



August 1, 2011

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Water Quality Standards Section  
Oklahoma Water Resources Board  
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SENT VIA FEDERAL EXPRESS AND E-MAIL

Re: June 10, 2011 Public Notice; Oklahoma Scenic Rivers Phosphorus Criterion Review; Request for Best Scientific Information

Dear Mr. Moershel and Mr. Childress:

This letter and the attached Technical Memorandum from GBMc & Associates is submitted in response to the June 10, 2011 Public Notice requesting Best Scientific Information for use in the Oklahoma Water Resources Board review of the Oklahoma phosphorus criterion.

The City of Siloam Springs, Arkansas has an intense interest in the criterion review process. The City is committed to environmental protection based only on defensible science. The City also is committed to fiscal responsibility and strives to ascertain that all regulatory requirements are defensible as necessary based on science and an appropriate cost/benefit balance.

The City of Siloam Springs looks forward to continued participation in the criterion review process. Please contact me if you have any questions or items for discussion regarding this submittal.

Sincerely,

David W. Cameron  
City Administrator

Attachment/Technical Memorandum (GBMc & Associates)

cc: Shon Simpson, GBMc & Associates  
Parthy Evans, Stinson Morrison Hecker LLP  
Steve Drown, ADEQ



August 1, 2011

Mr. David Cameron  
City Administrator  
City of Siloam Springs  
400 N. Broadway  
Siloam Springs, AR 72761

Re: June 11, 2010 Public Notice: Oklahoma Scenic Rivers Phosphorus Criterion Review, Request for Technical Information  
GBMc No. 4600-10-700

Dear Mr. Cameron:

As requested, GBM<sup>c</sup> & Associates has completed a project to review the Oklahoma Scenic Rivers phosphorus criterion, and to determine if there is better scientific information available that could be used by the Oklahoma Water Resources Board and the Technical Advisory Group as they review the Oklahoma Scenic Rivers phosphorus criterion. Our conclusions, recommendations, and discussion are provided in this letter.

### **Conclusions**

1. There are better scientific approaches and data available today than were used for the current phosphorus criterion.
2. No local data and only sparse regional data were used in the Clark study, which was the basis for the current phosphorus criterion.
3. Only undeveloped or minimally developed watershed data were used in the Clark study.
4. Local data were available for the 2002 phosphorus criterion evaluation, but did not fit the specific time period analyzed by Clark, and thus were not used.
5. In a non-exhaustive search we identified numerous Ozark Highlands streams with mean phosphorus concentrations substantially higher than 0.037 mg/L that were denoted as "high quality" or "reference streams" by Oklahoma and Arkansas Agencies.
6. Oklahoma now has abundant local data on which to base the phosphorus criterion review.

### **Recommendations**

1. Use the stressor-response relationship approach (EPA, 2010) in review of the current phosphorus criterion.
2. Use predominantly local and regional data in review of the current phosphorus criterion.
3. Include data from moderately developed watersheds in review of the current phosphorus criterion.
4. Make raw data to be used for the phosphorus criterion review available to the public.

### **Oklahoma's Phosphorus Criterion for Scenic Rivers**

Our review of the basis for the promulgation of the 0.037 total phosphorus criterion suggests strongly that there is much better scientific information available today than used to develop the 2002

Oklahoma Scenic Rivers phosphorus criterion, and that information would yield a different phosphorus criterion that is properly specific to watersheds in eastern Oklahoma. *Nutrient Concentrations and Yield in Undeveloped Stream Basins of the United States* (Clark and others, 2000) was used as the basis for the Scenic Rivers phosphorus criterion. There were no Oklahoma streams and very few regional streams used in the Clark study. In fact, the nationwide study stated that some areas of the country were poorly represented in the assessment, and Oklahoma was specifically listed.

Some local data were available at the time of the Clark study, but were not used. For example, the Kiamichi River is listed in Figure 1 of the Clark study as a Hydrologic Benchmark Network (HBN) site. However, phosphorus data for the site was not used in the Clark study as part of the total phosphorus analysis, which apparently used only data from 1990 – 1995. Data for total phosphorus from the Kiamichi River HBN site is available for a period from 1979 to 1985. The average for total phosphorus for the Kiamichi River HBN site was 0.086 mg/L, the 75<sup>th</sup> percentile was 0.09 mg/L, and the 95<sup>th</sup> percentile was 0.177 mg/L. If more local and regional streams, such as the Kiamichi River would have been used in the assessment, rather than those in the Rocky Mountains or New England, the resulting total phosphorus criterion may have been considerably different than 0.037 mg/L.

The Clark study used undeveloped or minimally developed watershed sites (many noted as being in National Parks or National Forests). Exclusive use of undeveloped or minimally developed watersheds in other parts of the country for the assessment of a phosphorus criterion in Oklahoma does not take advantage of the best scientific information available, and results in an unrealistic criterion for some of the Scenic River Watersheds that are more developed.

#### ***EPA Recommended Approaches to Developing Numerical Nutrient Criteria***

EPA provides three recommended approaches for determining numeric nutrient criteria for states waters; 1) the reference stream approach, 2) the mechanistic modeling approach, and 3) the empirical stressor-response approach (EPA, 2010). The approach used by the OWRB to develop the current Scenic Rivers criterion of 0.037 mg/L was the reference stream approach. The criterion was developed from a national database of streams from undeveloped basins, none of which were located in Oklahoma. The 0.037 mg/L criterion is not associated with any known level of stream quality in Oklahoma or to an expected level of improvement in any stream characteristic. A technically more appropriate approach would be to use the stressor-response approach or a combination of the stressor response and reference stream approach to develop the instream total phosphorus criteria for the Scenic Rivers. One strength in using such an approach is the creation of a linkage between the instream criteria and an actual measurable goal, such as aquatic life improvement.

The OWRB and the Technical Advisory Group should review the 0.037 mg/L total phosphorus criterion following the 2010 EPA Guidance, "Using Stressor-response Relationships to Derive Numeric Nutrient Criteria" (EPA-820-S-10-001) using local and regional data that is more appropriate and that constitutes better scientific information for criteria development in Oklahoma than the streams used in the Clark study.

The stressor-response relationship approach provides for development of conceptual models for a given study area using established relationships between water quality, nutrients,

biological responses, and attainment of designated uses. It can be accomplished using local and regional data, if available. Our review of local data collected in recent years by the Oklahoma Agencies indicates that ample data now exists for an evaluation of the 0.037 mg/L total phosphorus criterion.

In fact, it appears that Oklahoma has already made significant progress towards establishment of phosphorus criteria using the stressor response approach or a hybrid of the two approaches. Oklahoma Conservation Commission (OCC) has been assessing stream aquatic communities and water quality in Oklahoma Ecoregions since 2001 as part of their Rotating Basin Monitoring Program. This program assesses a network of streams that range from excellent condition (un-impacted) to poor condition (moderately impacted). Each stream is evaluated for aquatic habitat, macroinvertebrates, fish community and water quality, including collection of phosphorus data 10 times per year for each of the two years assessed per monitoring cycle. Stream data are compared to the OCC "high quality" streams database (OCC, 2005a) to determine if they are meeting their designated uses.

In addition, a collaborative effort between the OWRB and the OCC was completed in 2009 and titled Implementation of a Stream/River Probabilistic Monitoring Network for the State of Oklahoma. This project utilized much of the same evaluation techniques as used in the OCC Rotating Basin Monitoring Program but focused the effort at stressor identification using unbiased site selection and statistical data analysis techniques. The goals stated by the OWRB and the OCC for the projects were:

1. Estimate the condition of various measures of biological integrity for the Oklahoma's waters through a statistically-valid approach.
2. Estimate the extent of stressors that may be associated with the biological condition.
3. Evaluate the relationship between stressors and the condition for use in various long and short term environmental management strategies.
4. Assess waters for inclusion in Oklahoma's Integrated Water Quality Report.

The types of data being collected by the Oklahoma Agencies lend themselves well in the use of the stressor-response approach to criteria development. We think that much better local and regional scientific information exists today compared with 10 and 20 years ago.

#### ***Conceptual Approach to Developing a Stressor-Response Based Phosphorus Criteria***

Instream phosphorus criteria could be developed using either the stressor-response approach or a hybridized version of the stressor response approach and the reference stream approach.

1. Stressor-Response Approach. Aquatic life data and total phosphorus data (or orthophosphorus if the relationships are stronger) from stations grouped by Ecoregion can be analyzed in a fashion similar to methods used by the OCC in their Rotating Basin Monitoring Program wherein phosphorus values would be statistically compared to aquatic life conditions to develop a statistical relationship. The relationship would then be examined to determine the phosphorus level division point between un-impacted (high quality aquatic life) streams/sites and impacted (moderate aquatic life quality) streams/sites. That level could then be used to establish a phosphorus criterion.

2. Hybrid Approach. Aquatic life data from all streams in each Ecoregion would be evaluated for quality. Statistical analysis of phosphorus data from all streams in that Ecoregion that were found to contain good quality aquatic life would be completed. A statistical value representative of the upper edge (95%tile, mean+2 standard deviations, etc.) of the range of phosphorus values could be used to establish a criterion for phosphorus.

By use of either of these methodologies the resulting phosphorus criterion would have a direct link to a measurable effect instream, *i.e.*, improvement of aquatic life.

**Phosphorus levels in High Quality Streams in the Ozark Highlands Ecoregion**

A cursory review of the existing data acquired since 2004 in Oklahoma and Arkansas indicate that several streams (or reaches of stream) in the Ozark Highlands Ecoregion (in which three of the five Scenic Rivers are located) have good quality aquatic communities with mean phosphorus substantially higher than the 0.037 mg/L standard (Table 1). Note these are mean values, with ranges that can be as much as twice as high. In addition, the “high quality” stream sites identified by the OCC (OCC, 2005a) and used as reference streams for their Rotating Basin Monitoring Program in the Ozark Highlands Ecoregion have a mean total phosphorus level of approximately 0.062 mg/L with an upper cut-off (used for screening other stream data) of approximately 0.13 mg/L. These data indicate that the 0.037 mg/L phosphorus criterion for the Illinois River may be overly restrictive.

Table 1. Summary of phosphorus levels in selected Ozark Highland streams.

Stream Name	State	Group completed By	Mean Total Phosphorus (mg/L)	Macroinvertebrates Assessed	Fish Assessed
Battle Creek	OK	OCC	0.085	Yes	Yes
Ballard Creek	OK	OCC	0.106	Yes	Yes
Fourteenmile Creek	OK	OCC	0.054	Yes	Yes
Flint Creek	AR	EPA Reg.6	0.067	Yes	Yes
Illinois River	AR	EPA Reg.6	0.187	Yes	Yes
Osage Creek	AR	EPA Reg.6	0.042	Yes	Yes
War Eagle Creek	AR	ADEQ	0.067	Yes	No
Spavinaw Creek	AR	ADEQ	0.098	Yes	No
Little Sugar Creek	AR	ADEQ	0.985 <sup>1</sup>	Yes	No

<sup>1</sup>Represented as orthophosphorus

**Data Available to OWRB to Revise the 0.037 mg/l Phosphorus Criterion**

The following data sources contain recent data (developed since the 0.037 mg/l criterion was established) that should be used in development of a revised phosphorus criterion for the Illinois River. This list of available data should not be considered exhaustive, but only a subset of the data that may be available from the Ozark Highlands Ecoregion that is appropriate for use in reviewing the criterion.

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1. OCC Rotating Basin Monitoring program data.
2. OWRB BUMP data.
3. ADEQ ambient monitoring network data.
4. Report prepared for EPA Region 6 titled: Water Quality and Biological Assessment of Selected Segments in the Illinois River Basin and Kings River Basin (EPA, 2004).
5. OWRB/OCC Probabilistic Monitoring Network data.
6. AWRC data from the Illinois River Monitoring Network.

Unfortunately, a review of the EPA database STORET did not provide us with the raw data necessary to complete an in-depth evaluation and the OWRB should make any raw data included in the phosphorus criterion review available to the public.

We appreciate the opportunity to assist you with this project. Please contact me at [ssimpson@gbmcassoc.com](mailto:ssimpson@gbmcassoc.com) or (501) 847-7077 if you would like additional information or have questions.

Sincerely,  
GBM<sup>c</sup> & ASSOCIATES



Shon Simpson  
Principal/Senior Project Manager

Mr. David Cameron  
August 1, 2011  
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### **References**

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USEPA. 2010. Using Stressor-response Relationships to Derive Numeric Nutrient Criteria. USEPA Office of Water, Washington D.C.

USEPA. STORET Database. Washington D.C.

USEPA Region 6. 2004. Water Quality and Biological Assessment of Selected Segments in the Illinois River Basin and Kings River Basin, Arkansas, Final Report -Volume 1. Parsons, Austin, TX and University of Arkansas, Fayetteville, AR.