

Dry Branch Embayment Wheeler Reservoir Intensive Basin Survey 2013

Tennessee River Basin

WHEL-7: Dry Branch immediately downstream stream of Alt. Hwy 72 bridge (Morgan Co 34.62081/-87.00064)

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 Dry Branch 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 at WHEL-7 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.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Dry Branch is classified as a *Fish & Wildlife (F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the very small 10 mi² watershed is predominantly developed (83%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 16 NPDES permits within the watershed. All of those permits are located within 10 mi upstream of the station (Fig. 2).

SITE DESCRIPTION

Draining into Wheeler Reservoir near river mile 303, the Dry Branch embayment is located near the center of downtown Decatur, AL. Nearly the entire watershed is contained within its city limits. It is a shallow embayment with a mean bottom depth of 1.78 m (Table 2) at the sampling location. There is no aquatic vegetation present in this embayment.



Figure 1. Photo of Dry Branch at WHEL-7.

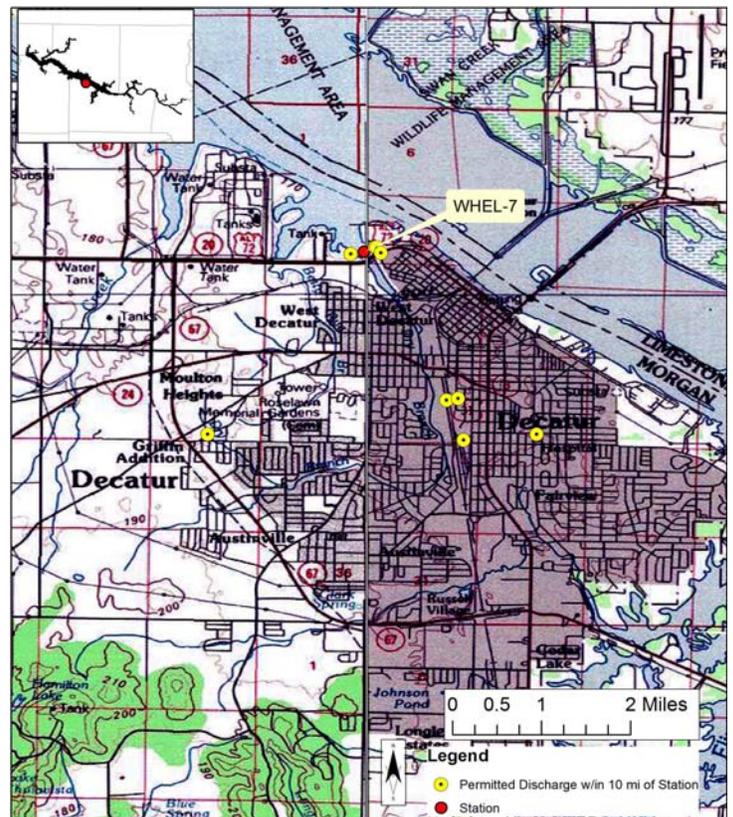


Figure 2. Map of Dry Branch embayment of Wheeler Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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 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.

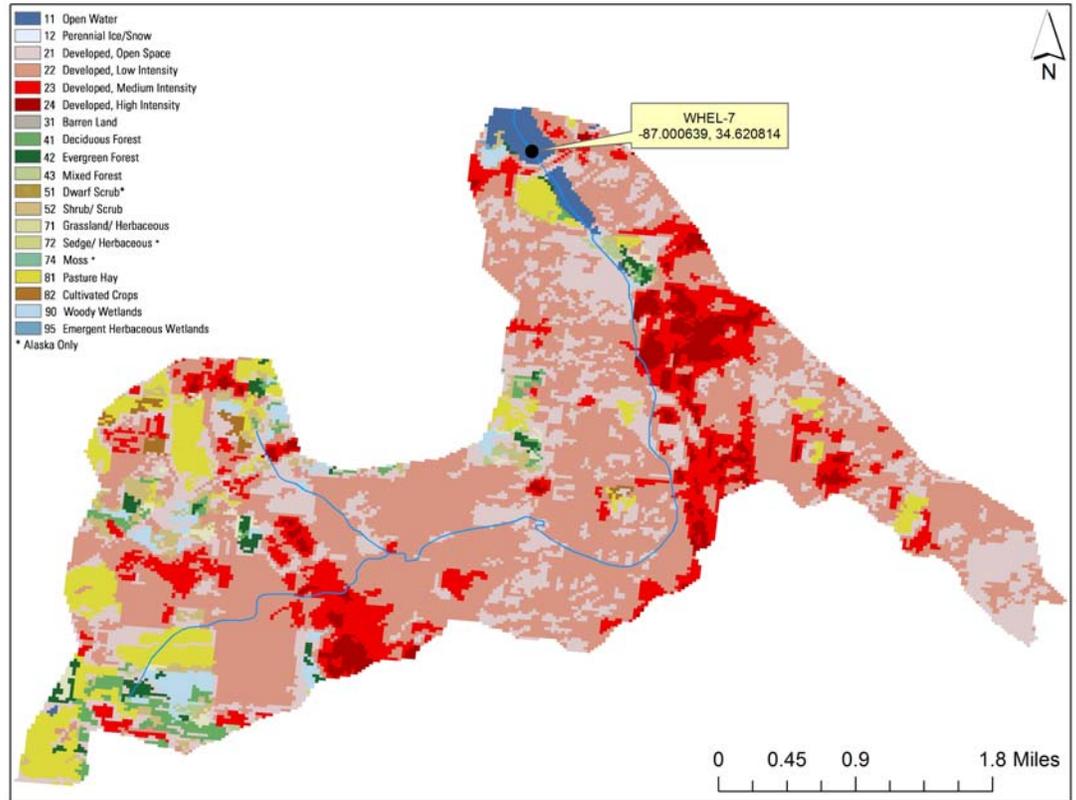


Figure 3. Land use within the Dry Branch watershed at WHEL-7.

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.

Mean growing season TN values have increased from 2003 through 2013 (Fig. 4). Monthly TN concentrations were similar April through October.

Mean growing season TP values have decreased from 2003 through 2013 (Fig. 4). Monthly TP concentrations were highest in August.

Mean growing season chl *a* values have decreased from 2003 through 2013 (Fig. 4). Monthly chl *a* concentrations were variable with the highest concentrations measured in May and August.

Mean TSI values remained eutrophic in 2013 (Fig. 4). Monthly TSI values in Dry Branch were eutrophic April through October.

The mean growing season TSS value was higher in 2013 than 2009, but lower than 2003 (Fig. 5). Monthly TSS concentrations were highest in July and October.

AGPT results show that Dry Branch has remained nitrogen limited all years monitored (Table 3). The mean maximum standing crop (MSC) values from 2013 and 2009 were below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

DO concentrations in the Dry Branch 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).

Table 1: Summary of Watershed WHEL-7

| Basin | | Tennessee R |
|----------------------------------|------------------|-------------|
| Drainage Area (mi ²) | | 10 |
| Ecoregion ^a | | 71g |
| % Land use | | |
| Open Water | | 1% |
| Developed | Open Space | 21% |
| | Low Intensity | 46% |
| | Medium Intensity | 12% |
| | High Intensity | 4% |
| Barren Land | | <1% |
| Forest | Deciduous Forest | 2% |
| | Evergreen Forest | 1% |
| | Mixed Forest | <1% |
| Shrub/Scrub | | 2% |
| Herbaceous | | 1% |
| Hay/Pasture | | 7% |
| Cultivated Crops | | 1% |
| Wetlands | Woody | 2% |
| | Emergent Herb. | <1% |
| | | |
| #NPDES Permits ^b | | TOTAL |
| 401 Water Quality Certification | | 1 |
| Construction Stormwater | | 7 |
| Industrial General | | 7 |
| Underground Injection Control | | 1 |

a. Eastern Highland Rim

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

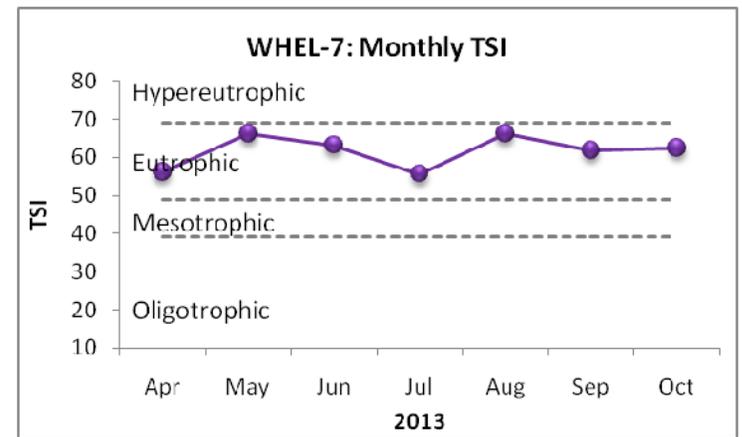
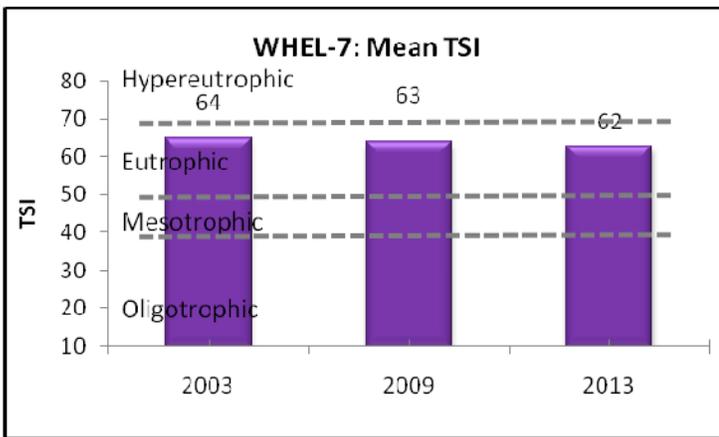
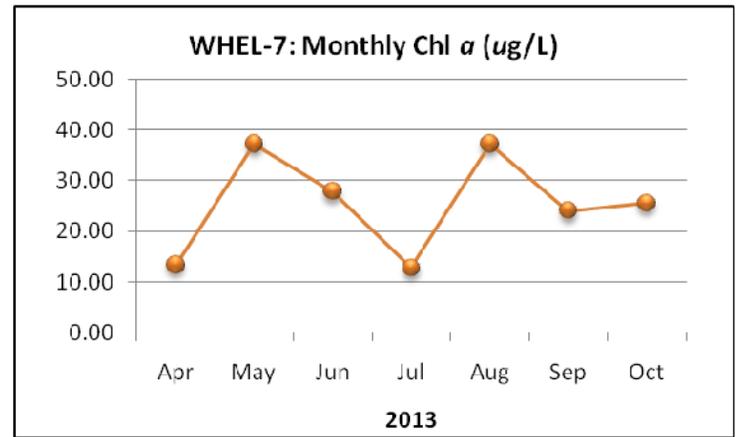
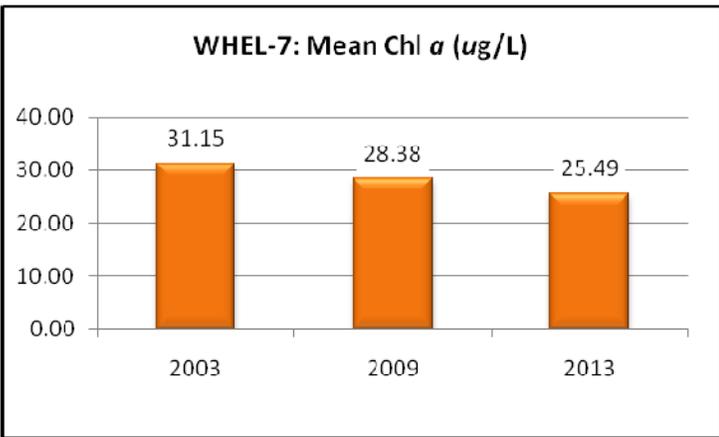
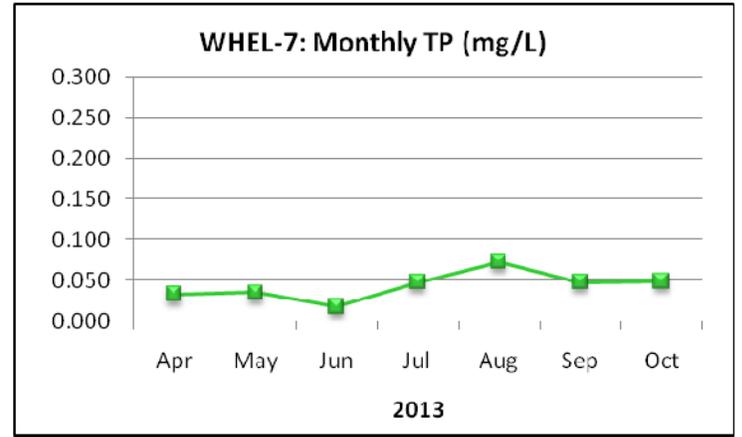
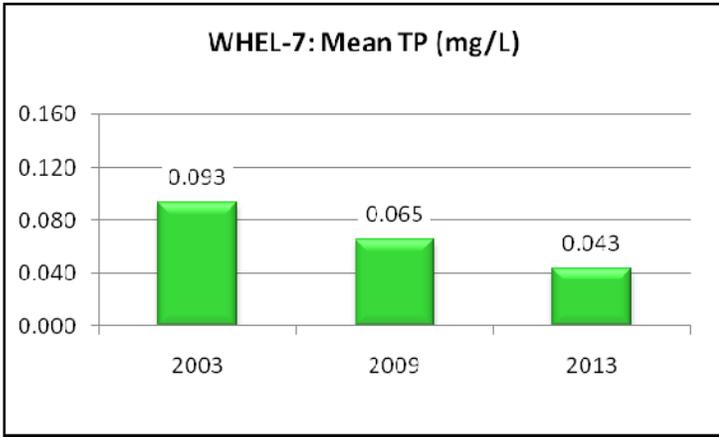
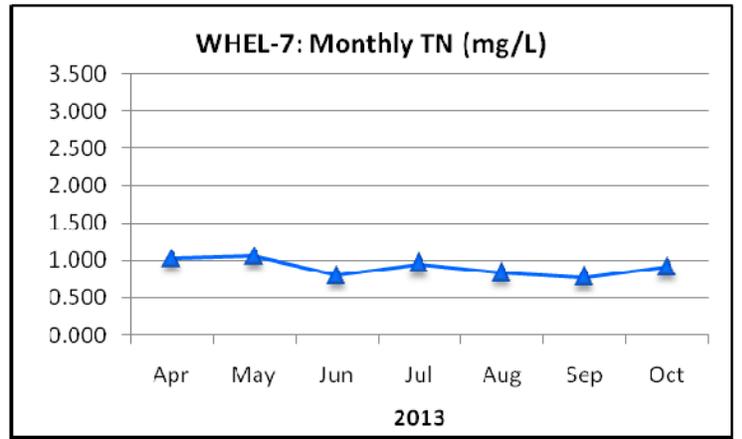
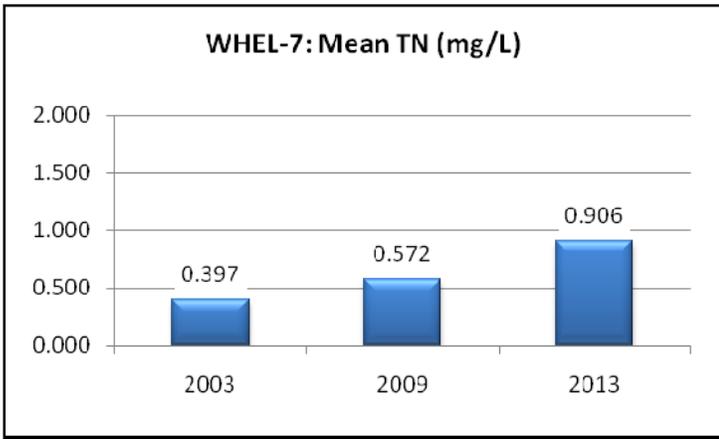


Figure 4. Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Dry Branch embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

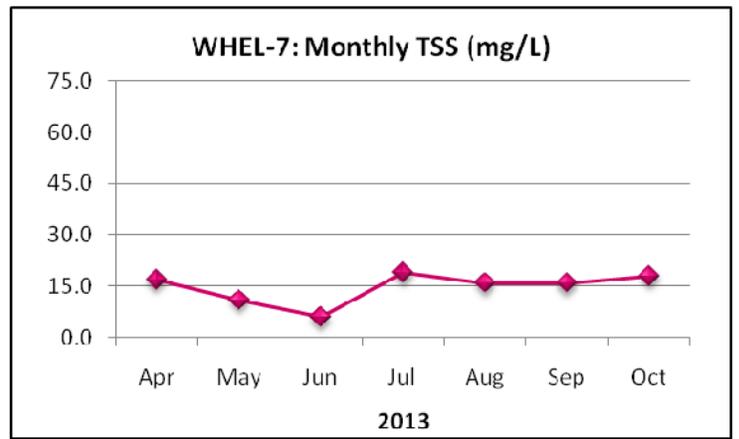
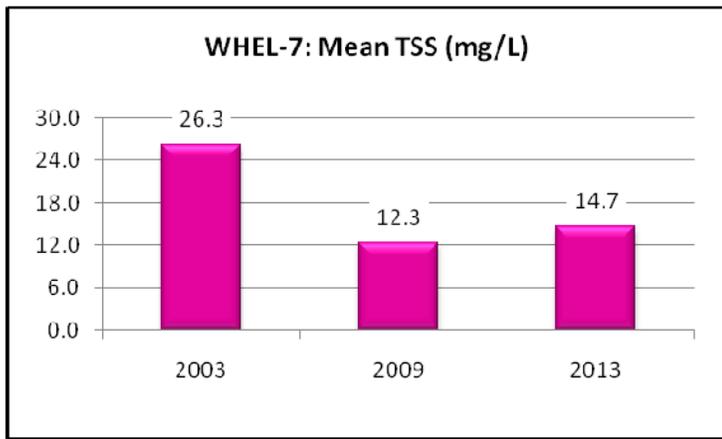


Figure 5. Mean growing season and monthly TSS measured in the Dry Branch embayment of Wheeler Reservoir.

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-7 | N | Min | Max | Med | Mean | SD |
|---|---|---------|-------|-------|-------|-------|
| Physical | | | | | | |
| Turbidity (NTU) | 7 | 6.9 | 18.2 | 12.7 | 13.2 | 3.5 |
| Total Dissolved Solids (mg/L) ^J | 7 | 87.0 | 116.0 | 100.0 | 100.1 | 8.8 |
| Total Suspended Solids (mg/L) | 7 | 6.0 | 19.0 | 16.0 | 14.7 | 4.6 |
| Hardness (mg/L) | 4 | 61.6 | 88.8 | 71.8 | 73.5 | 11.4 |
| Alkalinity (mg/L) | 7 | 30.8 | 56.6 | 45.6 | 44.1 | 8.4 |
| Photic Zone (m) | 7 | 1.13 | 2.16 | 1.82 | 1.73 | 0.33 |
| Secchi (m) | 7 | 0.54 | 0.98 | 0.72 | 0.75 | 0.14 |
| Bottom Depth (m) | 7 | 1.00 | 2.16 | 1.83 | 1.78 | 0.36 |
| Chemical | | | | | | |
| Ammonia Nitrogen (mg/L) ^J | 7 | < 0.015 | 0.127 | 0.008 | 0.034 | 0.046 |
| Nitrate+Nitrite Nitrogen (mg/L) ^J | 7 | < 0.003 | 0.359 | 0.004 | 0.060 | 0.132 |
| Total Kjeldahl Nitrogen (mg/L) | 7 | 0.662 | 1.040 | 0.831 | 0.845 | 0.123 |
| Total Nitrogen (mg/L) ^J | 7 | < 0.776 | 1.052 | 0.909 | 0.906 | 0.108 |
| Dissolved Reactive Phosphorus (mg/L) ^J | 7 | < 0.005 | 0.007 | 0.005 | 0.005 | 0.002 |
| Total Phosphorus (mg/L) ^J | 7 | 0.018 | 0.073 | 0.048 | 0.043 | 0.017 |
| CBOD-5 (mg/L) ^J | 7 | < 2.0 | 3.3 | 2.4 | 2.4 | 0.8 |
| Chlorides (mg/L) ^J | 7 | 4.2 | 5.4 | 4.8 | 4.8 | 0.5 |
| Biological | | | | | | |
| Chlorophyll a (ug/L) | 7 | 12.80 | 37.40 | 25.60 | 25.49 | 9.99 |
| E. coli (col/100mL) | 3 | 2 | 10 | 5 | 6 | 4 |

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-7 | MSC | Limiting Nutrient |
|-----------|------|-------------------|
| 8/20/2003 | 5.52 | NITROGEN |
| 8/19/2009 | 3.32 | NITROGEN |
| 8/21/2013 | 3.6 | NITROGEN |

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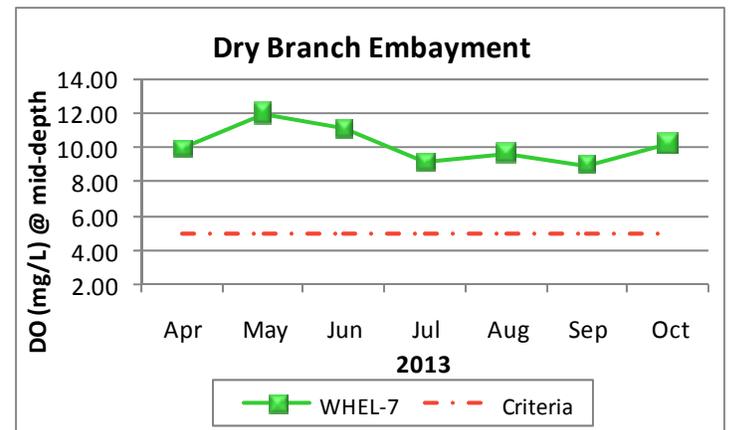


Figure 6. Monthly DO concentrations at mid-depth for Dry Branch embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

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