Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Spring Creek Embayment
Wheeler Reservoir
Intensive Basin Survey 2013

WHEL-9: Spring Creek approx 0.5 mi upstream of CR400 bridge (Lawrence Co 34.72263/-87.28049)

BACKGROUND

The Alabama Department of Environmental Management (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 the Rivers and Reservoirs Monitoring Program (RRMP)] was initiated by 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).

In 2013, ADEM monitored the Spring Creek tributary embayment of Wheeler Reservoir as part of the intensive basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Spring Creek embayment (WHEL-9) during the 2013 growing season (Apr-Oct). This is the third intensive basin assessment of the Tennessee River since ADEM began sampling on a basin rotation. Monthly and/or 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)] from 2013 were compared to ADEM's historical data and established criteria.

Figure 1. Photo of Spring Creek at WHEL-9.

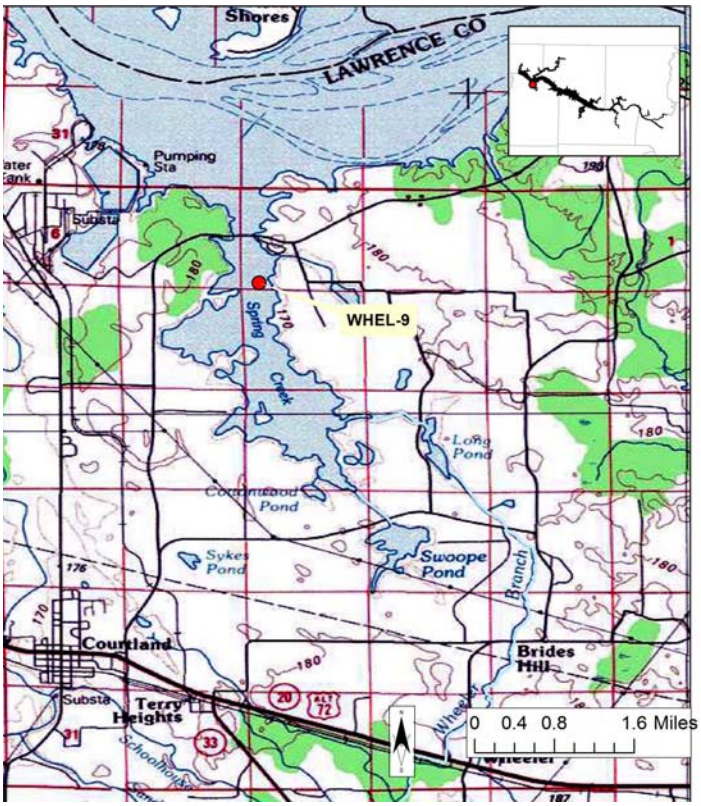


Figure 2. Map of Spring Creek embayment of Wheeler Reservoir. No permitted discharges exist within this watershed.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Spring Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the small 18 mi^2 watershed is predominantly cultivated crops (52%) (Fig. 3). As of October 1, 2013, ADEM has issued no NPDES permits within the watershed (Fig. 2).

SITE DESCRIPTION

The Spring Creek embayment at WHEL-9 is located near the community of Courtland, AL, halfway between Florence and Decatur. It is a narrow, deep embayment which flows into the Tennessee River near river mile 283. Spring Creek has a mean bottom depth of 4.07 m (Table 2) at the sampling location and is fairly clear most of the year.

METHODS

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 2013b), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013a).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2013 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

Table 1: Summary of Watershed **WHEL-9**

Basin		Tennessee R
Drainage Area (mi^2)		18
Ecoregion[a]		71g
% Land use		
Open Water		8%
Developed	Open Space	4%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	7%
	Evergreen Forest	4%
	Mixed Forest	2%
Shrub/Scrub		5%
Herbaceous		2%
Hay/Pasture		10%
Cultivated Crops		52%
Wetlands	Woody	5%
	Emergent Herb.	<1%
# NPDES Permits[b]	TOTAL	0

a. Eastern Highland Rim

b. # NPDES permits downloaded from ADEM's NPDES Management System database, Oct 1, 2013.

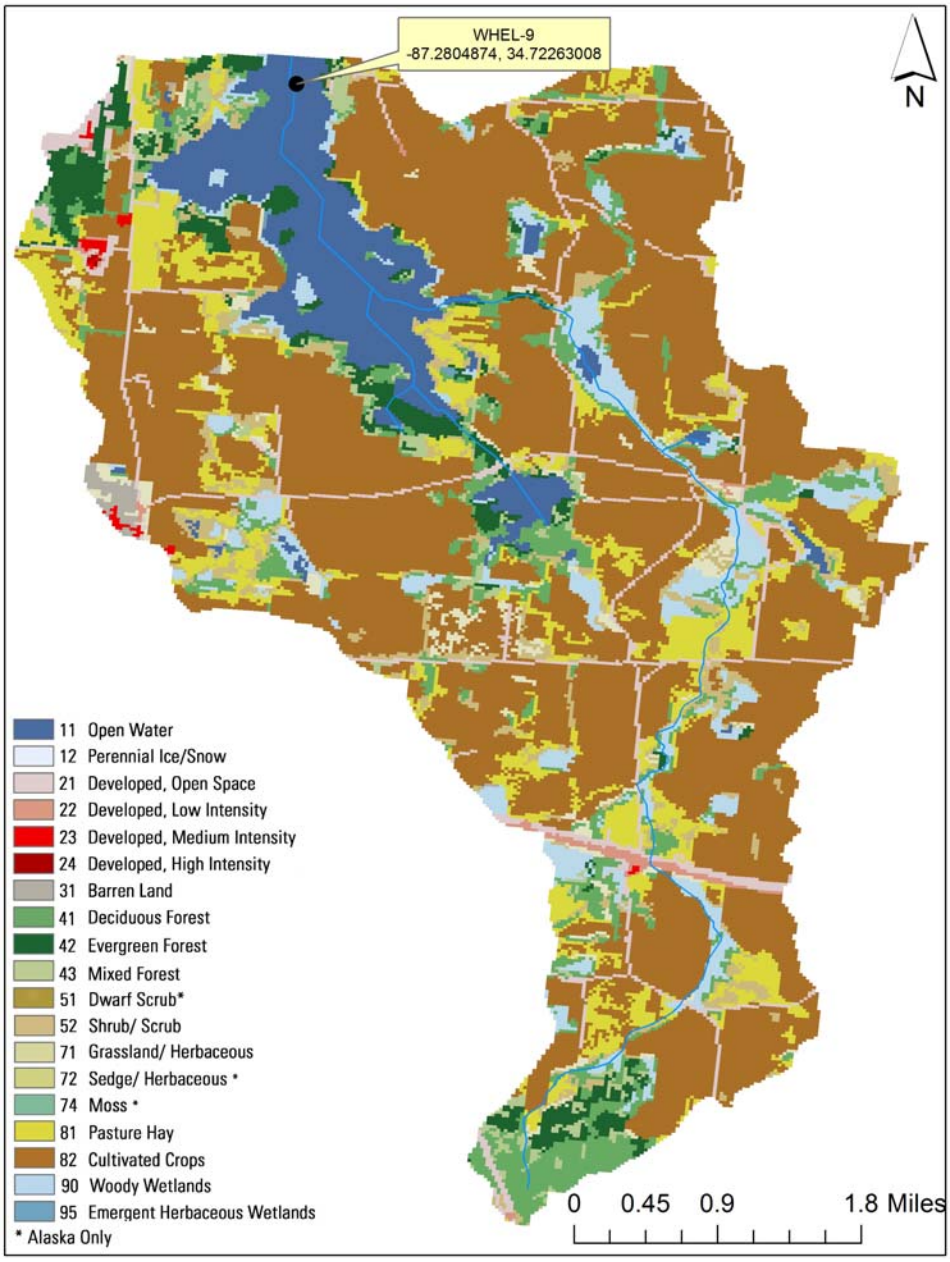


Figure 3. Landuse within the Spring Creek watershed at WHEL-9.

The mean growing season TN value increased from 2003 through 2013 (Fig. 4). Monthly TN concentrations generally declined April through September.

The mean growing season TP concentration declined from 2003 through 2013 (Fig. 4). Monthly TP concentrations were highest in May.

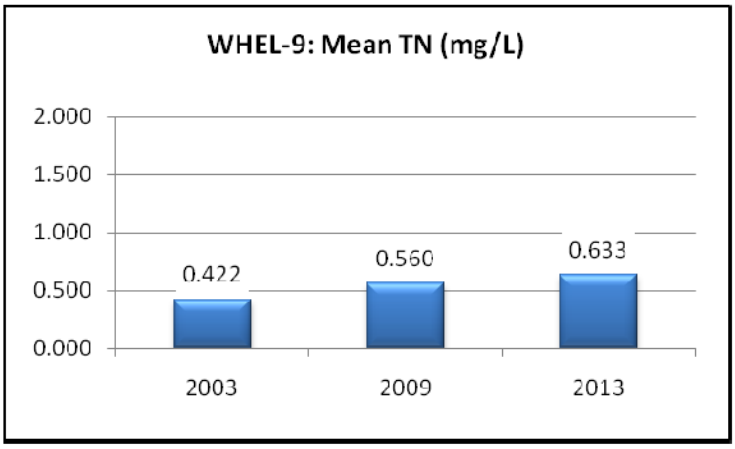
The mean growing season chl *a* value increased from 2003 through 2013 (Fig. 4). Monthly chl *a* concentrations were highest in September.

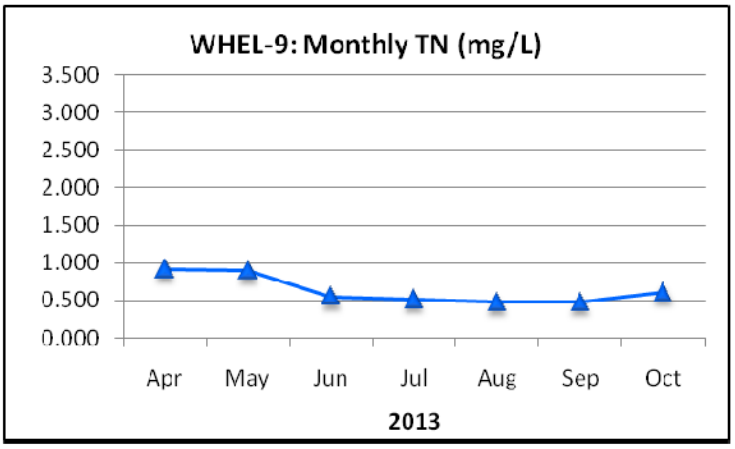
Mean TSI values have remained eutrophic all years monitored. Monthly TSI in Spring Creek was eutrophic April-October (Fig. 4).

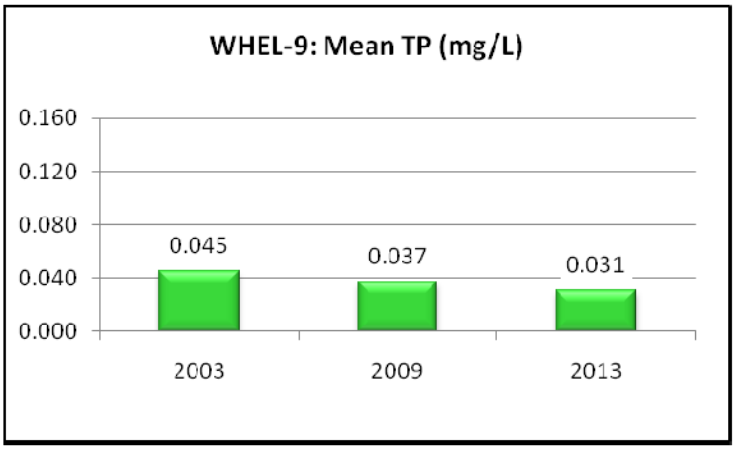
The mean growing season TSS value in 2013 was higher than in 2009 but lower than in 2003 (Fig. 5). The highest monthly TSS concentration was measured in May.

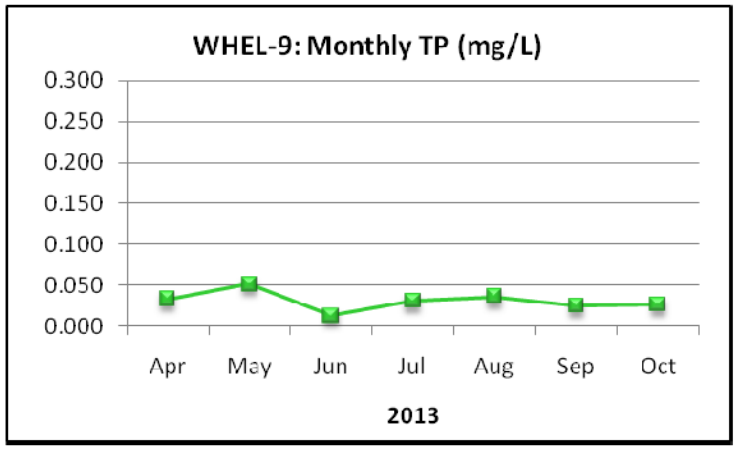
AGPT results show that WHEL-9 was nitrogen limited in 2013 and co-limited in both 2003 and 2009 (Table 3). The mean maximum standing crop (MSC) increased in 2013 to exceed 5.0 mg/L, the value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

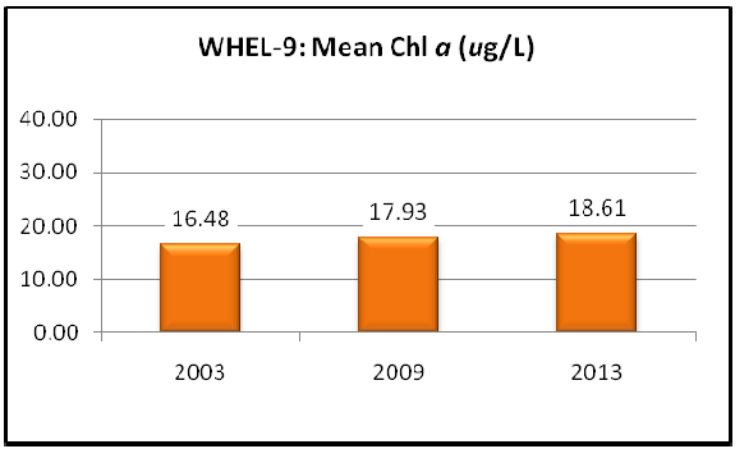
DO concentrations in the WHEL-9 station remained above the ADEM criteria limit (ADEM Admin. Code R. 335-6-10-.09) of 5.0 mg/l at 5.0 ft (1.5 m) April through October (Fig. 6).

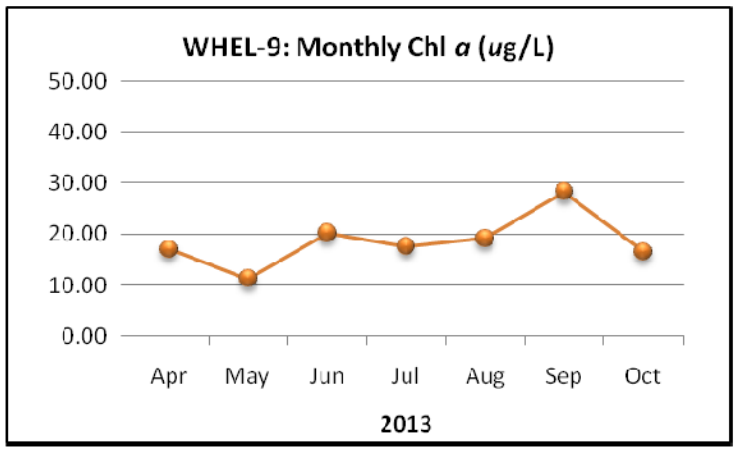


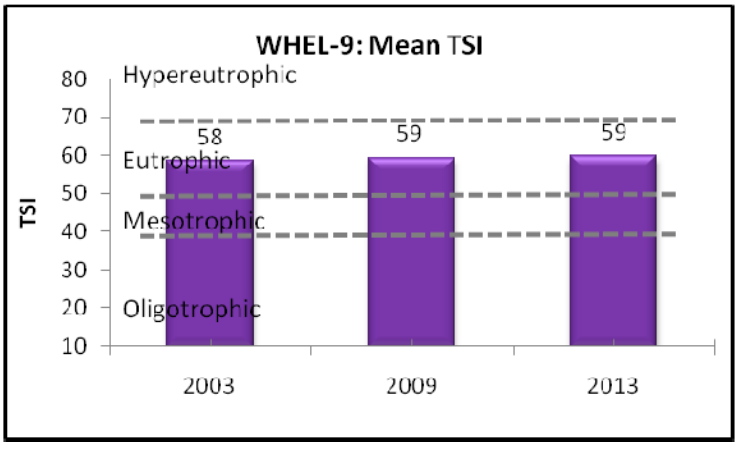












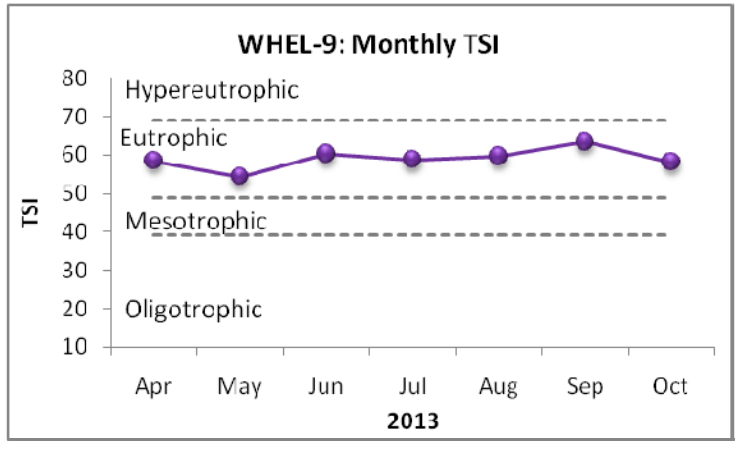
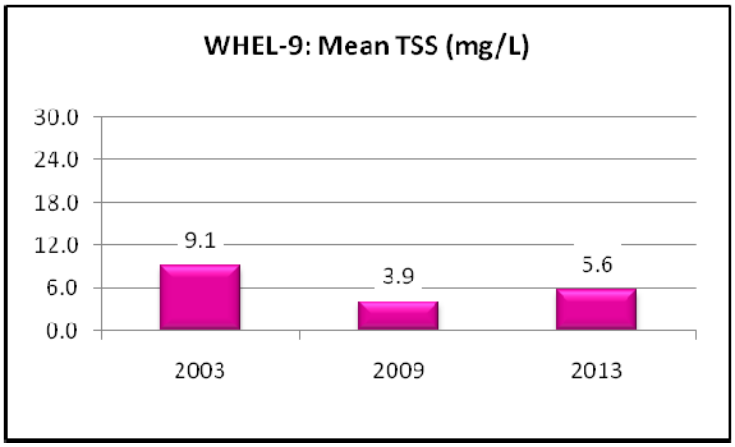


Figure 4. Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Spring Creek embayment of Wheeler Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



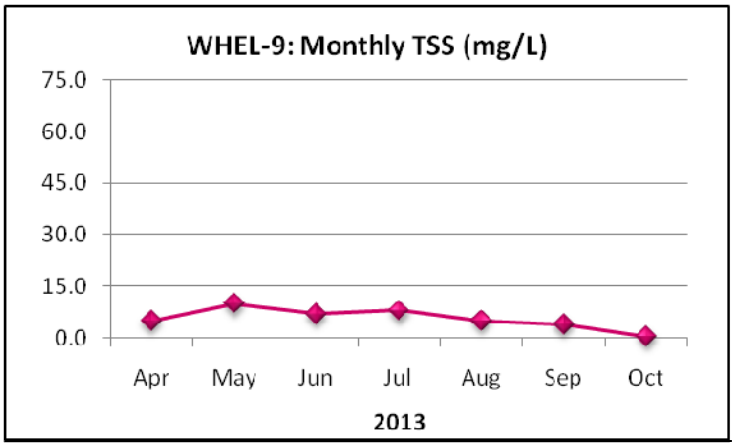


Figure 5. Mean growing season and monthly TSS measured in the Spring Creek embayment of Wheeler Reservoir.

Table 2. Summary of water quality data collected April-October, 2013. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

WHEL-9	N		Min	Max	Med	Mean	SD
Physical							
Turbidity (NTU)	7		3.8	9.4	4.4	5.2	2.0
Total Dissolved Solids (mg/L)[J]	7	<	1.0	180.0	106.0	103.4	53.2
Total Suspended Solids (mg/L)[J]	7	<	1.0	10.0	5.0	5.6	3.1
Hardness (mg/L)	4		60.0	92.3	81.2	78.7	13.6
Alkalinity (mg/L)	7		39.0	76.1	53.2	55.2	12.0
Photic Zone (m)	7		2.35	5.05	3.42	3.49	0.83
Secchi (m)	7		0.93	1.58	1.48	1.33	0.27
Bottom Depth (m)	7		2.00	5.57	4.19	4.07	1.06
Chemical							
Ammonia Nitrogen (mg/L)[J]	7	<	0.015	0.098	0.014	0.030	0.036
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.009	0.381	0.085	0.130	0.147
Total Kjeldahl Nitrogen (mg/L)	7		0.438	0.599	0.499	0.504	0.055
Total Nitrogen (mg/L)[J]	7	<	0.476	0.916	0.552	0.633	0.190
Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.014	0.006	0.007	0.004
Total Phosphorus (mg/L)[J]	7		0.013	0.051	0.031	0.031	0.012
CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.1	0.4
Chlorides (mg/L)[J]	7		4.0	6.4	4.6	4.8	0.9
Biological							
Chlorophyll a (ug/L)	7		11.20	28.30	17.60	18.61	5.15
E. coli (col/100mL)[J]	3	<	1	24	1	9	14

J= one or more of the values is an estimate; N= # samples.

Table 3. Algal growth potential test results (expressed as mean 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 (Raschke and Schultz 1987).

WHEL-9	MSC	Limiting Nutrient
8/20/2003	2.24	CO-LIMITING
8/18/2009	2.37	CO-LIMITING
8/20/2013	7.71	NITROGEN

FOR MORE INFORMATION, CONTACT:
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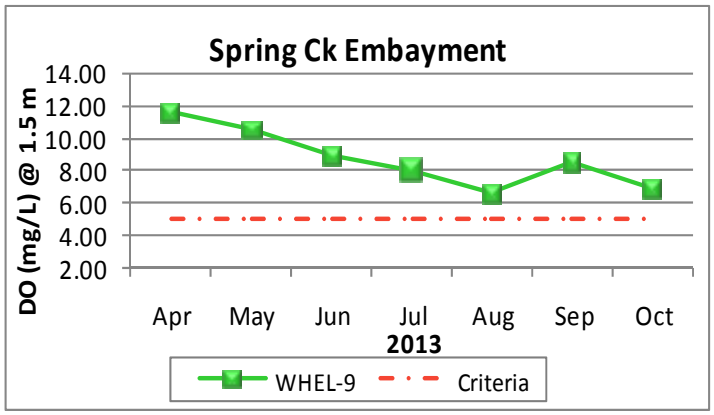

Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Spring Creek embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

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