2010 Weiss Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
May 2013

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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
APCo	Alabama Power Company
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
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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INTRODUCTION

Weiss Dam was the first dam built as a part of an Alabama Power Company construction program that further developed the Coosa River in the late 1950s and the 1960s. Construction began in 1958 and was finished three years later. The 27,780 ac reservoir is located in northeast Alabama in Cherokee County. Weiss provides a number of valuable resources to the area including hydroelectricity, flood control, irrigation and drinking water. The reservoir is also well known for its excellent fish and wildlife habitats.

Weiss Reservoir was placed on Alabama's 1996 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its Public Water Supply (PWS)/Swimming (S)/Fish & Wildlife (F&W) water use classifications. The reservoir was listed for impairments caused by priority organics (PCBs), nutrients, pH, and organic enrichment/dissolved oxygen (OE/DO). USEPA approved delisting Weiss for OE/DO and pH in the 2000 and 2004 §303(d) lists, respectively, based on intensive monitoring data. In 2004, USEPA approved two TMDLs for Weiss Reservoir, addressing PCB and nutrient impairments. After additional years of monitoring and with the development of the Coosa River TMDL, a revised Weiss Reservoir nutrient TMDL was approved by the USEPA in 2008 (ADEM 2008c).

The Alabama Department of Environmental Management (ADEM) monitored Weiss Reservoir as part of the 2010 assessment of the Alabama, Coosa, and Tallapoosa (ACT) River basins under the Rivers and Reservoirs Monitoring Program (RRMP). 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 RRMP) was initiated by the Field Operations Division of the ADEM. The current 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 (ADEM 2012).

Specific water quality criteria for nutrient management were implemented in 2001 at two locations on Weiss. These criteria represent the maximum growing season mean (Apr-Oct) chlorophyll *a* concentration allowable while still fully supporting the reservoir's designated uses.

The purpose of this report is to summarize data collected at nine stations in Weiss Reservoir during the 2010 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and/or 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. Weiss was sampled in the dam forebay, mid reservoir, and upper reservoir (transition area). Since Weiss is the first reservoir of the Coosa River chain, a station was also established at the stateline to monitor incoming water quality. Tributary embayment stations monitored include: Spring, Cowan, and Big Nose Creeks and Little and Chattooga Rivers.

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 2010), Surface Water Quality Assurance Project Plan (ADEM 2008a), and Quality Management Plan (ADEM 2008b).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions at each site. Monthly concentrations of these parameters were graphed with the closest available Alabama Power Company (APCo) discharge data and ADEM's previously collected data to help interpret the 2010 results.

Figure 1. Weiss Reservoir with 2010 sampling locations. A description of each sampling location is provided in Table 1.

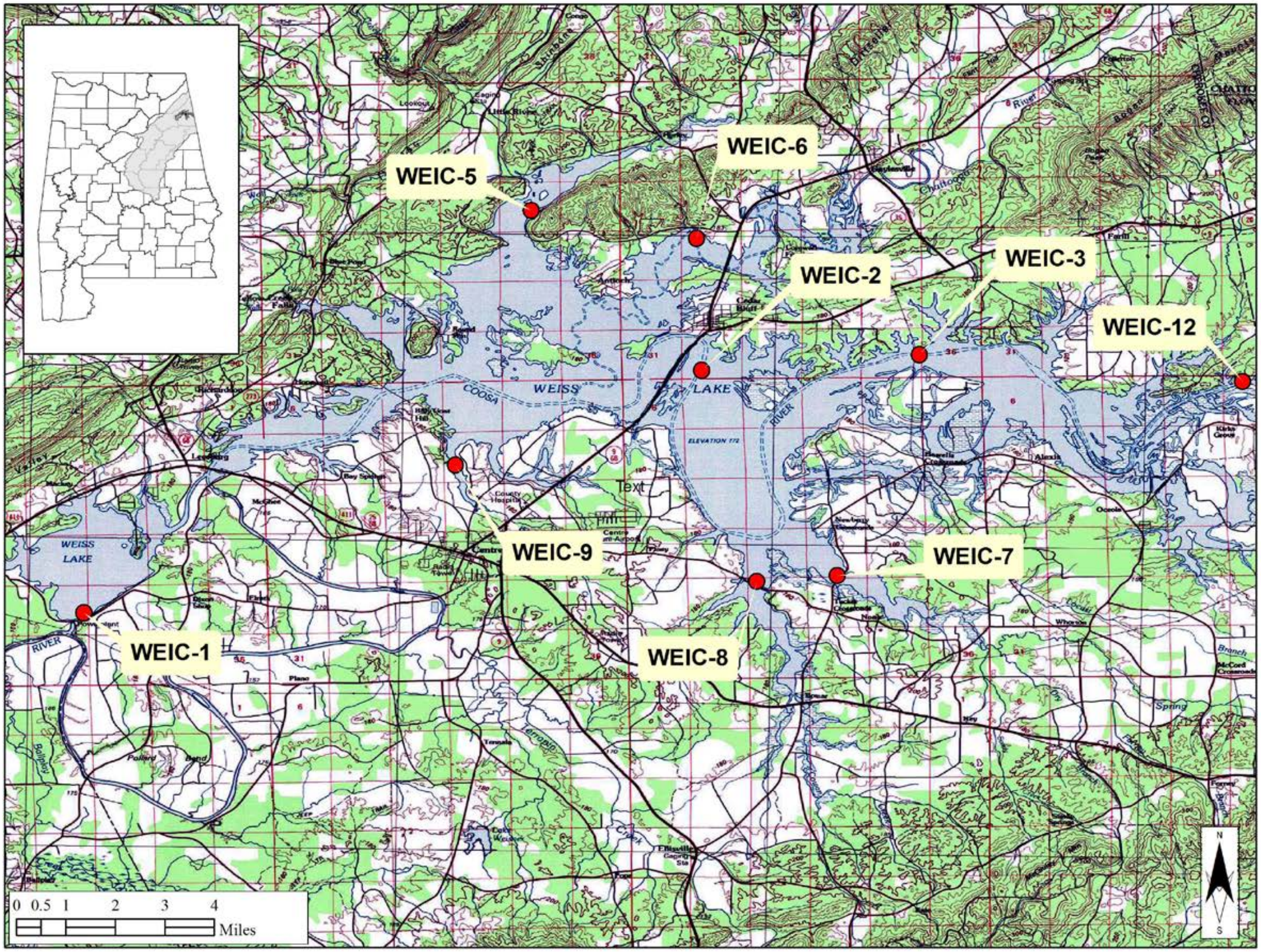


Table 1. Descriptions for the monitoring stations in 2010 for Weiss Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
031501051003	Cherokee	WEIC-1*	Lower	Coosa R	Deepest point, main river channel, power dam forebay.	20 µg/L	34.1348	-85.7911
031501051002	Cherokee	WEIC-2*	Mid	Coosa R	Deepest point, main river channel, immediately upstream of causeway at Cedar Bluff.	20 µg/L	34.2057	-85.6105
031501050207	Cherokee	WEIC-3	Upper	Coosa R	Deepest point, main river channel, at power line crossing upstream of Spring Creek.		34.2103	-85.5468
031501050807	Cherokee	WEIC-5	Little R	Little R	Deepest point, main river channel, Little River embayment, LRM 12.5		34.2525	-85.6603
031501050605	Cherokee	WEIC-6	Chattooga R	Chattooga R	Deepest point, main river channel, Chattooga River embayment, CRM 12.5		34.2443	-85.6120
031501050304	Cherokee	WEIC-7	Spring Cr	Spring Cr	Deepest point, main creek channel, Spring Creek embayment, downstream of Cherokee Co. Hwy. 31 bridge.		34.1457	-85.5708
031501050303	Cherokee	WEIC-8	Cowan Cr	Cowan Cr	Deepest point, main creek channel, Cowan Creek embayment, downstream of Cherokee Co. Hwy. 16 bridge.		34.1440	-85.5943
031501051002	Cherokee	WEIC-9	Big Nose Cr	Big Nose Cr	Deepest point, main creek channel, Big Nose Creek embayment, approximately 0.5 miles upstream of lake confluence.		34.1780	-85.6824
031501050206	Cherokee	WEIC-12	Stateline	Coosa R	Deepest point, main river channel, Alabama/Georgia stateline.		34.2024	-85.4524

*Growing season mean Chl a criteria implemented at this station in 2001

RESULTS

Growing season mean graphs for TN, TP, chl *a*, and TSS are provided in this section (Figs. 2-5). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided (Figs. 6-10, and 13). Mean monthly discharge is included in monthly graphs for TN, TP, chl *a*, TSS, and TSI 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 Figs. 11-12. Summary statistics of all data collected during 2010 are presented in Appendix Table 1. The table contains the minimum, maximum, median, mean, and standard deviation of each parameter analyzed. Results for TKN, TP and TN analyses in Weiss Reservoir tributary embayment stations were not included because of data quality concerns.

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

In 2010, the highest mean growing season TN values were calculated for the upper and stateline stations with concentrations decreasing further downstream (Fig. 2). Mean growing season TN values in the mid station increased 2003-2010 while values in the lower station declined 2005-2010. Monthly TN concentrations in the two upper mainstem stations were similar with highest concentrations in April and June and historically low concentrations in August (Fig. 6). Concentrations in the mid and lower stations were at or above historic means in five of the seven months.

In 2010, the highest mean growing season TP value was calculated for the stateline station (Fig. 3). Overall, growing season mean TP concentrations are decreasing, with 2010 concentrations among the lowest measured. Monthly TP concentrations for mainstem stations gradually increased across the growing season at the stateline, upper and mid stations (Fig. 7). All monthly TP concentrations at all stations were below historic means April-October.

In 2010, highest mean growing season chl *a* values were calculated for the mid and Spring Cr stations (Fig. 4). From 2005 to 2010, Chattooga R and Big Nose Cr mean chl *a* concentrations decreased while concentrations from the remaining embayment stations were similar to the previous sampling. Specific water quality criteria for nutrient management have been established for the lower and mid stations in Weiss Reservoir and the growing season mean chl *a* concentrations for both stations have consistently been above criteria limits placing this reservoir in category 4A[1]. Monthly concentrations in the upper station were above historic means in all but one month (Fig. 8). Highest concentrations were achieved in June, September, and July for the stateline, mid, and lower stations, respectively. All stations were below historic means in September.

In 2010, highest mean growing season TSS values were calculated for the Spring Cr and Chattooga R stations (Fig. 5). Growing season mean TSS concentrations at all mainstem stations were similar. Concentrations have generally decreased at both the stateline and the mid station since 2001. Spring Cr and Chattooga R showed an increase while Cowan Cr, Little R, and Big Nose Cr showed a decrease in mean TSS concentrations compared to 2005. Monthly TSS concentrations in the stateline, mid and lower stations were below historic means in most month sampled, reaching historic lows in the mid station in June and July (Fig. 9). Monthly concentrations were slightly higher at the upper station, however concentrations were still at or below historic means four of six months.

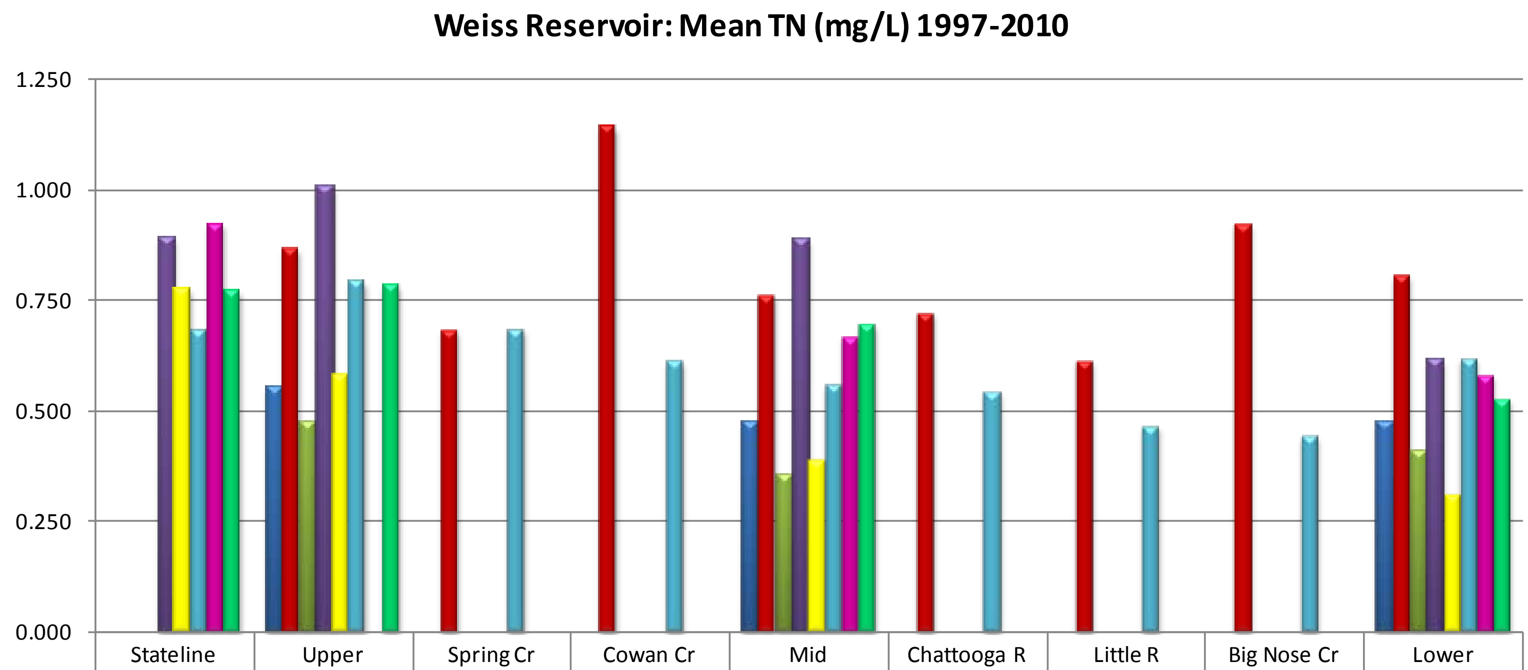
AGPT results for the stateline station indicate it was phosphorus limited in 2010 (Table 2). Due to resource constraints, AGPT samples were not collected at the lower, mid and upper stations in August 2010. With the exception of phosphorus limiting conditions in the upper station in April 2001, upper, mid and lower stations have remained nitrogen limited all years monitored, 1997-2005. Historic AGPT results in both the lower and mid stations average just above the 5 mg/L MSC, the value that Raschke et al. (1996) defined as protective of reservoir and lake systems. The more riverine stateline and upper stations are above 20mg/L MSC, the value that Raschke et al. (1996) defined as protective of flowing stream and river systems.

[1]*Category 4A:* Waters in which one or more applicable water quality standards are not met but all TMDLs needed to result in attainment of all applicable WQSs have been approved or established by EPA (ADEM 2010).

Lower mainstem station, Spring Cr and Cowan Cr were below the DO criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in August (ADEM Admin. Code R. 335-6-10-.09) (Fig. 10). All other measurements of DO concentrations in Weiss Reservoir met the ADEM criteria. Based on monthly DO profiles, DO stratification occurred May-September in the lower station and in most months at the mid station (Figs. 11 & 12). At the stateline station, the water column was stratified June-September (Fig. 13). No thermoclines were observed. Highest temperatures were measured in July and August.

TSI values calculated using monthly chl *a* concentrations and Carlson's Trophic State Index show the mainstem stations of Weiss Reservoir were eutrophic April-October (Fig. 14). Chattooga R, Spring and Cowan Creeks were eutrophic all months monitored. Big Nose Creek dropped to oligotrophic conditions in June and was eutrophic all other months monitored. TSI values calculated for Little R were mesotrophic in April and reached mid-eutrophic range by July.

Figure 2. Mean growing season TN measured in Weiss Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.

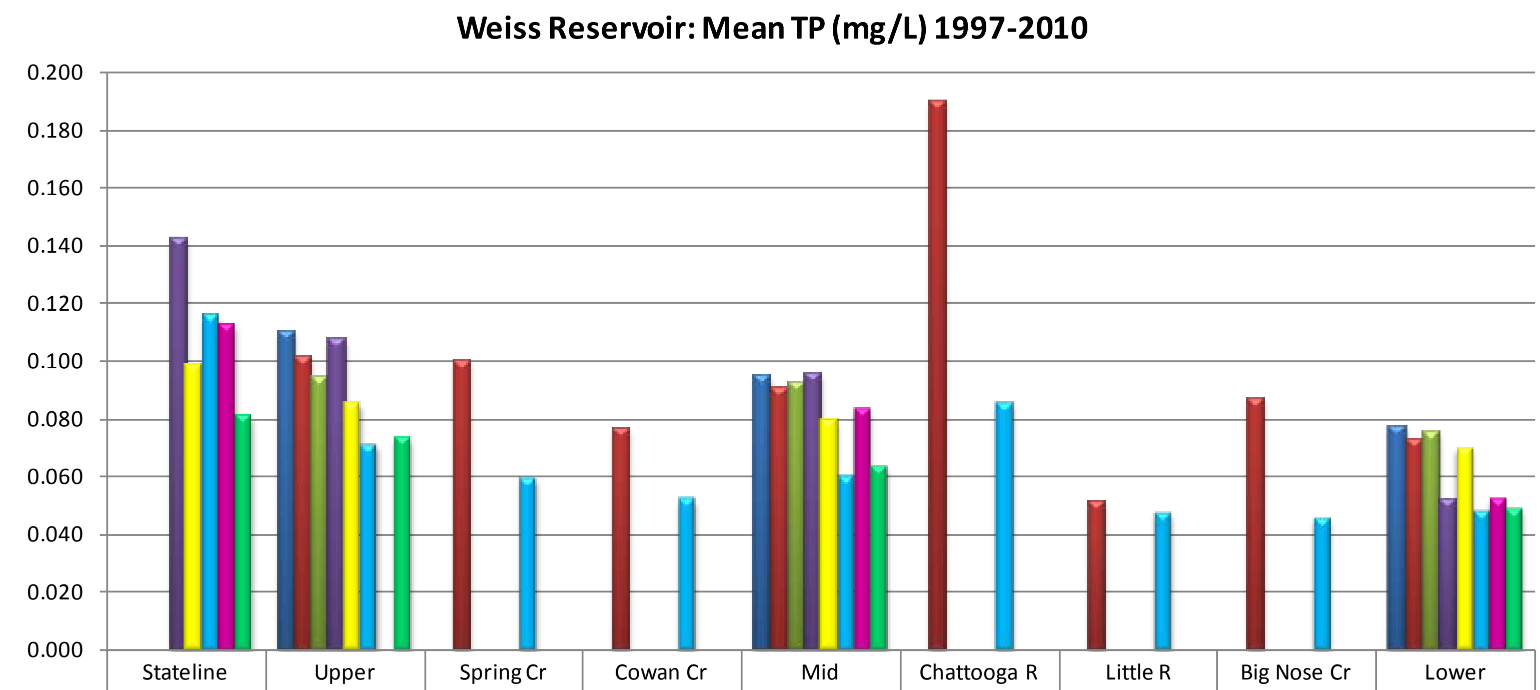


	Stateline	Upper	Spring Cr	Cowan Cr	Mid	Chattooga R	Little R	Big Nose Cr	Lower
1997		0.555			0.475				0.477
2000		0.869	0.684 *	1.145 *	0.764	0.723 *	0.615 *	0.924 *	0.808
2001		0.475			0.358				0.410
2002	0.893	1.008			0.890				0.618
2003	0.779	0.586			0.392				0.315
2005	0.684	0.794	0.686	0.613	0.561	0.544	0.466	0.443	0.620
2008	0.925				0.668				0.583
2010	0.774	0.787	**	**	0.697	**	**	**	0.529

*Mean of Apr/Jun/Aug only

**TN Data data did not meet ADEM's laboratory QC requirements.

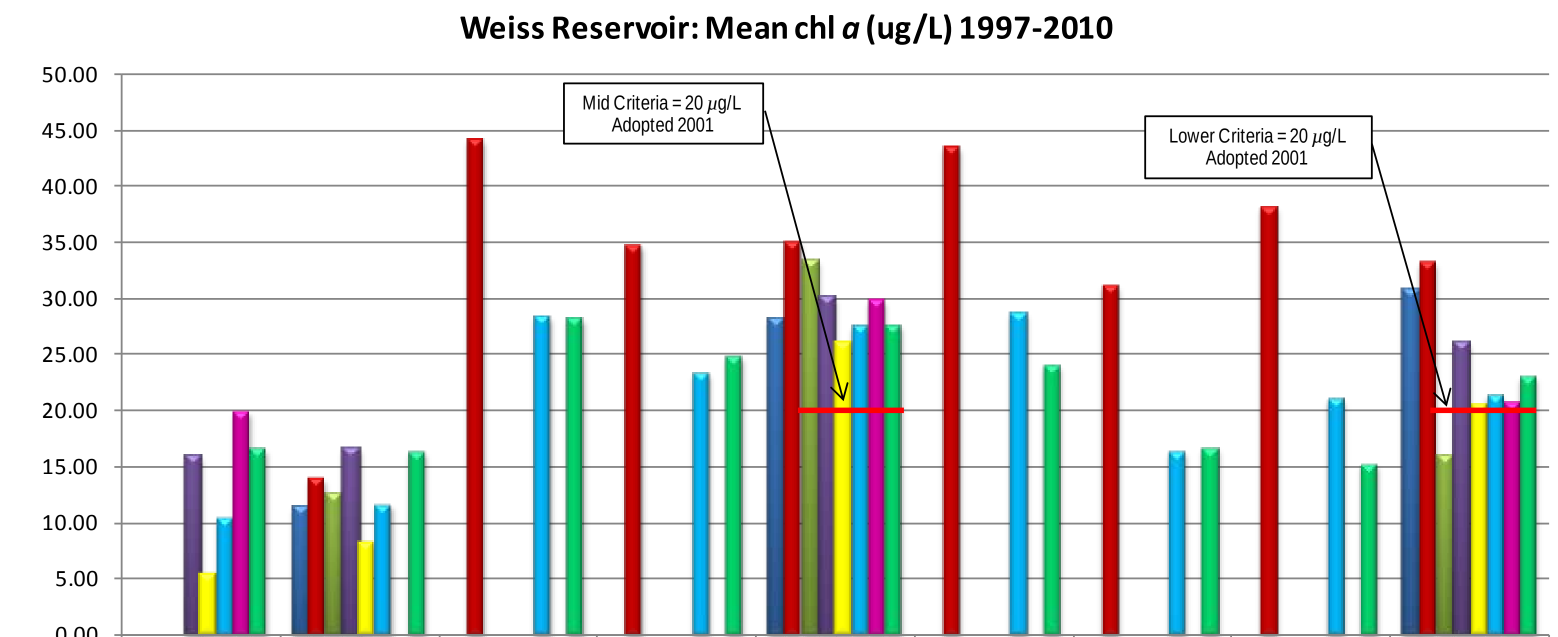
Figure 3. Mean growing season TP measured in Weiss Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Stateline	Upper	Spring Cr	Cowan Cr	Mid	Chattooga R	Little R	Big Nose Cr	Lower
1997		0.110			0.095				0.077
2000		0.101	0.100 *	0.077 *	0.091	0.190 *	0.051 *	0.087 *	0.073
2001		0.094			0.093				0.076
2002	0.142	0.108			0.096				0.052
2003	0.099	0.085			0.080				0.070
2005	0.116	0.071	0.059	0.052	0.060	0.086	0.047	0.046	0.048
2008	0.113				0.083				0.053
2010	0.081	0.073	**	**	0.063	**	**	**	0.049

*Mean of Apr/Jun/Aug only
**TP Data data did not meet ADEM's laboratory QC requirements.

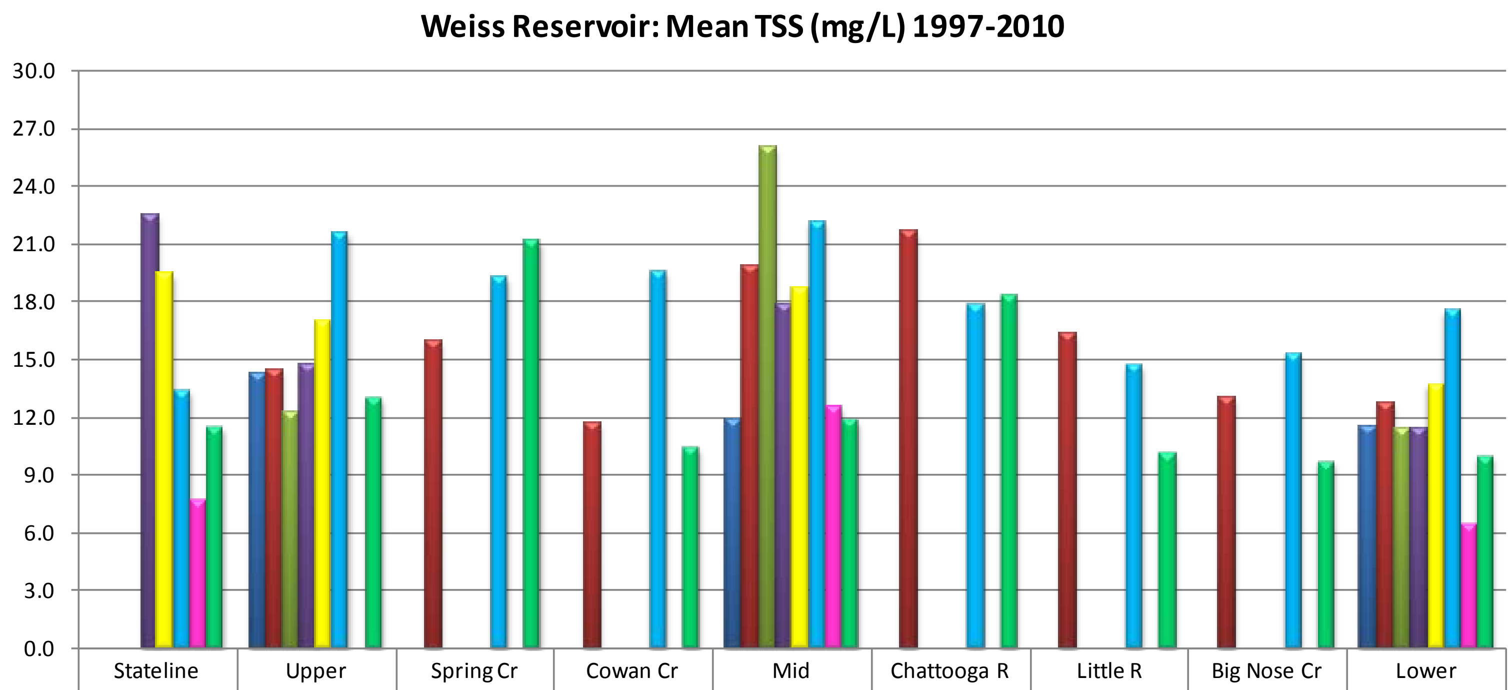
Figure 4. Mean growing season chl *a* measured in Weiss Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Stateline	Upper	Spring Cr	Cowan Cr	Mid	Chattooga R	Little R	Big Nose Cr	Lower
1997		11.51			28.23				30.81
2000		14.04	44.31 *	34.90 *	35.17	43.62 *	31.27 *	38.29 *	33.32
2001		12.56			33.41				15.96
2002	15.93	16.63			30.18				26.09
2003	5.64	8.34			26.13				20.69
2005	10.53	11.69	28.46	23.39	27.62	28.82	16.42	21.13	21.50
2008	19.98				29.90				20.82
2010	16.65	16.38	28.31	24.87	27.70	24.10	16.72	15.27	23.09

*Mean of Apr/Jun/Aug only

Figure 5. Mean growing season TSS measured in Weiss Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Stateline	Upper	Spring Cr	Cowan Cr	Mid	Chattooga R	Little R	Big Nose Cr	Lower
1997		14.3			11.9				11.6
2000		14.4	16.0 *	11.7 *	19.9	21.7 *	16.3 *	13.0 *	12.7
2001		12.3			26.0				11.4
2002	22.6	14.7			17.9				11.4
2003	19.4	17.0			18.7				13.7
2005	13.4	21.6	19.3	19.6	22.1	17.9	14.7	15.3	17.6
2008	7.7				12.6				6.4
2010	11.5 **	13.0 **	21.1	10.4	11.8 **	18.3	10.1	9.7	10.0 **

*Mean of Apr/Jun/Aug only

**Sep data unavailable

Figure 6. Monthly TN concentrations measured in Weiss Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Weiss Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

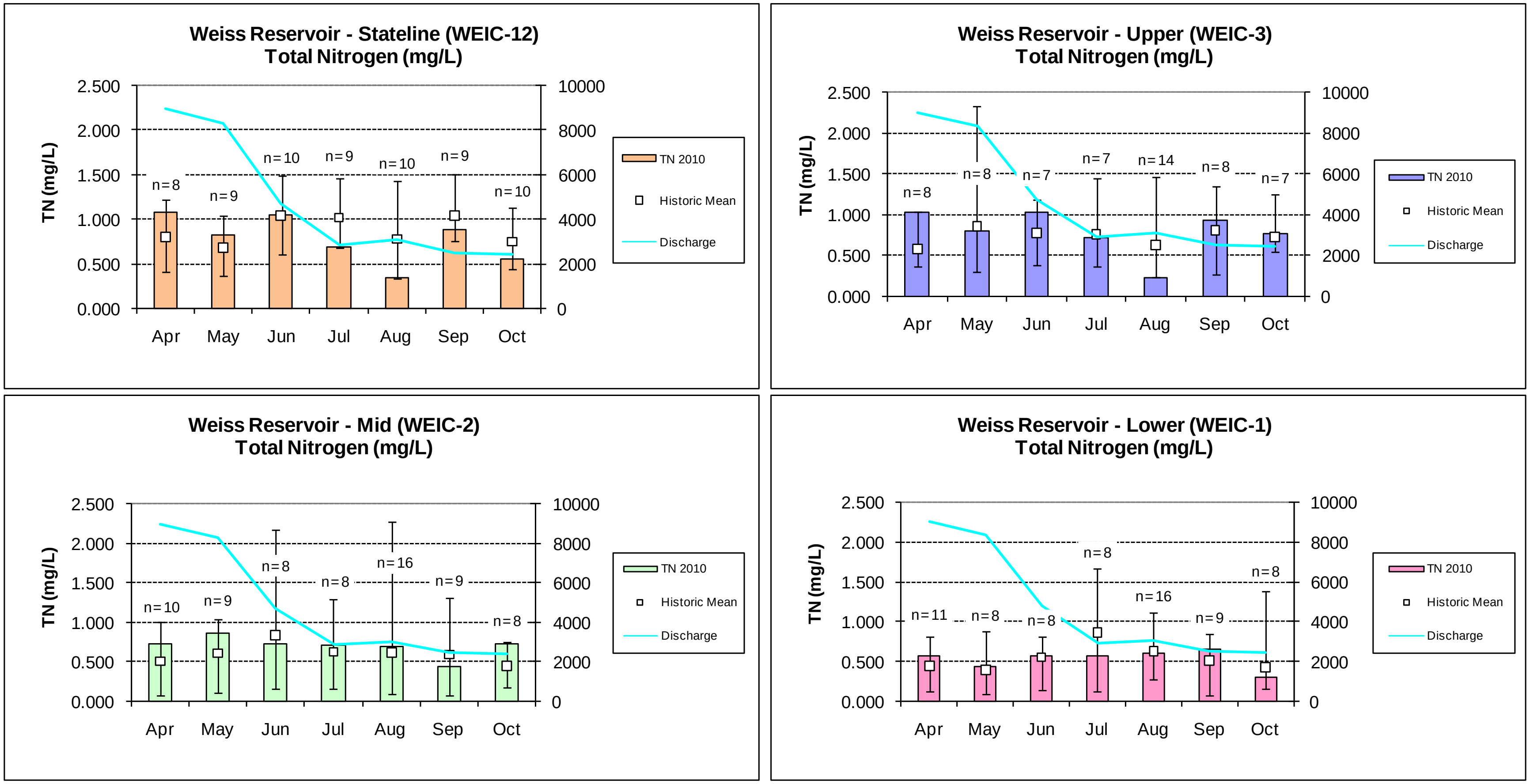


Figure 7. Monthly TP concentrations measured in Weiss Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Weiss Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

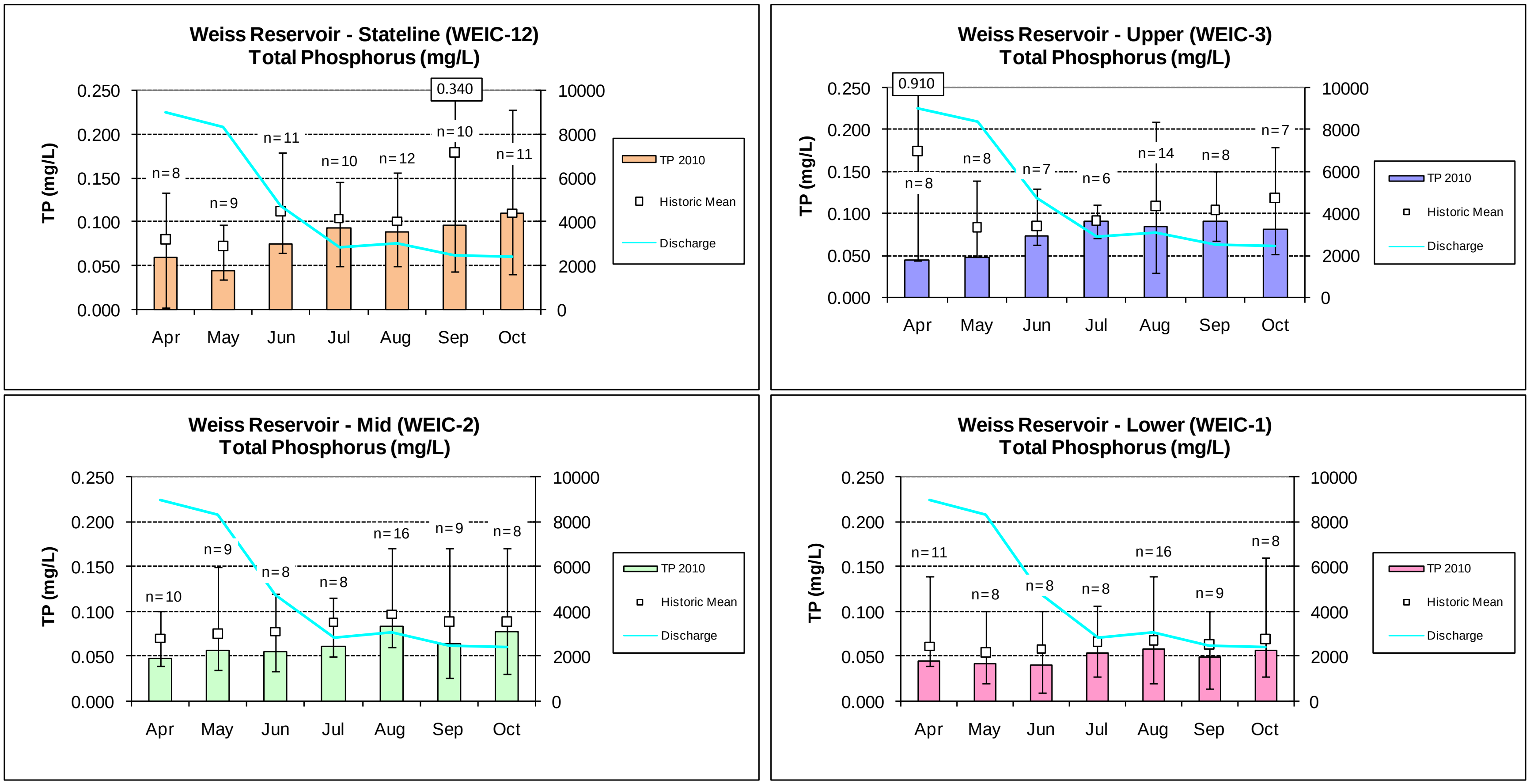


Figure 8. Monthly chl *a* concentrations measured in Weiss Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Weiss Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

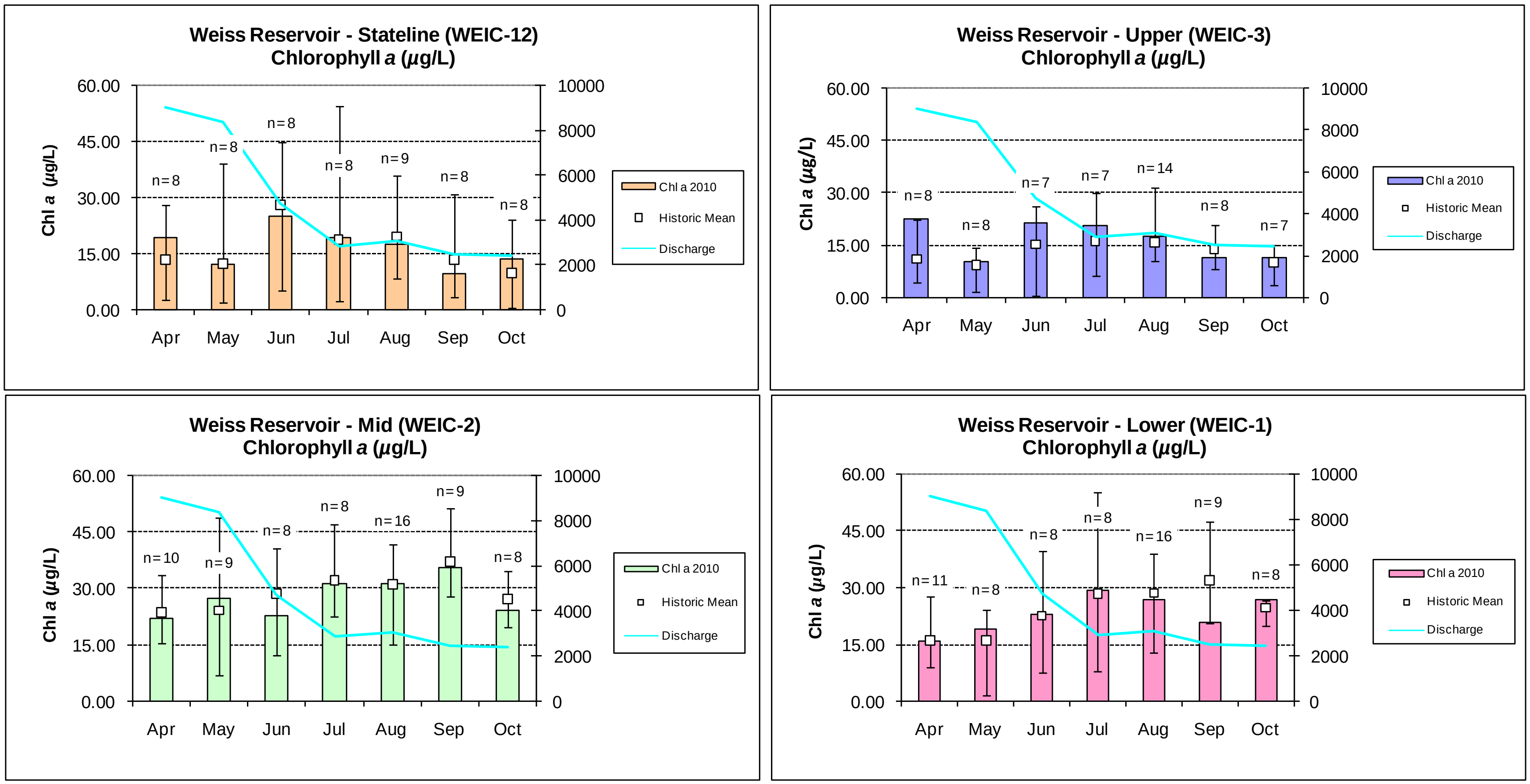


Figure 9. Monthly TSS concentrations measured in Weiss Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Weiss Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

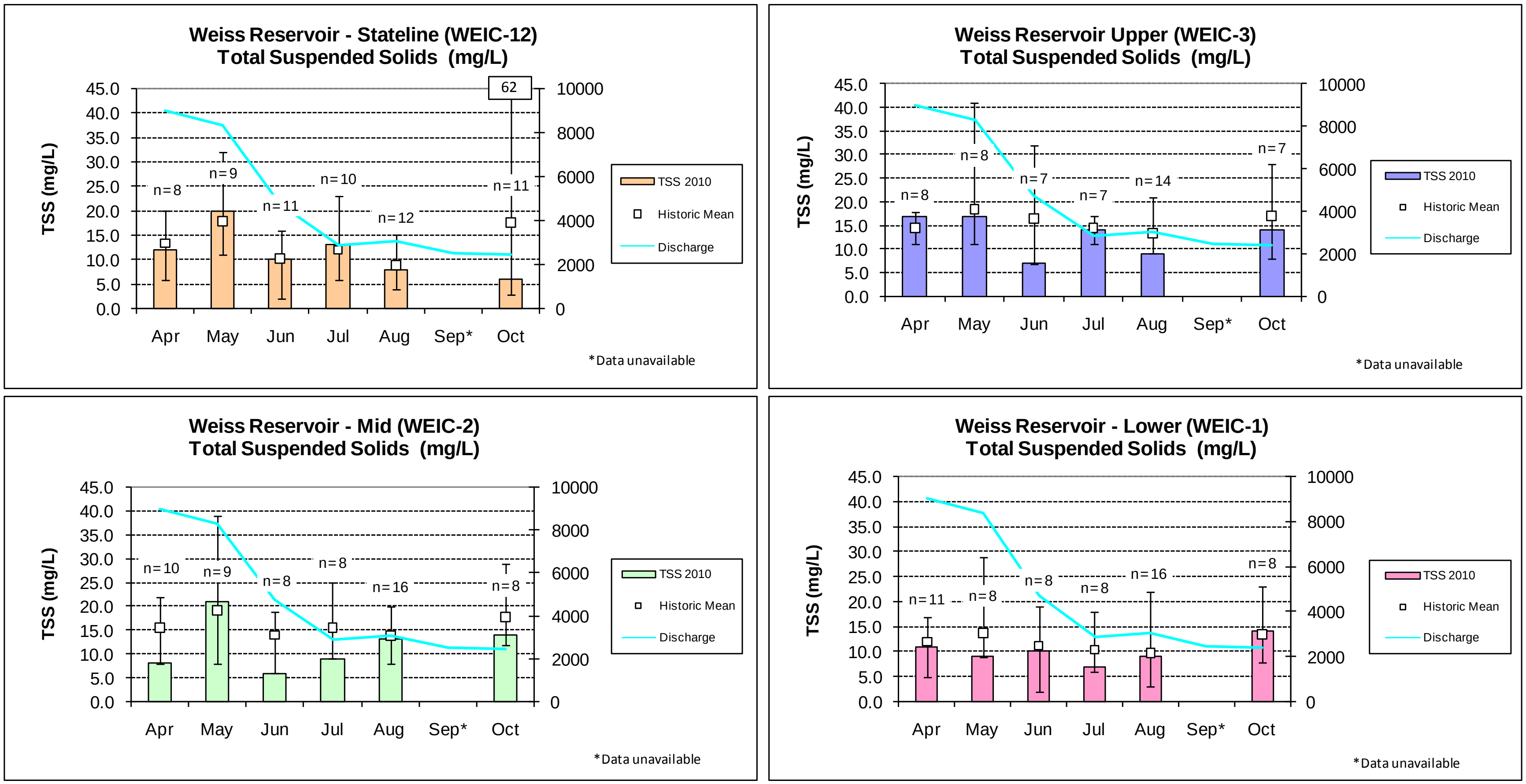
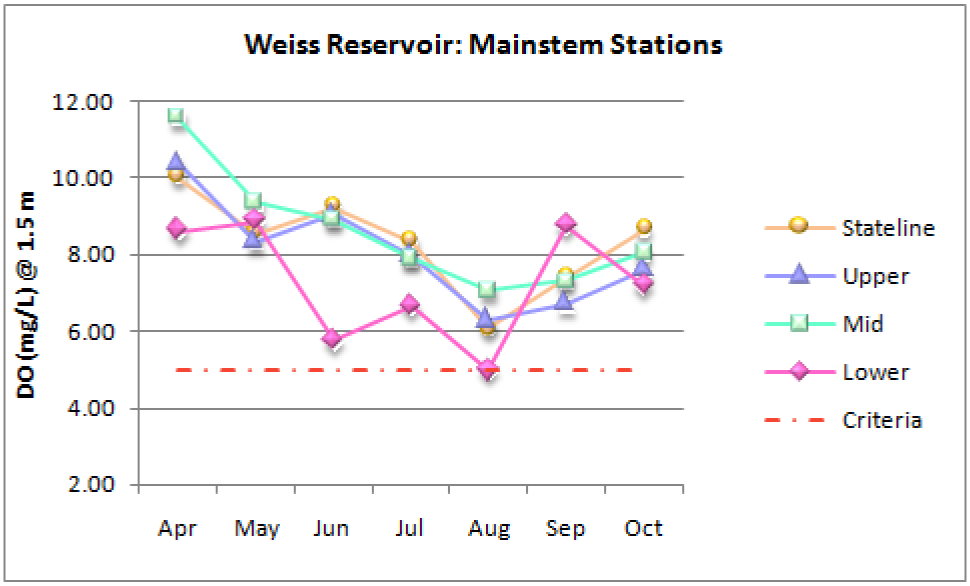


Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) or dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. Mean standing crop (MSC) values below 5 mg/L are considered to be protective in reservoirs and lakes; MSC values below 20 mg/L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

	WEIC-1		**WEIC-2**		**WEIC-3**		**WEIC-12**	
	Limiting Nutrient	Mean MSC	Limiting Nutrient	Mean MSC	Limiting Nutrient	Mean MSC	Limiting Nutrient	Mean MSC
8/1997	NITROGEN	6.82	NITROGEN	5.68	NITROGEN	25.54	---	---
8/2000	NITROGEN	8.35	NITROGEN	5.59	NITROGEN	28.32	---	---
4/2001	NITROGEN	6.11	NITROGEN	6.89	PHOSPHORUS	22.60	---	---
5/2001	NITROGEN	5.24	NITROGEN	5.29	NITROGEN	31.55	---	---
6/2001	NITROGEN	4.26	NITROGEN	3.69	NITROGEN	16.56	---	---
7/2001	NITROGEN	6.01	NITROGEN	11.36	NITROGEN	27.64	---	---
8/2001	NITROGEN	4.46	NITROGEN	4.05	NITROGEN	20.44	---	---
9/2001	NITROGEN	2.96	NITROGEN	5.37	NITROGEN	25.78	---	---
10/2001	NITROGEN	2.77	NITROGEN	3.05	NITROGEN	23.92	---	---
8/2005	NITROGEN	4.73	NITROGEN	5.69	NITROGEN	18.20	NITROGEN	39.4
8/2010	---	---	---	---	---	---	PHOSPHORUS	21.2

Figure 10. Monthly DO concentrations at 1.5 m (5 ft) for Weiss Reservoir stations collected April-October 2010. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2010).



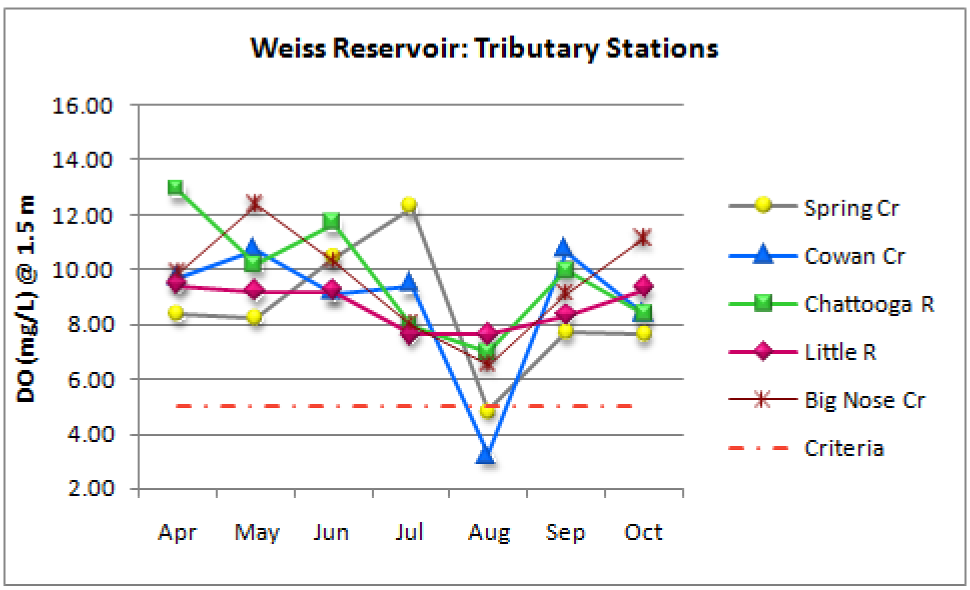


Figure 11. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the lower Weiss Reservoir station, April-October 2010.

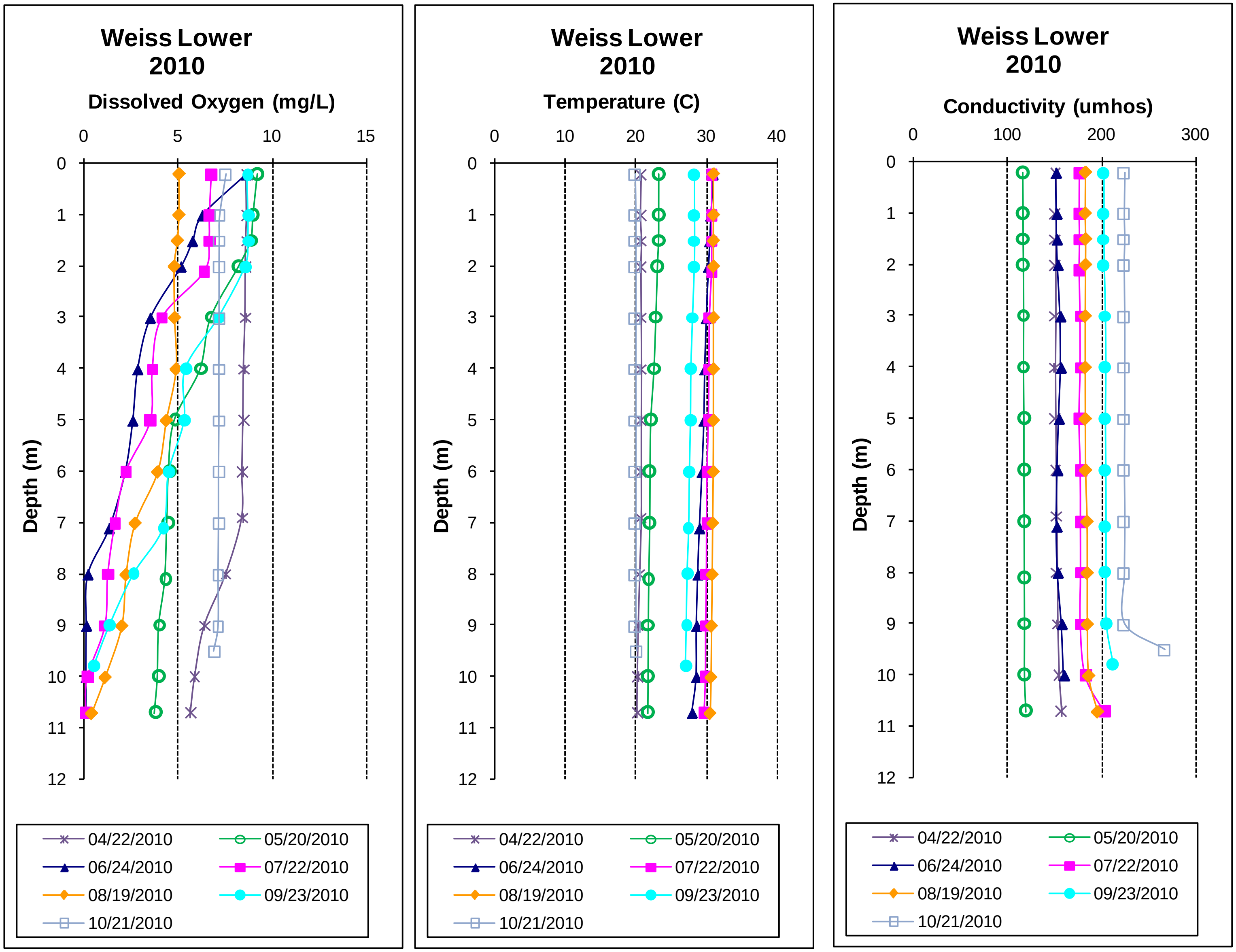


Figure 12. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the mid Weiss Reservoir station, April-October 2010.

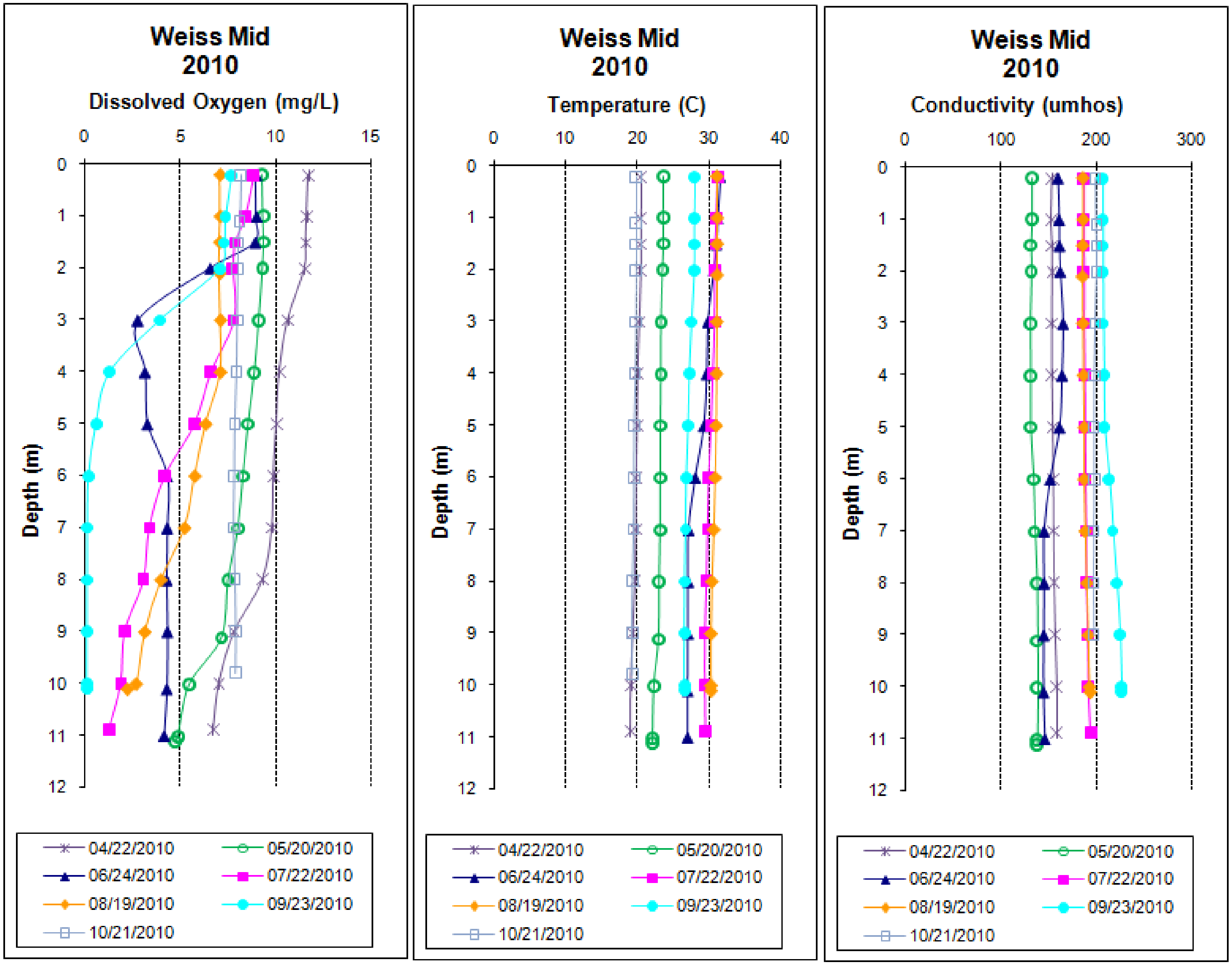


Figure 13. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the stateline Weiss Reservoir station, April-October 2010.

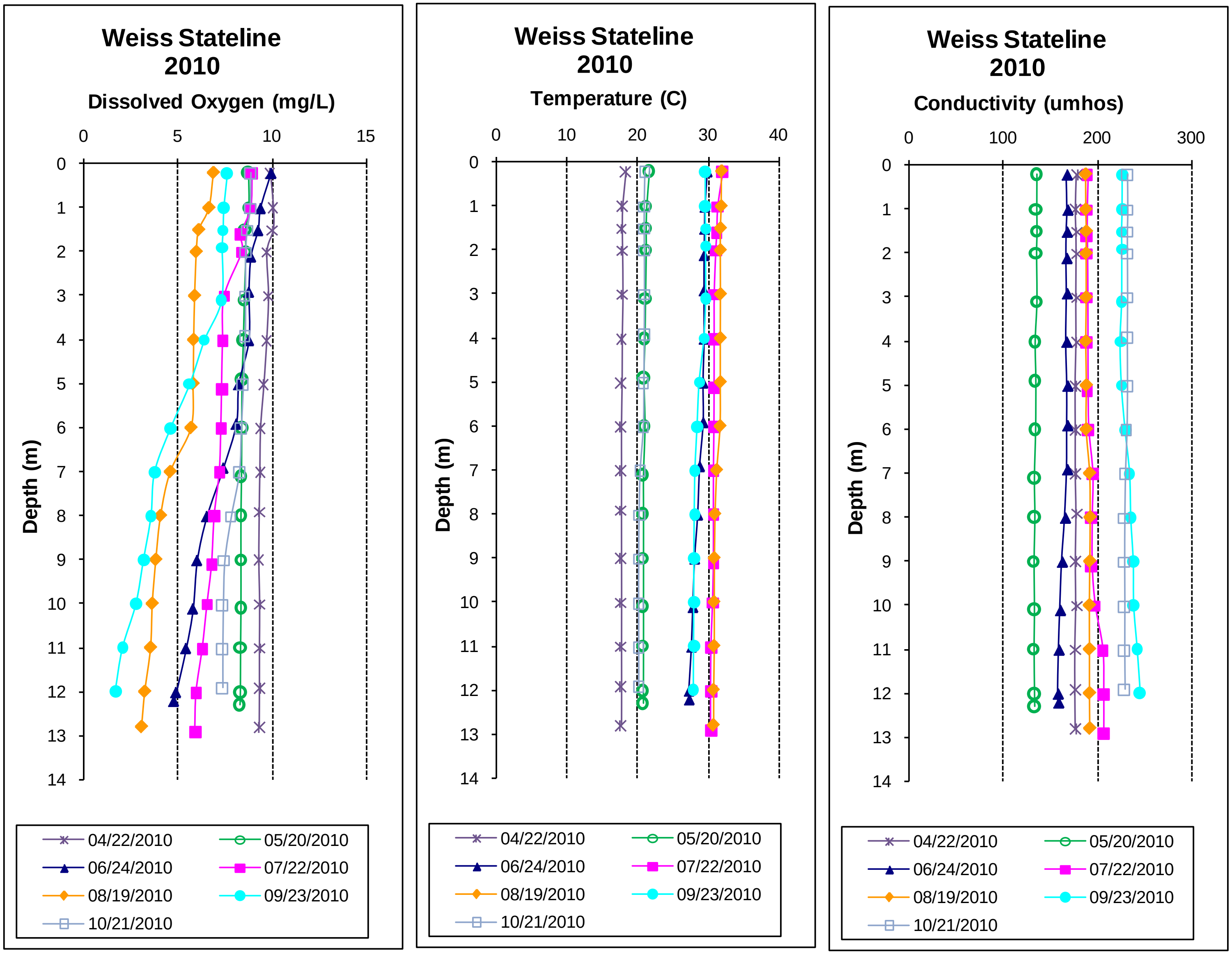
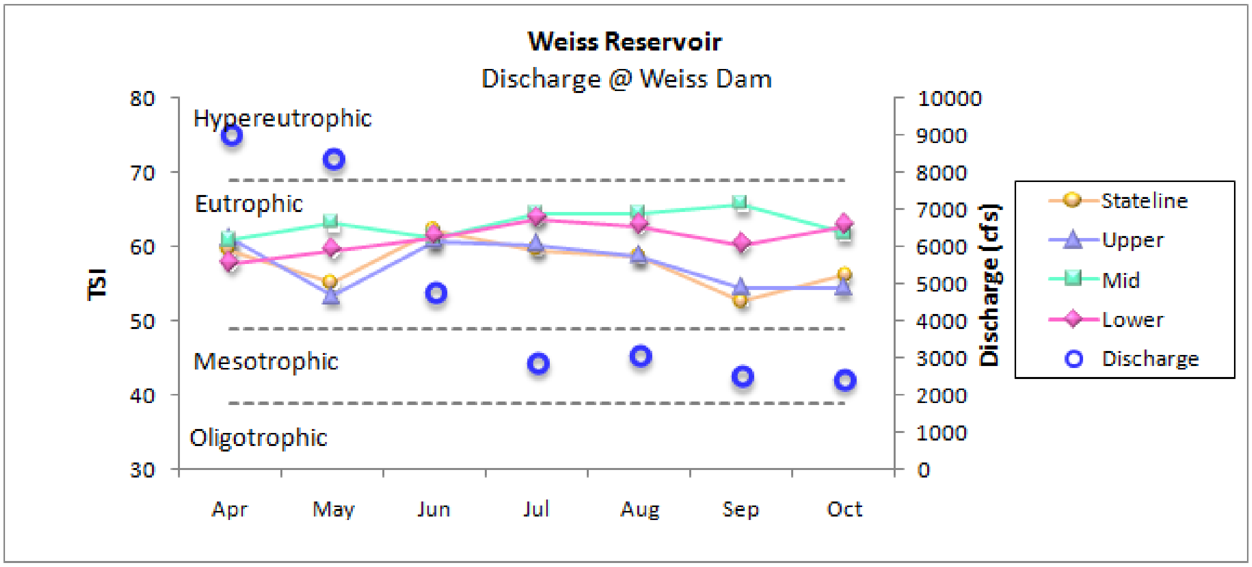
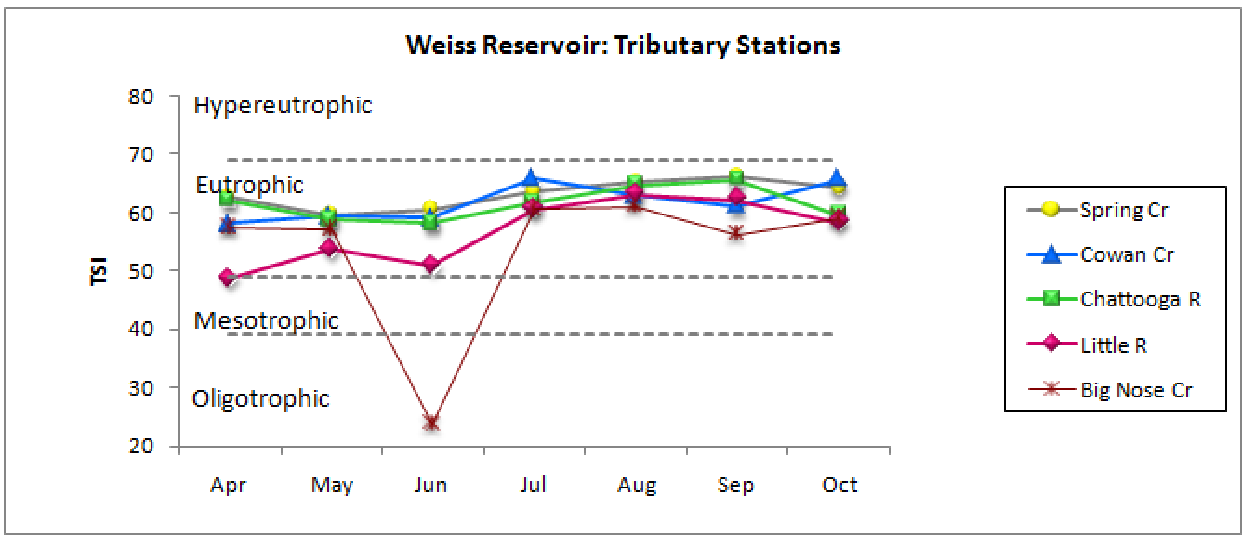


Figure 14. Monthly TSI values calculated for mainstem and tributary Weiss Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. Monthly discharge acquired from APCo at Weiss Dam.





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APPENDIX

Appendix Table 1. Summary of Weiss Reservoir water quality data collected April-October, 2010. 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
WEIC-1	**Physical**							
	Turbidity (NTU)	7		7.2	16.8	8.7	10.3	3.5
	Total Dissolved Solids (mg/L)[J]	7		64.0	132.0	116.0	103.7	27.1
	Total Suspended Solids (mg/L)[J]	6		7.0	14.0	9.5	10.0	2.4
	Hardness (mg/L)	4		56.6	73.9	62.0	63.6	7.7
	Alkalinity (mg/L)	7		45.7	74.2	67.4	64.5	9.6
	Photic Zone (m)	7		1.63	2.75	2.60	2.40	0.40
	Secchi (m)	7		0.62	0.84	0.80	0.76	0.09
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.021	0.022	0.010	0.012	0.004
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.095	0.005	0.022	0.034
	Total Kjeldahl Nitrogen (mg/L)	7		0.290	0.660	0.570	0.508	0.136
	Total Nitrogen (mg/L)[J]	7	<	0.295	0.661	0.572	0.529	0.122
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.008	0.004	0.005	0.002
	Total Phosphorus (mg/L)	7		0.040	0.058	0.049	0.049	0.007
	CBOD-5 (mg/L)	7	<	2.0	2.6	1.0	1.4	0.7
	Chlorides (mg/L)	7		3.7	12.9	6.3	7.2	3.2
	Biological							
	Chlorophyll a (ug/L)	7		16.00	29.37	22.96	23.09	4.77
	E. coli (mpn/100mL)[J]	3	<	1	1	1	1	0
WEIC-2	**Physical**							
	Turbidity (NTU)	7		9.9	20.4	14.7	14.6	4.2
	Total Dissolved Solids (mg/L)	7		54.0	152.0	96.0	97.1	32.2
	Total Suspended Solids (mg/L)[J]	6		6.0	21.0	11.0	11.8	5.4
	Hardness (mg/L)	4		59.7	67.5	63.8	63.7	4.0
	Alkalinity (mg/L)	7		51.7	69.7	65.6	64.3	6.2
	Photic Zone (m)	7		1.42	2.70	2.01	2.02	0.45
	Secchi (m)	7		0.57	0.88	0.62	0.65	0.11
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.102	0.013	0.034	0.043
	Total Kjeldahl Nitrogen (mg/L)	7		0.440	0.757	0.685	0.663	0.105
	Total Nitrogen (mg/L)[J]	7	<	0.441	0.859	0.720	0.697	0.125
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.004	0.010	0.007	0.007	0.003
	Total Phosphorus (mg/L)	7		0.047	0.083	0.061	0.063	0.013
	CBOD-5 (mg/L)	7	<	2.0	3.0	2.0	2.0	0.8
	Chlorides (mg/L)	7		4.5	11.3	8.4	8.0	2.7
	Biological							
	Chlorophyll a (ug/L)	7		21.90	35.60	27.37	27.70	5.14
	E. coli (mpn/100mL)	3	<	1	1	1	1	0

Station	Parameter	N	Min	Max	Med	Mean	SD
WEIC-3	**Physical**						
	Turbidity (NTU)	7	10.4	17.3	14.6	14.1	2.3
	Total Dissolved Solids (mg/L) [J]	7	86.0	142.0	114.0	112.6	17.9
	Total Suspended Solids (mg/L) [J]	6	7.0	17.0	14.0	13.0	4.2
	Hardness (mg/L)	4	58.0	69.5	64.8	64.3	5.1
	Alkalinity (mg/L)	7	62.3	72.9	67.7	66.9	3.7
	Photic Zone (m)	7	1.88	2.96	2.29	2.29	0.34
	Secchi (m)	7	0.56	0.85	0.74	0.71	0.11
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.073	0.010	0.019	0.024
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.123	0.471	0.293	0.288	0.119
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.080	0.807	0.589	0.499	0.264
	Total Nitrogen (mg/L)	7	< 0.234	1.032	0.805	0.787	0.273
	Dissolved Reactive Phosphorus (mg/L) [J]	7	0.008	0.052	0.028	0.029	0.016
	Total Phosphorus (mg/L)	7	0.044	0.091	0.082	0.073	0.020
	CBOD-5 (mg/L)	7	< 2.0	2.5	1.0	1.2	0.6
	Chlorides (mg/L)	7	5.3	13.0	8.7	8.6	2.8
	Biological						
	Chlorophyll a (ug/L)	7	10.15	22.40	17.55	16.38	5.30
	E. coli (mpn/100mL)	3	1	2	2	2	1
WEIC-5	**Physical**						
	Turbidity (NTU)	7	6.0	14.2	10.2	9.8	3.4
	Total Dissolved Solids (mg/L)	7	64.0	166.0	115.0	118.0	38.8
	Total Suspended Solids (mg/L)	7	6.0	16.0	10.0	10.1	3.5
	Hardness (mg/L)	4	44.2	91.4	67.3	67.6	21.0
	Alkalinity (mg/L)	7	24.3	74.6	50.0	49.7	20.0
	Photic Zone (m)	7	1.59	3.47	2.32	2.42	0.70
	Secchi (m)	7	0.67	1.43	0.81	0.90	0.25
	Chemical						
	Ammonia Nitrogen (mg/L) [J, B]	1				0.500	
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.007	0.020	0.004	0.009	0.007
	Total Kjeldahl Nitrogen (mg/L) [B]						
	Total Nitrogen (mg/L) [B]						
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.009	0.002	0.002	0.003
	Total Phosphorus (mg/L) [B]						
	CBOD-5 (mg/L) [J]	7	1.2	2.8	1.6	1.7	0.6
	Chlorides (mg/L)	7	10.0	29.5	20.4	20.9	7.0
	Biological						
	Chlorophyll a (ug/L)	7	6.41	27.80	17.10	16.72	8.58
	E. coli (mpn/100mL) [J]	3	1	2	1	1	1

Station	Parameter	N	Min	Max	Med	Mean	SD
WEIC-6	**Physical**						
	Turbidity (NTU)	7	9.1	26.7	16.9	16.2	6.2
	Total Dissolved Solids (mg/L)	7	135.0	326.0	234.0	223.9	76.2
	Total Suspended Solids (mg/L)	7	8.0	30.0	18.0	18.3	7.6
	Hardness (mg/L)	4	81.4	115.0	109.5	103.8	15.5
	Alkalinity (mg/L)	7	61.8	100.2	90.4	84.1	14.3
	Photic Zone (m)	7	1.51	4.64	2.02	2.26	1.08
	Secchi (m)	7	0.49	0.92	0.69	0.71	0.17
	Chemical						
	Ammonia Nitrogen (mg/L) [J, B]	1				0.500	
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.007	0.015	0.004	0.008	0.006
	Total Kjeldahl Nitrogen (mg/L) [B]						
	Total Nitrogen (mg/L) [B]						
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.024	0.006	0.009	0.008
	Total Phosphorus (mg/L) [B]						
	CBOD-5 (mg/L) [J]	7	1.8	3.4	2.4	2.5	0.6
	Chlorides (mg/L)	7	18.6	53.7	27.0	34.8	14.5
	Biological						
	Chlorophyll a (ug/L)	7	16.60	35.20	23.50	24.10	7.17
	E. coli (mpn/100mL) [J]	3	< 1	1	1	1	0
WEIC-7	**Physical**						
	Turbidity (NTU)	7	7.3	44.1	17.8	21.8	12.1
	Total Dissolved Solids (mg/L)	7	97.0	188.0	118.0	124.4	30.1
	Total Suspended Solids (mg/L)	7	9.0	35.0	22.0	21.1	9.3
	Hardness (mg/L)	4	66.4	74.4	72.3	71.4	3.6
	Alkalinity (mg/L)	7	31.2	43.2	36.6	36.5	4.2
	Photic Zone (m)	7	1.08	2.64	2.10	1.88	0.62
	Secchi (m)	7	0.44	0.82	0.78	0.71	0.16
	Chemical						
	Ammonia Nitrogen (mg/L) [J, B]	1				0.500	
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.007	0.053	0.004	0.013	0.018
	Total Kjeldahl Nitrogen (mg/L) [B]						
	Total Nitrogen (mg/L) [B]						
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.003	0.002	0.002	0.000
	Total Phosphorus (mg/L) [B]						
	CBOD-5 (mg/L) [J]	7	1.6	3.7	2.4	2.6	0.8
	Chlorides (mg/L)	7	17.3	39.9	31.6	31.4	7.1
	Biological						
	Chlorophyll a (ug/L)	7	19.20	37.40	28.80	28.31	6.58
	E. coli (mpn/100mL) [J]	3	< 1	16	1	6	9

Station	Parameter	N	Min	Max	Med	Mean	SD
WEIC-8	Physical						
	Turbidity (NTU)	7	7.0	13.9	9.2	9.3	2.4
	Total Dissolved Solids (mg/L)	7	92.0	200.0	111.0	119.7	36.8
	Total Suspended Solids (mg/L)	7	6.0	14.0	10.0	10.4	2.8
	Hardness (mg/L)	4	63.3	72.0	67.1	67.4	4.2
	Alkalinity (mg/L)	7	30.1	47.2	40.8	40.4	6.2
	Photic Zone (m)	7	1.76	3.15	2.32	2.50	0.53
	Secchi (m)	7	0.62	1.35	0.91	0.90	0.26
	Chemical						
	Ammonia Nitrogen (mg/L) [J, B]	1				0.500	
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.007	0.076	0.004	0.025	0.032
	Total Kjeldahl Nitrogen (mg/L) [B]						
	Total Nitrogen (mg/L) [B]						
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L) [B]						
	CBOD-5 (mg/L) [J]	7	1.5	3.4	2.7	2.4	0.7
	Chlorides (mg/L)	7	21.0	37.9	26.0	26.3	5.6
	Biological						
	Chlorophyll a (ug/L)	7	16.60	36.30	22.40	24.87	8.14
	E. coli (mpn/100mL) [J]	3	< 1	1	1	1	0

Station	Parameter	N	Min	Max	Med	Mean	SD
WEIC-9	Physical						
	Turbidity (NTU)	7	7.0	13.8	8.6	9.6	2.4
	Total Dissolved Solids (mg/L)	7	91.0	166.0	111.0	116.4	25.7
	Total Suspended Solids (mg/L)	7	5.0	18.0	9.0	9.7	4.1
	Hardness (mg/L)	4	59.9	77.9	65.4	67.1	7.7
	Alkalinity (mg/L)	7	24.3	49.9	43.6	38.0	9.8
	Photic Zone (m)	7	2.01	3.35	2.75	2.74	0.49
	Secchi (m)	7	0.60	1.15	0.85	0.86	0.17
	Chemical						
	Ammonia Nitrogen (mg/L) [J, B]	1				0.500	
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.007	0.014	0.004	0.006	0.004
	Total Kjeldahl Nitrogen (mg/L) [B]						
	Total Nitrogen (mg/L) [B]						
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.005	0.002	0.002	0.002
	Total Phosphorus (mg/L) [B]						
	CBOD-5 (mg/L) [J]	7	1.4	2.2	2.0	1.9	0.3
	Chlorides (mg/L)	7	18.4	38.1	23.9	27.6	8.4
	Biological						
	Chlorophyll a (ug/L)	7	< 1.00	22.40	15.50	15.27	7.27
	E. coli (mpn/100mL) [J]	3	< 1	2	1	1	1

Station	Parameter	N	Min	Max	Med	Mean	SD
WEIC-12	**Physical**						
	Turbidity (NTU)	7	8.0	15.9	11.6	11.5	2.6
	Total Dissolved Solids (mg/L) [J]	7	82.0	140.0	116.0	112.0	19.8
	Total Suspended Solids (mg/L)	6	6.0	20.0	11.0	11.5	4.9
	Hardness (mg/L)	4	59.0	71.0	62.4	63.7	5.1
	Alkalinity (mg/L)	7	49.1	69.3	66.0	63.5	7.0
	Photic Zone (m)	7	2.16	2.90	2.65	2.56	0.26
	Secchi (m)	7	0.69	0.97	0.89	0.85	0.11
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.043	0.010	0.015	0.012
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.282	0.533	0.378	0.371	0.087
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.080	0.765	0.380	0.403	0.265
	Total Nitrogen (mg/L)	7	< 0.339	1.071	0.829	0.774	0.265
	Dissolved Reactive Phosphorus (mg/L)	7	0.010	0.077	0.050	0.042	0.026
	Total Phosphorus (mg/L)	7	0.044	0.109	0.089	0.081	0.023
	CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7	5.5	13.5	8.3	8.9	3.4
	Total Metals						
	Aluminum (mg/L)	1				0.222	
	Iron (mg/L)	1				0.257	
	Manganese (mg/L)	1				0.090	
	Dissolved Metals						
	Aluminum (mg/L)	1				< 0.033	
	Antimony (µg/L)	1				< 1.9	
	Arsenic (µg/L)	1				< 2.1	
	Cadmium (mg/L)	1				< 0.014	
	Chromium (mg/L)	1				< 0.013	
	Copper (mg/L)	1				< 0.013	
	Iron (mg/L)	1				< 0.026	
	Lead (µg/L)	1				< 1.7	
	Manganese (mg/L)	1				< 0.001	
	Mercury (µg/L)	1				< 0.080	
	Nickel (mg/L)	1				< 0.019	
	Selenium (µg/L)	1				< 1.7	
	Silver (mg/L)	1				< 0.002	
	Thallium (µg/L)	1				< 0.6	
	Zinc (mg/L)	1				< 0.030	
	Biological						
	Chlorophyll a (ug/L)	7	9.61	25.10	17.62	16.65	5.23
	E. coli (mpn/100mL)	7	< 1	25	2	8	9

J=one or more of the values provided are estimated;
< = Actual value is less than the detection limit;
B=Parameter has samples did not meet ADEM's laboratory QC requirements.