2010 Neely Henry 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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Table of Contents

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

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Neely Henry Reservoir is located in northeast Alabama on the Coosa River near the city of Gadsden, Alabama. It is one of the original dams built as a part of an Alabama Power Company construction program in the late 1950s and the 1960s. The 11,235 acre reservoir borders Etowah, St. Clair and Calhoun counties.

The Alabama Department of Environmental Management (ADEM) monitored Neely Henry 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).

Neely Henry 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 Neely Henry for nutrients, OE/DO and pH in the 2010 §303(d) lists after a TMDL developed to address these pollutants was approved in 2008 (ADEM 2008c). A TMDL for the last two segments of Neely Henry that remain on the §303(d) list with impairments due to PCBs will be developed based upon ongoing RCRA/CERCLA program activities.

In 2010, the ADEM implemented specific water quality criteria for nutrient management at the dam forebay and mid stations of Neely Henry Reservoir. These criteria represent the maximum growing season mean (April-October) chlorophyll *a* (chl *a*) concentration allowable while still fully supporting Neely Henry Reservoir's PWS/S/F&W use classifications.

The purpose of this report is to summarize data collected at nine stations in Neely Henry 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. Neely Henry Reservoir was sampled in the dam forebay, mid and upper reservoir along with six tributary stations; Cane, Blue Eye, Choccolocco, Dye, Cropwell and Clear Creeks.

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's (APCo) dam discharge data and ADEM's previously collected data to help interpret the 2010 results.

Figure 1. Neely Henry Reservoir with 2010 sampling locations.

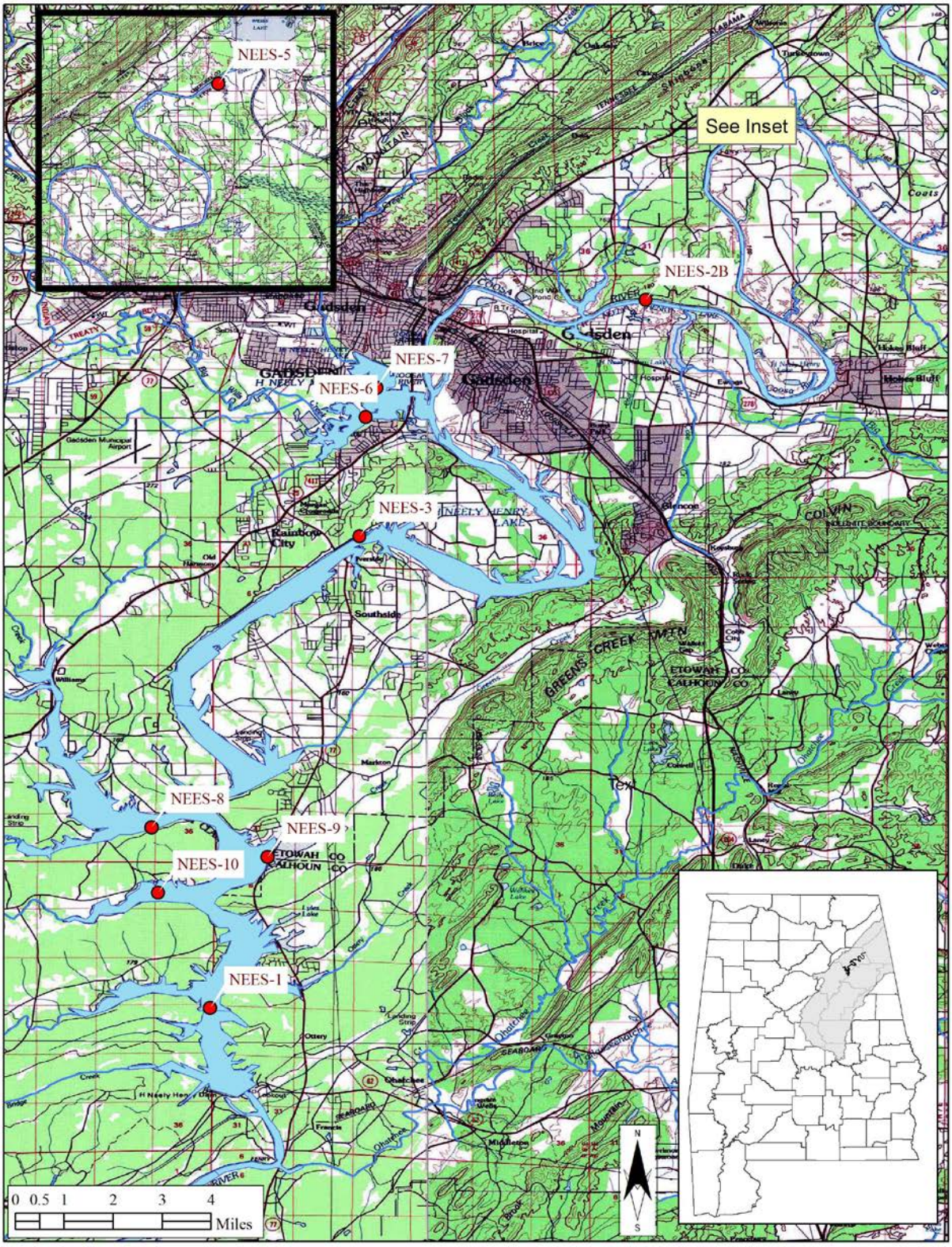


Table 1. Descriptions of the 2010 monitoring stations in Neely Henry Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
031501060309	Calhoun	NEES-1*	Lower	Coosa R	Deepest point, main river channel, dam forebay.	18 µg/L	33.80662	-86.06447
031501060204	Etowah	NEES-2B	Upper	Coosa R	Deepest point, main river channel, reservoir mile 28.0, above Gadsden.		34.01744	-85.93572
031501060309	Etowah	NEES-3*	Mid	Coosa R	Mid reservoir. Deepest point, main river channel, immediately upstream of Alabama Hwy 77 bridge. Reservoir mile 16.0.	18 µg/L	33.94763	-86.02021
031501060201	Etowah	NEES-5	Ballplay Cr	Ballplay Cr	Deepest point, main creek channel, Ballplay Creek embayment, approximately 0.5 miles upstream of Coosa River confluence.		34.11786	-85.81752
031501060108	Etowah	NEES-6	Big Wills Cr	Big Wills Cr	Deepest point, main creek channel, Big Wills Creek embayment, approximately 1.0 mi upstream of US Hwy. 411 bridge.		33.98290	-86.01840
031501060107	Etowah	NEES-7	Black Cr	Black Cr	Deepest point, main creek channel, Black Creek embayment, immediately upstream of Interstate 759 bridge.		33.99157	-86.01532
031501060306	Etowah	NEES-8	Big Canoe Cr	Big Canoe Cr	Deepest point, main creek channel, Big Canoe Creek embayment, downstream of Canoe Creek Campground.		33.86174	-86.08170
031501060309	Etowah	NEES-9	Greens Cr	Greens Cr	Deepest point, main creek channel, Greens Creek embayment, immediately upstream of AL Hwy. 77 bridge.		33.85293	-86.04744
031501060307	St Clair	NEES-10	Beaver Cr	Beaver Cr	Deepest point, main creek channel, Beaver Creek embayment, upstream of Greensport Marina.		33.84250	-86.07972

*Growing season mean chl *a* criteria implemented at this station in 2010.

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). In 2005, the upper mainstem monitoring station was moved from NEES-2 to NEES-2B, above the influence of the city of Gadsden. Since this is the second year of monitoring, no historic analysis could be performed in Figs. 6-10 on the upper station (NEES-2B). 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 Ballplay Cr tributary embayment station (NEES-5) 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 value was calculated for the Big Wills Cr station (Fig. 2). The 2010 mean concentrations in all mainstem stations were the lowest since 2000. Growing season mean TN concentrations at all mainstem stations have declined overall from 2000-2010. Black, Big Wills and Big Canoe Cr stations showed an increase in mean TN concentrations compared to 2005 while concentrations at Green and Beaver Cr stations decreased. Monthly TN concentrations at the upper and mid stations were highest in September and the lower station in July (Fig. 6). Historic high monthly TN concentrations were measured in the lower station in July and the mid station September.

In 2010, the highest mean growing season TP value was calculated for the Big Wills Cr station (Fig. 3). The 2010 mean concentrations in all three mainstem stations were the lowest

calculated. Mean concentrations in Big Wills and Black Cr stations increased from 2005 while Big Canoe, Greens and Beaver Creeks were similar to previous sampling. Monthly TP concentrations for mainstem stations were relatively stable across the growing season and were below historic means in most months (Fig. 7).

In 2010, the highest mean growing season chl *a* value was calculated for the mid station (Fig. 4). Mean concentrations in all tributaries except Ballplay Cr increased from 2005 to 2010. Mean chl *a* concentrations at Ballplay have decreased since 2000. The growing season mean chl *a* value calculated in both the lower and mid stations exceeded the established criteria limits placing the reservoir in category 4A[1]. Monthly chl *a* was highest in July at the upper station and August in the lower station (Fig. 8). Monthly concentrations at the mid station increased overall from April-October, exceeding historic means in most months sampled.

In 2010, the highest mean growing season TSS value was calculated for the Black Cr station (Fig. 5). Growing season mean TSS concentrations at all mainstem stations have declined overall 1997-2010. Mean concentrations have decreased since 2000 in Ballplay, Big Canoe, Greens, and Beaver Creek stations. The highest monthly TSS concentration was measured in August at the upper station and June in both the mid and lower stations (Fig. 9). Historic lows were measured in October for the mid and lower stations. The mid station was above historic means April-Jun.

AGPT results for the upper station indicated nitrogen limited conditions in August 2010 (Table 2). Due to resource constraints, AGPT samples were not collected at the mid and lower stations in August. Mean MSC at the more riverine upper station was below 20.0 mg/L, the value that Raschke et al. (1996) defined as protective of flowing stream and river systems.

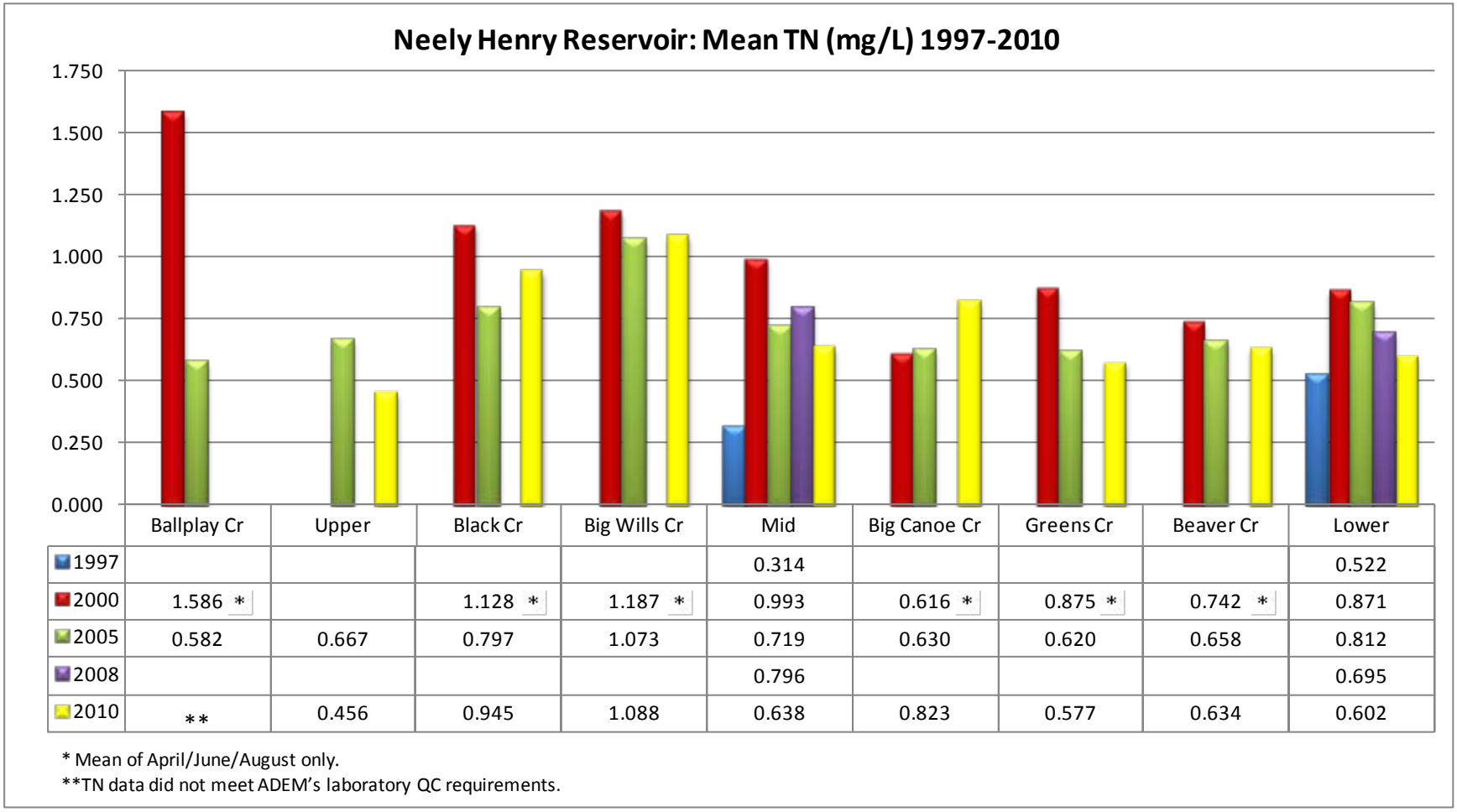
DO concentrations in Ballplay Cr were below the ADEM Criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in July and August (ADEM Admin. Code R. 335-6-10-.09) (Fig. 10). All other measurements of DO concentrations in Neely Henry Reservoir met the criteria limit, though the upper station was near 5 mg/L in August. The lower station was stratified May-Oct with a

[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).

majority of the water column near or below 5.0 mg/L (Fig. 11). The mid station was stratified April-October (Fig. 12). Highest temperatures were reached June-August.

Monthly TSI values were calculated using chl *a* concentrations and Carlson's Trophic State Index (Fig. 13). The mid and Big Wills Cr stations were nearly hypereutrophic in Jul and October. TSI values for all stations but Ballplay Cr remained highly eutrophic June-October. Ballplay Cr was mesotrophic in April, oligotrophic in May and eutrophic the remainder of the growing season.

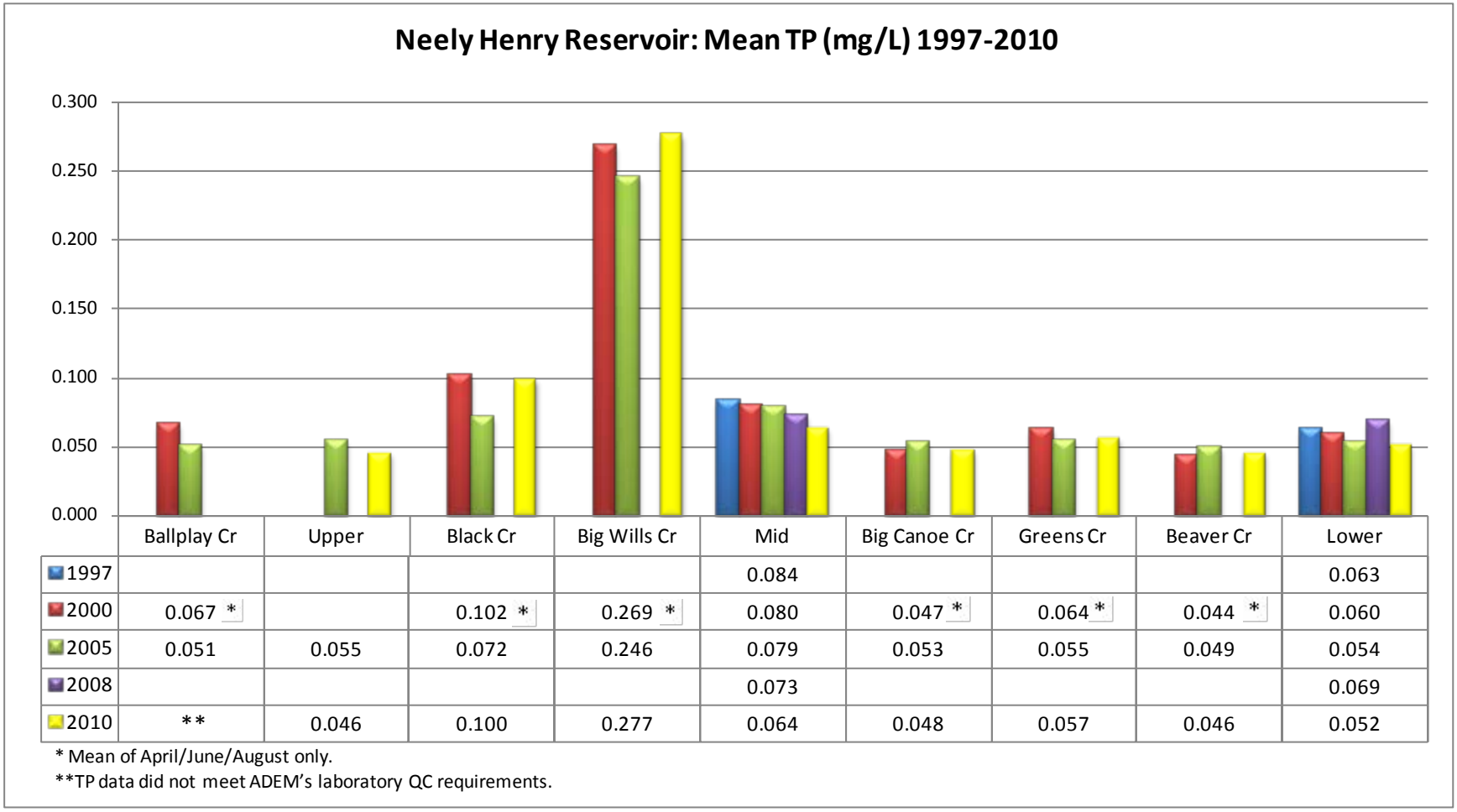
Figure 2. Mean growing season TN measured in Neely Henry Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Ballplay Cr	Upper	Black Cr	Big Wills Cr	Mid	Big Canoe Cr	Greens Cr	Beaver Cr	Lower
1997					0.314				0.522
2000	1.586 *		1.128 *	1.187 *	0.993	0.616 *	0.875 *	0.742 *	0.871
2005	0.582	0.667	0.797	1.073	0.719	0.630	0.620	0.658	0.812
2008					0.796				0.695
2010	**	0.456	0.945	1.088	0.638	0.823	0.577	0.634	0.602

* Mean of April/June/August only.
**TN data did not meet ADEM's laboratory QC requirements.

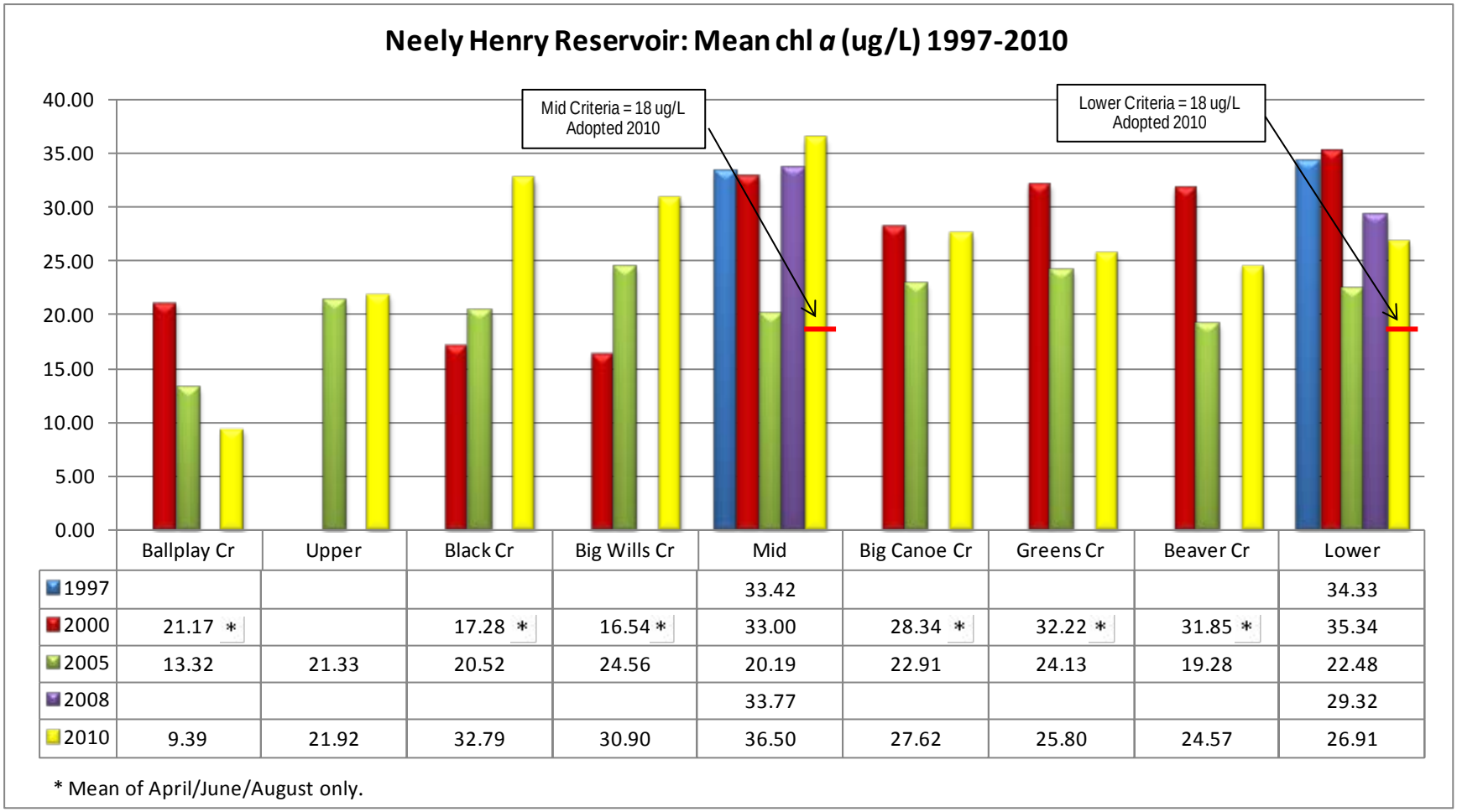
Figure 3. Mean growing season TP measured in Neely Henry Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Ballplay Cr	Upper	Black Cr	Big Wills Cr	Mid	Big Canoe Cr	Greens Cr	Beaver Cr	Lower
1997					0.084				0.063
2000	0.067 *		0.102 *	0.269 *	0.080	0.047 *	0.064 *	0.044 *	0.060
2005	0.051	0.055	0.072	0.246	0.079	0.053	0.055	0.049	0.054
2008					0.073				0.069
2010	**	0.046	0.100	0.277	0.064	0.048	0.057	0.046	0.052

* Mean of April/June/August only.
**TP data did not meet ADEM's laboratory QC requirements.

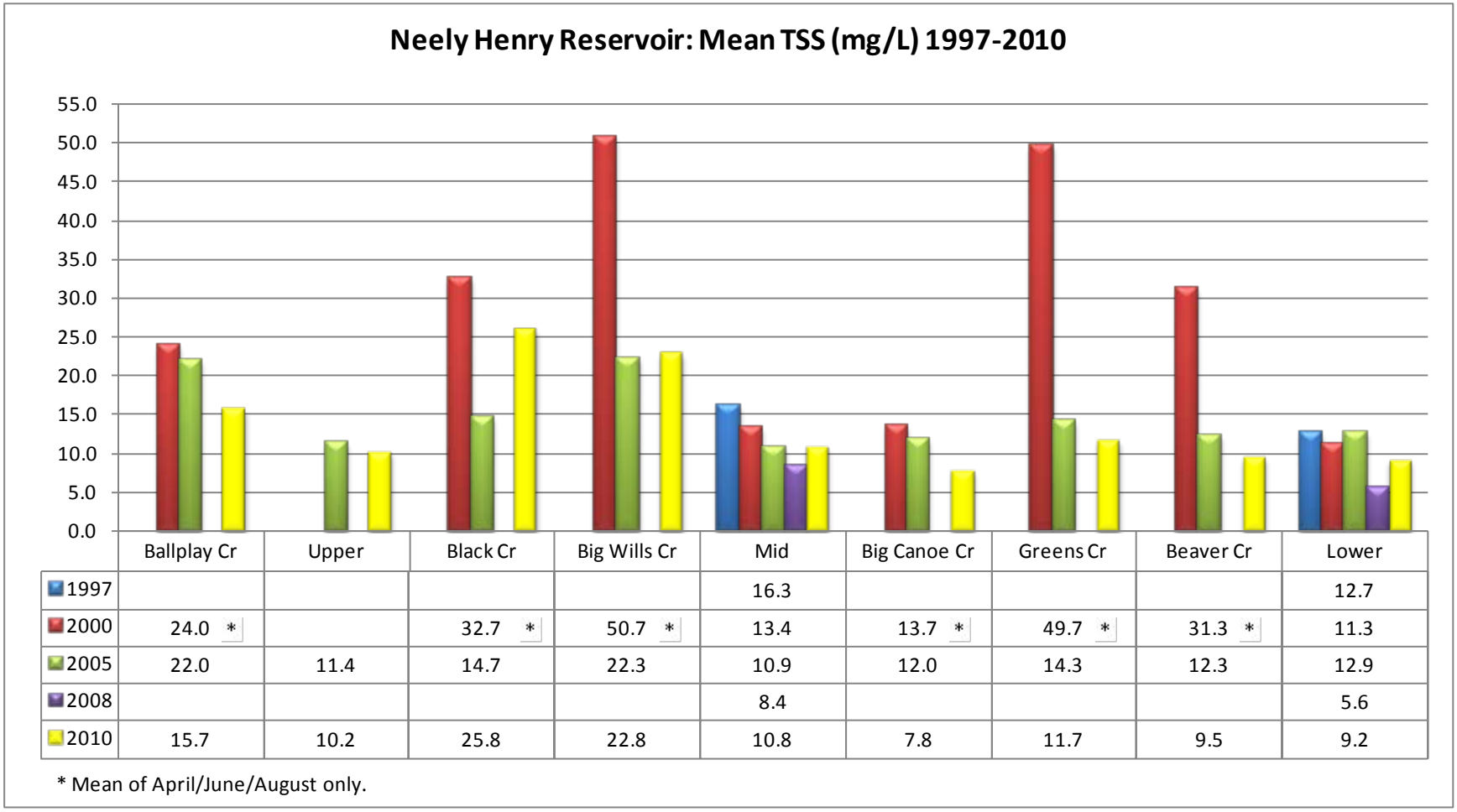
Figure 4. Mean growing season chl *a* measured in Neely Henry Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria applies to the growing season mean of the mid and lower stations only.



	Ballplay Cr	Upper	Black Cr	Big Wills Cr	Mid	Big Canoe Cr	Greens Cr	Beaver Cr	Lower
1997					33.42				34.33
2000	21.17 *		17.28 *	16.54 *	33.00	28.34 *	32.22 *	31.85 *	35.34
2005	13.32	21.33	20.52	24.56	20.19	22.91	24.13	19.28	22.48
2008					33.77				29.32
2010	9.39	21.92	32.79	30.90	36.50	27.62	25.80	24.57	26.91

* Mean of April/June/August only.

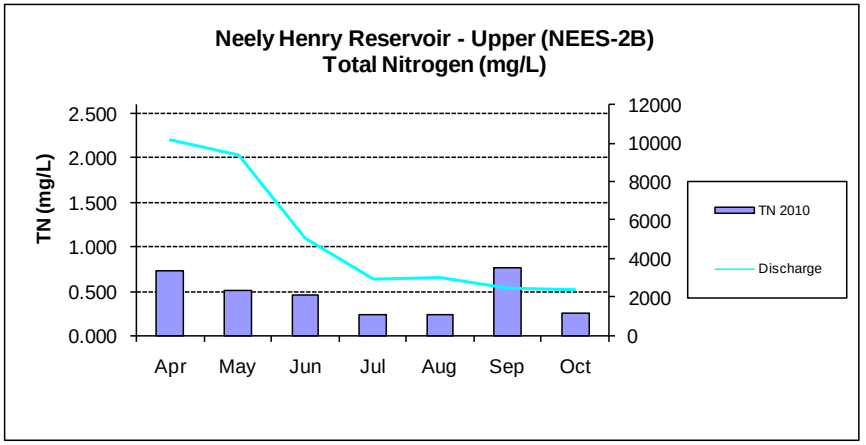
Figure 5. Mean growing season TSS measured in Neely Henry Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.

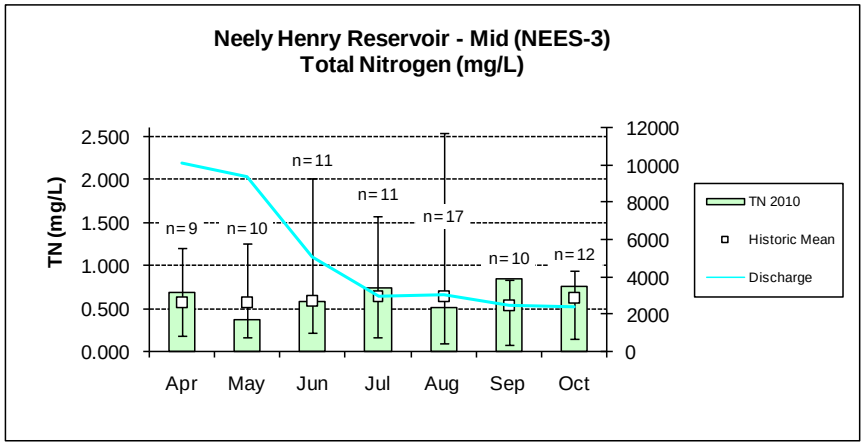


	Ballplay Cr	Upper	Black Cr	Big Wills Cr	Mid	Big Canoe Cr	Greens Cr	Beaver Cr	Lower
1997					16.3				12.7
2000	24.0 *		32.7 *	50.7 *	13.4	13.7 *	49.7 *	31.3 *	11.3
2005	22.0	11.4	14.7	22.3	10.9	12.0	14.3	12.3	12.9
2008					8.4				5.6
2010	15.7	10.2	25.8	22.8	10.8	7.8	11.7	9.5	9.2

* Mean of April/June/August only.

Figure 6. Monthly TN concentrations measured in Neely Henry Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Neely Henry Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges (for months with 3 or more values) are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





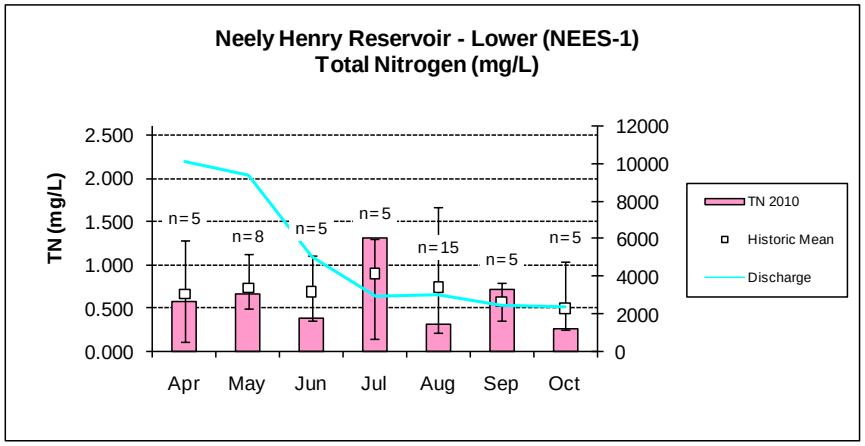


Figure 7. Monthly TP concentrations measured in Neely Henry Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Neely Henry Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges (for months with 3 or more values) are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

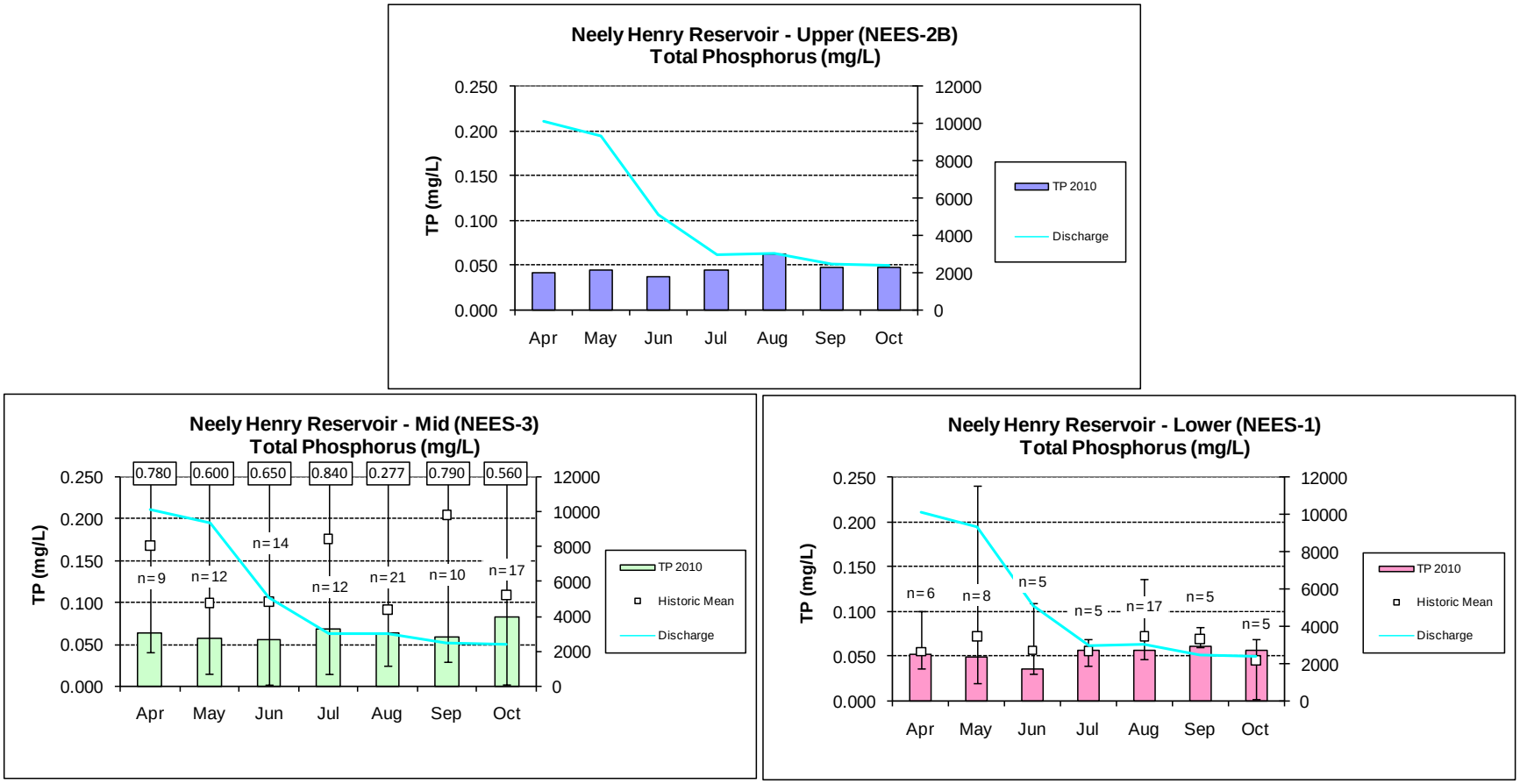
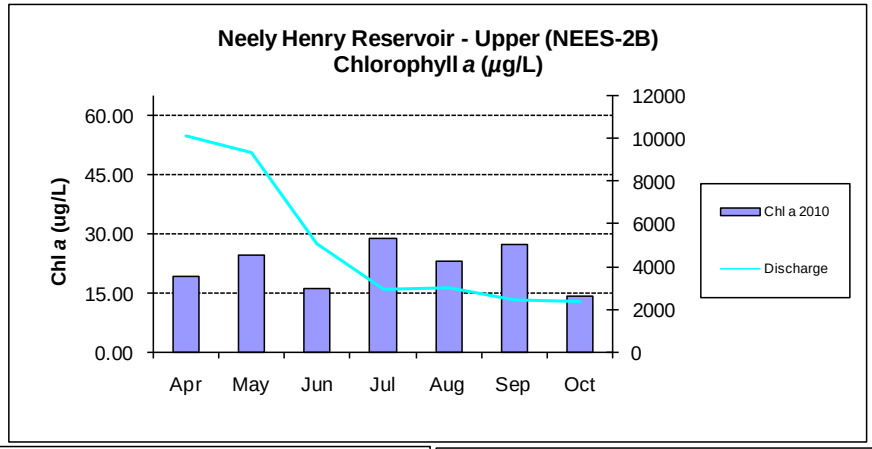
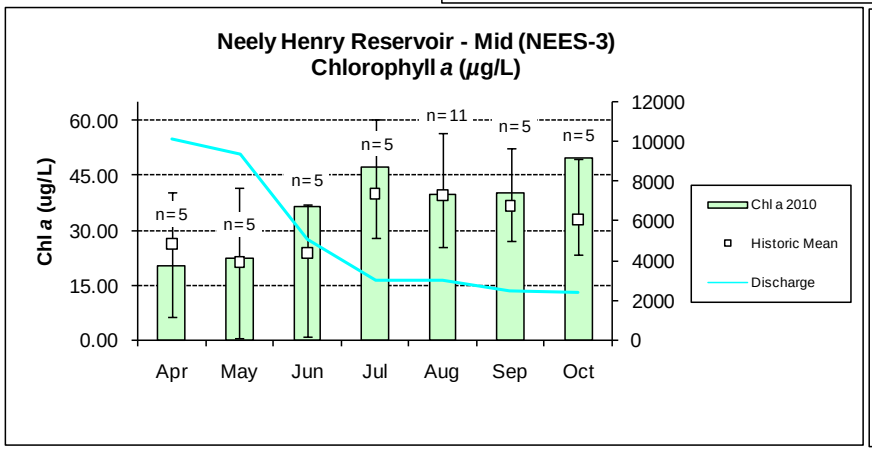


Figure 8. Monthly chl *a* concentrations measured in Neely Henry Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Neely Henry Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges (for months with 3 or more values) are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





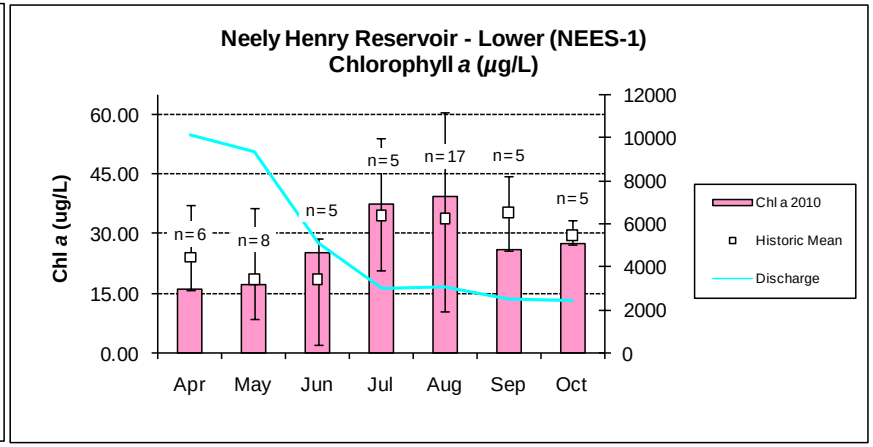
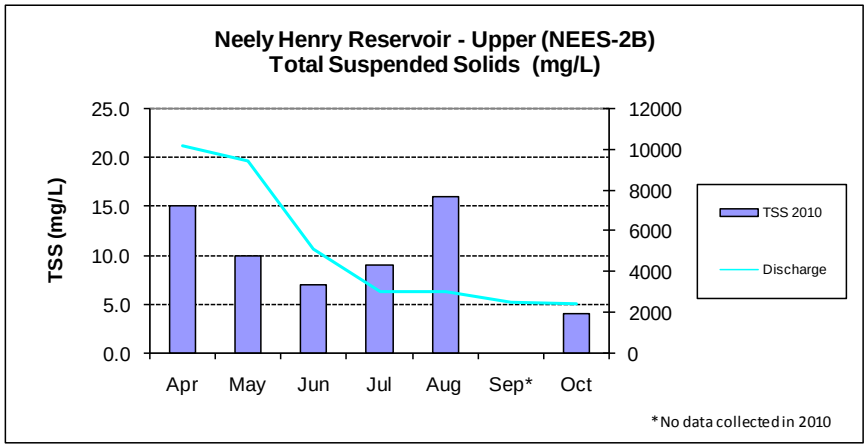
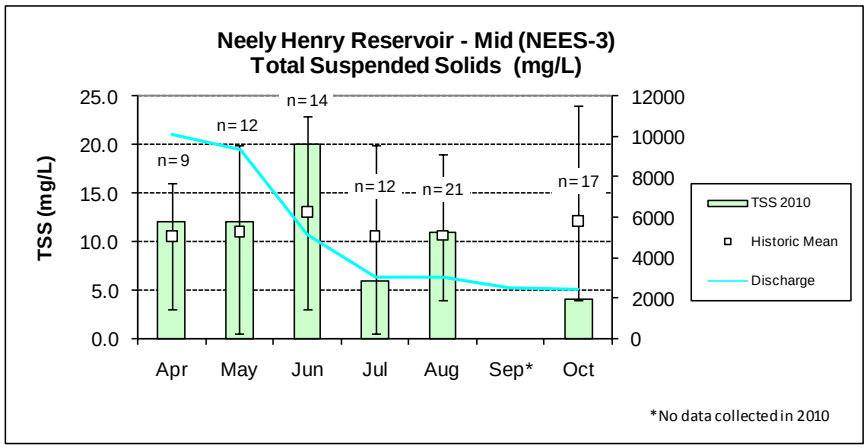


Figure 9. Monthly TSS concentrations measured in Neely Henry Reservoir, April-October 2010 vs. average monthly discharge. Monthly discharge acquired from APCo at Neely Henry Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max ranges (for months with 3 or more values) are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





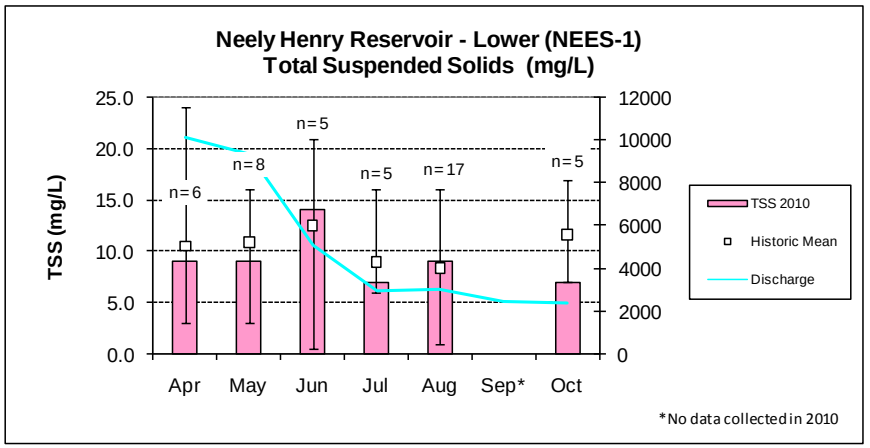
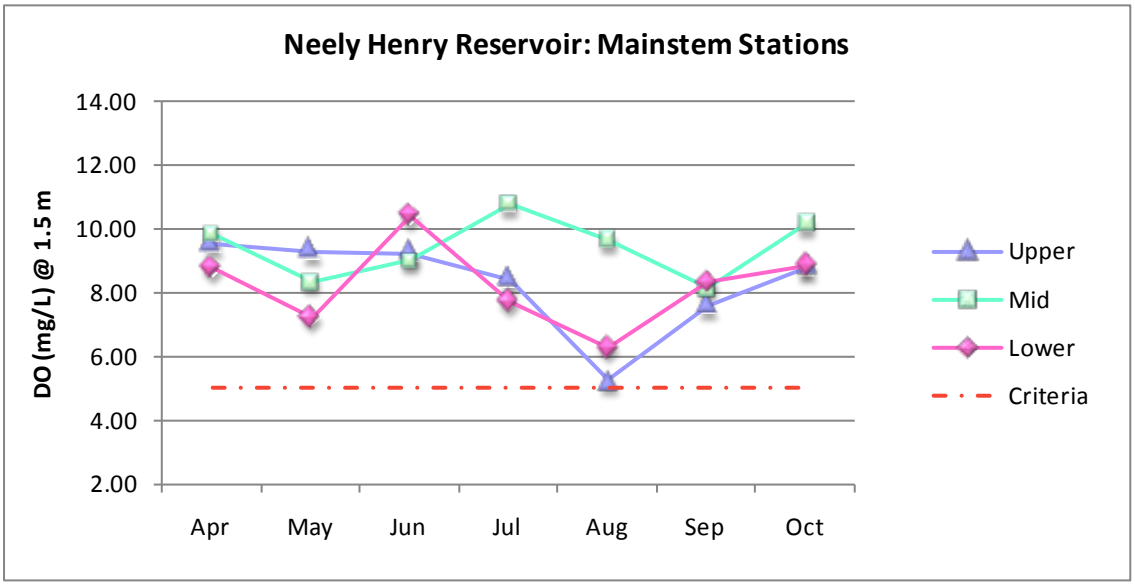


Table 2. Algal growth potential test results, Neely Henry Reservoir, 1999-2010 (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers. (Raschke and Schultz 1987).

Station	**Upper (NEES-2B)**		**Mid (NEES-3)**		**Lower (NEES-1)**	
	Control mean MSC	**Limiting Nutrient**	**Control mean MSC**	**Limiting Nutrient**	**Control mean MSC**	**Limiting Nutrient**
8/1997	---	---	3.4	NITROGEN	3.4	NITROGEN
8/2000	---	---	8.1	NITROGEN	4.35	NONE
8/2005	---	---	5.56	NONE	7.07	NITROGEN
8/2010	10.13	NITROGEN	---	---	---	---

Figure 10. Monthly DO concentrations at 1.5 m (5 ft) for Neely Henry 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).



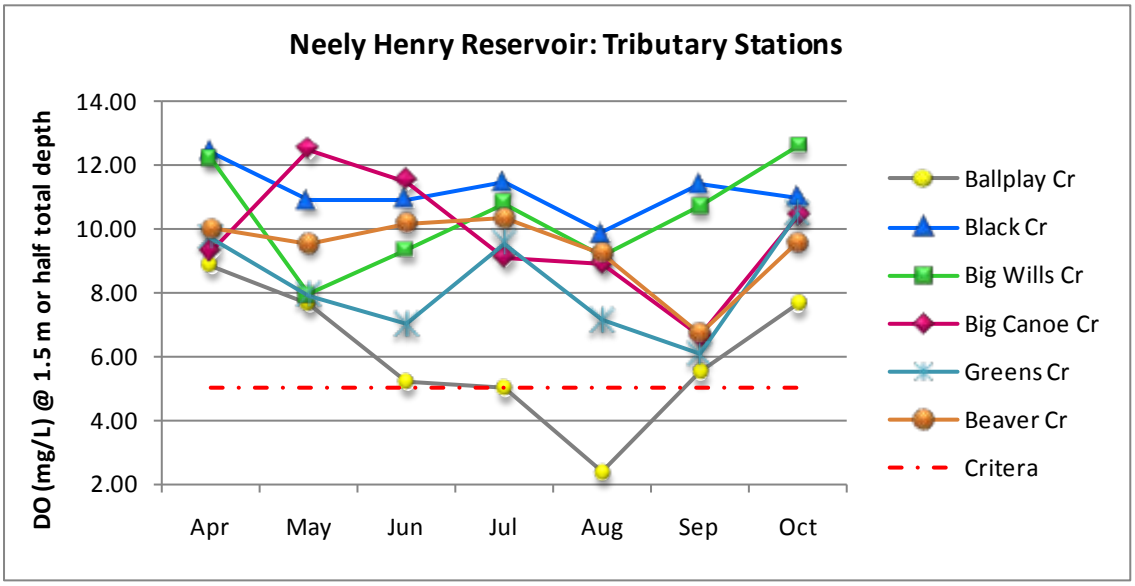


Figure 11. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Neely Henry Reservoir station, April-October 2010.

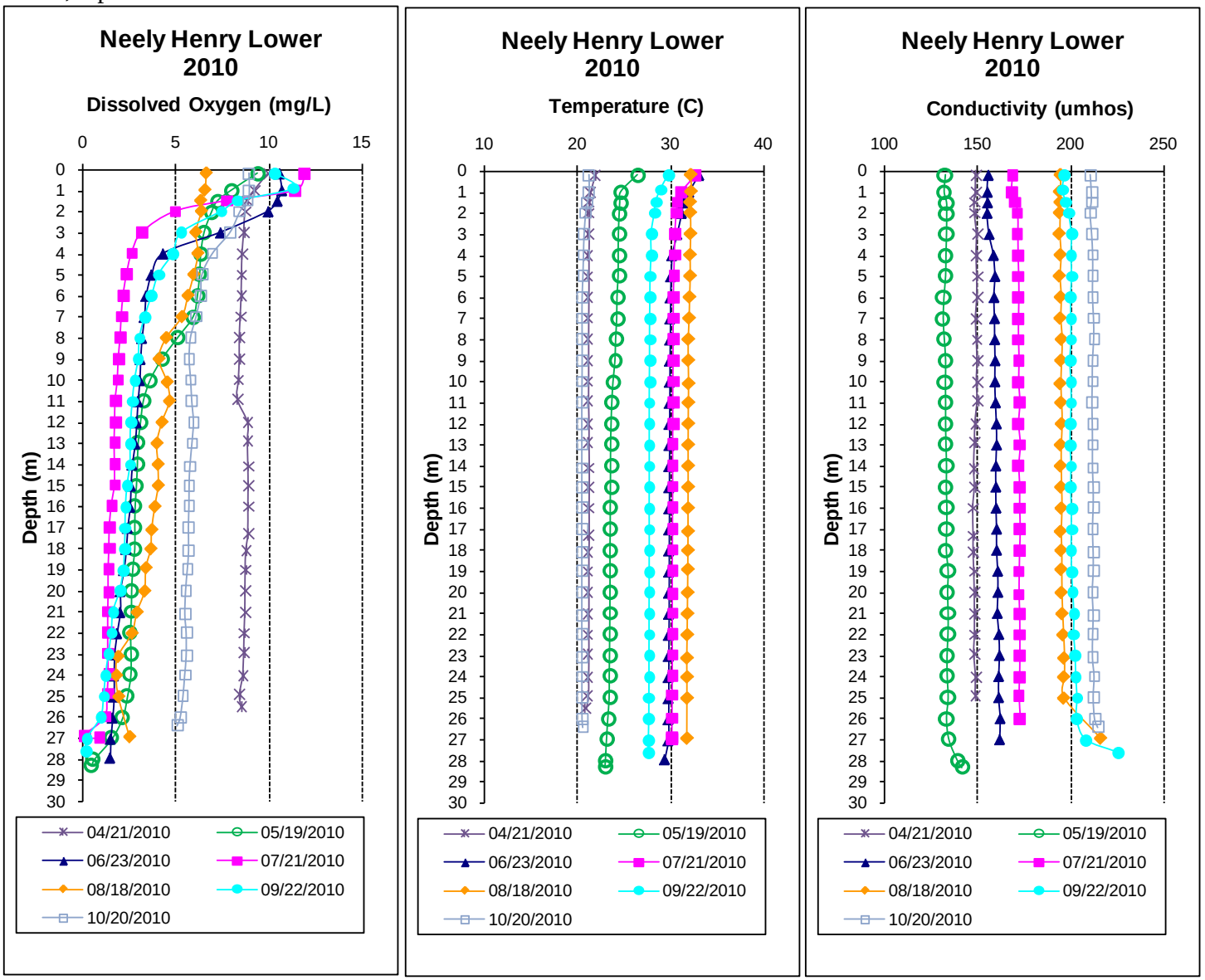


Figure 12. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the mid Neely Henry Reservoir station, April-October 2010.

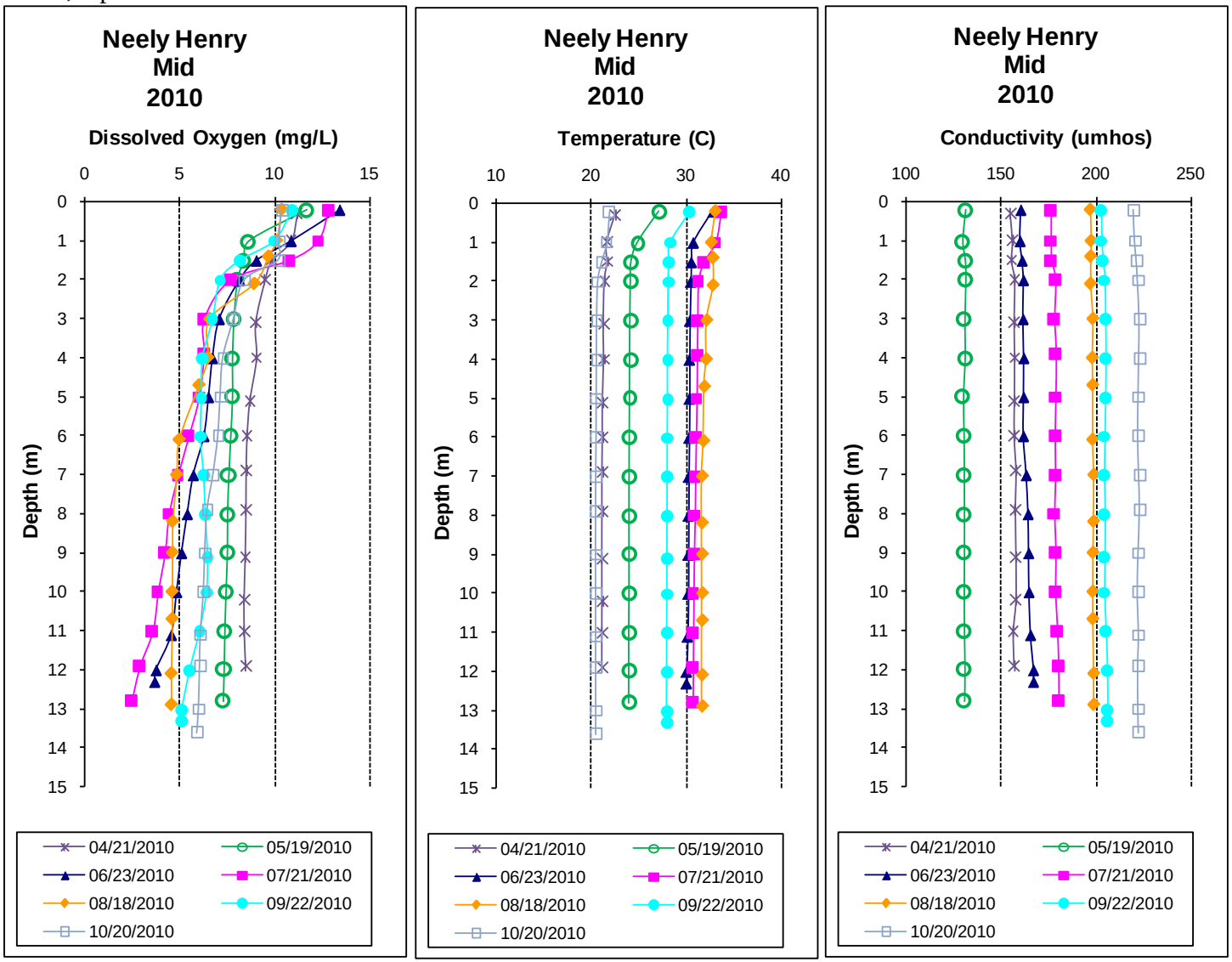
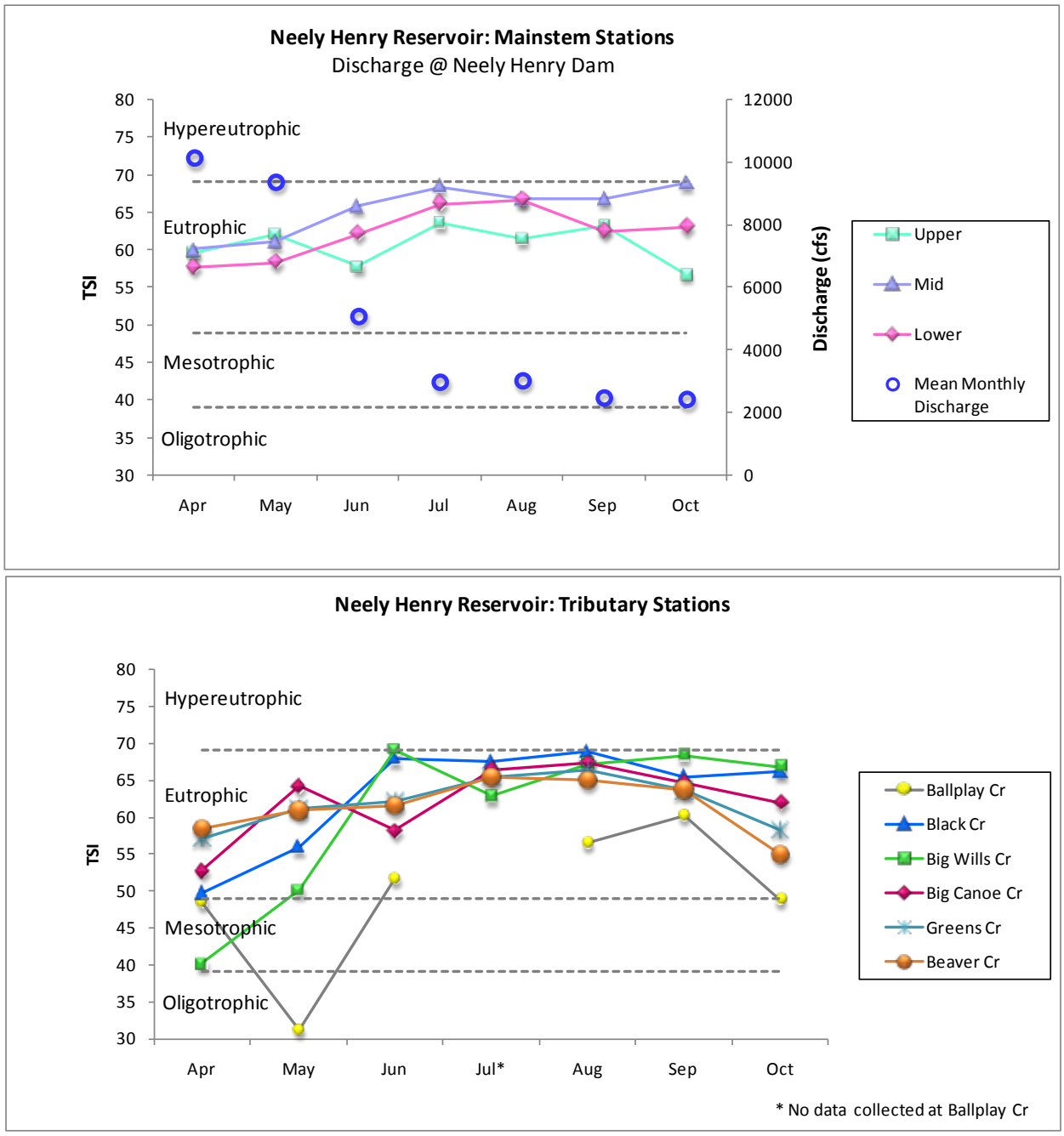


Figure 13. Monthly TSI values calculated for mainstem and tributary Neely Henry Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. Monthly discharge acquired from APCo at Neely Henry Dam.



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APPENDIX

Appendix Table 1. Summary of Neely Henry 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
NEES-1	**Physical**						
	Turbidity (NTU)	7	5.9	12.3	9.2	9.2	2.2
	Total Dissolved Solids (mg/L)[J]	7	82.0	138.0	106.0	105.1	20.0
	Total Suspended Solids (mg/L)[J]	6	7.0	14.0	9.0	9.2	2.6
	Hardness (mg/L)	4	58.2	75.3	67.2	67.0	8.4
	Alkalinity (mg/L)	7	54.1	78.5	71.8	68.7	9.1
	Photic Zone (m)	7	2.35	3.78	2.61	2.77	0.47
	Secchi (m)	7	0.68	1.27	0.74	0.84	0.21
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.043	0.010	0.015	0.012
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	< 0.002	0.107	0.002	0.018	0.039
	Total Kjeldahl Nitrogen (mg/L)	7	0.255	1.304	0.555	0.583	0.357
	Total Nitrogen (mg/L)[J]	7	< 0.256	1.306	0.581	0.602	0.356
	Dissolved Reactive Phosphorus (mg/L)[J]	7	< 0.003	0.008	0.006	0.005	0.002
	Total Phosphorus (mg/L)	7	0.035	0.061	0.056	0.052	0.008
	CBOD-5 (mg/L)	7	< 2.0	3.1	2.4	1.9	0.9
	Chlorides (mg/L)	7	3.6	10.4	5.7	6.4	2.5
	Biological						
	Chlorophyll a (ug/L)	7	16.00	39.52	25.94	26.91	9.02
	E. coli (mpn/100mL)[J]	3	< 1	<1	1	1	0
NEES-2B	**Physical**						
	Turbidity (NTU)	7	7.6	16.5	9.0	10.3	3.4
	Total Dissolved Solids (mg/L)[J]	7	< 1.0	154.0	106.0	96.6	46.1
	Total Suspended Solids (mg/L)	6	4.0	16.0	9.5	10.2	4.6
	Hardness (mg/L)	4	56.0	74.2	66.2	65.6	8.6
	Alkalinity (mg/L)	7	49.1	75.7	69.0	65.9	8.1
	Photic Zone (m)	7	2.26	3.19	2.54	2.61	0.31
	Secchi (m)	7	0.66	0.89	0.82	0.81	0.08
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	< 0.003	0.117	0.015	0.037	0.043
	Total Kjeldahl Nitrogen (mg/L)	7	0.167	0.754	0.395	0.419	0.233
	Total Nitrogen (mg/L)[J]	7	< 0.230	0.761	0.467	0.456	0.228
	Dissolved Reactive Phosphorus (mg/L)[J]	7	< 0.004	0.009	0.005	0.006	0.002
	Total Phosphorus (mg/L)	7	0.037	0.062	0.045	0.046	0.008
	CBOD-5 (mg/L)	7	< 2.0	2.9	2.4	2.0	0.9
	Chlorides (mg/L)	7	3.6	11.9	6.1	6.9	3.0
	Biological						
	Chlorophyll a (ug/L)	7	14.42	28.70	23.14	21.92	5.52
	E. coli (mpn/100mL)[J]	3	1	6	3	3	3

Station	Parameter	N	Min	Max	Med	Mean	SD
NEES-3	**Physical**						
	Turbidity (NTU)	7	8.5	12.6	10.9	10.9	1.4
	Total Dissolved Solids (mg/L) [J]	7	86.0	144.0	106.0	108.6	20.7
	Total Suspended Solids (mg/L)	6	4.0	20.0	11.5	10.8	5.6
	Hardness (mg/L)	4	59.7	76.9	68.3	68.3	7.9
	Alkalinity (mg/L)	7	53.0	78.0	71.7	68.9	8.9
	Photic Zone (m)	7	2.08	3.13	2.36	2.46	0.35
	Secchi (m)	7	0.65	0.83	0.78	0.76	0.07
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.003	0.134	0.019	0.040	0.046
	Total Kjeldahl Nitrogen (mg/L)	7	0.234	0.826	0.622	0.598	0.196
	Total Nitrogen (mg/L) [J]	7	< 0.368	0.845	0.682	0.638	0.166
	Dissolved Reactive Phosphorus (mg/L) [J]	7	0.004	0.016	0.006	0.008	0.004
	Total Phosphorus (mg/L)	7	0.055	0.083	0.063	0.064	0.009
	CBOD-5 (mg/L)	7	< 2.0	3.6	2.1	2.1	1.1
	Chlorides (mg/L)	7	3.8	11.6	6.5	7.0	2.7
	Biological						
	Chlorophyll a (ug/L)	7	20.30	49.59	39.67	36.50	11.32
	E. coli (mpn/100mL) [J]	3	< 1	<1	1	1	0
NEES-5	**Physical**						
	Turbidity (NTU)	7	15.4	27.1	20.2	21.1	5.0
	Total Dissolved Solids (mg/L)	7	83.0	280.0	107.0	130.4	67.6
	Total Suspended Solids (mg/L)	7	11.0	20.0	16.0	15.7	3.5
	Hardness (mg/L)	4	62.7	84.5	73.6	73.6	10.0
	Alkalinity (mg/L)	7	54.5	72.8	69.4	64.6	8.2
	Photic Zone (m)	7	0.77	1.58	1.10	1.11	0.28
	Secchi (m)	7	0.48	1.10	0.82	0.78	0.23
	Chemical						
	Ammonia Nitrogen (mg/L) [J, B]	1				0.500	
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.007	0.149	0.022	0.058	0.060
	Total Kjeldahl Nitrogen (mg/L) [B]						
	Total Nitrogen (mg/L) [B]						
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.008	0.002	0.002	0.002
	Total Phosphorus (mg/L) [B]						
	CBOD-5 (mg/L) [J]	7	< 1.0	1.6	1.3	1.1	0.4
	Chlorides (mg/L)	7	5.7	23.4	11.0	11.6	6.0
	Biological						
	Chlorophyll a (ug/L)	6	1.07	20.30	7.48	9.39	6.76
	E. coli (mpn/100mL) [J]	3	34	61	39	45	14

Station	Parameter	N	Min	Max	Med	Mean	SD
NEES-6	**Physical**						
	Turbidity (NTU)	7	14.6	40.9	27.0	27.7	8.6
	Total Dissolved Solids (mg/L) [J]	7	120.0	188.0	156.0	157.7	22.1
	Total Suspended Solids (mg/L)	6	11.0	36.0	18.5	22.8	10.2
	Hardness (mg/L)	4	102.0	126.0	119.0	116.5	10.7
	Alkalinity (mg/L)	7	111.0	138.0	123.0	125.6	9.8
	Photic Zone (m)	7	1.11	1.73	1.49	1.47	0.25
	Secchi (m)	7	0.35	0.53	0.43	0.43	0.07
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.035	0.010	0.014	0.009
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.413	0.743	0.628	0.602	0.127
	Total Kjeldahl Nitrogen (mg/L)	7	0.222	0.869	0.434	0.486	0.231
	Total Nitrogen (mg/L)	7	0.697	1.417	1.123	1.088	0.264
	Dissolved Reactive Phosphorus (mg/L)	7	0.066	0.320	0.223	0.203	0.092
	Total Phosphorus (mg/L)	7	0.106	0.410	0.283	0.277	0.102
	CBOD-5 (mg/L)	7	< 2.0	4.9	2.9	2.8	1.5
	Chlorides (mg/L)	7	8.4	16.3	11.0	11.4	2.8
	Biological						
	Chlorophyll a (ug/L)	7	2.67	50.73	40.05	30.90	19.26
	E. coli (mpn/100mL) [J]	3	4	37	19	20	17
NEES-7	**Physical**						
	Turbidity (NTU)	6	17.9	26.7	23.2	22.5	3.8
	Total Dissolved Solids (mg/L) [J]	7	86.0	160.0	128.0	123.4	28.1
	Total Suspended Solids (mg/L)	6	20.0	34.0	25.0	25.8	4.8
	Hardness (mg/L)	4	41.5	95.3	79.6	74.0	23.7
	Alkalinity (mg/L)	7	38.1	106.0	92.9	81.7	27.1
	Photic Zone (m)	7	1.00	1.40	1.11	1.18	0.14
	Secchi (m)	7	0.34	0.69	0.50	0.51	0.11
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.053	0.010	0.017	0.016
	Nitrate+Nitrite Nitrogen (mg/L) [J]	7	< 0.002	0.086	0.003	0.025	0.038
	Total Kjeldahl Nitrogen (mg/L)	7	0.353	1.838	0.834	0.920	0.504
	Total Nitrogen (mg/L) [J]	7	< 0.426	1.839	0.920	0.945	0.489
	Dissolved Reactive Phosphorus (mg/L) [J]	7	0.005	0.037	0.009	0.015	0.012
	Total Phosphorus (mg/L)	7	0.036	0.163	0.115	0.100	0.047
	CBOD-5 (mg/L)	7	< 2.0	5.1	4.4	3.8	1.4
	Chlorides (mg/L)	7	3.6	13.5	9.7	8.3	3.9
	Biological						
	Chlorophyll a (ug/L)	7	7.12	49.40	37.38	32.79	16.24
	E. coli (mpn/100mL) [J]	3	1	24	4	10	13

Station	Parameter	N	Min	Max	Med	Mean	SD
NEES-8	**Physical**						
	Turbidity (NTU)	7	7.0	10.3	8.7	8.7	1.3
	Total Dissolved Solids (mg/L) [J]	7	88.0	138.0	104.0	111.1	18.1
	Total Suspended Solids (mg/L) [J]	6	5.0	11.0	7.0	7.8	2.6
	Hardness (mg/L)	4	62.7	76.9	72.8	71.3	6.8
	Alkalinity (mg/L)	7	59.0	82.7	71.2	73.4	8.2
	Photic Zone (m)	7	2.24	3.58	2.61	2.79	0.57
	Secchi (m)	7	0.63	1.29	0.81	0.90	0.24
	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	0.017	0.002	0.004	0.006
	Total Kjeldahl Nitrogen (mg/L)	7	0.378	1.064	0.810	0.820	0.243
	Total Nitrogen (mg/L) [J]	7	< 0.379	1.065	0.812	0.823	0.242
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.014	0.004	0.006	0.004
	Total Phosphorus (mg/L)	7	0.036	0.064	0.048	0.048	0.010
	CBOD-5 (mg/L)	7	< 2.0	3.9	2.6	2.4	1.1
	Chlorides (mg/L)	7	3.1	10.0	5.6	5.9	2.6
	Biological						
	Chlorophyll a (ug/L)	7	9.61	42.05	30.44	27.62	11.59
	E. coli (mpn/100mL) [J]	3	< 1	5	1	2	2
NEES-9	**Physical**						
	Turbidity (NTU)	7	9.5	17.1	13.5	13.4	2.8
	Total Dissolved Solids (mg/L) [J]	7	90.0	140.0	102.0	109.1	19.1
	Total Suspended Solids (mg/L)	6	8.0	16.0	11.5	11.7	3.0
	Hardness (mg/L)	4	61.1	75.3	68.4	68.3	7.5
	Alkalinity (mg/L)	7	54.5	81.4	70.1	70.7	9.4
	Photic Zone (m)	7	1.62	2.67	2.34	2.26	0.39
	Secchi (m)	7	0.56	0.87	0.63	0.68	0.13
	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	0.093	0.002	0.014	0.035
	Total Kjeldahl Nitrogen (mg/L)	7	0.294	0.735	0.600	0.562	0.139
	Total Nitrogen (mg/L) [J]	7	< 0.295	0.828	0.602	0.577	0.161
	Dissolved Reactive Phosphorus (mg/L) [J]	7	< 0.003	0.011	0.003	0.005	0.003
	Total Phosphorus (mg/L)	7	0.047	0.073	0.053	0.057	0.008
	CBOD-5 (mg/L)	7	< 2.0	3.5	2.6	2.4	1.1
	Chlorides (mg/L)	7	3.6	10.7	5.8	6.5	2.7
	Biological						
	Chlorophyll a (ug/L)	7	15.00	38.14	24.70	25.80	8.67
	E. coli (mpn/100mL) [J]	3	< 1	2	1	1	1

Station	Parameter	N	Min	Max	Med	Mean	SD
NEES-10	**Physical**						
	Turbidity (NTU)	7	7.8	11.5	8.9	9.2	1.2
	Total Dissolved Solids (mg/L) J	7	36.0	132.0	102.0	100.0	31.1
	Total Suspended Solids (mg/L)	6	5.0	16.0	8.5	9.5	4.0
	Hardness (mg/L)	4	71.1	80.8	75.6	75.8	3.1
	Alkalinity (mg/L)	7	68.0	85.7	78.6	77.6	5.6
	Photic Zone (m)	7	2.23	3.05	2.65	2.66	0.30
	Secchi (m)	7	0.62	1.19	0.80	0.81	0.19
	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	0.034	0.002	0.006	0.012
	Total Kjeldahl Nitrogen (mg/L)	7	0.396	0.882	0.646	0.628	0.176
	Total Nitrogen (mg/L) J	7	< 0.410	0.884	0.648	0.634	0.169
	Dissolved Reactive Phosphorus (mg/L) J	7	< 0.003	0.007	0.003	0.004	0.002
	Total Phosphorus (mg/L)	7	0.034	0.057	0.043	0.046	0.009
	CBOD-5 (mg/L)	7	< 2.0	2.7	2.5	2.1	0.8
	Chlorides (mg/L)	7	3.2	9.5	5.0	5.9	2.5
	Biological						
	Chlorophyll a (ug/L)	7	12.02	34.71	23.50	24.57	8.42
	E. coli (mpn/100mL) J	3	< 1	3	1	2	1

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.