



# Beaver Lake Nutrient Criteria

Tate Wentz  
Aquatic Ecologist Coordinator-Research and Field Programs  
Office of Water Quality-Planning Branch  
Arkansas Department of Environmental Quality  
501-682-0661



# Beaver Lake Scientific Workgroup

- In 2004, ADEQ assembled a Technical Subcommittee of the Beaver Lake Scientific Workgroup to develop site-specific numeric nutrient criteria for Beaver Lake.
- This subcommittee included representatives from ADEQ, USGS, Beaver Water District, FTN Associates, Ltd., AWRC, and Dr. Joe Nix.
- In 2008, FTN Associates, Ltd. published the *Beaver Lake Site-Specific Water Quality Criteria Development: Recommended Criteria* report.
- January 2013, APC&EC adopted Beaver Lakes criteria  
(EPA Approved October 31, 2016)
- July 14, 2014 ADEQ reconvened the Beaver Lake Scientific Workgroup



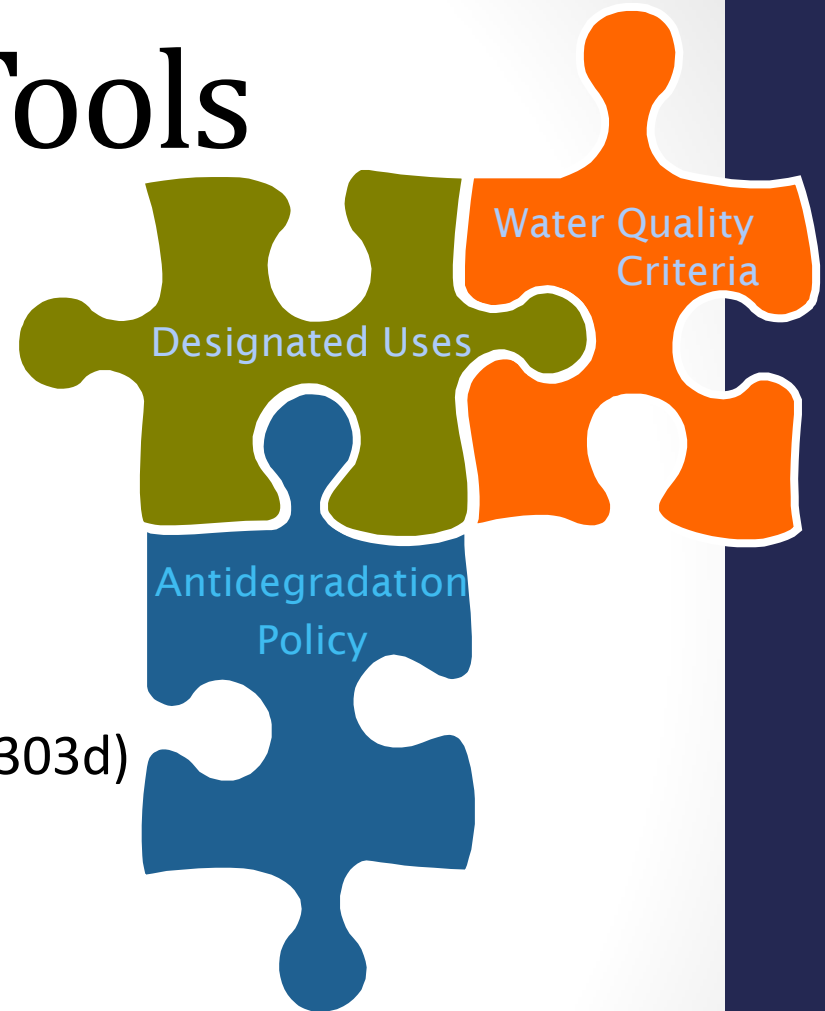
# Clean Water Act

- Objective:
  - To restore and maintain the chemical, physical and biological integrity of the Nation's waters
- National goals:
  - Eliminate discharge of pollutants to surface water
  - All waters will be “fishable and swimmable” wherever attainable

Clean Water Act, Section 101(a)

# Clean Water Act Tools

- Water quality standards
  - Designated Uses
  - Water Quality Criteria
  - Antidegradation Policy
- Discharge (NPDES) permits
- Threatened and impaired waters list (303d)
- Total Maximum Daily Loads (TMDLs)



# Water Quality Standards

*“A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses.*

40 CFR 131.2

# Water Quality Standards: Water Quality Criteria

*“States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use.”*

40 CFR 131.11(a)(1)

# Typical Criteria

**Numeric:** *measurable benchmarks*

**Narrative:** *desirable conditions*

# Criteria should address:

- **How much?**

Concentration of exposure or magnitude

- **How long?**

Time period of exposure or duration

- **How often?**

Frequency of exposure or frequency



# Recommended Criteria

## Weight-of-evidence

1. Surrounding state criteria for chlorophyll, Secchi, TP, TN
2. EPA ecoregion values
3. Percent values of reference and extant for Beaver Lake
4. Hydrologic plunge point analyses
5. Statistical analyses for Beaver and reference lakes
6. Empirical nutrient loading relationships
7. Dynamic modeling

# Recommended Criteria

- Site-specific effect-based nutrient criteria were recommended for the Hickory Creek site in Beaver Lake:
  - **Growing season geometric mean chlorophyll *a* concentration: 8 µg/L**
  - **Secchi transparency: 1.1 meters**
- Total nitrogen and total phosphorus criteria were not recommended because secchi transparency and chlorophyll *a* concentrations integrate total nitrogen, total phosphorus, and other contributing factors in their response.
  - **Target values were recommended for total nitrogen (1.4 mg/L) and total phosphorus (0.4 mg/L).**

# Recommended Criteria

- The Hickory Creek site was selected to receive site-specific effects-based criteria for various reasons, including:
  - The site would integrate the loadings from the White River, Richland and War Eagle Creeks;
  - The site occurred downstream from the plunge point;
  - The site occurred directly upstream of a major Beaver Lake drinking water intake;
  - Accessibility.
- Water samples were not collected at the Hickory Creek site during the monitoring period of the study.

# Recommended Criteria

- Estimates for secchi transparency and chlorophyll *a* concentrations at the Hickory Creek site were determined by extrapolating water quality data from the Highway 412 and Lowell sites.
- A range of target values were evaluated to determine the relative risk of exceeding the proposed numeric criteria. The intent was to protect Beaver Lake's water quality and designated uses without establishing overly stringent water quality criteria.
- The relative risk of exceeding the 95<sup>th</sup> percentile value at Lowell associated with the recommended criteria at Hickory Creek was approximately 10%.



# Adoption of Criteria into Reg. 2

In 2013, APC&EC adopted the following language into part (B) Site Specific Nutrient Standards of Regulation 2.509, Nutrients:

(B) Site Specific Nutrient Standards

Lake	Chlorophyll a (ug/L)**	Secchi Transparency (m)***
Beaver Lake*	8	1.1

\*These standards are for measurement at the Hickory Creek site over the old thalweg, below the confluence of War Eagle Creek and the White River in Beaver Lake.

\*\*Growing season geometric mean (May - October)

\*\*\*Annual Average

# Arkansas Assessment Guidelines

- Pursuant to 40 C.F.R. § 130.7(b)(5), ADEQ assembles and evaluates all existing and readily available data.
- The period of record for assessments is five (5) years, with the exception of metals and ammonia toxicity.
- Data must have been collected and analyzed under a QA/QC protocol equivalent to or more stringent than that of ADEQ or USGS to be utilized in making water quality standard and designated use attainment decisions.

# Assessment Methodology

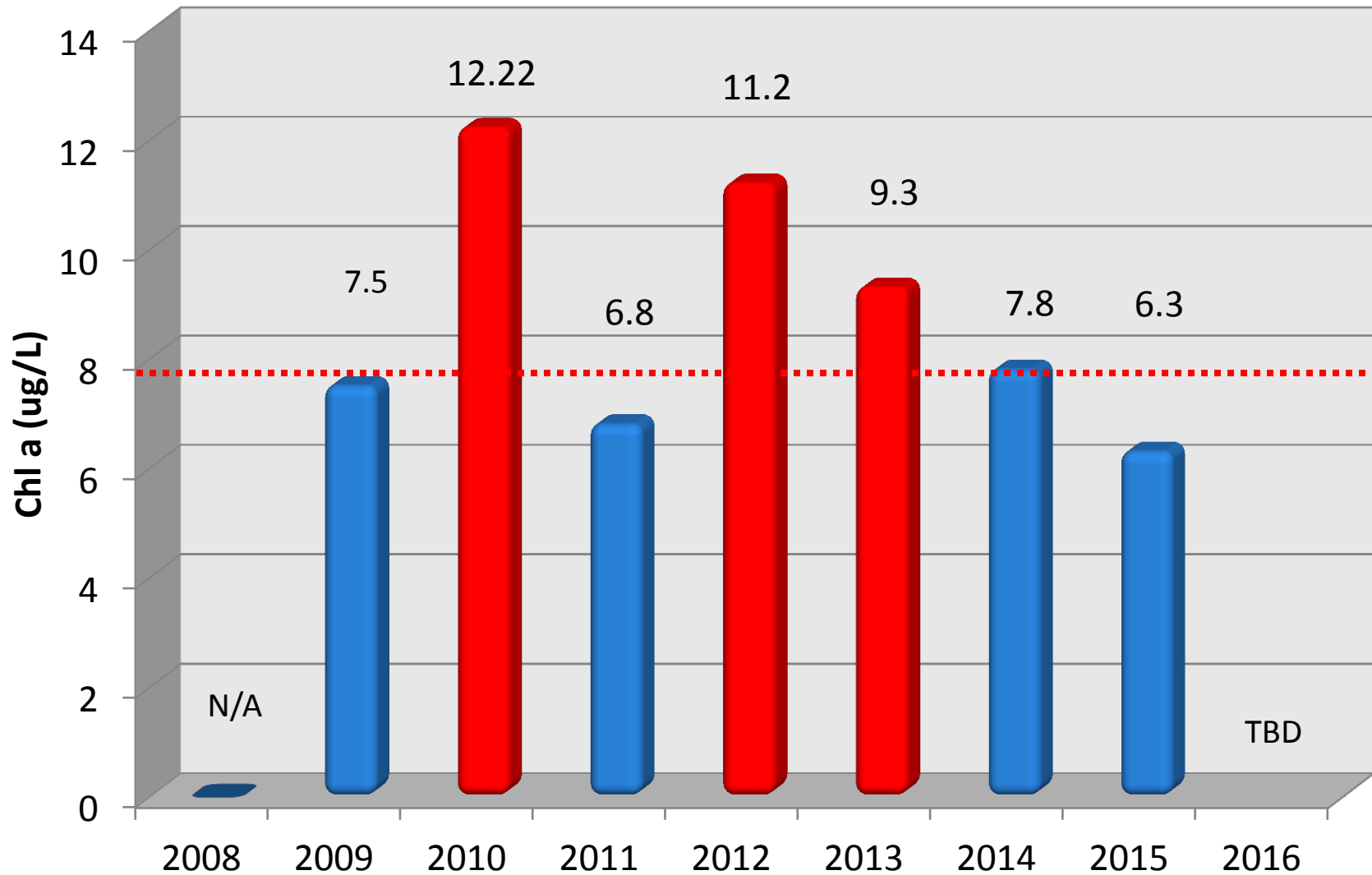
- Reconvened workgroup July 17, 2014
- 2015 Beaver Watershed Alliance Phase I, II, III
  - U of A recommendations of criteria developed from average
  - Longer period of record
  - Uncertainty analysis and water quality trends
- 2016 ADEQ implemented assessment of drinking water designated use as non-support if there are 3 or more exceedances in a 5 year period



# 2009 Beaver Lake Data

Sample Date	Chlorophyll a, $\mu\text{g/L}$
1/12/2009	7.2
2/12/2009	2
3/11/2009	2.5
4/16/2009	3.6
5/4/2009	
6/10/2009	12.9
7/8/2009	7.5
8/21/2009	11.3
9/14/2009	7.8
10/14/2009	2.8
11/5/2009	6.6
12/17/2009	3.3
<b>2009 Geometric Mean</b>	<b>7.5</b>

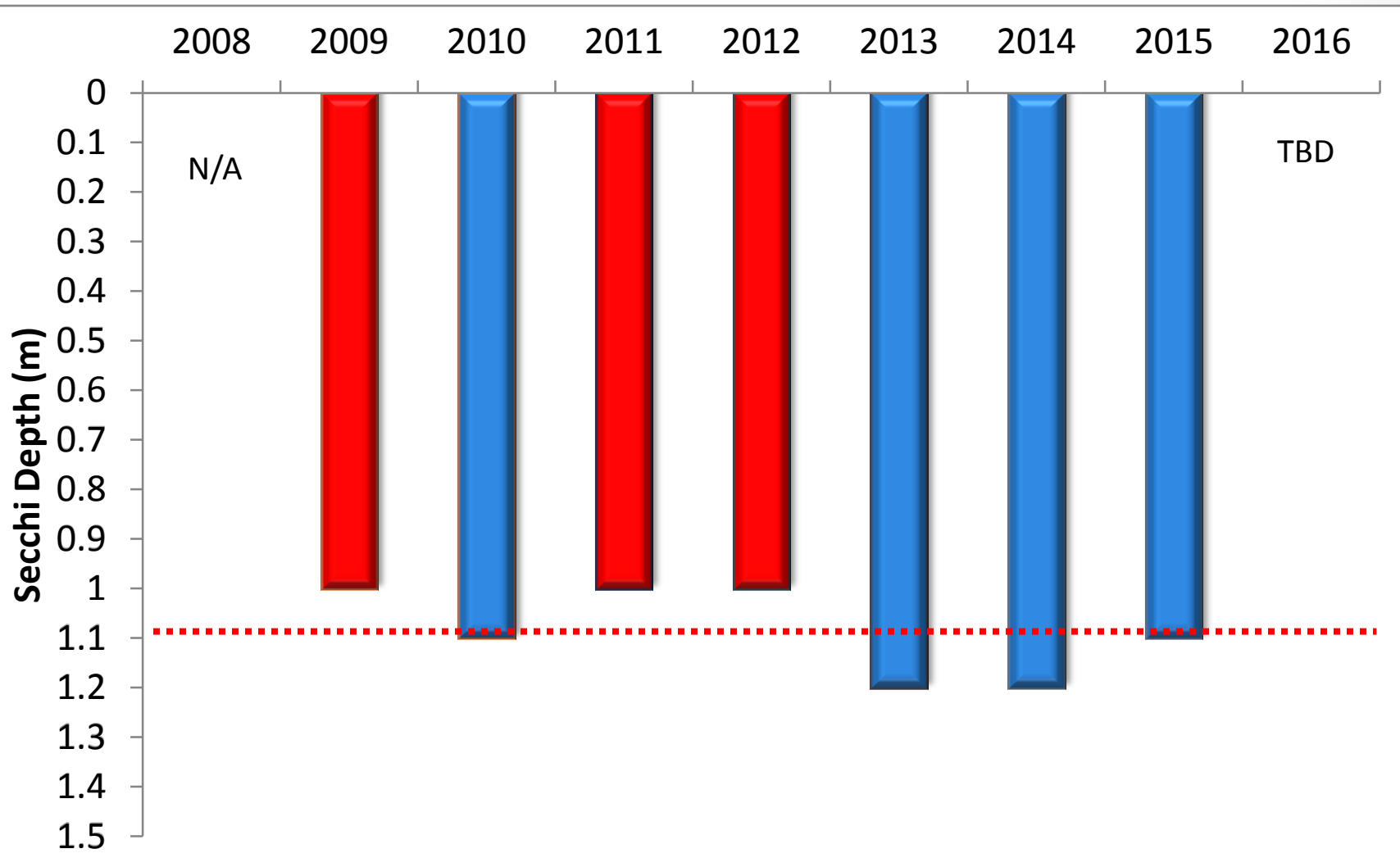
# Compilation of Chlorophyll *a* Data



# 2009 Secchi Transparency Data

Sample Date	Secchi Transparency, meters
1/12/2009	1.28
2/12/2009	1.01
3/11/2009	0.55
4/16/2009	0.64
5/4/2009	0.37
6/10/2009	1.7
7/8/2009	2.0
8/21/2009	1.5
9/14/2009	1.8
10/14/2009	0.21
11/5/2009	0.55
12/17/2009	0.85
<b>2009 Annual Average</b>	<b>1.0</b>

# Secchi Transparency Data





# Questions?

*We protect, enhance and restore the natural environment for the well-being of all Arkansans.*