

Big Nance Creek Embayment Wilson Reservoir Intensive Basin Survey 2009

Tennessee River Basin

WILL-1: Big Nance Creek immediately upstream of AL Hwy 101 bridge (Lawrence Co 34.77935/-87.39315)

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 Big Nance 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 Big Nance Creek embayment (WILL-1) 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.

A consumption advisory was issued by the Alabama Department of Public Health in 2010 for mercury in fish from Big Nance Creek. As a result, Big Nance Creek from the embayment to its source is listed on the 2012 Alabama's Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its water use classifications.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Big Nance Creek is classified as a *Fish & Wildlife (F&W)* stream located in the Interior Plateau ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 197 mi² watershed is predominantly agriculture [hay/pasture (37%) and crops (9%)] (Fig. 3). As of October 1, 2013, ADEM has issued a total of 24 NPDES permits within the watershed. Four of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Big Nance Creek embayment at WILL-1 is located just downstream of the Joe Wheeler Reservoir dam and upstream of State Highway 101. It is a clear, shallow embayment. The mean depth for Big Nance Creek is 2.96 m (Table 2) at the sampling location.



Figure 1. Photo of Big Nance Creek at WILL-1

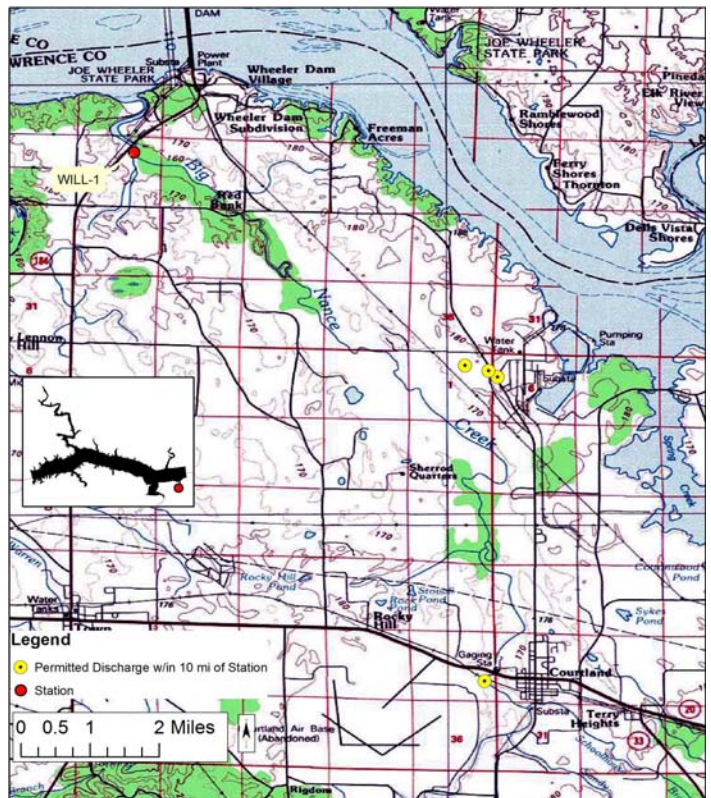


Figure 2. Map of Big Nance Creek embayment of Wilson Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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-1

Basin	Tennessee R
Drainage Area (mi ²)	197
Ecoregion ^a	71g
% Land use	
Open Water	1%
Developed	Open Space 5%
	Low Intensity 1%
	Medium Intensity <1%
	High Intensity <1%
Barren Land	<1%
Forest	Deciduous Forest 18%
	Evergreen Forest 5%
	Mixed Forest 4%
Shrub/Scrub	7%
Herbaceous	4%
Hay/Pasture	37%
Cultivated Crops	9%
Wetlands	Woody 7%
	Emergent Herb. <1%
# NPDES Permits ^b TOTAL 24	
401 Water Quality Certification	3
Construction Stormwater	7
Mining	1
Industrial General	9
Municipal Individual	4

a. Interior Plateau

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

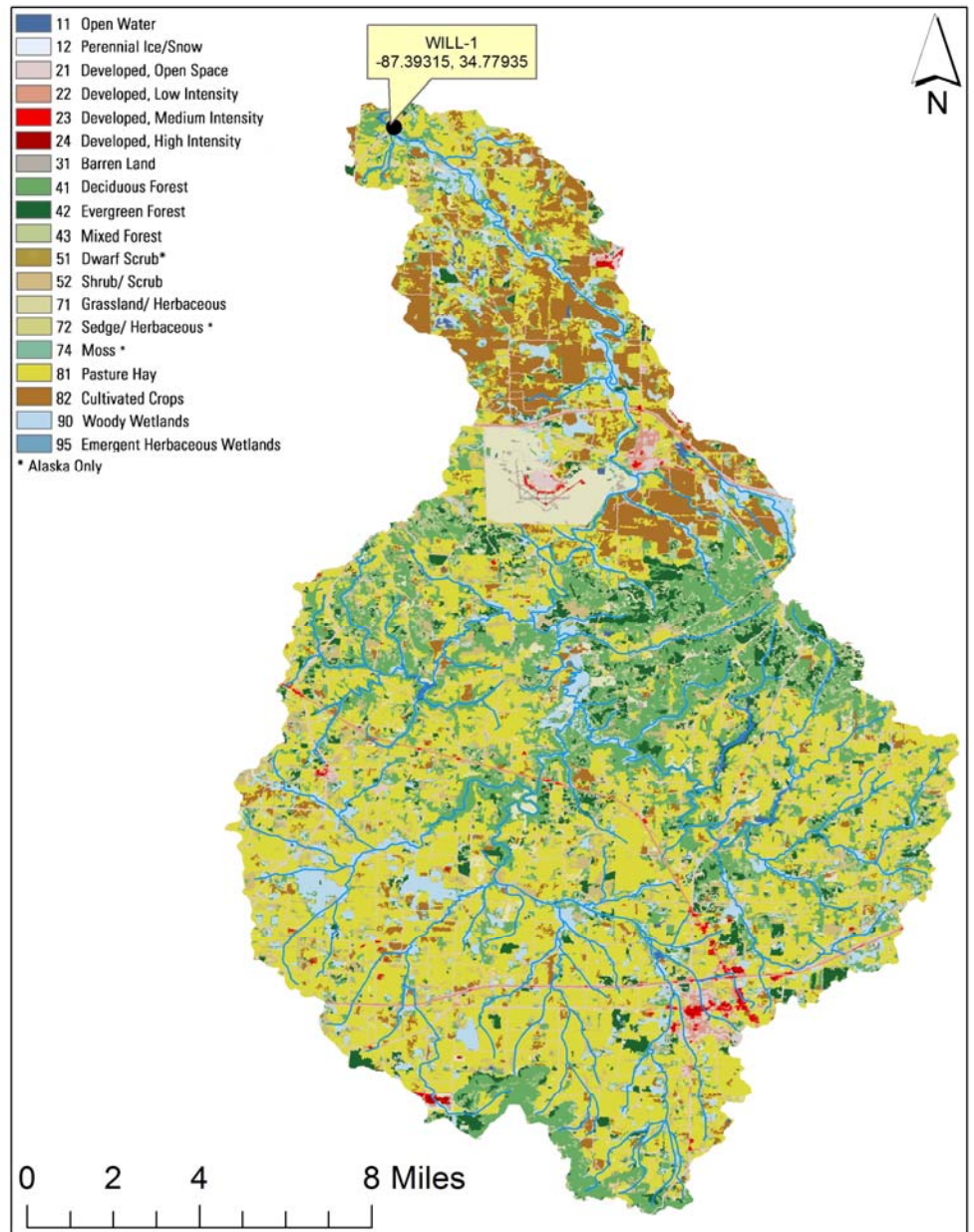


Figure 3. Land use within the Big Nance Creek watershed at WILL-1.

The mean growing season TN value was higher in 2009 than in 2003 (Fig. 4). Monthly TN concentrations were highest in May and variable month to month, always remaining at or above 1.0 mg/L.

Similar to mean TN concentration, the mean growing season TP concentration was higher in 2009 (Fig. 4). The highest monthly TP concentrations were reached in June and September.

In 2009, the growing season mean chl *a* value was higher than 2003 (Fig. 4). Monthly chl *a* concentrations peaked in July and decreased through October.

Mean TSI was eutrophic in 2009, an increase from oligotrophic trophic status in 2003. Monthly TSI in Big Nance Creek was eutrophic in April, July, and August (Fig. 4).

The mean growing season TSS value was higher in 2009 than 2003 (Fig. 5). The monthly TSS concentration was highest in June and variable most other months sampled.

AGPT results show that WILL-1 was phosphorus limited in both 2003 and 2009 (Table 3). The mean maximum standing crop (MSC) value from 2009 was below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems. The mean MSC value in 2003 was well above the 5.0 mg/L.

The DO concentration in the WILL-1 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).

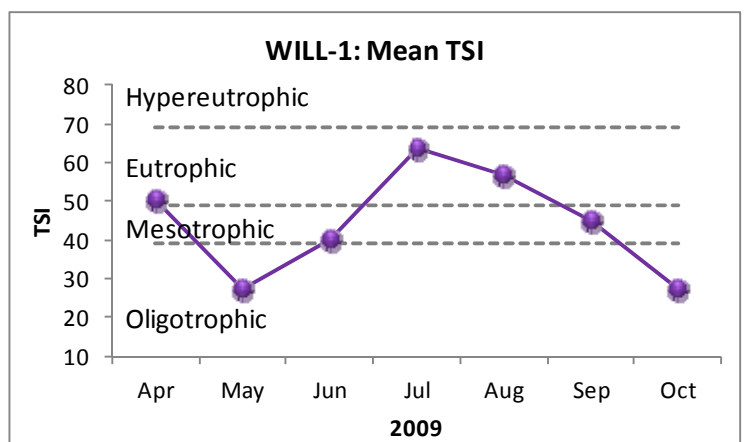
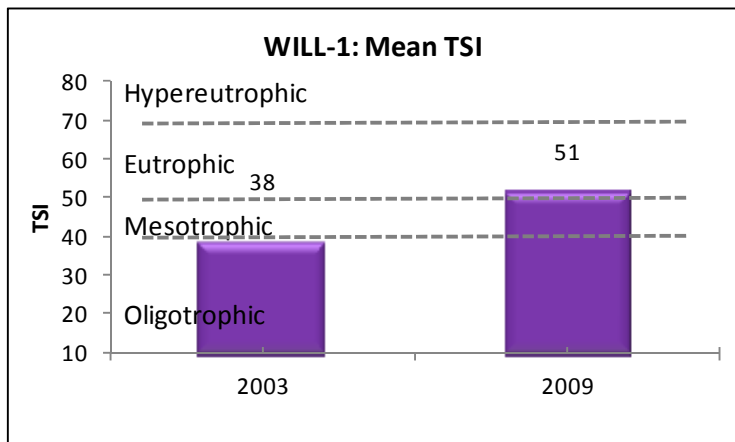
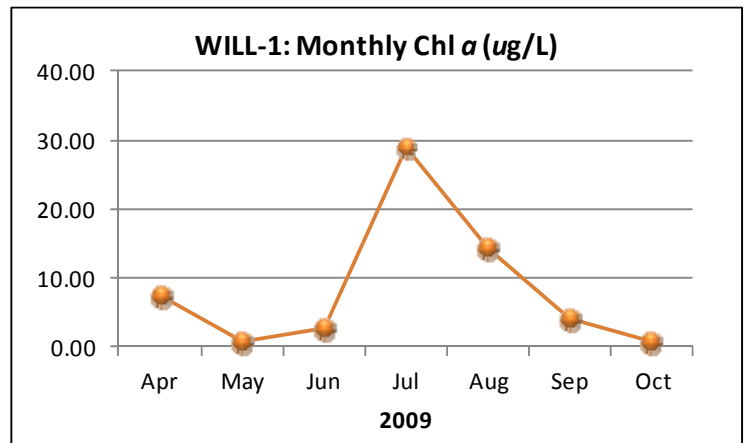
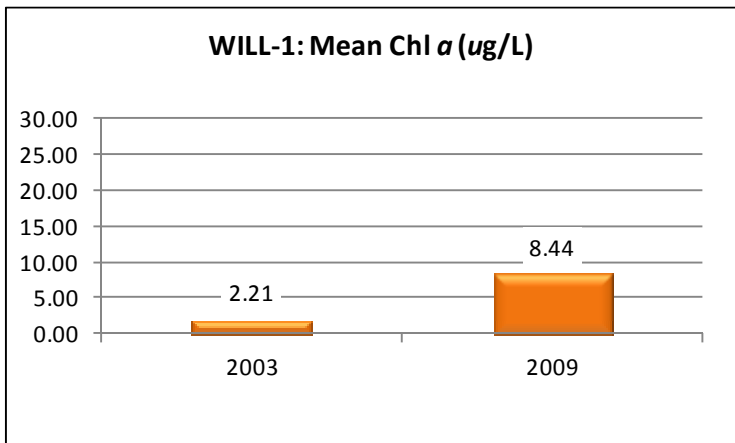
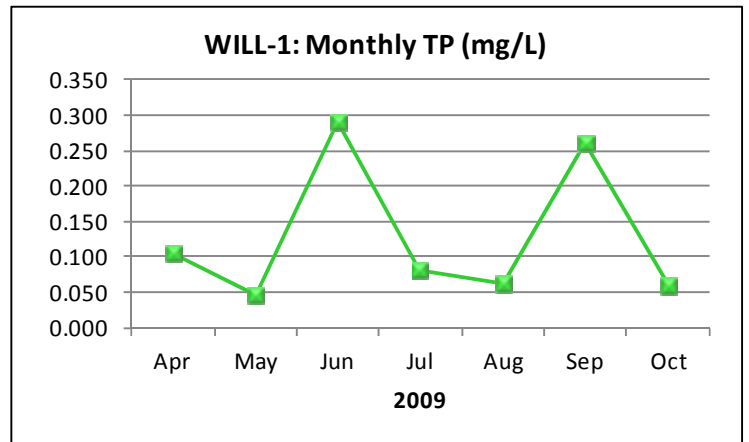
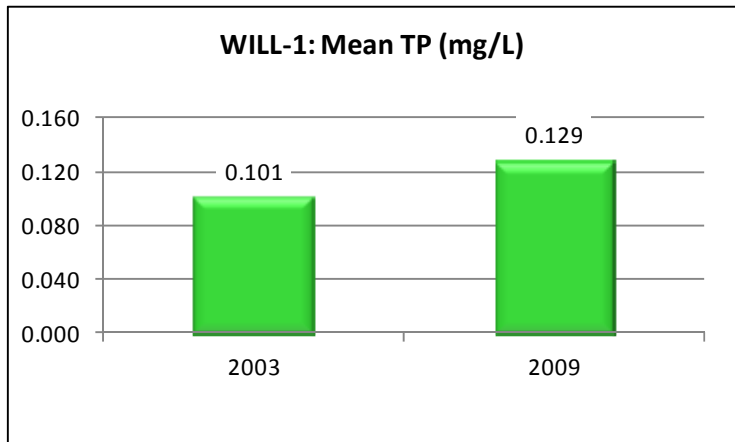
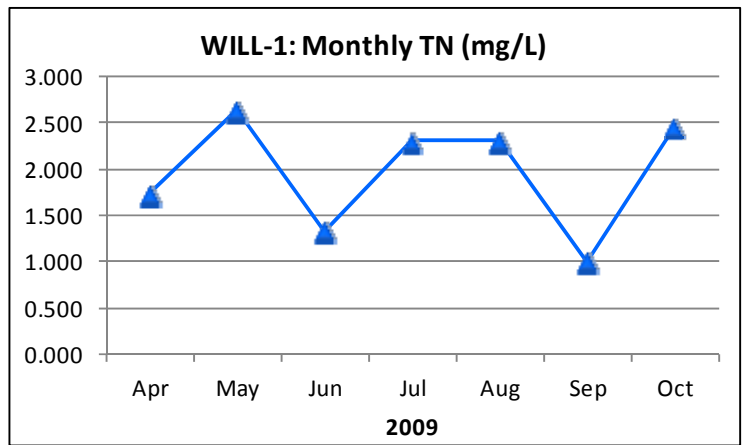
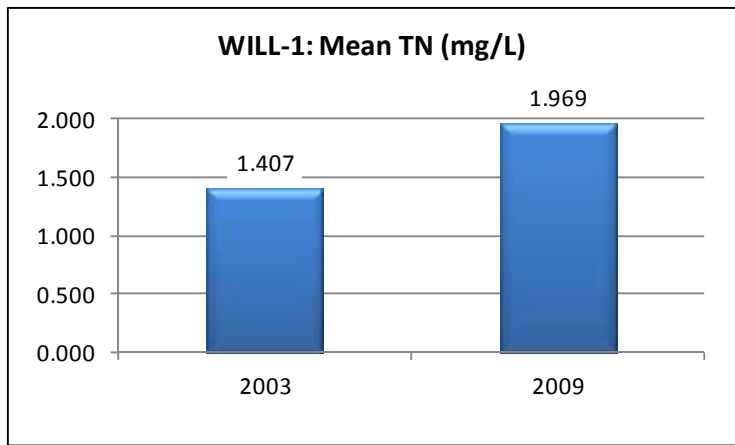


Figure 4. Mean growing season (2003-2009) and monthly (April-October, 2009) TN, TP, chl *a* and TSI measured in the Big Nance Creek embayment of Wilson Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

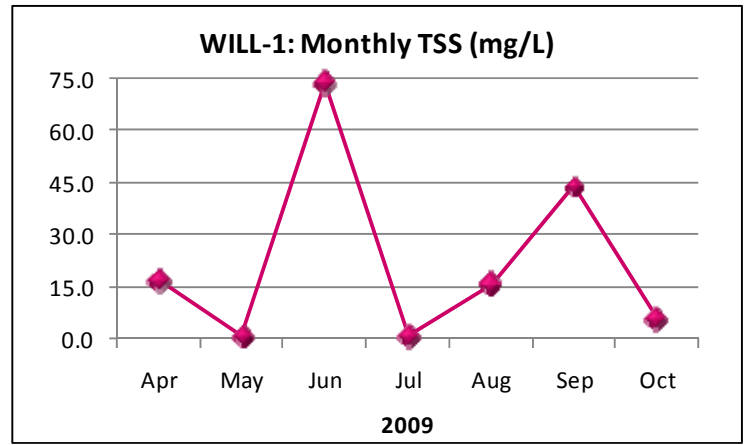
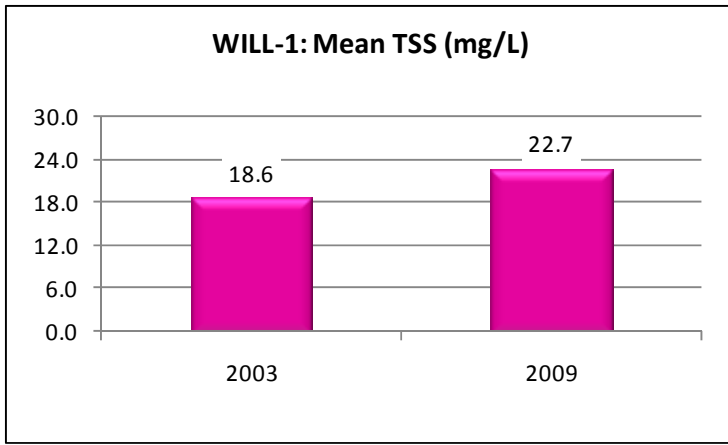


Figure 5. Mean growing season and monthly TSS measured in the Big Nance Creek embayment of Wilson Reservoir.

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-1	N	Min	Max	Med	Mean	SD
Physical						
Turbidity (NTU)	7	7.1	70.4	11.6	25.9	24.4
Total Dissolved Solids (mg/L) ^J	7	56.0	172.0	118.0	119.4	44.4
Total Suspended Solids (mg/L) ^J	7	1.0	74.0	16.0	22.7	27.0
Hardness (mg/L)	3	13.9	118.0	75.3	69.1	52.3
Alkalinity (mg/L)	7	44.2	129.0	81.9	88.5	28.6
Photic Zone (m)	7	0.75	3.00	2.65	2.05	1.00
Secchi (m)	7	0.31	1.15	0.66	0.64	0.30
Bottom Depth (m)	7	2.90	3.05	2.98	2.96	0.08
Chemical						
Ammonia Nitrogen (mg/L)	7	< 0.006	0.048	0.007	0.013	0.016
Nitrate+Nitrite Nitrogen (mg/L)	7	0.486	2.575	1.798	1.414	0.827
Total Kjeldahl Nitrogen (mg/L)	7	< 0.141	1.030	0.521	0.555	0.312
Total Nitrogen (mg/L)	7	< 1.007	2.646	2.305	1.969	0.620
Dissolved Reactive Phosphorus (mg/L)	7	0.014	0.166	0.037	0.066	0.068
Total Phosphorus (mg/L)	7	0.045	0.290	0.080	0.129	0.102
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.0	6.6	4.4	4.5	1.2
Biological						
Chlorophyll a (ug/L)	7	0.71	28.84	4.27	8.44	10.19
Fecal Coliform (col/100 mL) ^J	3	20	>400	60	160	209

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).

Year	Mean MSC	Limiting Nutrient
8/20/2003	9.09	PHOSPHORUS
8/19/2009	2.02	PHOSPHORUS

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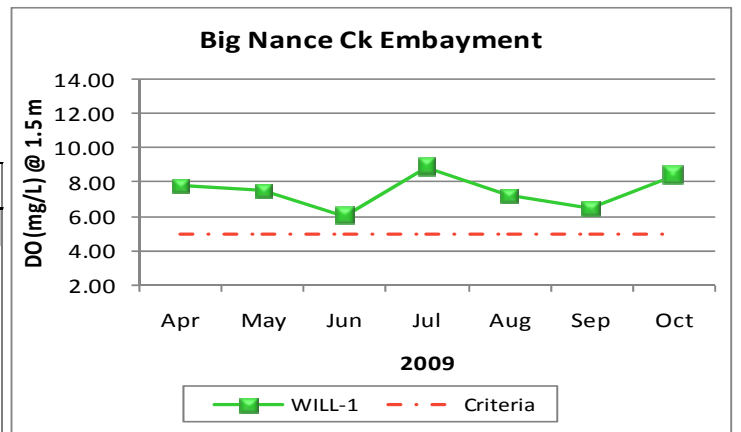


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Big Nance Creek embayment station of Wilson Reservoir collected April-October 2009. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

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