5). In 2020, the site was eutrophic in July and August.

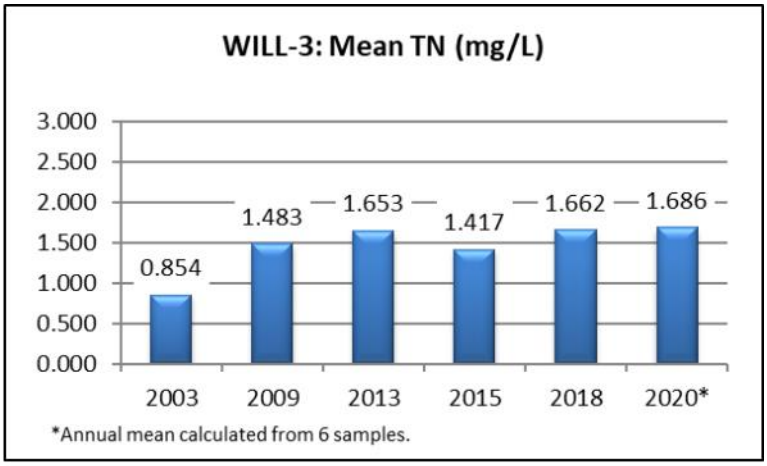
In general, mean growing season TSS concentrations decreased since 2003 with the 2020 mean being the lowest calculated for all sampling years (Figure 4). In 2018, all monthly TSS concentrations were <15 mg/L (Figure 6). In 2020, the highest monthly TSS value was measured in late October.

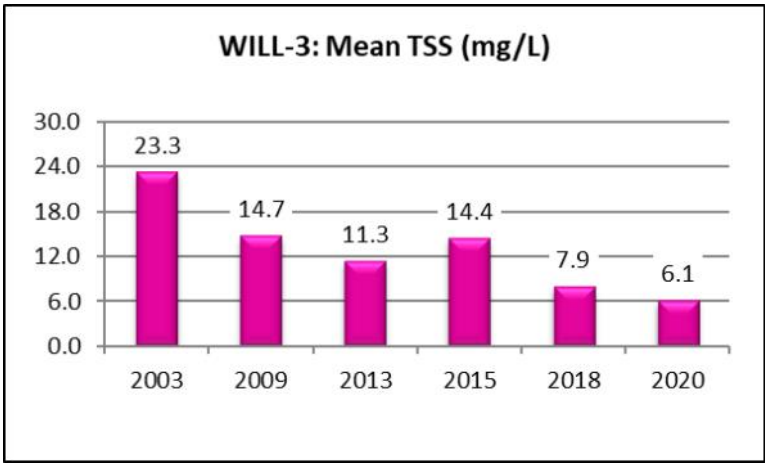
AGPT results show that Town Creek (Wilson Lake) was nitrogen-limited in 2003 and 2013 and co-limiting in 2009 (Table 3). While all samples were above the maximum standing crop (MSC) value of 5.0 mg/L that Raschke and Schultz (1987) found protective of reservoir and lake systems, the 2003 and 2013 samples were below 20.0 mg/L MSC, which they define as protective of flowing stream and river systems.

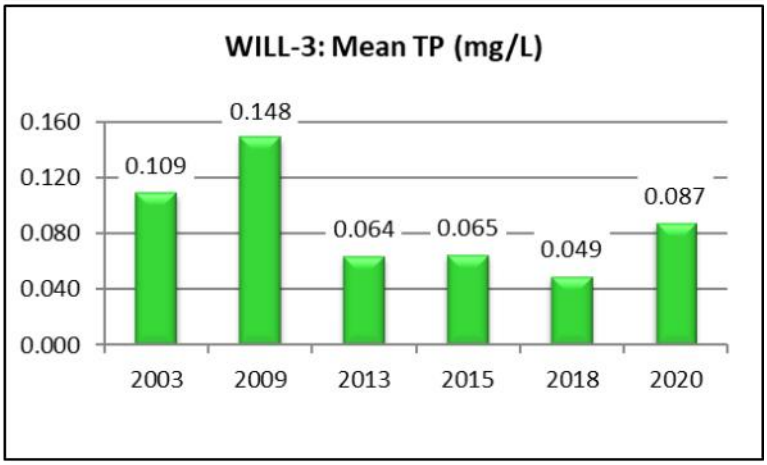
While dissolved oxygen (DO) concentrations at WILL-3 were above the ADEM minimum criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in all months sampled during both 2018 and 2020 (ADEM Admin. Code R. 335-6-10-.09), some monthly readings in 2020 showed super-saturated DO conditions with concentrations >10.0 mg/L (Figure 7). DO was above 10.0 mg/L in June and August of 2020.

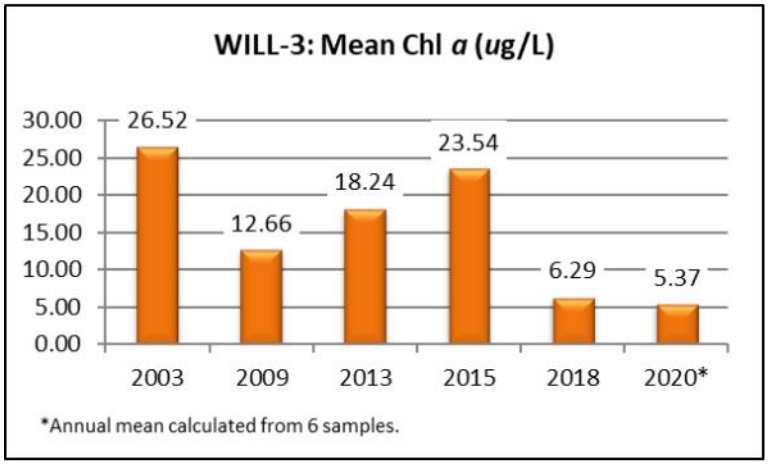
Table 3. Algal growth potential test results (expressed as mean maximum standing crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
2003	19.0	Nitrogen
2009	30.58	Co-limiting
2013	10.97	Nitrogen









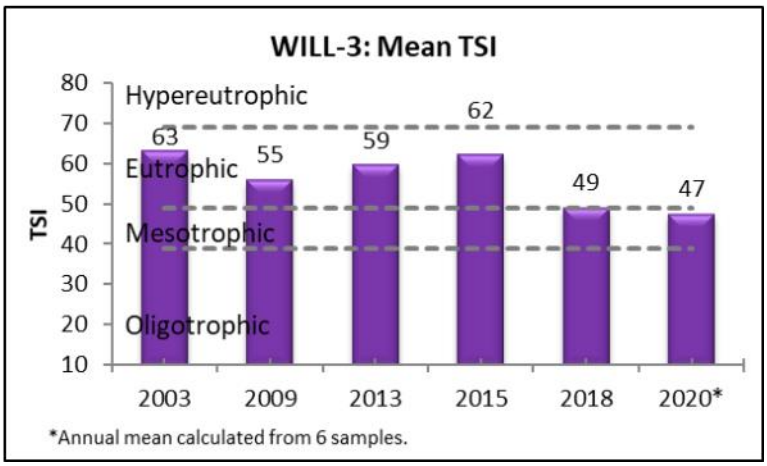
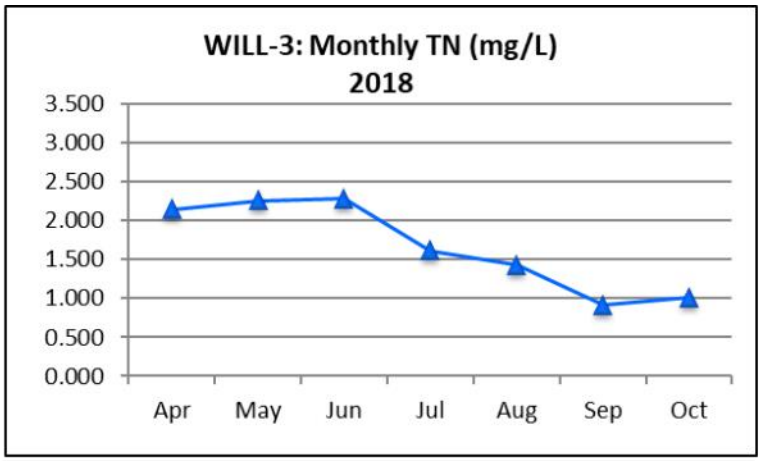
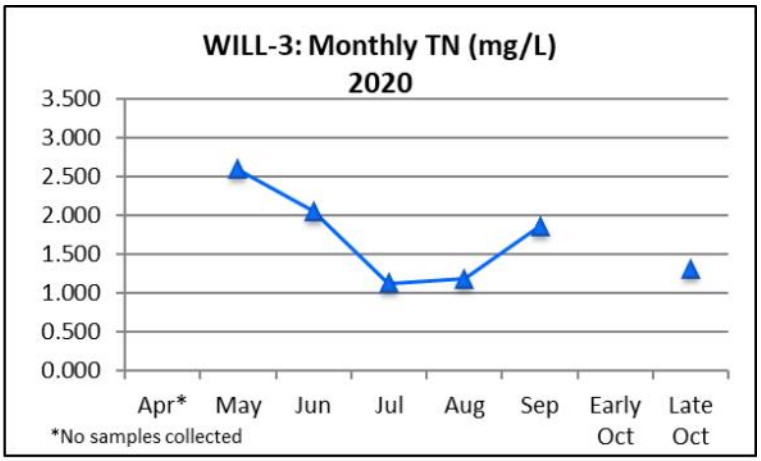
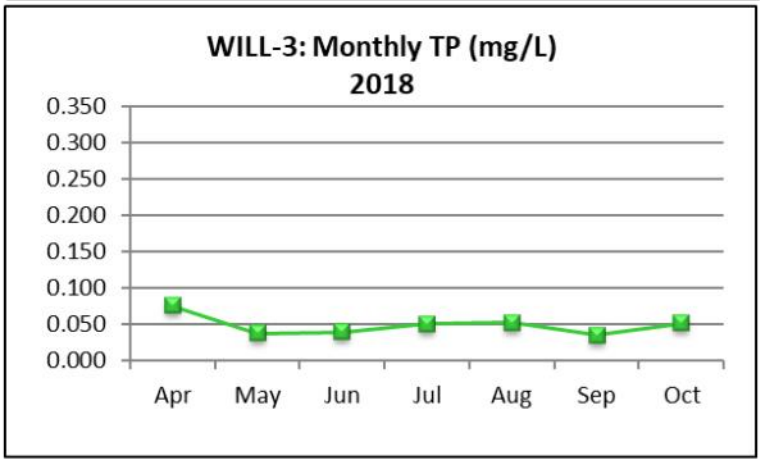
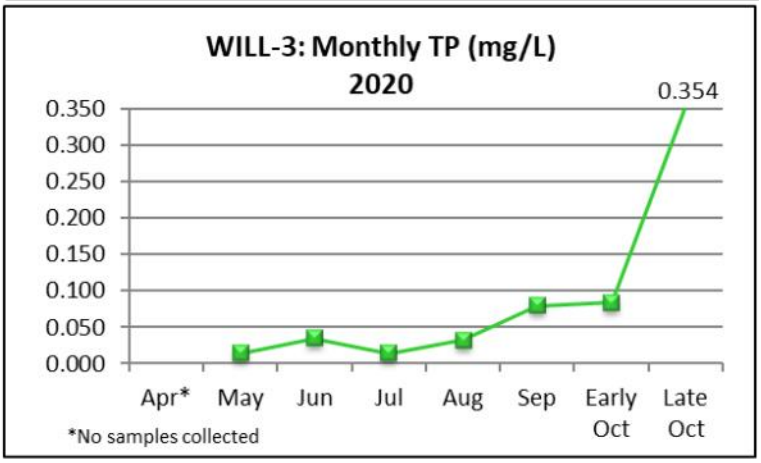


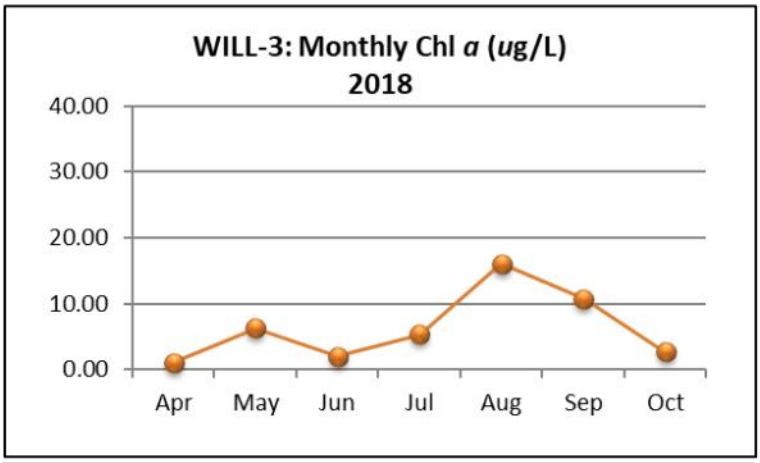
Figure 4. Mean growing season (2003-2020). TN, TP, chl *a,* and TSI measured in the Town Creek (Wilson Lake) embayment (WILL-3). Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

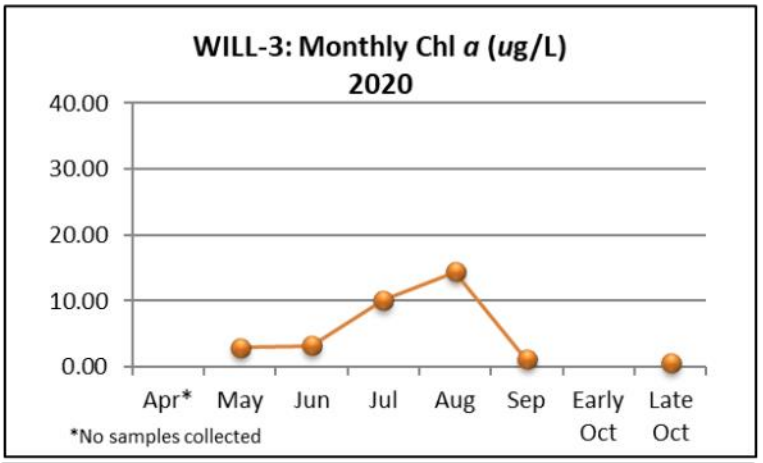


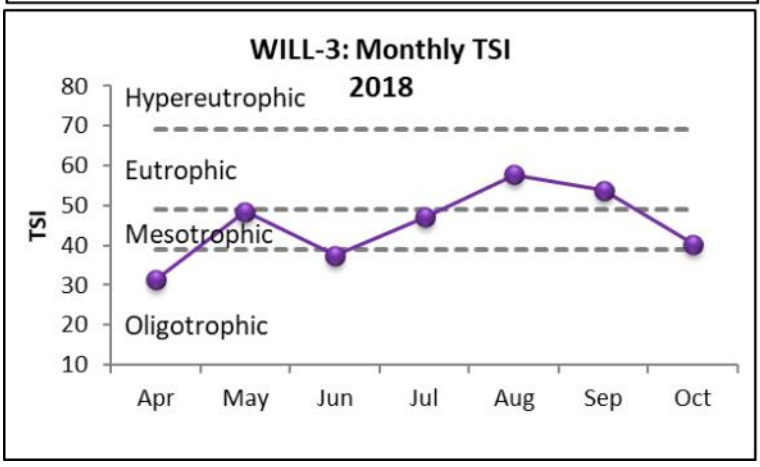












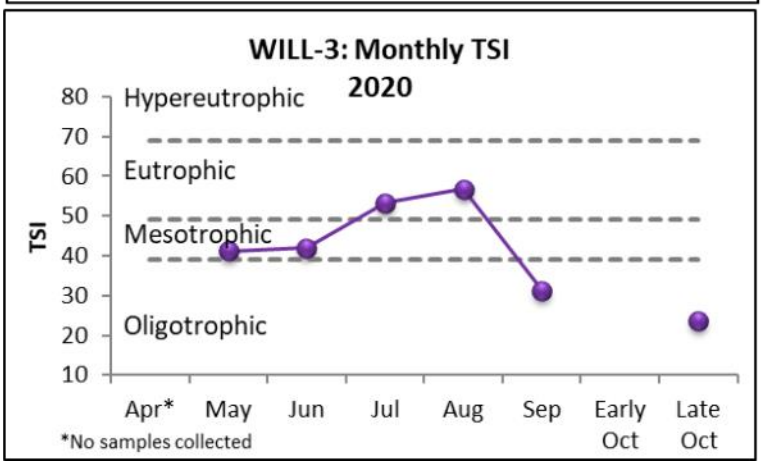


Figure 5. TN, TP, chl *a,* and TSI measured in the Town Creek (Wilson Lake) embayment (WILL-3)**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

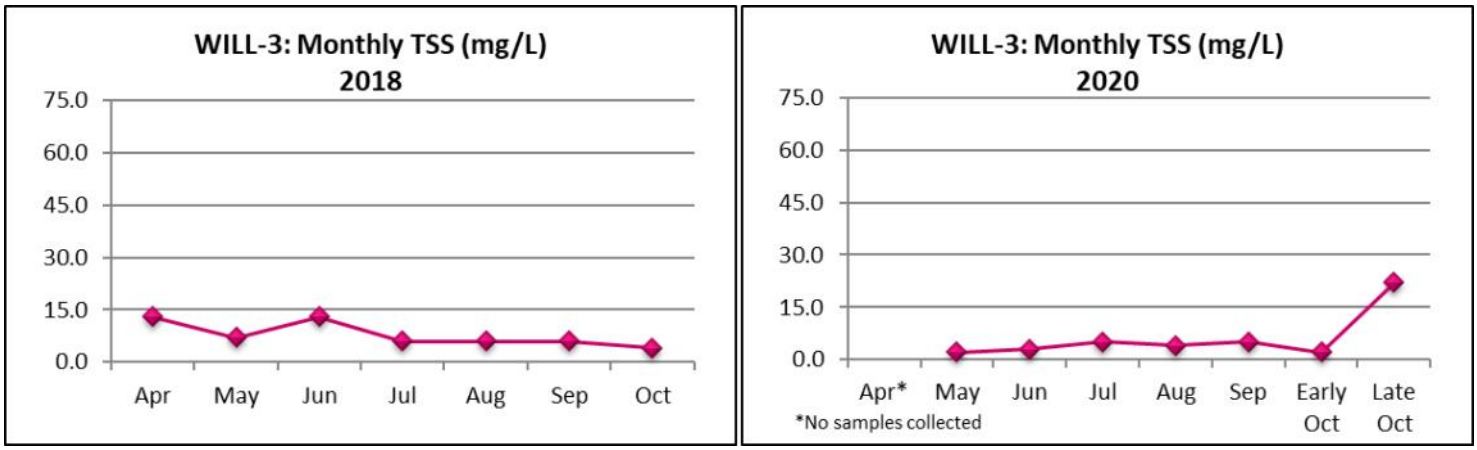


Figure 6. Monthly TSS measured in the Town Creek (Wilson Lake) embayment (WILL-3) in 2018 and 2020.

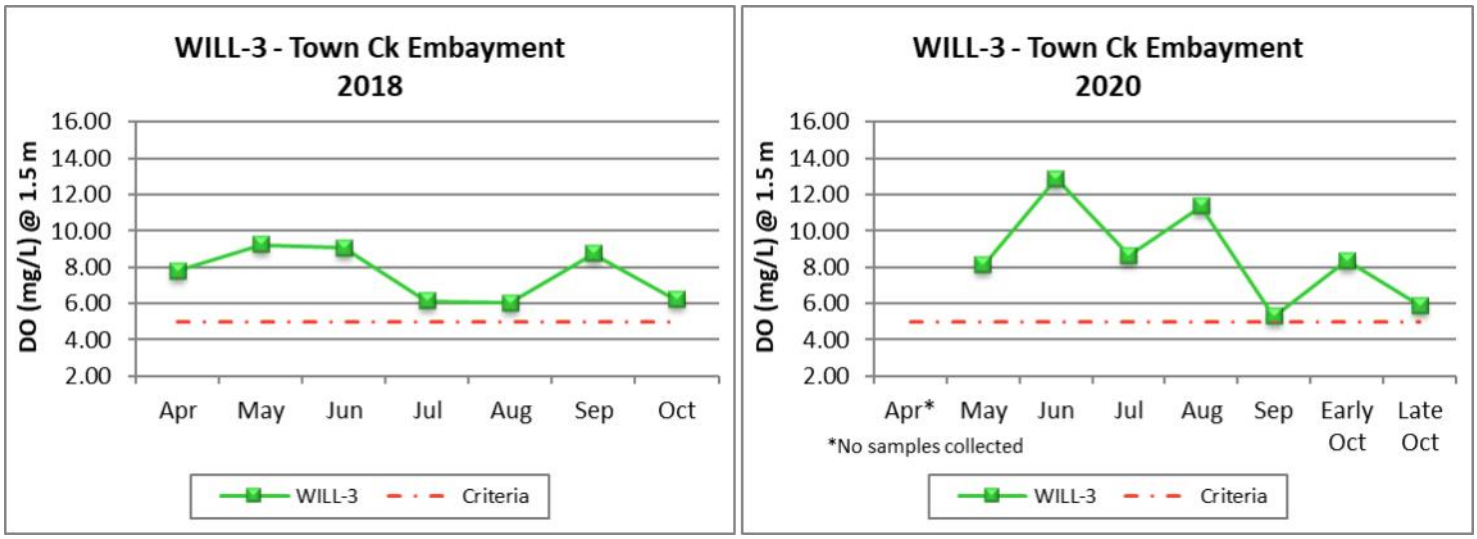


Figure 7. Monthly DO concentrations at 1.5 m (5 ft) for Town Creek (Wilson Lake) embayment (WILL-3) in 2018 and 2020. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

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