2008 West Point Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
November 2012

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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. Corp of Engineers (Corp) with the completion of West Point Dam on the Chattahoochee River system. The Corp maintains the dam for flood control, hydroelectric production, and recreation.

The Alabama Department of Environmental Management (ADEM) monitored West Point as part of the 2008 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, 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 2012 Monitoring Strategy.

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 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 criteria. This criterion represents the maximum growing season mean (Apr-Oct) chlorophyll *a* (chl *a*) concentration allowable while still fully supporting the reservoir's Swimming and Fish & Wildlife (S/F&W) use classifications.

The purpose of this report is to summarize data collected at three stations in West Point during the 2008 growing season and to evaluate growing season trends in mean lake trophic status and nutrient concentrations using ADEM's ten-year 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 (Fig. 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 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 2008), Surface Water Quality Assurance Project Plan (ADEM 2005), and Quality Management Plan (ADEM 2003).

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 2008 results.

Figure 1. West Point Reservoir with 2008 sampling locations. A description of each sampling location is provided in Table 1.

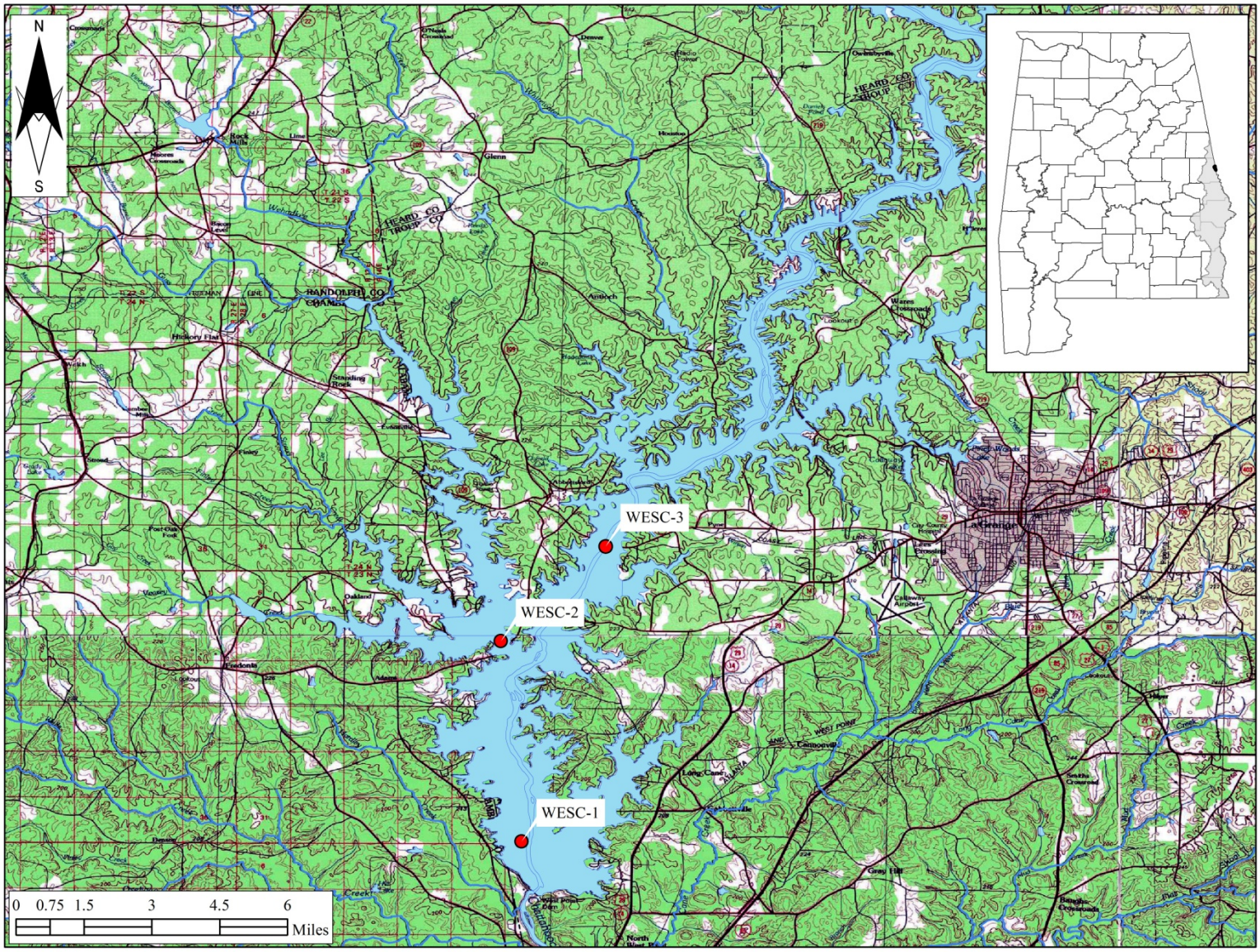


Table 1. Descriptions of the 2008 monitoring stations in West Point Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Latitude	Longitude
Smith Reservoir							
031300020808	Chambers	WESC-1	Lower	Chattahoochee R.	Deepest point, main river channel, dam forebay.	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

RESULTS

Growing season mean graphs for TN, TP, chl *a* and TSS are provided in this section (Figs. 2 and 3). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided (Figs. 4-8 and 11), with mean monthly discharge included as an indicator of flow and retention time in the months sampled. Algal growth potential test (AGPT) results appears in Table 2. Depth profile graphs of temperature, conductivity and DO appear in Figs. 9-10. Summary statistics of all data collected during 2008 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.

As in previous years, highest mainstem growing season mean TN in 2008 was observed at the upper station (Fig. 2). Monthly TN concentrations were highest in May at the upper station, but all results were within previously observed ranges (Fig. 4). The Wehadkee and lower reservoir monthly TN concentrations were the highest of the season and on record in September and April respectively (Fig. 4).

The growing season mean TP concentrations for West Point were similar at all stations in 2007 and 2008 and much lower than 2004 (Fig. 2). Monthly TP concentrations at all stations were generally at or below historic means (Fig. 5).

Mean chl *a* concentrations for 2008 were similar to previously observed concentrations (Fig. 3). All concentrations are well below the criteria which was established upstream of the upper station (Fig. 3). Monthly chl *a* concentrations demonstrated a large swing in values with historic low concentrations observed at all three stations in May, and at or near historic highs in June and July (Fig. 6). Discharge values did not show a strong relationship to chl *a* values in April-October (Fig. 6).

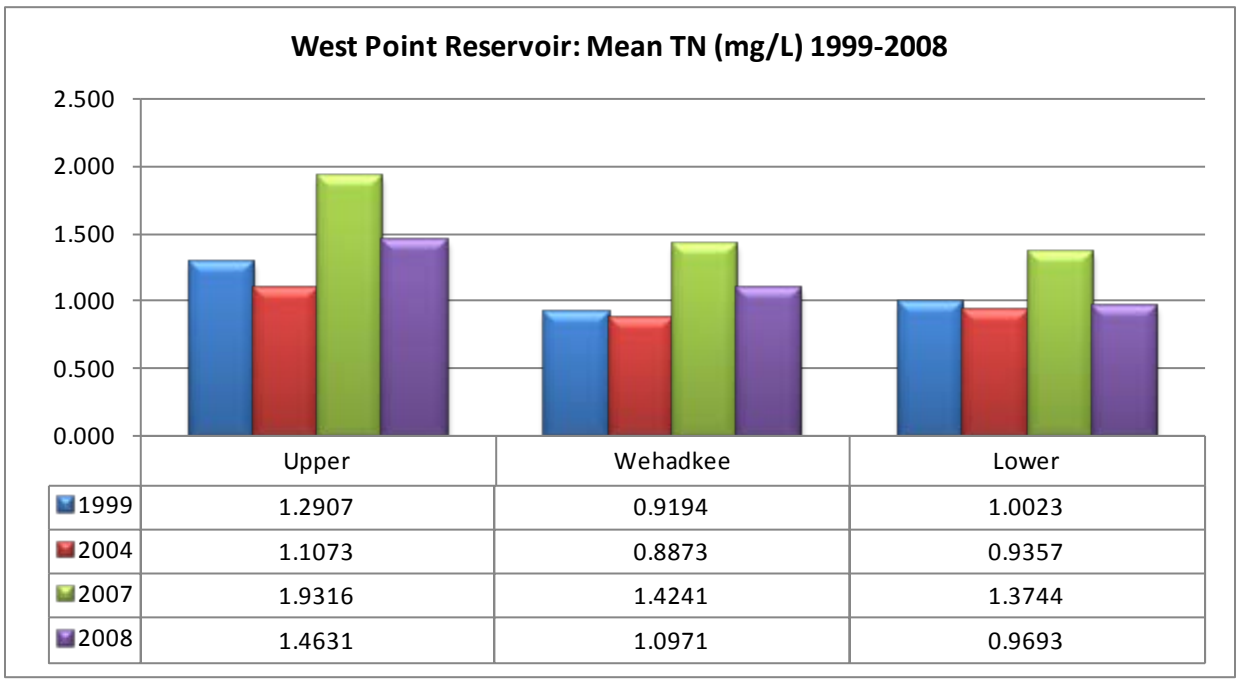
Growing season mean TSS concentrations of the upper and Wehadkee stations in 2008 are the lowest of all previous years sampled and have decreased since 2004, while concentrations for the lower station increased from 2007 to 2008 (Fig. 3). Monthly TSS concentrations were variable month to month, independent of discharge (Fig. 7). With the exception of the lower station in October, all other stations were well below historical means May through October (Fig. 7).

AGPT results show all stations remained phosphorus limited since 1999 (Table 2). All mean standing crop (MSC) values were below 5 mg/L, the value that Raschke et al. (1996) defined as protective of reservoir and lake systems (Table 2).

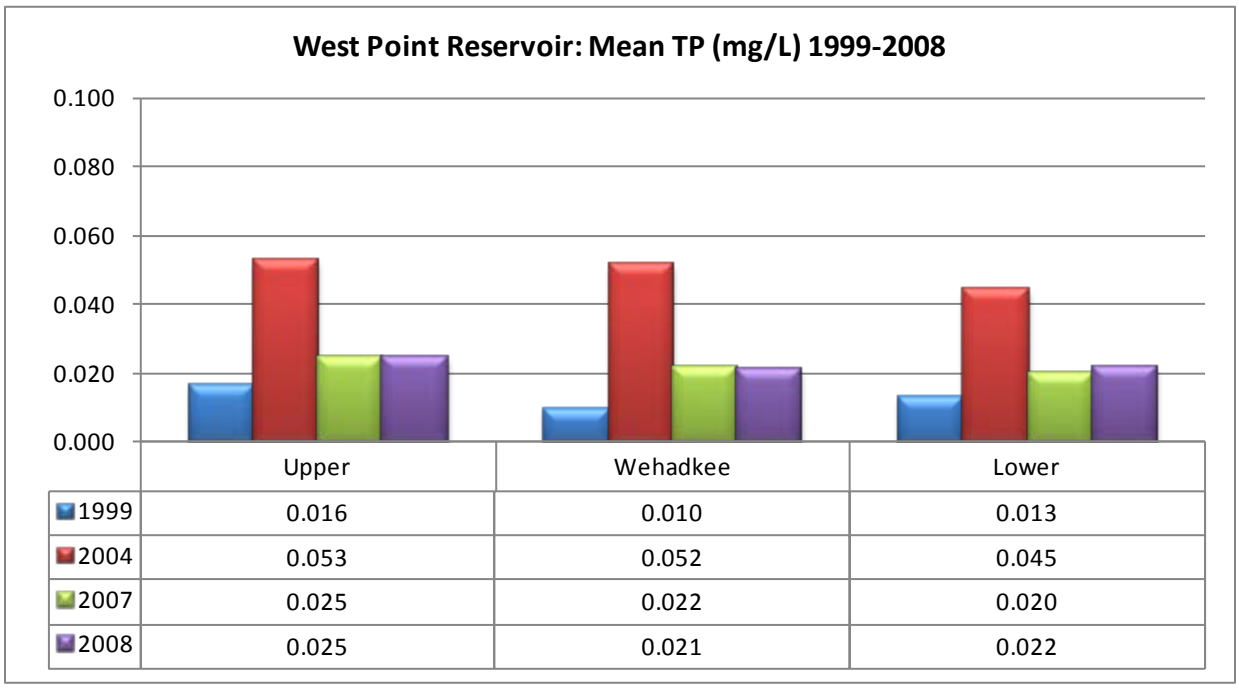
All measurements of dissolved oxygen concentrations in West Point Reservoir met the ADEM Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/l at 5.0 ft (1.5 m), though concentrations declined overall during the growing season (Fig. 8). The lower and Wehadkee reservoir stations showed stratification April-Sep (Fig. 9-11). The water column at both the lower and Wehadkee stations were deoxygenated below 11m in May and below 7m for June and July. Conductivity varied little throughout the water column (Fig. 9-11). Highest temperatures were recorded in July (Fig. 9-11).

The monthly TSI values were calculated using season mean chl *a* concentrations and Carlson's Trophic State Index. TSI values for all locations indicate the reservoir was eutrophic in all months but May, when the values dropped into the oligotrophic range (Fig. 12).

Figure 2. Growing season mean TN and TP concentrations measured in West Point Reservoir, April-October 1999-2008. Bar graphs consist of mainstem stations, illustrated from upstream to downstream as the graph is read from left to right.

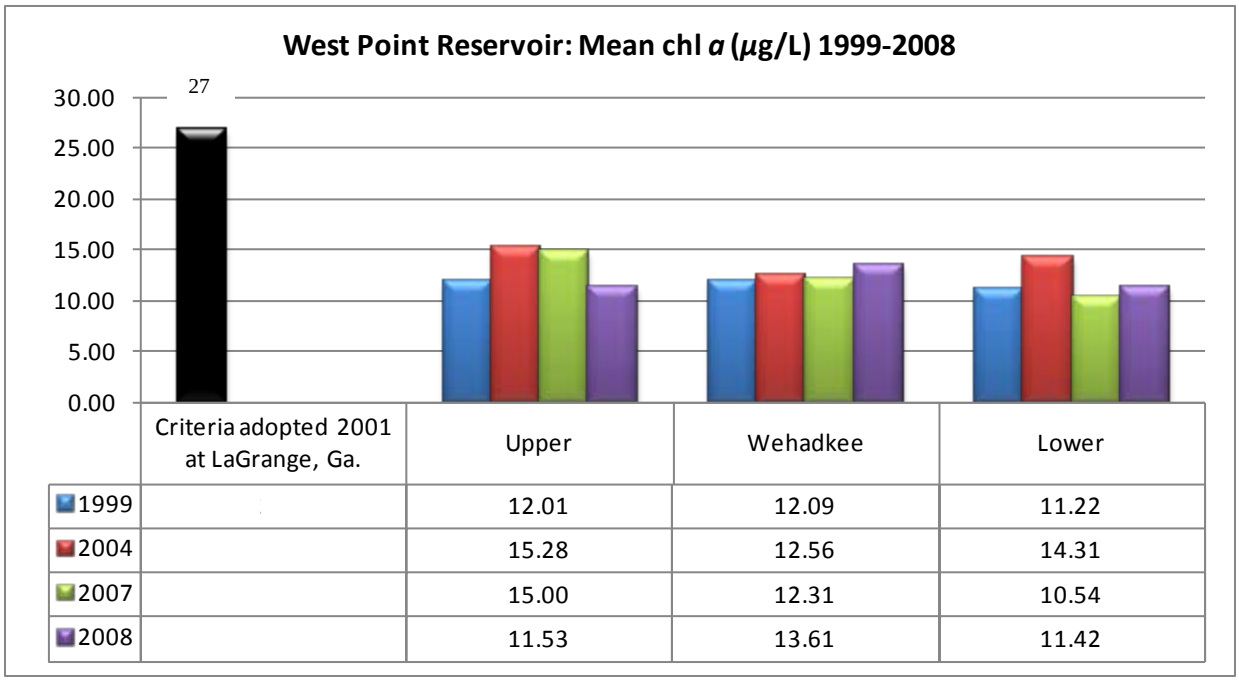


	Upper	Wehadkee	Lower
1999	1.2907	0.9194	1.0023
2004	1.1073	0.8873	0.9357
2007	1.9316	1.4241	1.3744
2008	1.4631	1.0971	0.9693

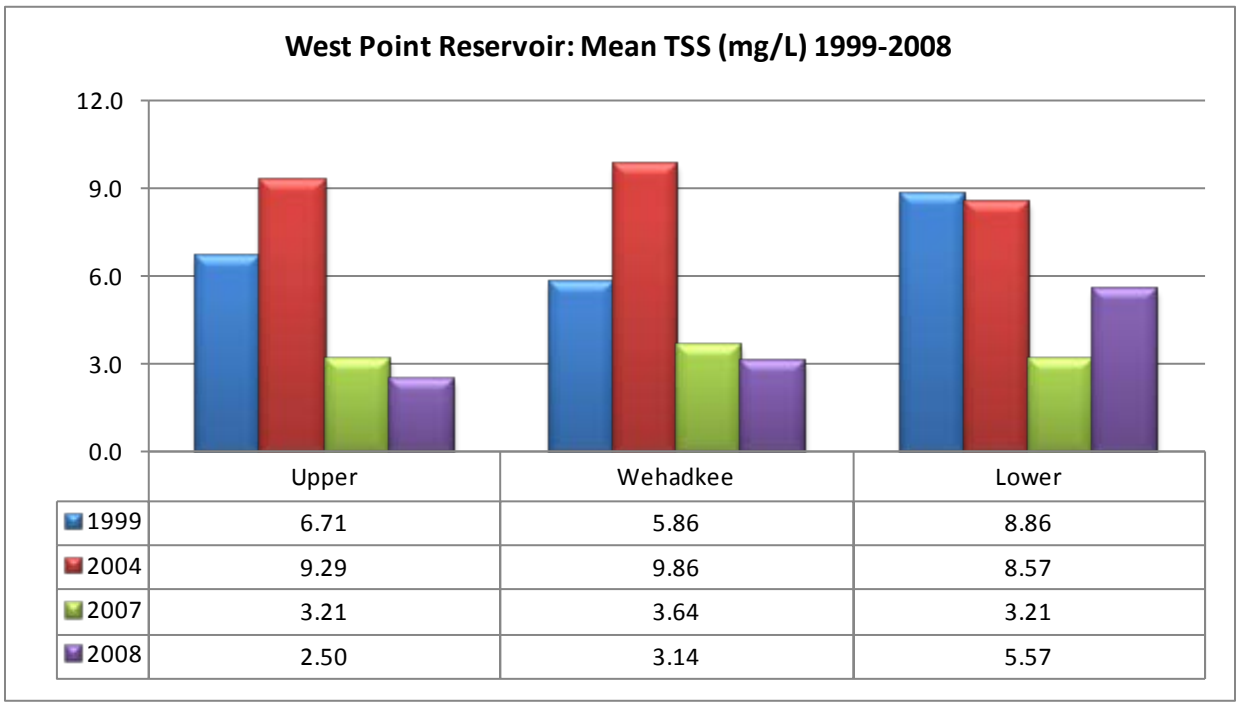


	Upper	Wehadkee	Lower
1999	0.016	0.010	0.013
2004	0.053	0.052	0.045
2007	0.025	0.022	0.020
2008	0.025	0.021	0.022

Figure 3. Growing season mean chl *a* and TSS concentrations measured in West Point Reservoir, April-October 1999-2008. Bar graphs consist of mainstem stations, illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria at LaGrange, Ga is used as a comparison for compliance at downstream locations.

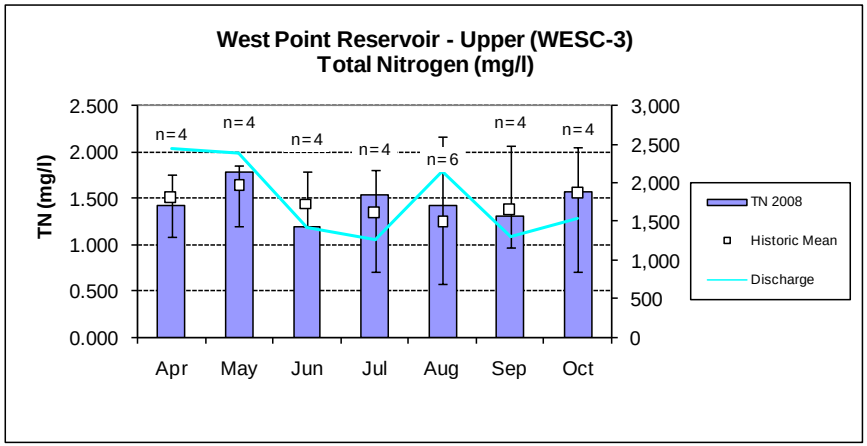


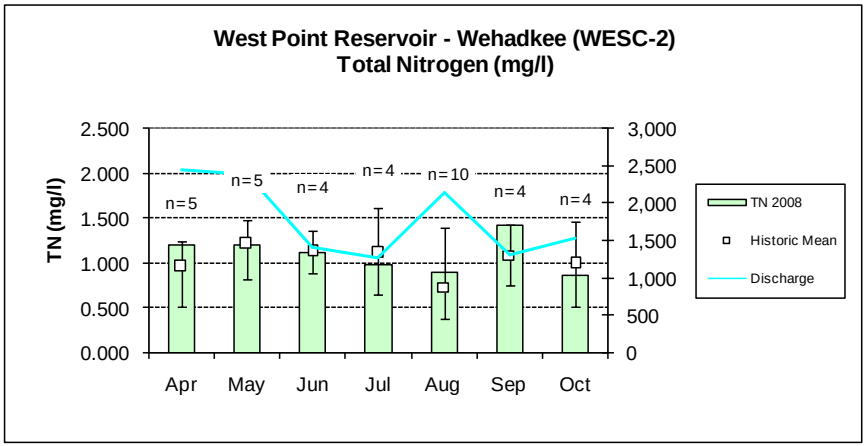
	Criteria adopted 2001 at LaGrange, Ga.	Upper	Wehadkee	Lower
1999		12.01	12.09	11.22
2004		15.28	12.56	14.31
2007		15.00	12.31	10.54
2008		11.53	13.61	11.42



	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

Figure 4. Monthly TN concentrations of the mainstem stations in West Point Reservoir, April-October 2008. Each bar graph depicts monthly changes in each station. The historic mean (1990-2008) 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. Corp of Engineers).





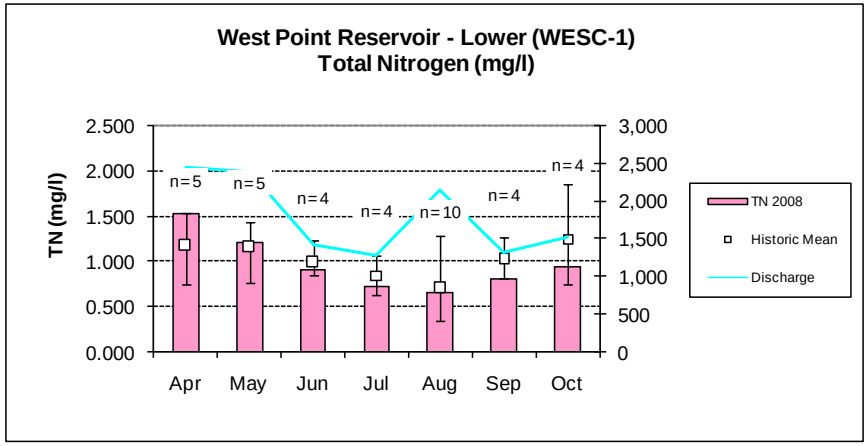
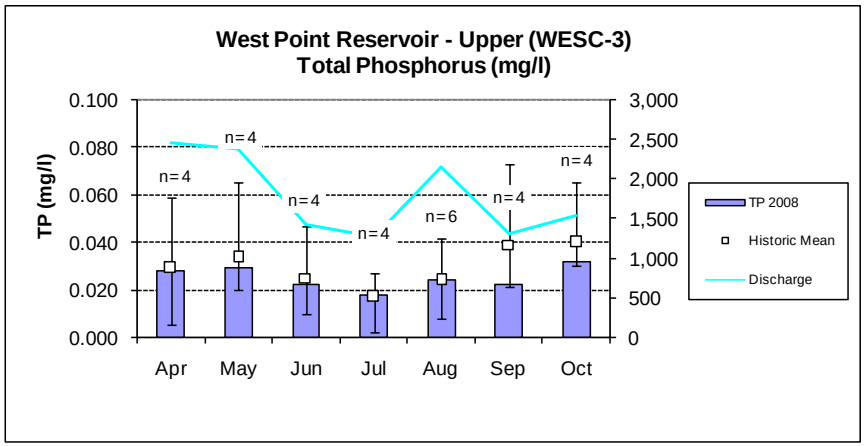
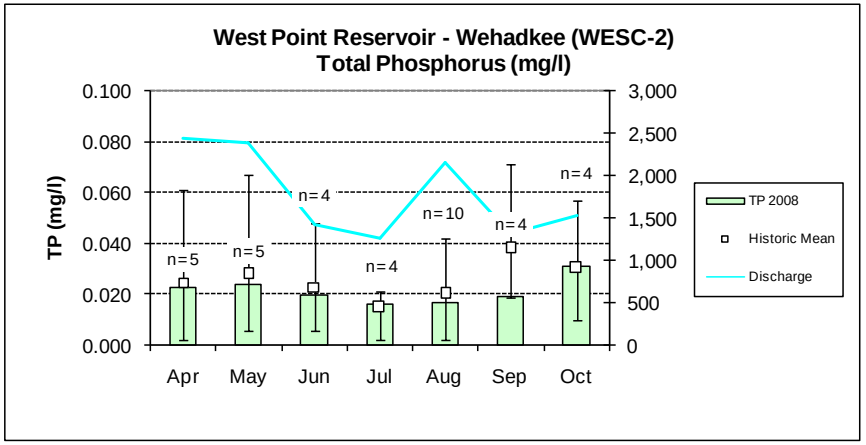


Figure 5. Monthly TP concentrations of the mainstem stations in West Point Reservoir, April-October 2008. Each bar graph depicts monthly changes in each station. The historic mean (1990-2008) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. TP was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).





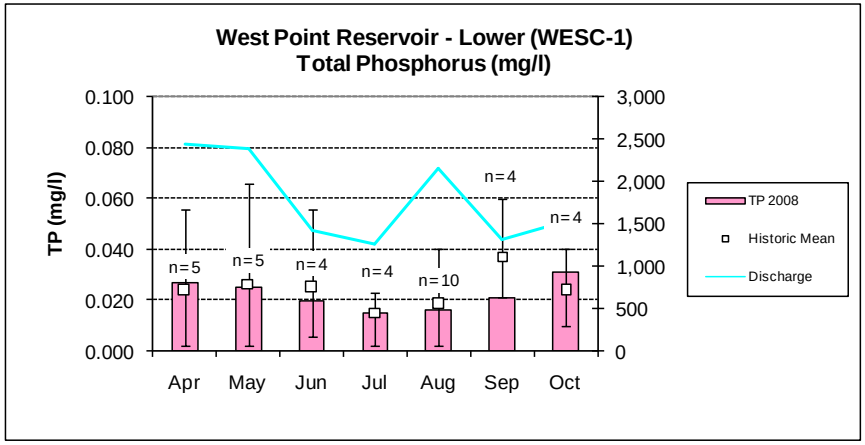


Figure 6. Monthly chl *a* concentrations of the mainstem stations in West Point Reservoir, April-October 2008. Each bar graph depicts monthly changes in each station. The historic mean (1990 -2008) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. Chl *a* was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).

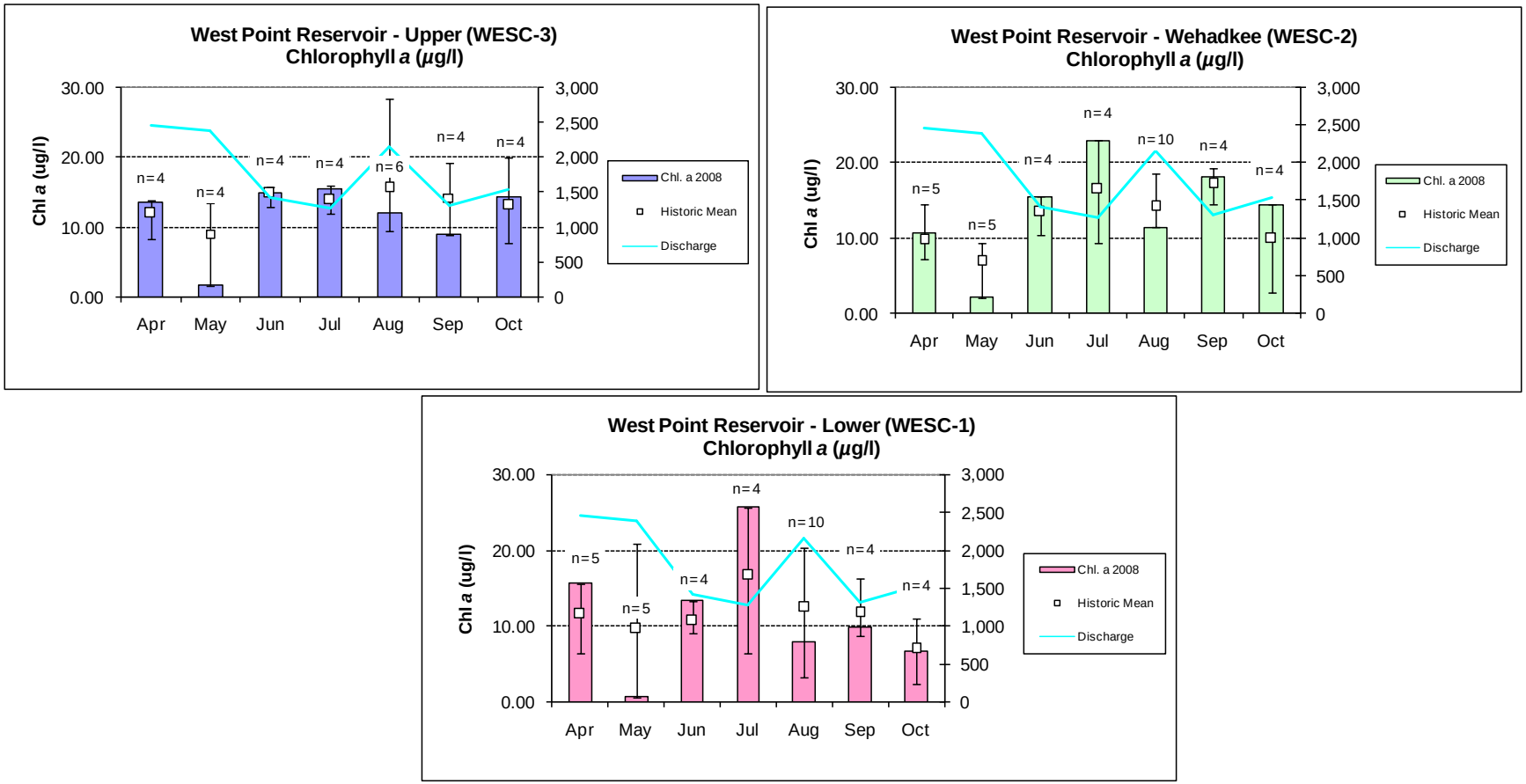


Figure 7. Monthly TSS concentrations of the mainstem stations in West Point Reservoir, April-October 2008. Each bar graph depicts monthly changes in each station. The historic mean (1990-2008) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. TSS was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).

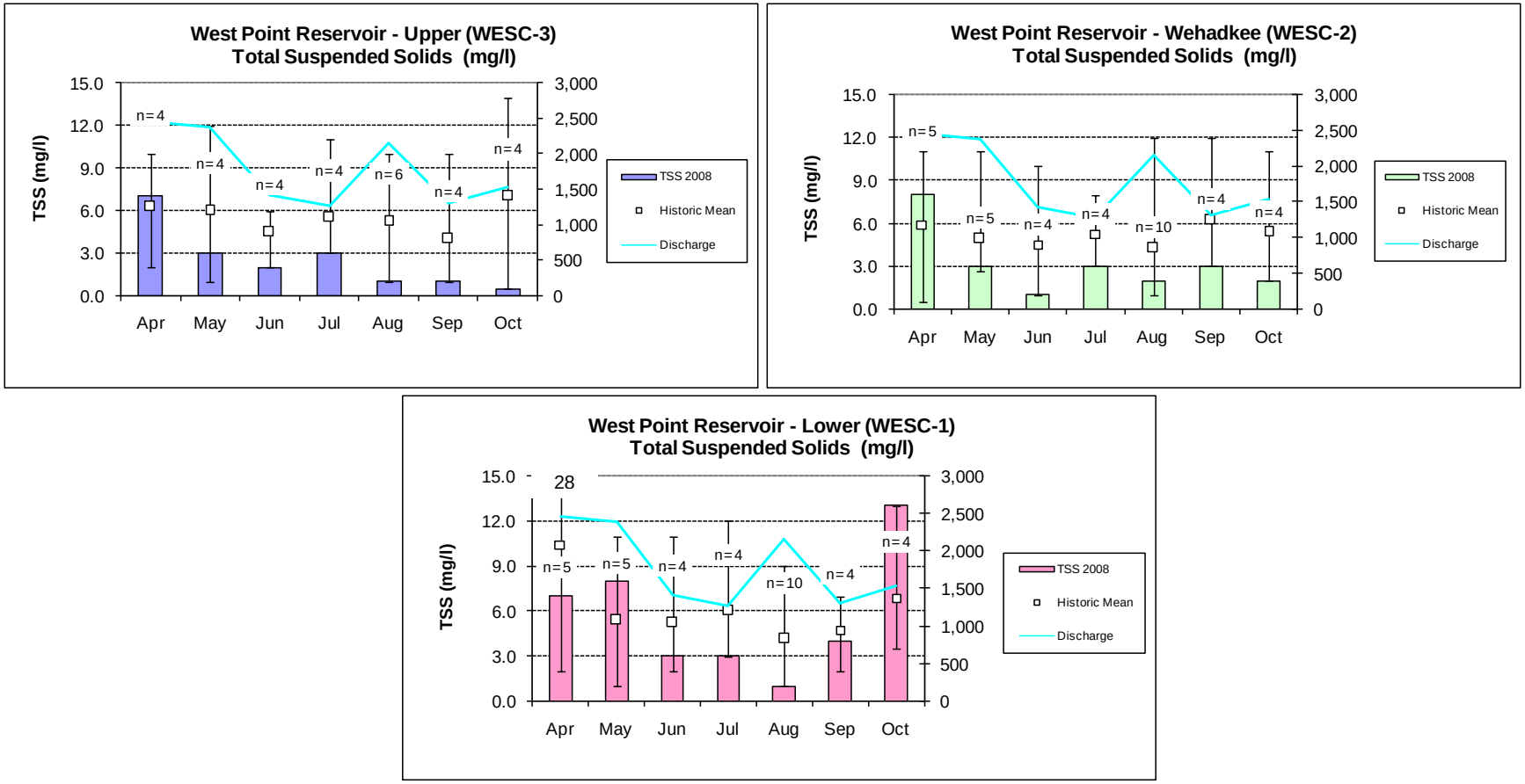


Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/l are considered to be protective in reservoirs and lakes; values below 20 mg/l MSC are considered protective 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

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for West Point Reservoir stations collected April-October 2008. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/l at this depth (ADEM 2005).

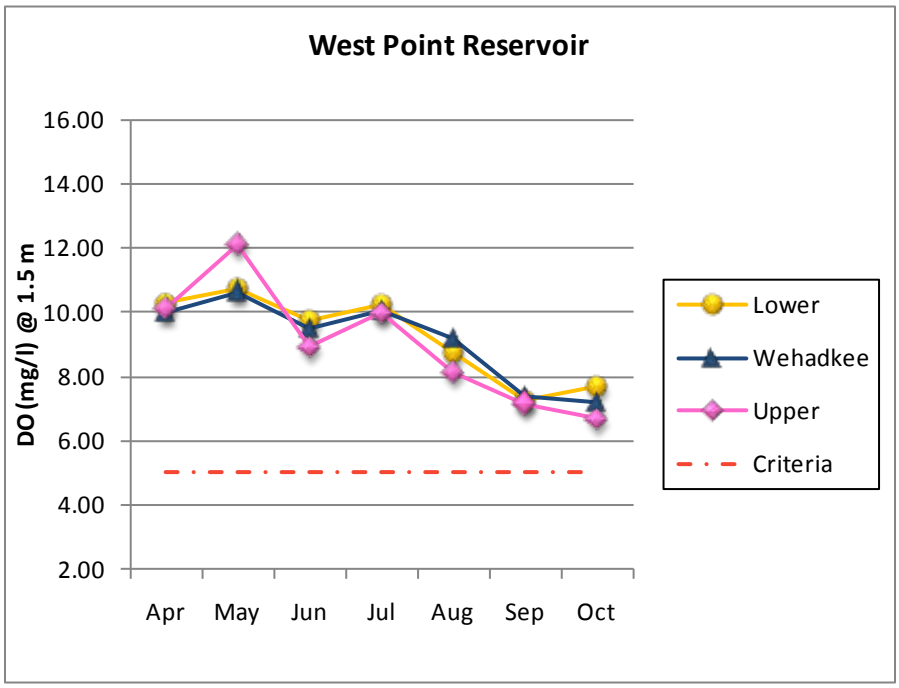


Figure 9. Monthly depth profiles of dissolved oxygen, temperature and conductivity in the lower West Point Reservoir station, April-October 2008.

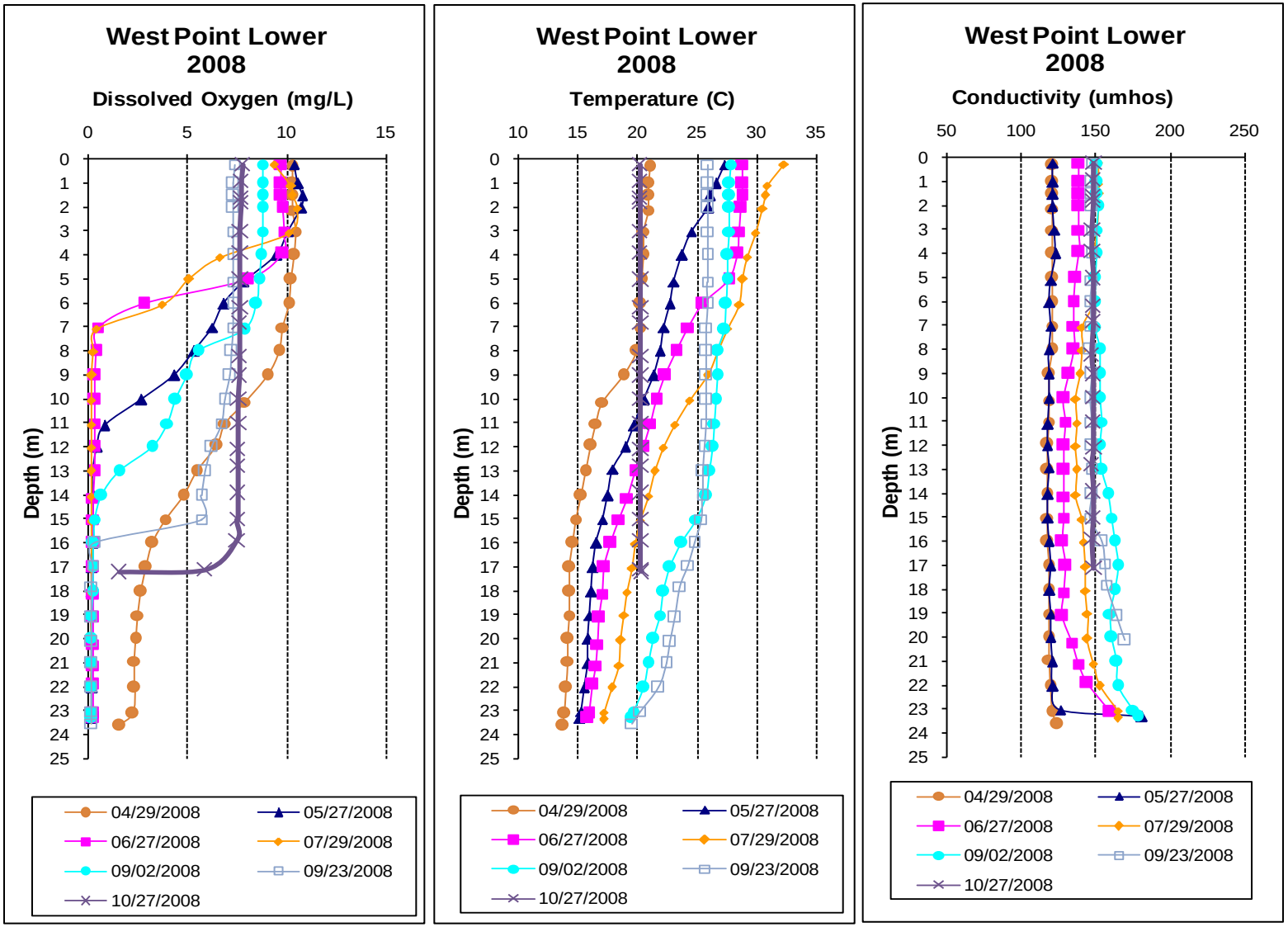


Figure 10. Monthly depth profiles of dissolved oxygen, temperature and conductivity in the Wehdakee station, April-October 2008.

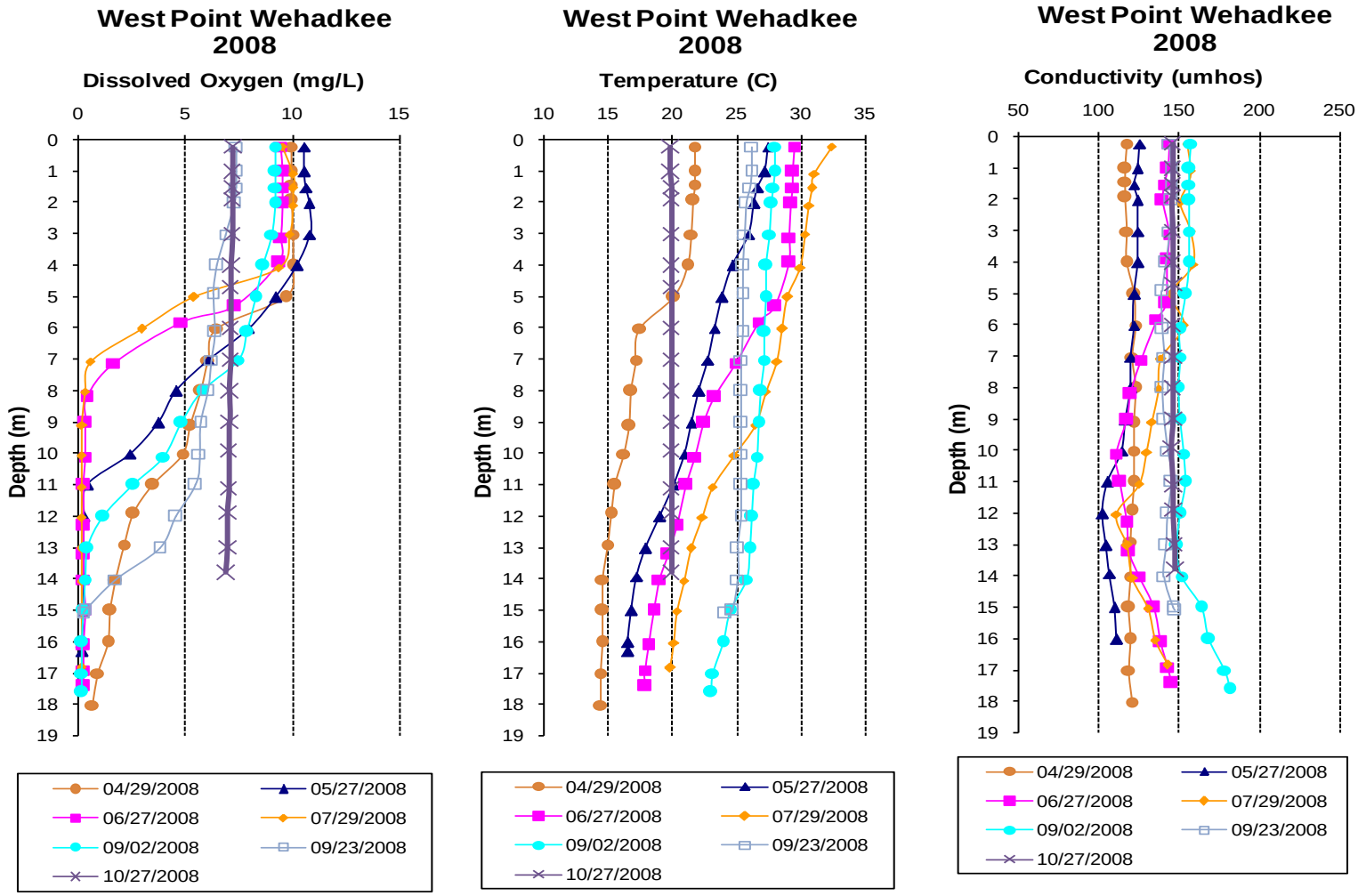


Figure 11. Monthly depth profiles of dissolved oxygen, temperature and conductivity in the upper station, April-October 2008.

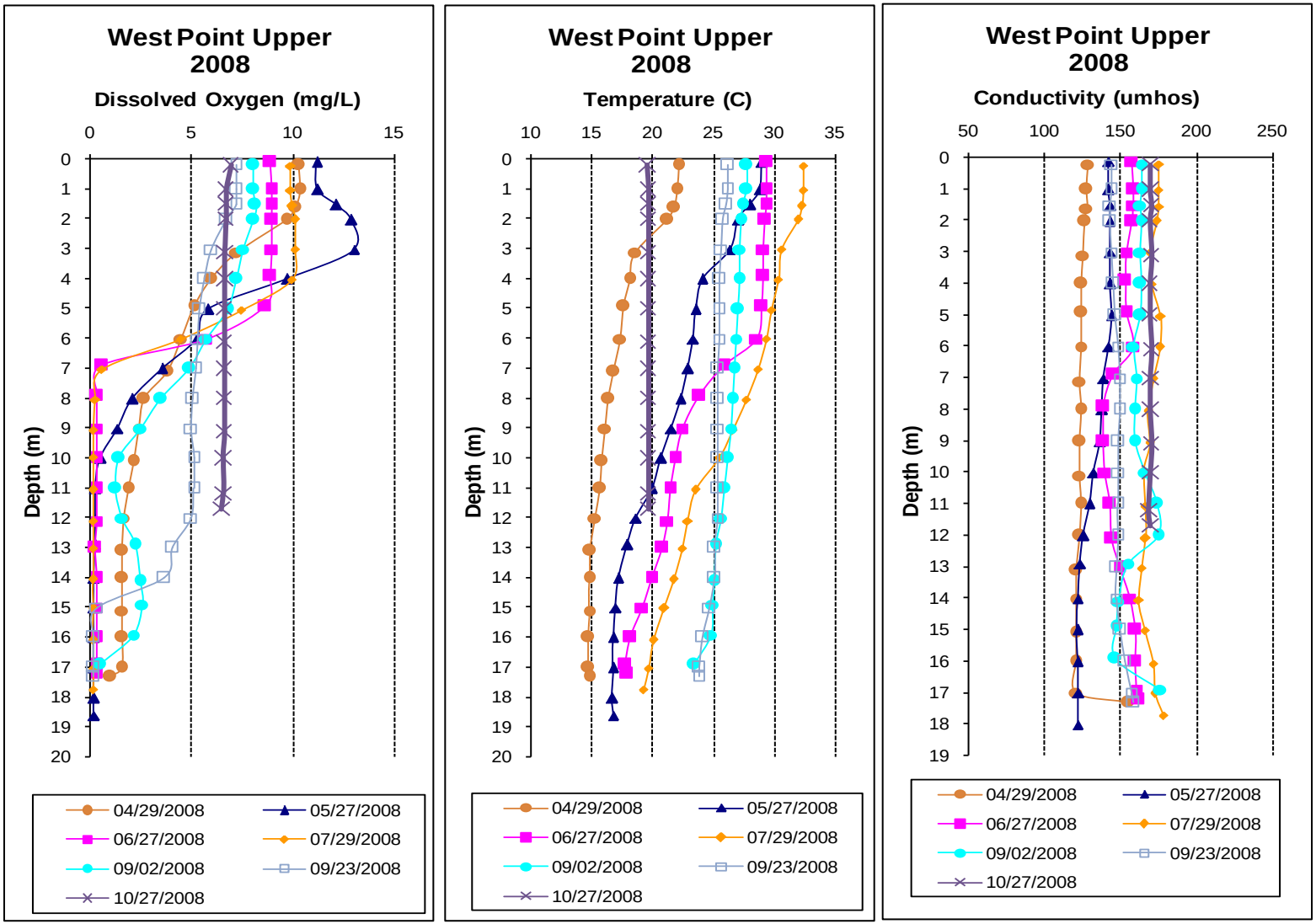
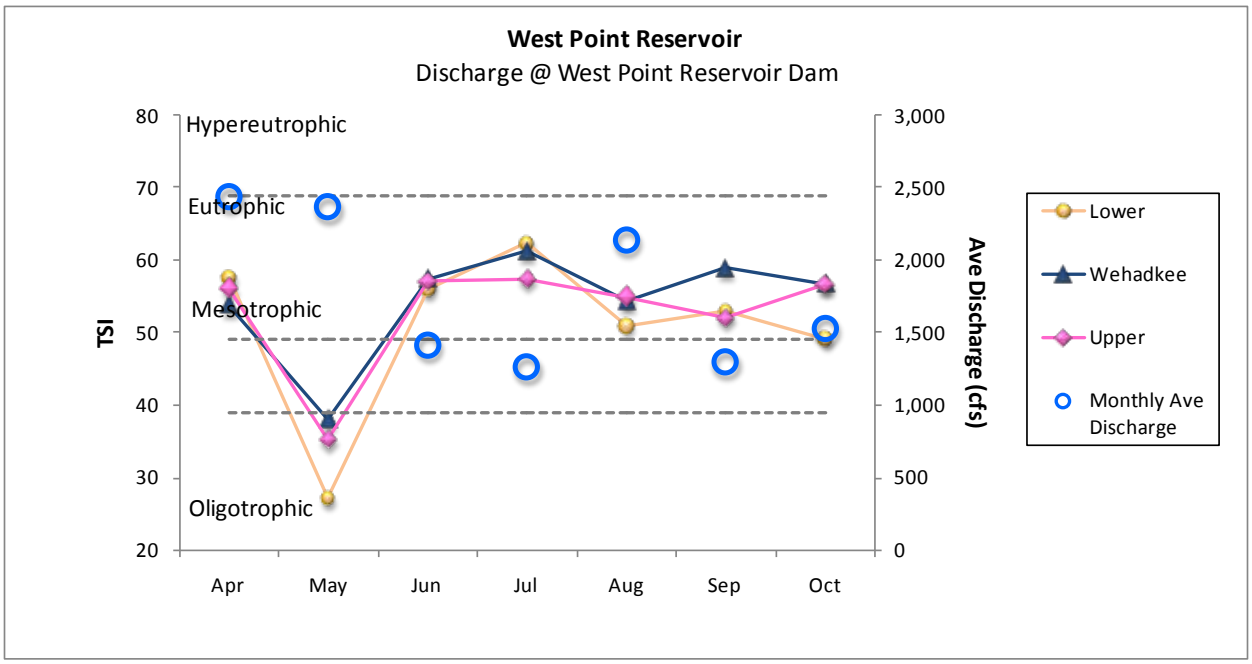


Figure 12. Monthly TSI values for stations using chl *a* concentrations and Carlson's Trophic State Index calculation.



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APPENDIX

Appendix Table 1. Summary of water quality data collected April-October, 2008. 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	1.8	4.1	2.6	2.6	0.8
	Total Dissolved Solids (mg/L)	7	34.0	102.0	56.0	64.6	30.4
	Total Suspended Solids (mg/L)	7	1.0	13.0	4.0	5.6	4.1
	Hardness (mg/L)	4	22.6	29.7	26.2	26.2	3.9
	Alkalinity (mg/L)	7	22.9	33.9	31.5	29.7	4.4
	Photic Zone (m)	7	4.15	8.31	6.06	6.23	1.38
	Secchi (m)	7	1.08	2.58	1.82	1.86	0.48
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.015	0.008	0.008	---
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.411	0.810	0.485	0.564	0.160
	Total Kjeldahl Nitrogen (mg/L)	7	0.241	0.717	0.341	0.406	0.161
	Total Nitrogen (mg/L)	7	0.652	1.527	0.911	0.969	0.305
	Dissolved Reactive Phosphorus (mg/L)	7	0.005	0.010	0.006	0.007	0.002
	Total Phosphorus (mg/L)	7	0.015	0.031	0.021	0.022	0.006
	CBOD-5 (mg/L)	7	< 1.0	2.0	0.5	0.6	0.2
	Chlorides (mg/L)	7	5.9	14.5	11.0	10.4	3.3
	Biological						
	[J]Chlorophyll a (ug/L)	7	0.71	25.63	9.88	11.42	7.90
	[J]Fecal Coliform (col/100 mL)	1				1	
WESC-2	**Physical**						
	Turbidity (NTU)	7	2.1	4.8	2.8	3.0	0.9
	Total Dissolved Solids (mg/L)	7	50.0	86.0	80.0	71.7	14.6
	Total Suspended Solids (mg/L)	7	1.0	8.0	3.0	3.1	2.3
	Hardness (mg/L)	4	22.6	30.1	26.2	26.3	3.6
	Alkalinity (mg/L)	7	22.9	33.3	31.8	29.8	3.9
	Photic Zone (m)	7	4.74	6.87	5.86	5.79	0.80
	Secchi (m)	7	1.10	2.15	1.75	1.67	0.32
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.036	0.008	0.013	0.011
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.505	0.731	0.653	0.633	0.086
	Total Kjeldahl Nitrogen (mg/L)	7	0.218	0.899	0.478	0.464	0.223
	Total Nitrogen (mg/L)	7	0.858	1.425	1.110	1.097	0.200
	Dissolved Reactive Phosphorus (mg/L)	7	0.007	0.010	0.008	0.008	0.001
	Total Phosphorus (mg/L)	7	0.016	0.031	0.020	0.021	0.005
	CBOD-5 (mg/L)	7	< 1.0	2.0	0.5	0.6	0.2
	Chlorides (mg/L)	7	3.3	14.6	11.5	10.3	4.1
	Biological						
	[J]Chlorophyll a (ug/L)	7	2.14	22.96	14.42	13.61	6.55
	[J]Fecal Coliform (col/100 mL)	1				1	

Station	Parameter	N	Min	Max	Med	Mean	SD
WESC-3	**Physical**						
	Turbidity (NTU)	7	2.2	5.6	2.8	3.1	1.2
	Total Dissolved Solids (mg/L)	7	38.0	102.0	64.0	68.6	22.3
	Total Suspended Solids (mg/L)	7	< 1.0	7.0	2.0	2.5	2.2
	Hardness (mg/L)	4	23.2	33.6	29.0	28.7	4.7
	Alkalinity (mg/L)	7	25.3	33.9	31.0	30.7	2.7
	Photic Zone (m)	7	3.52	6.09	5.35	5.17	0.91
	Secchi (m)	7	1.24	1.95	1.56	1.54	0.23
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.032	0.008	0.011	0.009
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.855	1.410	0.955	1.027	0.183
	Total Kjeldahl Nitrogen (mg/L)	7	0.160	0.749	0.389	0.436	0.216
	Total Nitrogen (mg/L)	7	1.199	1.789	1.422	1.463	0.192
	Dissolved Reactive Phosphorus (mg/L)	7	0.007	0.011	0.008	0.009	0.002
	Total Phosphorus (mg/L)	7	0.018	0.032	0.024	0.025	0.005
	CBOD-5 (mg/L)	7	< 1.0	2.0	0.5	0.6	0.2
	Chlorides (mg/L)	7	5.8	18.0	13.0	12.3	4.0
	Biological						
	[J]Chlorophyll a (ug/L)	7	1.60	15.49	13.53	11.53	4.91
	[J]Fecal Coliform (col/100 mL)	1				1	

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