Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

# Indian Creek Embayment
# Wheeler Reservoir
# Intensive Basin Survey 2015

**WHEL-3:** Indian Creek approx 1 mi upstream of confluence with TN River (Madison Co 34.58431/-

## 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 2015, ADEM monitored the Indian 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 Indian Creek embayment (WHEL-3) during the 2015 growing season (Apr-Oct). This is the fourth 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 2015 were compared to ADEM's historical data and established criteria.

## WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Indian Creek is classified as a *Public Water Supply/Fish & Wildlife (PWS/F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 191 $mi^2$ watershed is predominantly developed (44%) (Fig. 3). As of January 28, 2016, ADEM has issued a total of 572 NPDES permits within the watershed. Nineteen of those permits are located within 10 mi of the station (Fig. 2).

## SITE DESCRIPTION

The Indian Creek embayment at WHEL-3 is located just south of Redstone Arsenal near Huntsville, AL. Nearly the entire watershed is contained within the Huntsville city limits. It is a riverine embayment that flows into the Tennessee River near river mile 321. Indian Creek has a mean bottom depth of 5.18 m (Table 2) at the sampling location.

**Figure 1**. Photo of Indian Creek at WHEL-3.

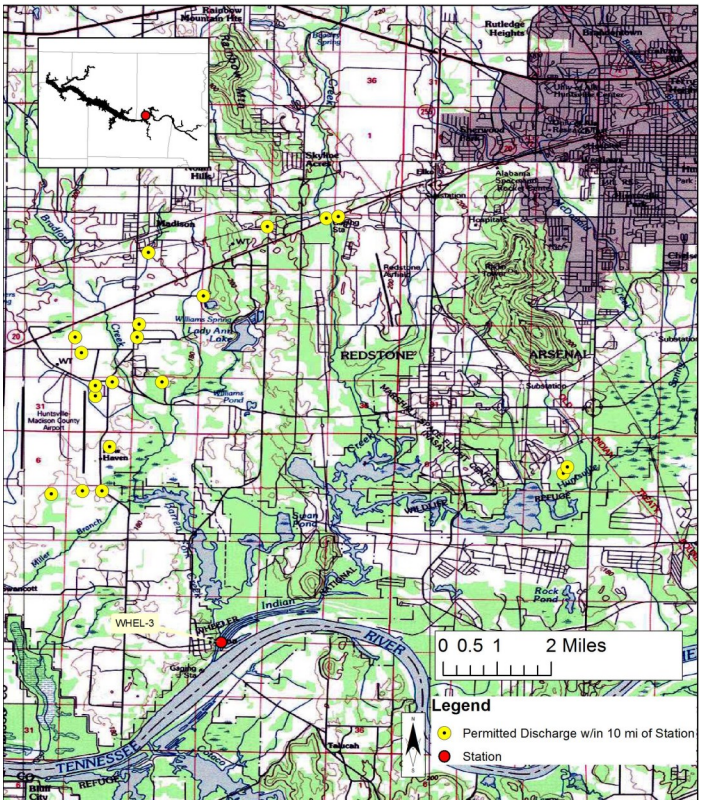



**Figure 2**. Map of Indian Creek embayment of Wheeler Reservoir. Though additional permitted facilities may occur in the watershed (Table 1), only those within 10 miles upstream of the station are displayed on the map.

## 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 2015), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

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 2015 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-3**

| | | |
|---|---|---|
| Basin | | Tennessee R |
| Drainage Area (mi$^2$) | | 191 |
| Ecoregion[a] | | 71g |
| % Land use | | |
| Open Water | | 1% |
| Developed | Open Space | 16% |
| | Low Intensity | 20% |
| | Medium Intensity | 6% |
| | High Intensity | 2% |
| Barren Land | | <1% |
| Forest | Deciduous Forest | 13% |
| | Evergreen Forest | 5% |
| | Mixed Forest | 3% |
| Shrub/Scrub | | 4% |
| Herbaceous | | 1% |
| Hay/Pasture | | 12% |
| Cultivated Crops | | 11% |
| Wetlands | Woody | 6% |
| | Emergent Herb. | <1% |
| # NPDES outfalls[b] | TOTAL | 572 |
| Construction Stormwater | | 358 |
| Mining | | 10 |
| Small Mining | | 4 |
| Industrial General | | 114 |
| Industrial Individual | | 61 |
| Municipal | | 1 |
| Underground Injection Control | | 24 |

a. Eastern Highland Rim

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.

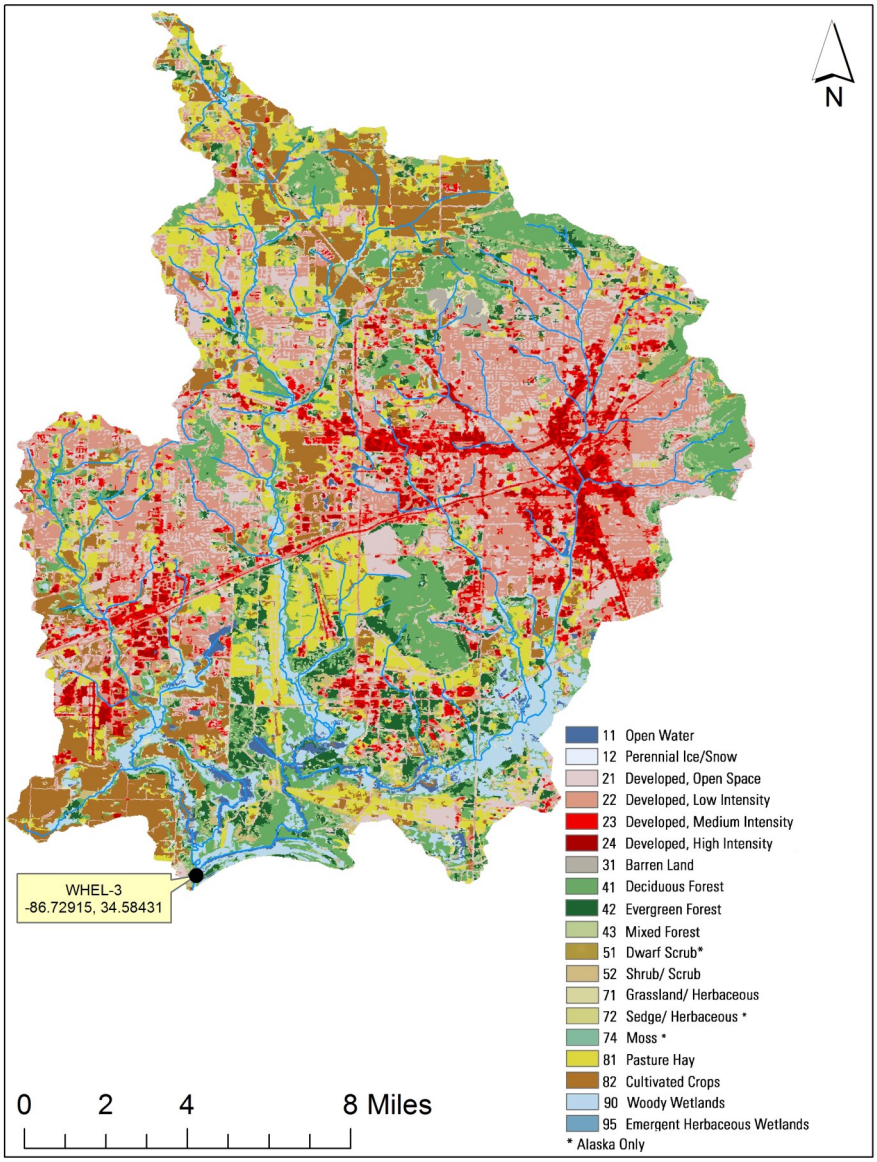



**Figure 3**. Land use within the Indian Creek watershed at WHEL-3.

The mean growing season TN value was lower in 2015 than 2013 (Fig. 4). Monthly TN concentrations were highest in April and October.

The mean growing season TP concentration in 2015 was similar to 2013 and lower than 2003 and 2009. (Fig. 4). Monthly TP concentrations were highest in April and October.

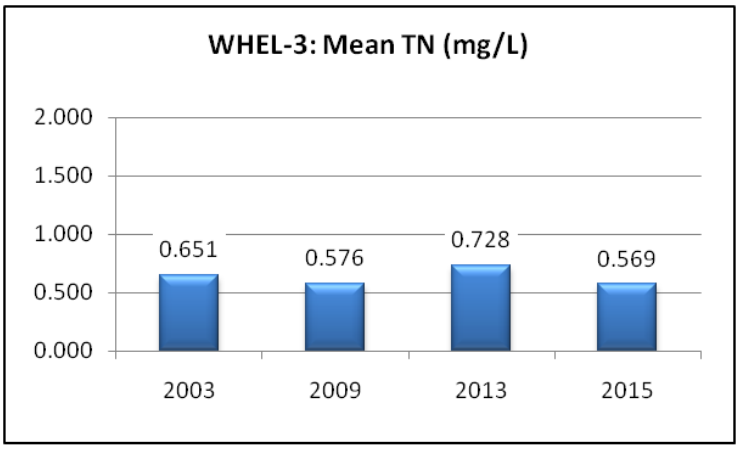
In 2015, the growing season mean chl *a* value was slightly higher than 2013 (Fig. 4). Monthly chl *a* concentrations were highest in July and September.

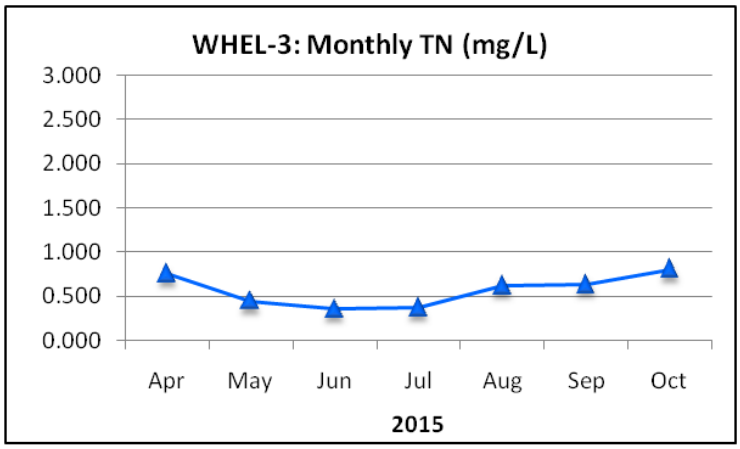
Mean TSI was oligotrophic in 2015, exactly the same as conditions in 2013. Monthly TSI in Indian Creek was mostly oligotrophic throughout growing season but reached eutrophic conditions in July and September.

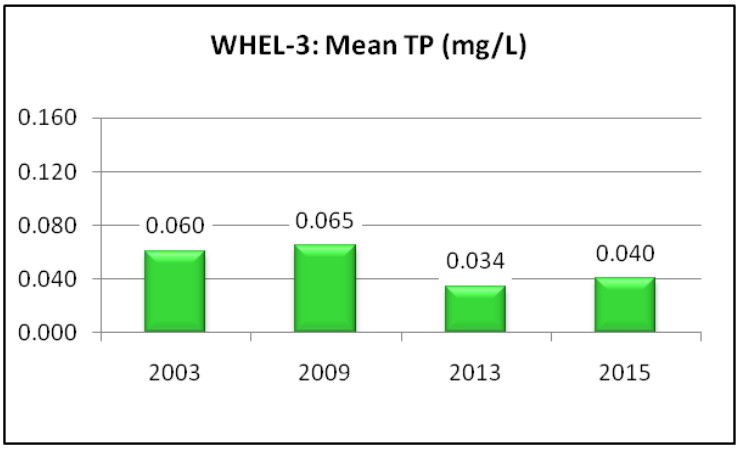
The mean growing season TSS value was higher in 2015 than 2013 (Fig. 5). The highest monthly TSS concentration was in October.

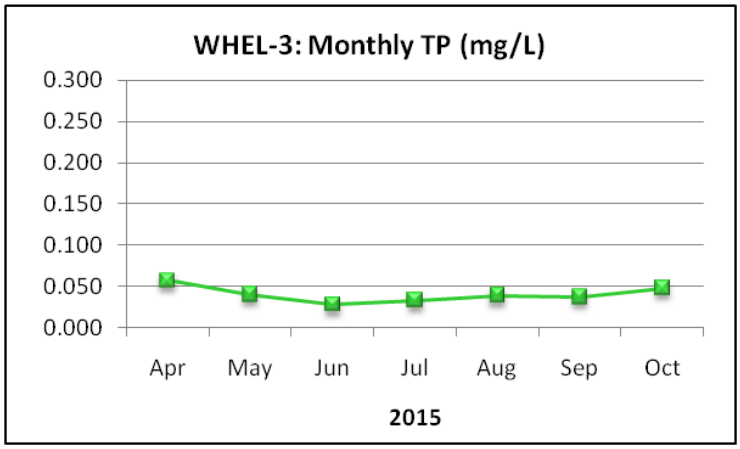
No AGPT sample was collected from Indian Creek in 2015. Results from 2003-2013 are shown in Table 3.

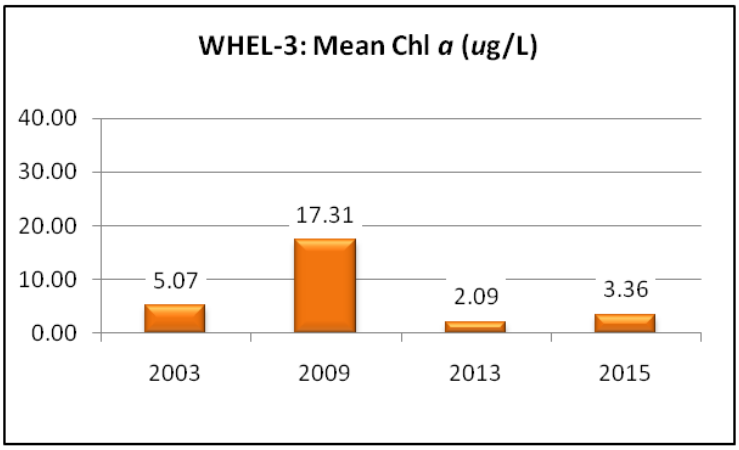
DO concentrations in the WHEL-3 station were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in all months, though it was near the limit in April (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

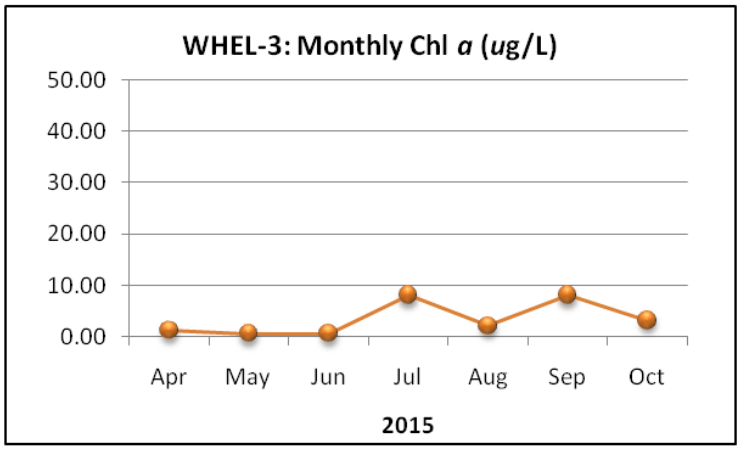


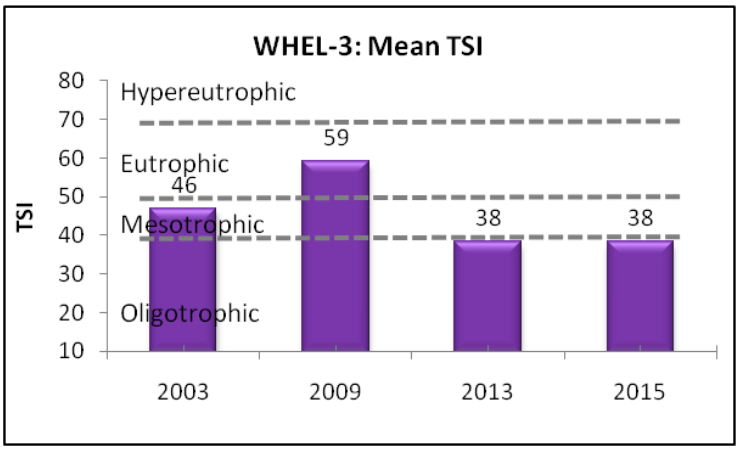



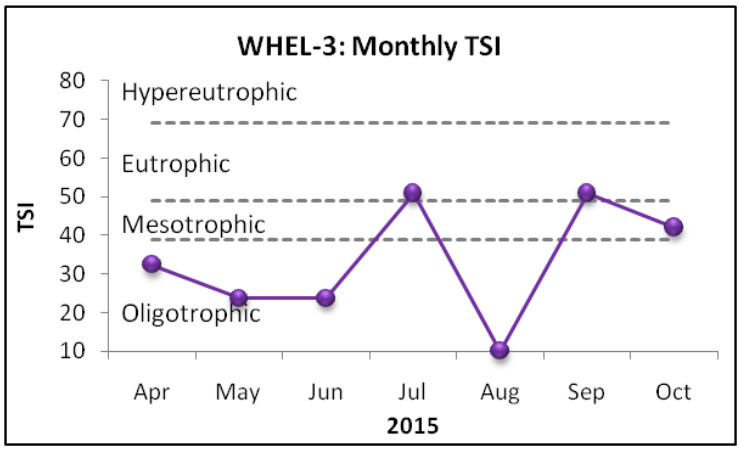
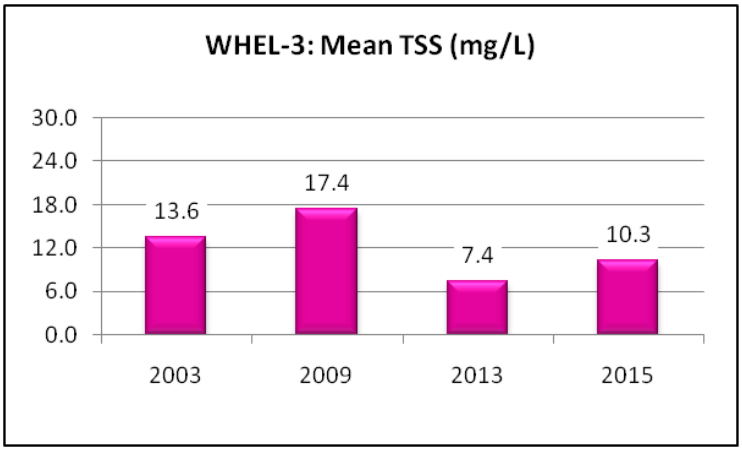




**Figure 4**. Mean growing season (2003-2015) and monthly (April-October, 2015) TN, TP, chl *a* and TSI measured in the Indian Creek embayment of Wheeler Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



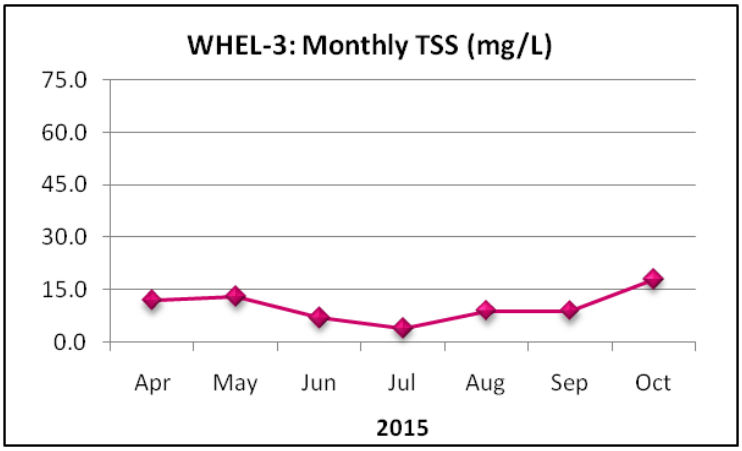




**Figure 5**. Mean growing season and monthly TSS measured in the Indian Creek embayment of Wheeler Reservoir.

**Table 2**. Summary of water quality data collected April-October, 2015. 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-3 | N | Min | Max | Med | Mean | SD |
|---|---|---|---|---|---|---|
| **Physical** | | | | | | |
| Turbidity (NTU) | 7 | 6.3 | 20.0 | 8.9 | 12.0 | 5.8 |
| Total Dissolved Solids (mg/L) | 7 | 92.0 | 137.0 | 111.0 | 113.0 | 16.2 |
| Total Suspended Solids (mg/L) | 7 | 4.0 | 18.0 | 9.0 | 10.3 | 4.5 |
| Hardness (mg/L) | 4 | 72.4 | 90.5 | 84.2 | 82.8 | 8.1 |
| Alkalinity (mg/L) | 7 | 68.7 | 119.0 | 81.3 | 85.5 | 17.0 |
| Photic Zone (m) | 7 | 1.75 | 4.09 | 3.06 | 2.90 | 0.92 |
| Secchi (m) | 7 | 0.66 | 1.83 | 0.98 | 1.19 | 0.53 |
| Bottom Depth (m) | 7 | 4.90 | 6.00 | 5.20 | 5.18 | 0.43 |
| **Chemical** | | | | | | |
| Ammonia Nitrogen (mg/L) | 7 | < 0.007 | 0.081 | 0.045 | 0.046 | 0.025 |
| Nitrate+Nitrite Nitrogen (mg/L) | 7 | 0.107 | 0.377 | 0.160 | 0.197 | 0.091 |
| Total Kjeldahl Nitrogen (mg/L) | 7 | 0.155 | 0.560 | 0.379 | 0.372 | 0.152 |
| Total Nitrogen (mg/L) | 7 | 0.354 | 0.803 | 0.622 | 0.569 | 0.182 |
| Dissolved Reactive Phosphorus (mg/L)[J] | 7 | 0.006 | 0.025 | 0.017 | 0.018 | 0.006 |
| Total Phosphorus (mg/L) | 7 | 0.028 | 0.057 | 0.039 | 0.040 | 0.010 |
| CBOD-5 (mg/L)[J] | 7 | < 2.0 | 2.0 | 1.0 | 1.0 | 0.0 |
| Chlorides (mg/L) | 7 | 2.5 | 8.7 | 7.3 | 6.7 | 2.0 |
| **Biological** | | | | | | |
| Chlorophyll a (ug/L) | 7 | < 1.00 | 8.01 | 2.14 | 3.36 | 3.31 |
| E. coli (col/100mL)[J] | 3 | 3 | 36 | 11 | 17 | 17 |

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 | 10.13 | PHOSPHORUS |
| 8/18/2009 | 4.87 | PHOSPHORUS |
| 8/20/2013 | 11.87 | PHOSPHORUS |

FOR MORE INFORMATION, CONTACT:
Michael Len, ADEM Environmental Indicators Section
1350 Coliseum Boulevard, Montgomery, AL 36110
(334) 260-2787, mlen@adem.state.al.us

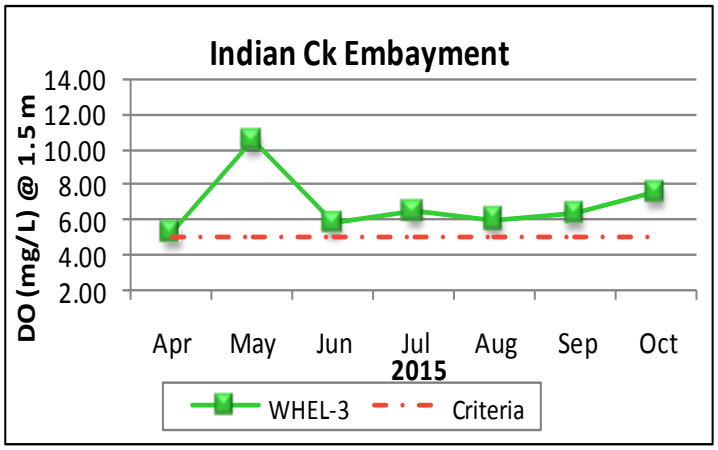



**Figure 6**. Monthly DO concentrations at 1.5 m (5 ft) for Indian Creek embayment station of Wheeler Reservoir collected April-October 2015. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

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