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July 29, 2011

Via Electronic Delivery & First Class Mail

Mr. Phillip Moershel
Mr. Jason Childress
Water Quality Standards Section
Oklahoma Water Resources Board
3800 N. Classen Boulevard
Oklahoma City, OK 73118

Re: Response to OWRB Call for Submissions to Technical Advisory Group

Dear Messrs. Moershel & Childress:

We have been retained by the Northwest Arkansas Regional Planning Commission to assist the Commission's Intergovernmental Working Group with respect to water quality planning issues related to the Illinois River. The Intergovernmental Working Group members represent the cities of Bentonville, Fayetteville, Rogers, Siloam Springs, and Springdale, Arkansas. Each of the five cities owns or is served by a wastewater treatment facility that discharges into a tributary of the Illinois River. In addition, the cities are situated such that some portions of the storm water run-off in the Upper Illinois River watershed originates within their boundaries. As a consequence, the cities have a direct interest in the decisions that will be made by Oklahoma and EPA in the reevaluation of Oklahoma's numeric water quality standard for phosphorus in the Oklahoma Scenic Rivers.

The cities recognize that the OWRB Public Notice called only for the submission of scientific studies and information. The cities are aware of the scientific information that is being submitted by the Wright Water Engineers and Professors Matlock, Haggard, and Sharpley. The cities concur with this information and urge the OWRB Technical Advisory Group to give all of their findings and supporting citations careful consideration.

In addition to purely technical scientific information, the cities believe there are some important practical, economic, and legal considerations that should be included in the reevaluation process, including the TAG deliberations. Failure to include these "non-technical" considerations in the deliberations of the TAG would risk making the TAG's recommendation an abstract theoretical exercise without adequate connection to practical reality. The cities offer the following observations on these "non-technical" considerations.

1. As a part of the longstanding dialogue between Oklahoma and Arkansas regarding the Illinois River, the cities made major investments to upgrade their wastewater treatment facilities and reduce the concentration of phosphorus in their treated effluent. Collectively the cities expended more than $225 million on capital equipment and systems upgrades alone. The cities agreed in connection with the Statement of Joint Principles and Actions to voluntarily accept a 1 mg/L numeric discharge limit on phosphorus in their NPDES permits. As a consequence of the upgrades and in compliance with their permits, the cities' wastewater treatment plants now consistently reduce phosphorus concentrations in their discharge to levels well below the 1 mg/L permit limits. The cities' collective 30-day phosphorus averages for the calendar year 2010 were as follows:

January 2010	0.27
February 2010	0.16
March 2010	0.27
April 2010	0.41
May 2010	0.34
June 2010	0.37
July 2010	0.52
August 2010	0.44
September 2010	0.39
October 2010	0.50
November 2010	0.44
December 2010	0.35
2010 Yearly Average	0.37

In addition to reducing phosphorus concentrations in their treated effluent, the cities have implemented plans for managing wastewater treatment solids and controlling urban storm water run-off to further reduce phosphorus contributions to the watershed. The net result of these efforts is that the cities have fulfilled the commitment they made in connection with the Statement of Joint Principles and Actions and dramatically reduced their contribution of phosphorus to the watershed. Recent monitoring results clearly reflect the success of the cities' efforts. *See, e.g.*, L. Massey & B. Haggard, Water Quality Monitoring and Constituent Load Estimation in the Upper Illinois River Watershed, 2009, ARKANSAS WATER RESOURCES CENTER, UNIV. OF ARKANSAS, TECHNICAL PUBLICATION NO. MSC 363 (2010); B. Haggard, A. Sharpley, & L. Massey, Water Quality and Watershed Conditions in the Upper Illinois River Watershed, ARKANSAS WATER RESOURCES CENTER, UNIV. OF ARKANSAS, TECHNICAL PUBLICATION NO. MSC 359 (2010); Water Quality Monitoring Report Illinois River Basin CY2009, Arkansas-Oklahoma Arkansas River Compact Commission (2010); Oklahoma's 5-Year Rolling Average Phosphorus Report for the Illinois River Basin, Arkansas-Oklahoma Arkansas River Compact Commission (Draft 2010);

Environmental Committee Report, Arkansas-Oklahoma Arkansas River Compact Commission (Draft September 23, 2010).

A practical corollary to the reductions already achieved by the cities is the fact that additional reductions will be much more difficult to achieve and far more costly for each new increment of phosphorus removed. The cities estimate that modification of their existing facilities to consistently achieve a lower phosphorus limit (0.1 mg/L) would require expenditures of $80 to $100 million in capital equipment alone, without any regard to added costs of operation and maintenance. Although technical literature suggests that 0.1 mg/L is the current practical limit of wastewater treatment technology for phosphorus, one must consider whether the enormous cost of moving to such a limit would result in any significant benefit in water quality (or reduction in the total phosphorus load) that would justify the expense. Moreover, given the chemical use and increased energy required to meet extremely low phosphorus limits, there is a very real question whether efforts to achieve additional reductions in phosphorus would actually be harmful to the overall environment when impacts on air quality, carbon footprint, and added solid waste disposal are taken into account.

2. The Secondary Data Quality Assurance Project Plan indicates that OWRB believes the TAG should recommend no change to the existing .037 numeric phosphorus standard unless scientific information demonstrates that a materially higher or lower standard is required. The QAPP specifically states that if there is inadequate information the existing standard should not be changed. Secondary Data QAPP at p. 16. The cities disagree.

The cities believe that the original selection of the existing numeric standard was not supported by valid technical or scientific considerations. More recent explanations of the basis for adopting the .037 standard seem to confirm this point. The cities respectfully submit that any genuine reevaluation of the .037 standard must include a good faith evaluation of the scientific basis that would warrant selection of the .037 standard. More specifically, the cities believe that the TAG's reevaluation of the .037 standard should include a finding or conclusion which states whether there is a valid scientific basis for the .037 standard, including a finding on whether there is scientific information demonstrating that the standard is attainable in the Illinois River watershed. On this latter point, the cities urge careful consideration of the information prepared by Wright Water Engineers.

If the TAG does not identify any new scientific justification supporting the selection of the .037 standard, the validity of the standard in any subsequent review or challenge will necessarily rise or fall based solely on the record and reasoning identified when the standard was originally selected.

3. The cities are concerned that there are no clearly identified, objectively measurable water quality goals connected to the reevaluation of the numeric phosphorus standard. A given concentration of phosphorus, standing alone, is not a straightforward measure of water quality. The critical question is whether the concentration of phosphorus in question is such that it causes an identifiable adverse effect (e.g., excessive algae growth) given the relevant combination of site specific conditions, such as light, clarity, velocity, substrate, etc. The cities believe that the TAG should identify the relevant ecological endpoints to be protected by the phosphorus standard and then examine the scientific information and monitoring data to determine whether there is a cause and effect relationship between the chosen ecological endpoints and the relevant phosphorus concentration, whether it is .037 or some other number.

The cities are concerned that discussion of the environmental goals of the phosphorus standard has occasionally been confused by the use of terms that seem superficially laudable but have no objectively identifiable or measurable meaning. Thus, for example, protection of an esthetic "use" is a concept that has no commonly understood, objectively measurable meaning. Similarly, "restoration" of a water body simply begs the question: "Restoration to what?"

If there is to be a legitimate reevaluation of the numeric phosphorus standard based on the best available science, the TAG should clearly identify the relevant water quality goals in terms of objectively measurable ecological endpoints. If that is not done, the cities believe there will be no rational basis for connecting any scientific information to the selection of an appropriate standard.

4. The monitoring results for phosphorus in the Illinois River show that concentrations are highly variable, particularly on a seasonal basis and with changes in flow. *See, e.g.*, ARKANSAS WATER RESOURCES CENTER PUBLICATIONS MSC 359 & 363 cited in paragraph 1, *supra*. The variability in phosphorus concentrations has important implications for the selection of a water quality standard. More specifically, the variability suggests that reliance on a single number, even when that number is an average or geometric mean of multiple samples, is not likely to provide a meaningful standard against which to measure either compliance or progress toward protecting a chosen ecological endpoint. The cities believe the TAG reevaluation should include serious consideration of the manner in which the standard is measured, including the frequency of sampling, duration of sampling, the relation of sample results to flow, the number of allowable exceedances, the propriety of seasonal variations in the standard, and the manner of averaging or combining sample results to determine compliance.

5. The Secondary Data QAPP indicates that OWRB proposes to have the TAG include impacts on Lake Tenkiller within the scope of the reevaluation of the numeric phosphorus standard for the Scenic Rivers. The cities believe the TAG should focus on the task that the Statement of Joint Principles and Actions contemplated for the TAG, namely reevaluation of the phosphorus standard warranted to protect water quality in the Illinois River. As you know, this issue was raised in comments to EPA on the Illinois River Watershed Water Quality Modeling Project and again in comments to OWRB on the QAPP. We believe those comments apply equally here. We are attaching copies of those comments and ask that they be made part of the record reviewed by the TAG.

   In the end, the cities believe that inclusion of Lake Tenkiller in this reevaluation raises serious questions about the allocation of upstream and downstream states' responsibilities and authority under the Clean Water Act. The cities recognize that an upstream state has certain obligations with respect to a downstream state's water quality standards at the state line, but Lake Tenkiller is not located at or even near the state line. When dealing with the water quality of a wholly intrastate waterbody far removed from the state boundary, the cities question whether the Clean Water Act authorizes a downstream state to avoid difficult or costly choices of in-state regulation by shifting much of the burden of compliance upstream to a different state.

6. The cities believe that there are important questions of fairness and equity at stake in the reevaluation of Oklahoma's numeric phosphorus standard. When it comes to phosphorus, the Illinois River watershed in Northwest Arkansas is the most intensively regulated river watershed in EPA Region 6. The five cities in Northwest Arkansas all have in their permit, and all consistently comply with, a 1 mg/L numeric phosphorus limit for their discharge to the Illinois River basin. Moreover, a mandatory program of non-point source regulation of phosphorus-based fertilization has been implemented throughout the Illinois River watershed in Arkansas. By way of comparison, in Oklahoma there are more than sixty-five major publicly-owned wastewater treatment facilities, but of that number it appears that only four small facilities (Tahlequah, Stillwell, Del City, and Westville) have any numeric discharge limit for phosphorus. The rest apparently are not even asked to monitor for phosphorus in their permits. One cannot help but wonder what the reaction of the utility managers and ratepayers might be if Tulsa, Oklahoma City, and other communities in Oklahoma were required to meet a 0.1 mg/L phosphorus permit limit, particularly if there was no scientific information demonstrating that the imposition of such a permit limit would result in any demonstrable improvement in downstream ecological conditions.

   In making this point we do not mean to suggest any criticism of Oklahoma or its cities. Indeed, when one surveys all of the POTW permits in effect in EPA Region 6 it is extremely rare to find any permits which have numeric discharge limits for phosphorus. The relevant point is simply that, when it comes to phosphorus, Northwest Arkansas is already intensively regulated. Against that background, the cities believe the TAG should carefully consider what more in the way of regulation one can fairly and reasonably expect, and what changes in identifiable ecological endpoints are likely to result.

The cities appreciate the opportunity to offer these comments and look forward to the results of the TAG review.

Very truly yours,

MITCHELL, WILLIAMS, SELIG,
GATES & WOODYARD, P.L.L.C.

By Allan Gates
Allan Gates

and

MCGOODWIN, WILLIAMS, & YATES, INC.

By L Carl Yates by ag
L. Carl Yates, P.E.

AG:ce

cc: **Via Electronic Delivery**
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Edward Swaim, Esq.
Ms. Shanon Phillips
Mr. Quang Pham
Ms. Shellie Chard-McClary
Ms. Cara Cowan Watts
Ms. Melinda McCoy
Mr. Derek Smithee

References & Attachments

L. Massey & B. Haggard, Water Quality Monitoring and Constituent Load Estimation in the Upper Illinois River Watershed, 2009, ARKANSAS WATER RESOURCES CENTER, UNIV. OF ARKANSAS, TECHNICAL PUBLICATION NO. MSC 363 (2010) accessible at: http://www.uark.edu/depts/awrc/pdf_files/MSC/MSC_363.pdf

B. Haggard, A. Sharpley, & L. Massey, Water Quality and Watershed Conditions in the Upper Illinois River Watershed, ARKANSAS WATER RESOURCES CENTER, UNIV. OF ARKANSAS, TECHNICAL PUBLICATION NO. MSC 359 (2010) accessible at: http://www.uark.edu/depts/awrc/pdf_files/MSC/MSC_359.pdf

Water Quality Monitoring Report Illinois River Basin CY2009, Arkansas-Oklahoma Arkansas River Compact Commission (2010) (copy attached).

Oklahoma's 5-Year Rolling Average Phosphorus Report for the Illinois River Basin, Arkansas-Oklahoma Arkansas River Compact Commission (Draft 2010) (copy attached).

Environmental Committee Report, Arkansas-Oklahoma Arkansas River Compact Commission (Draft September 23, 2010) (copy attached).

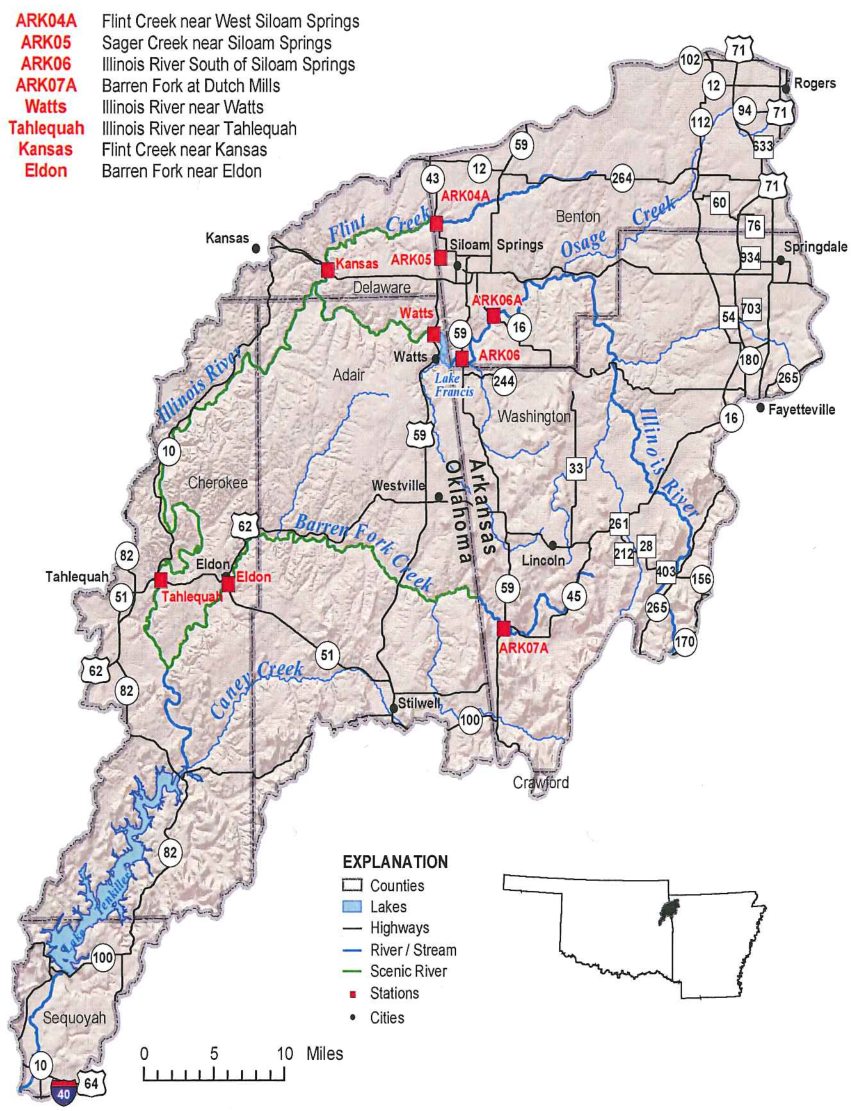
April 14, 2011 Letter from Steven L. Drown to Philip Moershel (copy attached).

April 22, 2011 Comments on Oklahoma Water Resources Board Draft QAPP for Secondary Data (copy attached)

January 14, 2010 [sic 2011] Letter from John Bailey, P.E. to Claudia Hosch (including attachments) (copy attached).

December 1, 2010 Letter from J. Ryan Benefield, P.E. to Miguel Flores (copy attached).

Water Quality Monitoring Report
Illinois River Basin
Arkansas-Oklahoma Compact



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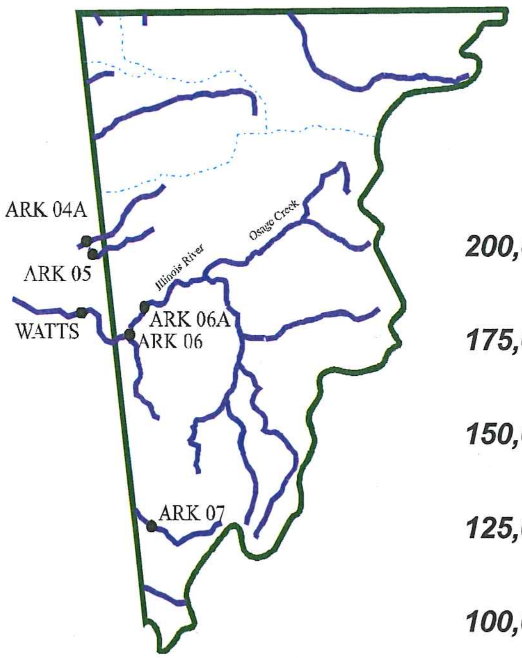
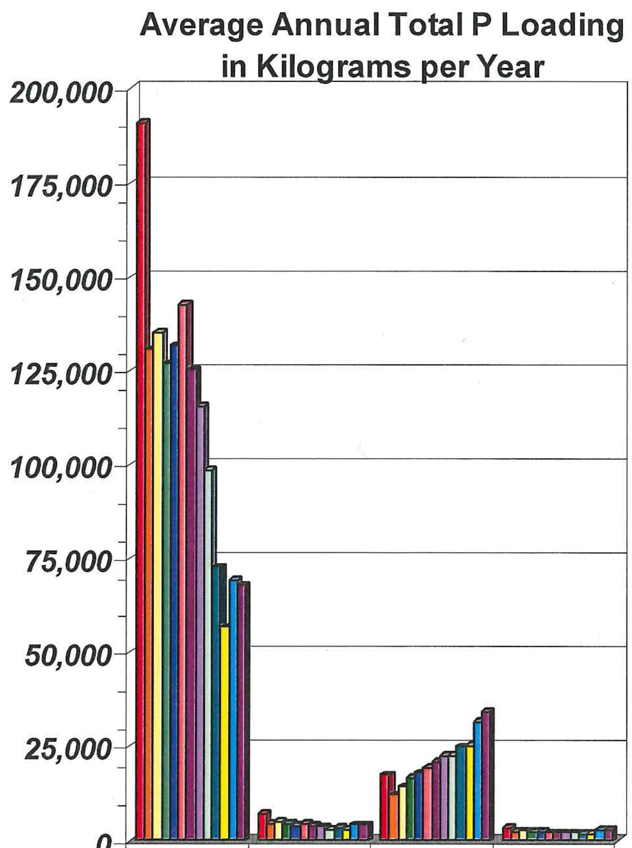




	Illinois River ARK06	Baron Fork ARK07A	Sager Creek ARK05	Flint Creek ARK04A
Total P 80-93	190,577	7,160	17,566	3,267
Total P 94-98	130,567	4,519	12,133	2,488
Total P 95-99	134,951	4,874	14,284	2,555
Total P 96-00	126,713	4,571	16,796	2,187
Total P 97-01	131,495	4,002	18,008	2,213
Total P 98-02	142,446	4,354	19,332	2,043
Total P 99-03	125,156	3,792	20,798	2,019
Total P 00-04	115,417	3,661	22,418	2,106
Total P 01-05	98,479	2,777	22,616	2,049
Total P 02-06	72,654	3,274	24,905	1,855
Total P 03-07	56,817	3,062	25,113	1,707
Total P 04-08	69,349	4,145	31,649	2,848
Total P 05-09	67,883	4,237	34,347	2,723

Flint Creek Northwest of West Siloam Springs - Loadings			
ARK04A Year	Flow (cfs)	Total P (mg/L)	Total P (kg/yr)
1981	19.8	0.149	2,635
1982	29.9	0.171	4,566
1983	19.0	0.073	1,239
1984	53.5	0.112	5,351
1985	91.3	0.063	5,137
1986	78.4	0.067	4,691
1987	58.3	0.049	2,551
1988	41.8	0.031	1,157
1989	38.0	0.050	1,697
1990	71.3	0.060	3,821
1991	51.6	0.054	2,489
1992	56.1	0.047	2,355
1993	88.2	0.045	3,545
1994	53.0	0.051	2,414
1995	61.3	0.075	4,106
1996	33.5	0.050	1,496
1997	37.3	0.074	2,448
1998	42.9	0.056	2,142
1999	63.5	0.045	2,578
2000	55.6	0.038	1,893
2001	39.4	0.047	1,636
2002	44.6	0.047	1,850
2003	21.4	0.075	1,438
2004	64.6	0.055	3,173
2005	43.0	0.046	1,772
2006	12.6	0.056	630
2007	22.4	0.059	1,180
2008	76.9	0.147	10,096
2009	55.6	0.054	2,679
Avg.	49.1	0.067	2,943

Sager Creek near West Siloam Springs - Loadings			
ARK05 Year	Flow (cfs)	Total P (mg/L)	Total P (kg/yr)
1981	6.5	2.125	12,336
1982	9.0	2.025	16,277
1983	6.3	1.964	11,050
1984	15.4	0.950	13,066
1985	24.8	1.736	38,450
1986	21.1	0.834	15,716
1987	16.7	0.948	14,136
1988	12.6	1.154	12,986
1989	11.7	1.227	12,821
1990	20.2	0.860	15,515
1991	15.5	0.914	12,653
1992	16.5	1.284	18,921
1993	24.6	0.637	13,995
1994	15.7	0.721	10,110
1995	17.8	0.697	11,080
1996	11.0	0.919	9,028
1997	17.8	1.029	16,354
1998	18.1	0.858	13,876
1999	24.5	0.979	21,429
2000	30.7	0.820	22,469
2001	21.2	0.803	15,201
2002	21.8	1.192	23,231
2003	11.7	1.503	15,700
2004	34.5	0.916	28,224
2005	18.5	1.461	24,200
2006	14.9	1.799	23,940
2007	21.0	1.306	24,494
2008	48.9	0.945	41,271
2009	38.1	1.286	43,769
Avg.	19.6	1.169	20,413

NOTES: 1) Flow data provided by USGS Arkansas & Oklahoma. 2) P concentrations provided by the ADEQ Technical Services Division.

Illinois River South of Siloam Springs - Loadings			
ARK06 Year	Flow (cfs)	Total P (mg/L)	Total P (kg/yr)
1981	197	0.420	73,895
1982	591	0.370	195,294
1983	352	0.386	121,347
1984	706	0.442	278,693
1985	947	0.289	244,426
1986	879	0.305	239,436
1987	815	0.294	213,996
1988	531	0.253	119,982
1989	558	0.291	145,020
1990	1127	0.204	205,331
1991	724	0.220	142,253
1992	760	0.222	150,684
1993	1163	0.181	188,000
1994	674	0.190	114,370
1995	783	0.237	165,733
1996	667	0.225	134,032
1997	497	0.213	94,504
1998	668	0.246	146,960
1999	737	0.206	135,413
2000	597	0.230	122,831
2001	598	0.293	156,581
2002	570.4	0.282	143,700
2003	344	0.219	67,422
2004	633	0.153	86,496
2005	436	0.120	46,785
2006	290	0.120	31,048
2007	436	0.131	51,022
2008	1,051	0.158	148,306
2009	907	0.080	64,782
Avg.	663	0.241	142,624

Baron Fork at Dutch Mills - Loadings			
ARK07A Year	Flow (cfs)	Total P (mg/L)	Total P (kg/yr)
1981	18.4	0.135	2,218
1982	37.4	0.484	16,167
1983	27.2	0.125	3,037
1984	51.8	0.183	8,466
1985	79.4	0.211	14,962
1986	64.0	0.147	8,402
1987	63.2	0.134	7,563
1988	31.8	0.097	2,755
1989	50.2	0.124	5,559
1990	102.0	0.109	9,929
1991	49.4	0.086	3,794
1992	47.9	0.127	5,433
1993	104.0	0.083	7,709
1994	37.0	0.081	2,677
1995	54.2	0.162	7,842
1996	64.4	0.084	4,831
1997	35.9	0.067	2,151
1998	61.1	0.107	5,822
1999	45.8	0.102	4,176
2000	52.6	0.133	6,230
2001	41.4	0.065	2,387
2002	38.0	0.104	3,536
2003	20.1	0.133	2,386
2004	44.5	0.087	3,458
2005	26.1	0.069	1,595
2006	62.0	0.088	4,873
2007	32.3	0.087	2,510
2008	86.0	0.132	10,138
2009	62.3	0.066	3,672
Avg.	51.4	0.125	5,715

NOTES: 1) Flow data provided by USGS Arkansas & Oklahoma. 2) P concentrations provided by the ADEQ Technical Services Division.

Five-Year Average Values by Station

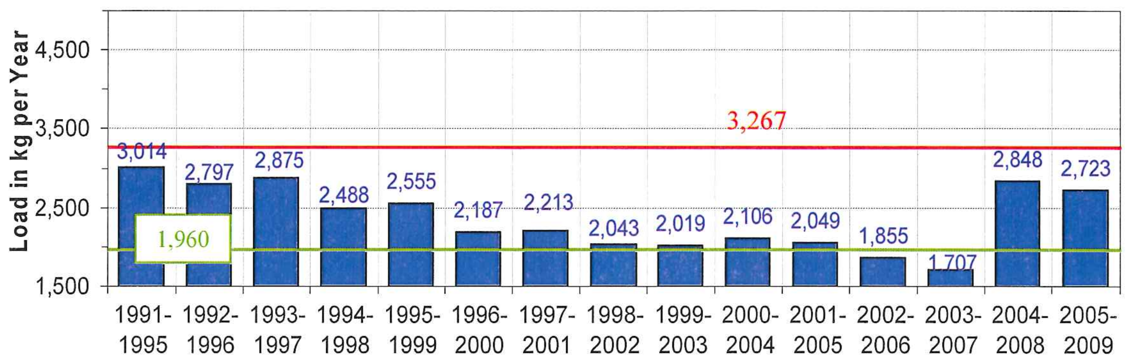
Flint Creek NW of W Siloam Springs				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.079	50.7	3,267	0.0%
91-95	0.054	62.0	3,014	7.7%
92-96	0.054	58.4	2,797	14.4%
93-97	0.059	54.7	2,875	12.0%
94-98	0.061	45.6	2,488	23.9%
95-99	0.060	47.7	2,555	21.8%
96-00	0.053	46.6	2,187	33.1%
97-01	0.052	47.7	2,213	32.3%
98-02	0.046	49.2	2,043	37.5%
99-03	0.050	44.9	2,019	38.2%
00-04	0.052	45.1	2,106	35.5%
00-05	0.054	42.6	2,049	37.3%
02-06	0.056	37.2	1,855	43.2%
03-07	0.058	32.8	1,707	47.7%
04-08	0.073	43.9	2,848	12.8%
05-09	0.072	42.1	2,723	16.7%

Illinois River South of Siloam Springs				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.311	680	190,577	0.0%
91-95	0.210	821	153,942	19.2%
92-96	0.211	809	152,527	20.0%
93-97	0.209	757	141,386	25.8%
94-98	0.222	658	130,567	31.5%
95-99	0.225	670	134,951	29.2%
96-00	0.224	633	126,713	33.5%
97-01	0.238	619	131,495	31.0%
98-02	0.252	634	142,446	25.3%
99-03	0.246	569	125,156	34.3%
00-04	0.236	548	115,417	39.4%
00-05	0.214	516	98,479	48.3%
02-06	0.179	455	72,654	61.9%
03-07	0.149	428	56,817	70.2%
04-08	0.136	569	69,349	63.6%
05-09	0.122	624	67,883	64.4%

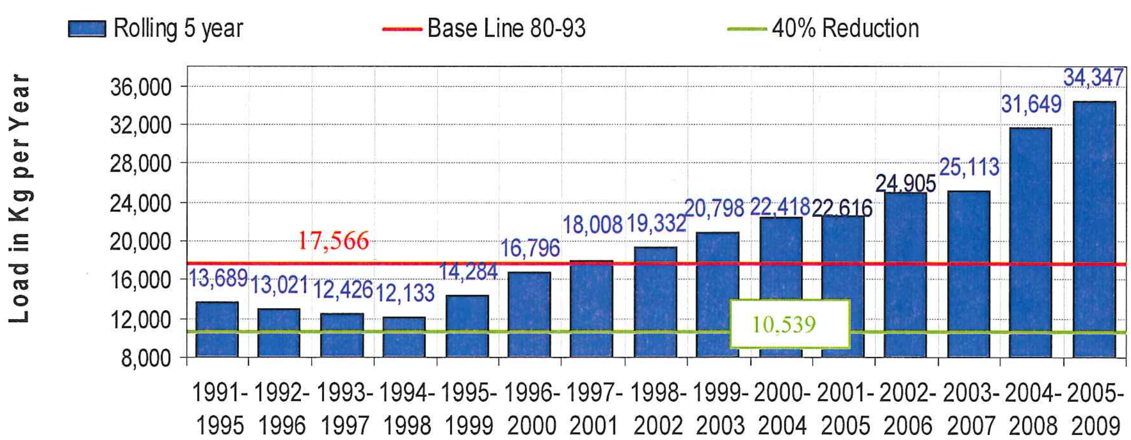
Sager Creek near W Siloam Springs				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	1.363	14.7	17,566	0.0%
91-95	0.851	18.0	13,689	22.1%
92-96	0.852	17.1	13,021	25.9%
93-97	0.801	17.4	12,426	29.3%
94-98	0.845	16.1	12,133	30.9%
95-99	0.896	17.8	14,284	18.7%
96-00	0.921	20.4	16,796	4.4%
97-01	0.898	22.5	18,008	-2.5%
98-02	0.930	23.3	19,332	-10.1%
99-03	1.059	22.0	20,798	-18.4%
00-04	1.047	24.0	22,418	-27.6%
00-05	1.175	21.6	22,616	-28.7%
02-06	1.374	20.3	24,905	-41.8%
03-07	1.397	20.1	25,113	-43.0%
04-08	1.285	27.6	31,649	-80.2%
05-09	1.359	28.3	34,347	-95.5%

Baron Fork at Dutch Mills				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.153	52.6)	7,160	0.0%
91-95	0.108	58.5	5,632	21.3%
92-96	0.107	61.5	5,899	17.6%
93-97	0.095	59.1	5,036	29.7%
94-98	0.100	50.5	4,519	36.9%
95-99	0.104	52.3	4,874	31.9%
96-00	0.099	52.0	4,571	36.2%
97-01	0.095	47.4	4,002	44.1%
98-02	0.102	47.8	4,354	39.2%
99-03	0.107	39.6	3,792	47.0%
00-04	0.104	39.3	3,661	48.9%
00-05	0.091	34.0	2,777	61.2%
02-06	0.096	38.1	3,274	54.3%
03-07	0.093	37.0	3,062	57.2%
04-08	0.093	50.2	4,145	42.1%
05-09	0.088	53.7	4,237	40.8%

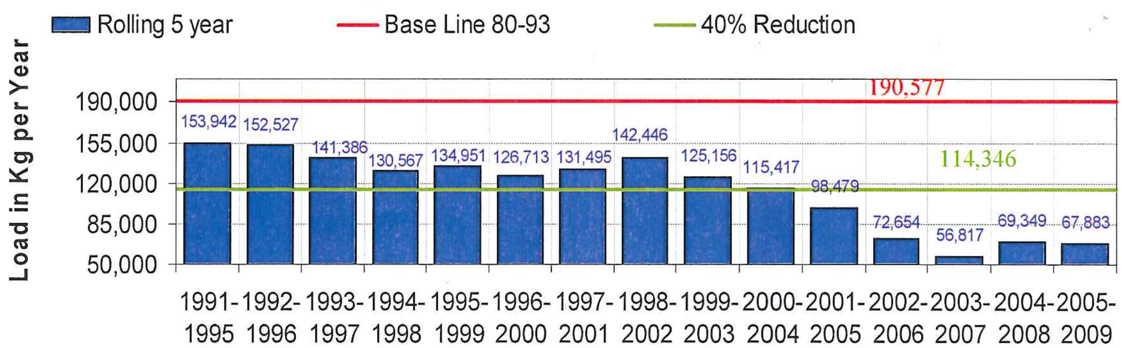
Flint Creek Northwest of West Siloam Springs



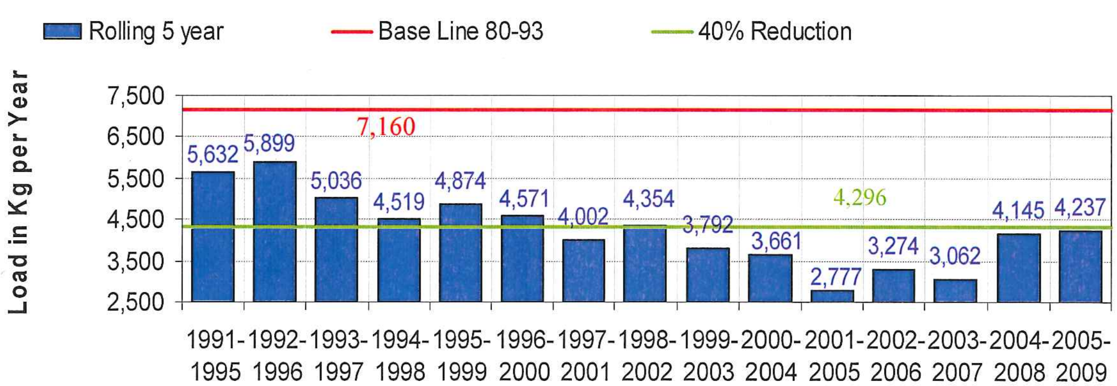
Sager Creek near West Siloam Springs



Illinois River South of Siloam Springs

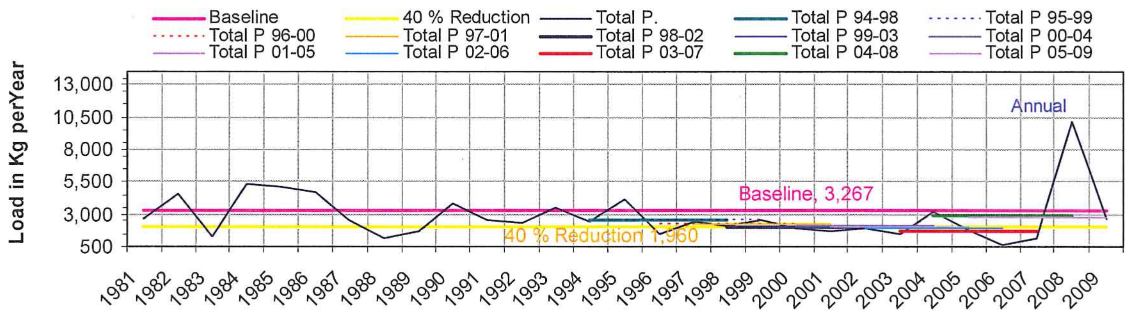


Baron Fork at Dutch Mills

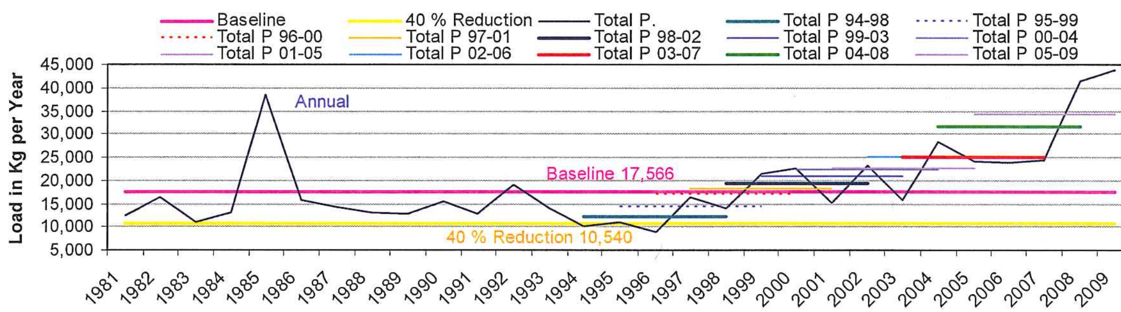


ARKANSAS

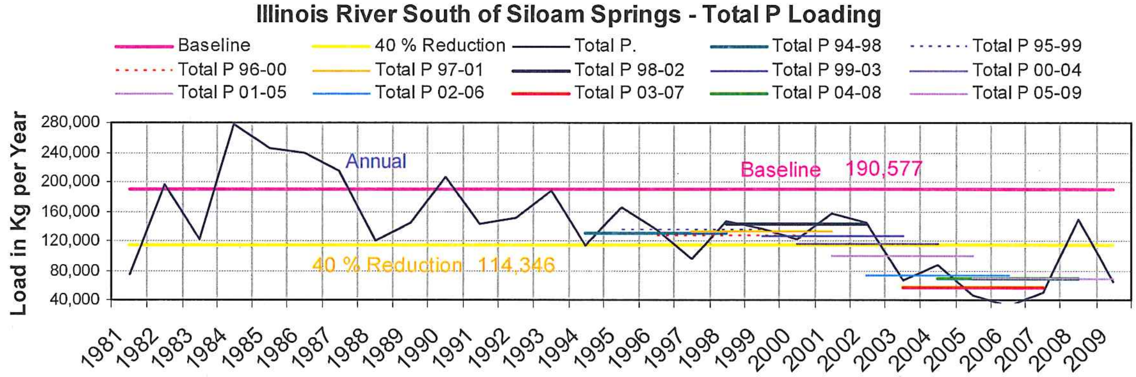
Flint Creek Northwest of W. Siloam Springs - Total P Loading



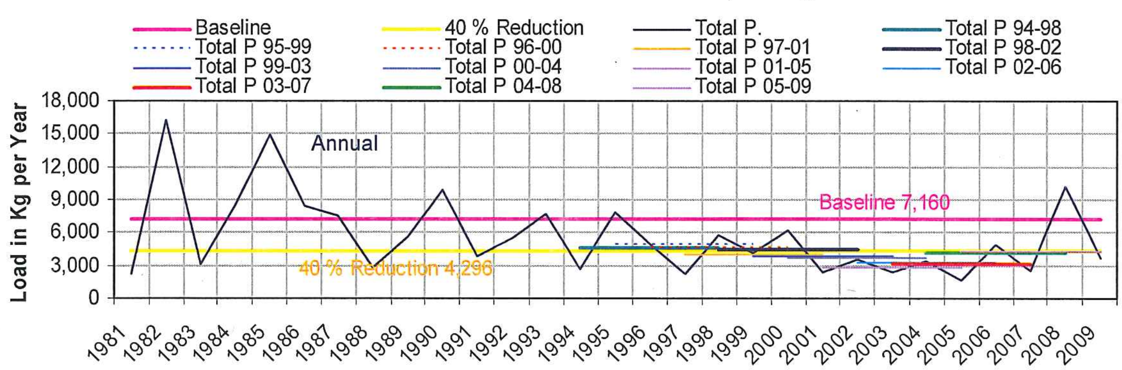
Sager Creek near W. Siloam Springs - Total P Loading



Illinois River South of Siloam Springs - Total P Loading



Baron Fork at Dutch Mills - Total P Loading



ARKANSAS

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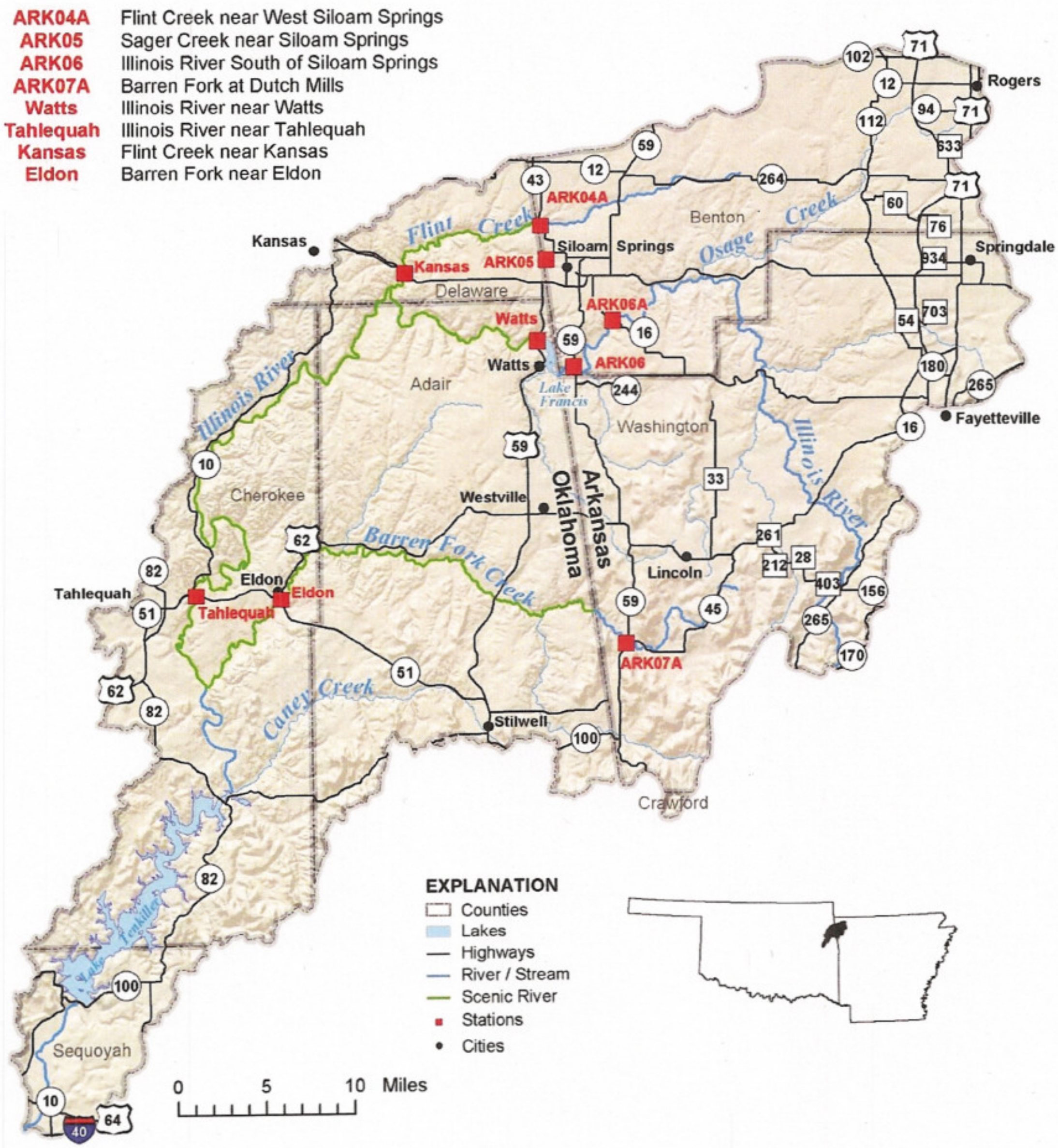
OKLAHOMA

Oklahoma's 5-year Rolling Average Phosphorus Report for the Illinois River Basin

Illinois River Basin
Arkansas – Oklahoma Compact



OKLAHOMA'S PHOSPHORUS LOADING REPORT FOR THE ILLINOIS RIVER BASIN

CY 2009

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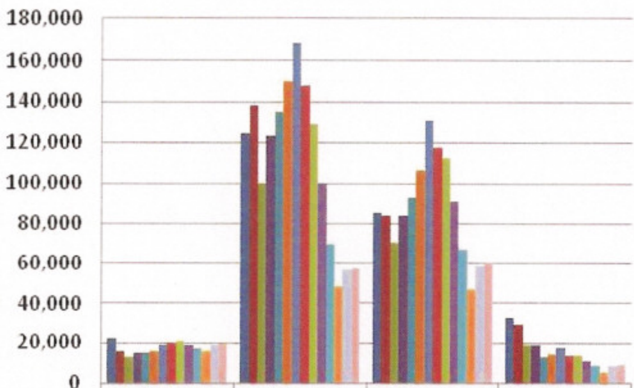
Average Annual Total P Loading in Kilograms per Year (excluding targeted high flows)



	Flint Creek near Kansas	Illinois River near Watts	Illinois River near Tahlequah	Barren Fork near Eldon
Total P 80-93	22,279	124,832	85,235	33,001
Total P 93-97	15,705	138,508	83,799	29,482
Total P 94-98	12,986	99,898	70,546	19,163
Total P 95-99	14,949	123,581	83,632	19,257
Total P 96-00	15,103	134,986	92,876	13,163
Total P 97-01	15,992	149,927	106,797	14,548
Total P 98-02	19,259	167,987	131,491	17,603
Total P 99-03	20,620	148,151	117,524	14,059
Total P 00-04	21,004	129,533	112,341	13,685
Total P 01-05	19,098	100,347	91,325	11,465
Total P 02-06	17,415	69,482	67,345	8,500
Total P 03-07	15,977	48,448	47,216	5,716
Total P 04-08	19,356	56,951	58,605	8,574
Total P 05-09	19,586	57,275	60,827	9,195

Values represent all available data, which is routinely collected and excludes targeted high flow events.

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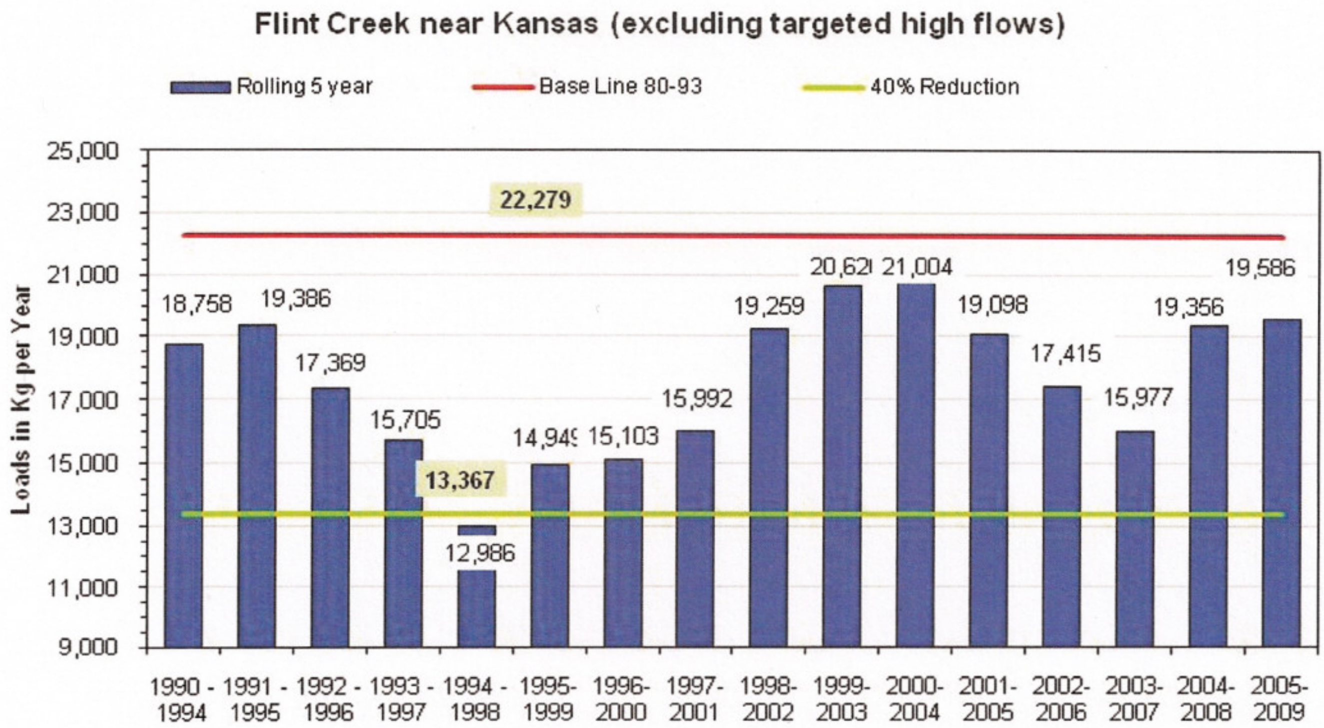
Flint Creek near Kansas (excluding targeted high flows)
Rolling 5 year
Base Line 80-93
40% Reduction
Loads in Kg per Year
22,279
13,367
18,758
19,386
17,369
15,705
12,986
14,949
15,103
15,992
19,259
20,62
21,004
19,098
17,415
15,977
19,356
19,586
1990 - 1994
1991 - 1995
1992 - 1996
1993 - 1997
1994 - 1998
1995-1999
1996-2000
1997-2001
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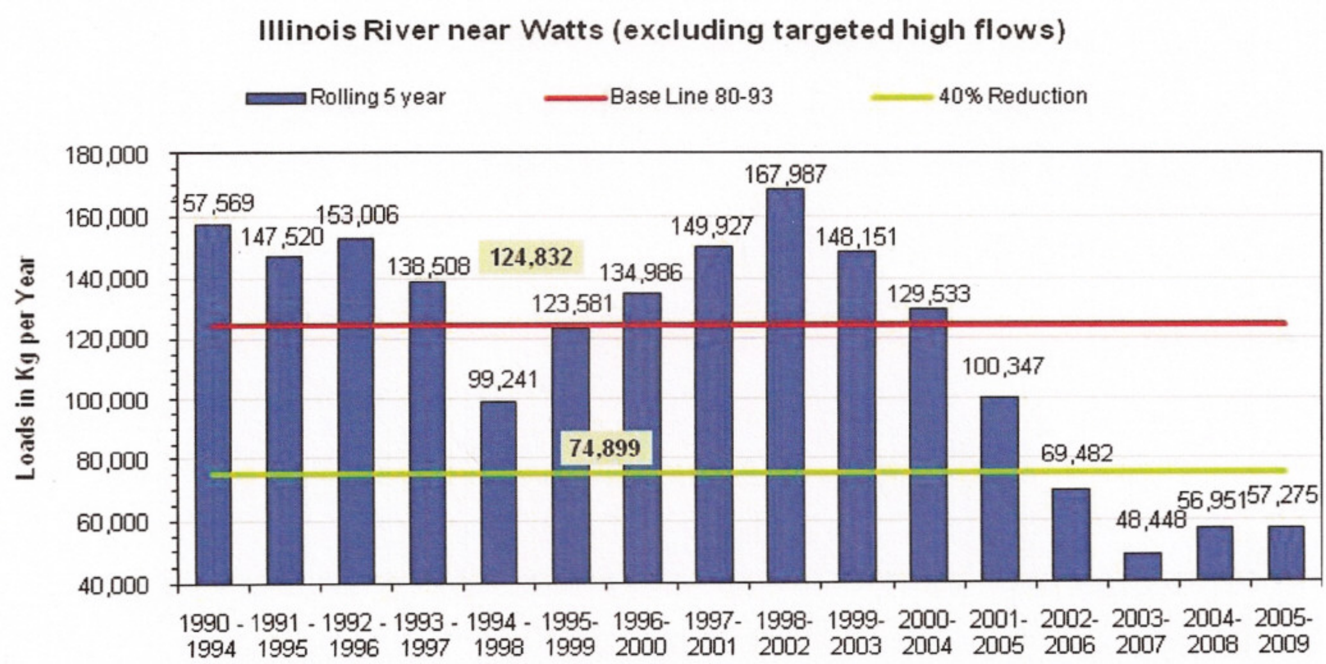
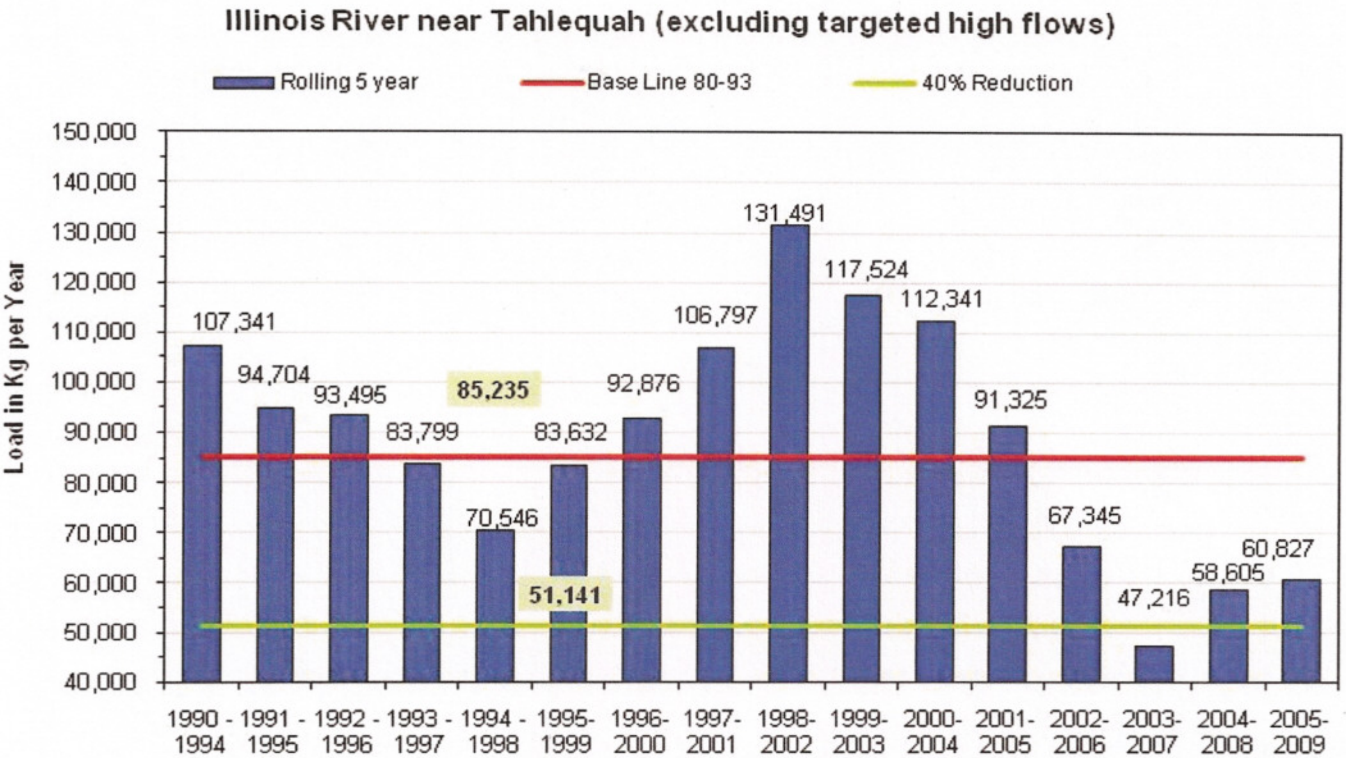
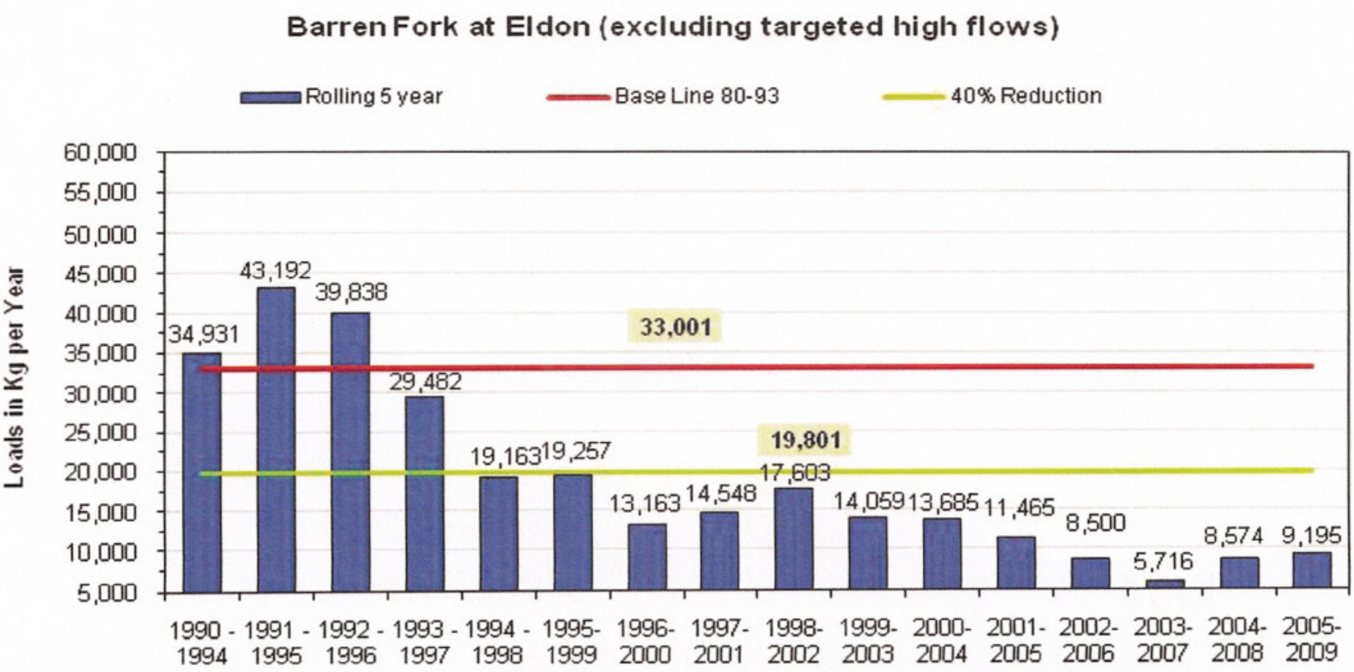
2000-2004
2001-2005
2002-2006
2003-2007
2004-2008
2005-2009


Illinois River near Watts (excluding targeted high flows)
Rolling 5 year
Base Line 80-93
40% Reduction
Loads in Kg per Year
124,832
74,899
57,569
147,520
153,006
138,508
99,241
123,581
134,986
149,927
167,987
148,151
129,533
100,347
69,482
48,448
56,951
57,275
1990 - 1994
1991 - 1995
1992 - 1996
1993 - 1997
1994 - 1998
1995-1999
1996-2000
1997-2001
1998-2002
1999-2003
2000-2004
2001-2005
2002-2006
2003-2007
2004-2008
2005-2009

OKLAHOMA



Illinois River near Tahlequah (excluding targeted high flows)
Rolling 5 year
Base Line 80-93
40% Reduction
Load in Kg per Year
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
107,341
94,704
93,495
83,799
70,546
83,632
92,876
106,797
131,491
117,524
112,341
91,325
67,345
47,216
58,605
60,827
85,235
51,141
1990 - 1994
1991 - 1995
1992 - 1996
1993 - 1997
1994 - 1998
1995-1999
1996-2000
1997-2001
1998-2002
1999-2003
2000-2004
2001-2005
2002-2006
2003-2007
2004-2008
2005-2009



Barren Fork at Eldon (excluding targeted high flows)
Rolling 5 year
Base Line 80-93
40% Reduction
Loads in Kg per Year
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
34,931
43,192
39,838
29,482
19,163
19,257
13,163
14,548
17,603
14,059
13,685
11,465
8,500
5,716
8,574
9,195
33,001
19,801
1990 - 1994
1991 - 1995
1992 - 1996
1993 - 1997
1994 - 1998
1995-1999
1996-2000
1997-2001
1998-2002
1999-2003
2000-2004
2001-2005
2002-2006
2003-2007
2004-2008
2005-2009

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Illinois River near Watts			Loadings
Year	Flow (cfs)	Total P (mg/L)	Total P kg/year
1980	173	0.423	65,279
1981	260	0.190	44,119
1982	591		
1983	352		
1984	706		
1985	947		
1986	879		
1987	815		
1988	531		
1989	558	0.210	104,653
1990	1,127	0.181	182,432
1991	724	0.162	104,534
1992	760	0.161	109,571
1993	1,163	0.277	287,317
1994	674	0.168	101,127
1995	783	0.143	100,233
1996	693	0.188	116,542
1997	573	0.163	83,415
1998	713	0.138	87,876
1999	793	0.250	177,057
2000	648	0.309	178,827
2001	649	0.346	200,549
2002	619	0.316	174,694
2003	347	0.155	48,035
2004	688	0.104	63,903
2005	459	0.106	43,453
2006	349	0.116	36,156
2007	464	0.106	43,926
2008	1177	0.068	71,480
2009	915	0.069	56,398
Average	671	0.189	113,318

Illinois River Near Tahlequah			Loadings
Year	Flow (cfs)	Total P (mg/L)	Total P kg/year
1980	249		
1981	384		
1982	812		
1983	537		
1984	1,157		
1985	1,651		
1986	1,452		
1987	1,218		
1988	820		
1989	808		
1990	1,695	0.098	147,579
1991	1,094	0.079	76,796
1992	1,207	0.080	86,205
1993	1,751	0.099	154,647
1994	1,071	0.084	80,223
1995	1,123	0.080	80,229
1996	938	0.085	71,207
1997	812	0.069	49,797
1998	1,044	0.081	75,524
1999	1,143	0.121	123,518
2000	1,083	0.136	131,543
2001	1,033	0.158	145,766
2002	851	0.211	160,366
2003	478	0.100	42,690
2004	1,157	0.075	77,499
2005	712	0.060	38,148
2006	426	0.074	28,154
2007	736	0.066	43,383
2008	1,839	0.062	101,829
2009	1,407	0.072	90,462
Average	1,023	0.094	86,265

NOTES : Flow & Water quality data provided by USGS Oklahoma District

* WQ data from 1999 to the present also includes data routinely collected by the OWRB

ᵏ Values represent data that is routinely collected and excludes targeted high flow events.

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Flint Creek Near Kansas				Loadings
Year	Flow (cfs)	Total P (mg/L)		Total P kg/year
1980	32	0.189		5,454
1981	57	0.178		9,077
1982	69	0.186		11,537
1983	49	0.284		12,415
1984	143	0.240		30,532
1985	237	0.224		47,591
1986	183	0.223		36,430
1987	141	0.157		19,840
1988	97	0.265		22,946
1989	90	0.557		44,981
1990		0.114		
1991		0.120		
1992		0.118		
1993	182	0.156		25,359
1994	136	0.127		15,418
1995	140	0.185		23,207
1996	76	0.152		10,294
1997	94.8	0.117		9,871
1998	96.5	0.127		10,945
1999	137	0.186		22,758
2000	133	0.178		21,143
2001	101	0.164		14,793
2002	82	0.310		22,703
2003	49.8	0.316		14,055
2004	149.0	0.165		21,957
2005	91.8	0.168		13,774
2006	36.8	0.226		7,428
2007	70.3	0.240		15,068
2008	218.0	0.157		30,567
2009	141.6	0.187		23,649
Average	112	0.200		20,134

Baron Fork at Eldon				Loadings
Year	Flow (cfs)	Total Phos. (mg/L)		Total P kg/year
1980	77			
1981	201			
1982	296			
1983	184			
1984	364			
1985	593			
1986	536			
1987	491			
1988	269			
1989	320			
1990	666			
1991	451	0.060		24,145
1992	440	0.095		37,315
1993	700	0.108		67,234
1994	328	0.037		10,878
1995	422	0.263		98,819
1996	432	0.025		9,645
1997	332	0.023		6,671
1998	409	0.033		12,054
1999	361	0.048		15,476
2000	376	0.043		14,440
2001	343	0.064		19,605
2002	262	0.088		20,591
2003	145	0.025		3,237
2004	403	0.029		10,438
2005	228	0.027		5,498
2006	169	0.027		4,075
2007	254	0.026		5,898
2008	559	0.045		22,466
2009	460	0.033		13,548
Average	369	0.058		19,040

*1999 TP was modified to include less than detect values (1/2 LTD, n=5)

*2002 TP was modified to include less than detect values (1/2 LTD, n=2)

NOTES : Flow & Water quality data provided by USGS Oklahoma District

* WQ data from 1999 to the present also includes data routinely collected by the OWRB

* Values represent data that is routinely collected and excludes targeted high flow events.

OKLAHOMA

Illinois River at Watts				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.204	685	124,832	0.0%
90-94	0.198	890	157,569	-26.2%
91-95	0.201	821	147,520	-18.2%
92-96	0.210	815	153,006	-22.6%
93-97	0.200	777	138,508	-11.0%
94-98	0.162	687	99,241	20.5%
95-99	0.195	711	123,581	1.0%
96-00	0.221	684	134,986	-8.1%
97-01	0.249	675	149,927	-20.1%
98-02	0.275	684	167,987	-34.6%
99-03	0.271	611	148,151	-18.7%
00-04	0.246	590	129,533	-3.8%
2001-2005	0.203	552	100,347	19.6%
2002-2006	0.158	492	69,482	44.3%
2003-2007	0.118	461	48,448	61.2%
2004-2008	0.102	627	56,951	54.4%
2005-2009	0.095	673	57,275	54.1%

Flint Creek near Kansas				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.214	117	22,279	0.0%
90-94	0.132	159	18,758	15.8%
91-95	0.142	153	19,386	13.0%
92-96	0.146	134	17,369	22.0%
93-97	0.140	126	15,705	29.5%
94-98	0.133	109	12,986	41.7%
95-99	0.154	109	14,949	32.9%
96-00	0.157	107	15,103	32.2%
97-01	0.159	112	15,992	28.2%
98-02	0.196	110	19,259	13.6%
99-03	0.230	101	20,620	7.4%
00-04	0.228	103	21,004	5.7%
2001-2005	0.226	95	19,098	14.3%
2002-2006	0.238	82	17,415	21.8%
2003-2007	0.225	80	15,977	28.3%
2004-2008	0.191	113	19,356	13.1%
2005-2009	0.196	112	19,586	12.1%

Illinois River near Tahlequah				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.090	1060	85,235	0.0%
90-94	0.088	1364	107,341	-25.9%
91-95	0.085	1249	94,704	-11.1%
92-96	0.086	1218	93,495	-9.7%
93-97	0.082	1139	83,799	1.7%
94-98	0.079	998	70,546	17.2%
95-99	0.093	1012	83,632	1.9%
96-00	0.104	1004	92,876	-9.0%
97-01	0.117	1023	106,797	-25.3%
98-02	0.143	1031	131,491	-54.3%
99-03	0.143	918	117,524	-37.9%
00-04	0.137	920	112,341	-31.8%
2001-2005	0.121	846	91,323	-7.1%
2002-2006	0.104	725	67,345	21.0%
2003-2007	0.075	702	47,216	44.6%
2004-2008	0.067	974	58,605	31.2%
2005-2009	0.067	1024	60,827	28.6%

Barren Fork at Eldon				
Year	Pt (mg/l)	Flow (cfs)	Pt (kg/yr)	% Decrease
80-93	0.093	399	33,001	0.0%
90-94	0.076	517	34,931	-5.8%
91-95	0.103	468	43,192	-30.9%
92-96	0.096	464	39,838	-20.7%
93-97	0.075	443	29,482	10.7%
94-98	0.056	384	19,163	41.9%
95-99	0.055	391	19,257	41.6%
96-00	0.039	382	13,163	60.1%
97-01	0.045	364	14,548	55.9%
98-02	0.056	350	17,603	46.7%
99-03	0.053	297	14,059	57.4%
00-04	0.050	306	13,865	58.0%
2001-2005	0.046	276	11,465	65.3%
2002-2006	0.039	241	8,500	74.2%
2003-2007	0.027	24	5,716	82.7%
2004-2008	0.030	323	8,574	74.0%
2005-2009	0.031	334	9,195	72.1%

Funding for Cities and Districts In the Illinois River Basin Provided by the OWRB's Financial Assistance Program

AppID	OldSystemID	APPLICANT	COUNTY	ClosedAmt	ApprovedDate	AppType	ShortProjectDesc
1628	FAP-00-0058-R	Adair County Rural Water District #5	Adair	$99,500.00	07/10/2001	REAP	constructing a new 200,000-gallon water storage ta
2130	FAP-97-0124-R	Adair County Rural Water District #5	Adair	$75,000.00	06/08/1999	REAP	Water system improvements
2653	FAP-89-0062-G	Adair County Rural Water District #5	Adair	$50,000.00	09/10/1991	Emergency	NEW WATER SYSTEM
1641	FAP-00-0071-R	Adair County Rural Water District #6	Adair	$146,875.00	04/09/2002	REAP	drilling a production-test well with casing, insta
3195	FAP-06-0015-R	Adair County RWS & SWMD #2	Adair	$99,999.00	03/11/2008	REAP	Line repair and water line extension
2565	FAP-85-0155-G	Adair County RWS & SWMD #2	Adair	$100,000.00	06/11/1985	Emergency	
1963	FAP-96-0077-R	Braggs	Muskogee	$36,995.00	01/14/1997	REAP	WATER PLANT IMPROVEMENTS--SOURCE WATER WELL AND PU
2714	FAP-90-0100-G	Braggs Public Works Authority	Muskogee	$70,000.00	02/12/1991	Emergency	Sanitary sewage collection and treatment plant imp
2179	FAP-98-0011-R	Burnt Cabin Rural Water District Incorporated	Cherokee	$65,427.00	06/09/1998	REAP	WATER LINE EXTENSION
2478	FAP-83-0019-G	Burnt Cabin Rural Water District Incorporated	Cherokee	$24,000.00	11/02/1983	Emergency	
3388	FAP-08-0005-R	Cherokee County Rural Water District #12	Cherokee	$70,000.00	06/09/2009	REAP	
1764	FAP-02-0026-R	Cherokee County Rural Water District #13	Cherokee	$135,000.00	06/08/2004	REAP	installing approximately 4000 L.F. of 6-inch PVC w
1477	FAP-00-0007-L	Cherokee County Rural Water District #13	Cherokee	$1,810,000.00	06/11/2002	FA Loan	INSTALL A MICROFILTRATION WATER PLANT
2109	FAP-97-0098-R	Cherokee County Rural Water District #13	Cherokee	$80,000.00	03/14/2000	REAP	constructing a new intake platform, access structu
2847	FAP-95-0060-G	Cherokee County Rural Water District #13	Cherokee	$100,000.00	01/09/1996	Emergency	CONSTRUCT 12' 9 X 110' STAND PIPE AND BACKWASH LAG
1278	FAP-95-0031-L	Cherokee County Rural Water District #13	Cherokee	$170,000.00	01/09/1996	FA Loan	CONSTRUCT A STANDPIPE & REPLACE WATER MAINS
1493	FAP-02-0004-L	Cherokee County Rural Water District #2	Cherokee	$645,000.00	08/13/2002	FA Loan	WATER SYSTEM IMPROVEMENTS
2897	FAP-98-0052-G	Cherokee County Rural Water District #3	Cherokee	$45,000.00	02/10/1999	Emergency	WATER DISTRIBUTION SYSTEM EXTENSION
2488	FAP-83-0033-G	Cherry Tree Rural Water District	Adair	$10,000.00	01/10/1984	Emergency	
2517	FAP-84-0015-G	Colcord	Delaware	$95,816.00	04/10/1984	Emergency	
2117	FAP-97-0107-R	Colcord Public Works Authority	Delaware	$94,800.00	01/12/1999	REAP	UPGRADE & ENLARGEMENT OF SEWER LAGOONS.
2864	FAP-96-0045-G	East Central OK Water	Muskogee	$97,750.00	04/14/1998	Emergency	WATER LINE EXTENSION
2056	FAP-97-0021-R	East Central OK Water	Muskogee	$59,700.00	03/11/1997	REAP	SEWER LINE EXTENSION
1653	FAP-01-0005-R	Gore Public Works Authority	Sequoyah	$60,000.00	11/13/2001	REAP	conducting a public information notification progr
2472	FAP-83-0012-G	Kansas	Delaware	$92,516.00	03/13/1984	Emergency	
1742	FAP-02-0003-R	Kansas Public Works Authority	Delaware	$67,000.00	11/12/2002	REAP	installing two (2) vertical in-line centrifugal pu
2108	FAP-97-0097-R	Kansas Public Works Authority	Delaware	$109,500.00	11/16/1999	REAP	rehabilitating two water storage tanks, filters an
2066	FAP-97-0040-R	Kansas Public Works Authority	Delaware	$139,270.00	03/10/1998	REAP	ADDITIONAL WELL AND WATER SYSTEM IMPROVEMENTS
2582	FAP-86-0002-G	Kansas Public Works Authority	Delaware	$65,000.00	01/12/1988	Emergency	
2471	FAP-83-0008-G	Marble City	Sequoyah	$100,000.00	02/14/1984	Emergency	
2416	FAP-02-0011-G	Muskogee County Rural Water District #5	Muskogee	$100,000.00	06/08/2004	Emergency	installing approximately 42,000 L.F. of 4-inch PVC
1523	FAP-02-0011-L	Muskogee County Rural Water District #5	Muskogee	$1,390,000.00	05/13/2003	FA Loan	WATER SYSTEM IMPROVEMENTS
2493	FAP-83-0041-G	Muskogee County Rural Water District #7	Muskogee	$90,000.00	04/10/1984	Emergency	
1242	FAP-94-0042-L	Porum Public Works Authority	Muskogee	$350,000.00	11/01/1994	FA Loan	EXTENSION OF WATER LINES
1111	FAP-88-0040-L	Porum Public Works Authority	Muskogee	$730,000.00	01/10/1989	FA Loan	REFINANCE EXISTING DEBT
2429	FAP-02-0025-G	Sequoyah County Rural Water District #5	Sequoyah	$49,384.91	11/12/2002	Emergency	installing approximately 5,860 L.F. of 4-inch and
2181	FAP-98-0013-R	Sequoyah County Rural Water District #5	Sequoyah	$99,883.00	01/12/1999	REAP	constructing approximately 2 miles of 6-inch water
2594	FAP-86-0050-G	Sequoyah County Rural Water District #5	Sequoyah	$75,000.00	05/08/1990	Emergency	WATER TREATMENT PLANT, RAW WATER INTAKE, RAW WATER
1460	FAP-01-0013-L	Stilwell Area Development Authority	Adair	$2,760,000.00	03/12/2002	FA Loan	WATER SYSTEM IMPROVEMENTS
1371	ORF-98-0010-CW	Stilwell Area Development Authority	Adair	$4,000,000.00	08/10/1999	CWSRF	WASTEWATER SYSTEM IMPROVEMENTS
1268	FAP-93-0073-L	Stilwell Area Development Authority	Adair	$1,000,000.00	12/12/1995	FA Loan	WATER & SEWER SYSTEM IMPROVEMENTS
3530	ORF-09-0040-DW	Tahlequah Public Works Authority	Cherokee	$16,320,000.00	12/08/2009	DWSRF	Construct new water plant & appurtenances
2332	FAP-99-0081-R	Vian	Sequoyah	$59,500.00	11/16/1999	REAP	SEWER SYSTEM INFLOW/INFILTRATION EVALUATION SURVEY
3281	FAP-07-0006-G	Vian Public Works Authority	Sequoyah	$75,000.00	01/08/2008	Emergency	Water main repair
2102	FAP-97-0089-R	Vian Public Works Authority	Sequoyah	$150,000.00	06/10/2003	REAP	replacing approximately 1,150 LF of 12-inch line,
1391	ORF-98-0017-CW	Vian Public Works Authority	Sequoyah	$1,100,000.00	02/08/2000	CWSRF	WASTEWATER TREATMENT PLANT RENOVATIONS
2331	FAP-99-0080-R	Watts Public Works Authority	Adair	$99,800.00	11/16/1999	REAP	installing a 6" altitude valve with box and access
2131	FAP-97-0125-R	Watts Public Works Authority	Adair	$149,750.00	02/10/1998	REAP	WATER IMPROVEMENTS
2631	FAP-88-0053-G	Watts Public Works Authority	Adair	$85,000.00	07/16/1990	Emergency	WATER SYSTEM REPAIRS
2556	FAP-85-0129-G	Watts Public Works Authority	Adair	$10,000.00	02/12/1985	Emergency	
2207	FAP-98-0044-R	West Siloam Springs	Delaware	$96,350.00	03/14/2000	REAP	constructing approximately 4,400 linear feet of 8-
2816	FAP-94-0013-G	West Siloam Springs	Delaware	$18,315.00	07/12/1994	Emergency	
2536	FAP-84-0059-G	West Siloam Springs	Delaware	$100,000.00	06/10/1986	Emergency	
1470	FAP-01-0008-L	West Siloam Springs Municipal Authority	Delaware	$275,000.00	11/13/2001	FA Loan	CONSTRUCT FACILITIES TO SHIP WASTE TO SILOAM SPRIN
3115	FAP-05-0013-G	Westville Utility Authority	Adair	$100,000.00	10/11/2005	Emergency	New sewage lagoon system
1820	FAP-03-0019-R	Westville Utility Authority	Adair	$99,969.00	06/14/2005	REAP	SBR Treatment plant
1483	ORF-99-0020-CW	Westville Utility Authority	Adair	$430,400.00	12/11/2001	CWSRF	CONSTRUCT A SEWER CONNECTION AND LIFT STATION

FUNDING PROVIDED BY OWRB'S
FINANCIAL ASSISTANCE PROGRAM

Permits for Water Rights in the Illinois River Watershed Issued by the OWRB's Planning and Management Division in CY 2009

Permits Issued within the Illinois River Basin for Calendar Year 2007

			Diversion Point Legal												
Permit #	LASTNAME	FIRSTNAME	1/4	1/4	1/4	SECT	TWP	RNG	COUNTY	RATE	STREAM SYSTEM	DATE FILED	DATE ISSUED	PURPOSE	AMT (af/yr)
20060038	Carr	Richard B	NW	NW	SE	10	19N	25EI	Adair	350GPM	2-17	2006-07-25	2007-01-09	Irrigation	87.0
20070033	Illinois Farms Inc		NW	NW	SE	13	19N	25EI	Adair	600GPM	2-17	2007-05-08	2007-10-09	Irrigation	177.0

No new permits were issued for either surface water use or groundwater use.

Permits For Water Rights Issued by OWRB's Planning & Management Division

OKLAHOMA CONSERVATION COMMISSION

OKLAHOMA CONSERVATION COMMISSION
Program Activities in the Illinois River Watershed
For the Period August 2009 through September 2010

1.) Illinois River Supplemental - The OCC began its supplemental Illinois River project, the *Illinois River Watershed Riparian Protection Program,* in July of 2007. The intent of this project is to extend and compliment ongoing programs in the Illinois River watershed to reduce nonpoint source pollution and restore beneficial use support to waterbodies in the watershed. Objectives of the project are to:

- Implement practices in the Illinois River Watershed that will reduce nutrient loading to help meet load reduction goals set out in the watershed based plan currently under development. The draft Oklahoma plan sets an interim goal of 40% phosphorus load reduction (132,000 kg), followed by a long-term load reduction goal of 70 – 80%;
- Support the Oklahoma Conservation Reserve Enhancement Program (CREP) to protect riparian areas with the greatest potential to reduce nutrient loading;
- Provide technical assistance to producers in the development of total resource conservation plans; and
- Determine the effectiveness of the project through water quality monitoring and computer modeling to document current changes and predict the long-term effects of best management practice implementation.

OCC hired a project coordinator, Tashina Kirk, in May 2008. Tashina is a long time resident of the watershed and very familiar with its challenges. She conducted producer meetings to promote the project and sign up cooperators for priority cost-share of best management practice (BMP) implementation. As of August 2010, a total of $1,348,005 has been spent on installation of conservation practices, with $906,860 from federal 319 funding. In addition, a total of $1,520,868 has been obligated for further implementation of BMPs by 99 applicants.

Major BMPs implemented include septic system replacement, riparian area exclusion fencing, alternative watering facilities, animal feeding/waste storage facilities, and heavy use areas. Practices installed as of August 2010 include:

- 621.8 acres of riparian area exclusion including 36,783 linear feet of exclusion fencing
- 46 watering facilities, 9 water wells, 2 ponds, and 32,305 feet of pipeline
- 8 winter feeding facilities/ waste storage facilities
- 68 heavy use areas
- 61 septic system replacements

- 27,886 feet of cross fencing for pasture improvement

For more information concerning this project, please contact Tashina Kirk at 918-696-3563.

2.) Poultry Waste Transfer Program in the Illinois River and Eucha-Spavinaw Watersheds

The purpose of this project, which was begun in 2002 and has been supplemented multiple times since, is to protect water quality in the Illinois River and Eucha-Spavinaw watersheds by reducing land application of poultry waste through exportation. The latest iteration was launched in late 2007 and uses lessons learned from the previous program to help expand the poultry waste market. Now, buyers are eligible to receive $0.03/ton/mile, up to $8.00/ton, for poultry waste purchased from the Illinois River or Eucha/Spavinaw watersheds. Haulers and growers are not subsidized through this program, and buyers are responsible for locating their own sources and haulers of waste.

This revamped program is administered by local Conservation Districts, which ensure buyers complete the steps necessary to receive the subsidy. Conservation Districts who support the program are eligible to receive up to $1.00/ton for the waste that moves to their district. In return for these administrative fees, Conservation Districts process claims and advertise the program. It is believed that this subsidy will help encourage cash-strapped districts to strongly endorse the use of poultry waste as an alternative to commercial fertilizer. Many one-time users of poultry waste become repeat users; therefore, the intent of these subsidy programs is to get producers hooked on the economic and agronomic benefits of poultry waste such that they will continue to purchase it beyond the life of the subsidy. Through the latest federally-funded and now exclusively state-funded programs, a total of 95,682 tons of poultry waste have been moved out of the Illinois River and Eucha-Spavinaw Watersheds from October 2007 through November 2009. Approximately $325,000 federal and $288,000 state funds were spent to accomplish this effort. The supplemental FY 2008 Poultry Waste Transfer Program funded the movement of 70,682 tons of poultry waste from the Illinois River and Eucha-Spavinaw threatened watersheds from March 2008 to December 2009 (Figure 1).

Tons of Poultry Litter Transferred from Illinois River and Eucha/Spavinaw Watersheds to Non-Nutrient Limited Watersheds in Oklahoma

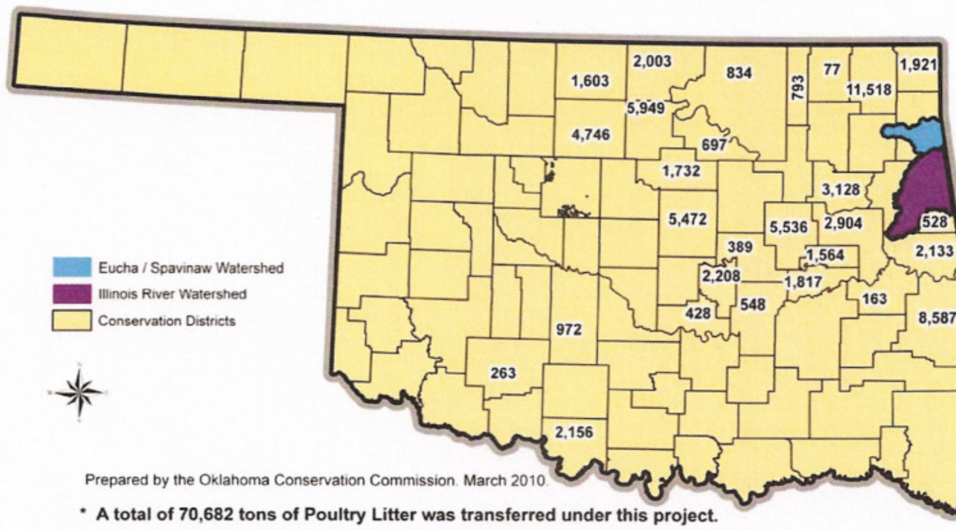


Figure 1. Poultry Litter Transferred from the Illinois River and Eucha-Spavinaw Watersheds.

3.) <u>Illinois River CREP</u> – In April 2007, Oklahoma and the Farm Services Agency (FSA) signed an agreement for a $20,652,500 Conservation Reserve Enhancement Program to protect 9,500 acres of riparian area in the Illinois River and Eucha-Spavinaw Watersheds. The CREP program provides incentives to farmers and ranchers to remove streamside pasture or cropland from production activities for at least fifteen years. In return, the landowners are reimbursed for the cost of installing practices such as alternative water supplies for livestock, fencing, grass planting, stream crossings, and winter feeding facilities. The landowners also receive an annual rental payment for the fifteen-year period based on the average area rental rate, a signing bonus payment, and an annual practice maintenance payment.

The program began with the hiring of three conservation plan writers and one conservation plan writer/water quality specialist. Producer sign-ups for the Oklahoma CREP began June 1, 2007 and were facilitated by conservation district outreach meetings in the counties in which the program operates, including Adair, Cherokee, Delaware, and Sequoyah Counties. A media signing event for the first CREP contract occurred in Tahlequah on October 26, 2007. As of September 2010, CREP has a total of 74 contracts, of which 34 of these contracts are in the Illinois River Watershed. Currently, CREP has a total of 731 acres contracted. A total of 325 acres are contracted in the Illinois River watershed, and 406 acres are contracted in the Eucha-Spavinaw Watershed.

CREP has installed approximately 16,188 linear feet of the 62,632 linear feet of riparian fencing scheduled in the Illinois River watershed. In addition, 16,242 of the 42,055 scheduled bare root seedling trees have been planted. Additional work completed in the Illinois River watershed includes a pond and a heavy use area. As of September 2010, $727,955 is scheduled to be spent, which includes $59,921 in landowner contributions. For more information concerning the CREP program, please contact Gina Levesque, CREP Program Coordinator, at 918-456-1919.

4.) Monitoring

CREP and Illinois River Supplemental

To evaluate the effects of BMP implementation on stream water quality resulting from CREP and the Illinois River Watershed Projects, OCC initiated automated water sampler monitoring plan in the spring of 2007 at key locations in the program area (Figure 2 and Table 1). The monitoring design follows methods employed for the Peacheater National Monitoring Program and the Beaty Creek 319 Project, which utilized a paired watershed monitoring scheme. Use of autosamplers allows for a continuous assessment of both a true average concentration of constituents in the stream water and continuous discharge data, both crucial to accurate calculation of loading estimates necessary to account for changes in the water quality brought about in relatively short project timeframes. Routine physico-chemical, instream habitat, and biological sampling are also conducted at monitoring sites. Data from this monitoring program will be used to evaluate changes in key parameters (particularly nutrients) over time throughout the fifteen year lifespan of the CREP program.

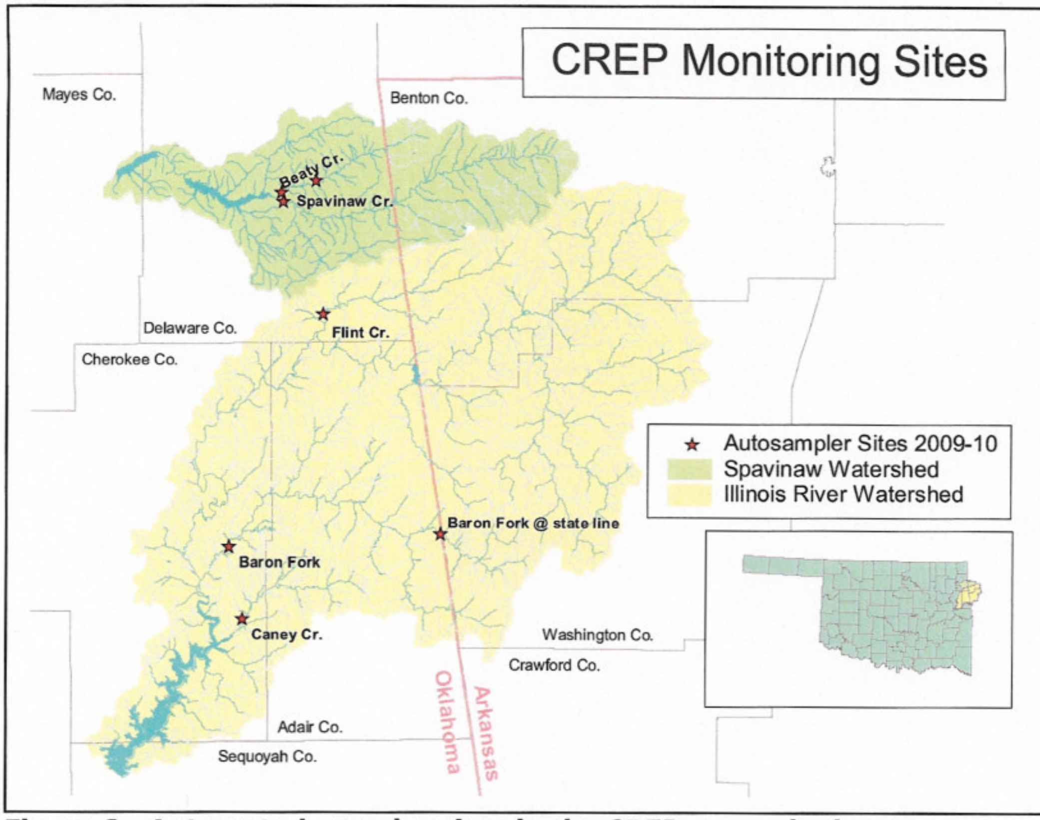


Figure 2. Automated sampler sites in the CREP watershed area.

Table 1. OCC autosampler locations in the Illinois River watershed and control watershed.

SiteName	Watershed	Latitude	Longitude	County
Flint Creek	Illinois	36.1961	-94.7078	Delaware
Baron Fork @ Welling	Illinois	35.8933	-94.8657	Cherokee
Baron Fork @ State line	Illinois	35.9062	-94.5191	Adair
Caney Creek	Illinois	35.7982	-94.8433	Cherokee
Little Saline Creek	Reference	36.2796	-95.0710	Mayes
Saline Creek	Reference	36.2820	-95.0929	Mayes

Rotating Basin Monitoring Program

In the late 1990s, the OCC, in cooperation with sister agencies and working through the Water Quality Monitoring Council, agreed to coordinate efforts to ensure that all complete USGS eleven digit (i.e., HUC 11) watersheds across the state were monitored in a five year rotation. This endeavor, known as the Rotating Basin Monitoring Program (RBMP), comprises a significant component of Oklahoma's ambient monitoring effort for streams. The purpose of this program is to collect routine water quality (physical and chemical), instream habitat, and biological (fish and benthic macroinvertebrates) data in support of federal mandates to assess state waters regarding their attainment/nonattainment of water quality standards. It serves a dualistic role in fulfilling NPS Program requirements for an *NPS Assessment Report,* as data are analyzed and submitted biannually to the ODEQ for compilation in the state's Integrated Report. Figure 3 shows the basin schedule and statewide distribution of sites sampled for the RBMP, two of which fall in the Illinois River watershed as part of Basin Year 3 (Table 2). OCC began the second iteration of sampling for these and other Year 3 sites in May 2008 and completed the second cycle of monitoring in this basin in April 2010.

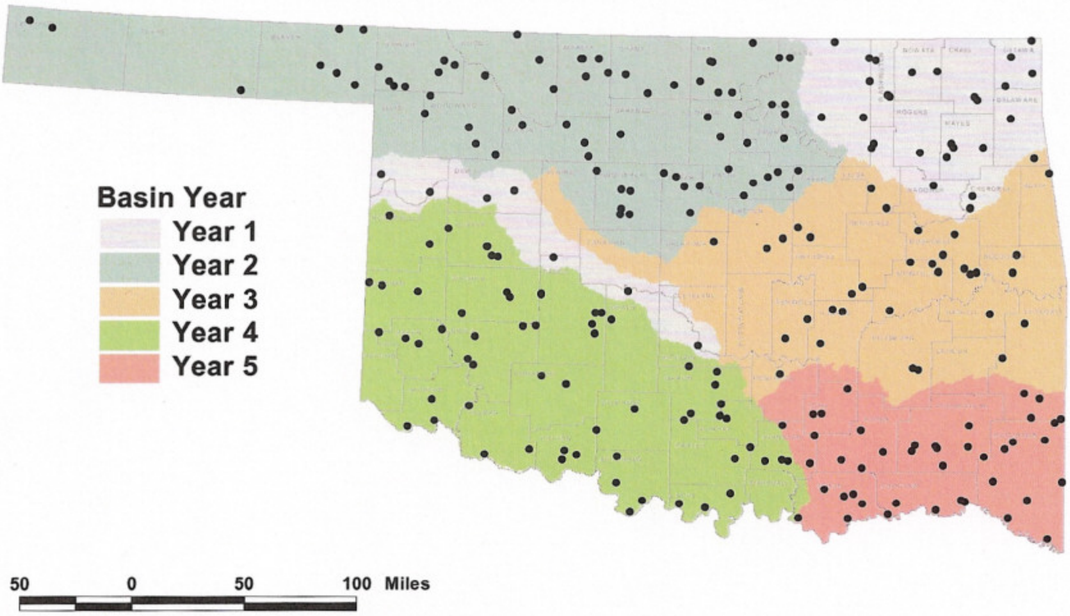


Figure 3. Basin schedule and statewide distribution of Rotating Basin Monitoring Program sites.

Table 2. RBMP monitoring sites in the Illinois River watershed.

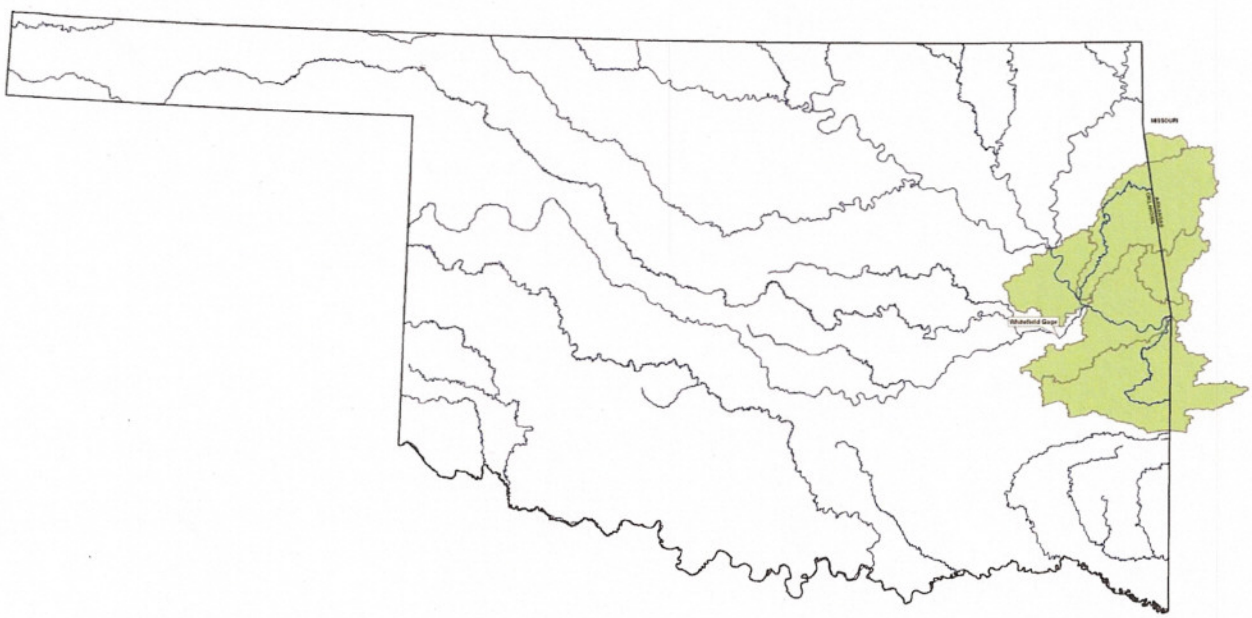
Basin Year	Site Name	Lat	Long	Legal Description	County
RB Year 3	Ballard Creek: Lower	36.10627778	-94.56463889	NW¼ SW¼ SW¼ Section 20 19N 26E	Adair
RB Year 3	Battle Creek: Battle Branch	36.2104167	-94.68436111	SW¼ NE¼ SW¼ Section 18 20N 25E	Delaware

INTRODUCTION

Arkansas-Oklahoma Arkansas River Compact Commission

Draft

Environmental Committee Report



September 23, 2010

INTRODUCTION

This document is a compilation of data that has been collected within the Arkansas/Oklahoma Arkansas River Compact area. Items included for review;

	Introduction
	Water Quality Trends at Different Flow Regimes
	OWRB Beneficial Use Monitoring Program - Streams/Rivers
	OWRB Beneficial Use Monitoring Program – Lakes/Reservoirs
	Compact Waters included in the Oklahoma Water Quaity Integrated Report – 303(d)
	Water Quality Standards Revisions Relevant to the Arkansas-Oklahoma Compact Commission Area
	TMDL's Completed in the Compact Area
	Oklahoma's Phosphorus Loading Report for the Illinois River Basin
	Funding Provided by OWRB's Financial Assistance Program
	Permits Issued for Water Rights in the Illinois River Watershed
	Oklahoma Conservation Commission Efforts in the Illinois River Watershed

Table 1. Data from Oklahoma's Six Scenic Rivers collected subsequent to standards approval by EPA were evaluated following the new rule.

Site	% Monthly determinations exceeding 0.037 criterion	Beneficial use support status
Illinois River near Tahlequah	93%	Not supporting
Illinois River near Chewey	100%; High flow monitoring data are minimal	Not supporting
Illinois River near Watts	100%	Not supporting
Flint Creek near Flint, OK	100%	Not supporting
Barren Fork near Eldon	40%	Not supporting
Lee Creek, SH 101, near Short	0%; High flow monitoring data are minimal.	Supporting, but high flow monitoring data are minimal.
Mountain Fork near Smithville	9.5%; High flow monitoring data are minimal.	Supporting, but high flow monitoring data are minimal.

Table 2. Waters Listed on Oklahoma's 2008 303(d) List

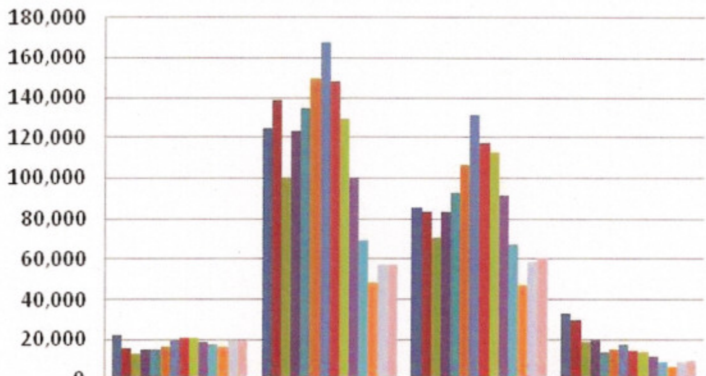
Impaired Waters in the Illinois River Basin

OKWBID	Name	Listed on 303(d) for Impairements
121700020020	Tenkiller Ferry Lake	Chlorophyl a,Dissolved Oxygen, TP, added as an NLW in the OWQS
121700020110	Chicken Creek	Fish Bioassessment
121700020220	Tenkiller Ferry Lake, Illinois River Arm	Dissolved Oxygen, chlorophyll-a, added as an NLW in the OWQS
121700030010	Illinois River – Tahlequah	TP,Enterococcus
121700030040	Tahlequah Creek (Town Branch)	*Eschericia coli*
121700030080	Illinois River	TP, Lead, *Eschericia coli*, Fecal Coliform
121700030280	Illinois River – Chewey Bridge	TP
121700030290	Flint Creek	TP,Dissolved Oxygen
121700030350	Illinois River – Watts	TP,Turbidity,Enterococcus
121700030370	Ballard Creek	Enterococcus
121700040010	Caney Creek	Enterococcus
121700050010	Illinois River - Baron Fork	TP, Enterococcus
121700050090	Tyner Creek	Enterococcus
121700050120	Peacheater Creek	Enterococcus
121700060010	Flint Creek	TP,Enterococcus
121700060040	Battle Creek (Battle Branch)	Enterococcus
121700060080	Sager Creek	Enterococcus, Nitrates

Other Notable Impaired Waters in the Compact Area

OKWBID	Name	Listed on 303(d) for Impairements
220100010010	Poteau River (Below Wister)	Silver, Cadmium, Copper, Lead, Selenium, Turbidty, Enterococcus
220100020020	Wister Lake	Chlorophyll-a, pH, Dissolved Oxygen, Turbidity TP, Color, listed as an NLW in the OWQS
220200050010	Lee Creek	Lead, Dissolved Oxygen, Total Phosphorus, Enterococcus
220200050010	Little Lee Creek	Total Phosphorus, Enterococcus

Average Annual Total P Loading in Kilograms per Year (excluding targeted high flows)



	Flint Creek near Kansas	Illinois River near Watts	Illinois River near Tahlequah	Barren Fork near Eldon
Total P 80-93	22,279	124,832	85,235	33,001
Total P 93-97	15,705	138,508	83,799	29,482
Total P 94-98	12,986	99,898	70,546	19,163
Total P 95-99	14,949	123,581	83,632	19,257
Total P 96-00	15,103	134,986	92,876	13,163
Total P 97-01	15,992	149,927	106,797	14,548
Total P 98-02	19,259	167,987	131,491	17,603
Total P 99-03	20,620	148,151	117,524	14,059
Total P 00-04	21,004	129,533	112,341	13,685
Total P 01-05	19,098	100,347	91,325	11,465
Total P 02-06	17,415	69,482	67,345	8,500
Total P 03-07	15,977	48,448	47,216	5,716
Total P 04-08	19,356	56,951	58,605	8,574
Total P 05-09	19,586	57,275	60,827	9,195

Values represent all available data, which is routinely collected and excludes targeted high flow events.

Water Quality Trends at Different Flow Regimes

Trend analyses were performed for total phosphorus concentrations at four BUMP permanent monitoring stations in the Arkansas River Compact area (Table 1). Using the Seasonal Kendall, a series of trends were calculated for each station including all total phosphorus data from 1993-2009, all total phosphorus data from 1999-2009, total phosphorus concentrations measured at higher flows from 1999-2009, and total phosphorus concentrations measured at lower flows from 1999-2009. Furthermore, for each data set, a trend was calculated using both unadjusted total phosphorus data and flow-adjusted total phosphorus data. Graphical representations of these trends are not presented but may be obtained by contacting Monty Porter with the OWRB at 405-530-8933. Some general conclusions may be drawn from the data set.

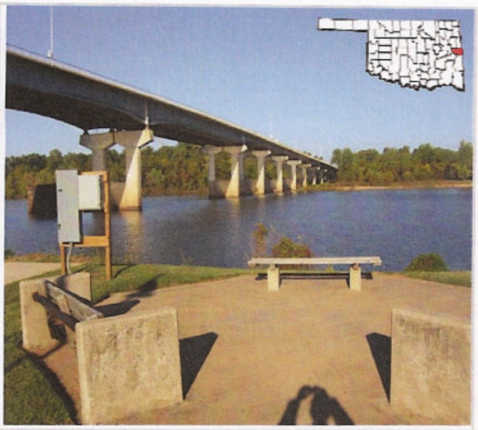
1. When considering all total phosphorus data with a period of record (POR) beginning in 1993, only Flint Creek near Kansas demonstrated a highly significant upward trend for both tests. Conversely, the Illinois River had a highly significant downward trend at Watts with no significant trend at Tahlequah. Notably, the Barren Fork River showed mixed results depending on the test, with a slightly significant upward trend for unadjusted values.
2. Likewise, when all data from 1999-2008 are analyzed, all stations but Kansas show a highly significant downward or no significant trend in total phosphorus concentrations. The Kansas data demonstrate a highly significant upward trend.
3. All stations but Kansas show a highly to moderately significant downward or no significant trend when only higher flow total phosphorus concentrations are considered. The Kansas data demonstrate a slightly significant upward trend for only unadjusted data.
4. All stations but Kansas show a highly significant downward or no significant trend in total phosphorus concentrations when only lower flow data are analyzed. Conversely, the Kansas data demonstrate a highly significant upward trend in total phosphorus concentration at lower flows.

Table 1. Trends calculated for total phosphorus concentrations at certain BUMP permanent monitoring stations in the Compact area. (Boxes shaded in yellow represent changes from the 2009 report, and 2009 results are in superscript.)

Station	All Data (1993-2009)		All Data (1999-2009)		Higher Flow Data (1999-2009)		Lower Flow Data (1999-2009)	
	Unadj	Flow Adj	Unadj	Flow Adj	Unadj	Flow Adj	Unadj	Flow Adj
Illinois River near Watts	↓↓↓	↓↓↓	↓↓↓	↓↓↓	↓↓↓	↓↓↓	↓↓↓	↓↓↓
Illinois River near Tahlequah	NT	NT	↓↓↓	↓↓↓	$\downarrow^{(\downarrow\downarrow\downarrow)}$	↓↓↓	↓↓↓	↓↓↓
Flint Creek near Kansas	↑↑↑	↑↑↑	↑↑↑	↑↑↑	$\uparrow^{(\uparrow\uparrow)}$	NT	↑↑↑	↑↑↑
Barren Fork near Eldon	$\uparrow^{(NT)}$	NT	NT	$\downarrow\downarrow\downarrow^{(NT)}$	NT	$\downarrow\downarrow^{(NT)}$	NT	NT

↓↓↓ = Decreasing Trend at the 95% Confidence Level
↑↑↑ = Increasing Trend at the 95% Confidence Level
↓↓ = Decreasing Trend at the 90% Confidence Level
↑ = Increasing Trend at the 80% Confidence Level
↓ = Decreasing Trend at the 80% Confidence Level
NT = No Signficant Trend

Arkansas River at Moffett



Sample Record	Times Visited	Station ID
November 1998 - Current	83	220200010010-001AT

Stream Data			
County	Sequoyah	View Site Data
Location	East of the Town of Moffett on State Highway 64	
Latitude/Longitude	35.39242903, -94.43267795	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110104)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	18.5	18.5	5.4/31.9	
In-Situ	Turbidity (NTU)	27	22	12/51	
In-Situ	pH (units)	7.96	7.90	7.39/8.60	
In-Situ	Dissolved Oxygen (ppm)	9.79	9.70	6.60/14.0	
In-Situ	Hardness (ppm)	189.7	148.5	39.0/658.0	
Minerals	Total Dissolved Solids (ppm)	406.9	358.4	127.0/1082.0	16.3% of values> OWQS of 620
Minerals	Specific Conductivity (uS)	623.6	551.5	195.0/1690.0	
Minerals	Chloride (ppm)	94.9	81.1	20.9/293.0	
Minerals	Sulfate (ppm)	46.2	43.3	22.3/99.1	
Nutrients	Total Phosphorus (ppm)	0.128	0.127	0.052/0.227	
Nutrients	Nitrate/Nitrite (ppm)	0.321	0.303	0.010/0.843	
Nutrients	Chlorophyll A (mg/m^3)	11.3	8.4	3.2/34.7	TSI=54.4
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	80.1*	30.0	<10/10100	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	33.9*	10.0	<10/12000	Mean> OWQS of 33
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	24.6*	10.0	<10/2035	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	S	S	S	S						S	S	S
Aesthetics												NEI
Agriculture					S		S	NS				
Primary Body Contact Recreation									NS			
Public & Private Water Supply				S		S			S			
Fish Consumption				NS								

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Fish consumption not supporting for Thallium*

Arkansas River at Muskogee

Sample Record	Times Visited	Station ID
November 1998 - Current	76	121400010260-001AT

Stream Data

County	Muskogee	View Site Data
Location	East of the Town of Muskogee on State Highway 62	
Latitude/Longitude	35.77016066, -95.30031102	
Planning Watershed	Middle Arkansas (8-digit HUC - 11110102)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	18.2	17.6	5.7/32.4	
In-Situ	Turbidity (NTU)	21	17	6/79	
In-Situ	pH (units)	8.08	8.12	7.44/8.74	
In-Situ	Dissolved Oxygen (ppm)	9.27	9.42	4.53/13.88	
Minerals	Hardness (ppm)	169.1	150.5	104.0/306.0	
Minerals	Total Dissolved Solids (ppm)	515.9	320.5	160.7/1580.0	35.7% of values> OWQS of 516
Minerals	Specific Conductivity (uS)	844.9	532.4	231.1/2462.0	
Minerals	Chloride (ppm)	156.7	100.2	11.3/624.0	40.0% of Values> OWQS of 135
Minerals	Sulfate (ppm)	58.7	47.3	28.5/140.0	
Nutrients	Total Phosphorus (ppm)	0.148	0.141	0.088/0.266	
Nutrients	Nitrate/Nitrite (ppm)	0.440	0.405	0.050/0.980	
Nutrients	Chlorophyll A (mg/m^3)	20.6	15.5	0.10/90.0	TSI=60.3
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	138.1*	100.0	<10/17000	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	80.2*	50.0	<10/75000	Mean> OWQS of 33
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	45.9*	31.0	<10/5492	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	S	S	S	S						S	S	S
Aesthetics												S
Agriculture					S		NS	NS				
Primary Body Contact Recreation									NS			
Public & Private Water Supply				S		S			S			
Fish Consumption				NS								

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Fish consumption not supporting for Thallium*

Barren Fork at Eldon

Sample Record	Times Visited	Station ID
November 1998 - Current	188	121700050010-001AT

Stream Data			
	County	Cherokee	View Site Data
	Location	South of the Town of Eldon on State Highway 51	
	Latitude/Longitude	35.92173377, -94.83726494	
	Planning Watershed	Lower Arkansas (8-digit HUC - 11110103)	

Parameters	Parameter *(Descriptions)*	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	17.3	17.7	6.2/27.43	
	Turbidity (NTU)	3	2	1/8	
	pH (units)	7.65	7.70	6.37/8.56	
	Dissolved Oxygen (ppm)	9.69	9.64	4.40/15.00	
	Hardness (ppm)	98.7	98.0	53.0/150.0	
Minerals	Total Dissolved Solids (ppm)	124.0	128.0	69.6/159.0	
	Specific Conductivity (uS)	194.5	199.5	91.0/246.0	
	Chloride (ppm)	<10.0	<10.0	<10.0	
	Sulfate (ppm)	10.2	<10.0	<10.0/14.0	
Nutrients	Total Phosphorus (ppm)	0.070	0.031	0.005/0.920	See Notes
	Nitrate/Nitrite (ppm)	1.195	1.240	0.150/2.790	
	Chlorophyll A (mg/m^3)	1.8	1.0	0.1/11.7	TSI=36.3
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	43.3*	40.0	<10/2000	
	Enterococcus (cfu/100ml)(*-Geo. Mn.)	31.2*	20.0	<10/2000	
	E. Coli (MPN/100ml)(*-Geo. Mean)	24.9*	20.0	4/389	

Beneficial Uses: *Click to learn more about Beneficial Uses*	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment	Total Phosphorus
Fish & Wildlife Propagation	S	S	S	S						S	S	S	
Aesthetics												NS	NS
Agriculture					S		S	S					
Primary Body Contact Recreation									S				
Public & Private Water Supply				S		S			S				
Fish Consumption				S									

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *40.0%(22 of 55) of 3-month rolling Geo. Mean exceed OWQS criterion of 0.037 ppm*

Caney Creek at Barber

Sample Record	Times Visited	Station ID
September 1999 - Current	120	121700040010-001AT

Stream Data			
	County	Cherokee	View Site Data
	Location	North of the Town of Barber off State Highway 100	
	Latitude/Longitude	35.72381643, -94.85787184	
	Planning Watershed	Lower Arkansas (8-digit HUC - 11110103)	

Parameters		Parameter (Descriptions)	Mean	Median	Range	Comments
	In-Situ	Water Temperature (C°)	17.9	17.6	5.1/27.6	
	In-Situ	Turbidity (NTU)	2	1	1/5	
	In-Situ	pH (units)	7.72	7.70	6.40/9.06	
	In-Situ	Dissolved Oxygen (ppm)	9.54	9.38	5.40/15.60	
	In-Situ	Hardness (ppm)	109.3	109.5	54.0/174.0	
	Minerals	Total Dissolved Solids (ppm)	140.6	136.8	89.6/237.0	
	Minerals	Specific Conductivity (uS)	219.8	221.0	112.0/292.0	
	Minerals	Chloride (ppm)	<10.0	<10.0	<10.0/10.2	
	Minerals	Sulfate (ppm)	10.1	10.0	<10.0/12.0	
	Nutrients	Total Phosphorus (ppm)	0.081	0.039	0.005/1.060	
	Nutrients	Nitrate/Nitrite (ppm)	0.815	0.870	0.130/1.800	
	Nutrients	Chlorophyll A (mg/m^3)	1.4	0.7	0.0/12.1	TSI=34.03
	Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	37.8*	30.0	<10.0/1170.0	
	Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	27.7*	20.0	<10.0/1408.0	
	Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	25.4*	20.0	<10.0/2382.0	

Beneficial Uses	Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
	Fish & Wildlife Propagation	S	S	S	S						S	S	S
	Aesthetics												S
	Agriculture					S		S	S				
	Primary Body Contact Recreation									S			
	Public & Private Water Supply				S		S			S			
	Fish Consumption				S								

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NEI = Not Enough Information

Notes

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Flint Creek at Flint

Sample Record	Times Visited	Station ID
November 1998 - Current	144	121700060010-001AT

Stream Data

County	Delaware	View Site Data
Location	North of the Town of Flint on county road	
Latitude/Longitude	36.1867733, -94.70680493	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110103)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	16.7	16.9	5.3/27.5	
In-Situ	Turbidity (NTU)	1	1	1/4	
In-Situ	pH (units)	7.69	7.70	6.62/8.70	
In-Situ	Dissolved Oxygen (ppm)	9.55	9.30	5.28/13.50	
In-Situ	Hardness (ppm)	119.3	120.0	87.0/210.0	
Minerals	Total Dissolved Solids (ppm)	188.6	192.3	83.8/254.7	
Minerals	Specific Conductivity (uS)	282.1	285.8	109.0/398.0	
Minerals	Chloride (ppm)	15.5	14.6	<10.0/26.4	
Minerals	Sulfate (ppm)	18.6	18.4	<10.0/32.2	
Nutrients	Total Phosphorus (ppm)	0.235	0.197	0.007/1.060	See Notes
Nutrients	Nitrate/Nitrite (ppm)	3.109	3.010	1.590/4.830	
Nutrients	Chlorophyll A (mg/m^3)	0.9	0.7	0.0/4.2	TSI=29.9
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	81.2*	70.0	<10/6400	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	46.7*	41.0	<10/5475	Mean> OWQS of 33
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	36.8*	31.0	<10/4611	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment	Total Phosphorus
Fish & Wildlife Propagation	S	S	S	S						S	S	S	
Aesthetics												S	NS
Agriculture					S		S	S					
Primary Body Contact Recreation									NS				
Public & Private Water Supply				S					S				
Fish Consumption				S									

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *100%(54 of 54) of rolling Geo. Mean exceed OWQS criterion of 0.037 ppm*

Fourche-Maline Creek at Red Oak

Sample Record	Times Visited	Station ID
November 1998 - Current	130	220100040020-001AT

Stream Data

County	Latimer	View Site Data
Location	S.E. of the Town of Red Oak off US Highway 270	
Latitude/Longitude	34.91232472, -95.15608416	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110105)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	17.9	19.2	1.1/31.6	
In-Situ	Turbidity (NTU)	27	26	5/91	
In-Situ	pH (units)	7.29	7.22	6.07/8.47	
In-Situ	Dissolved Oxygen (ppm)	6.63	6.32	1.61/12.72	23.29% of values> OWQS of 5.00
Minerals	Hardness (ppm)	48.1	43.5	19.0/155.0	
Minerals	Total Dissolved Solids (ppm)	93.8	88.2	35.0/203.5	
Minerals	Specific Conductivity (uS)	143.5	133.0	38.0/318.0	
Minerals	Chloride (ppm)	11.1	10.0	0.0/22.3	
Minerals	Sulfate (ppm)	22.6	22.8	0.0/37.2	
Nutrients	Total Phosphorus (ppm)	0.082	0.069	0.005/0.297	
Nutrients	Nitrate/Nitrite (ppm)	0.136	0.120	0.050/0.330	
Nutrients	Chlorophyll A (mg/m^3)	No Data	No Data	No Data	
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	129.3*	90.0	<10/54000	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	115.8*	97.5	<10/8000	Mean> OWQS of 33
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	88.5*	82.0	<10/80000	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	S	S	NS	NS						S	S	S
Aesthetics												S
Agriculture					S		S	S				
Primary Body Contact Recreation									NS			
Public & Private Water Supply				S		S			S			
Fish Consumption				NS								

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NS = Not Supporting
NEI = Not Enough Information

Notes

Fish and Wildlife Propagation not supporting for Lead
Fish Consumption not supporting for Lead

Illinois River at Tahlequah

Sample Record	Times Visited	Station ID
November 1998 - Current	154	121700030010-001AT

Stream Data			
County	Cherokee	View Site Data
Location	East of the town of Tahlequah on US Highway 62	
Latitude/Longitude	35.92606447, -94.92380373	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110103)	

Parameters	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	17.5	18.3	5.01/29.4	
	Turbidity (NTU)	4	3	1/14	
	pH (units)	7.79	7.80	6.47/8.77	
	Dissolved Oxygen (ppm)	9.49	9.10	5.20/15.44	
Minerals	Hardness (ppm)	114.9	116.5	73.0/155.0	
	Total Dissolved Solids (ppm)	174.2	178.0	42.0/230.4	
	Specific Conductivity (uS)	263.9	273.0	66.0/360.0	
	Chloride (ppm)	13.6	12.0	<10.0/23.5	
	Sulfate (ppm)	16.2	14.7	<10.0/47.9	
Nutrients	Total Phosphorus (ppm)	0.121	0.086	0.005/0.640	See Notes
	Nitrate/Nitrite (ppm)	1.455	1.425	0.300/3.450	
	Chlorophyll A (mg/m^3)	3.2	2.2	0.2/14.2	TSI=42.1
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	57.1*	50.0	<10.0/1000.0	
	Enterococcus (cfu/100ml)(*-Geo. Mn.)	28.6*	20.0	<10.0/1100.0	
	E. Coli (MPN/100ml)(*-Geo. Mean)	20.7*	10.0	<10.0/683.0	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment	Total Phosphorus
Fish & Wildlife Propagation	S	S	S	S						S	S	S	
Aesthetics												S	NS
Agriculture					S		S	S					
Primary Body Contact Recreation									S				
Public & Private Water Supply				S									
Fish Consumption				S									

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Notes: *93.0%(50 of 54) of 3-month rolling Geo. Mean above OWQS Criterion of 0.037 ppm*

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Illinois River at Watts

Sample Record	Times Visited	Station ID
November 1998 - Current	149	121700030350-001AT

Stream Data

County	Adair	View Site Data
Location	North of the Town of Watts on US Highway 59	
Latitude/Longitude	36.12994064, -94.57151225	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110103)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	17.0	17.1	4.3/31.0	
In-Situ	Turbidity (NTU)	6	5	2/24	11.5% of values> OWQS of 10
In-Situ	pH (units)	7.76	7.80	6.20/8.86	
In-Situ	Dissolved Oxygen (ppm)	9.95	9.50	6.35/18.88	
In-Situ	Hardness (ppm)	127.6	130.0	76.0/215.0	
Minerals	Total Dissolved Solids (ppm)	201.8	206.0	93.4/286.7	
Minerals	Specific Conductivity (uS)	299.9	305.0	132.0/448.0	
Minerals	Chloride (ppm)	15.9	13.6	<10.0/28.3	
Minerals	Sulfate (ppm)	17.0	16.0	<10.0/27.3	
Nutrients	Total Phosphorus (ppm)	0.153	0.120	0.011/0.680	See Notes
Nutrients	Nitrate/Nitrite (ppm)	2.117	1.960	0.880/3.960	
Nutrients	Chlorophyll A (mg/m^3)	2.8	1.9	0.0/9.5	TSI=39.8
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	74.4*	50.0	<10.0/11740	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	40.5*	20.0	<10.0/15531	Mean> OWQS of 31
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	35.9*	20.0	<10.0/12997	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment	Total Phosphorus
Fish & Wildlife Propagation	NS	S	S	S						S	S	S	
Aesthetics												S	NS
Agriculture					S		S	S					
Primary Body Contact Recreation									NS				
Public & Private Water Supply				S					S				
Fish Consumption				S									

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NEI = Not Enough Information

Notes: *100%(53 of 53) of rolling Geo. Mean exceed OWQS criterion of 0.037 ppm*

Sampling and Assessment by the **Oklahoma Water Resources Board** – 3800 Classen Blvd, Oklahoma City, OK, 73118 – 405.530.8800 – http://www.owrb.ok.gov

Lee Creek at Short

Sample Record	Times Visited	Station ID
January 2003 - Present	94	220200050010-001AT

Stream Data		
County	Sequoyah	View Site Data
Location	West of the town of Short on State Highway 101	
Latitude/Longitude	35.56589868, -94.53152717	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110104)	

Parameters	Parameter *(Descriptions)*	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	17.3	16.2	1.7/30.8	
	Turbidity (NTU)	5	4	1/20	
	pH (units)	7.61	7.60	6.31/8.60	
	Dissolved Oxygen (ppm)	8.89	8.92	3.80/13.94	
	Hardness (ppm)	40.0	37.5	14.0/85.0	
Minerals	Total Dissolved Solids (ppm)	53.5	56.0	20.0/104.0	
	Specific Conductivity (uS)	84.3	89.0	31.3/161.0	
	Chloride (ppm)	<10.0	<10.0	<10.0	
	Sulfate (ppm)	11.0	<10.0	<10.0/49.0	
Nutrients	Total Phosphorus (ppm)	0.016	0.016	0.005/0.053	See Notes
	Nitrate/Nitrite (ppm)	0.117	0.060	0.050/0.390	
	Chlorophyll A (mg/m^3)	3.0	0.9	0.1/92.0	TSI=41.5
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	32.8*	21.5	4.0/3600.0	
	Enterococcus (cfu/100ml)(*-Geo. Mn.)	31.9*	<10.0	<10.0/7100.0	
	E. Coli (MPN/100ml)(*-Geo. Mean)	27.4*	19.0	2.0/2359.0	

Beneficial Uses: *Click to learn more about Beneficial Uses*	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment	Total Phosphorus
Fish & Wildlife Propagation	S	S	S	NS						S	S	S	
Aesthetics												S	S
Agriculture					S		S	S					
Primary Body Contact Recreation									S				
Public & Private Water Supply				S									
Fish Consumption				S									

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NS = Not Supporting
NEI = Not Enough Information

Notes
0.0%(0 of 52) of 3-month rolling Geo. Mean exceed OWQS of 0.037 ppm
Fish & Wildlife Propagation not supporting for Lead

Little Lee Creek at Nicut

Sample Record	Times Visited	Station ID
February 2008 - Current	21	220200050040-001AT

Stream Data

County	Sequoyah	View Site Data
Location	West of the town of Short on State Highway 101	
Latitude/Longitude	35.58, -94.56	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110104)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	14.5	12.8	0.3/30.2	
	Turbidity (NTU)	5	4	1/15	
	pH (units)	7.68	7.71	6.30/8.35	
	Dissolved Oxygen (ppm)	10.00	10.18	5.01/12.98	
	Hardness (ppm)	56.8	53.5	41.0/80.0	
Minerals	Total Dissolved Solids (ppm)	75.7	78.0	52.0/97.0	
	Specific Conductivity (uS)	121.7	126.0	81.0/159.0	
	Chloride (ppm)	<10	<10.0	<10.0	
	Sulfate (ppm)	<10	<10.0	<10.0	
Nutrients	Total Phosphorus (ppm)	0.025	0.007	0.005/0.250	
	Nitrate/Nitrite (ppm)	0.097	0.050	0.020/0.260	
	Chlorophyll A (mg/m^3)	0.6	0.3	0.1/2.1	TSI=26.0
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	43.3*	50.0	<10.0/380.0	
	Enterococcus (cfu/100ml)(*-Geo. Mn.)	22.1	<10.0	<10.0/529.0	
	E. Coli (MPN/100ml)(*-Geo. Mean)	71.7*	40.0	<10.0/6488.0	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment	Total Phosphorus
Fish & Wildlife Propagation	S	S	S	NEI						S	S	S	
Aesthetics												S	NEI
Agriculture					S		S	S					
Primary Body Contact Recreation									NEI				
Public & Private Water Supply				NEI					NEI				
Fish Consumption				NEI									

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes

Poteau River at Heavener

Sample Record	Times Visited	Station ID
November 1998 - Current	100	220100020010-001AT

Stream Data

County	LeFlore	View Site Data
Location	South of the Town of Heavener on State Highway 59	
Latitude/Longitude	34.85833476, -94.62923436	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110105)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	19.2	20.1	4.5/34.9	
	Turbidity (NTU)	14	12	0/46	
	pH (units)	7.41	7.40	6.02/8.97	
	Dissolved Oxygen (ppm)	8.08	7.44	4.00/16.00	
	Hardness (ppm)	42.8	33.7	1.5/170.0	
Minerals	Total Dissolved Solids (ppm)	86.5	68.9	16.1/306.6	
	Specific Conductivity (uS)	136.0	106.5	25.2/479.0	
	Chloride (ppm)	14.6	<10.0	<10.0/105.0	
	Sulfate (ppm)	36.4	24.4	13.5/136.0	
Nutrients	Total Phosphorus (ppm)	0.076	0.063	0.011/0.290	
	Nitrate/Nitrite (ppm)	0.161	0.100	0.000/0.490	
	Chlorophyll A (mg/m^3)	6.4	6.4	3.4/9.5	TSI=48.9
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	103.7*	85.0	<10.0/10000	
	Enterococcus (cfu/100ml)(*-Geo. Mn.)	28.1*	20.0	<10.0/400.0	
	E. Coli (MPN/100ml)(*-Geo. Mean)	51.8*	41.0	<10.0/9200.0	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	S	S	S	NS						S	S	S
Aesthetics												NEI
Agriculture					S		S	S				
Primary Body Contact Recreation									S			
Public & Private Water Supply				S		S			S			
Fish Consumption				NS								

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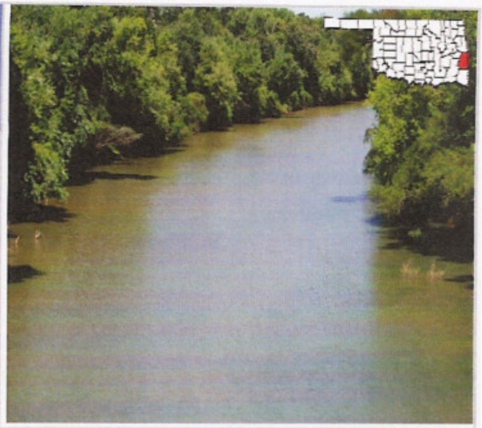
NS = Not Supporting
NEI = Not Enough Information

Notes

Fish and Wildlife Propagation not supporting for Lead
Fish consumption not supporting for Lead

Poteau River at Pocola



Sample Record	Times Visited	Station ID
November 1998 - Current	84	220100010010-001AT

Stream Data

County	LeFlore	View Site Data
Location	West of the Town of Pocola on County Road E 1220	
Latitude/Longitude	35.23864842, -94.52021262	
Planning Watershed	Lower Arkansas (8-digit HUC -11110105)	

Parameters

	Parameter (Descriptions)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	19.1	22.1	1.5/31.9	
In-Situ	Turbidity (NTU)	56	46	12/144	42.9% of values >OWQS of 50
In-Situ	pH (units)	7.49	7.56	5.96/8.99	
In-Situ	Dissolved Oxygen (ppm)	7.83	7.24	4.13/15.22	
Minerals	Hardness (ppm)	53.2	46.5	14.1/414.0	
Minerals	Total Dissolved Solids (ppm)	93.7	89.5	18.0/207.0	
Minerals	Specific Conductivity (uS)	146.2	138.7	29.0/319.0	
Minerals	Chloride (ppm)	12.5	<10.0	<10.0/33.2	
Minerals	Sulfate (ppm)	40.3	37.3	23.4/78.9	
Nutrients	Total Phosphorus (ppm)	0.133	0.118	0.031/0.292	
Nutrients	Nitrate/Nitrite (ppm)	0.295	0.200	0.050/1.870	
Nutrients	Chlorophyll A (mg/m^3)	19.2	12.4	4.3/77.3	TSI=59.6
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	70.6*	50.0	<10/22000	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	59.0*	40.0	<10/46000	Mean> OWQS of 33
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	39.9*	31.0	<10/3873	

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	NS	S	S	NS						S	S	S
Aesthetics												NEI
Agriculture					S		S	S				
Primary Body Contact Recreation									NS			
Public & Private Water Supply				S		S			S			
Fish Consumption				NS								

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes
Fish Consumption not supporting for Lead
Fish & Wildlife Propagation not supporting for Lead

Sager Creek at West Siloam Springs

Sample Record	Times Visited	Station ID
November 1998 - Current	99	121700060080-001AT

Stream Data

County	Delaware	View Site Data
Location	West of the town of West Siloam Springs off US Highway 412	
Latitude/Longitude	36.20164298, -94.60538182	
Planning Watershed	Lower Arkansas (8-digit HUC - 11110103)	

Parameters

	Parameter (*Descriptions*)	Mean	Median	Range	Comments
In-Situ	Water Temperature (C°)	17.0	17.7	5.9/28.2	
In-Situ	Turbidity (NTU)	3	1	1/36	
In-Situ	pH (units)	7.71	7.69	6.59/8.40	
In-Situ	Dissolved Oxygen (ppm)	9.26	8.72	3.30/13.80	
In-Situ	Hardness (ppm)	136.6	137.0	71.0/198.0	
Minerals	Total Dissolved Solids (ppm)	287.5	277.0	170.0/441.6	
Minerals	Specific Conductivity (uS)	444.8	433.5	253.0/690.0	
Minerals	Chloride (ppm)	33.3	32.2	<10.0/73.0	
Minerals	Sulfate (ppm)	31.3	28.4	13.6/63.7	
Nutrients	Total Phosphorus (ppm)	1.159	1.090	0.360/2.460	
Nutrients	Nitrate/Nitrite (ppm)	7.870	7.960	2.880/17.500	100% of values > OWQS of 2.4
Nutrients	Chlorophyll A (mg/m^3)	1.6	0.7	0.1/8.3	TSI=35.2
Bacteria	Fecal Coliform (cfu/100ml)(*-Geo. Mn.)	103.7*	80.0	<10.0/8200.0	
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	102.5*	73.0	<10.0/9700.0	Mean> OWQS of 33
Bacteria	E. Coli (MPN/100ml)(*-Geo. Mean)	54.3*	31.0	<10.0/4360.0	

Beneficial Uses

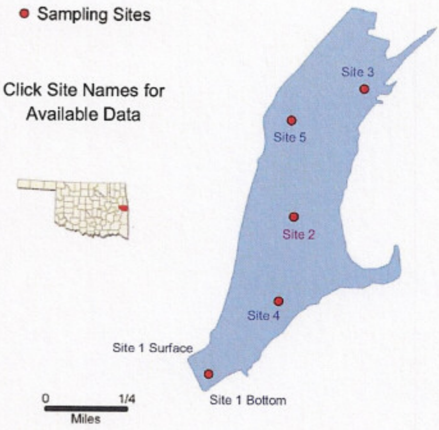
Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	S	S	S	S						S	S	S
Aesthetics												NEI
Agriculture					S		S	S				
Primary Body Contact Recreation									NS			
Public & Private Water Supply				S		NS			S			
Fish Consumption				NS								

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Fish consumption not supporting for Thallium*

Brushy Creek

Sample Period	Times Visited	Sampling Sites
October 2007 - July 2008	4	5



General

Location	Sequoyah County	Click map for site data
Impoundment	1964	
Area	358 acres	
Capacity	3,258 acre-feet	
Purposes	Flood Control and Recreation	

Parameters

	Parameter (Descriptions)	Result	Notes/Comments
	Average Turbidity	10 nephelometric turbidity units (NTU)	25% of values > 25 NTU
	Average True Color	41 units	25% of values > OWQS of 70
	Average Secchi Disk Depth	103 cm	
	Water Clarity Rating	good	
	Trophic State Index	53	Previous value = 51
	Trophic Class	eutrophic	
Profile	Salinity	0.00 - 0.10 ppt	
Profile	Specific Conductivity	36.3 - 605 µS/cm	
Profile	pH	6.02 - 8.12 pH units	Only 7 values < 6.5 units
Profile	Oxidation-Reduction Potential	33 to 606 mV	
Profile	Dissolved Oxygen	Up to 69% of water column < 2 mg/L in July	Occurred at site 1, the dam
Nutrients	Surface Total Nitrogen	0.38 mg/L to 0.72 mg/L	
Nutrients	Surface Total Phosphorus	0.016 mg/L to 0.050 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	20:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	S	NS	S							
Aesthetics					S	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											

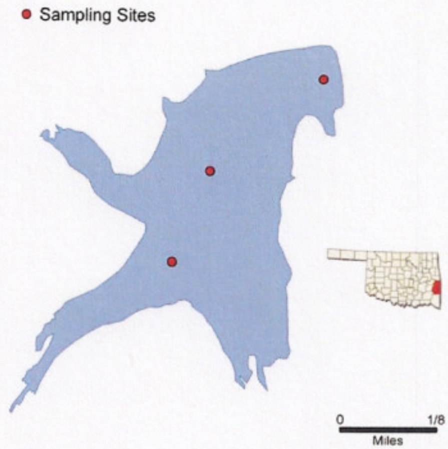
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Precipitation data suggests the peak in color & turbidity are likely due to runoff, therefore the uses are considered supporting.*

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Cedar

Sample Period	Times Visited	Sampling Sites
October 2005 - July 2006	4	3



General			
	Location	Le Flore County	Click map for site data
	Impoundment	1937	
	Area	78 acres	
	Capacity	1,000 acre-feet	
	Purposes	Recreation	

Parameters		Parameter (Descriptions)	Result	Notes/Comments
		Average Turbidity	4 NTU	100% of values < OWQS of 25 NTU
		Average True Color	19 units	100% of values < OWQS of 70
		Average Secchi Disk Depth	162 cm	
		Water Clarity Rating	excellent	
		Trophic State Index	53	
		Trophic Class	eutrophic	
	Profile	Salinity	0.0– 0.09 ppt	
	Profile	Specific Conductivity	4.9 – 195.7 µS/cm	
	Profile	pH	5.43– 9.16 pH units	36% of values < 6.5 and 6% >9 pH units
	Profile	Oxidation-Reduction Potential	18 - 560 mV	
	Profile	Dissolved Oxygen	Up to 70% of water column < 2 mg/L in July	Occurred at site 1, the dam
	Nutrients	Surface Total Nitrogen	0.34 mg/L to 0.84 mg/L	
	Nutrients	Surface Total Phosphorus	0.019 mg/L to 0.376 mg/L	
	Nutrients	Nitrogen to Phosphorus Ratio	7:1	Possibly co-limited

Beneficial Uses: Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	NS	S	S							
Aesthetics					S	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

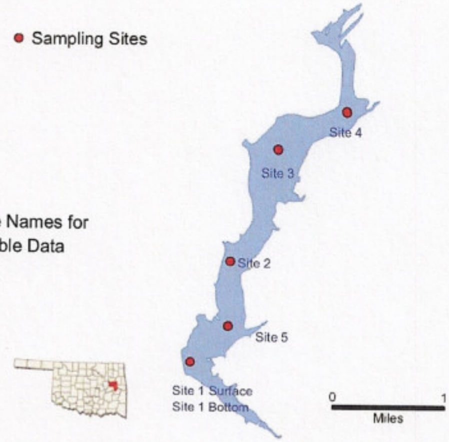
Greenleaf

Sample Period	Times Visited	Sampling Sites
November 2005 – Sept. 2006	4	5

General

Location	Muskogee County	Click map for site data
Impoundment	1939	
Area	920 acres	
Capacity	14,720 acre-feet	
Purposes	Recreation	

Click Site Names for Available Data



Parameters

	Parameter (Descriptions)	Result	Notes/Comments
	Average Turbidity	7 NTU	100% of values< OWQS of 25 NTU
	Average True Color	15 units	100% of values < OWQS of 70
	Average Secchi Disk Depth	111 cm	
	Water Clarity Rating	good	
	Trophic State Index	52	
	Trophic Class	eutrophic	
Profile	Salinity	0.06– 0.14 ppt	
Profile	Specific Conductivity	143.6 – 297 µS/cm	
Profile	pH	6.81 – 8.31 pH units	
Profile	Oxidation-Reduction Potential	55 – 511 mV	
Profile	Dissolved Oxygen	Up to 71% of water column < 2 mg/L in September	
Nutrients	Surface Total Nitrogen	0.42 mg/L to 0.83 mg/L	
Nutrients	Surface Total Phosphorus	0.025 mg/L to 0.067 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	15:1	Phosphorus limited

Beneficial Uses

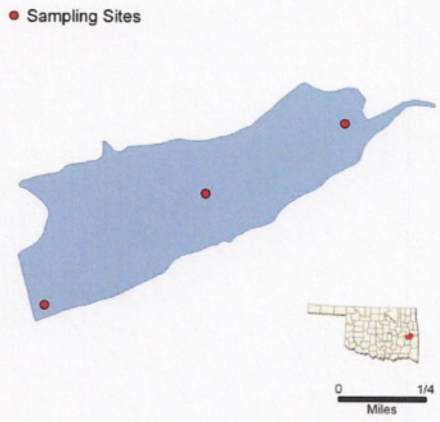
Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	S	NS	S							
Aesthetics					S	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											NS

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

John Wells



Sample Period	Times Visited	Sampling Sites
October 2008 – July 2009	4	3

General

Location	Haskell County	Click map for site data
Impoundment	1936	
Area	194 acres	
Capacity	1,352 acre-feet	
Purposes	Water Supply, Recreation	

Parameters

	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	3 NTU	100% of values < OWQS of 25 NTU (n=12)
	Average True Color		Did not collect for true color
	Average Secchi Disk Depth	180 cm	
	Water Clarity Rating	Excellent	
	Trophic State Index	45	Previous value = 46
	Trophic Class	Mesotrophic	
Profile	Salinity	0.02 – 0.10 ppt	
Profile	Specific Conductivity	73 – 207.5 µS/cm	
Profile	pH	6.3 – 9.13 pH units	1% of values < 6.50 and 2.38% > 9.00 pH units
Profile	Oxidation-Reduction Potential	-35 – 503 mV	
Profile	Dissolved Oxygen	Up to 50% of water column < 2.0 mg/L in July	
Nutrients	Surface Total Nitrogen	0.30 mg/L to 0.54 mg/L	
Nutrients	Surface Total Phosphorus	0.005 mg/L to 0.014 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	43:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	En & E. coli	Chlor-a
Fish & Wildlife Propagation	S	S	S	*							
Aesthetics					S	*					
Agriculture							*	*	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											

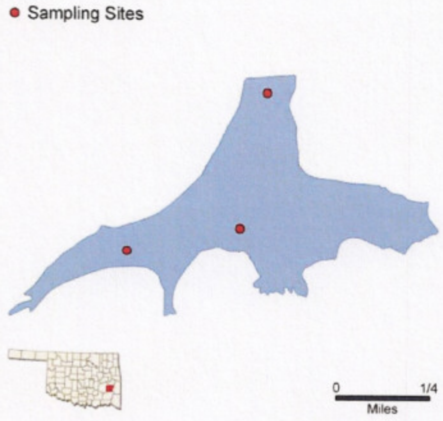
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Did not collect for these parameters

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Lloyd Church (Wilburton)

Sample Period	Times Visited	Sampling Sites
November 2005 – August 2006	4	3



General

Location	Latimer County	Click map for site data
Impoundment	1964	
Area	160 acres	
Capacity	3,060 acre-feet	
Purposes	Water Supply, Recreation, Flood Control	

Parameters

	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	14 NTU	25% of values > OWQS of 25 NTU
	Average True Color	79 units	75% of values > OWQS of 70
	Average Secchi Disk Depth	64 cm	
	Water Clarity Rating	good	
	Trophic State Index	45	
	Trophic Class	mesotrophic	
Profile	Salinity	0.0 – 0.01 ppt	
Profile	Specific Conductivity	25.4 – 71.9 µS/cm	
Profile	pH	5.9 – 7.51 pH units	26% of values <6.5 pH units
Profile	Oxidation-Reduction Potential	79 -503 mV	
Profile	Dissolved Oxygen	Up to 62% of water column < 2 mg/L in August	
Nutrients	Surface Total Nitrogen	0.15 mg/L to 0.57 mg/L	
Nutrients	Surface Total Phosphorus	0.020 mg/L to 0.043 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	12:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	NS	NS	S							
Aesthetics					S	NS					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											

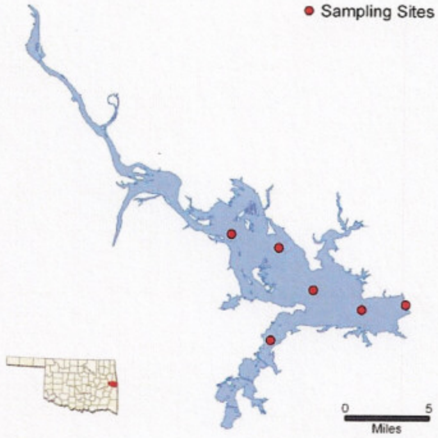
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: Available flow and rainfall data suggest that the peak in turbidity, which occurred in March is likely due to seasonal storm events, therefore Lloyd Church Lake will be listed as supporting its Fish & Wildlife Propagation (FWP) beneficial use

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Robert S. Kerr

Sample Period	Times Visited	Sampling Sites
October 2007 – July 2008	4	6



General		
Location	Sequoyah County	Click map for site data
Impoundment	1970	
Area	43,800 acres	
Capacity	525,700 acre feet	
Purposes	Navigation, Hydropower, and Recreation	

Parameters	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	78 nephelometric turbidity units (NTU)	88% of values > 25 NTU
	Average True Color	137 units	All values > OWQS of 70
	Average Secchi Disk Depth	26 cm	
	Water Clarity Rating	poor	
	Trophic State Index	50	Previous value = 58
	Trophic Class	eutrophic	
Profile	Salinity	0.02 – 0.60 ppt	
Profile	Specific Conductivity	57.6 – 1148 μS/cm	
Profile	pH	6.98 – 8.43 pH units	Neutral to slightly alkaline
Profile	Oxidation-Reduction Potential	272 to 526 mV	
Profile	Dissolved Oxygen		Never below 6.0 mg/L
Nutrients	Surface Total Nitrogen	0.70 mg/L to 1.72 mg/L	
Nutrients	Surface Total Phosphorus	0.065 mg/L to 0.210 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	8:1	Phosphorus limited

Beneficial Uses — *Click to learn more about Beneficial Uses*	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	NS	S	S	S							
Aesthetics					S	NS					
Agriculture							S	S	S		
Primary Body Contact Recreation										NEI	
Public & Private Water Supply											

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes *The PBCR cannot be assessed as minimum data requirements were not met due to QA/QC issues for E. coli and fecal coliform.*

NTU = nephelometric turbidity units
μS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
μS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

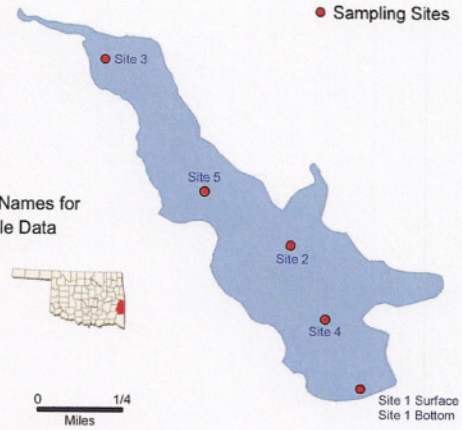
New Spiro

Sample Period	Times Visited	Sampling Sites
October 2005 – July 2006	4	5

General

Location	Le Flore County	Click map for site data
Impoundment	1960	
Area	254 acres	
Capacity	2,160 acre-feet	
Purposes	Water Supply, Recreation	

Click Site Names for Available Data



Parameters

	Parameter *(Descriptions)*	Result	Notes/Comments
	Average Turbidity	18 NTU	8% of values >OWQS of 25 NTU
	Average True Color	26 units	100% of values < OWQS of 70
	Average Secchi Disk Depth	47 cm	
	Water Clarity Rating	good	
	Trophic State Index	68	
	Trophic Class	hypereutrophic	
Profile	Salinity	0.04 – 0.09 ppt	
Profile	Specific Conductivity	106.8 – 155.4 µS/cm	
Profile	pH	7.09 – 9.24 pH units	10% of values > 9.0 pH units
Profile	Oxidation-Reduction Potential	121 - 483 mV	
Profile	Dissolved Oxygen	Up to 33% of water column < 2 mg/L in August	Occurred at site 2
Nutrients	Surface Total Nitrogen	0.98 mg/L to 1.68 mg/L	
Nutrients	Surface Total Phosphorus	0.076 mg/L to 0.170 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	11:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	NS	S	S							
Aesthetics					NS*	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											NS

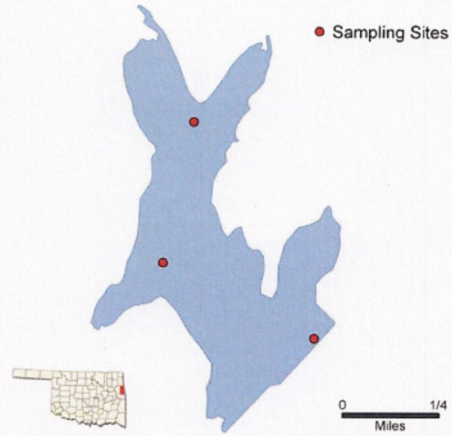
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *The lake is listed in the WQS as a NLW indicating that the Aesthetics beneficial use is considered threatened by nutrients until studies can be conducted to confirm non-support status

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Stilwell City

Sample Period	Times Visited	Sampling Sites
October 2005 – August 2006	3	3



General		
Location	Adair County	Click map for site data
Impoundment	1965	
Area	188 acres	
Capacity	3,110 acre-feet	
Purposes	Water Supply, Recreation, Flood Control	

Parameters

	Parameter (Descriptions)	Result	Notes/Comments
	Average Turbidity	6 NTU	100% of values < OWQS of 25 NTU
	Average True Color	14 units	100% of values < OWQS of 70
	Average Secchi Disk Depth	161 cm	
	Water Clarity Rating	excellent	
	Trophic State Index	54	
	Trophic Class	eutrophic	
Profile	Salinity	0.07 – 0.14 ppt	
Profile	Specific Conductivity	159.1 – 297.2 µS/cm	
Profile	pH	6.87 – 8.53 pH units	
Profile	Oxidation-Reduction Potential	88 – 452 mV	
Profile	Dissolved Oxygen	Up to 64% of water column < 2 mg/L in August	Occurred at site 1, the dam
Nutrients	Surface Total Nitrogen	0.32 mg/L to 0.88 mg/L	
Nutrients	Surface Total Phosphorus	0.019 mg/L to 0.044 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	20:1	Phosphorus limited

Beneficial Uses

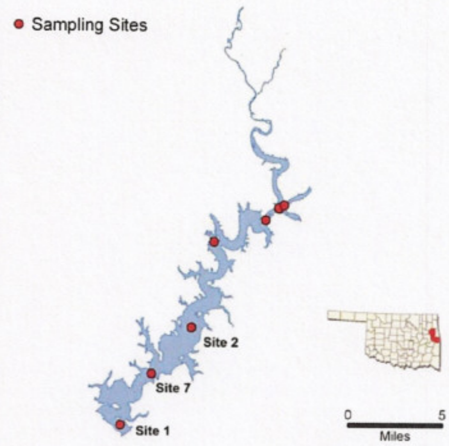
Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	S	NS	S							
Aesthetics					S	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Tenkiller (1,2,7)



Sample Period	Times Visited	Sampling Sites
October 2005 – August 2006	4	7

General

Location	Sequoyah County	Click map for site data
Impoundment	1953	
Area	12,900 acres	
Capacity	654,100 acre-feet	
Purposes	Flood Control, Hydropower	

Parameters

	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	2 NTU	100% of values < OWQS of 25 NTU
	Average True Color	11 units	100% of values < OWQS of 70
	Average Secchi Disk Depth	217 cm	
	Water Clarity Rating	excellent	
	Trophic State Index	48	
	Trophic Class	mesotrophic	
Profile	Salinity	0.05 – 0.42 ppt	
Profile	Specific Conductivity	135.3 – 806.2 µS/cm	
Profile	pH	6.57 – 10.05 pH units	10% of recorded values > 9.0 pH units
Profile	Oxidation-Reduction Potential	mV	
Profile	Dissolved Oxygen	52 to 69% of water column < 2 mg/L in July	
Nutrients	Surface Total Nitrogen	0.11 mg/L to 0.46 mg/L	
Nutrients	Surface Total Phosphorus	0.009 mg/L to 0.022 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	23:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S*	S	NS	S							
Aesthetics					NS	S					
Agriculture							S*	S	S		
Primary Body Contact Recreation										NEI	
Public & Private Water Supply											

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

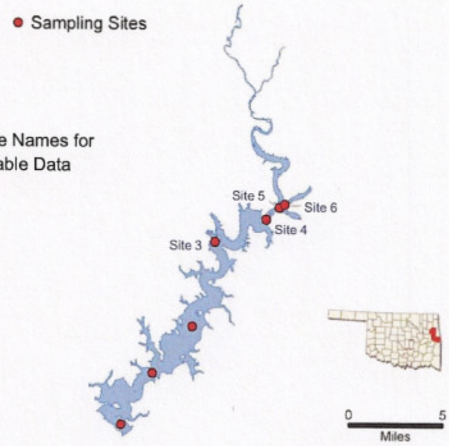
Notes: *An assessment of the FWP beneficial use for turbidity cannot be made, as minimum data requirements are not being met. True color, like turbidity there are not enough data for this segment to assess the Aesthetics beneficial use. The lake is listed in the WQS as a NLW indicating that the Aesthetics beneficial use is considered threatened by nutrients until studies can be conducted to confirm non-support status.

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Tenkiller, Illinois River Arm (3-6)

Sample Period	Times Visited	Sampling Sites
October 2005 – August 2006	4	7

Click Site Names for Available Data



General			
	Location	Sequoyah County	Click map for site data
	Impoundment	1953	
	Area	12,900 acres	
	Capacity	654,100 acre-feet	
	Purposes	Flood Control, Hydropower	

Parameters		Parameter (*Descriptions*)	Result	Notes/Comments
		Average Turbidity	7 NTU	100% of values < OWQS of 25 NTU
		Average True Color	13 units	100% of values < OWQS of 70
		Average Secchi Disk Depth	106 cm	
		Water Clarity Rating	excellent	
		Trophic State Index	59	
		Trophic Class	eutrophic	
	Profile	Salinity	0.07 – 0.41 ppt	
	Profile	Specific Conductivity	159.3 – 786.4 μS/cm	
	Profile	pH	7.02 – 9.23 pH units	4% of recorded values > 9.0 pH units
	Profile	Oxidation-Reduction Potential	mV	
	Profile	Dissolved Oxygen	50 to 60% of water column < 2 mg/L in July	
	Nutrients	Surface Total Nitrogen	0.19 mg/L to 0.85 mg/L	
	Nutrients	Surface Total Phosphorus	0.015 mg/L to 0.085mg/L	
	Nutrients	Nitrogen to Phosphorus Ratio	10:1	Phosphorus limited

Beneficial Uses: *Click to learn more about Beneficial Uses*	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S*	S	NS	S							
Aesthetics					NS	S					
Agriculture							S*	S	S		
Primary Body Contact Recreation										NEI	
Public & Private Water Supply											NS

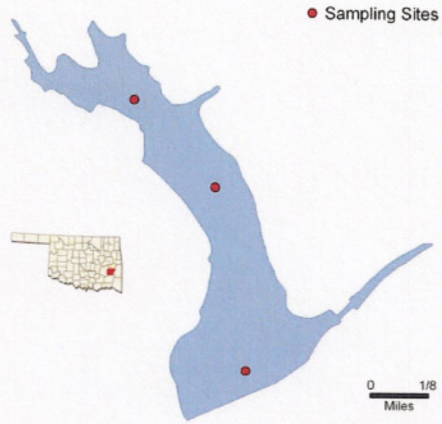
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *An assessment of the FWP beneficial use for turbidity cannot be made, as minimum data requirements are not being met. True color, like turbidity there are not enough data for this segment to assess the Aesthetics beneficial use. The lake is listed in the WQS as a NLW indicating that the Aesthetics beneficial use is considered threatened by nutrients until studies can be conducted to confirm non-support status.

NTU = nephelometric turbidity units
μS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
μS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Wayne Wallace

Sample Period	Times Visited	Sampling Sites
December 2007 – August 2008	4	3



General

Location	Latimer County	Click map for site data
Impoundment	1969	
Area	94 acres	
Capacity	1,746 acre feet	
Purposes	Flood Control and Recreation	

Parameters

	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	16 nephelometric turbidity units (NTU)	All values < 25 NTU
	Average True Color	98 units	All values > OWQS of 70
	Average Secchi Disk Depth	76 cm	
	Water Clarity Rating	average	
	Trophic State Index	48	Previous value = 41
	Trophic Class	mesotrophic	
Profile	Salinity	0.0 – 0.02 ppt	
Profile	Specific Conductivity	46 – 59.5 µS/cm	
Profile	pH	6.09 – 7.11 pH units	33% of pH values < 6.5
Profile	Oxidation-Reduction Potential	437 to 542 mV	
Profile	Dissolved Oxygen	Up to 20% of water column , 2 mg/L in August	Occurred at site 1, the dam
Nutrients	Surface Total Nitrogen	0.47 mg/L to 0.59 mg/L	
Nutrients	Surface Total Phosphorus	0.027 mg/L to 0.045 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	16:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	NS	S	S							
Aesthetics					S	NS					
Agriculture							S	S	S		
Primary Body Contact Recreation										NEI	
Public & Private Water Supply											

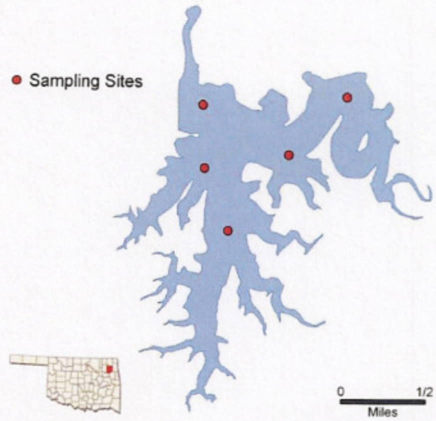
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Slightly acidic conditions are common in this part of the state, due to relatively low soil pH and lack of soluble bedrock. Due to these conditions it is likely that the low pH values may be due to natural causes; therefore the Water Board is looking at the applicability of developing site-specific criteria for waters in the southeastern portion of the state.*

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

W.R. Holway

Sample Period	Times Visited	Sampling Sites
November 2006 - August 2007	4	5



General

Location	Mayes County	Click map for site data
Impoundment	1968	
Area	712 acres	
Capacity	48,000 acre-feet	
Purposes	Water Supply, Hydropower, Recreation	

Parameters

	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	4 NTU	100% of values < OWQS of 25 NTU
	Average True Color	24 units	100% of values < OWQS of 70
	Average Secchi Disk Depth	161 cm	
	Water Clarity Rating	excellent	
	Trophic State Index	58	
	Trophic Class	eutrophic	
Profile	Salinity	0.09 – 0.16 ppt	
Profile	Specific Conductivity	190.1 – 322.2 µS/cm	
Profile	pH	7.10 – 9.25 pH units	Only 8% of values > 9.0 pH units
Profile	Oxidation-Reduction Potential	263 - 514 mV	
Profile	Dissolved Oxygen	Up to 41% of water column < 2 mg/L in August	
Nutrients	Surface Total Nitrogen	0.529 mg/L to 1.35 mg/L	
Nutrients	Surface Total Phosphorus	0.022 mg/L to 0.088 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	13:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	S	S	S	S							
Aesthetics					S	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

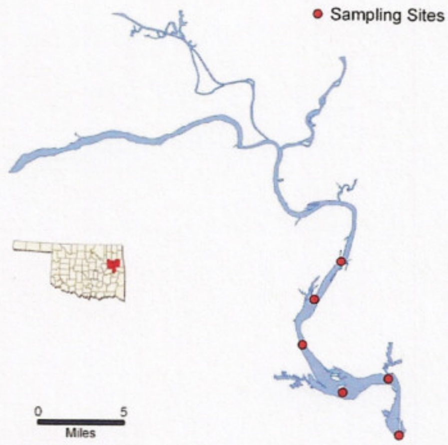
Notes

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Sampling and Assessment by the **Oklahoma Water Resources Board** – 3800 Classen Blvd, Oklahoma City, OK, 73118 – 405.530.8800 – http://www.owrb.ok.gov

Webbers Falls

Sample Period	Times Visited	Sampling Sites
October 2008 – July 2009	4	6



General

Location	Muskogee County	Click map for site data
Impoundment	170	
Area	11,600 acres	
Capacity	170,100 acre-feet	
Purposes	Navigation, Hydropower	

Parameters

	Parameter (*Descriptions*)	Result	Notes/Comments
	Average Turbidity	23 NTU	29% of values > OWQS of 25 NTU (n=17)
	Average True Color		Did not collect for true color
	Average Secchi Disk Depth	37 cm	
	Water Clarity Rating	Average	
	Trophic State Index	55	Previous value = 56
	Trophic Class	Eutrophic	
Profile	Salinity	0.15 – 0.77 ppt	
Profile	Specific Conductivity	303.3 – 1460 µS/cm	
Profile	pH	7.67 – 8.78 pH units	
Profile	Oxidation-Reduction Potential	332 to 560 mV	
Profile	Dissolved Oxygen	All data are above screening level of 2.0 mg/L	
Nutrients	Surface Total Nitrogen	0.68 mg/L to 1.64 mg/L	
Nutrients	Surface Total Phosphorus	0.101 mg/L to 0.189 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	10:1	Phosphorus limited, possibly co-limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	En & E. coli	Chlor-a
Fish & Wildlife Propagation	NEI	S	S	*							
Aesthetics					S	*					
Agriculture							S	S	S		
Primary Body Contact Recreation										NEI	
Public & Private Water Supply											

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: The PBCR beneficial use is supported for *E.coli*, but cannot be assessed for *Enterococci* as minimum data requirement were not met due to QA/QC issues. Although 29% of turbidity samples exceed 25 NTU, an assessment of the FWP beneficial use cannot be made due to minimum data requirements not being met for this sample year.

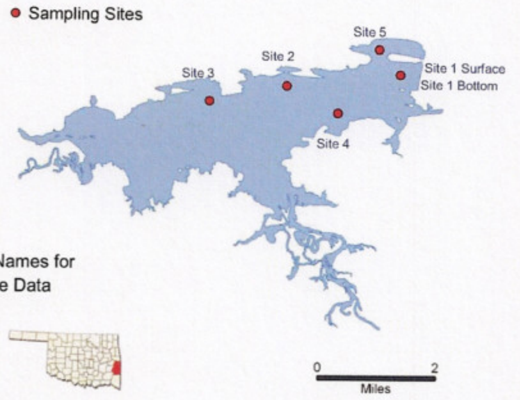
NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Wister

Sample Period	Times Visited	Sampling Sites
November 2008 – July 2009	4	5

General

Location	LeFlore County	Click map for site data
Impoundment	1949	
Area	7,333 acres	
Capacity	62,360 acre feet	
Purposes	Flood Control, Water Supply, Low flow Regulation, and Conservation	



Click Site Names for Available Data

Parameters

	Parameter (Descriptions)	Result	Notes/Comments
	Average Turbidity	21 NTU	10% of values > 25 NTU (n=20)
	Average True Color		Did not collect for true color
	Average Secchi Disk Depth	41 cm	
	Water Clarity Rating	Average	
	Trophic State Index	62	Previous value = 61
	Trophic Class	Hypereutrophic	
Profile	Salinity	0.0 – 0.06 ppt	
Profile	Specific Conductivity	58.0 – 148.4 µS/cm	
Profile	pH	6.39 – 7.28 pH units	Only 4% of pH values < 6.50
Profile	Oxidation-Reduction Potential	16 to 548 mV	
Profile	Dissolved Oxygen	Up to 45% of water column < 2.0 mg/L in July	
Nutrients	Surface Total Nitrogen	0.45 mg/L to 0.71 mg/L	
Nutrients	Surface Total Phosphorus	0.040 mg/L to 0.082 mg/L	
Nutrients	Nitrogen to Phosphorus Ratio	10:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	En & E. coli	Chlor-a
Fish & Wildlife Propagation	S	S	S	*							
Aesthetics					NS*	*					
Agriculture							*	*	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											NS

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

Notes: *Did not collect for these parameters. *Currently, the lake is listed as a Nutrient Limited Watershed (NLW) in the Oklahoma Water Quality Standards (WQS). This listing means that the lake is considered threatened from nutrients until a more intensive study can confirm the Aesthetics beneficial use non-support status.

NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

Oklahoma 2008 Integrated Report
Appendix B

Legend

Legend for Attainment	
Code	**Description**
F	Fully Supporting
N	Not Supporting
I	Insufficient Information
X	Not Assessed

USE ID	Description
124	Aesthetic
125	Agriculture
129	Emergency Water Supply
130	Cool Water Aquatic Community
131	Habitat Limited Aquatic Community
132	Trout Fishery
133	Warm Water Aquatic Community
134	Hydropower
135	Indus. & Muni. Process/Cooling Water
136	Navigation
137	Primary Body Contact Recreation
138	Public and Private Water Supply
139	Secondary Body Contact Recreation
1003	Fish Consumption
1004	Outstanding Resource
1005	Sensitive Water Supply
1006	High Quality Water

Category	Description
1	Attaining the Water Quality Standard and no use is threatened
2	Attaining some of the designated uses; no use is threatened; and insufficient or no data or information is available to determine if the remaining uses are attained or threatened
3	Insufficient or no data and information to determine if any designated use is attained
4	Impaired or threatened for one or more designated uses but does not require the development of a TMDL
4a	• TMDL has been completed
4b	• Other pollution control requirements are reasonable expected to result in the attainment of the water quality standard in the near future
4c	• Impairment is not caused by a pollutant
5	The water quality standard is not attained. The waterbody is impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL

ID	Description
91	Ammonia (Unionized) -Toxin
96	Arsenic
104	Barium
127	Cadmium
138	Chloride
153	Chlorpyrifos
154	Chromium (total)
163	Copper
187	Diazinon
198	Dieldrin
215	Enterococcus
217	Escherichia coli
230	Fishes Bioassessments
267	Lead
302	Nitrates
317	Oil and Grease
322	Oxygen, Dissolved
372	Selenium
375	Silver
385	Sulfates
398	Total Coliform
399	Total Dissolved Solids
400	Total Fecal Coliform
413	Turbidity
423	Zinc
441	pH
462	Total Phosphorus

ID	Description
2	Acid Mine Drainage
33	Discharges from Biosolids (SLUDGE) Storage, Application or Disposal
62	Industrial Point Source Discharge
68	Land Application of Wastewater Biosolids (Non-agricultural)
70	Leaking Underground Storage Tanks
82	Mine Tailings
84	Municipal (Urbanized High Density Area)
85	Municipal Point Source Discharges
92	On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)
100	Runoff from Permitted Confined Animal Feeding Operations (CAFOs)
102	Petroleum/natural Gas Activities (Legacy)
119	Silviculture Harvesting
124	Spills from Trucks or Trains
127	Surface Mining
140	Source Unknown
155	Natural Sources
156	Agriculture
157	Habitat Modification - other than Hydromodification

2008 Category 5 Waters for the Oklahoma/Arkansas Compact Area

WBID	Name	Size	Unit	Causes	Potential Sources	TMDL Date
OK120400010070_00	Webbers Falls Lake	11600.0	ACRES	215	140	2016
OK120400010130_00	Greenleaf Lake	920.0	ACRES	150, 322,413	140	2013
OK120400010260_00	Arkansas River	14.7	MILES	127, 138, 267, 215, 399	34, 49, 62, 85,102, 133, 136, 140	2013
OK120400010400_00	Coody Creek	16.2	MILES	215, 322	46, 59, 87 , 92, 108,111, 133, 136, 140	2013
OK120400020010_00	Dirty Creek	44.2	MILES	413, 322	21, 46,49,87, 108, 92, 136, 140	2016
OK120400020030_00	Dirty Creek, South Fork	15.5	MILES	215, 322	84, 140, 46, 85, 87, 92, 108, 111, 133, 136,59 ,	2019
OK120400020110_00	Dirty Creek, Georges Fork	10.0	MILES	215, 322	46, 87, 92, 108, 111, 133, 136, 140	2016
OK120400020160_00	Butler Creek	10.3	MILES	215, 322	46, 59, 92, 87, 108, 111, 133, 136, 140	2019
OK120400020190_00	Elk Creek	13.9	MILES	413, 400, 385, 322	46, 49,62, 85, 87, 92, 108, 136, 111, 133, 140 ,97	2019
OK120400020240_00	Shady Grove Creek	10.8	MILES	441, 385, 399	49, 140	2019
OK121700020020_00	Tenkiller Ferry Lake	8440.0	ACRES	462, 322, 150	4, 59, 108, 136, 146, 140	2010
OK121700020110_00	Chicken Creek	4.9	MILES	230	140	2010
OK121700020220_00	Tenkiller Ferry Lake, Illinois River Arm	5030.0	ACRES	322	4, 46, 59, 92, 108, 136, 146, 140	2010
OK121700030010_00	Illinois River	7.7	MILES	462, 215	4,46,59,85,92,100,108,136,146,140	2010
OK121700030040_00	Tahlequah Creek (Town Branch)	6.2	MILES	217	46, 92, 108, 133, 136, 140	2010
OK121700030080_00	Illinois River	32.0	MILES	462, 217, 400, 267	4,46,59,92,108,133,136,140	2010
OK121700030280_00	Illinois River	15.2	MILES	462	4,46,59,92,108,133,136,146,140	2010
OK121700030290_00	Flint Creek	1.6	MILES	322, 462	4,46,59,92,108,133,136,146,140	2010
OK121700030350_00	Illinois River	5.2	MILES	462, 413, 215	4,34,46,59,92,100,108,133,136,146,140	2013
OK121700030370_00	Ballard Creek	12.6	MILES	215	4,46,59,92,108,111,133,136,140	2013
OK121700040010_00	Caney Creek	20.9	MILES	215	4,46,59,62,92,108,111,133,136,140	2016
OK121700050010_00	Illinois River, Baron Fork	23.3	MILES	462, 215	4,34,46,59,92,100,108,133,136,146,140	2013
OK121700050090_00	Tyner Creek	14.8	MILES	215	4,46,59,92,108,136,140	2013
OK121700050120_00	Peacheater Creek	10.3	MILES	215	4,46,59,92,100,108,128,136,140	2013
OK121700060010_00	Flint Creek	7.8	MILES	462, 215	4,46,59,92,100,108,111,133,136,146,140	2010
OK121700060040_00	Battle Creek (Battle Branch)	5.4	MILES	215	4,46,59,92,108,111,133,136,140	2010
OK121700060080_00	Sager Creek	4.2	MILES	215, 302	4,46,59,85,92,108,133,136,146,140	2010
OK220100010010_00	Poteau River	23.9	MILES	163, 267, 413, 215	46,49,59,62,85,108,133,136,140	2013
OK220100010010_30	Poteau River	1.6	MILES	127, 163, 267, 372, 375	140	2019
OK220100010010_40	Poteau River	21.4	MILES	163, 267, 413	140	2016
OK220100010050_00	New Spiro Lake	254.0	ACRES	150, 322, 413	46,92,108,133,136,140	2013

OK220100020020_00	Wister Lake	7333.0	ACRES	160, 150, 462, 322, 413, 441	46,92,108,133,136,140	2013
OK220100020040_00	Poteau River, Black Fork	30.2	MILES	441	140	2013
OK220100020060_00	Cedar Lake	78.0	ACRES	322, 441	46,92,108,133,136,140	2013
OK220100030010_00	Brazil Creek	17.8	MILES	215	4, 46, 59, 92, 108, 133, 136, 140	2016
OK220100040020_00	Fourche Maline Creek	36.9	MILES	267, 322, 215	140, 46, 62, 69, 85, 87, 92, 108, 111, 133, 136	2013
OK220100040050_00	Red Oak Creek	11.0	MILES	385, 399, 322, 441	46,,85, 92, 108, 133, 136, 140	2013
OK220100040080_00	Bandy Creek	12.5	MILES	413	140	2013
OK220100040100_00	Lloyd Church Lake (Wilburton City)	160.0	ACRES	322, 413, 441	46,92,108,133,136,140	2013
OK220100040150_00	Wayne Wallace Lake	94.0	ACRES	160, 413, 322, 441	46,92,108,133,136,140	2013
OK220200010010_00	Arkansas River	20.7	MILES	385	49, 102, 140	2016
OK220200020020_00	Robert S. Kerr Lake	43380.0	ACRES	413	140	2013
OK220200030010_10	Sallisaw Creek	9.0	MILES	385	49, 140	2013
OK220200030010_20	Sallisaw Creek	13.3	MILES	215	4,46,59,92,10,111,128,133,136,140	2013
OK220200030040_00	Brushy Creek Lake	358.0	ACRES	322, 441	46,92,108,133,136,140	2013
OK220200030120_00	Stilwell City Lake	188.0	ACRES	322	46,108,133,136,140	2013
OK220200040010_00	Sans Bois Creek	9.2	MILES	322, 441, 215, 217	85, 92, 140, 156	2015
OK220200040010_10	Sans Bois Creek	10.8	MILES	385, 399, 322	49, 103, 140, 46, 85, 87, 92, 108, 111, 133, 136	2015
OK220200040010_40	Sans Bois Creek	27.8	MILES	322, 413, 215, 217	4,46,59,85,92,108,133,136,140	2019
OK220200040030_00	John Wells Lake (Stigler)	194.0	ACRES	322	46,92,108,133,136,140	2019
OK220200040050_00	Sans Bois Creek, Mountain Fork	18.8	MILES	441, 217	46,92,108,133,136,156,140	2019
OK220200050010_00	Lee Creek	1.9	MILES	215,267	46,92,108,133,136,146,140	2013
OK220200050010_10	Lee Creek	15.7	MILES	462, 322	46,92,108,133,136,146,140	2013

Project : 7

Title: **Scenic Rivers Phosphorus Criterion Review**

Agency: Oklahoma Water Resources Board (OWRB)

Project Location: Illinois River Watershed

Background:

In 2003, Oklahoma and Arkansas signed a "Statement of Joint Principles and Actions" stating that "Oklahoma periodically reevaluates all of its water quality standards. In particular, Oklahoma will reevaluate Oklahoma's .037 mg/l criterion for total phosphorus in Oklahoma's Scenic Rivers by 2012, based on the best scientific information available at that time, and with the full, timely inclusion of officials from the State of Arkansas representing both point and non point source dischargers." To complete reevaluation by 2012, the process must be initiated no later than the spring of 2011.

Objectives:

The objective of this project will be to reevaluate the Oklahoma Scenic Rivers phosphorus criterion to reaffirm its appropriateness or to advise if a revised phosphorous criterion might better serve to restore and protect the integrity of Oklahoma's Scenic Rivers. The process embodied in this work plan will facilitate review of the best scientific information available utilizing a technical advisory group that includes appropriate technical staff designated by officials from EPA, Cherokee Nation and the States of Oklahoma and Arkansas representing both point and non point source dischargers. Staff of the OWRB will compile summaries of the information reviewed and recommendations made by the technical advisory group, then advise the Oklahoma Water Resources Board regarding whether it should separately pursue promulgation of a revised criterion or other alternatives.

If a revised criterion is ultimately pursued by the OWRB, revisions to the Oklahoma Water Quality Standards (OWQS) and Implementation Rules would be made following the procedures for rulemaking and public participation established in the Oklahoma Administrative Procedures Act and the Clean Water Act. Revision of the OWQS must be initiated with publication of formal notice of rule making intent. A rule impact statement must be drafted and along with a 45 day comment period, a formal hearing must be held. Proposed revisions must be approved by the Board and Governor and pass a 30 day legislative review period. The whole process must be certified by the Oklahoma Attorney General as compliant with state law. The revision process culminates with a 60 day EPA review and approval.

The outcome of this project will be reevaluation of the Oklahoma Scenic Rivers Criterion, which meets guidance measures 2.2.1 WQ-1a, 2.2.1 WQ-1b, 2.2.1 WQ-3a and 2.2.1 WQ-4a as listed in FY 09 National Water Program Guidance. The environmental result of this project will be to satisfy the joint principles and actions to allow full implementation of a criterion protective of Oklahoma's six Scenic Rivers.

OKLAHOMA'S WATER QUALITY STANDARDS REVISIONS RELEVANT TO THE ARK/OK COMPACT AREA

Project Tasks:

I. Establish Technical Advisory Group (TAG),

The reevaluation process will involve a Technical Advisory Group (TAG) including relevant technical staff from the State of Oklahoma, EPA, Cherokee Nation and the State of Arkansas representing both point and non point source dischargers. The TAG will review relevant best scientific information available regarding the phosphorus criterion and develop final recommendations to OWRB staff regarding whether additional action should be taken to revise the phosphorus criterion. The role of the TAG will be to:

1. Advise OWRB staff regarding the type of information necessary to reevaluate the criterion.
2. Recommend to OWRB staff sources of information to be reviewed
3. Assist OWRB staff in establishing the information review process including:
    a. information validation
    b. information ranking
    c. appropriate DQOs and QAPP processes for the review process
4. Review the validated and ranked information to advise OWRB staff on whether additional criteria development is necessary.

The following individuals are tentatively targeted to serve on the TAG, although final membership will be based upon assignments made by the participating agencies:

Shellie Chard-McClary – ODEQ
Shanon Phillips – OCC
Derek Smithee – OWRB
Amanda Storck – OSE
Earl Smith – ANRC
Steve Drown – ADEQ
Jane Watson – EPA
Environmental representative – Cherokee Nation

Time frame: October 2010 – November 2010

II. Prepare Secondary Data QAPP

OWRB staff will prepare a Secondary Data Quality Assurance Project Plan (QAPP) that will establish reevaluation processes based upon "best scientific information available". Data Quality Objectives (DQOs) can be established in 2-3 TAG meetings in early 2011. Data Quality Objectives will be established to support one of three recommendations regarding the criterion:

1. No change due to lack of adequate information.
2. No change necessary because collected information indicate that the criterion is protective.
3. Revise criterion because of clear and convincing information/data that the river's uses and downstream uses will be protected with an alternative criterion.

The types of information to be solicited for the information validation process will be established in the Secondary Data QAPP. Information/data sources may include:

- Peer reviewed literature search
- Water quality data
- TMDL model predictions and endpoints
- Compliance data NPDES permits
- NPS Implementation
- EPA guidance
- Academic input
- Data and information from litigation and
- NSTEPS review (EPA nutrient criteria development support program)

The QAPP will document how "best scientific information available" will be validated. Acquired information will be preliminarily reviewed by OWRB staff and categorized according to:

A. Information Quality:
   - Relevance
   - Technical rigor and defensibility

B. Performance Endpoints
   - Acceptable periphyton levels
   - Acceptable seston chlorophyll levels.
   - Acceptable turbidity
   - Beneficial uses protected (including those downstream)

The review and recommendation process used by the TAG will be established in the QAPP. The TAG recommendations will be presented to OWRB staff for appropriate action.

Time frame: October 2010 – January 2011
***Deliverables:* Secondary Data QAPP**

III. Solicit Best Scientific Information Available

Notice shall be published soliciting public input of scientific information regarding the phosphorus criterion. The request shall specify the need for technical information to retain the existing criterion or to revise the criterion to accomplish the performance endpoints established in the data quality objectives. The notice should be published in June of 2011 with at least a 45 day period after publication allowing information to be submitted.
A public hearing regarding Scenic Rivers Criterion will be held at the end of the information solicitation period on approximately July 15, 2011 (the Public Hearing to possibly be held in Tahlequah, Oklahoma). Pending DQOs, OWRB staff shall conduct:

- Literature search
- Data review

- TMDL review
- Compliance review
- NPS Implementation review
- EPA guidance review
- Target and request input from academics
- Review data and information from litigation.
- NSTEPS review

Time frame: February 2011 – June 2011
***Deliverables:* Public Notice**

IV. Information Review:

All information submitted as result of the public notice solicitation or acquired by OWRB staff shall be reviewed and ranked by OWRB staff for its quality, relevance and technical basis following procedures established in Task II. Information meeting DQOs, will be compiled into a Data and Information Report for the TAG's review.

Time frame: July 2011 – September 2011
***Deliverables*: Data and Information Report**

V. Criteria Reevaluation with *"full, timely inclusion of officials from the State of Arkansas"*

The Data and Information Report regarding the Scenic Rivers phosphorus criterion will be reviewed by the Technical Advisory Group. The TAG review should produce one of 3 recommendations:

1. No change due to lack of adequate information
2. No change necessary because of supporting information
3. Revise criterion because of clear and convincing information/data that the river's uses and downstream uses will be protected with an alternative criterion

The reevaluation process should culminate in a report including recommendation for OWRB staff consideration that take into account State and Federal requirements for modifying water quality standards.

Time frame: July 2011 – October 2011
***Deliverables:* Final Report presenting recommendations by TAG**

Measures of Success:

The overall measure of success for this project is to satisfy the reevaluation process embodied in the 2003 "Statement of Joint Principles and Actions" endorsed by the States of Oklahoma and Arkansas and EPA. Recommendations could either reaffirm the current criterion or provide a recommendation for further action that with timely implementation will restore and protect Oklahoma's six Scenic Rivers.

Outputs:

1. Secondary Data QAPP
2. Public Notice
3. Data and Information Report.
4. Final Report to OWRB staff presenting recommendations by the technical advisory group

Project Management:

The OWRB will be the lead agency and manage project activities for this project and will provide oversight for all project activities.

Project Duration:

The project will be approximately 12 months in duration. Outside of the scope of this project, additional activities could include Board action, additional criteria development and standards revision. These additional activities may extend well past the 12 month duration allotted for this project.

Project Milestones:

Secondary Data QAPP	October 2010 – January 2011
Data Solicitation	February 2011 – June 2011
Public Hearing	July 15th, 2011
Information Review	July 2011 – September 2011
Final TAG Recommendations	July 2011 – October 2011

Budget Summary:

A breakdown of the project budget is presented below.

Task I.	**Technical Advisory Group (TAG) Established**	**$**	**1,000**
Task II.	**Secondary Data QAPP Development**	**$**	**7,000**
Task III.	**Informaton and Data Solicitations**	**$**	**5,000**
Task IV.	**Information Review**	**$**	**15,000**
Task V.	**Criteria Reevaluation**	**$**	**15,080**
	TOTAL =	**$**	**43,080**

Allocation of funds and a detailed budget for work to be performed as part of this project are included in Tables 1 & 2.

***Table 1.* Allocation of Funds for Project**

Allocation of Funds	Monies
Environmental Protection Agency (100% of Total Cost)	$43,080
TOTAL PROJECT COST =	$43,080

***Table 2.* Proposed Budget**

ITEMIZED BUDGET

PROPOSED ITEMIZED BUDGET

Personnel		Years	Expenditure
Environmental Program Division Head		0.02	$1,440
Environmental Program Manager		0.1	$5,200
Environmental Program Specialist IV		0.1	$4,400
Environmental Program Specialist III		0.15	$5,250
Indirect and Fringe Costs			
Indirect Costs	FY10	64.17% of Personnel Costs	$10,453
Fringe Benefits	FY10	88.40% of Personnel Costs	$14,400
Lodging & Per Diem			
Travel & Per Diem (Per State Travel Act)			$1,500
printing costs			
Printing and distribution of notices			$437
TOTAL PROJECT COST			$43,080

OKLAHOMA'S WATER QUALITY STANDARDS REVISIONS RELEVANT TO THE ARK/OK COMPACT AREA

Completed TMDL's In the Arkansas-Oklahoma Compact Area Provided by the Oklahoma Department of Environmental Quality

COMPLETED TMDL'S PROVIDED BY
THE OKLAHOMA DEPT. OF
ENVIRONMENTAL QUALITY

Waterbody ID	Station Name	Cause Code	Parameter	
OK220100040020_00	Fourche Maline Creek	215	Enterococcus	35634
OK220200040010_40	Sans Bois Creek	215	Enterococcus	35635
OK220200040010_40	Sans Bois Creek	217	Escherichia coli	35635
OK220200040050_00	Sans Bois Creek, Mountain Fork	217	Escherichia coli	35626

ADEQ
ARKANSAS
Department of Environmental Quality

April 14, 2011

Mr. Philip Moershel
Water Quality Standards Section Head
Oklahoma Water Quality Programs Division
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, Oklahoma 73118

Re: Comments on the Draft Quality Assurance Project Plan for Secondary Data Collection and Analysis (Scenic Rivers Phosphorus Criterion Review)

Dear Mr. Moershel:

The Arkansas Department of Environmental Quality (ADEQ) would like to thank the Oklahoma Water Resources Board (OWRB) for allowing us to review and provide comments on the Draft Quality Assurance Project Plan (QAPP) for Secondary Data Collection and Analysis concerning the scenic rivers phosphorus criterion review.

Our comments include general and specific comments on the draft QAPP, as well as issues that we believe must also be considered in the forthcoming reevaluation of the phosphorus criterion. We hope these comments promote the scientific information exchange necessary to ensure the appropriateness of the phosphorus criterion that is ultimately selected. In keeping with the spirit of the Statement of Joint Principles and Actions and with the full and timely inclusion of officials from Arkansas representing both point and nonpoint sources dischargers, the Arkansas stakeholders have requested that the ADEQ management provide access to and allow participation in this process as well. The ADEQ management has agreed that the Arkansas stakeholders' input would be appropriate for this process. Throughout this process, we will continue to coordinate with the Arkansas stakeholders and will incorporate their comments into this process as well. Currently, the Arkansas stakeholders are reviewing the QAPP and will provide comments to ADEQ in the next several days. Consequently, ADEQ will follow-up this letter with an additional comment letter in the next few weeks. However, in the spirit of moving this process forward, ADEQ offers our preliminary comments below.

Quality Assurance Project Plan

In general, we concur that the QAPP as drafted appears to be appropriate for the stated objective of the reevaluation of the "Oklahoma Scenic Rivers phosphorus criterion to reaffirm its appropriateness or to recommend if a revised phosphorus criterion might better serve to restore and protect the integrity of Oklahoma's scenic rivers". (Please note that the term "restore" is employed in the QAPP, while the Scenic Rivers Act, enacted in the 1970's, uses the term "preserve". As such, the term "preserve" may be easier to define within the context of a total phosphorus water quality criterion for Oklahoma's Scenic Rivers.)

The QAPP, with the exception of addressing the downstream uses of Lake Tenkiller, also seems to be keeping with the spirit of the Statement of Joint Principles and Actions in that Oklahoma will reevaluate the 0.037 mg/l criterion for total phosphorus based on the "best scientific information" available. However, the emphasis seems to focus more on the solicitation of peer review data literature, nutrient related studies and models, and TMDLs (EPA's as well as others) and less on actual current in-stream conditions of the Oklahoma Scenic Rivers. While these and other data inputs as delineated in Section DQ03- Inputs into the Decision, may be reasonable (with the exception of the Lake Tenkiller TMDL), the ranking and weight afforded inputs should be transparent, well documented, technically sound, and adequately funded at a level to enable the Oklahoma Water Resources Board (OWRB) to conduct the reevaluation with full rigor. While the activities of the Technical Advisory Group (TAG) in the reevaluation process are supported with EPA funding of $43,000, we are concerned that this may not be adequate to fully reevaluate the phosphorus criterion in Oklahoma's Scenic Rivers.

We submit the following specific questions and comments associated with the draft QAPP, followed by comments addressing important issues associated with the inclusion of Lake Tenkiller in the reevaluation effort.

1. Section A.5. Problem Definition and Background, Page 13, Third Paragraph, Second Sentence, "The point and nonpoint source phosphorus dischargers of northwest Arkansas in particular have perceived the requirement to control phosphorus pollution as particularly onerous". This is an editorial comment that needs to be removed from this document.

2. Section A.7. Quality Objectives and Criteria, Page 17, DQ05, an apparent action level has been set at 0.010mg/l above and below the Scenic Rivers criterion. This range is not supported by a clear scientifically defensible justification. The range appears to be arbitrarily derived. This range is well within the margin of error for data analysis. We feel if the OWRB is going to establish an action level, this value should be justified and technically sound. Please explain how OWRB's action level was derived?

3. Section B.9.4 Secondary Data Analytical Methods of the QAPP beginning on Page 21, contemplates the evaluation of the acquired information to determine what should be considered "best scientific information" based on a ranking system for quality, geographic relevance, and environmental response. Ranking should be a transparent process and well documented. The information ranked should be technically sound. If the information is not technically sound (for example, information that is un-reviewed, has no quality assurance or is hearsay), that information should be eliminated from qualifying for "best scientific information" or further consideration in this reevaluation process. The review and ranking of information should be accomplished by the TAG or, if a subcommittee is used, the membership of the subcommittee should not be restricted and should be open to any TAG members interested in participating on the subcommittee.

   The ranking is to be performed using the guidelines contained in the QAPP or by *agreement* of the TAG. An agreement may be necessary where objections are raised on how information is ranked. While the goal of OWRB is for "agreement" of the TAG, what happens if an agreement is not reached? What will be the recommendation of TAG concerning the "best scientific information" if agreement cannot be reached on the ranking of the information?

The environmental response guidelines need to be expanded to include water chemistry data and other information that reflects instream water quality, including DO levels and instream nitrogen and phosphorus concentrations, among others.

ADEQ does not agree that un-reviewed studies or models should qualify for "best scientific information" without more information confirming the technical soundness of the studies or models.

While the description of the ranking guidelines may be helpful to evaluate the relevance of research literature, as stated in our general comments above, we believe the greatest emphasis must be placed on actual in-stream conditions in the Illinois River and the other Scenic Rivers. Why is the focus of the reevaluation of the 0.037mg/l total phosphorus criterion as contemplated in the Statement of Joint Principles and Actions driven by a literature search instead of focusing on actual in-stream conditions as they currently exist in the Oklahoma Scenic Rivers? The primary emphasis should be to adequately evaluate the current attainment of the designated use and all current site-specific water quality data in the Oklahoma Scenic Rivers as part of the 0.037 mg/L total phosphorus criterion.

Adequate time and resources should be allocated to make sure that the Oklahoma Scenic River designated use and site-specific water quality data are obtained and evaluated as the primary purpose of the reevaluation. The solicitation of nutrient research literature can certainly be used as supporting documentation, but again literature searches should not be the primary focus of this reevaluation. Actual, current instream conditions should have the highest position and receive the greatest weight in the ranking process.

4. Section.9.5., Secondary Data Quality Control, Page 23, "Acquired information regarding nutrients in Oklahoma's Scenic Rivers will be reviewed and ranked by a subcommittee of the TAG." This activity should be accomplished by the TAG or, if a subcommittee is used, the membership of the subcommittee should not be restricted and should be open to any TAG members interested in participating on the subcommittee.

Lake Tenkiller

As a final point, it seems important to address the issue of Lake Tenkiller. Although including the lake was contemplated in the QAPP, and certainly the Clean Water Act requires that States take into consideration the water quality standards of downstream waters and provide for the attainment of downstream uses, Lake Tenkiller appears to be an entirely separate issue from that which was contemplated by the Statement of Joint Principles and Actions. The lake's inclusion is important for Oklahoma as far as its Triennial Review process is concerned, but the inclusion of Lake Tenkiller seems to range far beyond the scope of the Statement of Joint Principles and Actions and may divert limited resources needed to achieve the QAPP's objectives as stated on the bottom of Page 13. Again, it is our understanding that the purpose of the QAPP is to reevaluate the 0.037 mg/L *total phosphorus criterion* as established for Oklahoma's Scenic Rivers. The Scenic River designation for the Illinois River ends at the confluence of Baron Fork (upstream of Lake Tenkiller). Lake Tenkiller is neither a Scenic River nor does it have any applicable total phosphorus water quality standard. Furthermore, Lake Tenkiller is not listed on

Oklahoma's 303(d) list as impaired for TP. For these reasons, the inclusion of Lake Tenkiller would appear to be outside the scope of the reevaluation process of the water quality crierion designed to protect the aesthetic uses of Oklahoma's Scenic Rivers.

Again, we thank you for the opportunity to provide comments and look forward to working with the OWRB as it proceeds to finalize the QAPP and begins the reevaluation process.

If you have any questions concerning these comments, you can contact me by phone at (501) 682-0655 or by email at the following address: drown@adeq.state.ar.us.

Sincerely,

FOR

Steven L. Drown, Chief
Water Division
ADEQ

cc: Teresa Marks, Director, ADEQ
Ryan Benefield, P.E. Deputy Director, ADEQ
Sarah Clem, Water Quality Planning Branch Manager, ADEQ

April 22, 2011

MEMORANDUM

To: Steven Drown, Chief of Water Division, ADEQ
Edward Swaim, Esq., Chief, Water Resources Management, ANRC

From: L. Carl Yates, P.E. CY
Allan Gates AG

Comments on Oklahoma Water Resources Board
Draft QAPP for Secondary Data Collection

On behalf of the cities of Bentonville, Fayetteville, Rogers, Siloam Springs, and Springdale, we want to thank you for the opportunity to review the Draft QAPP for Secondary Data Collection and Draft Public Notice that the Oklahoma Water Resources Board circulated to the Technical Advisory Group. We are pleased to provide you with our comments on the draft documents.

As a general introductory matter, we wish to state that we agree with all the comments that ADEQ submitted to OWRB by letter dated April 14, 2011. To avoid repetition we will not attempt to reiterate those points, but we wish to make clear that we strongly agree with those comments.

1. Section A.5, Problem Definition and Background, pp 11-13.

Pages 11-13 of the Draft QAPP contain a background discussion that purports to describe the history of events leading up to, and following, the adoption of the numeric phosphorus criterion in 2002. We believe that description is erroneous and incomplete in several significant respects. However, we do not think it would be productive to engage at this time in a debate about the accuracy or completeness the QAPP's description of the historical background. We would simply note that we do not agree that the background description is accurate or complete and we assume that such disagreements can be taken up at a later date if and when they become material to any decision making.

2. <u>Section A.5, Objectives, pp. 13-14.</u>

   This section of the draft QAPP purports to describe the objectives of the project. Most of the description involves procedures that are specified by state or federal laws and regulations or the Statement of Joint Principles and Actions. Those provisions speak for themselves. We presume there is nothing about the description of the project objectives that is intended to depart from those requirements.

3. <u>Section A.5, Objectives, p. 13 & Section A.7, Quality Objective and Criteria, p. 15.</u>

   The descriptions of project objectives data quality objectives suggest that the decision to reaffirm or alter the numeric phosphorus criterion should be based on whether the criterion is best suited "to restore . . . the integrity of Oklahoma's Scenic Rivers." We question the idea that restoration is an appropriate basis for deciding whether to reaffirm or alter the numeric criterion for phosphorus. Unless there is very serious elaboration, the concept of restoration is not a legitimate basis for decision making. One can only guess "Restoration to what?" Restoration to pristine or undisturbed conditions would only be possible if all human development and population is to be removed from the watershed. We believe that protection of uses in compliance with Clean Water Act requirements is the appropriate guide for decision making is deciding whether to affirm or alter the criterion.

4. Section A.7, DQO1, p. 15, DQO2 p. 16 & DQO 3, p. 17.

The text of these sections suggests that downstream uses generally, and conditions in Lake Tenkiller in particular, are relevant to the selection of a phosphorus criterion in this proceeding. ADEQ's comments and previous correspondence challenge this notion. We emphatically agree. No phosphorus water quality standard has been adopted for Lake Tenkiller. The Scenic River criterion under review was adopted, as its name suggests, pursuant to the Oklahoma Scenic Rivers Act, Title 82 Okla. Stat. § 1451 *et seq.* Lake Tenkiller water quality is beyond the scope of the Oklahoma Scenic Rivers Act. Conditions in Lake Tenkiller are not relevant to a determination of what criteria are appropriate to protect values in the Scenic Rivers. Moreover, from a scientific standpoint, chlorophyll a and dissolved oxygen levels in Lake Tenkiller (the water quality parameters of most concern) cannot be managed through a phosphorus criterion applicable to the Scenic Rivers.

5. Section A.7 DQO 3, pp. 16-17.

This section suggests that published scientific literature and nutrient studies and models will be important, and perhaps primary, sources of scientific information for the review. We believe this is inappropriate. We believe the primary focus of the review should be on conditions in the river and the identification of criteria that are necessary to protect objectively identifiable conditions or values in the river.

6. Section A.7, DQO6, pp. 17-18.

This section purports to provide rules for decision making. These "decision rules" appear problematic in several respects. The "decision rules" appear to suggest that all participants agree to be bound by a majority vote. We do not believe that any participant has agreed that their views would be subservient to a majority vote. The "decision rules" also suggest that if the majority concludes there is not adequate scientific information to support a different value, the TAG is bound to recommend that no change be made in the criterion. This ignores a fundamental element of the Statement of Joint Principles and Actions. It is our belief that the current numeric phosphorus criterion is not based on any defensible scientific information. Arkansas parties agreed to defer challenging EPA's approval of the criterion under the Statement of Joint Principles and Actions, but no one agreed that the existing criterion would be presumed to be valid. Instead, we believe that all parties agreed to defer any challenge to the existing standard while significant steps were taken to reduce phosphorus loading in the watershed and time was allowed to pass so that the effects of those efforts could be observed. We believe that whatever decision OWRB ultimately makes, whether to reaffirm the .037 value or to select a different value, that decision must stand or fall based on the adequacy of the information that is actually presented to establish that the value is appropriate and necessary.

7. Section B.9.2 to B.9.4, pp. 21-23.

These sections of the draft QAPP repeat the focus on secondary literature, rather than on actual conditions in the relevant river segments. The comments previously offered by ADEQ and paragraph 5 above apply to these sections of the draft QAPP as well. In addition, we note that there is no mention of considering whether the literature or studies gathered involve watersheds with total acreage, land uses, and levels of human development comparable to the Illinois River watershed. We do not believe that any study can be considered to have value or relevance unless the TAG review addresses the extent to which the watersheds involved in the study are comparable to the Illinois River watershed.

8. Public Access.

We believe the data review should include steps that will assure any interested stakeholder timely identification of, and reasonable access to, all scientific information under consideration by the TAG.

ADEQ
A R K A N S A S
Department of Environmental Quality

January 14, 2010

Claudia Hosch (6WQ-P)
Associate Director
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Comments on the Memorandum for Model Selection for the Illinois River TMDL in AR/OK

Dear Ms. Hosch:

The Arkansas Department of Environmental Quality (ADEQ) would like to thank Region 6 Environmental Protection Agency (EPA) for allowing us to review and provide comments on Aqua Terra's November 22, 2010 draft "Model Selection for Illinois River Memorandum" (the Memo). Up to this point, EPA has responded only to comments on draft documents during conference calls. In an effort to provide clarity on the decisions that are made going forward, ADEQ requests EPA to provide written responses to our comments. We also ask EPA to notify us when draft documents are finalized.

The following comments have been developed with Arkansas stakeholders, including Rogers Water Utilities (Tom McAlister, Director) and consultants to Rogers Water Utilities, including Professor Marty Matlock, P.E., of the University of Arkansas, Professor Larry Roesner, P.E., of Colorado State University, and Wright Water Engineers, Inc., of Denver (Jonathan Jones, P.E., D.WRE, and Jane Clary, CPESC, LEED AP). Our comments include general and specific comments on the draft Model Selection Memo, as well as issues that we believe must be addressed in the forthcoming Model Simulation Plan. We hope these comments foster the information exchange necessary to ensure the usefulness of the models selected. Throughout this process, we will continue to emphasize that model outcomes are dependent upon the comprehensiveness and accuracy of the data utilized in calibrating and validating the models, and more importantly the capability of the models to simulate current conditions in the watershed for purposes of TMDL development.

Model Selection Memo

In general, we concur that the models selected in the Memo appear to be appropriate for the Illinois River Watershed, given the advantages and disadvantages characterized in the report. The selection of the Hydrological Simulation Program – Fortran (HSPF), integrated into BASINS, for watershed modeling is reasonable if the calibration and validation processes are transparent and well documented and funded at a level to enable Aqua Terra to conduct the analysis with full rigor.

ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
5301 NORTHSHORE DRIVE / NORTH LITTLE ROCK / ARKANSAS 72118-5317 / TELEPHONE 501-682-0744 / FAX 501-682-0880
www.adeq.state.ar.us

The selection of Environmental Fluids Dynamic Code (EFDC) for lake modeling is reasonable for lake hydrodynamics and water quality simulation. This model would be most advantageous in three-dimensional analysis; however, detailed bathymetry and sectional monitoring of Lake Tenkiller have not been conducted for more than 15 years. The sediment and nutrient regimes of the riverine, transitional, and lacustrian zones have changed in that time period. These data are critical for understanding and modeling the ecological productivity and hydrogeobiochemical elements in EFDC when analyzed at three dimensions. Adequate time and resources should be allocated to this project to obtain the needed data.

We submit the following specific questions and comments associated with the Model Selection Memorandum, followed by comments addressing important issues associated with the forthcoming model simulation plan, data adequacy and the inclusion of Lake Tenkiller in the modeling effort.

1. Page 1, Third Paragraph: This paragraph describes changes that have occurred in Arkansas related to "fast-growing urban areas" and "intensive agricultural animal production." Have there been changes in Oklahoma that should be similarly described? Further the geomorphological characteristics of the Illinois River in Arkansas are vastly different than the geomorphological characteristics of the Illinois River in Oklahoma. These differences should be characterized in the Memo.

2. Page 1, Fourth Paragraph: This paragraph notes the Illinois River in Arkansas is not listed as impaired for Total Phosphorus (TP) but states "several" tributaries to the Illinois River in Arkansas are impaired for TP and lists three examples (which happen to be the only examples possible). ADEQ has on numerous occasions maintained that these three tributaries have met and currently meet all their designated uses, and these tributaries have not been included on any Impaired Water Bodies List through an independent action of ADEQ. EPA added these three segments to Arkansas' previous 303(d) lists and supported its listing of these streams for TP by comparing ambient monitoring data with the national criterion for TP. However, neither ADEQ nor EPA has adopted this national criterion as the numeric water quality standard for TP. Arkansas' water quality standards contain a narrative nutrient standard—not a numeric TP standard. Consequently, the Memo should be revised to reflect that, prior to the 2010 303(d) list, three (not "several") streams were added by EPA to Arkansas' 303(d) list and, furthermore, it has been demonstrated through an intensive two year study concluding in 2009 that two of those tributaries (Osage and Spring Creeks) meet all designated uses and are not impaired by TP.

3. Page 5, Third Paragraph: The report references the "Illinois River Watershed Partnership Watershed Management Plan." How does Aqua Terra currently envision that this watershed management plan will interface with the development of models to support the TMDL?

4. Page 28., #5: How will cyanobacteria be addressed since EFDC does not simulate cyanobacteria?

Model Simulation Plan

While the models selected are considered reasonably appropriate for modeling conditions in the basin, the usefulness of these models will be contingent on the proper use of the most recent existing data, model calibration and validation, and explicit incorporation of uncertainty for modeling results. While these issues are anticipated to be addressed in the forthcoming Model Simulation Plan, the following comments are provided to EPA to aid in the preparation of that plan.

1. It will be important to document how agricultural loadings and BMP practices are being simulated in the HSPF model.

2. Page 7, Table 2.2 states that Basins/HSPF can provide "detailed instream routing and WQ processes, including sediment-nutrient interactions." Similarly, page 13 states, "The sediment transport and instream water quality capabilities of HSPF provide a better process-based representation of the fate and transport processes for nutrients, including phosphorus, along with sediment-nutrient interactions and scour/deposition impacts with the sediment bed. This is expected to provide an improved simulation of both point source and nonpoint source contributions of phosphorus both to the OK/AR state line and to Lake Tenkiller." Can these sediment-nutrient interactions and scour/deposition processes be accurately simulated in the Illinois River Watershed? We believe this is an important issue, given that much of the phosphorus movement will be in association with sediment. We request EPA to provide more information regarding how this will be accomplished in the Model Simulation Plan.

3. Pages 12 and 13, Bullet Points Comparing HSPF and SWAT Models: Ability to model karst topography is not included in this list. Will HSPF be able to adequately incorporate surface water/groundwater interactions and are there enough data to provide calibration and validation of this important factor? We request EPA to further describe how this issue is addressed in the Model Simulation Plan.

4. The minimum level of rigor for allocation of loads in a complex watershed TMDL should be calibration and validation over the range of expected outcomes. A suite of calibration metrics should be applied to analyze these processes: hydrology (base flow and storm conditions) and water temperature (indicator of groundwater and interflow calibration) at each USGS gauging station; land-based constituent loading parameters; in-stream processes including sediment and nutrient biochemical processes; and biotic processes, including chlorophyll density and concentrations.

5. Both models should be calibrated and validated across conditions that bracket existing and expected future conditions, to the extent feasible. Using a model to predict a parameter or condition outside the range of calibration is not an appropriate level of rigor, given the substantial potential investments that may be necessary to reduce loads as a result of model outcomes. The challenge for Aqua Terra in the Illinois River Watershed is that conditions have been changing significantly for the last 10 years. Phosphorus

loads from point and nonpoint sources have been decreasing, sediment loads predominantly from hydrologic regime alteration have been increasing, and stream bed sediment and gravel loads have been increasing, while size has been decreasing. Riparian cover has decreased across the upper Illinois River Watershed. Calibration and sensitivity analysis using data from before 2004 will not represent the current and future condition of this ecosystem.

6. Sensitivity analysis should be performed for both models as part of the calibration and validation process. The most sensitive input variables that impact the outcome parameters of concern should be characterized for each of the bracketed conditions. The relative sensitivity of each input variable should be stable across simulated conditions.

7. Uncertainty analysis should be performed to determine the variability and uncertainty in model outputs associated with variability and uncertainty in model inputs. Without uncertainty analysis, the utility of the model to predict outcomes for critical parameters is compromised. Any remediation strategy should predict outcomes that are significantly different from current conditions. Failure to predict significant changes in outcome parameters undermines the utility of the model for policy development.

8. For the reservoir modeling, the simulation plan should address reservoir operations and management options as part of the long-term strategy for protecting lake water quality.

ADEQ emphasizes the critical importance of the proper use of existing data, model calibration and validation, and performing the sensitivity analysis and uncertainty analysis. We highlight the importance of all these steps, in part, due to a statement made in the "Quality Assurance Project Plan Water Quality Modeling and TMDL Development for the Illinois River Watershed" (Aqua Terra December 15, 2009). This document acknowledged the need to consider sensitivity analysis and uncertainty analysis, but qualified this need with the caveat, "Subject to the concurrence of the EPA WAM and subject to budget limitations..." **Limited time and resources must not impede the proper development, calibration, and validation of the HSPF model**. We ask EPA and Aqua Terra to review the existing schedule and budget to determine whether the proposed schedule and funding are adequate to accomplish the goals of the project—that is, to develop reliable hydrologic and water quality models for this extensive and complex hydrologic area, including a large reservoir. If schedule and budget are not adequate, we ask EPA and Aqua Terra to determine how much additional time and funding are required to adequately accomplish the project goals or how this project can be modified to ensure the proper development, calibration and validation of the watershed model.

We believe the project schedule provides that a draft "Simulation Plan" will be available within four to six weeks. ADEQ respectfully requests adequate time to review this very important document with the Arkansas stakeholders. Accordingly, we ask that a minimum of six weeks be provided for review and comment on that document

Data Adequacy Issues

On page 28 of the Memo, Aqua Terra states, "We believe that adequate data are available to support application of either [lake] model." ADEQ previously provided to EPA comment letters from Arkansas stakeholders raising concerns about data adequacy for model development and calibration (see Attachments 1 and 2 to these comments) Formal responses to these comments have not been provided by EPA, so it is not clear how these issues are being resolved. These data adequacy issues are not repeated in this comment letter, but remain substantial concerns. Irrespective of which models are selected, there must be adequate physical, chemical and biological data to assure that the models realistically represent the Illinois River, its major tributaries and Lake Tenkiller. Representative areas of concern include:

1. Use of current land use conditions, particularly given significant changes in land use in recent years and changes projected to occur in the coming years.

2. Use of the most current and comprehensive water quality data (see specific comments in Attachments 1 and 2). The project should reflect current water quality conditions, including recent data, and not rely on historical data or extensively on reference stream data.

3. Use of the most reliable rainfall source, which is believed to be NexRad.

4. Use of an appropriate data quality screening process.

5. Full consideration and incorporation of all nutrient sources around Lake Tenkiller in Oklahoma, in addition to those addressed for the main stem of the Illinois River.

Lake Tenkiller

As a final point, it seems important to again address the issue of Lake Tenkiller. Although including the lake was contemplated in the Project plan, modeling Lake Tenkiller appears to be an entirely separate project from the Illinois River TMDL. The lake's inclusion is important for Oklahoma, but this modeling effort seems to range far beyond the scope of EPA's Illinois River TMDL and may divert limited resources needed to achieve the Project's objectives. ADEQ has previously indicated that it has no objection to including Lake Tenkiller (see attached December 1, 2010 letter), assuming the results of that modeling effort have no impact on the Arkansas portion of the Illinois River. However, if modeling the lake consumes scarce resources needed to achieve reliable watershed modeling results for TP in the Illinois River, then the lake modeling may have unintended adverse impacts on Arkansas. In short, if time and financial constraints require the Project to be modified, a logical place to "cut-back" would be in the lake modeling. It has been our understanding that the purpose of the Illinois River TMDL Project was to address the impairment in the Oklahoma portion of the Illinois River due to the exceedance of the 0.037 mg/L *total phosphorus standard* established for Oklahoma's Scenic Rivers. The Scenic River designation for the Illinois River ends at the confluence of Baron Fork (upstream of Lake Tenkiller). Lake Tenkiller is neither a Scenic River nor does it have any applicable total phosphorus water quality standard. Furthermore, Lake Tenkiller is not listed on Oklahoma's 303(d) list as impaired for TP. For these reasons, the lake modeling would appear to be outside the scope of EPA's proposed Illinois River TMDL Project and should not be included if doing so diverts limited resources from the principal project purposes. For clarification, we ask EPA to explain how the Lake Tenkiller water quality standards interface with the 0.037 mg/l TP goal (at the state line).

Again, we thank you for the opportunity to provide comments and look forward to working with EPA as it proceeds to finalize the Model Selection Memo and begins drafting a Simulation Plan. If you have any questions concerning these comments, you can contact me by phone at (501) 682-0629 or by email at the following address: bailey@adeq.state.ar.us

Sincerely,

John Bailey, P.E.
Permits Branch Manager, Water Division

Attachments:

1. January 6, 2010 Letter from 2010 Letter to Mr. John Bailey, Arkansas Dept. of Environmental Quality from Tom McAlister, Rogers Water Utilities Regarding Comments on the Draft Illinois River Phosphorus TMDL QAPP.

2. August 30, 2010 Letter to Mr. John Bailey, Arkansas Dept. of Environmental Quality from Tom McAlister, Rogers Water Utilities Regarding Comments on Draft Preliminary Data Review and Analysis for Water Quality Modeling and TMDL Development for the Illinois River Watershed.

3. December 1, 2010 Letter to Miguel I. Flores, USEPA Region 6 from J. Ryan Benefield, P.E., Deputy Director, ADEQ Regarding EPA's Illinois River TMDL Project.

cc: Teresa Marks, Director, ADEQ
Ryan Benefield, P.E. Deputy Director, ADEQ
Steve Drown, Water Division Chief, ADEQ
Sarah Clem, Water Quality Planning Branch Manager, ADEQ
Robert George, V.P. & Associate General Counsel, Tyson Foods, Inc.
J. Randy Young, P.E., Executive Director, ANRC
Tom McAlister, Director, Rogers Water Utilities
Steven A. Thompson, Executive Director, Oklahoma Department of Environmental Quality
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Tom Elkins, Administrator for Cherokee Nation Environmental Programs, Cherokee Nation
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ROGERS WATER UTILITIES

"SERVING ROGERS - PROTECTING THE ENVIRONMENT"

January 6, 2010

Mr. John Bailey
Arkansas Department of Environmental Quality
ADDRESS
CITY STATE ZIP

Re: Comments on the Draft Illinois River Phosphorus TMDL QAPP

Dear Mr. Bailey:

Rogers Water Utilities has retained Wright Water Engineers, Inc., (WWE) to review and comment on the December 15, 2009 version of the document entitled "Quality Assurance Project Plan Water Quality Modeling and TMDL Development for the Illinois River Watershed," (draft QAPP) prepared by Aqua Terra Consultants of Mountain View, California. WWE was joined in this review by Professor Marty Matlock, Ph.D., P.E., CSE, of the University Arkansas-Fayetteville, and Professor Larry Roesner, Ph.D., P.E., D.WRE of Colorado State University. The purpose of this letter is to summarize our major comments on the draft QAPP. Rogers Water Utilities would urge ADEQ to include these comments in its comments on the draft QAPP.

The draft QAPP is well written—the text is clear and logical. There are many valuable components of quality assurance proposed, and many EPA and Aqua Terra staff have been assigned to promoting quality in the overall project. Aqua Terra is highly qualified to perform the necessary modeling, and apparently has prior experience in the Illinois River watershed. The QAPP indicates that Aqua Terra may bring in additional consultants to assist them, which could be valuable. The four models that are currently under consideration for this TMDL are, in a general sense, appropriate, although our review team offers some comments (below) on potential model limitations. The QAPP appropriately emphasizes the importance of proper model calibration and validation, and specifies performance criteria. The QAPP indicates that wide-ranging data sources will be reviewed, which is essential.

We turn now to potential concerns and recommendations for the draft QAPP.

Page 1, 4th Paragraph—Is the scope of this effort limited to watershed model development or does it also include applying the model to determine any necessary point and nonpoint source phosphorus reductions?

Page 3, Section 2, provides four Project Quality Assurance/Quality Control Goals for the project. These goals are critical for legitimate policy development from complex modeling activities. However, the QAPP does not provide an explicit description of how each goal will be accomplished. For example, the goal of "Transparency" implies participation from stakeholders throughout the process.

No mechanism has been proposed to engage stakeholders in this process, other than EPA and state agencies. The municipalities whose NPDES permits will be affected do not have a voice in this process. The Cherokee Nation, which has unambiguous jurisdiction over the Oklahoma portion of the Illinois River, does not have a voice in this process. The legitimacy of the analysis is dependent upon some level of direct participation and agreement to the process by the major stakeholders.

Page 3, Section 2–One of the stated goals for the work assignment is "Transparency." The text indicates that the documentation will make it clear which sources of data are used. It would be helpful if the documentation could also indicate which potential data sources were not used.

Page 8, Section 4.3, concerning "Dispute Resolution"–The QAPP notes that there will be "open and frank communication among members of the quality and technical staff." Although this will be important, what about open and frank communication with representatives of the state agencies and with outside parties who can offer important perspectives and data and who will be affected by the ultimate outcome of the TMDL?

Page 9, Section 5.0 "Project/Task Organization"–The first paragraph states that the objective "is to develop a scientifically robust and defensible watershed model to determine reductions in phosphorus loads needed to meet water quality standards in both states, Arkansas and Oklahoma." However, on page 14, the stated goal is limited to Oklahoma, without mention of Arkansas. Then, on page 18 in Section 7.1, the text again mentions both states. Can the draft QAPP authors please clarify?

Page 9, Section 5.0, the objective of Work Assignment (WA) 3-36 is "to develop a scientifically robust and defensible watershed model to determine reductions in phosphorus loads needed to meet water quality standards in both states, Arkansas and Oklahoma." The numeric criteria for Oklahoma are described, but not those for Arkansas. If the goal is to meet the Oklahoma standard at the Oklahoma state line, and to meet the narrative criteria of Arkansas, that should be explicitly stated. It would not be appropriate to apply Oklahoma's standard as the Arkansas standard, or to establish a daily load for both Arkansas and Oklahoma sources to meet Oklahoma's standard.

Furthermore, the decision of the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015, (April 25, 2006), and subsequent memorandum from EPA Assistant Administrator Benjamin Grumbles, the recommendation is that load allocations be made on a daily basis, unless explicitly justified otherwise. Thus, the time-step of the load allocation should be explicitly stated in the goals and justified (daily, monthly geometric mean, annual not-to-exceed, etc.).

Page 9, Section 5.1–Can Aqua Terra elaborate on the significance of its past modeling efforts in the Illinois River watershed, such as data limitations, important lessons learned from the modeling, anticipated limitations, etc.?

On Page 9, Section 5.1–The data compilation section describes what data will be used in calibrating and validating the model(s) for load allocation. This dataset is incomplete and inadequate. No USGS sites in Arkansas are included in Figure 4, probably because this figure was the product of Storm et al., (2006). While we recognize that this does not mean that Arkansas USGS stations will not be used, it does raise questions regarding the scope and rigor of the effort for data compilation. The model cannot be calibrated effectively without the Arkansas sites.

Additional concerns are raised regarding the data temporal context for calibration and validation. For example, the City of Springdale AR completed upgrades to its wastewater treatment plant (WWTP) in 2004 that reduced TP in the outfall to Spring Creek from >5 mg/l to <1 mg/l. Only after 2005 did instream total phosphorus (TP) concentrations begin to reflect the total impact of Springdale's reductions because of stream channel sediment release of P. If the model selected for the TMDL is calibrated with pre-2004 data, it will not represent current conditions. In fact, calibrating the model under pre-2005 conditions could result in boundary condition failures for validation. Predicting what was will have little utility for developing the TMDL.

The QAPP goes on to describe nonpoint source (NPS) load estimates on Page 10. As with point source (PS), NPS loads and production activities have changed in the basin over the past 4 years. Dr. Storm's initial model was for 2005 land use. That dataset was incomplete at the time (as are almost all NPS model datasets) and is out of date now. It will not allow for contemporary assessment of loads from NPS activities. A new, recalibrated model of the entire system that incorporates the impact of the $60 million Conservation Reserve Program (CRP) impact on riparian zone protection should be conducted. Failure to consider this and other land use management changes in the basin will undermine the legitimacy of the TMDL allocation.

Page 10, Section 5.1–How will Aqua Terra and EPA determine what assumptions will be made regarding poultry litter management practices?

Page 11, Section 5.1–Will Tenkiller Reservoir operational practices change in the future, and if so, how will this effect reservoir operations? This emphasizes the importance of the observation that the data relied upon must reflect contemporary point and nonpoint source management practices as well as anticipated (short term) management practices, such as operations of Tenkiller Reservoir.

Page 11, Section 5.1–The draft QAPP notes that, per the WA request, within 15 days following QAPP approval, Aqua Terra will complete and submit a data gaps analysis report. Is this a sufficient amount of time to develop a report of such great importance? In addition, what happens if additional data gaps emerge as the project proceeds? Will state representatives be able to comment on data gaps as the modeling effort unfolds?

Page 12, Section 5.3, provides a description of water quality model development. The goal as stated is to develop both watershed and reservoir models for this system, and to link them together. As stated, sediment fate and transport is a key variable for watershed process modeling of TP, and is not addressed well by SWAT. HSPF has some improvements in sediment transport, but the hydrogeology of this region is Karst-dominated, with significant interflow and surface-groundwater interactions. These become particularly dominant during the critical flow period of July - September. HSPF does not simulate this complex mass balance well, but rather uses mass losses and returns as calibration points for flow. A more appropriate hydrologic model for this system could potentially be MIKE-SHE or similar complex hydrologic models; unfortunately, these are not public domain models and thus violate the transparency criterion for this TMDL. Reservoir modeling is similarly challenging. The EFDC might serve the purpose of complex flow balance, but the model was released in 2002, has not been updated (at least publicly) since, and the GIS preprocessor has still not been released. Calibration of hydrology in this system for daily flows is going to be a major challenge. AQUATOX was not recommended for use in TMDLs by the EPA peer review panel (Dr. Matlock served on the first two) because of complexity and difficulty with daily flows in case studies.

The criteria for selection of the models are not clearly stated; only that the team will perform "further evaluation of the previous applications..." and give "consideration of the specific modeling needs of EPA Region 6." This raises a number of concerns that should be addressed in the QAPP. The stated objective of the project is "to develop a scientifically robust and defensible watershed model to determine reductions in phosphorus loads needed to meet water quality standards in both states, Arkansas and Oklahoma. This watershed model will serve as a tool for sound technical decisions on appropriate point and nonpoint source controls to meet those standards." This should be the criterion for selection.

Page 14, Section 5.3, says "Following the model calibration and validation, and in consultation with the EPA WAM, we will develop various point and nonpoint source reduction scenarios to meet the State of Oklahoma's TP water quality criterion." There is no discussion in the QAPP as to how this will be accomplished. There is no acknowledgement that there will be wastewater treatment plant flow and quality data that will need to be integrated into the calibration.

Page 15, Section 6, describes data acquisition. The distinction between primary data, secondary data, and supplemental data is not clear. The use of each class of data is not clear. The presumption is that secondary data are those that were not collected for this TMDL; thus all data used in this analysis will be secondary or supplemental data. How will the Team ensure that all relevant data are inventoried, categorized, and utilized appropriately? How will data usage be documented? How will data use be attributed? How will the Team integrate data across studies and over time? Each of these questions should be explicitly addressed in the QAPP.

Page 15, Section 6—The authors state, "To a large extent, the quality of a modeling study is determined by the expertise of the modeling and quality assessment teams." Although we agree with the importance of the expertise of the modeling study team, we also believe that the quality of the underlying data that the model relies upon is extremely important. We believe that the draft QAPP should note the importance of comprehensive and contemporary data upon which the model was based.

Page 16, Section 6.1–The draft QAPP talks about the need to "maintain a continuing dialog with the EPA WAM on technical data issues." Can this statement be broadened to include continuing dialog with the relevant state agencies?

Page 18, Section 7, describes model setup and calibration. As indicated earlier, TP concentrations in this system due to point source contributions are on a temporal trajectory downward. Calibration and validation using temporal data that do not correct for or account for this trajectory will introduce significant bias. The purpose of the model is to be able to predict loads of TP from PS and NPS in the basin. The criteria for calibration are reasonable IF the data are representative of the system being modeled. How will this change over time be accounted for in modeling the system?

Page 19, Section 7.1–This section includes a quotation, in italics, regarding the 30-day geometric mean of 0.037 mg/L adopted by the State of Oklahoma. Can the draft QAPP please clarify the distinction between meeting this concentration versus managing phosphorus loads, which is frequently listed as an objective in the draft QAPP?

Page 19–The following statement is made: "The overarching objective is to identify/evaluate phosphorus management scenario(s) that achieve (in the waters of the Illinois River at the border between the States) the numerical water quality standard that the State of Oklahoma adopted in 2002 for phosphorus. . . While the stated purpose of this study is as stated above, EPA recognizes the value of performing holistic modeling of the Illinois River Watershed that includes consideration of Tenkiller Lake." Please clarify what value is recognized in doing this additional holistic modeling.

Page 20, Table 2–A monthly and annual time-step is too long to accomplish the stated objectives of the draft QAPP. For example, wet weather issues will probably need to be addressed on a daily time-step.

Beginning on Page 23, Section 8 describes assessment and oversight. On pages 24 and 25 of this section, the team acknowledges the need to consider sensitivity analysis and uncertainty analysis, but qualifies this with "Subject to the concurrence of the EPA WAM, and subject to budget limitations..." The seven tasks indicated on page 25 (data acquisition assessments, model calibration studies, sensitivity analyses, uncertainty analyses, data quality assessments, model evaluations, and internal peer reviews) are not optional for competent TMDL assessment. The costs to stakeholders resulting from implementation of this TMDL could potentially be measured in millions of dollars. Consequently, the effort should not be shorted due to "budget limitations."

All data points have some uncertainty about them. The higher the uncertainty associated with an input variable, the less certain any results derived from that variable. Sources of uncertainty are a function of many facets of data, including reliability of measurements, sample size relative to total populations, representativeness of the sample, geographic variability, and many other characteristics. Sources of uncertainty can generally be categorized as (1) variability and (2) knowledge uncertainty. Variability is the inherent noisiness of a system, the stochastic nature of a process. An example would be rainfall intensity; no matter how much you measure rainfall intensity, it will still vary over time and space because rainfall is inherently variable, though the characterization of the distribution of probable outcomes can be enhanced. Knowledge uncertainty is a measure of our ignorance of a system; it could be defined, given knowledge about the system (data), but those data are often not available for the given analysis. Each type of uncertainty exists in any complex analysis, especially in TMDLs. The major sources of uncertainty are knowledge uncertainty associated with water quality data. Honest assessment and development of a TMDL requires quantifying both types of uncertainty in the output. Failure to consider uncertainty in complex system modeling is simply intellectually dishonest.

Page 24, Section 8.0–This section speaks of "limitations in scope and/or budget." At this stage in the process, does EPA and/or Aqua Terra anticipate that there will be significant limitations in the scope and/or budget? If so, these should be disclosed to relevant parties and the implications should be defined. How will any such limitations be addressed?

Page 25, Section 8.0–This section notes "internal peer reviews." Can this be broadened to include external peer reviews?

On Page 27, Section 10.0–"Project breakpoints" are listed. Will draft deliverables of each of the listed items be made available to state representatives for review?

Page 27, Section 10 describes seven project breakpoints. However, no clear timelines are provided, no critical path analysis is presented, and no deadlines for completion are provided. The QAPP should have each of these elements.

In closing, our review team has a few general questions, as follows:

1. A number of important major issues were raised in the draft QAPP, but there was no follow-up discussion. These issues include POTWs, poultry farm runoff, blue-green algae and turbidity. It would be helpful for the final QAPP to elaborate on each of these topics.

2. We did not find discussion regarding background water quality. Are there adequate data to determine what the background phosphorus concentrations in this watershed would be in the absence of man-caused point and nonpoint sources? Will the watershed model be utilized to determine whether the Oklahoma standard of 0.037 mg/L would be attainable if there were no anthropogenic point and nonpoint sources? This is an essential element and the final product should include this information.

3. Additional discussion of how wet weather issues will be addressed is merited, such as the process to define the broad categories of nonpoint sources, how event mean concentrations for each land use category will be

assigned, what approach will be used for establishing BMP performance, assumed effectiveness of hydrologic controls in urban areas, etc. The model simulation period must be long enough to include large storms that will have associated high sediment loads (and phosphorus concentrations).

4. The draft QAPP does not appear to discuss whether and how the model will be updated in the future in response to new data, new regulations or other changing factors. This would be helpful.

5. How do Tenkiller Reservoir water quality standards interface with the 0.037 mg/L total phosphorus goal (at the state line)? If point and nonpoint discharges in Arkansas are going to have to meet a 0.037 mg/L standard at the state line, why is the model being extended downstream into Tenkiller Reservoir?

6. We are curious to learn what, specifically, the 0.037 mg/l standard represents and how that will relate to the constituent, "TP," as simulated in the model. Does this geometric mean apply to nonsettleable phosphorus (dissolved plus colloidal material) that would be measured in a sample taken during normal flow regimes when bottom sediment has not been scoured and entrained into the water column, or does it also include the high flow regimes when bottom sediment that contains attached phosphorus has been entrained into the water column and would be captured in a water sample taken under those conditions? Depending on the answer, it is important to know whether the collected samples data were filtered during high flow events and, if so, the size filter opening. Are the modelers optimistic that they will be able to reasonably track the fate and transport of TP in river sediment in light of potential model and data limitations?

On behalf of Wright Water Engineers, Inc., Prof. Marty Matlock, P.E., and Prof. Larry Roesner, P.E., the Rogers Water Utility sincerely appreciates the opportunity to offer these comments for your consideration. In the event you have any questions or need additional information to assist in forwarding these comments to EPA, please do not hesitate to contact me.

Very truly yours,

Tom McAlister, Manager
Rogers Water utilities

cc EPA
Aqua Terra
Chuck Nestrud
File: Comment letter to ADEQ re QAPP for Illinois River Watershed TMDL, 1-6-10

Via email
Mr. John Bailey
Arkansas Department of Environmental Quality
5301 North Shore Drive
North Little Rock, AR 72118

Re: Comments on Draft *Preliminary Data Review and Analysis for Water Quality Modeling and TMDL Development for the Illinois River Watershed* (Prepared August 3, 2010 by Aqua Terra Consultants, Mountain View, CA, for the U.S. EPA)

Dear Mr. Bailey:

Rogers Water Utilities sincerely appreciates the opportunity to comment on the draft document noted above, which we will subsequently refer to as the ―Data Review Report. ‖ As you may recall, Rogers Water Utilities commented on the Draft Illinois River Phosphorus TMDL QAPP in a letter on January 6, 2010, and we continue to maintain considerable interest in the development of this TMDL. To assist us with reviewing the Data Review Report, we have again engaged Wright Water Engineers, Inc. (WWE)[1] to assist in preparation of the comments provided in this letter.

As was the case in our January 6, 2010, letter, we have many positive comments regarding the draft Data Review Report; for example:

The report is well written—it is comprehensive, understandable, with helpful supporting graphics, well referenced and professional.

Aqua Terra has obtained data from many different sources, in both Arkansas and Oklahoma, and listed many of the data gaps they have uncovered to date. Aqua Terra staff demonstrate familiarity with the Illinois River watershed from past modeling experience.

Aqua Terra has acknowledged the importance of the karst geology that characterizes a significant part of the watershed and has stated that they are currently determining how to best represent karst characteristics in the model that will be selected for the Simulation Report.

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1 These comments also include review and input from WWE's peer reviewers/advisors for this project, Dr. Larry Roesner, P.E., of Colorado State University, and Dr. Marty Matlock, P.E., of the University of Arkansas.

For the available hydrologic, water quality, land use and other data that they will be drawing upon, Aqua Terra has clearly indicated the time period during which the data were collected. This will be very helpful when weighing the comparative value of the various datasets as the model is developed. For example, older data will not represent upgrades in municipal and industrial wastewater treatment facility performance or current land use.

The Data Review Report indicates that the best available land use dataset, collected during 2001, is old, and they will attempt to address this shortcoming.

The Data Review Report correctly indicates that channel sediments can be an important sink/source of phosphorus, and duly notes the limitations of the currently available data of this kind.

The authors refer to not only model calibration but to validation as well, which causes us to be optimistic that the final models will do a reasonable job of reflecting —real world || conditions.

We concur with the important language at the bottom of page 37 which emphasizes the importance of modeling —all significant sources of phosphorus. || Given the great regulatory and financial significance of this phosphorus TMDL, particularly in light of historic interactions between Oklahoma and Arkansas, it will be essential for the models to properly represent all significant phosphorus sources as well as the behavior of phosphorus in the Illinois River, its tributaries and Tenkiller Reservoir.

The remainder of this letter provides specific questions and comments on the Data Review Report. Attachment 1 provides Dr. Marty Matlock's comments, which focus primarily on additional data sources that should be included in the report.
Addressing Identified Data Gaps: The report identifies much available data that will be considered for use in the model as well as various data gaps and relative adequacies of the data. A summary list of data that will be pursued due to the identified data gaps and inadequacies would be helpful and important in ensuring that these data gaps are appropriately addressed. The —Data Deficiencies for GIS Coverages || provides a good start on such a list, noting the following data deficiencies:

NRCS Hydrologic Soil Groups (*WWE Note: GIS soil group coverage should be available through the NRCS, located in Field 18 of the table "muaggatt."*)

More recent land use/land cover data

Location of known karst formations

Animal populations and distribution

Fertilizer and manure applications

Soil nutrient concentrations

What steps will be taken to address these and other data deficiencies between now and the modeling effort? Will targeted data collection occur, and if so, can the way that this will occur please be explained?
Baseline Dataset: A number of the datasets that Aqua Terra includes in the data summary are pre-2004 data. However, as explained on page 3 of our January 6 letter, utilizing pre-2004 data will not represent current conditions. Calibrating the model under pre-2005 conditions could result in boundary condition failures for validation. Timeframe is an important factor in assessing adequacy of the existing dataset.

Relationship to Previous and Concurrent Efforts: We have these questions regarding use of data from previous and ongoing efforts:
Aqua Terra does a nice job of summarizing previous computer modeling efforts in the watershed. In the final draft, could Aqua Terra elaborate on data gaps/deficiencies that were identified in these past modeling studies, and provide an update as to whether these gaps/deficiencies have been addressed? If not, what are the implications for the current modeling effort? As an example, the QAPP noted that Storm (2006) relied on a relatively simple representation of riverine processes for Total P—was this because of data limitations that will also affect the current modeling effort?

Additionally, the Data Review Report notes that the —Illinois River Watershed Partnership Watershed Management Plan ‖ (for the State of Arkansas) was recently published and that there is a —comparable effort ongoing for the Oklahoma portion by the Oklahoma Conservation Commission. ‖ How will the modeling effort/TMDL interface with the Arkansas and Oklahoma watershed management plans?

We asked our utilities attorney to comment on the advisability of utilizing data from the ongoing litigation involving the State of Oklahoma and the poultry industry. In this regard, we observe that before raw data from any source are used, Aqua Terra should independently verify that the data are complete, reliable and verifiable, including a thorough a review of sample collection and laboratory analytical QA/QC procedures. To the extent that raw data are included in a report prepared for litigation, the raw data, but not the interpretive report, may be an appropriate source of information, provided the raw data are found to be complete, reliable and verifiable.

Figure 2-4, —USGS Stream Gage Locations in the IRW, ‖ indicates that there was only one USGS station in Arkansas used in previous HSPF and SWAT models.

By contrast, five were used in Oklahoma upstream from the reservoir. Why is there such a discrepancy?
Background Conditions: Background loading is a key component of the TMDL load allocations; however, neither the QAPP nor the Data Review Report provides much information in this regard. Are existing data adequate to determine background phosphorus concentrations and loads in this watershed? Fundamentally, it is important to know whether background sources would cause the Oklahoma standard of 0.037 mg/L to be exceeded in the absence of anthropogenic point and nonpoint sources.

Land Use Data: Section 3.3 addresses land use. We have questions regarding how both urban and pervious land use data will be integrated, as well as specific questions related to agricultural management practices.
With regard to pervious areas, we presume that Aqua Terra will identify different kinds of forest cover, meadows, pastures and other areas that are largely pervious. In our experience, in these areas, it will be important to realistically represent surface runoff, interflow (both —quick || and —delayed || interflow), groundwater return flow and deep groundwater loss. Are there watershed-specific data for these factors that Aqua Terra has been able to locate? We believe that defining the nature of return flows to the surface stream system is very important because phosphorus concentrations (and types of phosphorus) will vary depending on the nature of the return flow.

With regard to the cropland GIS data layer, how will NLCD data be adjusted to reflect 2005 – 2007 land use for non-cropland land uses? What percent of the basin is cropland and covered by the CDL? An additional issue related to characterizing agricultural land use in the model includes management practices such as crop rotation and varying land use conditions due to demand for product. Will these practices be taken into consideration with regard to agricultural land use characterization? The ability to account for such factors should be a consideration in model selection, given the significant land area dedicated to agriculture in this watershed.

With regard to urban land uses, runoff quantities and quality, the Data Review Report has very little discussion regarding urban runoff quantities or quality, use of BMPs, and how the hydrology will be simulated, depending on the timestep selected for modeling. We presume that this type of information will be more clearly described in the Simulation Report.
Precipitation Data: How will data from the five stations with hourly precipitation data be adjusted to represent rainfall in other parts of the watershed? It appears that none of these stations are in the watershed itself. Does the Fayetteville Airport have hourly data that could be used? If only hourly data are available, will that time step be sufficient to simulate runoff from urban areas?

Water Quality Data: We recognize that it is very difficult to model the various forms of phosphorus, including transformations, in a system of this size and complexity. Nevertheless, we were anticipating more discussion of this topic in the Data Review Report. It is not clear whether adequate data are available for the various water chemistry parameters that affect phosphorus transformations/chemistry. Per the Executive Summary, Aqua Terra indicates that the water quality data —appear to be adequate based on this initial assessment || and will address this further in the Model Simulation report. We concur that a more thorough evaluation of the adequacy of the water quality data is needed. Specific comments include: With regard to the STORET data, how many of the stations include flow data taken at the time of water quality sampling? Does the CDM/USGS effort include both flow and water quality?

Hardness should be among the constituents included in the phosphorus model since it influences the chemical processes that precipitate and dissolve various compounds of phosphorus into and from stream sediments and minerals. Hardness may be particularly important in karst areas. Additionally, alkalinity may also be important (particularly in

Tenkiller Reservoir) due to its buffering effect on pH, which in turn affects phosphorus transformations.

Phosphorus Transport/Sources: Delivery processes for nutrients can include surface water, groundwater, atmospheric deposition, release from sediment, and natural background/other sources. The primary emphasis of the Data Review Report is on surface water. Although it may be determined later that surface water is the dominant source of phosphorus, information on other sources should not be discounted in the early stages of the project. For example: Regarding Table 1.1, ―Data Requirements for Typical Watershed Model Applications, ‖ we do not see an item that addresses the interrelationship between groundwater and surface water, yet this is very important. Similarly, there seems to be more emphasis on storm runoff than on baseflows.

Internal loading of phosphorus from reservoir sediments in Tenkiller Reservoir could be a significant limiting factor for modeling the lake and the effect of management alternatives during later stages of the project.

The report recognizes that atmospheric deposition of phosphorus, known to be significant, is a data-gap item, and attempts will be made to try to estimate it. It is our understanding that data for atmospheric loading of phosphorus may be available through the USGS National Atmospheric Data Program (NADP), even though such data are not explicitly listed on the NADP website.

Channel Characteristics: The Data Review Report discusses the significance of channel cross sections and sediment-bound phosphorus movement through the system. This is noted as an area where more data are desirable. Based on the information presented in the report, it is not clear how much of the stream has adequate cross-section data or geomorphic/ecologic data, nor is it clear how much more additional data are required. Will it be feasible to gather enough data for this key topic, given the geographic scope and diversity of channel types in the watershed? What is the plan for acquiring these data and how current are the existing cross-section data? Also, will sediment contributions from channel scour be distinguishable from surface runoff? Will the data collected, particularly for higher order streams, be sufficient to distinguish between varying bed load characteristics as stream order and morphology change?

Geology: In addition to soils data, are GIS data available with information on geology/bedrock? EPA's Nutrient TMDL Guidance (1999) notes that streams draining watersheds with phosphorus-rich geologic formations (such as those of sedimentary or volcanic origin) can be sources of phosphorus loading. Although this may not be a specific input parameter for the model itself, this information may be important to consider, since it could affect background loading.

Effect of Karst Geology: As previously noted, we are pleased that the report includes consideration of karst geology. We anticipate that karst geology may have both water quality and hydrologic implications for modeling. Key comments include:

General: From Figure 3.5, it is difficult to discern how the karst areas relate to the stream system and the watershed in general. An overlay onto the stream system would be helpful in assessing adequacy of the karst information. This is an area where a local karst expert would be very helpful in appropriately accounting for karst conditions in the model.

Hydrology: Karst formations in the watershed could significantly reduce storm runoff, and stream flows could be affected by water flowing out of the karst layer into the river or into the karst layer from the river. If the karst intersects the river channel, this could result in additions or subtractions of river flow that would be challenging to quantify.
Adequacy of Point Source Data: The report states that point source data are —not a data gap ‖ (p. ii); however, adequate characterization of point sources in terms of time series and loads is critical to the model and must be carefully completed. This is acknowledged in the report, but we emphasize that this is an area where careful review of screening criteria and assumptions will be important in the next stage of the project. From the Data Review Report, it is not clear whether currently available data for point sources are adequate. Other specific questions related to point sources include:

Because this TMDL process has the potential to significantly impact the wastewater treatment facilities in the watershed, could a list of the NPDES permittees be provided to include information for each, including permitted flow rate, type of treatment processes, etc? Based on the information presented in Figure 2.7, there appears to be only ten NPDES permits with point sources.

Page 27 of the Data Review Report indicates that where site-specific data are unavailable, effluent data may be derived from a national inventory of wastewater NPDES records that were used to develop a table of typical effluent concentrations. When effluent data for specific facilities are available, we concur that site-specific datasets should be used rather than generalized, national data (as per Table 2.10 on page 28). With regard to potential use of national data, we have the following additional questions and comments:
i. Which of the wastewater treatment facilities in the watershed have specific phosphorus loading data?

ii. Where site-specific data are not available, can site-specific monitoring be requested to obtain these data? This is a critical aspect to the entire study.

iii. Lacking site-specific phosphorus data from the wastewater dischargers, can a more refined research effort be made to determine the phosphorus concentrations in wastewater effluent with specific, different kinds of treatment? Relying on the national inventory of NPDES records is not adequate for the purposes of establishing TMDLs. Based on our own research, the phosphorus data that are presented in Table 2.10 for —Secondary, ‖ —Advanced Secondary, ‖ and —Advanced Wastewater Treatment ‖ mischaracterize the removal and concentrations.
The importance of using current data for POTWs is demonstrated in the QAPP report, which notes that the City of Springdale, Arkansas, POTW upgrades in 2004 reduced total phosphorus concentrations in the discharge from > 5 mg/L to < 1 mg/L.

Figure 2.7 on page 30 indicates that there are many construction stormwater general permits, particularly in Arkansas. Is Aqua Terra proposing to model sediment/phosphorus inputs from construction sites, and if so, what data will be utilized regarding quantity and quality of these sites?
Mass and Water Balances: Would it be feasible for Aqua Terra to provide simple schematic diagrams depicting the key components of hydrologic and mass balances for this watershed as part of final Data Review Report? In such schematics, all of the significant surface and

subsurface factors that affect the water balance and phosphorus balance for the river system, and the corresponding data for each component, could be shown. Based on our review of the draft Data Review Report, we are not certain that all of the significant components of these balances have been taken into account.

Tenkiller Reservoir: We have questions regarding scope of effort and operational practices.

Scope: From the standpoint of interests in Arkansas, why is it necessary to include Tenkiller Reservoir in the TMDL and associated modeling effort? Will the reservoir modeling be used to determine whether the current state-line phosphorus standard of 0.037 mg/L is appropriate to achieve beneficial uses and accompanying numeric standards in Tenkiller Reservoir?

Reservoir Operational Practices: Will Tenkiller Reservoir operational practices change in the future and, if so, how will this affect phosphorus and chlorophyll-a concentrations? This emphasizes the importance of our observation that the data relied upon must reflect contemporary activities and management practices.

Other Preliminary Comments Related to Subsequent Phases of the Project
As we reviewed the Data Review Report, several additional considerations were apparent that are more applicable to subsequent stages of the project, including:
Project Scope: We have two general questions regarding the scope of the modeling effort:
1. Model Uses: A question that we posed in our January 6 letter still applies: Is the scope of this effort limited to watershed model development or does it also include applying the model to allocate point and nonpoint source phosphorus reductions and evaluate alternative management approaches? Assuming that the model will be used to evaluate management alternatives, when will data collection regarding expected performance of management alternatives (e.g., BMPs) be addressed?

2. Phosphorus-only versus General Water Quality Model: Our understanding is that the overall objective of the project is to determine reductions in phosphorus loads needed to meet standards. If this is the case, why are nitrogen species included in the modeling? Will the study include the analysis of nitrogen loading and impacts to the water quality standards regarding nitrogen forms? Will the objectives of the study be expanded to include an analysis of the impact of nitrogen/phosphorus relationships to the overall trophic status of the streams and Tenkiller Reservoir? Similarly, will the model assess the dissolved oxygen conditions in the reservoir with respect to water quality standards?
General TMDL Approach: Given potential data gaps and inadequacies, is a phased TMDL with adaptive management provisions being considered as the general direction of the project? If this type of process is envisioned, then there may be more flexibility in terms of assumptions related to data gaps and inadequacies than if this is envisioned as a one-phase, final TMDL. A phased TMDL could account for improved wastewater treatment, significant land use changes, new regulations, etc. The initial TMDL is always limited by available data, and after it is in place, more data gaps become evident, and there should be a mechanism for updating.

Margin of Safety: Given the ultimate use of the model in development of the TMDL, will an implicit or explicit margin of safety envisioned? Although only peripherally related to this

Data Review Report, assumptions related to data sources that are conservative should be well documented if an implicit margin of safety is envisioned.

Reasonableness Checks: Although Aqua Terra thoroughly emphasizes the importance of data for calibration and validation, we did not see text regarding simple —reasonableness checks. || That is, before even getting to the stage of calibration/validation, are the model results reasonable? For example:

Are unit rates of runoff for various return frequencies for different categories of land use and soil types reasonable and consistent with other hydrologic studies in the area? (Stated another way, are the calculated values in terms of cfs/acre reasonable?)

Are predicted phosphorus concentrations from different kinds of land use for different return frequency storms reasonable?

For different kinds of land use, are the predicted ratios of dissolved phosphorus to total phosphorus reasonable and consistent with other data from comparable land use types?

Again, Rogers Water Utilities sincerely appreciates your consideration of our questions and comments. We would welcome the opportunity to meet in person with all interested parties.

Very truly yours,

Tom McAlister Director
Attachment

ADEQ
ARKANSAS
Department of Environmental Quality

December 1, 2010

Mr. Miguel I. Flores
Director, Water Quality Protection Division
USEPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Re: EPA's Illinois River TMDL Project

Dear Mr. Flores:

As per the November 12, 2010 meeting regarding the Illinois River Watershed TMDL, I was asked to respond to the issue of including Lake Tenkiller in the Illinois River TMDL Project. Including the lake, as I understand it, was contemplated in the Project plan; however, I have never understood how the lake's inclusion would impact water quality standards or permit effluent discharge limits for nutrients (specifically total phosphorus) beyond Oklahoma's borders. I understood the Illinois River TMDL Project purpose was to address the impairment in the Oklahoma portion of the Illinois River due to the exceedance of the 0.037 mg/L *total phosphorus standard* established for Oklahoma's Scenic Rivers. Lake Tenkiller is almost 70 miles from the Oklahoma/Arkansas border and is not designated as a Scenic River. To the best of my knowledge, Oklahoma has no total phosphorus water quality standard for Lake Tenkiller. For these reasons, the lake would appear to be outside the scope of EPA's proposed Illinois River TMDL project.

Oklahoma does have a chlorophyll-a standard for Lake Tenkiller. However, ADEQ would not expect a model to adequately represent the complex and dynamic relationship among total phosphorus, total nitrogen, and chlorophyll-a in Lake Tenkiller. Nonetheless, I have no objection to including Lake Tenkiller in the TMDL Project provided that the results of the modeling effort on the lake will have no impact on the Arkansas portion of the Illinois River, which is not impaired and resides many miles from the lake. However, ADEQ reserves the right to object, and will object, to the lake's inclusion should EPA's TMDL Project fail to consider the sources of nutrients posed by all the development on and around Lake Tenkiller or, further, if the inclusion of Lake Tenkiller results in any effort to regulate nutrients outside Oklahoma's border. My understanding of the basis for including the Arkansas portion of the Illinois River in EPA's TMDL Project, was to ascertain the point and nonpoint source allocations of total phosphorus in Arkansas necessary to meet a 0.037 mg/L standard at the Oklahoma border. Any other

ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
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application of EPA's TMDL Project to Arkansas's waters will serve as a basis for ADEQ to withdraw its support for EPA's Illinois River TMDL Project.

In addition, I would like to emphasize that the data utilized in the TMDL Project should reflect current water quality conditions and not rely on historical data or extensively on reference stream data. We are fortunate a great deal of total phosphorus data from the Illinois River has been collected over the last few years. In order to obtain a meaningful cause and effect relationship from this Project, data should not be used which does not reflect current in-stream values.

Thank you for the opportunity to comment on this issue.

Sincerely,

J. Ryan Benefield, P.E.
Deputy Director

cc: Steven L. Drown, Water Division Chief, ADEQ
Steven A. Thompson, Executive Director, Oklahoma Department of Environmental Quality
Randy Young, P.E., Arkansas Natural Resource Commission
J.D. Strong, Oklahoma Water Resource Board

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