

## Shoal Creek Embayment Wilson Reservoir Intensive Basin Survey 2009

Tennessee River Basin

**WILL-4:** Shoal Creek immediately upstream of US Hwy 72 bridge (Lauderdale Co 34.85183/-87.56932)

### 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 2009, ADEM monitored the Shoal Creek tributary embayment of Wilson 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 Shoal Creek embayment (WILL-4) during the 2009 growing season (Apr-Oct). This is the second 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 2009 were compared to ADEM's 2003 data and established criteria.

### WATERSHED CHARACTERISTICS

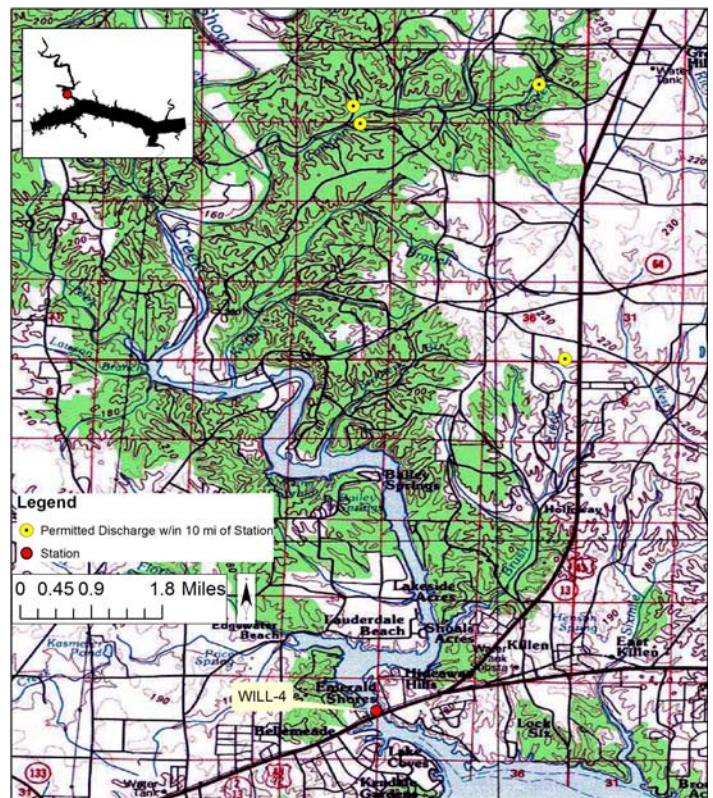
Watershed land uses are summarized in Table 1. Shoal Creek is classified as a *Swimming/Fish & Wildlife (S/F&W)* stream located in the Interior Plateau ecoregion (71f). Based on the 2006 National Land Cover Dataset, land use within the 419 mi<sup>2</sup> watershed is predominantly forest (57%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 14 NPDES permits within the watershed. Four of those permits are located within 10 mi of the station (Fig. 2).

### SITE DESCRIPTION

The Shoal Creek at WILL-4 is a deep, urbanized embayment located just east of Florence, AL. It has a mean bottom depth of 13.41 m (Table 2) at the sampling location and is just upstream of US Highway 72. Residential houses and a marina surround the sampling site.



**Figure 1.** Photo of Shoal Creek at WILL-4



**Figure 2.** Map of Shoal Creek embayment of Wilson Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

## 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 2009), 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. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2009 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

## RESULTS

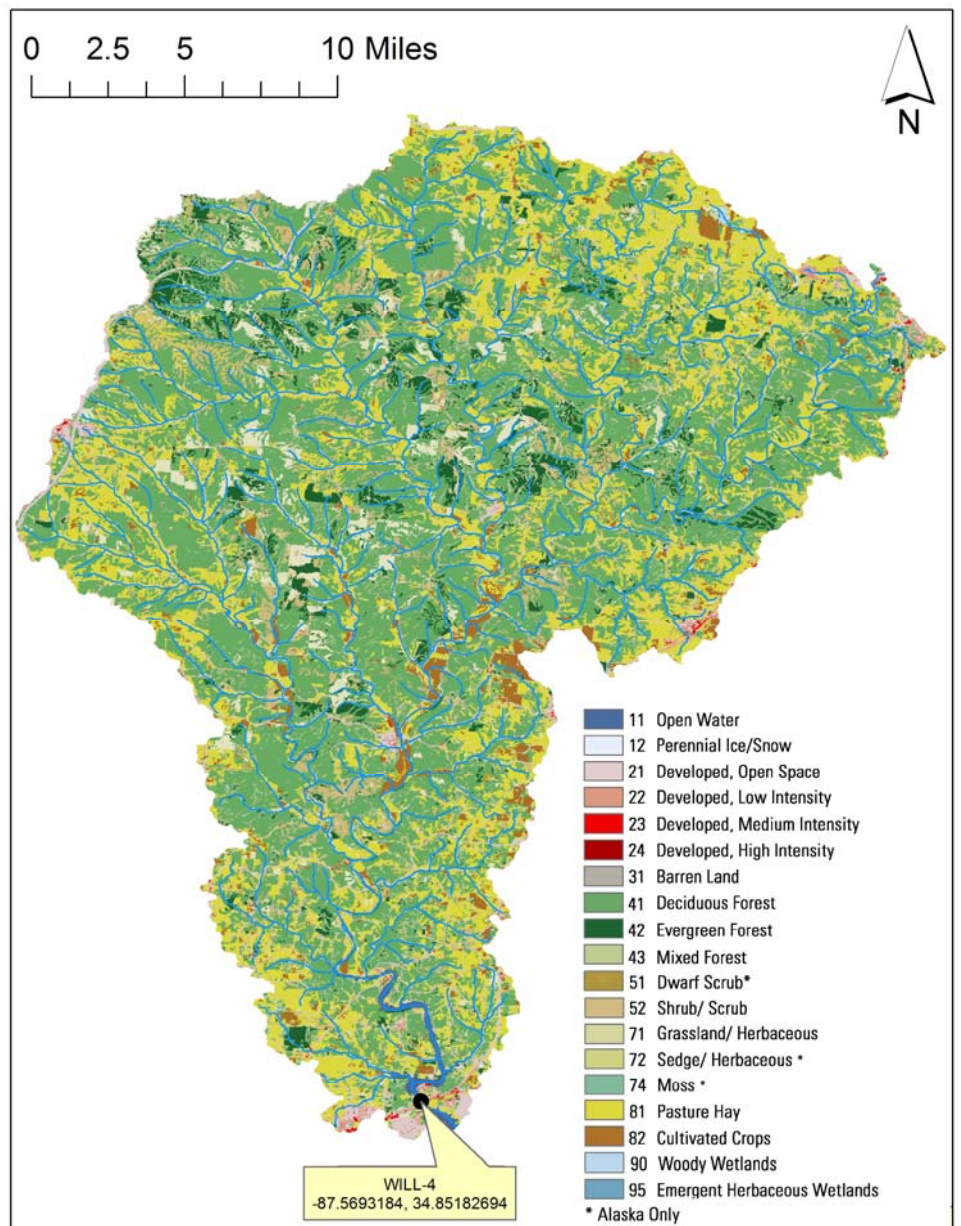
The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir-wide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

**Table 1: Summary of Watershed WILL-4**

Basin	Tennessee R
Drainage Area (mi <sup>2</sup> )	419
Ecoregion <sup>a</sup>	71f
% Land use	
Open Water	1%
Developed Open Space	5%
Low Intensity	1%
Medium Intensity	<1%
High Intensity	<1%
Barren Land	<1%
Forest Deciduous Forest	48%
Evergreen Forest	5%
Mixed Forest	4%
Shrub/Scrub	7%
Herbaceous	4%
Hay/Pasture	23%
Cultivated Crops	3%
Wetlands Woody	1%
Emergent Herb.	<1%
# NPDES Permits <sup>b</sup> TOTAL	14
401 Water Quality Certification	1
Construction Stormwater	10
Industrial General	1
Municipal Individual	2

a. Interior Plateau

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



**Figure 3.** Land use within the Shoal Creek watershed at WILL-4.

The mean growing season TN value was higher in 2009 than in 2003 (Fig. 4). Monthly TN concentrations were variable April-October.

Similar to mean TN concentration, the mean growing season TP concentration was slightly higher in 2009 (Fig. 4). Monthly TP concentrations gradually increased April-September.

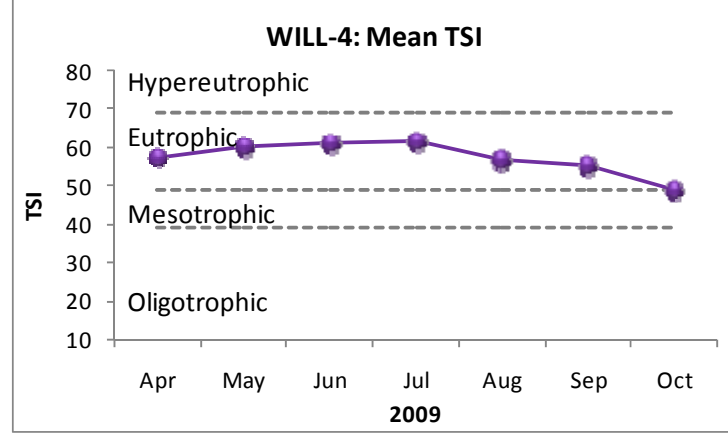
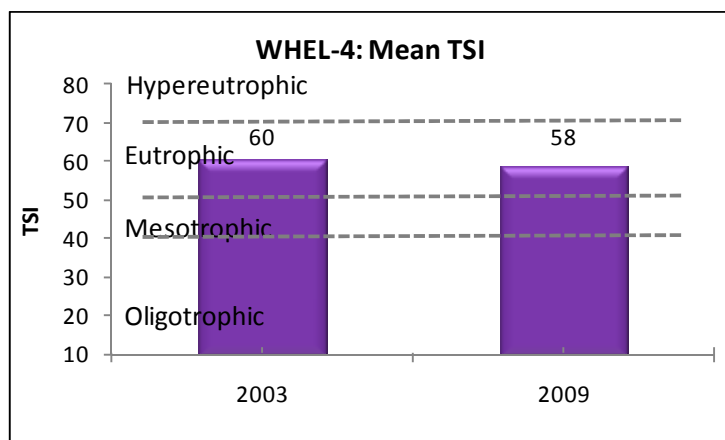
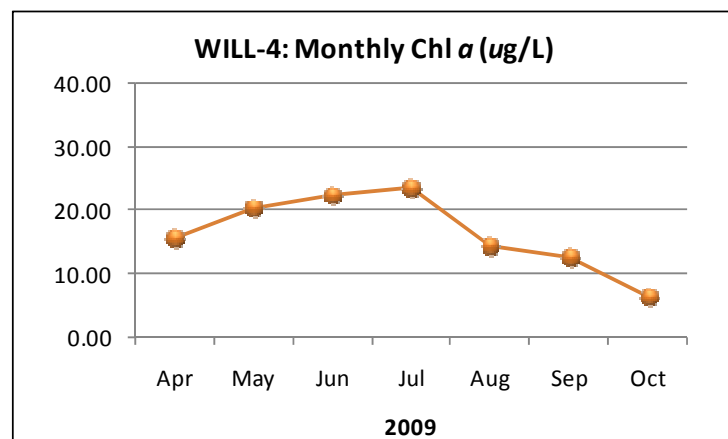
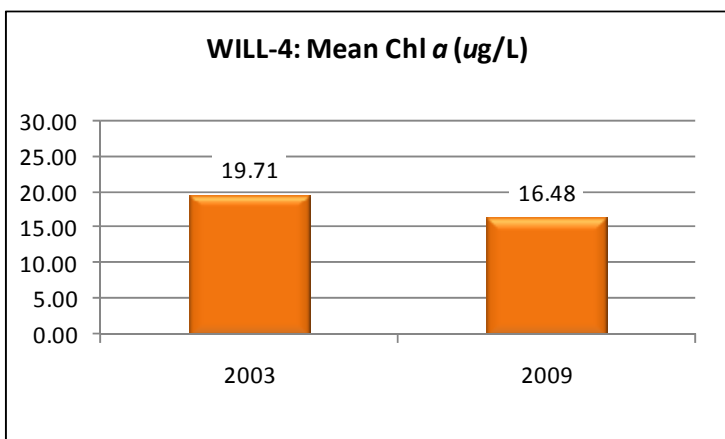
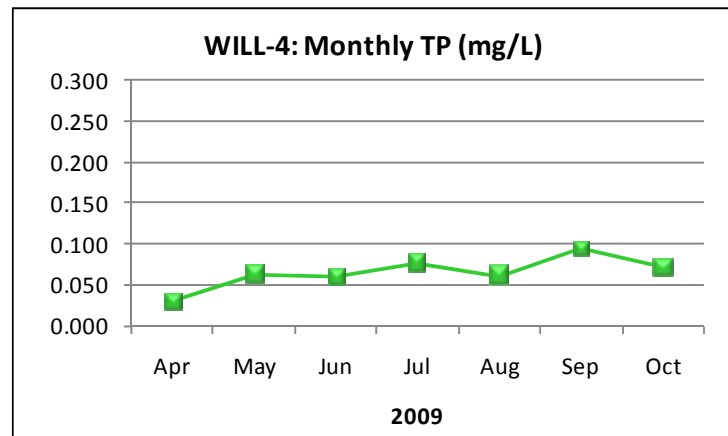
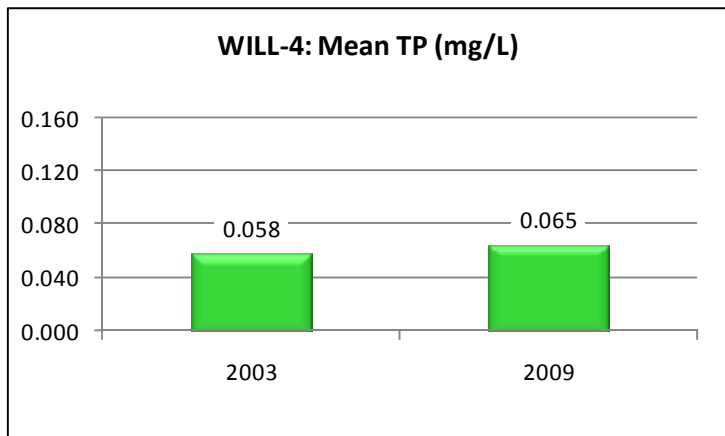
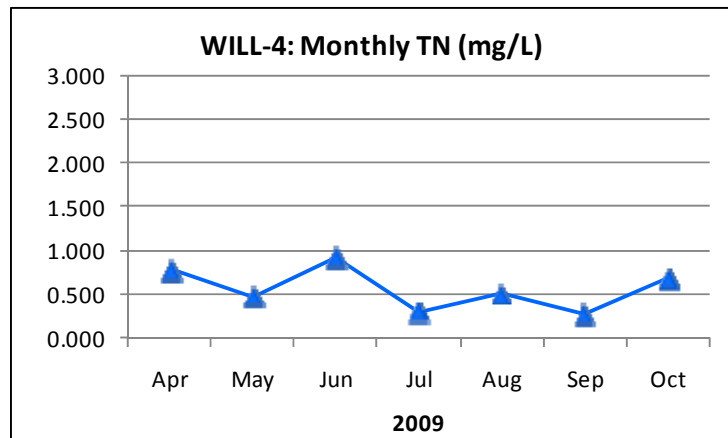
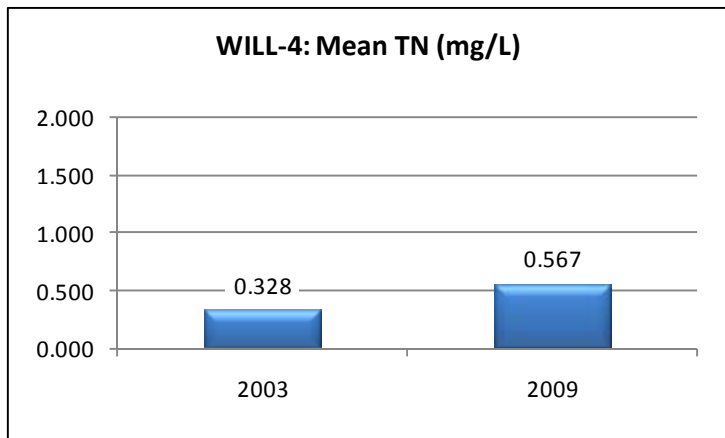
In 2009, the growing season mean chl *a* value was lower than 2003 (Fig. 4). Monthly chl *a* concentrations increased through July then decreased through October.

Mean TSI was eutrophic in both 2009 and 2003. Monthly TSI in Shoal Creek was eutrophic April-September (Fig. 4).

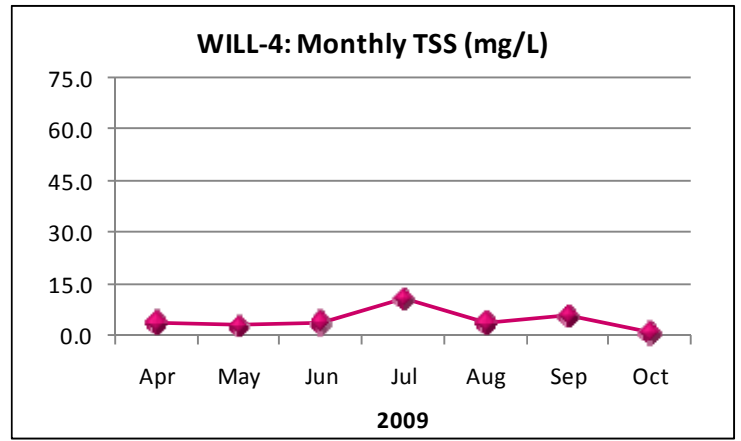
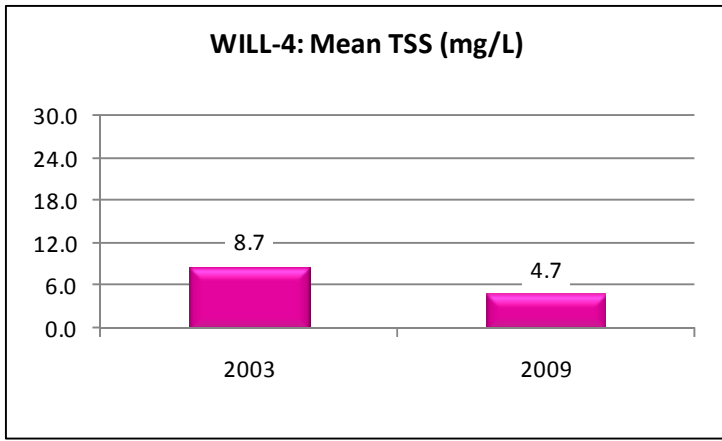
The mean growing season TSS value was lower in 2009 than 2003 (Fig. 5). Monthly TSS concentration had a small peak in July and low most other months sampled.

AGPT results show that WILL-4 was nitrogen limited in both 2003 and 2009 (Table 3). The mean maximum standing crop (MSC) value from both years were below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems, though the 2003 value was very close.

The DO concentration in the WILL-4 station was above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months (ADEM Admin. Code R. 335-6-10-09) (Fig. 6). Concentrations decreased April-August.



**Figure 4.** Mean growing season (2003-2009) and monthly (April-October, 2009) TN, TP, chl *a* and TSI measured in the Shoal Creek embayment of Wilson 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 Shoal Creek embayment of Wilson Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2009. 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.

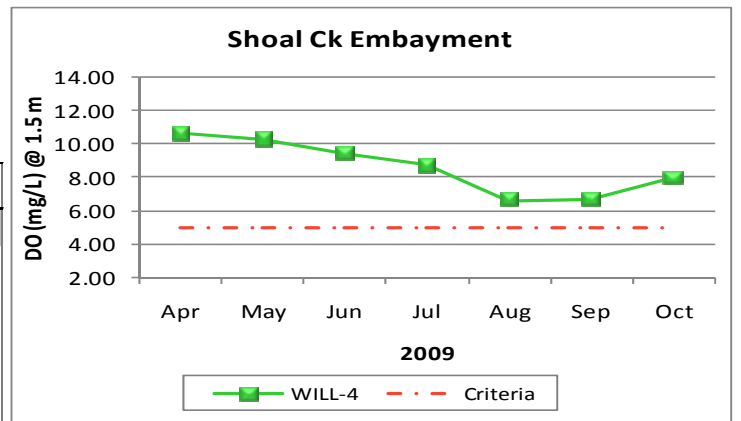
WILL-4	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	3.1	6.1	4.6	4.6	1.0
Total Dissolved Solids (mg/L) <sup>J</sup>	7	26.0	142.0	92.0	90.9	43.5
Total Suspended Solids (mg/L) <sup>J</sup>	7	1.0	11.0	4.0	4.7	3.2
Hardness (mg/L)	3	71.4	77.3	72.1	73.6	3.2
Alkalinity (mg/L)	7	38.0	110.0	67.3	69.4	21.3
Photic Zone (m)	7	3.46	5.48	4.20	4.40	0.70
Secchi (m)	7	0.99	1.53	1.44	1.34	0.23
Bottom Depth (m)	7	12.00	13.84	13.48	13.41	0.30
<b>Chemical</b>						
Ammonia Nitrogen (mg/L)	7	< 0.006	0.020	0.007	0.007	0.006
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	0.006	0.419	0.224	0.193	0.182
Total Kjeldahl Nitrogen (mg/L)	7	< 0.089	0.922	0.296	0.374	0.278
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.268	0.931	0.512	0.567	0.247
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	0.007	0.072	0.029	0.030	0.025
Total Phosphorus (mg/L)	7	0.030	0.094	0.063	0.065	0.020
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.1	8.2	5.8	6.1	1.8
<b>Biological</b>						
Chlorophyll a (ug/L)	7	6.41	23.50	15.49	16.48	6.05
Fecal Coliform (col/100 mL) <sup>J</sup>	3	< 1	29	1	10	16

<sup>J</sup>= 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).

Year	Mean MSC	Limiting Nutrient
8/20/2003	4.99	NITROGEN
8/19/2009	4.42	NITROGEN

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Shoal Creek embayment station of Wilson Reservoir collected April-October 2009. 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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