2005 Jordan Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
January 6, 2009

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INTRODUCTION

The Alabama Department of Environmental Management (ADEM) monitored Jordan Reservoir as part of the 2005 assessment of the Alabama, Coosa, and Tallapoosa (ACT) River basins under the Rivers and Reservoirs Monitoring Program (RRMP). Implemented in 1990, the objectives of this program were 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.

ADEM has classified Jordan Reservoir as a public water supply (PWS)/swimming (S)/fish & wildlife (F&W) waterbody. It must maintain all state water quality standards for swimmable waters, public water supply use, and to support the propagation of fish and wildlife. After evaluation, Jordan was determined to meet the criteria of all of its use classifications, making it the only reservoir of the Coosa River chain not on the Section §303(d) of the Clean Water Act List of Impaired Waterbodies (303(d) list).

The purpose of this report is to summarize data collected at five stations in Jordan Reservoir during the 2005 sampling season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's 20 year dataset. Monthly and 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)) are compared to ADEM's historical data.

METHODS

Sampling stations were determined using historical data and previous assessments [Fig. 1]. Specific location information can be found in Table 1. Water quality assessments were conducted at monthly intervals April-October. Jordan Reservoir was sampled in the dam forebay with an additional station added in the transitional area of the upper reservoir. Three tributary embayment stations were established in the largest embayments.

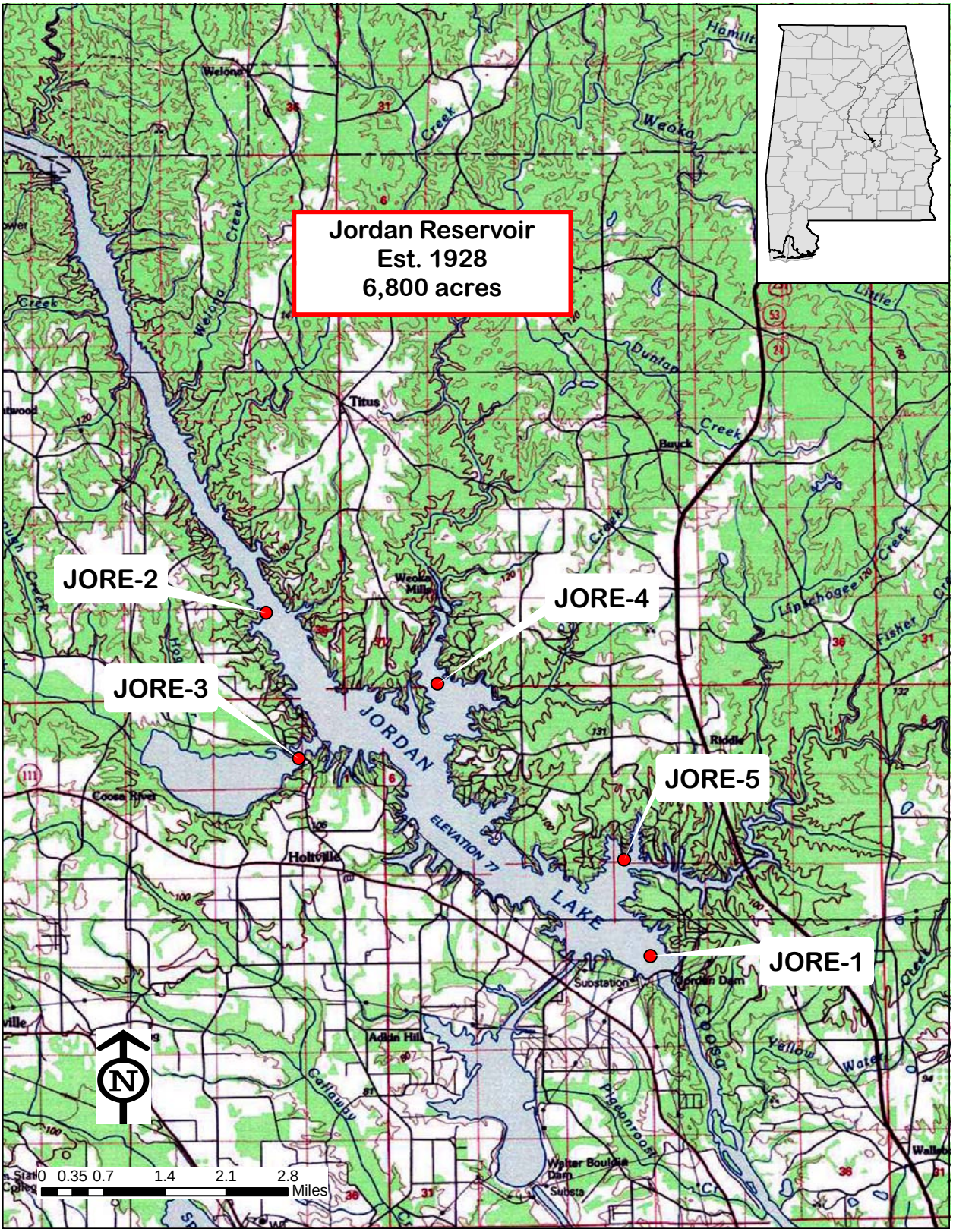


Figure 1. Jordan Reservoir with 2005 sampling locations. A description of each sampling location is provided in Table 1.

Table 1. Descriptions for the monitoring stations in 2005 for Jordan Reservoir.

Jordan Reservoir							
Sub-watershed	**County**	**Station Number**	**Report Designation**	**Waterbody Name**	**Station Description**	**Latitude**	**Longitude**
Lower Coosa (0315-0107)							
0901	Elmore	JORE-1**	Lower	Coosa R	Lower reservoir. Deepest point, main river channel, dam forebay .	32.6213	-86.2595
0901	Elmore	JORE-2	Upper	Coosa R	Upper reservoir. Deepest point, main river channel, upstream of the Weoka Creek / Coosa River confluence.	32.6783	-86.3338
0903	Elmore	JORE-3	Shoal Cr.	Shoal Cr	Deepest point, main creek channel, Shoal Creek embayment, immediately upstream of the Elmore County Rd. 23 bridge.	32.6542	-86.3277
0905	Elmore	JORE-4	Weoka Cr.	Weoka Cr	Deepest point, main creek channel, Weoka Creek embayment, approximately 0.5 miles upstream of lake confluence.	32.6664	-86.3006
0906	Elmore	JORE-5	Sofkahatchee Cr.	Sofkahatchee Cr	Deepest point, main creek channel, Sofkahatchee Creek embayment, approximately 0.5 miles upstream of lake confluence.	32.6372	-86.2645

**Growing season mean Chl a criteria will be established at this station in 2010

All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (SOP), Surface Water Quality Assurance Project Plan (QAPP), and Quality Management Plan (QMP).

RESULTS

Summary statistics of all data collected during 2005 are presented in Appendix Table 1. The table contains the min, max, median, average, and standard deviation of each parameter analyzed.

Mean TN concentrations ranged from 0.375 mg/l to 0.493 mg/l (Fig. 2). Monthly TN concentrations were lowest in May (Fig. 3 & 4).

Mean TP ranged from 0.032 mg/l in Shoal Creek to 0.047 mg/l in the upper reservoir (Fig. 2). Concentrations >0.025-0.100 mg/l are considered to be in the eutrophic range. Monthly TP concentrations were generally higher than historic means during April-July and generally lower than historic means during August-October (Fig. 3 & 4).

The mean chl *a* concentrations ranged from 11.63 ug/l at the upper mainstem station to 17.94 ug/l at the Weoka tributary embayment station (Fig. 2). Monthly chl *a* concentrations in September and October were lower than the corresponding historic means (Fig. 3 & 4). Mean chl *a* concentrations varied little over time (Fig. 5).

Mean TSS concentrations ranged from 7.00 mg/l in Shoal Creek to 8.29 mg/l in Weoka Creek (Fig. 2). Highest monthly TSS concentrations in the mainstem stations occurred in August (Fig. 3 & 4).

AGPT results showed co-limiting nutrients at the upper station and nitrogen limited conditions at the lower station (Table 2). By constrast, both stations were phosphorus limited in 2000. Mean standing crop (MSC) values in both years were well below the 5 mg/l limit considered to be protective in reservoirs and lakes (Raschke and Schultz 1987; Raschke et al. 1996)

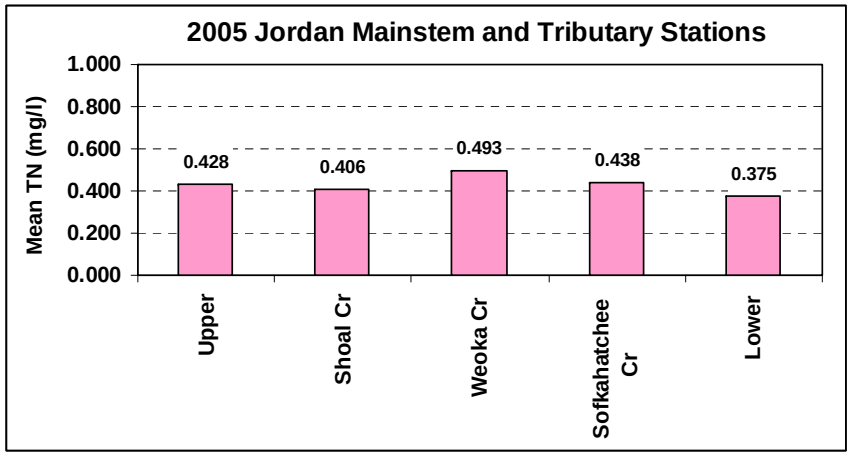
Dissolved oxygen concentrations were above the ADEM Water Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/l at all stations (Fig. 6 & 7). Both the upper and lower stations

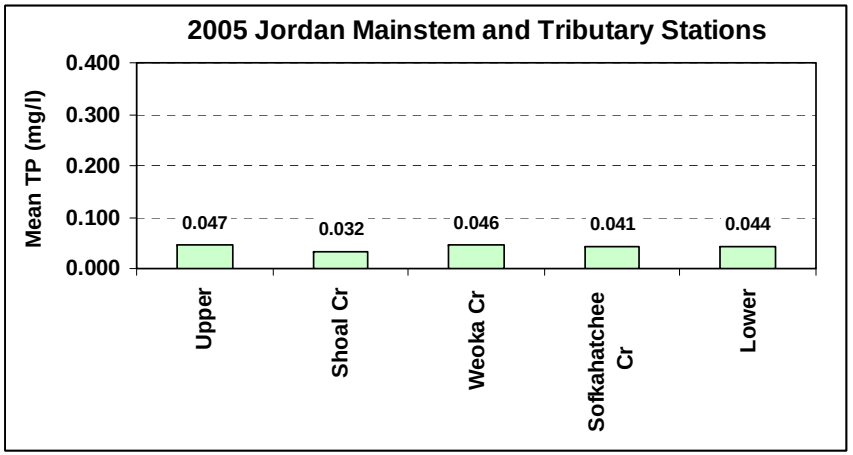
were stratified in most months June-September. Dissolved oxygen concentrations in tributaries generally declined April-October (Fig. 7).

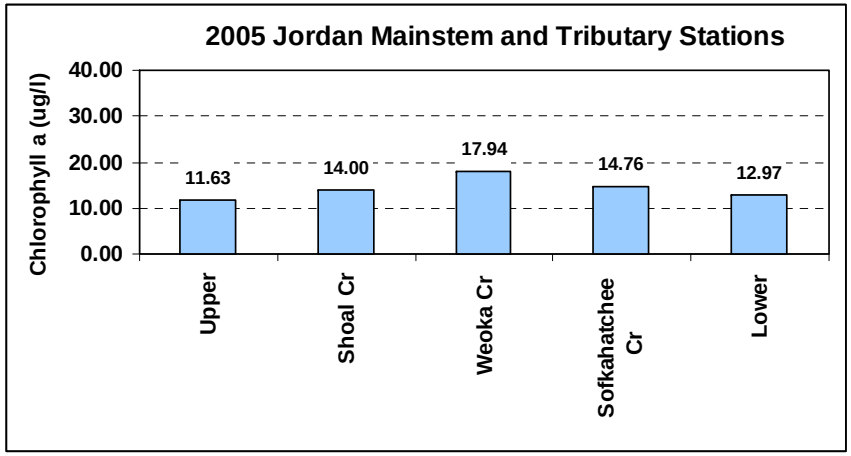
Carlson's TSI was calculated from corrected chl *a* concentrations. Values for the mainstem stations and tributaries were mostly eutrophic, with the exception of May values (Fig. 8).

August TSI values calculated from data collected at mainstem stations, 1985-2005, are presented in Fig. 9. August TSI values have remained relatively stable in the mid-eutrophic range since 1998.

Figure 2. Mean total nitrogen (TN), mean total phosphorus (TP), mean chlorophyll a (Chl *a*) and mean total suspended solids (TSS) of all stations in Jordan Reservoir, April-October 2005. Bar graphs consist of multiple stations, illustrated from upstream to downstream as the graph is read from left to right.







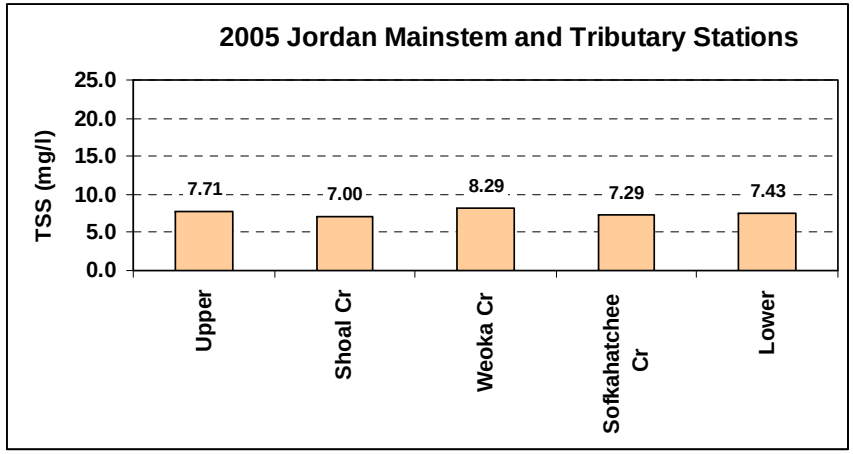
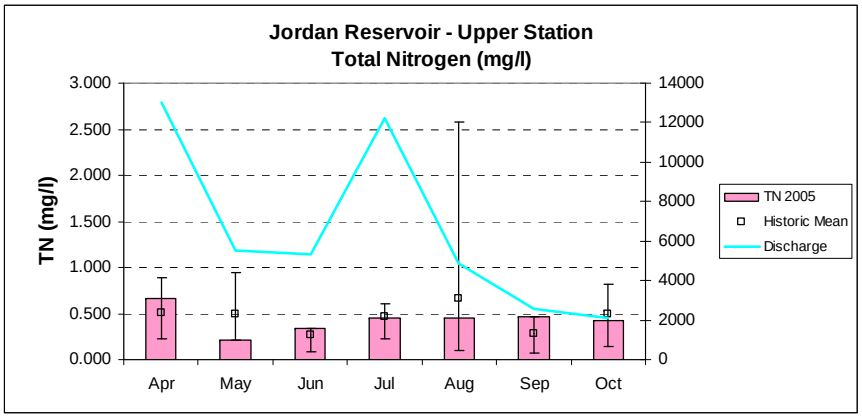
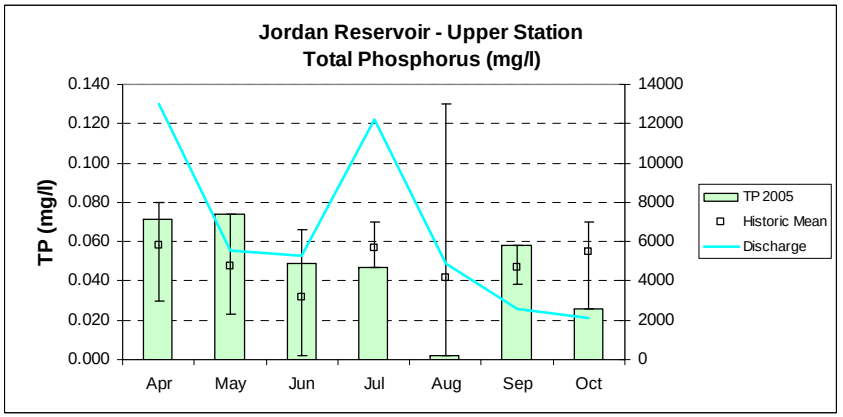
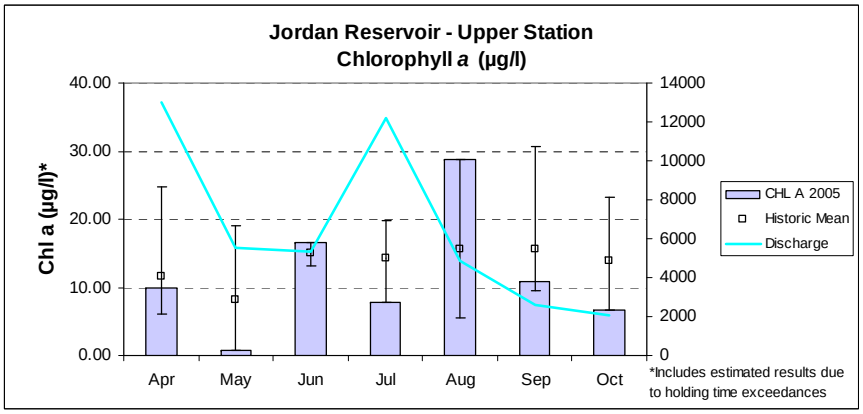


Figure 3. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl *a*) and total suspended solids (TSS) of the upper station in Jordan Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the upper station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (Coosa River near Rome, GA).







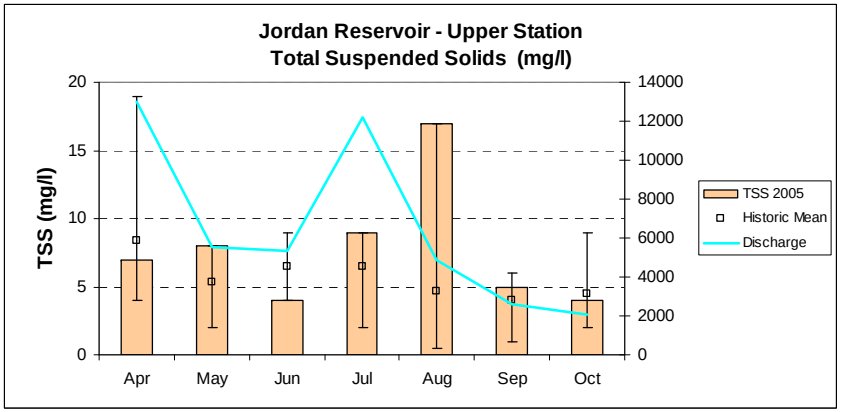


Figure 4. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl *a*) and total suspended solids (TSS) of the lower station in Jordan Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the lower station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (Coosa River near Rome, GA).

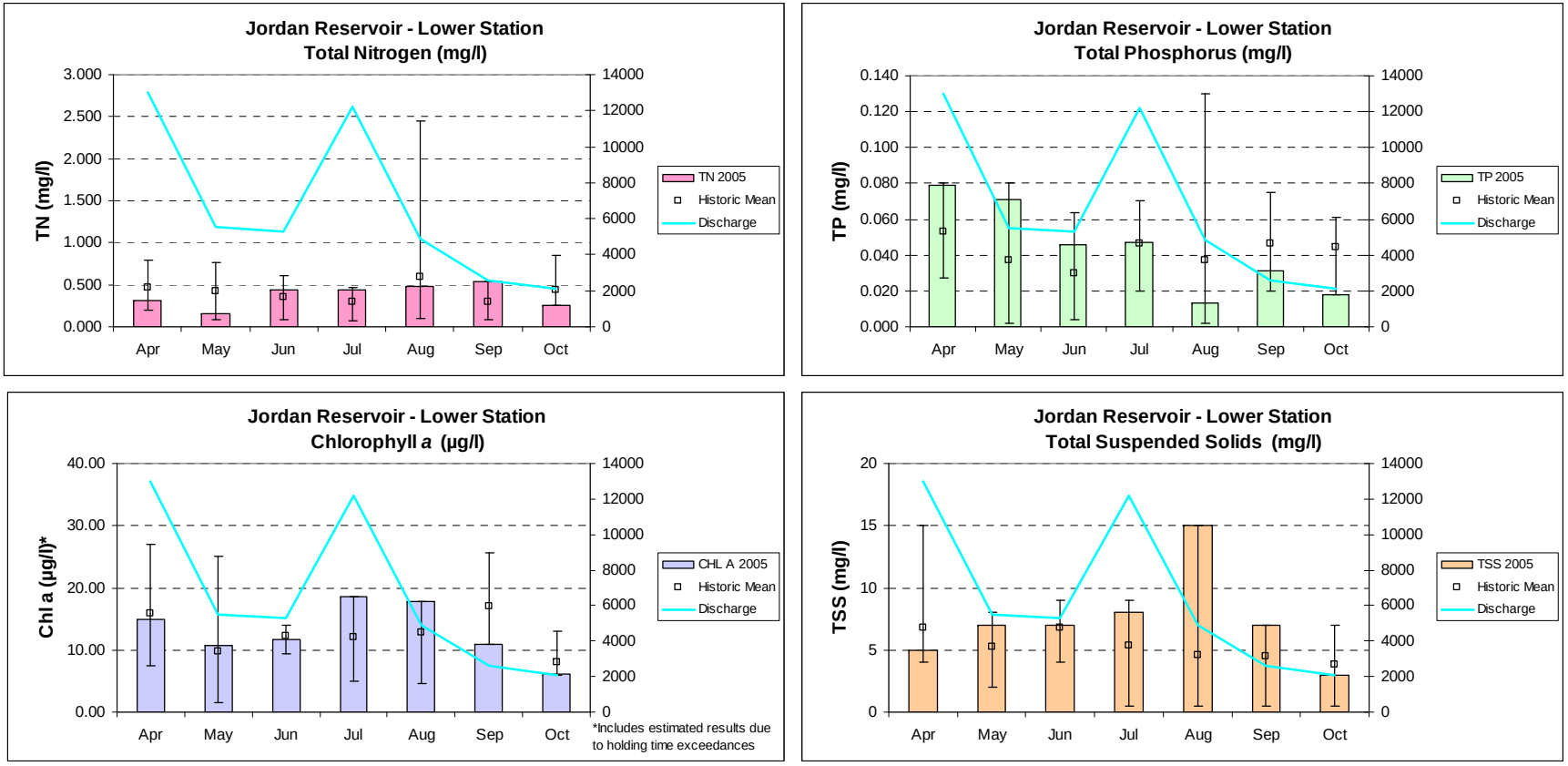


Figure 5. Growing season mean chlorophyll a concentrations of mainstem Jordan Reservoir, 1997 through 2005.

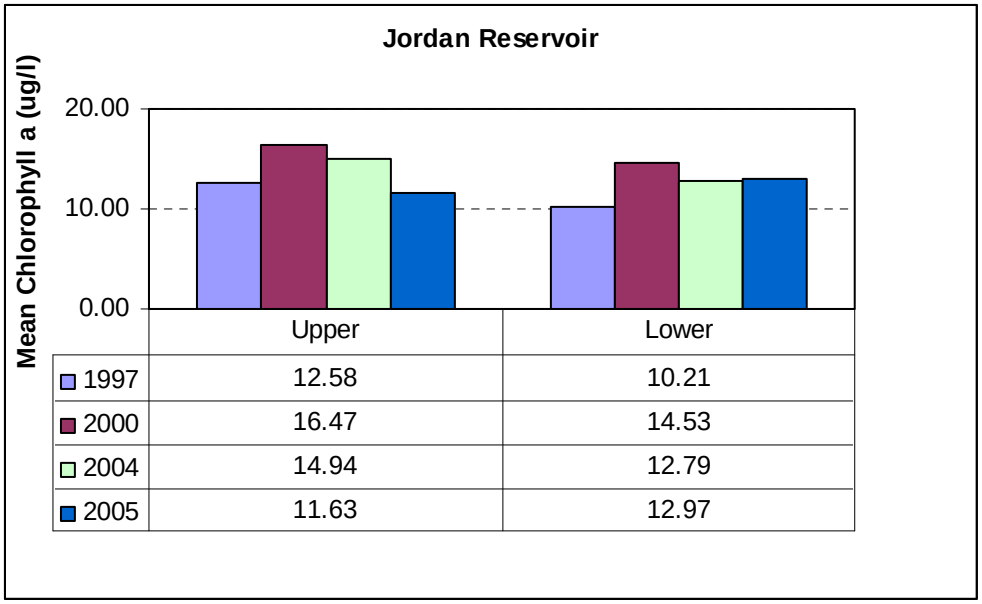


Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) or dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status from 2000 and 2005. Mean standing crop (MSC) values below 5 mg/l are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Station	2000 Control mean MSC	2000 Limiting Nutrient	2005 Control mean MSC	2005 Limiting Nutrient
Upper	1.79	Phosphorus	2.86	Co-Limiting
Lower	2.41	Phosphorus	2.74	Nitrogen

Figure 6. Depth profiles of dissolved oxygen (DO) and temperature (Temp) in Jordan Reservoir, June-September 2005. Although profiles were measured April-October, these select months were chosen as they represent the warmest water temperatures and most stratified dissolved oxygen concentrations. ADEM Water Quality Criteria pertaining to non-wadeable river and reservoir waters require a DO concentration of 5.0 mg/l at 5.0 ft (1.5m)(ADEM Admin. Code R. 335-6-10-.09). Under extreme natural conditions such as drought, the DO concentration may be as low as 4.0 mg/l.

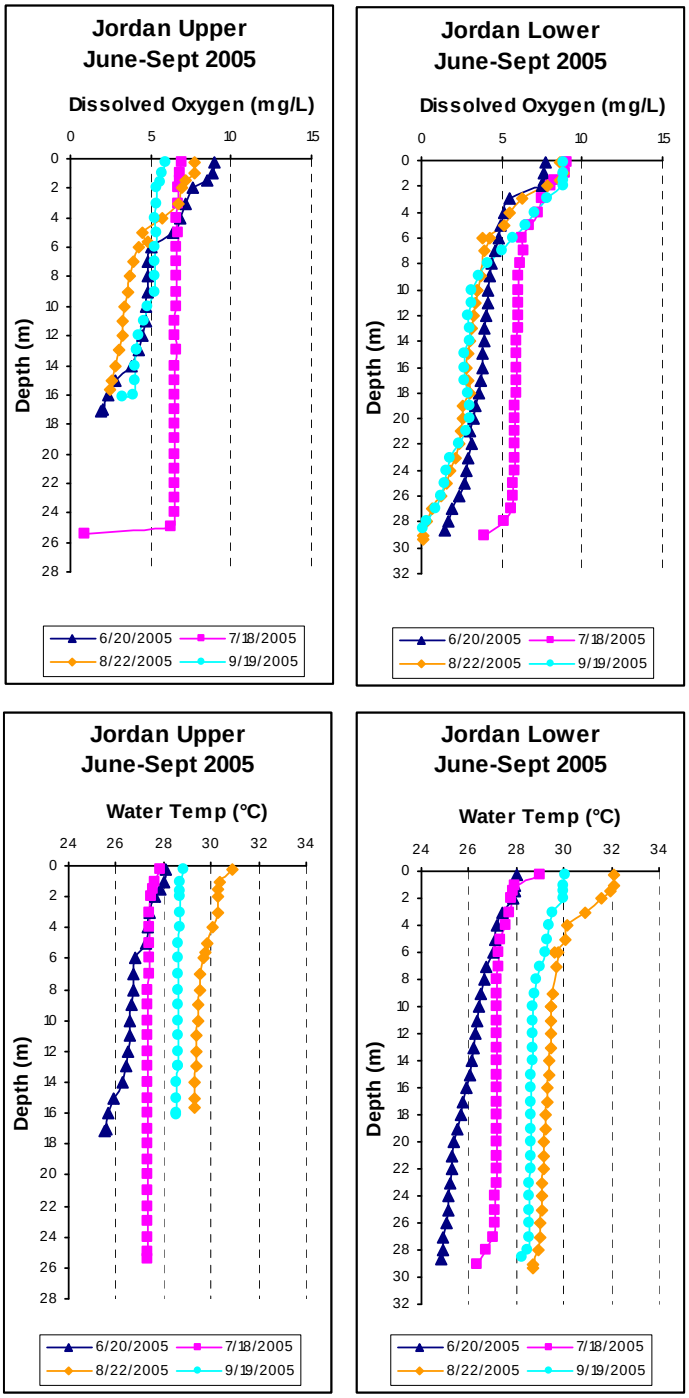


Figure 7. DO concentrations at 5 ft. for Jordan Reservoir tributaries collected April-October 2005. For tributary embayments, which are typically not as deep as mainstem stations and usually maintain a mixed water column throughout the season, profiles were collected but only the monthly DO concentrations at a depth of 5ft (1.5m) are graphed. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/l at this depth (ADEM 2005).

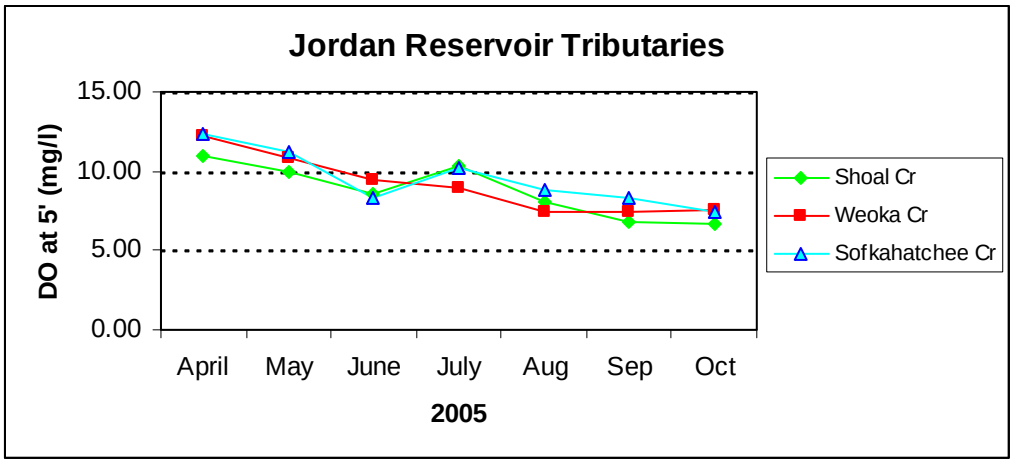
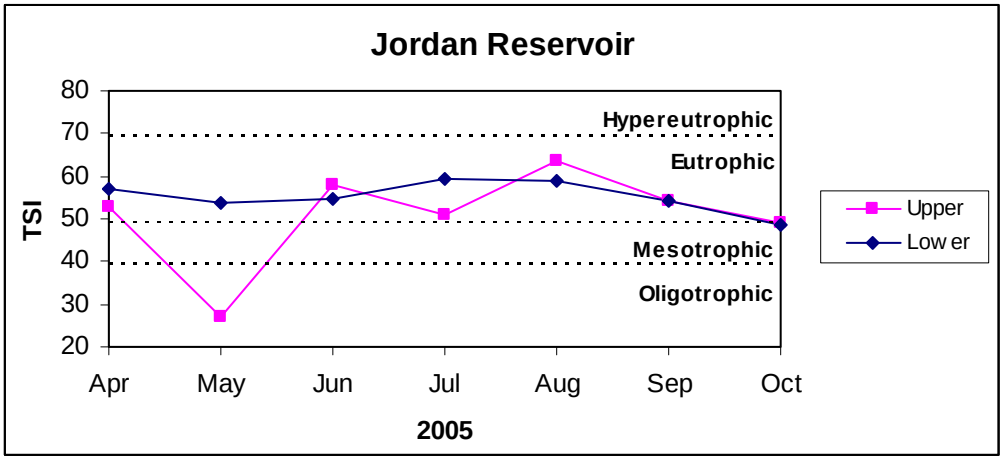


Figure 8. Monthly TSI values for mainstem and tributary stations using chlorophyll a concentrations and the Carlson's Trophic State Index calculation, April-October 2005.



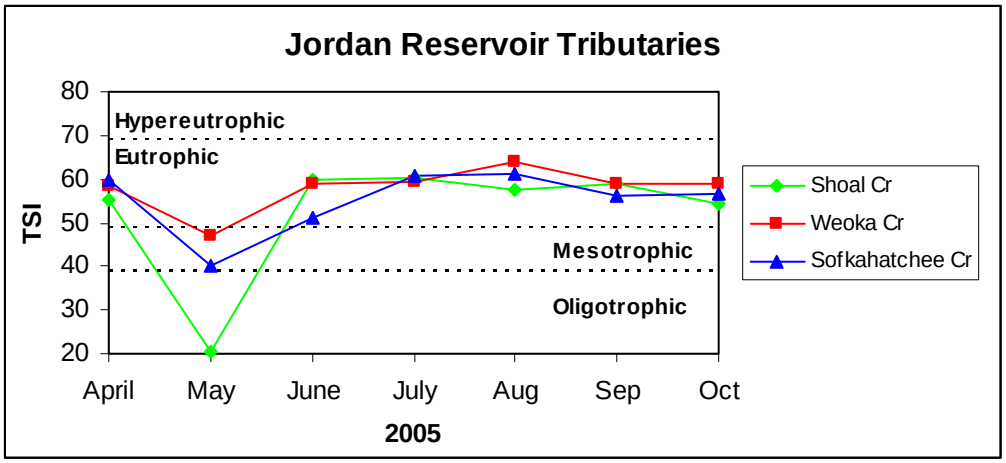
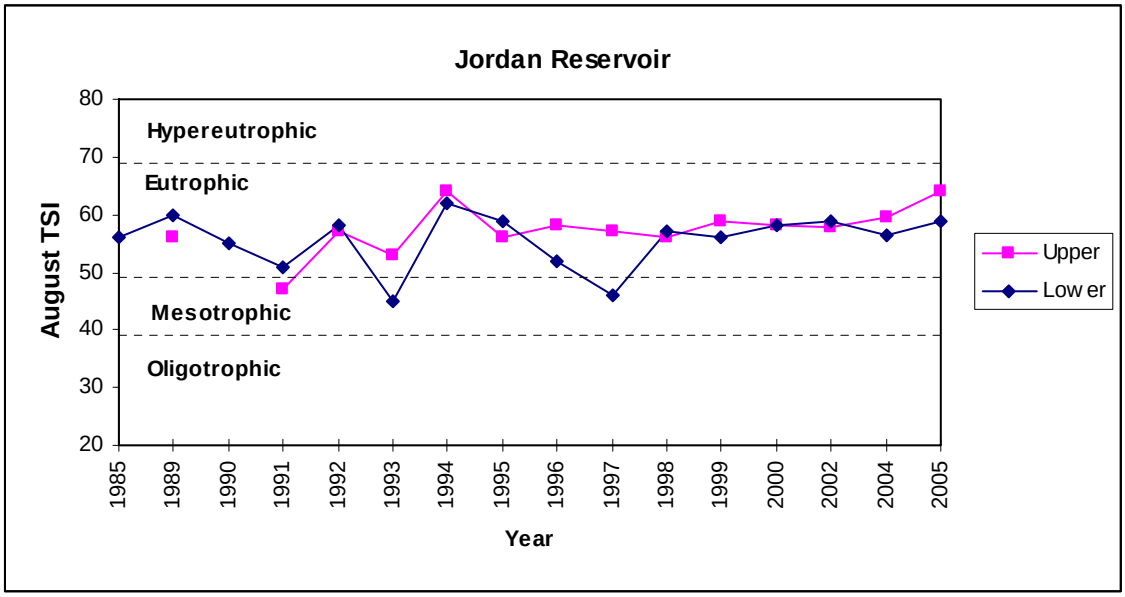


Figure 9. Trophic State Index values from critical period sampling (August sampling only) from 1985 to 2005.



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APPENDIX

Appendix Table 1. Summary of water quality data collected April-October, 2005. Minimum (Min) and maximum (Max) values calculated using minimum detection limits (MDL) when results were less than this value. Median (Med), average (Ave), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Station	Parameter	N	Min	Max	Median	Avg	SD
JORE-1	Alkalinity (mg/L)	7	39.0	60.5	50.1	49.7	7.9
	Hardness (mg/L)	4	40.8	56.7	47.8	48.3	6.7
	Total Dissolved Solids (mg/L)	7	59.0	97.0	80.0	78.0	13.0
	Total Suspended Solids (mg/L)	7	3.0	15.0	7.0	7.4	3.7
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.025	0.008	0.012	0.008
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.167	0.025	0.056	0.058
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.511	0.357	0.297	0.185
	Total Nitrogen (mg/L)	7	0.080	0.540	0.430	0.353	0.164
	Total Phosphorus (mg/L)	7	0.013	0.079	0.046	0.044	0.025
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.014	0.010	0.009	0.004
	Chlorophyll a (mg/L)[J]	7	6.14	18.51	11.75	12.97	4.39
	Turbidity (NTU)	7	1.61	6.39	2.73	3.33	1.70
	Secchi (m)	7	1.00	2.65	1.65	1.71	0.53
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	1	---
JORE-2	Alkalinity (mg/L)	7	38.9	56.2	50.5	49.0	6.3
	Hardness (mg/L)	4	42.3	56.9	46.7	48.1	6.7
	Total Dissolved Solids (mg/L)	7	8.0	108.0	81.0	75.6	31.4
	Total Suspended Solids (mg/L)	7	4.0	17.0	7.0	7.7	4.5
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.048	0.008	0.016	0.016
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.250	0.141	0.121	0.093
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.469	0.318	0.297	0.140
	Total Nitrogen (mg/L)	7	0.140	0.660	0.450	0.417	0.156
	Total Phosphorus (mg/L)	7	< 0.004	0.074	0.049	0.047	0.025
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.020	0.009	0.010	0.006
	Chlorophyll a (mg/L)[J]	7	0.71	28.84	9.88	11.63	8.96
	Turbidity (NTU)	7	3.44	6.47	4.57	4.89	1.21
	Secchi (m)	7	1.12	1.53	1.23	1.27	0.16
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	10	---
JORE-3	Alkalinity (mg/L)	7	32.9	55.4	47.7	45.3	8.3
	Hardness (mg/L)	4	38.7	57.1	44.6	46.2	8.4
	Total Dissolved Solids (mg/L)	7	48.0	97.0	81.0	76.3	18.9
	Total Suspended Solids (mg/L)	7	4.0	14.0	5.0	7.0	4.0
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.056	0.008	0.017	0.018
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.159	0.014	0.044	0.062
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.664	0.317	0.351	0.180
	Total Nitrogen (mg/L)	7	0.080	0.680	0.380	0.397	0.185
	Total Phosphorus (mg/L)	7	< 0.004	0.058	0.028	0.032	0.019
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.010	0.009	0.007	0.004
	Chlorophyll a (mg/L)[J]	7	0.36	20.29	16.02	14.00	6.89
	Turbidity (NTU)	7	2.86	5.61	4.32	4.11	0.88
	Secchi (m)	7	1.11	1.80	1.35	1.46	0.28
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	1	---

Station	Parameter	N	Min	Max	Median	Avg	SD
JORE-4	Alkalinity (mg/L)	7	34.8	53.1	45.4	43.9	6.8
	Hardness (mg/L)	4	38.1	56.6	41.7	44.5	8.2
	Total Dissolved Solids (mg/L)	7	29.0	96.0	73.0	69.3	22.4
	Total Suspended Solids (mg/L)	7	4.0	14.0	8.0	8.3	3.3
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.072	0.008	0.025	0.026
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.131	0.011	0.027	0.047
	Total Kjeldahl Nitrogen (mg/L)	7	0.178	1.044	0.423	0.466	0.288
	Total Nitrogen (mg/L)	7	0.180	1.060	0.430	0.494	0.287
	Total Phosphorus (mg/L)	7	< 0.004	0.083	0.046	0.046	0.028
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.014	0.006	0.006	0.004
	Chlorophyll a (mg/L)[J]	7	5.34	30.26	18.16	17.94	7.21
	Turbidity (NTU)	7	2.81	5.54	4.55	4.31	0.96
	Secchi (m)	6	1.19	1.66	1.31	1.21	0.56
	Fecal Coliform (col/100 mL)	1	---	---	---	46	---
JORE-5	Alkalinity (mg/L)	7	36.8	52.7	46.5	46.5	6.0
	Hardness (mg/L)	4	39.6	57.4	44.6	46.5	8.6
	Total Dissolved Solids (mg/L)	7	45.0	103.0	84.0	75.3	20.6
	Total Suspended Solids (mg/L)	7	4.0	10.0	8.0	7.3	2.4
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.058	0.008	0.015	0.019
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.099	0.014	0.029	0.034
	Total Kjeldahl Nitrogen (mg/L)	7	0.218	0.778	0.433	0.409	0.194
	Total Nitrogen (mg/L)	7	0.220	0.810	0.450	0.439	0.212
	Total Phosphorus (mg/L)	7	< 0.004	0.081	0.049	0.041	0.028
	Dissolved Reactive Phosphorus (mg/L)	7	0.005	0.016	0.007	0.008	0.004
	Chlorophyll a (mg/L)[J]	7	2.67	23.14	14.42	14.76	7.45
	Turbidity (NTU)	7	1.83	5.12	2.82	3.04	1.16
	Secchi (m)	7	1.27	2.01	1.61	1.63	0.29
	Fecal Coliform (col/100 mL)	1	---	---	---	25	---

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