2017 West Point Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Rivers & Reservoirs Unit
May 2021

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LIST OF ACRONYMS

A&I	Agriculture and Industry water supply use classification
ADEM	Alabama Department of Environmental Management
AGPT	Algal Growth Potential Test
CHL *a*	Chlorophyll *a*
DO	Dissolved Oxygen
F&W	Fish and Wildlife
MAX	Maximum
MDL	Method Detection Limit
MIN	Minimum
MSC	Mean Standing Crop
NTU	Nephelometric Turbidity Units
OAW	Outstanding Alabama Waters
ONRW	Outstanding National Resource Water
PWS	Public Water Supply
QAPP	Quality Assurance Project Plan
RRMP	Rivers and Reservoirs Monitoring Program
S	Swimming and Other Whole Body Water-Contact Sports
SD	Standard Deviation
SOP	Standard Operating Procedures
TEMP	Temperature
TN	Total Nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSI	Trophic State Index
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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INTRODUCTION

West Point Reservoir's (West Point) 25,900 acre water body was established in 1972 by U.S. Corps of Engineers (Corps) with the completion of West Point Dam on the Chattahoochee River system. The Corps maintains the dam for flood control, hydroelectric production, and recreation.

The Alabama Department of Environmental Management (ADEM) monitored West Point Reservoir as part of the 2017 assessment of the Chattahoochee and Perdido-Escambia River Basins under the Rivers and Reservoirs Monitoring Program (RRMP). Implemented in 1990, the 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 2001, the ADEM implemented a specific water quality criterion for nutrient management at one location on West Point at LaGrange, Georgia. Although this site is monitored by the Georgia Department of Environmental Protection, the upper West Point Reservoir station has been monitored by ADEM since 1999, and is used by ADEM to verify compliance of the criterion. A criterion was later issued at the lower station. These criteria represent a growing season mean (Apr-Oct) chlorophyll *a* (chl *a*) concentration that is protective of the reservoir's Swimming and Fish & Wildlife (S/F&W) use classifications (Table 1).

The purpose of this report is to summarize data collected at three stations in West Point during the 2017 growing season and to evaluate growing season trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [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.

METHODS

Sampling stations were selected using historical data and previous assessments (Figure 1). Specific location information can be found in Table 1. West Point Reservoir was sampled in the dam forebay with additional stations in the Wehadkee Creek embayment and upper reservoir.

Water quality sampling was conducted at monthly intervals through the growing season, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2017), Surface Water Quality Assurance Project Plan (ADEM 2017), and Quality Management Plan (ADEM 2013).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions at each site. For mainstem stations, monthly concentrations of these parameters were graphed with the closest available U.S. Corps of Engineers flow data and ADEM's previously collected data to help interpret the 2017 results.

Figure 1. West Point Reservoir with 2017 sampling locations. A description of each sampling location is provided in Table 1.

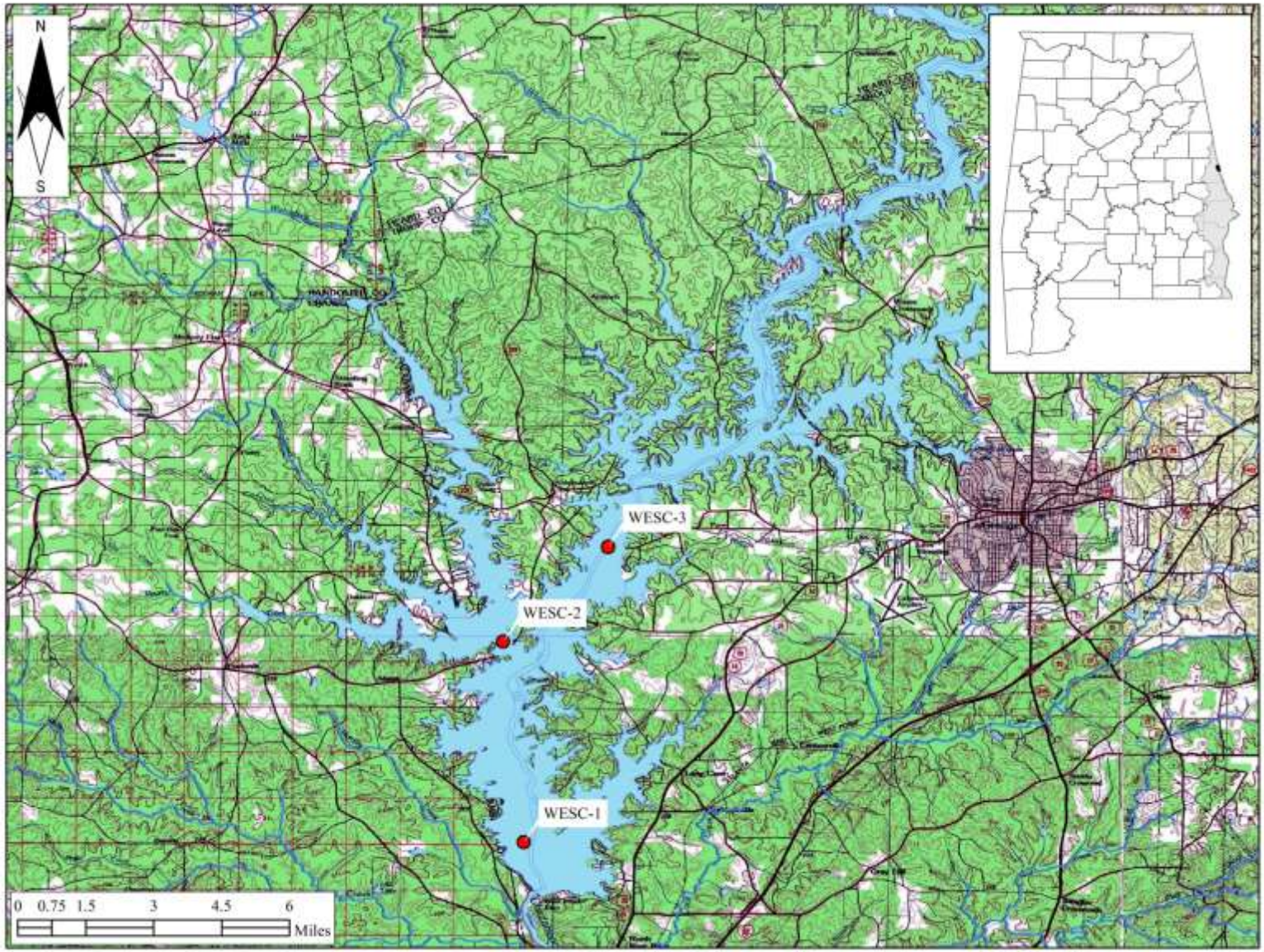


Table 1. Descriptions of the 2017 monitoring stations in West Point Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
West Point Reservoir								
031300020808	Chambers	WESC-1*	Lower	Chattahoochee R.	Deepest point, main river channel, dam forebay.	22 µg/L	32.93429	-85.19174
031300020806	Chambers	WESC-2	Wehadkee	Wehadkee Cr	Deepest point, main creek channel, immediately downstream of Wehadkee/Veasey/Stroud Creeks confluence.		32.99830	-85.19835
031300020807	Chambers	WESC-3	Upper	Chattahoochee R	Deepest point, main river channel, at GA Hwy. 109 bridge.		33.02865	-85.16483

* Growing season mean chl a criteria implemented at this station.

RESULTS

Growing season mean graphs for TN, TP, chl *a*, and TSS are provided in this section (Figures 2 and 3). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided (Figures 4-8 and 10), with mean monthly discharge included as an indicator of flow and retention time in the months sampled. AGPT results appear in Table 2. Depth profile graphs of temperature, DO, and conductivity appear in Figure 9. Summary statistics of all data collected during 2017 are presented in Appendix Table 1. The table contains the minimum, maximum, median, mean, and standard deviation of each parameter analyzed.

Stations with the highest concentrations of nutrients, chlorophyll, and TSS are noted in the paragraphs to follow. Though stations with lowest concentrations are not mentioned, review of the graphs that follow will indicate these stations that may be potential candidates for reference waterbodies and watersheds.

The highest growing season mean TN in 2017 was observed in the lower station (Figure 2). While the upper station appears to be trending downward 2012-2017, mean TN concentrations in Wehadkee Creek and the lower station were higher in 2017 than 2014. Monthly TN concentrations were variable throughout the growing season with the highest concentration measured in October at the upper station (Figure 4). Historic low TN concentrations occurred at all three stations in September. Historic highs were recorded in April at Wehadkee Creek and in June and July at the lower station.

The growing season mean TP concentration in each station has declined steadily since 2004 with the exception of the lower station in 2017 (Figure 2). Monthly TP concentrations at all stations were generally at or below historic means (Figure 5). Historic low TP concentrations were measured in May at the upper and Wehadkee Creek stations, in September at all three stations, and in October at the upper station.

Specific water quality criteria for nutrient management have been established for the upper and lower stations in West Point Reservoir. The mean growing season chl *a* values for both of these stations were well below their respective criteria limits in 2017 (Figure 3). However, mean growing season chl *a* concentrations in all West Point Reservoir stations were higher in 2017 than

in 2014. The highest monthly chl *a* concentration was measured in September at the upper station (Figure 6). Historic highs were measured in the upper station during June and in the Wehadkee Creek station during April.

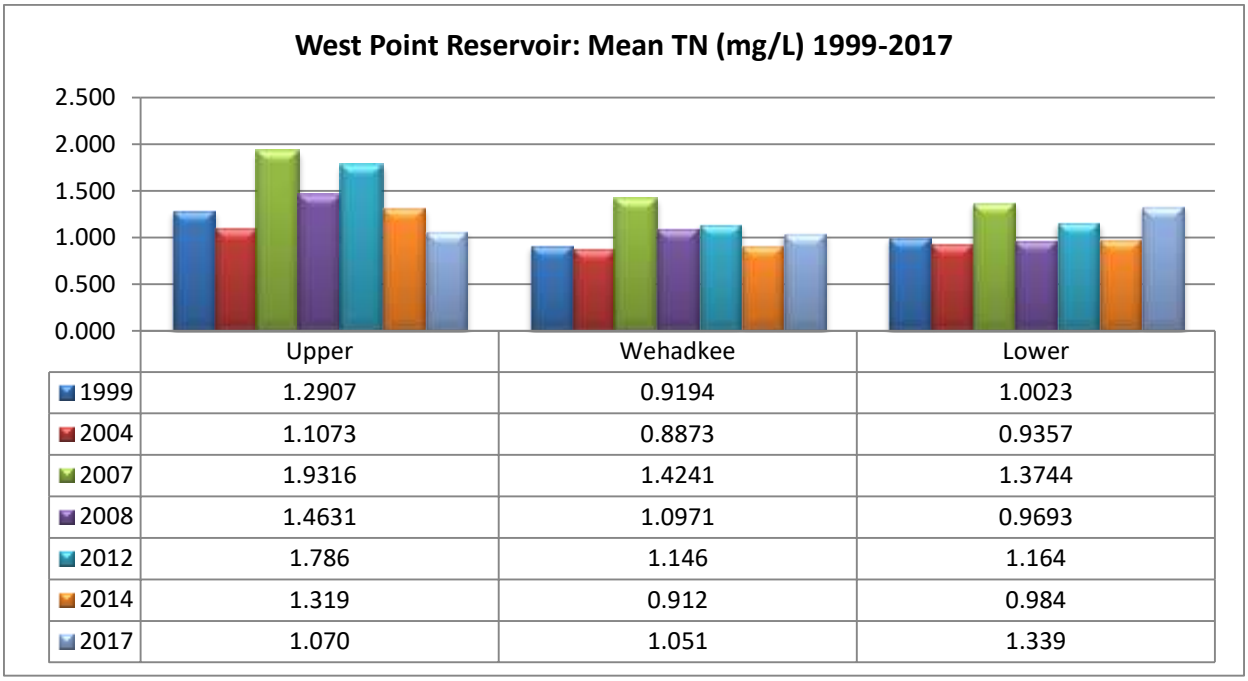
Growing season mean TSS concentrations in all West Point Reservoir stations were lower in 2017 compared to 2014 (Figure 3). The overall trend appears to be decreasing. Monthly TSS concentrations were below historic means the entire growing season, and numerous historic lows were measured at each station (Figure 7).

AGPT results show the upper station has remained phosphorus limited since 1999 (Table 2). Samples for AGPT were not collected for the lower and Wehadkee Creek stations in 2017. The mean standing crop (MSC) value in the upper station was below 5 mg/L, the value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

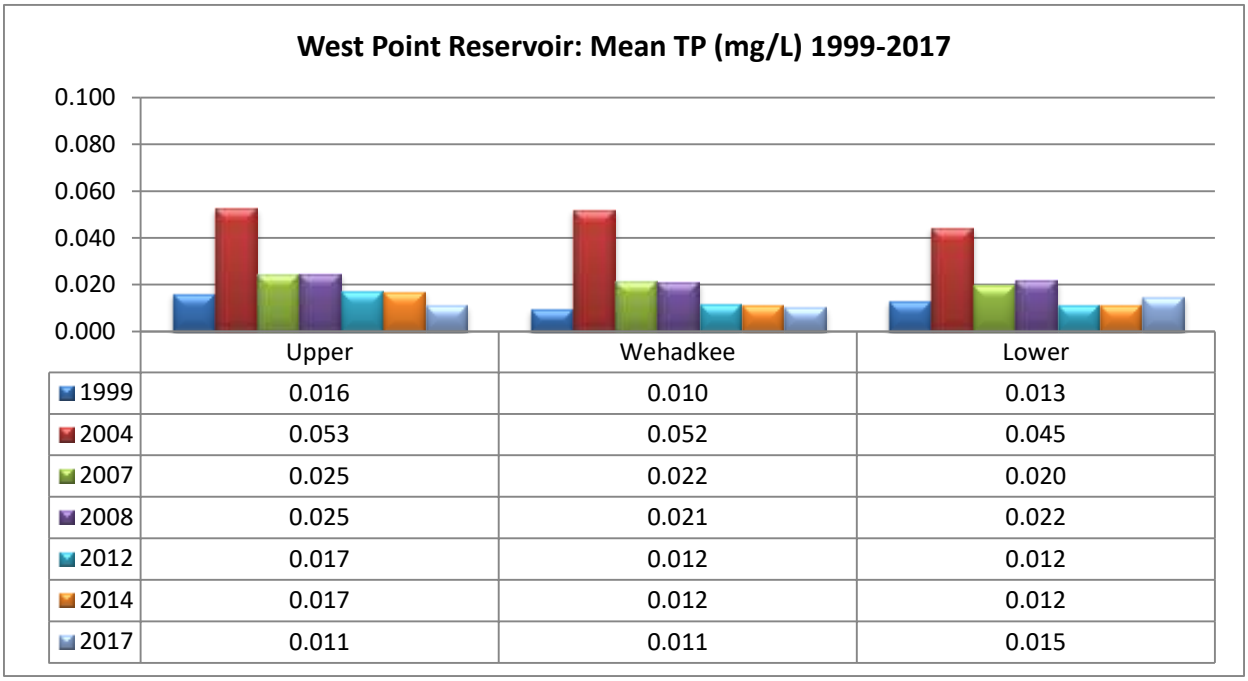
In 2017, monthly dissolved oxygen concentrations at each station met the ADEM criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) throughout the growing season (Figure 8). Although DO concentrations made a sharp decline from September to October after destratification, measurements remained above 5.0 mg/L. Based on monthly DO profiles from the lower station, the reservoir was stratified during months sampled, except October, when the reservoir destratified (Figure 9). From April through September, conditions were essentially anoxic below about 6 m. Highest water temperatures were recorded in July and August.

Monthly TSI values were calculated using chl *a* concentrations and Carlson's Trophic State Index. TSI values calculated for each station were eutrophic or borderline eutrophic for most of the growing season (Figure 10). The lower station and Wehadkee Creek both dropped to mesotrophic conditions in October.

Figure 2. Growing season mean TN and TP concentrations measured in West Point Reservoir, April-October 1999-2017. Bar graphs consist of the Wehadkee Creek and upper and lower mainstem stations, illustrated from upstream to downstream as the graph is read from left to right.

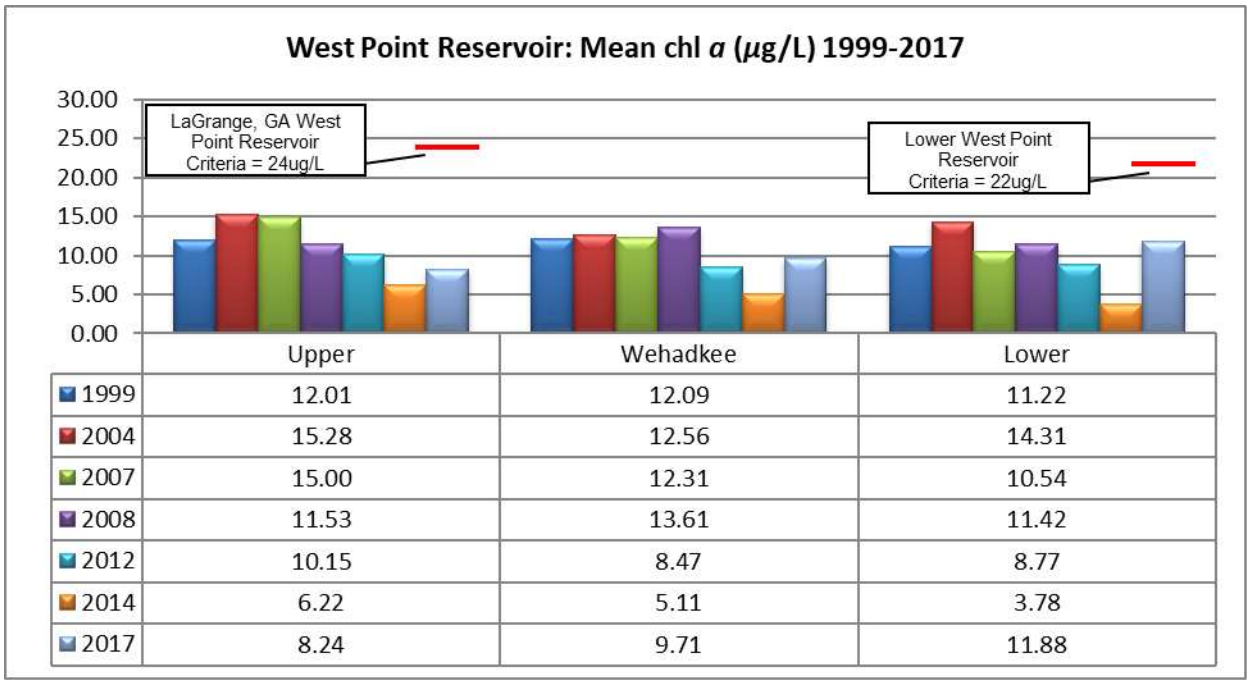


	Upper	Wehadkee	Lower
1999	1.2907	0.9194	1.0023
2004	1.1073	0.8873	0.9357
2007	1.9316	1.4241	1.3744
2008	1.4631	1.0971	0.9693
2012	1.786	1.146	1.164
2014	1.319	0.912	0.984
2017	1.070	1.051	1.339

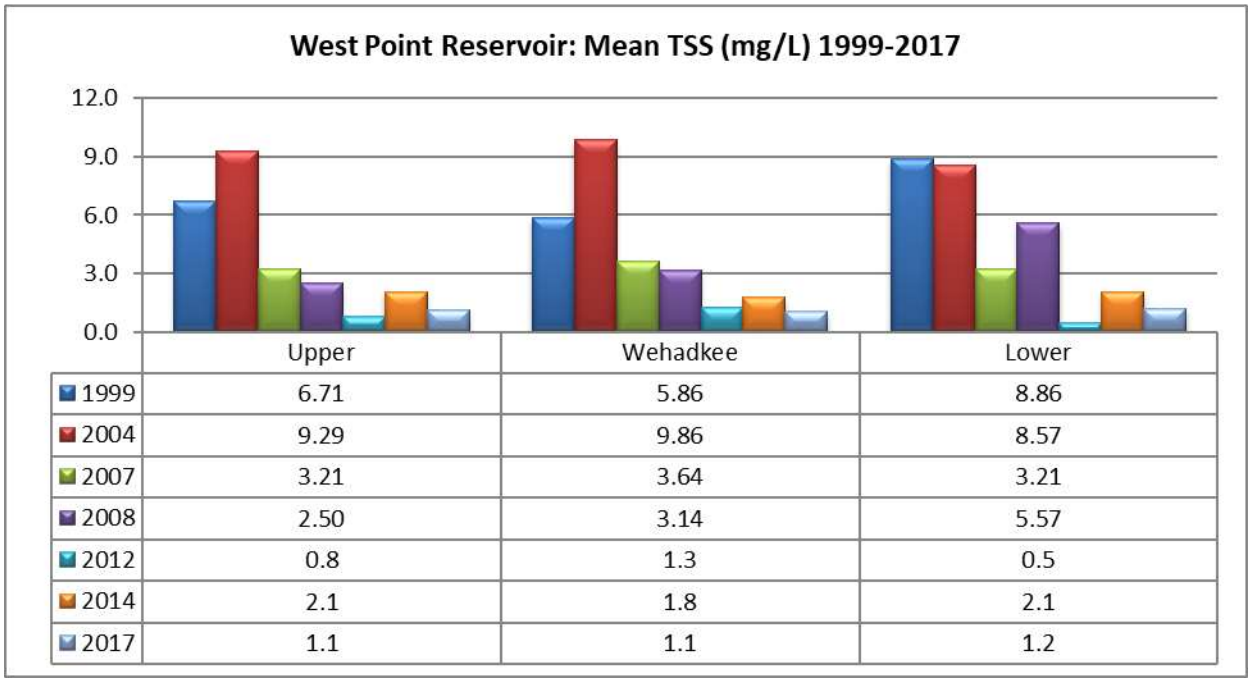


	Upper	Wehadkee	Lower
1999	0.016	0.010	0.013
2004	0.053	0.052	0.045
2007	0.025	0.022	0.020
2008	0.025	0.021	0.022
2012	0.017	0.012	0.012
2014	0.017	0.012	0.012
2017	0.011	0.011	0.015

Figure 3. Growing season mean chl *a* and TSS concentrations measured in West Point Reservoir, April-October 1999-2017. Bar graphs consist of the Wehadkee Creek and upper and lower mainstem stations, illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria applies to the growing season means of the LaGrange, GA (upper) and lower stations.



	Upper	Wehadkee	Lower
1999	12.01	12.09	11.22
2004	15.28	12.56	14.31
2007	15.00	12.31	10.54
2008	11.53	13.61	11.42
2012	10.15	8.47	8.77
2014	6.22	5.11	3.78
2017	8.24	9.71	11.88



	Upper	Wehadkee	Lower
1999	6.71	5.86	8.86
2004	9.29	9.86	8.57
2007	3.21	3.64	3.21
2008	2.50	3.14	5.57
2012	0.8	1.3	0.5
2014	2.1	1.8	2.1
2017	1.1	1.1	1.2

Figure 4. Monthly TN concentrations of the mainstem stations in West Point Reservoir, April-October 2017. Each bar graph depicts monthly changes in each station. The historic mean (1990-2017) and min/max range are also displayed for comparison. The "n" value equals the number of data points included in the monthly historic calculations. TN was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corps of Engineers).

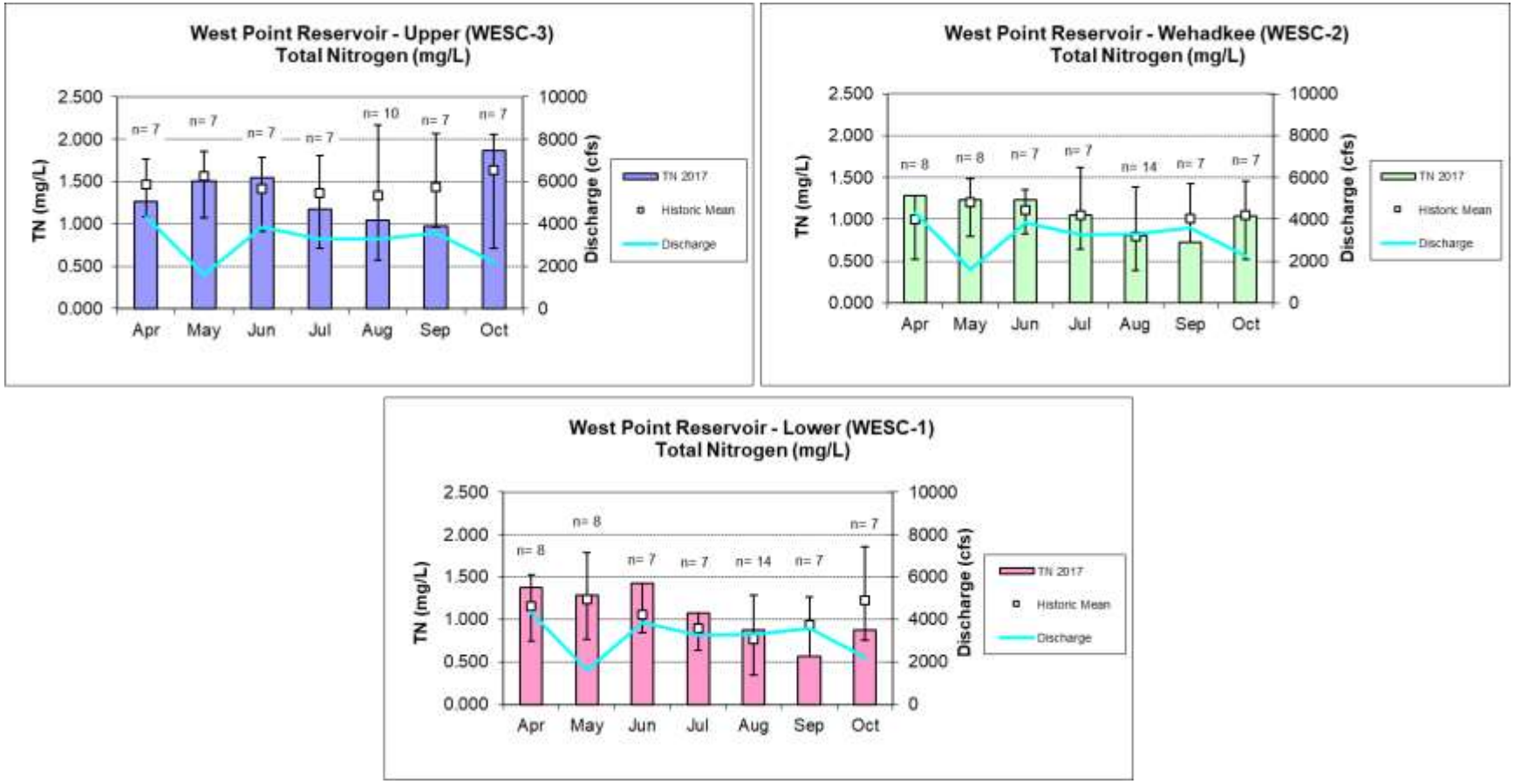


Figure 5. Monthly TP concentrations of the mainstem stations in West Point Reservoir, April-October 2017. Each bar graph depicts monthly changes in each station. The historic mean (1990-2017) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. TP was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corps of Engineers).

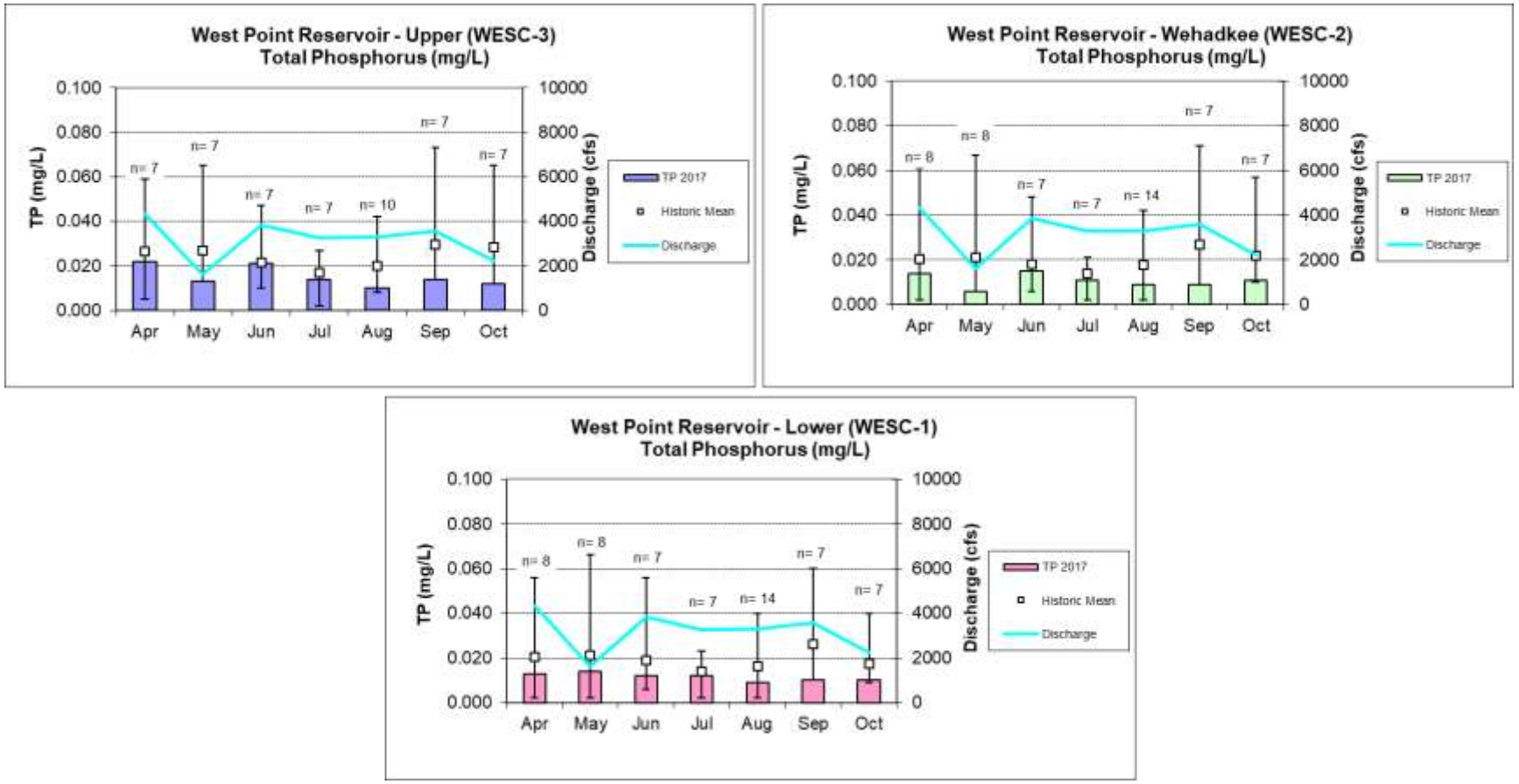
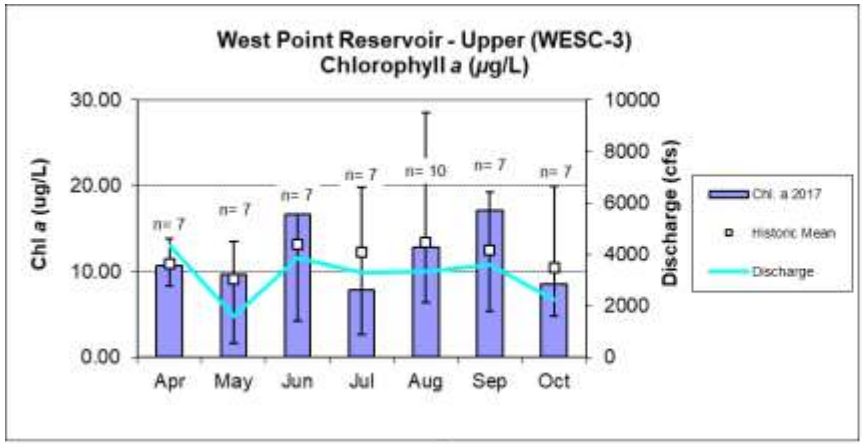
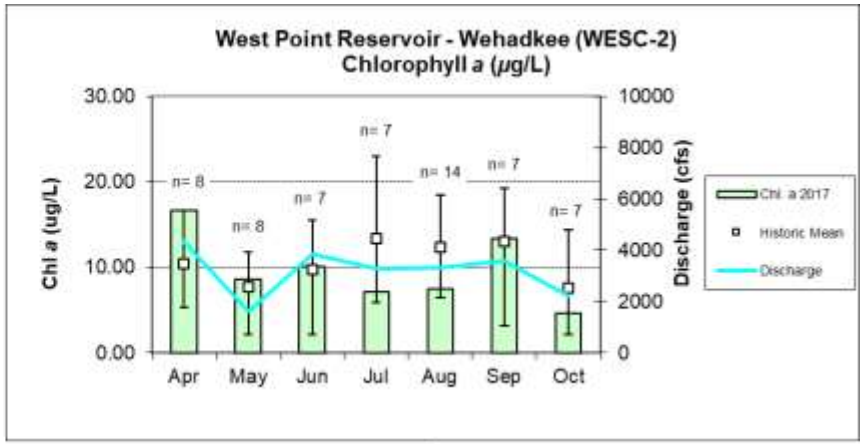


Figure 6. Monthly chl *a* concentrations of the mainstem stations in West Point Reservoir, April-October 2017. Each bar graph depicts monthly changes in each station. The historic mean (1990 -2017) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. Chl *a* was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corps of Engineers).





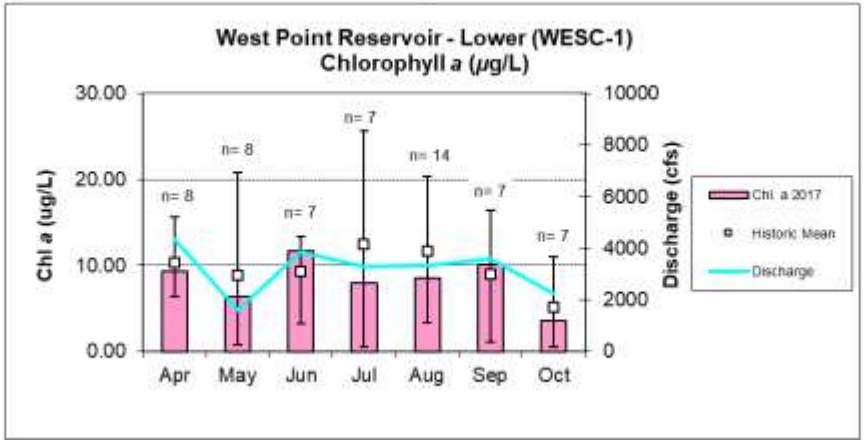
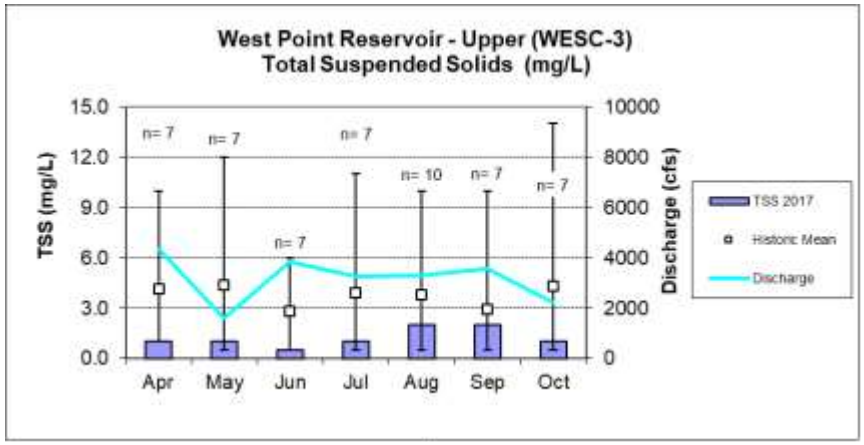
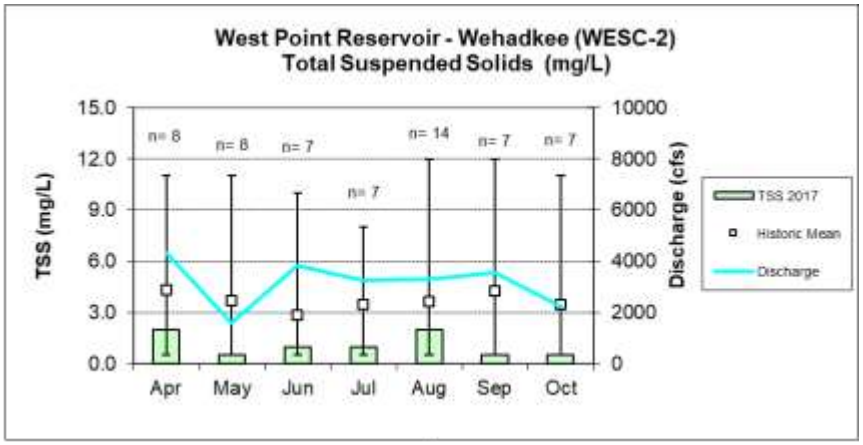


Figure 7. Monthly TSS concentrations of the mainstem stations in West Point Reservoir, April-October 2017. Each bar graph depicts monthly changes in each station. The historic mean (1990-2017) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. TSS was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corps of Engineers).





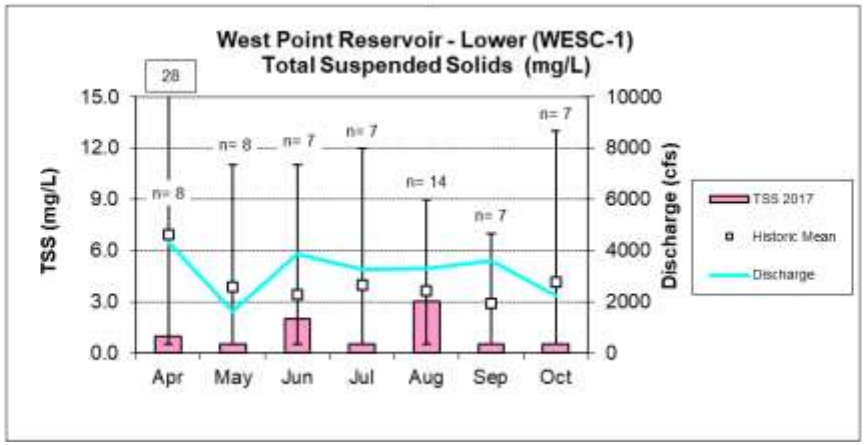


Table 2. Algal growth potential test results, West Point Reservoir, 1999-2017, (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers (Raschke and Schultz 1987).

Station	Upper		Wehadkee		Lower	
	MSC	Limiting Nutrient	MSC	Limiting Nutrient	MSC	Limiting Nutrient
June 1999	3.87	Phosphorus	1.74	Phosphorus	1.78	Phosphorus
July 1999	1.68	Phosphorus	1.33	Phosphorus	1.57	Phosphorus
August 1999	1.74	Phosphorus	1.24	Phosphorus	1.11	Phosphorus
August 2004	2.65	Phosphorus	2.25	Phosphorus	2.38	Phosphorus
August 2008	3.69	Phosphorus	---	---	2.84	Phosphorus
August 2014	6.94	Phosphorus	3.00	Phosphorus	3.00	Phosphorus
August 2017	4.44	Phosphorus	*	*	*	*

*No AGPT sample collected at this location.

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for West Point Reservoir stations collected April-October 2017. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2010).

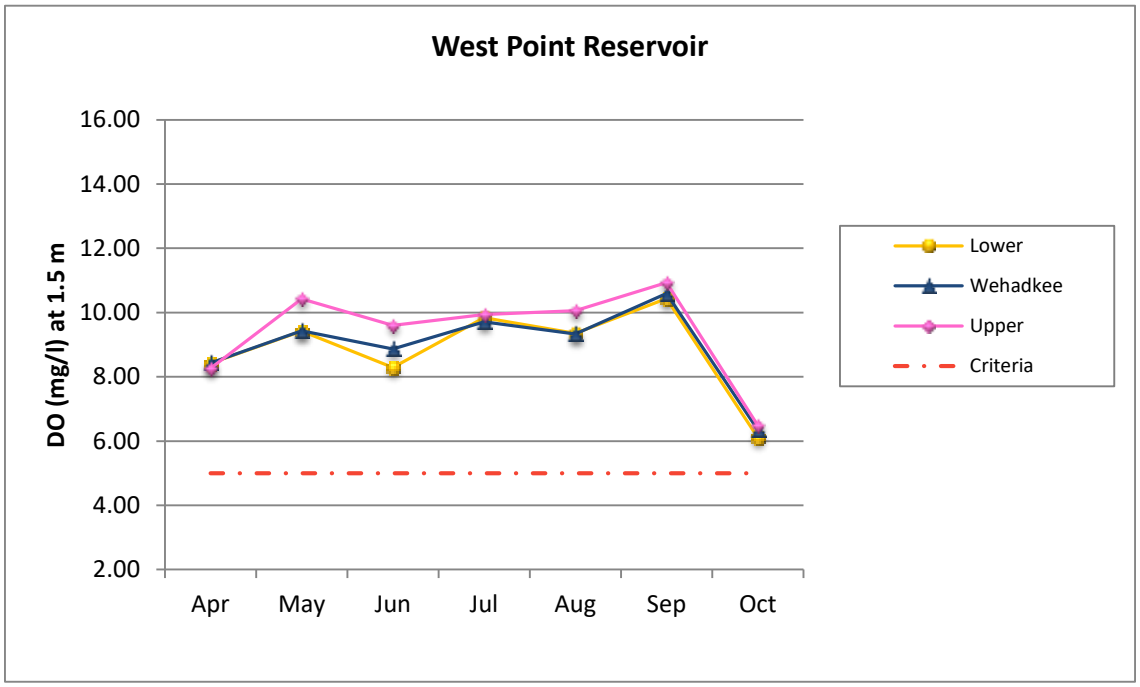


Figure 9. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the lower West Point Reservoir station, April-October 2017.

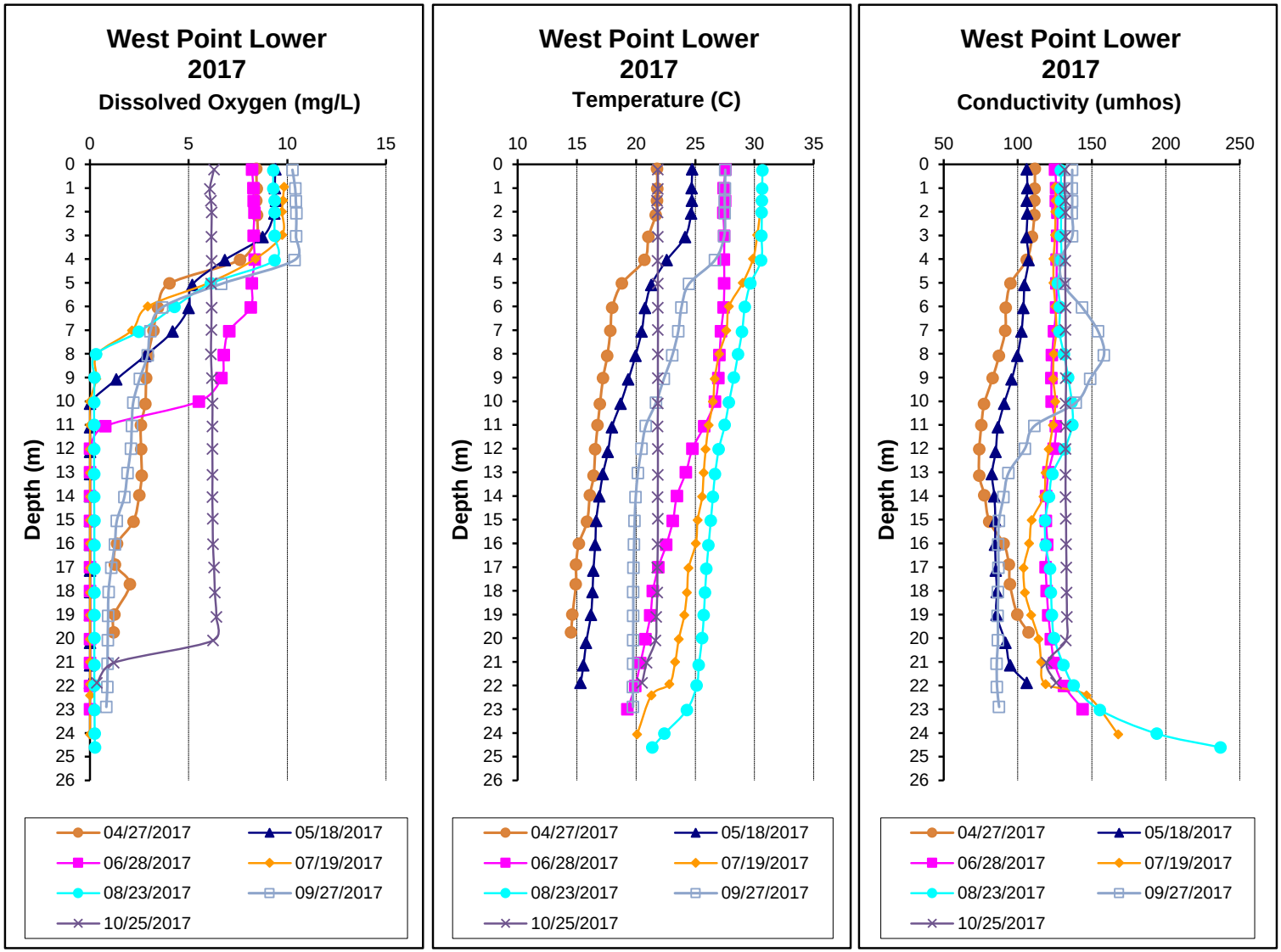
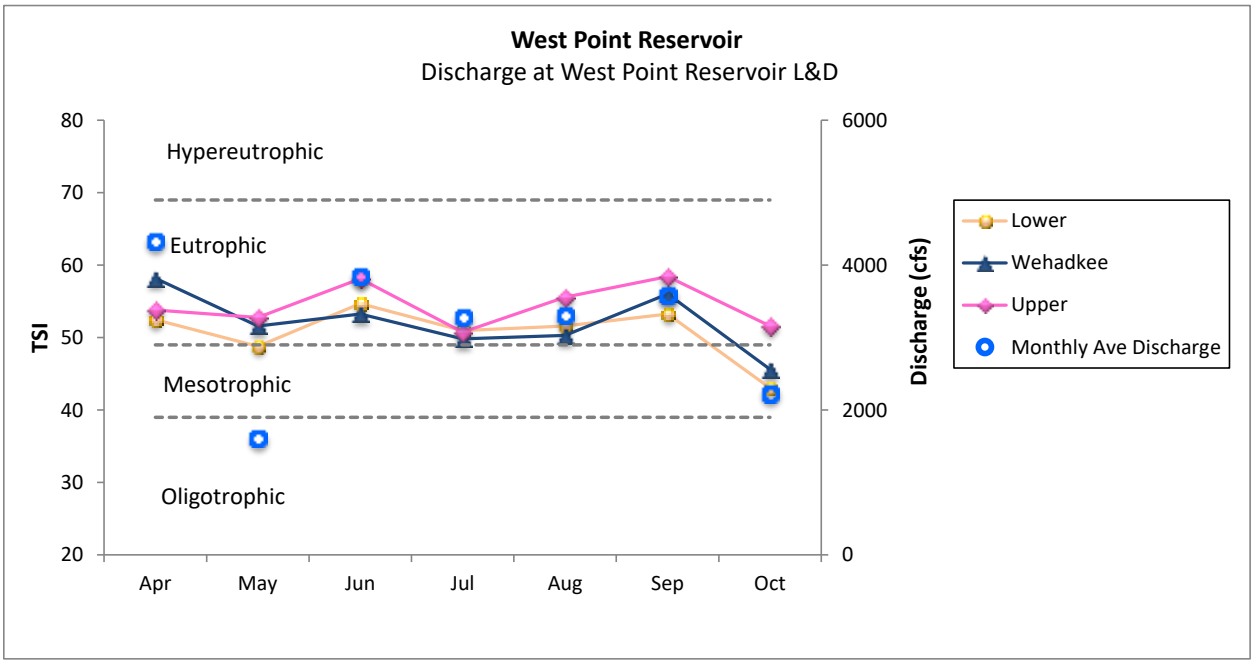


Figure 10. Monthly TSI values, April-October 2017, calculated for mainstem and tributary West Point Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. Monthly discharge acquired from USACE at West Point Lock and Dam.



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APPENDIX

Appendix Table 1. Summary of West Point Reservoir water quality data collected April-October, 2017. Minimum (min) and maximum (max) values calculated using minimum detection limits when results were less than this value. Median (med), mean, and standard deviation (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Station	Parameter	N		Min	Max	Med	Mean	SD
WESC-1	**Physical**							
	Turbidity (NTU)	7		1.9	3.5	2.7	2.7	0.5
	Total Dissolved Solids (mg/L)	7		18.0	160.0	90.0	83.6	43.4
	Total Suspended Solids (mg/L)	7	<	1.0	3.0	0.5	1.1	1.0
	Hardness (mg/L)	4		28.9	33.3	29.8	30.5	2.0
	Alkalinity (mg/L)	7		22.7	29.3	27.7	26.7	2.7
	Photic Zone (m)	7		3.75	6.96	6.23	5.95	1.09
	Secchi (m)	7		1.88	2.78	2.38	2.31	0.28
	Bottom Depth (m)	7		19.7	24.6	22.4	22.3	1.5
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.061	0.004	0.019	0.026
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.464	0.895	0.645	0.686	0.179
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.077	0.535	0.435	0.384	0.168
	Total Nitrogen (mg/L)	7	<	0.562	1.430	1.080	1.070	0.317
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L)[J]	7		0.009	0.014	0.012	0.011	0.002
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		9.8	11.8	11.1	11.0	0.8
	Biological							
	Chlorophyll a (mg/m³)	7		3.56	11.70	8.54	8.24	2.65
	E. coli (MPN/DL)[J]	4	<	1	1	1	1	0
WESC-2	**Physical**							
	Turbidity (NTU)	7		1.9	3.8	3.1	3.0	0.6
	Total Dissolved Solids (mg/L)[J]	7		44.0	79.0	65.0	64.7	11.7
	Total Suspended Solids (mg/L)[J]	7	<	1.0	2.0	1.0	1.1	0.7
	Hardness (mg/L)	4		27.3	32.1	30.2	30.0	2.1
	Alkalinity (mg/L)	7		22.7	29.4	26.7	26.6	2.9
	Photic Zone (m)	7		3.99	6.51	6.02	5.77	0.84
	Secchi (m)	7		1.82	2.23	2.17	2.11	0.14
	Bottom Depth (m)	7		15.2	18.3	17.3	17.0	1.1
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.052	0.004	0.016	0.020
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.457	0.776	0.682	0.644	0.125
	Total Kjeldahl Nitrogen (mg/L)	7		0.205	0.547	0.467	0.407	0.123
	Total Nitrogen (mg/L)	7		0.726	1.279	1.051	1.051	0.216
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.003	0.002	0.002	0.001
	Total Phosphorus (mg/L)[J]	7		0.006	0.015	0.011	0.011	0.003
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		9.8	12.1	10.6	10.7	1.0
	Biological							
	Chlorophyll a (mg/m³)	7		4.63	16.70	8.54	9.71	4.11
	E. coli (MPN/DL)[J]	4	<	1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Mean	SD
WESC-3	**Physical**							
	Turbidity (NTU)	7		2.7	4.6	3.4	3.4	0.6
	Total Dissolved Solids (mg/L)[J]	7		54.0	112.0	77.0	79.7	22.3
	Total Suspended Solids (mg/L)[J]	7	<	1.0	2.0	1.0	1.2	0.6
	Hardness (mg/L)	4		32.4	35.9	33.2	33.6	1.7
	Alkalinity (mg/L)	7		24.3	32.5	28.9	28.4	2.7
	Photic Zone (m)	7		3.55	5.58	5.31	5.05	0.71
	Secchi (m)	7		1.40	1.93	1.72	1.68	0.20
	Bottom Depth (m)	7		15.7	17.8	17.2	16.9	0.8
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.053	0.004	0.015	0.022
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.565	1.570	0.704	0.889	0.345
	Total Kjeldahl Nitrogen (mg/L)	7		0.276	0.572	0.479	0.450	0.117
	Total Nitrogen (mg/L)	7		0.972	1.872	1.263	1.339	0.318
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.003	0.002	0.002	0.001
	Total Phosphorus (mg/L)	7		0.010	0.022	0.014	0.015	0.005
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		9.1	15.1	11.3	11.6	1.9
	Biological							
	Chlorophyll a (mg/m³)	7		7.83	17.10	10.70	11.88	3.75
	E. coli (MPN/DL)[J]	4	<	1	1	1	1	0

J=one or more of the values provided are estimated; < = Actual value is less than the detection limit