Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Paint Rock River Embayment
Wheeler Reservoir
Intensive Basin Survey 2013

WHEL-1: Paint Rock R approx 1 mi upstream of confluence with TN River (Madison Co 34.48325/-86.45508)

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 Paint Rock River 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 Paint Rock River embayment (WHEL-1) 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 Paint Rock R at WHEL-1.

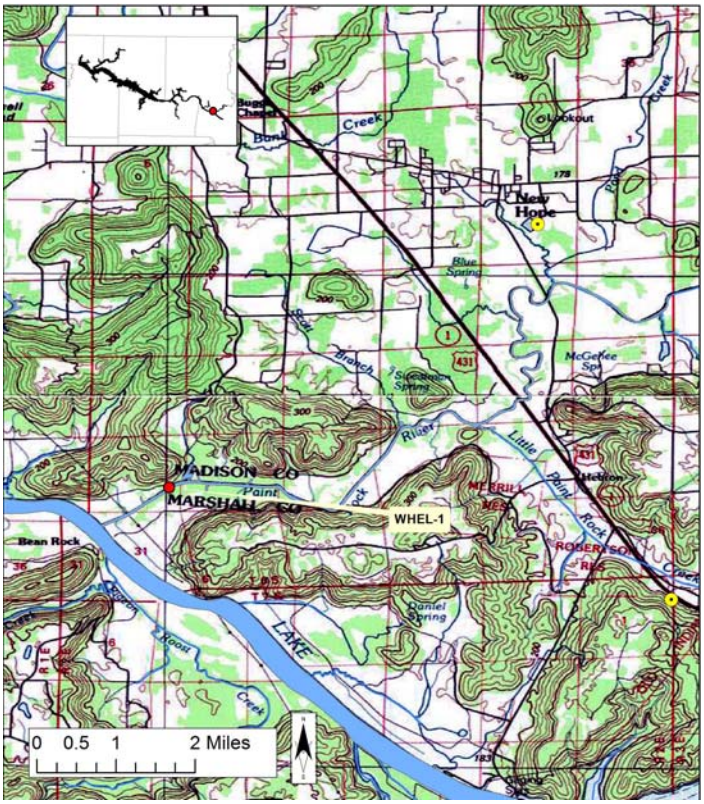


Figure 2. Map of Paint Rock River embayment of Wheeler Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Paint Rock River is classified as a *Fish & Wildlife (F&W)* stream located in the Plateau Escarpment ecoregion (68c). Based on the 2006 National Land Cover Dataset, land use within the 459 mi^2 watershed is predominantly forest (73%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 13 NPDES permits within the watershed. Two of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Paint Rock River embayment at WHEL-1 is a fairly small, riverine embayment flowing into the Tennessee River near river mile 344. Paint Rock River has a mean bottom depth of 4.77 m (Table 2) at the sampling location.

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-1**

Basin		Tennessee R
Drainage Area (mi^2)		459
Ecoregion[a]		68c
% Land use		
Open Water		<1%
Developed	Open Space	2%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	69%
	Evergreen Forest	1%
	Mixed Forest	3%
Shrub/Scrub		4%
Herbaceous		1%
Hay/Pasture		12%
Cultivated Crops		6%
Wetlands	Woody	2%
	Emergent Herb.	<1%
# NPDES Permits[b]	TOTAL	13
401 Water Quality Certification		1
Construction Stormwater		4
Mining		2
Industrial General		3
Municipal Individual		3

a. Plateau Escarpment

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

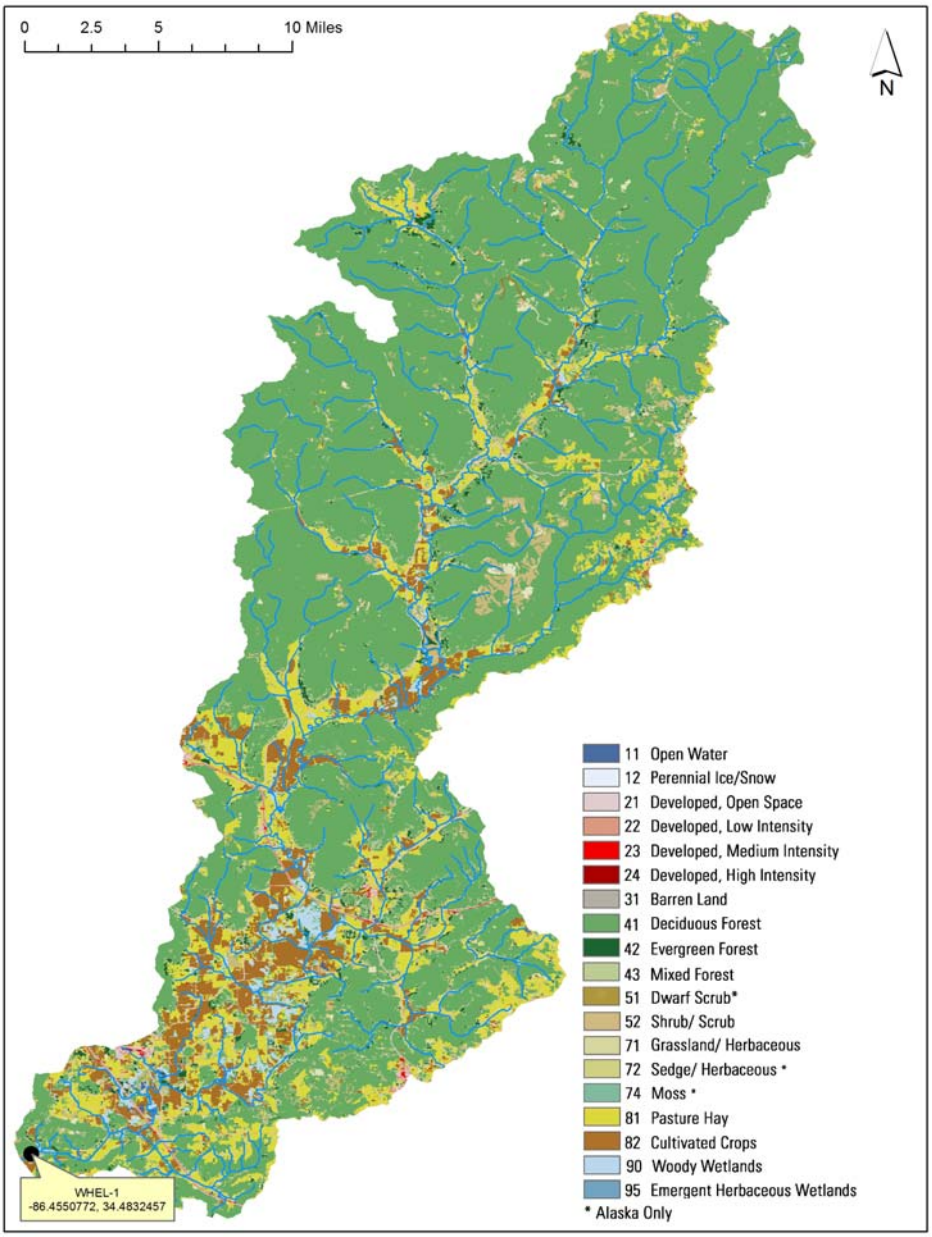


Figure 3. Land use within the Paint Rock River watershed at WHEL-1.

The mean growing season TN value was higher in 2013 than in 2003-2009 (Fig. 4). Monthly TN concentrations increased through June then decreased through September.

The mean growing season TP concentration in 2013 was the same as 2009 and lower than 2003 (Fig. 4). Monthly TP concentrations were highest in June and August.

In 2013, the growing season mean chl *a* value was lower than 2003 and 2009 (Fig. 4). Monthly chl *a* concentrations were similar April-October.

Mean TSI was oligotrophic in 2013, a decrease from eutrophic conditions in 2009. Monthly TSI in Paint Rock R was oligotrophic in all months sampled (Fig. 4).

The mean growing season TSS value was higher in 2013 than 2009 but lower than 2003 (Fig. 5). Monthly TSS concentration was highest in August and low most other months sampled.

AGPT results show that WHEL-1 was phosphorus limited 2003-2013 (Table 3). Although higher than 2003-2009, the 2013 mean maximum standing crop (MSC) value was below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

The DO concentrations in the WHEL-1 station fell below the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in June and July (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

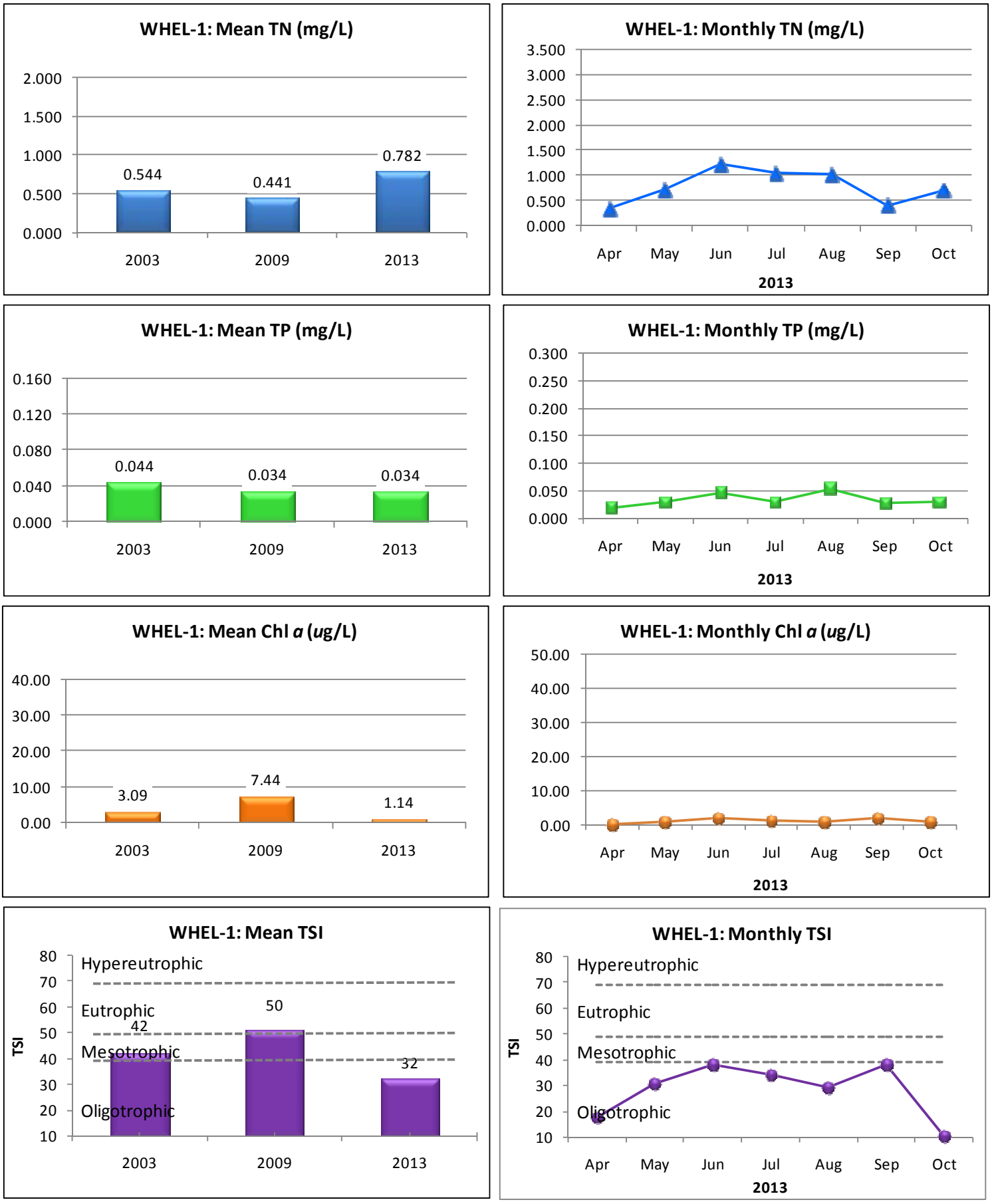
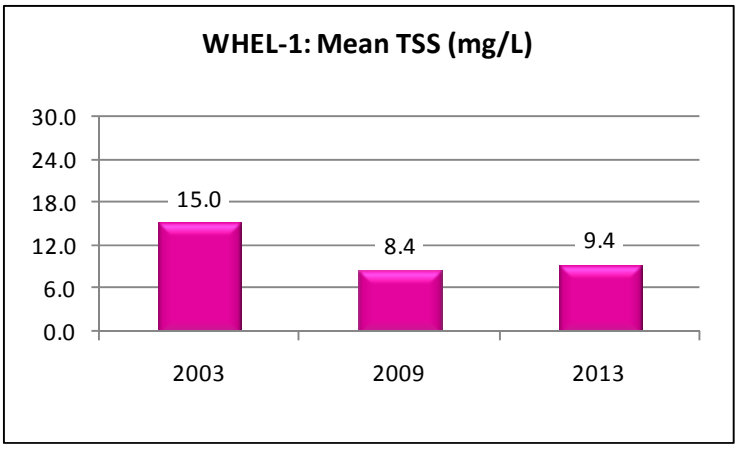


Figure 4. Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl *a* and TSI measured in the Paint Rock River embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



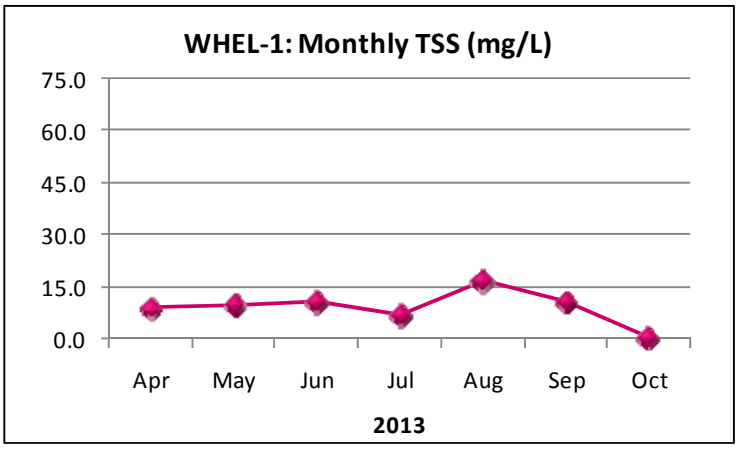


Figure 5. Mean growing season and monthly TSS measured in the Paint Rock River embayment of Wheeler Reservoir.

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-1	N		Min	Max	Med	Mean	SD
Physical							
Turbidity (NTU)	7		6.6	17.5	8.7	9.9	3.8
Total Dissolved Solids (mg/L)	7		73.0	163.0	134.0	123.4	32.3
Total Suspended Solids (mg/L)	7	<	1.0	17.0	10.0	9.4	5.0
Hardness (mg/L)	4		86.0	125.0	117.5	111.5	17.4
Alkalinity (mg/L)	7		66.8	130.0	113.0	103.4	23.1
Photic Zone (m)	7		2.21	4.50	3.68	3.60	0.79
Secchi (m)	7		0.63	1.49	1.03	1.04	0.27
Bottom Depth (m)	7		4.00	5.40	4.60	4.77	0.43
Chemical							
Ammonia Nitrogen (mg/L)	7	<	0.018	0.030	0.020	0.019	0.010
Nitrate+Nitrite Nitrogen (mg/L)	7		0.134	0.592	0.389	0.397	0.181
Total Kjeldahl Nitrogen (mg/L)[J]	7		0.098	0.626	0.420	0.384	0.169
Total Nitrogen (mg/L)[J]	7		0.348	1.218	0.724	0.782	0.330
Dissolved Reactive Phosphorus (mg/L)[J]	7		0.008	0.028	0.017	0.017	0.008
Total Phosphorus (mg/L)	7		0.019	0.054	0.030	0.034	0.012
CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7		1.9	5.8	3.0	3.6	1.5
Biological							
Chlorophyll a (ug/L)	7	<	0.10	2.14	1.07	1.14	0.83
E. coli (col/100mL)[J]	3		5	50	34	30	23

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
8/19/2003	1.22	PHOSPHORUS
8/18/2009	1.54	PHOSPHORUS
8/20/2013	4.12	PHOSPHORUS

FOR MORE INFORMATION, CONTACT:
Ransom Williams, ADEM Environmental Indicators Section
1350 Coliseum Boulevard, Montgomery, AL 36110
(334) 260-2715, rw@adem.state.al.us

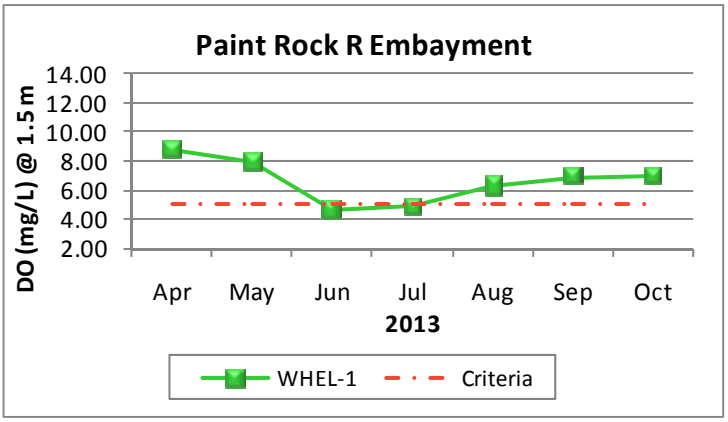


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Paint Rock R embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.

ADEM. 2013a. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.

ADEM. 2013b. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp.http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2010. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.

Carlson, R.E. 1977. A trophic state index. Limnology and Oceanography. 22(2):361-369.

Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. Journal of Water Pollution Control Federation 59(4):222-227.