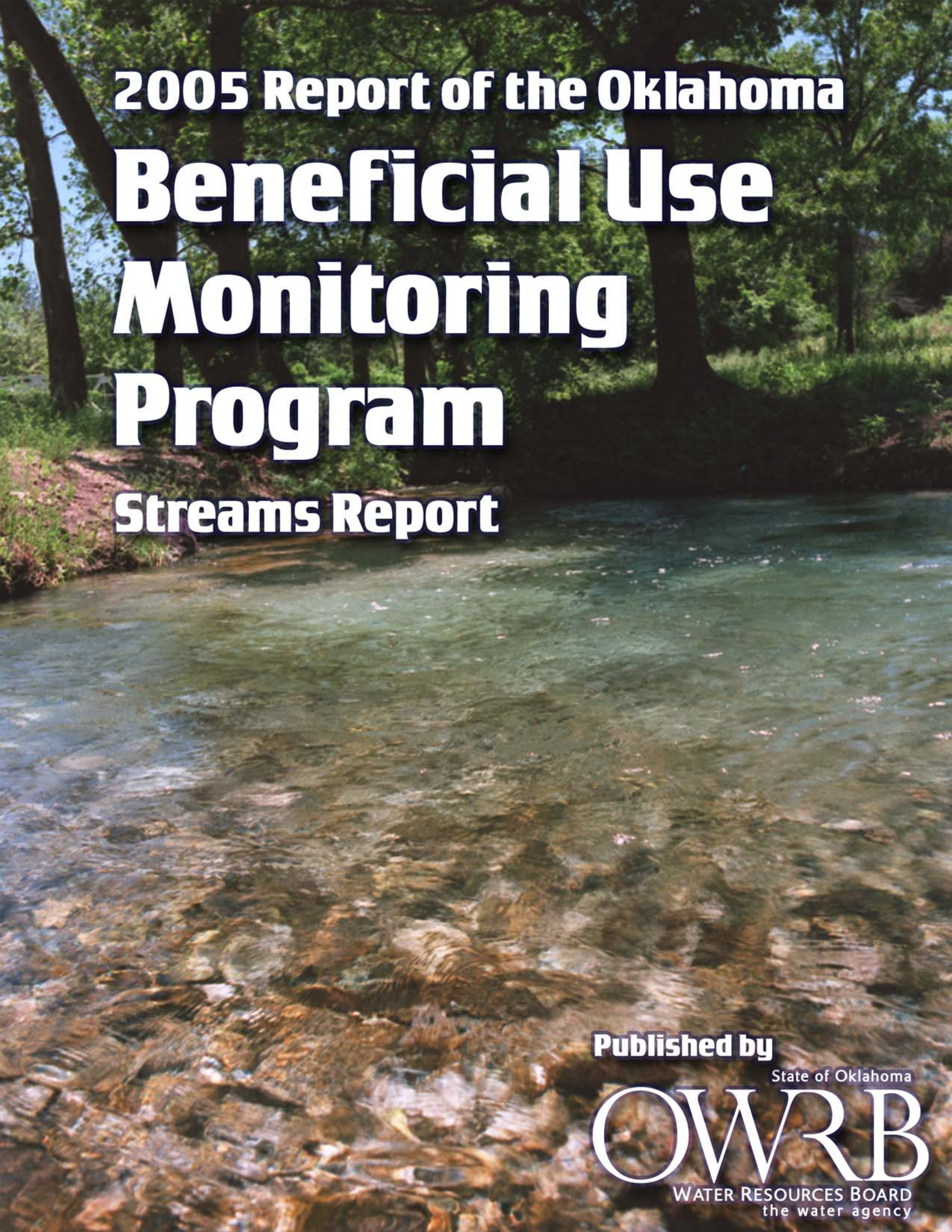
2005 Report of the Oklahoma

Beneficial Use Monitoring Program

Streams Report



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EXECUTIVE SUMMARY

Beneficial Use Monitoring Program Goal

The goal of the Beneficial Use Monitoring Program is to document beneficial use impairments, identify impairment sources (if possible), detect water quality trends, provide needed information for the WQS and facilitate the prioritization of pollution control activities.

The Beneficial Use Monitoring Program exists as a result of the vital economic and social importance of Oklahoma's lakes, streams, wetlands, and aquifers and the associated need for their protection and management. The data contained in this report is scientifically defensible and has been collected and analyzed following procedures outlined in Use Support Assessment Protocols (USAP), developed by the Oklahoma Water Resources Board with input and concurrence from Oklahoma's other environmental agencies. Specifically, USAPs establish a consistent method to determine if beneficial uses assigned for individual waters through Oklahoma Water Quality Standards (WQS) are being supported. Legitimacy of data analyzed following protocols other than those outlined in the USAP must be defended. If the BUMP report indicates that a designated beneficial use is impaired, threatened, or otherwise compromised, measures must be taken to mitigate or restore the water quality.

Traditionally, the State of Oklahoma has utilized numerous water monitoring programs conducted by individual state and federal agencies. In general, each environmental agency designs and implements its own program with only limited participation from with other state, municipal, or federal entities. These programs collect information for a specific purpose or project (e.g., development of Total Maximum Daily Loads, WQS process, lake trophic status determination, water quality impact assessments from nonpoint and point source pollution, stream flow measurement, assessment of best management practices, etc.). Therefore, the information is specific to each project's data quality objectives (DQOs) and is often limited to a very small geographic area.

To synchronize Oklahoma's monitoring efforts related to water quality, the State Legislature appropriated funds in 1998 to create the Beneficial Use Monitoring Program under the direction of the Oklahoma Water Resources Board, who promulgates the WQS and WQS Implementation Rules. The BUMP brings the OWRB's overall water quality management program full circle. From the promulgation of WQS, to permitting and enforcement of permits stemming from WQS-established criteria, to non-point source controls—all agency water quality management activities are intended to work in concert to restore, protect, and maintain designated beneficial uses.

The specific objectives of the BUMP are to detect and quantify water quality trends, document and quantify impairments of assigned beneficial uses, and identify pollution problems before they become a pollution crisis. This report interprets current Oklahoma lake and stream data collected as part of the comprehensive, long-term program, but also includes an assessment of data collected through the Water Board's volunteer water quality monitoring program, Oklahoma Water Watch (OWW). As the program matures, the BUMP report is sure to become one of the most important documents published annually in Oklahoma.

BENEFICIAL USE MONITORING PROGRAM COMPONENTS

- **Monitoring Rivers & Streams** - The OWRB is currently monitoring approximately one hundred thirty (130) stations on a monthly basis. These sites are segregated into two discrete types of monitoring activities. The first monitoring activity is focusing on fixed station monitoring on rivers and streams and the second monitoring activity focuses on a number of sample stations whose location rotate on an annual basis. The two monitoring components are explained below.

    - **Fixed Station Monitoring on Rivers & Streams** - Fixed station monitoring is based largely upon the sixty-seven (67) United States Geological Survey 8-digit hydrologic unit code (HUC) basins present in Oklahoma. In general, at least one (1) sample station was located in all of the HUC watersheds with the exception of some of the smaller HUC watersheds adjacent to the state line or in a HUC that does not contain a free flowing stream at some point during the year. After consultation with the other state environmental agencies and over time the OWRB has identified one hundred seventeen (117) fixed stations of which one hundred (100) are currently being monitored.

    - **Rotating Station Monitoring on Rivers & Streams** - Over the life of the BUMP, rotational sampling has occurred on over two hundred twenty (220) stream segments. Sample stations and variables monitored are based upon Oklahoma's 303(d) list and input from other state environmental agencies on their monitoring needs. Variables monitored as part of this program component are specific for each stream segment monitored

- **Fixed Station Load Monitoring** – The OWRB is currently working with several partners including the the USGS, US Army Corp of Engineers, Grand River Dam Authority, and National Weather Service to conduct flow monitoring on all of our fixed station sites that are not part of the Oklahoma/USGS Cooperative Gaging Network. This cooperative effort will allow for loadings to be calculated, trends to be assessed statewide, and provide much needed data for the Use Support Assessment process.

- **Fixed Station Lakes Monitoring** - Quarterly sampling (approximately once every 90 days) of approximately 55-60 lakes annually is currently occurring. This represents approximately a 40% increase in effort over historical BUMP Lake sampling efforts. In general, a minimum of three stations per reservoir, representing the lacustrine zone, transitional zone, and riverine zone are designated for sampling at each lake, with additional sites sampled as needed. Additional water quality parameters and lake sites were added to the lake sampling program beginning in 2001 to aid in making use support determinations.

- **Fixed Station Groundwater Monitoring** - Limited monitoring as part of this task has occurred in the program. Results of monitoring are presented in this report. OWRB staff has made recommendations in this report related to the scope and magnitude of groundwater monitoring activities that the state should pursue in the future. Any proposed groundwater monitoring efforts will be coordinated with the Oklahoma Department of Environmental Quality (ODEQ) program.

- **Intensive Investigation Sampling** - Although no funding was made available for this element of the program, it is important that waters identified as impaired be restored. If routine monitoring identifies impairment, then an intensive study will be undertaken to document the source of the impairment and recommend restorative actions if possible. This task will not be conducted in year one or year two of the program, but thereafter, intensive investigations will be conducted as warranted. If water bodies are not identified for intensive study as part of this task, then monies will be reallocated to Tasks **1** and **3**. Other entities (i.e. tribal or governmental units outside of Oklahoma) are involved as circumstances dictate or allow.

PROGRAM HISTORY/OVERVIEW

Sampling of the numerous lakes, streams, and rivers across this state was initiated in the summer and fall of 1998. Lake sampling in connection with the Beneficial Use Monitoring Program began in July of 1998. Sampling on numerous streams and rivers began in earnest in November of the same year. The two sampling programs, one for lakes and one for streams had separate starting dates for a number of reasons. First, the OWRB has been conducting a lake-sampling program during the warmer summer months since 1990 as part of the Federal Clean Lakes Program. This historical lake sampling program was funded through federal dollars with the express purpose of determining lake trophic status. The trophic status of a reservoir can range from oligotrophic (low biological productivity) to hyper-eutrophic (excessive biological productivity). In general, the more productive a reservoir, the more water quality problems it is likely to experience. Federal dollars to fund this trophic state assessment of our state's lakes were discontinued in 1994. At that time, the OWRB searched for other funding sources, and through working with the Secretary of the Environment and the Oklahoma Conservation Commission, the Water Board was able to obtain a one time federal 319 nonpoint source grant to continue the lake trophic state assessment program. The OWRB subsequently initiated a quarterly lake sampling program in the spring of 1998 and was able to roll the existing lake program into the BUMP.

For streams, no such comprehensive, statewide sampling effort was ongoing at the time the BUMP was funded. Because of this, the OWRB required a number of months to re-allocate staff and implement a monitoring regime on streams. In addition, OWRB staff greatly desired input from the other environmental agencies on the placement of stream monitoring stations. The existence of a previous statewide stream-monitoring network greatly aided in sample site selection. This historical ambient trend stream-monitoring network existed from 1975 until 1993 and was implemented by the Oklahoma State Health Department. Although this program did not evaluate sample results through comparison with the WQS criteria or determine use support, it did provide a framework upon which to build. The historical sampling network sampled streams on a monthly basis from 1975-1986 and on a semi-annual basis from 1987-1993. Based upon the historical program and input from other agencies, the OWRB has established an ambient monitoring network of 100 active permanent stations with numerous rotational sites. Both the permanent and rotational networks are evaluated annually to determine if any stations should be dropped and others added. The Water Resources Board relies heavily on the other state and federal agencies for input into this process. With continued funding it is the desire of BUMP staff to increase the number of permanent sites to 120 to more effectively monitor our stream resources. In addition, monitoring personnel with the OWRB work closely with the other state environmental agencies to avoid duplication of sampling effort (i.e. the Oklahoma Conservation Commission rotating and data gaps sampling initiatives), except on a very limited basis for quality assurance purposes. A very small number of sites that are duplicative in nature do allow for the comparison of results between sampling programs to ensure that sampling protocols and the Use Support Assessment Protocols (USAP - described below) are working effectively and that decisions on support status are being made in a consistent manner.

The OWRB has developed Use Support Assessment Protocols (USAP) for lakes and streams, which are essential if the state is to be consistent in identifying waters that are not meeting their assigned beneficial uses or are threatened. The Water Resources Board has incorporated the USAP into Oklahoma Administrative Code (OAC) 785:46 to ensure that consistent determinations for impairments are made by the all of the monitoring agencies.

The state must follow consistent procedures for listing waters as impaired. Using the OWRB Use Support Assessment Protocols, it was possible for OWRB staff to assess whether threats or impairments are present in our waterways. With continued funding, identification of impaired waters will be accomplished on additional waters.

Results of Stream Sampling Efforts

It is essential that Oklahoma quantify impacts in a comprehensive and scientific manner and look for trends in water quality to identify waters that are not meeting their assigned beneficial uses. As a state, we must manage our water resources effectively and direct money to areas in most need of protection or remediation to ensure that we continue to have good quality and sufficient quantity of water to meet our needs well into the 21st century. Comprehensive statewide data sets on rivers and streams for accurately assessing beneficial use impairments has not existed since 1993. With the implementation of monitoring on a large scale in October of 1998, this is no longer the case. With the availability of data, it is the desire of the Oklahoma Water Resources Board to provide the legislature and professional water managers with a comprehensive and up-to-date document for their review and approval. Administrative and Technical staff at the OWRB look forward to conducting the Beneficial Use Monitoring Program far into the future and providing the state of Oklahoma with the information it needs to make informed decisions that allow us to effectively manage our precious water resources.

The BUMP permanent ambient trend stream monitoring sites and their associated beneficial uses are listed in **Table 1**. Beneficial uses that are not being met are shown in **RED**. Listed next to the support code indicating that the beneficial use was not being met is the variable code which indicates which water quality variable violated the WQS criteria. It is apparent that an inordinate number of water bodies are deemed impaired due to their exceedance of the turbidity standard of 10 or 50 nephelometric turbidity units (NTU). The WQS states that turbidity standards only apply during seasonal base flow conditions. In other words, the criteria should not be applied where normal in-stream conditions exceed the WQS due to natural processes from a high-flow event. Several “quick” methods are available to assist in the determination of seasonal base flow including the existence of a periphyton line and visual estimation of the degree of flow. However, to reliably determine base flow, a measurement of stream discharge at the time of sampling is needed. This measurement when used in concert with the “quick” methods described above will give a reliable indication of whether the stream is at, below, or above seasonal base flow conditions. Because the BUMP network encompasses the state’s large rivers and streams, discharge is often obtained by comparing stream stage to a continuously updated rating curve. Due to the intense nature of establishing a reliable rating curve, rated discharges are often provisional for a number of months. Therefore, the determination of the previous year’s base flow and consequently eligible turbidity values are also **provisional** at the publication of this report. As of the beginning of 2002, the OWRB was gaging all but 4 permanent station locations. Where permanent water-quality monitoring stations were located near a United States Geological Survey (USGS) stream-flow monitoring station, the information collected by USGS is used to determine if a high-flow event exceeding seasonal base flow had occurred at the time of sampling.

Table 1. Permanent Ambient Trend Monitoring Stations and their Beneficial Use Support Status.

STATION NAME	FWP	PBCR	PPWS	AG	AES
Arkansas River, US 64, Moffett	S	**NS (8)**	S	S	NT
Arkansas River, SH 104, Haskell	S	S	N/A	**NS (10)**	NT
Arkansas River, SH 18, Ralston	**NS (5)**	**NS (8)**	S	S	NT
Arkansas River, SH 97, Sand Springs	S	S	N/A	S	NT
Arkansas River, US 62, Muskogee	**NS (3)**	**NS (8)**	N/A	S	NT
Arkansas River, US 64, Bixby	S	**NS (6, 7, 8)**	N/A	S	NT
Barren Fork, SH 51, Eldon	S	**NS (8)**	S	S	**NS (14)**
Beaver River, off US 64, Guymon	S	**NS (6, 7, 8)**	S	S	NT
Beaver River, US 83, Turpin	S	**NS (6, 7, 8)**	N/A	**NS (10, 11)**	NT
Beaver River, SH 23, Beaver	S	**NS (6, 8)**	N/A	**NS (10, 11)**	NT
Beaver River, US 283, Laverne	S	**NS (8)**	N/A	S	NT
Beaver River, CR N1650, Gate	S	**NS (6, 8)**	N/A	**NS (10, 11)**	NT
Beaver River, US 183, Fort Supply	S	**NS (8)**	N/A	S	NT
Big Cabin Creek, off US 69, Big Cabin	S	**NS (7, 8)**	S	**PS (12)**	NT
Bird Creek, SH 266, Port of Catoosa	**NS (5)**	**NS (6, 8)**	S	S	NT
Black Bear Creek, SH 18, Pawnee	**NS (5)**	**NS (6, 8)**	S	S	NT
Blue River, US 70, Durant	S	**NS (8)**	S	S	NT
Brushy Creek, off US 270, Haileyville	**NS (1, 3, 5)**	**NS (8)**	S	S	NT
Canadian River, SH 2, Whitefield	S	S	S	S	NT
Canadian River, US 183, Taloga	**PS (5)**	**NS (8)**	N/A	**NS (10, 11)**	NT
Canadian River, US 270, Calvin	**PS (5)**	**NS (8)**	S	**PS (12)**	**T (17)**
Canadian River, US 377, Konawa	**NS (3,5)**	**NS (8)**	S	**NS (10)**	**T (17)**
Canadian River, US 66, Bridgeport	**NS (5)**	**NS (8)**	N/A	S	NT
Canadian River, US 77, Purcell	**PS (5)**	N/A	N/A	S	**T (17)**
Caney Creek, off SH 100, Barber	S	S	S	S	NT
Caney River, off US 75, Ramona	**NS (3, 5)**	**NS (8)**	S	S	NT

STATION NAME	FWP	PBCR	PPWS	AG	AES
CHICKASKIA RIVER, US 177, BLACKWELL	NS (3, 5)	NS (6, 8)	S	S	NT
CIMARRON RIVER, OFF SH 8, NEAR AMES (ORIENTA)	PS (5)	NS (6, 7, 8)	N/A	NS (10, 11, 12)	NT
CIMARRON RIVER, SH 34, BUFFALO	S	NS (6, 7, 8)	N/A	NS (10)	NT
CIMARRON RIVER, SH 99, OILTON	NS (5)	NS (6, 8)	N/A	S	NT
CIMARRON RIVER, US 77, GUTHRIE	PS (5)	NS (6, 8)	N/A	S	NT
CIMARRON RIVER, US 81, DOVER	PS (5)	NS (7, 8)	N/A	NS (10)	NT
CIMARRON RIVER, OFF US 64, MOCANE	S	NS (6, 8)	S	NS (10, 11)	NT
CIMARRON RIVER, SH 33, RIPLEY	NS (5)	NS (8)	N/A	S	NT
CIMARRON RIVER, US 281, NEAR WAYNOKA	NS (16)		N/A	NS (10, 11)	NT
CLEAR BOGGY CREEK, OFF US 69, CANEY	NS (3, 5)	NS (6, 8)	S	S	NT
DEEP FORK RIVER, OFF SH 16, BEGGS	NS (3, 5)	NS (8)	S	S	NT
DEEP FORK RIVER, US 377, STROUD	NS (3, 5)	NS (8)	PS (9)	S	NT
EAST CACHE CREEK, SH 53, WALTERS	NS (5)	NS (6, 7, 8)	S	S	NT
ELK CREEK, OFF US 183, HOBART	NS (5)	NS (6, 8)	S	S	NT
ELK RIVER, SH 43, TIFF CITY (MO)	S	NS (8)	S	S	NT
ELM FORK RIVER, SH 9, MANGUM	S	NS (6, 7, 8)	S	S	NT
FLINT CREEK, US 412, FLINT	S	NS (8)	S	S	NS (14)
FOURCHE-MALINE CREEK, OFF US 270, RED OAK	NS (1, 3)	NS (8)	S	S	NT
GLOVER RIVER, SH 3, GLOVER	NS (1, 3, 5)	NS (8)	S	S	NT
HONEY CREEK, OFF SH 25, GROVE	S	NS (8)	S	S	T (15)
ILLINOIS RIVER, US 59, WATTS	PS (5)	NS (8)	S	S	NS (14)
ILLINOIS RIVER, US 62, TAHLEQUAH	S	S	S	S	NS (14)
KIAMICHI RIVER, OFF US 271, TUSKAHOMA	NS (2, 3)	S	S	S	NT
KIAMICHI RIVER, SH 63, BIG CEDAR	NS (3, 4)	NS (8)	S	S	NT
KIAMICHI RIVER, US 271, ANTLERS	NS (2, 3)	NS (8)	S	S	NT
KIAMICHI RIVER, SH 109, FORT TOWSON	PS (5)	NS (8)	S	S	NT
LEE CREEK, SH 101, SHORT	S	NS (8)	S	S	S
LITTLE RIVER, OFF SH 3, CLOUDY	NS (3, 5)	NS (8)	S	S	NT
LITTLE RIVER, OFF US 70, NEAR HOLLY CREEK	NS (1, 5)		S	S	NT
LITTLE RIVER, SH 56, SASAKWA	NS (3, 5)	NS (8)	S	S	NT
MOUNTAIN FORK, SH 4, SMITHVILLE	NS (2, 3, 5)	S	S	S	NS (14)
MOUNTAIN FORK, US 70, EAGLETOWN	NS (2, 3)	NS (8)	S	S	NT

STATION NAME	FWP	PBCR	PPWS	AG	AES
Mud Creek, SH 32, Courtney	NS (1, 5)	NS (8)	S	S	NT
Muddy Boggy Creek, US 70, Unger	NS (3, 5)	NS (6, 8)	S	S	NT
Muddy Boggy Creek, US 69, Atoka	NS (1, 3, 5)	NS (6, 8)	S	S	NT
Neosho River, off US 66, Commerce	NS (3, 5)	S	S	S	NT
Neosho River, off SH 137, Connor Bridge	PS (5)	S	S	S	NT
Neosho River, SH 82, Langley	S	S	S	S	NT
Neosho River, US 412, Chouteau	S	S	S	S	NT
North Canadian River, Ind. Nat. Tpk., Dustin	NS (3, 5)	NS (6, 8)	S	S	NT
North Canadian River, SH 3E, Shawnee	NS (3, 4, 5)	NS (8)	N/A	S	T (13, 17)
North Canadian River, off US 62, Harrah	PS (5)	NS (6, 8)	N/A	S	T (13, 17)
North Canadian River, US 270, Watonga	S	NS (6, 7, 8)	S	S	NT
North Canadian River, US 281, Seiling	PS (5)	NS (8)	S	S	NT
North Canadian River, US 75, Wetumka	NS (3, 5)	NS (6, 8)	S	S	T (13, 17)
North Canadian River, US 412, Woodward	S	NS (8)	N/A	S	NT
North Canadian River, US 81, El Reno	S	NS (8)	S	S	NT
North Fork of the Red River, US 62, Headrick	S	NS (8)	S	NS (10, 11)	T (17)
North Fork of the Red River, SH 34, Carter	S	NS (8)	S	S	NT
Poteau River, off SH 112, Pocola	NS (3, 5)	NS (8)	S	S	NT
Poteau River, US 59, Heavener	S	S	S	S	NT
Red River, SH 79, Waurika	NS (5)	NS (8)	S	NS (10, 11, 12)	NT
Red River, US 183, Davidson	NS (3, 5)	NS (6, 8)	N/A	NS (10, 11, 12)	T (17)
Red River, US 259, Harris	PS (5)	S	S	S	NT
Red River, US 271, Hugo	PS (5)	NS (8)	S	NS (10, 11)	NT
Red River, US 81, Terral	NS (5)	NS (8)	S	NS (11, 12)	NT
Sager Creek, off US 412, West Siloam Springs	S	NS (8)	PS (nitrates)	S	T (13, 15)
Salt Fork of the Arkansas, SH 58, Ingersoll	NS (5)	NS (6, 7, 8)	S	S	NT
Salt Fork of the Arkansas, US 77, Tonkawa	NS (5)	NS (8)	S	S	NT
Salt Fork of the Red River, SH 34, Mangum	S	NS (8)	S	S	NT
Salt Fork of the Red River, off US 283, Elmer	NS (3)	NS (6, 8)	S	PS (11)	NT
Sandy Creek, SH 6, Eldorado	NS (2, 3, 5)	N/A	N/A	NS (10, 11, 12)	NT
Skeleton Creek, SH 74, Lovell	NS (5)	NS (6, 8)	S	S	NT
Spring Creek, off US 412, Murphy	S	S	S	S	NT

STATION NAME	FWP	PBCR	PPWS	AG	AES
SPRING RIVER, OFF SH 137, QUAPAW	NS (2. 3, 5)	NS (8)	S	S	NT
VERDIGRIS RIVER, US 412, INOLA	NS (3, 5)	NS (8)	S	S	NT
VERDIGRIS RIVER, SH 10, LENEPAH	NS (3, 5)	NS (8)	S	S	NT
VERDIGRIS RIVER, SH 20, KEETONVILLE	PS (5)	NS (8)	S	S	NT
VERDIGRIS RIVER, SH 51, WAGONER	NS (2, 3, 5)	NS (8)	S	S	NT
WASHITA RIVER, OFF SH 19, ALEX	NS (5)	NS (6, 8)	S	S	NT
WASHITA RIVER, SH 152, CORDELL	NS (5)	NS (6, 7, 8)	S	S	T (17)
WASHITA RIVER, SH 19, PAULS VALLEY	NS (5)	NS (8)	S	S	NT
WASHITA RIVER, SH 33, HAMMON	PS (5)	NS (6, 7, 8)	S	S	NT
WASHITA RIVER, US 177, DURWOOD	NS (5)	NS (6, 8)	S	S	NT
WASHITA RIVER, US 281, ANADARKO	NS (5)	NS (6, 8)	S	S	NT
WEST CACHE CREEK, SH 5B, TAYLOR	NS (5)	NS (6, 7, 8)	S	PS (11)	NT
WOLF CREEK, OFF US 270, FORT SUPPLY	S	NS (8)	S	S	NT

ASSIGNED WQS BENEFICIAL USES

FWP = **FISH & WILDLIFE PROPAGATION**
PBCR = **PRIMARY BODY CONTACT RECREATION**
PPWS = **PUBLIC AND PRIVATE WATER SUPPLY**
AG = **AGRICULTURE**
AES = **AESTHETICS**

SUPPORT CODES

S—FULLY SUPPORTING	PS—PARTIALLY SUPPORTING	NS—NOT SUPPORTING
N/A—NOT APPLICABLE	NT-NOT THREATENED (NUTRIENTS)	T-THREATENED (NUTRIENTS)

WATER QUALITY VARIABLES

1—DISSOLVED OXYGEN	2—METALS (ACUTE)	3—METALS (CHRONIC)
4—pH	5—TURBIDITY	6—FECAL COLIFORM
7— *ESCHERICHIA COLI*	8— ENTEROCOCCI	9—METALS
10— TOTAL DISSOLVED SOLIDS	11— CHLORIDES	12— SULFATES
13— TOTAL PHOSPHORUS (TP)	14—TP OK SCENIC RIVER CRITERION	15— NITRITE + NITRATE
16—BIOCRITERIA	17—SESTONIC CHLOROPHYLLL-A (TSI)	

INTRODUCTION

Protecting Oklahoma's valuable water resources is essential to maintaining the quality of life for all Oklahomans. Used for a myriad of purposes—such as irrigation, hydropower, public/private water supply, navigation, and a variety of recreational activities—the state's surface and groundwaters provide enormous benefits to Oklahoma from both an economic and recreational standpoint.

The National Recreation Lakes Study Commission (NRLSC) estimates that 32,100 people in Oklahoma are employed in support of activities related to our numerous man-made lakes. Also according to the NRLSC, 18,718,000 visitor days are spent on Oklahoma lakes each year and recreation in and around these lakes contributes approximately $2.2 billion each year to Oklahoma's economy. Of additional value are the recreational benefits associated with our smaller municipal/watershed projects, Oklahoma Department of Wildlife lakes, and rivers and streams throughout the state, which infuse millions into state coffers through fishing, hunting, camping and related activities. (In 1987, the Oklahoma Comprehensive Outdoor Recreation Plan estimated that approximately $10.7 million was realized through camping and $15.2 million through hunting/fishing.[1]) According to a 2001 federal study, fishing activities alone contribute $476,019 dollars to Oklahoma's economy, not including the substantial ancillary costs associated with that extremely popular sport.[2]

In addition to surface waters, abundant groundwaters also fuel the state's economy serving as supply for thousands municipalities, rural water districts, industrial facilities, and agricultural operations. According to the 1995 update of the *Oklahoma Comprehensive Water Plan*, groundwater represents the primary water supply for approximately 300 cities and towns and comprises 60 percent of the total water used in the state each year.[3] Groundwater resources also supply approximately 90 percent of the state's irrigation needs.

Oklahoma works to protect and manage its water resources through a number of initiatives, with the Oklahoma Water Quality Standards (WQS) serving as the cornerstone of the state's water quality management programs. The Oklahoma Water Resources Board (OWRB) is designated by state statute as the agency responsible for promulgating water quality standards and developing or assisting the other environmental agencies with implementation framework. State agencies are responsible for implementing the WQS as outlined by the OWRB through development of Implementation plans. Protecting our waters is a cooperative effort between many state agencies and because the WQS are utilized by all agencies and represent a melding of both science and policy, they are an ideal mechanism to assess the effectiveness of our diverse water quality management activities.

The WQS are housed in OAC 785:45 and consist of three main components: beneficial uses, criteria to protect beneficial uses, and anantidegradation policy. An additional component, which is not directly part of the WQS but necessary to water resource protection, is a monitoring program. A monitoring program is required in order to ensure that beneficial uses are

[1] Oklahoma Statewide Comprehensive Outdoor Recreation Plan (SCORP), 1987.
[2] U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. *2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.*
[3] Oklahoma Water Resources Board, *Update of the Oklahoma Comprehensive Water Plan, 1995*.

maintained and protected. If uses are not being maintained, the cause of that impairment must be identified and restoration activities should be implemented to improve water quality such that it can meet it's assigned beneficial uses.

All state agencies are currently required to implement Oklahoma's Water Quality Standards within the scope of their jurisdiction through the development of an Implementation Plan specific for their agency. This process, called WQS Implementation, allows the WQS to be utilized by other state agencies in the performance of their regulatory (statutory) responsibilities to manage water quality or to facilitate best management practice initiatives.

In the late 1990's, the need for a protocol to determine beneficial use impairment was identified, which would facilitate state agencies in directing their time and money to the areas in most need of protection or remediation. The OWRB working in close concert with other state environmental agencies and other concerned parties developed Use Support Assessment Protocols (USAP) to be used by all parties for assessing if a water was meeting it's assigned beneficial uses. In addition, protocols were developed which could be coupled with a trend monitoring system to detect threatened waters before they become seriously impaired. Data collection efforts connected with protocol development and/or implementation also serves a vital purpose in refining numerical criteria currently included in the WQS and in developing appropriate numerical and narrative criteria for future WQS documents. It is essential that our waters meet their assigned uses and that WQS implementation protocols are appropriate. Please see APPENDIX A for the applicable Oklahoma Administrative Code OAC 785:46 related to the USAP. Final approval of the USAP occurred in 2000 and the OWRB has constantly worked to refine the existing protocols and pursue the addition or modification of USAP protocols to further enhance its utility and effectiveness.

Work to be performed towards development and implementation of the critical fourth component of the WQS program, monitoring, is the subject of this report. All sampling activities described and conducted as part of this program were consistent with the Oklahoma USAP. It is also important to note that they are consistent with Environmental Protection Agency (EPA) reporting requirements for the "*Integrated Water Quality Monitoring and Assessment Report"*, §319 Nonpoint Source (NPS) Assessment, and the §314 Lake Water Quality Assessment (LWQA).

BACKGROUND & PROBLEM DEFINITION

The State of Oklahoma has historically had numerous monitoring programs conducted by several state and federal agencies. In general, each environmental agency conducts their monitoring programs with some degree of integration and coordination with other state, municipal, or federal programs. Most water quality monitoring programs in Oklahoma are designed and implemented by each agency to collect information for one specific purpose or project (i.e. development of Total Maximum Daily Loads, WQS process, lake trophic status determination, water quality impacts from point source dischargers, stream flow measurements, document success of best management practices, etc.). Information of this type is very specific to each individual project's data quality objectives (DQOs) and is often limited to a very small geographic area. This document describes sampling activities the OWRB has historically conducted on lakes and efforts that are currently on going on lakes and streams across Oklahoma as part of a comprehensive, long-term, statewide Beneficial Use Monitoring Program (BUMP). The goal of the BUMP is to detect and quantify water quality trends, document and quantify impairments of assigned beneficial uses, and identify pollution problems before they become a pollution crisis.

BENEFICIAL USE MONITORING PROGRAM (BUMP) OVERVIEW

The overall goal of the Beneficial Use Monitoring Program is to document beneficial use impairments, identify impairment sources (if possible), detect water quality trends, provide needed information for the WQS, and facilitate the prioritization of pollution control activities.

BENEFICIAL USE MONITORING PROGRAM COMPONENTS

- **Monitoring Rivers & Streams** - The OWRB is currently monitoring approximately one hundred thirty (130) stations on a monthly basis. These sites are segregated into two discrete types of monitoring activities. The first monitoring activity is focusing on fixed station monitoring on rivers and streams and the second monitoring activity focuses on a number of sample stations whose locations rotate on an annual basis. The two monitoring components are explained below.

    - **Fixed Station Monitoring on Rivers & Streams** - Fixed station monitoring is based largely upon the sixty-seven (67) United States Geological Survey 8-digit hydrologic unit code (HUC) basins present in Oklahoma. In general, at least one (1) sample station was located in all of the HUC watersheds with the exception of some of the smaller HUC watersheds adjacent to the state line or in a HUC that does not contain a free flowing stream at some point during the year. After consultation with the other state environmental agencies and over time the OWRB has identified one hundred seventeen (117) fixed stations of which one hundred (100) are currently being monitored.

    - **Rotating Station Monitoring on Rivers & Streams** - Over the life of the BUMP, rotational sampling has occurred on two hundred twenty (220) stream segments. Sample stations and variables monitored are based upon Oklahoma's 303(d) list and input from other state environmental agencies on their monitoring needs. Variables monitored as part of this program component are specific for each stream segment monitored

- **Fixed Station Load Monitoring** - The OWRB is currently working with several partners including the the USGS, US Army Corp of Engineers, Grand River Dam Authority, and National Weather Service to conduct flow monitoring on all of our fixed station sites that are not part of the Oklahoma/USGS Cooperative Gaging Network. This cooperative effort will allow for loadings to be calculated, trends to be assessed statewide, and provide much needed data for the Use Support Assessment process. Along with the USGS cost share program, Oklahoma's 319 program, Oklahoma's 314 program and the 303(d)-process will drive sample site locations associated with this task.

- **Fixed Station Lakes Monitoring** - Fixed station lakes monitoring goal is designed to facilitate sampling on the 130 largest lakes in Oklahoma every other year. To accomplish this task, the OWRB is sampling approximately 55 to 60 lakes currently, on a quarterly basis. Under this scenario repeat sampling on a lake will occur approximately every other year, with the inclusion of lakes data collected by other sources, like the Corps of Engineers, to meet the goal of 130 lakes every two years. Data collected consists primarily of water chemistry, nutrients, and chlorophyll-a information. In general, sampling of three stations per reservoir, representing the lacustrine zone, transitional zone, and riverine zone occurs. On many reservoirs, additional sites are monitored, including major arms of the reservoir as appropriate. Water quality parameters have been added to the lakes sampling effort over the years to enhance our ability to make use support determinations.

- **Fixed Station Groundwater Monitoring** - Limited monitoring as part of this task has occurred in the program. Results of monitoring are presented in this report. OWRB staff has made recommendations in this report related to the scope and magnitude of groundwater monitoring activities that the state should pursue in the future. Any proposed groundwater monitoring efforts will be coordinated with the Oklahoma Department of Environmental Quality (ODEQ) program.
- **Intensive Investigations** - If beneficial use impairment is identified or suspected, then all appropriate state agencies will be alerted and an investigation will be initiated to confirm if beneficial use impairment is occurring. If routine monitoring cannot definitively identify impairments, then an intensive study will be undertaken and if impairment is present, the source of the impairment will be identified if possible. One potential use for the intensive studies envisioned was identified during the data analysis phase of this reporting process. For example, monies could be spent to identify if high turbidity readings in rivers and streams are due to natural processes or do to human activities in the watershed of concern. Some potential causes of beneficial use impairment are; improper beneficial use or criteria (Oklahoma Water Resources Board jurisdiction), point source problems (Oklahoma Department of Environmental Quality or Oklahoma Department of Agriculture), non-point source problems (Oklahoma Conservation Commission, Oklahoma Department of Agriculture, Oklahoma Corporation Commission, or Oklahoma Department of Environmental Quality), oil and gas contamination (Oklahoma Corporation Commission), agricultural activities (Oklahoma Department of Agriculture), or mining activities (Oklahoma Department of Mines). All monitoring activities will be cooperative in nature with the agency with statutory authority assuming the lead role for intensive monitoring. If water bodies are not identified for intensive study as part of this task, then monies will be reallocated for routine monitoring of beneficial use attainment. Other entities (i.e. tribal or governmental units outside of Oklahoma) will be involved as appropriate. All intensive-monitoring activities will be consistent with the WQS and the USAP. If no protocols exist, then best professional judgment or State/Environmental Protection Agency guidance is used as appropriate.

STREAM MONITORING PROGRAM

The Stream Beneficial Use Monitoring Program was initiated in November of 1998. Implementation of the program was delayed due to the relocation of the ODEQ State Environmental Laboratory to a new building and the fact that the OWRB required a few months to assemble the necessary infrastructure to implement stream sampling (purchase of equipment, database development, assignment of personnel, etc.). The BUMP streams staff began collecting monthly data in November of 1998 and changed to visiting stations on a 5-week schedule in 2003. A summary of the data results for the period of record from October 2000 through September 2005 is presented in this section. Results of stream sampling efforts are organized by their 4-digit USGS hydrologic unit code (HUC). Stream results are discussed in alphabetical order for each HUC. Each stream station is described individually with a brief narrative outlining the site location and other pertinent information followed by a brief synopsis of data results. Additional graphical representations of the data are included for each station. Toxicant or bacteria data used to determine a status of non-support are located in tables near the beginning of each section. All of the permanent monitoring sites are listed and discussed very briefly.

RIVER AND STREAM MONITORING OVERVIEW

Historically, data on rivers and streams across the state has been very sketchy. Over the years, various local, tribal, state, and federal agencies have managed a number of sampling programs. These programs have varied in nature ranging from short-term, site-specific sampling to the former Oklahoma State Department of Health (OSDH) statewide sampling program. However, a comprehensive, statewide ambient trend-monitoring program had not existed since 1989, the last year that the OSDH conducted monthly sampling. Furthermore, a program with the specific intent of documenting statewide beneficial use impairments on a long-term basis had never existed until the Beneficial Use Monitoring Program (BUMP) was started in September of 1998 with subsequent sampling begun in November of the same year. By establishing a monitoring network that evaluates general water quality through the use of an existing framework like the Oklahoma Water Quality Standards, the state of Oklahoma initiated a progressive phase in the long-term assessment of the overall health of our state's streams and rivers.

MATERIALS & METHODS

The Monitoring Network. The BUMP rivers and streams network consists of two major station classifications — permanent ambient trend sites and rotating sites. Permanent ambient trend monitoring stations are relatively static within the program. In general, they do not change from year to year and have been chosen to allow for long-term assessment of beneficial uses and water quality trends. Since program inception a small number of sites have been dropped from the program and new sites added to more effectively assess the water quality of our major stream basins. Rotating stations are only actively monitored for a predetermined period of time and for a specific purpose.

With the creation of the permanent monitoring network in September of 1998, OWRB staff established three overarching objectives for the program. First, the network must encompass the entire state. To accomplish this, a commitment was made to locate at least one site in each of the 8-digit USGS hydrologic units (HUC) (Table 2).

Table 2. Eight Digit United States Geological Survey HUC Watersheds.

8 Digit HUC Number	Description	8 Digit HUC Number	Description
11040001	Cimarron Headwaters	**11100301**	Middle North Canadian
11040002	Upper Cimarron	**11100302**	Lower North Canadian
11040006	Upper Cimarron – Liberal	**11100303**	Deep Fork
11040007	Crooked	**11110101**	Polecat – Snake
11040008	Upper Cimarron – Bluff	**11110102**	Dirty – Greenleaf
11050001	Lower Cimarron – Eagle Chief	**11110103**	Illinois
11050002	Lower Cimarron – Skeleton	**11110104**	Robert S. Kerr Reservoir
11050003	Lower Cimarron	**11110105**	Poteau
11060001	Kaw Lake	**11120105**	Lower Prairie Dog Town Fk., Red
11060002	Upper Salt Fork – Arkansas	**11120202**	Lower Salt Fork – Red
11060003	Medicine Lodge	**11120302**	Middle North Fork – Red
11060004	Lower Salt Fork – Arkansas	**11120303**	Lower North Fork – Red
11060005	Chickaskia	**11120304**	Elm Fork – Red
11060006	Black Bear – Red Rock	**11130101**	Groesbeck – Sandy
11070103	Middle Verdigris	**11130102**	Blue – China
11070105	Lower Verdigris	**11130201**	Farmers – Mud
11070106	Caney	**11130202**	Cache
11070107	Bird	**11130203**	West Cache
11070205	Middle Neosho	**11130208**	Northern Beaver
11070206	Grand Lake	**11130210**	Lake Texoma
11070207	Spring	**11130301**	Washita Headwaters
11070208	Elk	**11130302**	Upper Washita
11070209	Lower Neosho	**11130303**	Middle Washita
11090103	Rita Blanca	**11130304**	Lower Washita
11090201	Lower Canadian – Deer	**11140101**	Bois D’Arc – Island
11090202	Lower Canadian – Walnut	**11140102**	Blue
11090203	Little	**11140103**	Muddy Boggy
11090204	Lower Canadian	**11140104**	Clear Boggy
11100101	Upper Beaver	**11140105**	Kiamichi
11100102	Middle Beaver	**11140106**	Pecan – Waterhole
11100103	Coldwater	**11140107**	Upper Little
11100104	Palo Duro	**11140108**	Mountain Fork
11100201	Lower Beaver	**11140109**	Lower Little
11100203	Lower Wolf		

Currently, all but four of these 8-digit HUCs have at least one sampling station. A map of the 8-digit USGS HUCs is included as Figure 1. The second objective was that the foundation of the monitoring network should be principally the state's largest rivers, the Arkansas River and the Red River, and their major tributaries, such as the Canadian River and the Washita River. Currently, fifty-seven (57) of the 100 stations currently being monitored (57%) meet this criterion. These sites are dispersed over 20 different rivers and streams with the majority located on the Arkansas River and several tributaries including the Cimarron River, the Canadian River, the Verdigris River, and Neosho River as well as the Red River and several tributaries including the Washita River, the Kiamichi River, and the Little River. Secondary consideration was given to the major tributaries of rivers such as Canadian River and the Little River. Currently, thirty-six (36) of the 100 sites (36%) meet this criterion. Further consideration was given to areas of the state (e.g., the Panhandle) that were underrepresented as well as rivers and streams (e.g., The Deep Fork River) that were conspicuously missing from the network. Currently, seven (7) of the 100 monitoring stations (7%) meet one of these criteria. The third and last objective was to seek the advice and input of other state environmental agencies and professionals before making a final determination of permanent monitoring station locations. In particular, the ODEQ and OCC continue to be very helpful in assisting with locating permanent stations.

Operating within these overarching objectives, the staff of the OWRB has selected and performed monitoring on one hundred seventeen (117) permanent ambient trend-monitoring sites since September of 1998 and is currently monitoring 100 permanent stations (Table 3). The placement of a site location necessitates several considerations. Above all, a site must be accessible by vehicle and be safe for sampling personnel and other motorists. It is also essential that a site be located in an area where representative data can be acquired. The WQS Use Support Assessment Protocols (USAP) set spatial limitations on the data that is collected. In summary, a site can only represent twenty-five stream miles for non-wadable streams and ten stream miles for wadable streams (with some exceptions). Furthermore, a site can only be representative of the waterbody identification number (12 digit HUC number) in which it is located and the site cannot be located within a regulatory mixing zone. This requires that monitoring sites be selected so that they represent as long a stream reach as possible while maintaining the spatial integrity outlined in USAP. Thirdly, it is important that historical data be considered. Many of the current BUMP permanent monitoring sites were selected from a set of historical monitoring stations that were a part of the OSDH (the environmental Division that conducted the Ambient Program later became part of the ODEQ) Ambient Trend Monitoring Program. Before initial sampling began in 1998, OWRB staff worked closely with the ODEQ to integrate many of the historical sites into the BUMP. Although the historical data from these sites can not be used to assess beneficial uses (USAP sets a temporal limitation of five years), the historical data set benefits the state in assessing long-term water quality trends. Lastly, it is imperative that rivers and streams which have been designated in the WQS as Outstanding Resource Waters (ORW), High Quality Waters (HQW), or Sensitive Water Supplies (SWS) be given unique consideration even if they do not meet the objectives as outlined. For example, Sager Creek is not a tributary of a major tributary of a major river. However, it is listed as an ORW and therefore is sampled as part of the BUMP. The water quality status of each site is discussed in more detail in the individual HUC narrative sections that follow this section of the report.

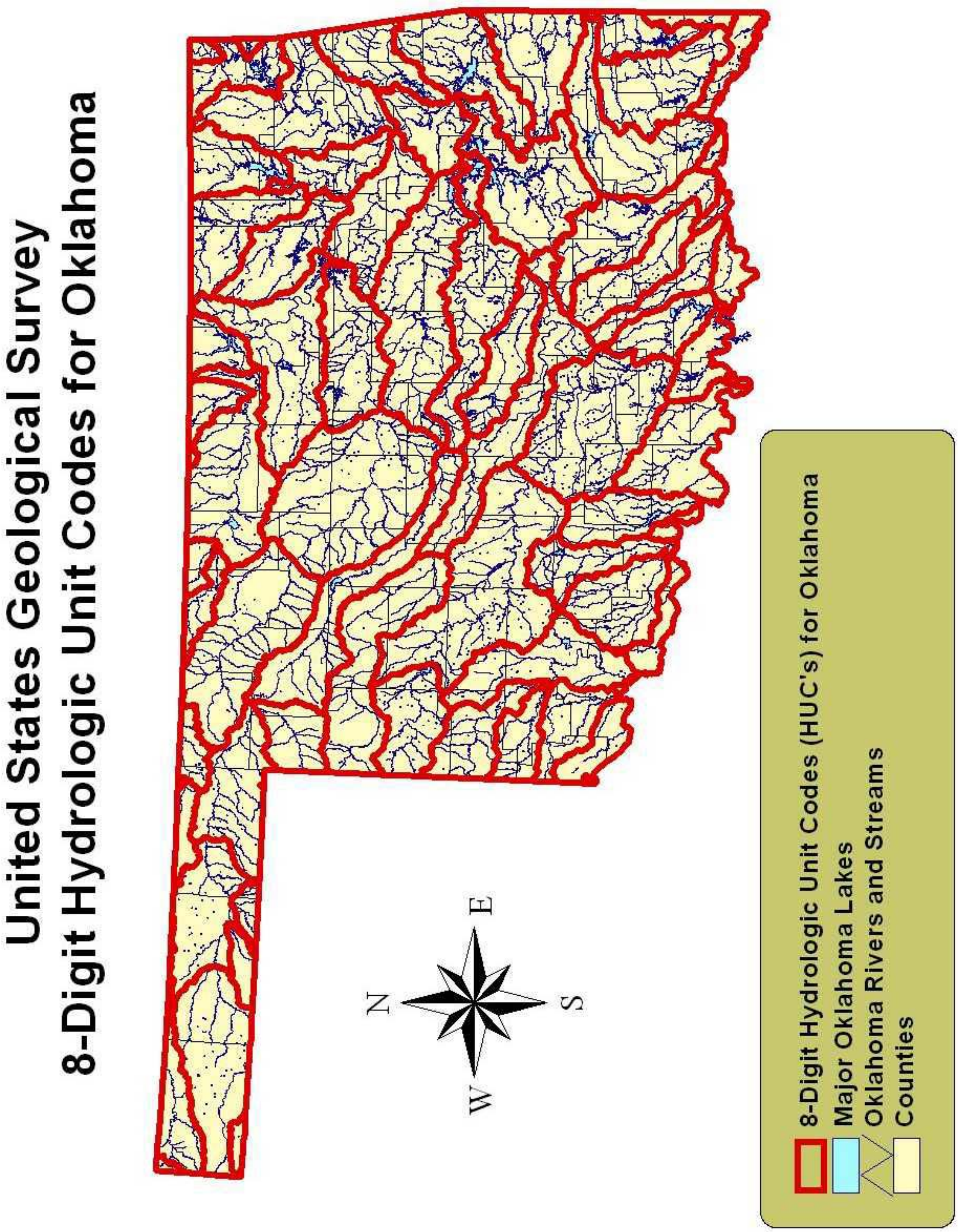

Figure 1. USGS 8-digit Hydrologic Unit Codes for Oklahoma.

Table 3. Permanent Ambient Trend Monitoring Stations.

	4-DIGIT USGS #	WBID #	STATION NAME	COUNTY	STATUS
1	1111	220200010010	Arkansas River, US 64, Moffett	Sequoyah	Active 11/98-P
2	1106	621210000030	Arkansas River, off US 77, Newkirk	Kay	Inactive 09/99-10/02
3	1111	120410010080	Arkansas River, SH 104, Haskell	Muskogee	Active 11/98-P
4	1106	621200010200	Arkansas River, SH 18, Ralston	Osage	Active 11/98-P
5	1111	120420010130	Arkansas River, SH 97, Sand Springs	Tulsa	Active 09/99-P
6	1111	121400010260	Arkansas River, US 62, Muskogee	Muskogee	Active 09/99-P
7	1111	120420010010	Arkansas River, US 64, Bixby	Tulsa	Active 11/98-P
8	1111	120400010260	Arkansas River, US 69, Muskogee	Muskogee	Inactive 11/98-12/99
9	1111	121700050010	Barren Fork, SH 51, Eldon	Cherokee	Active 11/98-P
10	1110	720500020010	Beaver River, US 183, Fort Supply	Harper	Active 10/00-P
11	1110	720500020140	Beaver River, CR N1650, Gate	Beaver	Active 10/00-P
12	1110	720510000150	Beaver River, off US 64, Guymon	Texas	Active 11/98-P
13	1110	720500020290	Beaver River, SH 23, Beaver	Beaver	Active 11/98-P
14	1110	720500020010	Beaver River, US 283, Laverne	Harper	Active 01/03-P
15	1110	720500020450	Beaver River, US 83, Turpin	Texas	Active 10/00-P
16	1107	121600060060	Big Cabin Creek, off US 69, Big Cabin	Craig	Active 09/99-P
17	1107	121600060010	Big Cabin Creek, SH 28, Pensacola	Mayes	Inactive 11/98-08/99
18	1107	121300010010	Bird Creek, SH 266, Port of Catoosa	Tulsa	Active 11/98-P
19	1106	621200030010	Black Bear Creek, SH 18, Pawnee	Pawnee	Active 11/98-P
20	1114	410600010010	Blue River, US 70, Durant	Bryan	Active 11/98-P
21	1109	220600030020	Brushy Creek, off US 270, Haileyville	Pittsburg	Active 11/98-P
22	1109	220600010120	Canadian River, Ind. Nat. Tpk., Hanna	McIntosh	Inactive 11/98-09/99
23	1109	220300000010	Canadian River, SH 2, Whitefield	Haskell	Active 09/99-P
24	1109	520620020120	Canadian River, US 183, Taloga	Dewey	Active 11/98-P
25	1109	220600010119	Canadian River, US 270, Calvin	Hughes	Active 11/98-P
26	1109	520600010010	Canadian River, US 377, Konawa	Seminole	Active 11/98-P
27	1109	520620010050	Canadian River, US 66, Bridgeport	Blain	Active 11/98-P
28	1109	520610010010	Canadian River, US 77, Purcell	McClain	Active 11/98-P
29	1111	121700040010	Caney Creek, off SH 100, Barber	Cherokee	Active 09/99-P
30	1107	121400010010	Caney River, off US 75, Ramona	Washington	Active 11/98-P
31	1106	621100000010	Chickaskia River, US 177, Blackwell	Kay	Active 11/98-P
32	1104	620930000010	Cimarron River, off US 64, Mocane	Beaver	Active 10/99-P
33	1105	620910020010	Cimarron River, SH 34, Buffalo	Woods	Active 11/98-P
34	1105	620900010170	Cimarron River, SH 99, Oilton	Creek	Active 11/98-P
35	1105	620920010010	Cimarron River, US 412, Ames/Orienta	Major	Active 11/98-P
36	1105	620910030010	Cimarron River, US 77, Guthrie	Logan	Active 11/98-P
37	1105	620910010010	Cimarron River, US 81, Dover	Kingfisher	Active 11/98-P

Stream Monitoring Program

	4-DIGIT USGS #	WBID #	STATION NAME	COUNTY	STATUS
38	1105	620900030010	CIMARRON RIVER, SH 33, RIPLEY	PAYNE	Active 10/00-P
39	1105	620920020010	CIMARRON RIVER, US 281, WAYNOKA	WOODS	Active 03/03-P
40	1114	410400030020	CLEAR BOGGY CREEK, OFF US 69, CANEY	ATOKA	Active 11/98-P
41	1110	720500020070	CLEAR CREEK, US 283, MAY	ELLIS	Inactive 11/98-09/00
42	1113	311200000030	COW CREEK, SH 5, WAURIKA	JEFFERSON	Inactive 11/98-09/02
43	1110	520700020010	DEEP FORK RIVER, OFF SH 16, BEGGS	OKMULGEE	Active 11/98-P
44	1110	520700040180	DEEP FORK RIVER, US 377, STROUD	LINCOLN	Active 11/98-P
45	1113	311300010020	EAST CACHE CREEK, SH 53, WALTERS	COTTON	Active 11/98-P
46	1112	311500030010	ELK CREEK, OFF US 183, HOBART	KIOWA	Active 11/98-P
47	1107	121600030440	ELK RIVER, SH 43, TIFF CITY (MO)	MCDONALD	Active 05/99-P
48	1112	311800000010	ELM FORK RIVER, SH 9, MANGUM	GREER	Active 11/98-P
49	1111	121700060010	FLINT CREEK, US 412, KANSAS	DELAWARE	Active 11/98-P
50	1111	220100040020	FOURCHE-MALINE CREEK, OFF US 270, RED OAK	LATIMER	Active 11/98-P
51	1114	410210080010	GLOVER RIVER, SH 3, GLOVER	MCCURTAIN	Active 11/98-P
52	1113	311100020010	HICKORY CREEK, OFF SH 32, MARIETTA	LOVE	Inactive 11/98-09/00
53	1107	121600030440	HONEY CREEK, OFF SH 25, GROVE	DELAWARE	Active 11/98-P
54	1111	121700030350	ILLINOIS RIVER, US 59, WATTS	ADAIR	Active 11/98-P
55	1111	121700030010	ILLINOIS RIVER, US 62, TAHLEQUAH	CHEROKEE	Active 11/98-P
56	1114	410310010010	KIAMICHI RIVER, OFF US 271, TUSKAHOMA	PUSHMATAHA	Active 11/98-P
57	1114	410310020010	KIAMICHI RIVER, SH 63, BIG CEDAR	LEFLORE	Active 11/98-P
58	1114	410300030010	KIAMICHI RIVER, US 271, ANTLERS	PUSHMATAHA	Active 11/98-P
59	1114	410300010010	KIAMICHI RIVER, SH 109, FORT TOWSON	BRYAN	Active 10/02-P
60	1110	720500020130	KIOWA CREEK, OFF US 283, LAVERNE	HARPER	Inactive 11/98-09/00
61	1111	220200050010	LEE CREEK, SH 101, NEAR SHORT	SEQUOYAH	Active 01/03-P
62	1114	410210020140	LITTLE RIVER, OFF SH 3, CLOUDY	PUSHMATAHA	Active 11/98-P
63	1109	520800010010	LITTLE RIVER, SH 56, SASAKWA	SEMINOLE	Active 11/98-P
64	1114	410200010200	LITTLE RIVER, OFF US 70, NEAR HOLLY CREEK	MCCURTAIN	Active 10/02-P
65	1114	410200010200	LITTLE RIVER, US 70, IDABEL	MCCURTAIN	Inactive 11/98-09/02
66	1114	410210060020	MOUNTAIN FORK, SH 4, SMITHVILLE	MCCURTAIN	Active 11/98-P
67	1114	410210040010	MOUNTAIN FORK, US 70, EAGLETOWN	MCCURTAIN	Active 11/98-P
68	1113	311100040010	MUD CREEK, SH 32, COURTNEY	LOVE	Active 11/98-P
69	1114	410400050270	MUDDY BOGGY CREEK, SH 3, FARRIS	ATOKA	Inactive 11/98-06/99
70	1114	410400050270	MUDDY BOGGY CREEK, US 69, ATOKA	ATOKA	Active 09/99-P
71	1114	410400010070	MUDDY BOGGY CREEK, US 70, UNGER	CHOCTAW	Active 07/99-P
72	1107	121600040220	NEOSHO RIVER, OFF US 66 , COMMERCE	OTTAWA	Active 10/00-P
73	1107	121600040010	NEOSHO RIVER, OFF SH 137, CONNOR BRIDGE	OTTAWA	Active 11/98-P
74	1107	121600020170	NEOSHO RIVER, SH 82, LANGLEY	MAYES	Active 11/98-P
75	1107	121600010280	NEOSHO RIVER, US 412, CHOUTEAU	MAYES	Active 11/98-P

	4-DIGIT USGS #	WBID #	STATION NAME	COUNTY	STATUS
76	1110	520510000110	North Canadian River, US 377, Centerview	Pottawatomie	Active 10/00-P
77	1110	520500010110	North Canadian River, Ind. Nat. Tpk., Dustin	McIntosh	Active 11/98-P
78	1110	520510000110	North Canadian River, off US 62, Harrah	Oklahoma	Active 11/98-P
79	1110	720500010010	North Canadian River, US 281, Seiling	Dewey	Active 11/98-P
80	1110	520510000010	North Canadian River, US 75, Wetumka	Hughes	Active 09/99-P
81	1110	520530000010	North Canadian River, US 81, El Reno	Canadian	Active 11/98-P
82	1110	720500010140	North Canadian River, US 412, Woodward	Woodward	Active 10/00-P
83	1112	311510010010	North Fork of the Red River, SH 34, Carter	Beckham	Active 11/98-P
84	1112	311500010020	North Fork of the Red River, US 62, Headrick	Tillman	Active 11/98-P
85	1110	720500020500	Palo Duro Creek, SH 3, Bryan's Corner	Texas	Inactive 11/98-09/00
86	1111	220100010010	Poteau River, off SH 112, Pocola	LeFlore	Active 11/98-P
86	1111	220100020010	Poteau River, US 59, Heavener	LeFlore	Active 11/98-P
87	1107	121610000010	Pryor Creek, US 69A, Sportsman Acres	Mayes	Inactive 09/99-09/00
88	1113	311100010190	Red River, I-35, Gainsville	Love	Inactive 11/98-08/99
89	1113	311200000010	Red River, SH 79, Waurika	Jefferson	Inactive 11/98-10/03
90	1113	311310010010	Red River, US 183, Davidson	Tillman	Active 11/98-P
91	1114	410100010010	Red River, US 259, Harris	McCurtain	Active 11/98-P
92	1114	410400010010	Red River, US 271, Hugo	Choctaw	Active 11/98-P
93	1113	311100010190	Red River, US 81, Terral	Jefferson	Active 11/98-P
94	1111	121700060080	Sager Creek, off US 412, West Siloam Springs	Delaware	Active 11/98-P
95	1106	621010010160	Salt Fork of the Arkansas, SH 58, Ingersoll	Alfalfa	Active 11/98-P
96	1106	621000010010	Salt Fork of the Arkansas, US 77, Tonkawa	Kay	Active 10/00-P
97	1106	621000010010	Salt Fork of the Arkansas, US 177, White Eagle	Noble	Inactive 11/98-09/00
98	1112	311600020010	Salt Fork of the Red River, off US 283, Elmer	Jackson	Active 11/98-P
99	1112	311600020010	Salt Fork of the Red River, off SH 34, Mangum	Greer	Active 10/00-P
100	1113	311600010040	Sandy Creek, SH 6, Eldorado	Jackson	Active 11/98-P
101	1105	620910030010	Skeleton Creek, SH 74, Lovell	Logan	Active 11/98-P
102	1107	121600010290	Spring Creek, off US 412, Murphy	Mayes	Active 11/98-P
103	1107	121600070010	Spring River, off SH 137, Quapaw	Ottawa	Active 11/98-P
104	1107	121500020260	Verdigris River, US 412, Inola	Rogers	Active 10/00-P
105	1107	121510010010	Verdigris River, US 60, Nowata	Nowata	Inactive 02/99-09/99
106	1107	121510020010	Verdigris River, SH 10, Lenepah	Nowata	Active 11/98-P
107	1107	121500030010	Verdigris River, SH 20, Keetonville	Rogers	Active 11/98-P
108	1107	121500010200	Verdigris River, SH 51, Wagoner	Wagoner	Active 09/99-P
109	1113	311100030010	Walnut Bayou, SH 32, Burneyville	Love	Inactive 09/99-09/00
110	1113	310810020010	Washita River, off SH 19, near Alex	Grady	Active 01/03-P
111	1113	310830030060	Washita River, SH 152, Cordell	Washita	Active 11/98-P
112	1113	310810010010	Washita River, SH 19, Pauls Valley	Garvin	Active 11/98-P

	4-DIGIT USGS #	WBID #	STATION NAME	COUNTY	STATUS
113	1113	310840010010	WASHITA RIVER, SH 33, HAMMON	CUSTER	Active 11/98-P
114	1113	310800020010	WASHITA RIVER, US 177, DURWOOD	CARTER	Active 11/98-P
115	1113	310830010010	WASHITA RIVER, US 281, ANADARKO	CADDO	Active 11/98-P
116	1113	311310020010	WEST CACHE CREEK, SH 5B, TAYLOR	COTTON	Active 11/98-P
117	1110	720500030040	WOLF CREEK, OFF US 270, FORT SUPPLY	WOODWARD	Active 11/98-P

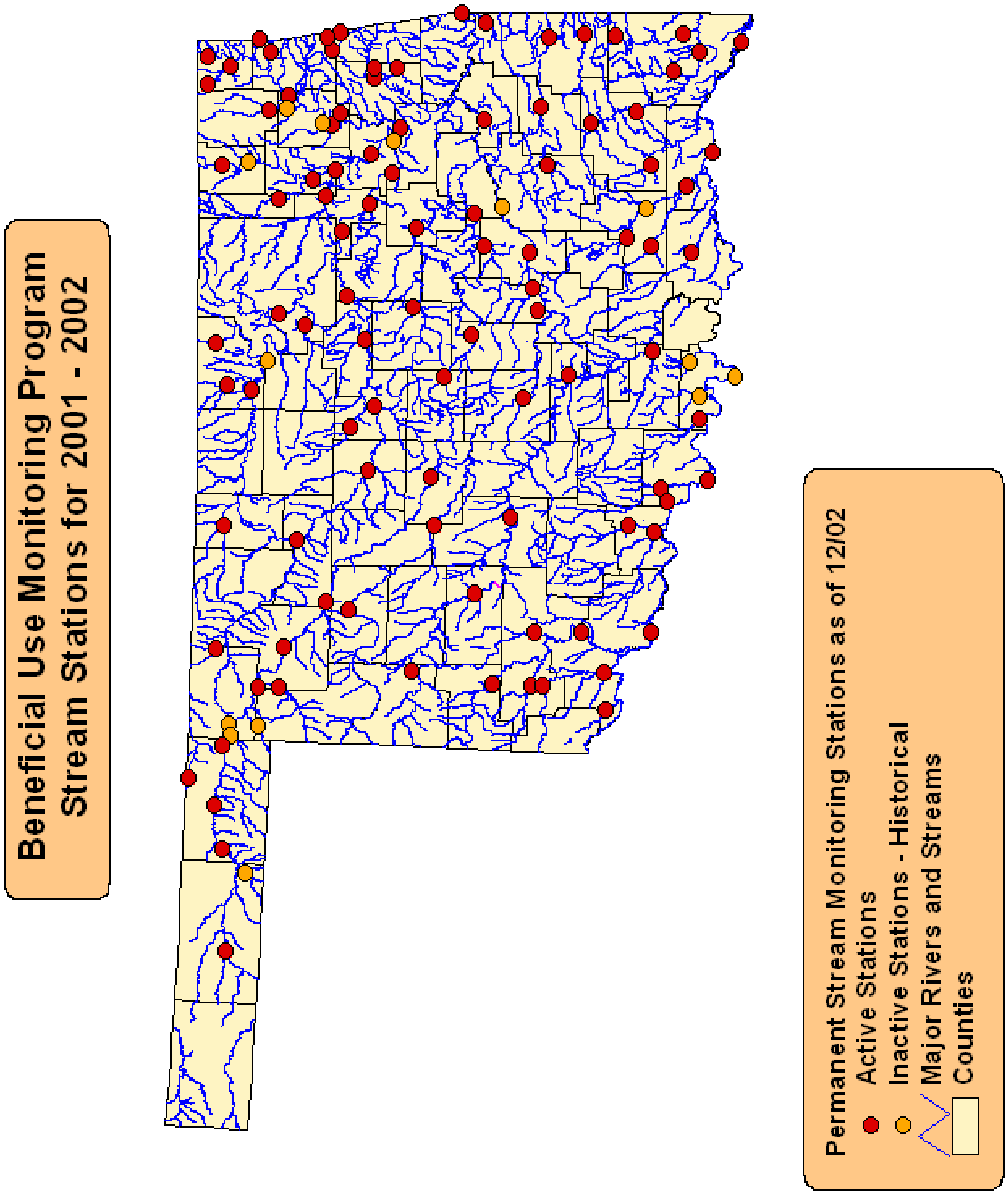

Figure 2. Beneficial Use Monitoring Program permanent ambient trend monitoring sites.

Rotating site selection is not as simple of a process. The goal of the rotating portion of the program is to provide short-term assessments on priority waters as identified by a state agency or other party. Two over-arching objectives were identified to aid in the determination of what would qualify as a rotating site. First of all, it was determined that data collection at a particular site should be short-term in nature and not extend past one sampling year, although some stations do remain in the network for up to two years. Data collected within that year should allow water quality managers to make the appropriate decisions regarding the segment being monitored. For instance, if a stream reach is listed as impaired due to pH on the 303(d) list, measuring pH throughout one year should allow the requesting agency or entity to either de-list the segment or determine what other monitoring efforts are necessary. Secondly, the monitoring should fall within the framework of the USAP. Since the inception of the program, the staff of the OWRB has met individually with representatives of other state agencies to identify their priority short-term monitoring needs. Once the OWRB receives a list of waters for monitoring from the interested agencies, staff evaluates the nominations and notifies the nominating agency of which waters would be monitored (all of the waters requested for monitoring have been accommodated since program inception). In all, over two hundred twenty (220) monitoring stations have been or are currently being monitored. In most instances, the segments were listed for one or more variables on the state's 303d list. For a comprehensive list of historic and/or current rotational monitoring stations, **please contact the Oklahoma Water Resources Board/Water Quality Programs Division at (405) 530-8800.**

Stream Monitoring Variables. The variables that are monitored were chosen to reflect both objectives of the programs — assessment of beneficial uses within the framework of USAP as well as the assessment of general water quality. Even though a variable may not be listed in the WQS with a specific criterion (e.g., hardness), the variable is an important constituent in analyzing and understanding the general water quality of a particular segment. See Table 4 for a list of monitoring variables.

Table 4. Variables Monitored by the BUMP Stream Sampling Program.

SAMPLE VARIABLES		
General Water Quality Variables – Sampled 10 times annually		
Dissolved Oxygen (D. O.)	pH	Specific Conductance
Temperature	Oxidation/Reduction Potential	% D. O. Saturation
Salinity	Total Alkalinity	Total Hardness
Chloride	Nephelometric Turbidity	Sulfate
Total Dissolved Solids		
Nutrients – Sampled 10 times annually		
*Kjeldahl Nitrogen	Ortho-Phosphorus	Total Phosphorus
*Nitrate Nitrogen	*Nitrite Nitrogen	Ammonia Nitrogen
Metals – Sampled as needed		
Arsenic	Cadmium	Chromium
Copper	Lead	Mercury
Nickel	Selenium	Silver
Zinc	Thallium	

STREAM MONITORING PROGRAM

SAMPLE VARIABLES		
Organics – Site specific sampling as needed		
Analysis of Pesticides, Herbicides, Fungicides, and other organics		
Bacteriological Communities – Sampled 5-10 times annually (during recreational season)		
Fecal Coliform	*Escherichia coli*	Enterococci
Biological Communities – Sampled as described below		
Sestonic Chlorophyll-a (10 times annually	Benthic Chlorophyll-a (as needed during summer)	Fish (once every 4-5 years)
Benthic Macroinvertebrates (2 summer/2 winter 2 out of every 5 years	Habitat (sampled with fish and macroinvertebrate sampling)	

*Total nitrogen is calculated by OWRB staff, based upon concentrations for these compounds.

Data for general water quality, nutrient, metals, organics, chlorophyll, and bacteriological variables are collected in one of two ways. Some variables are monitored in-situ utilizing a Hydrolab® Minisonde or YSI multi-probe instrument. The measurement is taken at the deepest point of the channel at a depth of at least 0.1 meters and no greater than one-half of the total depth. The data are uploaded from the instrument to a data recorder, transferred manually to a field log sheet, and downloaded to the OWRB monitoring database. These variables include dissolved oxygen (D. O.), %D. O. saturation, water temperature, pH, salinity, oxidation-reduction potential, total dissolved solids, and specific conductance. Data for all other variables are gathered from water quality samples collected at the station. Samples are collected either by suspending a depth-integrating sampler (DH-95 with polyethylene collection bottle) from a bridge, by wading the stream with a DH-81 wadable depth-integrating sampler (polyethylene collection bottle), or in rare cases as a composite or point grab sample. If sampling occurs from a bridge, the sampling is done on the down-stream side of the bridge spanning the stream of interest. Samples are collected using a combination of the depth-integration method and the equal-width increment method. The depth-integration method involves collection of samples from the surface of the water to the bottom of the water column with water collected at a consistent rate on both the descent and the ascent. The equal-width-increments-method allows for collection of a composite sample by sampling with depth-integration at 5 to 10 equal widths across the stream. As each increment is sampled, the water is added to a polyethylene churn splitter. From this composite water sample, water quality variables are monitored in several ways. For laboratory analysis of general water quality variables and nutrients, water is aliquotted from the churn splitter to two (2) 1-liter bottles (one for sulfuric acid/ice preservation and one for ice preservation). If a sample is needed for metals analysis, water is aliquotted into a 1-liter acid washed bottle, preserved with nitric acid, and placed on ice. Sample water for the determination of nephelometric turbidity, total hardness, and total alkalinity is also aliquotted from the splitter churn. Nephelometric turbidity is determined through use of a HACH Portable turbidimeter. Total hardness and alkalinity are determined using HACH test kits. All instruments and test kits are calibrated and used according to manufacturer's instructions. Sestonic chlorophyll-a samples are also gathered from the churn and are filtered to a glass fiber filter with subsequent chemical/physical extraction. Samples for organics analysis are collected separately using Teflon and glass containers as opposed to polypropylene. Because organics have an increased affinity for polypropylene, allowing a sample to contact polypropylene sample bottles or churn splitters may cause concentrations to be significantly underestimated. Therefore, a composite sample for organics analysis is collected using a 1-liter Teflon collection bottle. At each increment, water is added to a 2-gallon glass bottle. The laboratory sample is aliquotted by inverting the glass bottle 10 times and dispensing to one-quart or one-pint clear or amber glass jars depending on the type of organic analysis. The samples are placed on ice for preservation. Bacteriological samples are collected using a composite grab sample method and are aliquoted to 2 100-mL bacteria bottles for laboratory analysis.

Biological data are collected using a variety of methods. In short, fish are typically collected using siene in all waters, and where water conductivity allows, electrofishing methods are used. Benthic macroinvertebrates are collected by targeting the richest habitats in the waterbody including riffles, streamside vegetation, and woody debris. Collections are then sorted and a subsample taken for taxonomic analysis. Various habitat measures are also included during each biological sampling event. The long form habitat classification is used during fish collections, and staff gather data various instream and riparian characteristics using both quantitative and qualitative methods. A short form habitat classification is used during macroinvertebrate collections that focus on target habitat substrate composition. Benthic chlorophyll-a samples are gathered from the characteristic substrates of the stream.

For a more detailed discussion of water quality sampling procedures, please contact the OWRB for copy of the BUMP Standard Operating Procedures (SOP). The SOP document can be obtained by contacting the Oklahoma Water Resources Board/Water Quality Programs Division at (405) 530-8800 or by accessing and downloading the document via the web at the link below. http://www.state.ok.us/~owrb/reports/publications.html

OWRB stream sampling personnel collect water quality data for all variables on permanent ambient trend monitoring stations (Table 3). In all cases, the rotating stations have been derived from stream segments listed on Oklahoma's 303(d) list and on streams submitted for monitoring by other state agencies. Therefore, the water quality variables analyzed are determined from the 303(d) listed cause code or by the requesting agency, with concurrence by OWRB staff. The stations monitored for the OCC are located on stream segments designated for salinity on the 303(d) list. Each station is sampled monthly for a variety of cations and anions. Methods used at rotating sites are identical to methods described for the permanent sites.

Quality Assurance/Quality Control (QA/QC). QA/QC will not be discussed in detail in this report. However, for a comprehensive description of field QA/QC methods, please contact the Oklahoma Water Resources Board/Water Quality Programs Division at (405) 530-8800. For laboratory QA/QC methods please contact the Oklahoma Department of Environmental Quality/Customer Services Division at (405) 702-6100. Comprehensive QA/QC has been performed on all data collected and utilized for this report.

STREAM DATA ANALYSIS PROTOCOLS

BUMP data collection on streams began in November of 1998. In order to provide a structural framework for data analysis and interpretation within the confines of the WQS, the program uses the Use Support Assessment Protocols (USAP) promulgated into rule in Oklahoma Administrative Code (OAC) 785:46-15. A detailed explanation of the relationship between the USAP and the data collected on streams and rivers as part of the BUMP is presented below. This explanation is broken down into 8 subsections: Data Requirements, Default Protocols, Assessment of Fish and Wildlife Propagation Support, Assessment of Primary Body Contact Recreation Support, Assessment of Public and Private Water Supply Support, Assessment of Agriculture Support, Assessment of Aesthetics Support, and Assessment of Human Health

Support (fish consumption). The latest USAP is included with this document as Appendix A and should provide greater insight into exactly how use support determinations were made for this report. In addition, OAC 785:45 (Oklahoma Water Quality Standards) and the justification document for the USAP can be obtained by contacting the OWRB/Water Quality Programs Division at (405) 530-8800 or through accessing the documents on the OWRB web page at: http://www.state.ok.us/~owrb/rules/Rules.html.

Data Requirements. USAP divides the number of stream miles that can be represented by a single site/station (or spatial coverage) into two categories—non-wadable and wadable streams. Sites/stations can be representative of no more than 25 stream miles on non-wadable streams and 10 stream miles on wadable streams. These limitations can be adjusted based upon existing data, distance between monitoring sites, sources of pollution, and the influence of major hydrological features, such as major tributaries and dams (delineated by 12-digit waterbody identification segments). A definition of what constitutes a wadable and non-wadable stream is not outlined in the USAP, so OWRB staff use federal guidance as well as best professional judgment. Federal 305 (b) guidelines say that no monitoring site/station can be representative of more than 25 stream miles on large streams and rivers. Furthermore, in areas where topography and land use are relatively homogeneous and there are no other significant influences, a single monitoring station can be representative up to 50 to 75 stream miles. Therefore, only two firm guidelines are currently available for determining the spatial coverage of a monitoring site/station:

1) The spatial coverage can not extend outside the 12-digit segment in which the monitoring site/station is located except in those instances where it is determined that it is reasonable to do so (e.g., the segment break is not caused by a major hydrological influence).
2) No monitoring site/station can be representative of more than 25 stream miles (in some instances, monitoring sites/stations may be representative of up to 50 stream miles with a scientifically defensible justification).

Accordingly, spatial coverage for the 2004 - 2005 BUMP report on streams will be limited to these two guidelines. The spatial coverage is subject to change dependent upon the language of the latest version of USAP.

USAP sets two limitations on temporal coverage. First, data used in assessments must be collected such that decisions are not biased towards either critical-flow, base-flow, or high-flow conditions. This report uses data collected during all seasons. Secondly, stream data that is more than five years old cannot be used to assess support unless no other data exists or a scientifically defensible reason can be brought forth justifying the use of older data. This report uses no data collected before November of 1998.

USAP also sets data requirements on the number of samples needed and the magnitude of criteria exceedance for toxicants and dissolved oxygen before a use support determination can be made. The minimum number of samples required to assess use support for all general water quality variables is ten (10). This minimum number of samples is not applicable if data from samples already collected ensures that the use will not be supported. In other words, if a 25% percent exceedance is required to designate a use as not supporting and three (3) of the first five (5) samples collected were in exceedance of the criteria, then sampling can discontinue because you are assured of having >25% of the minimum number of samples exceeding the criteria. The BUMP program collects at least ten samples per year on all general water quality parameters with the exception of bacteria, organics and metals. Toxicants (metals and organics) require a minimum of five (5) samples to determine use support, however, less than 5 samples can be used to determine if a use is partially supported or not supported. Furthermore, if at least 2 sample concentrations of a toxicant exceed the criteria prescribed in the WQS by two or more orders of magnitude, then the use is determined to be "not supporting".

Finally, USAP gives guidance on the treatment of practical quantification limits (PQL), or detection limits. A PQL is the minimum value that a particular test or instrument can "read-to" with an acceptable level of confidence. If a value is determined to be less than the PQL, then it is generally reported as a "less than value" (e.g., variable data point "x" = <2.0 mg/L). In other words, the test or the instrument cannot deliver a value less than the PQL without introducing statistically significant uncertainty to the data. Moreover, when analyzing the data, data point "x" cannot be assigned a value of 2.0 mg/L or 0.0 mg/L because staff would be making an arbitrary determination that would assuredly be either an under estimation or an over estimation of the "true" value. Consequently, the OWRB staff assigns a value that is fifty percent of the PQL ("x" would equal 1.0 mg/L).

Default Protocols. USAP outlines the procedures for determining whether a set of data points for a particular variable **support**, **partially support**, or **do not support** a particular beneficial use. These protocols are constructed around two distinct types of numerical variables — short term averages and long term averages. In each case, samples collected for the range of water quality parameters are analyzed and aggregated in different ways.

Short-term average numerical variables measure variables with exposure periods of less than seven days (e.g., turbidity or a sample standard for chlorides). In other words, the set of samples that is being analyzed considers each sample as a separate entity. For example, **each** turbidity sample collected monthly from January through December is considered a unique sample, and consequently, every sample is not aggregated into a single sample for analysis but is considered a fraction of the whole. Use support determination for short-term numerical variables requires a three-step process:

1. Each sample exceeding the prescribed criterion or screening level for a particular variable is identified,
2. The number of samples exceeding the prescribed criterion or screening level is divided by the total number of samples collected to obtain a percent exceedance, and
3. The percent exceedance is compared to a range of prescribed percent exceedances to determine use support. The prescribed percent exceedances are:
   - i) Supporting — less than or equal to ten percent (10%),
   - ii) Partially supporting — greater than 10% but less than twenty-five percent (25%),
   - iii) Not supporting — greater than or equal to 25%.

Long-term average numerical variables measure variables with exposure periods of greater than or equal to seven days (e.g., yearly mean standard for chlorides). In other words, the **entire** set of samples that is being analyzed is considered a unique entity. For example, chloride samples collected monthly from January through December are aggregated through the calculation of a geometric mean. Use support determination for long-term numerical variables requires a three-step process:

1) Samples for a particular variable are aggregated into a geometric mean
2) The geometric mean is compared to the prescribed criterion or screening level

3) Use support is determined to be supporting if the mean is less than the prescribed criterion or screening level or not supporting if the mean is greater than the prescribed criterion or screening level.

Because the long-term average compares only one value (the geometric mean) to the prescribed criterion or screening level, it cannot be considered partially supporting. In most instances, at least ten samples are required to calculate a geometric mean. Furthermore, geometric means are calculated on a two-year rolling average using the most recent data available.

A particular change to this year's report is the addition of the lanquage "but is impaired per the CPP" when a beneficial use is determined to be partially supporting. The data produced by the BUMP is used to help develop Oklahoma's Integrated Report, which is a USEPA required report classifying all water bodies based on impairment status. Althought the USAP is the guiding document for use support attainment decisions; the State also uses the Continuing Planning Process (CPP) document as required by the USEPA. Its methodology section is mostly a reiteration of the USAP, however it does address areas where the USAP is silent or does not fully meet reporting requirements. Once such area is the use of "partial support" which is not a valid reporting endpoint for use attainment. The CPP classifies water bodies as "impaired" or "not impaired". Subsequently, for reporting purposes, those waters classified as "supporting" by the USAP are classified as "not impaired", and those waters classified as "partial supporting" or "not supporting" by the USAP are classified as "impaired".

So that the reader will fully understand how use support was determined for our rivers and streams for the various beneficial uses assigned to them a short discussion of the WQS beneficial uses and the Use Support Assessment Protocols (USAP) is included below.

Assessment of Fish and Wildlife Propagation (FWP) Support. The FWP beneficial use utilizes five different water quality variables to assess use support: dissolved oxygen (D.O.) concentration, toxicants, hydrogen ion activity (pH), turbidity, and biological criteria. Only one variable needs to exceed the assessment protocol for the beneficial use to be partially supported or not supported.

The WQS 785:45-5-12(g)(1) in a table entitled "Dissolved Oxygen Criteria" prescribes three screening levels for D.O. in streams. Streams are categorized in Appendix C of the WQS as habitat limited aquatic communities (HLAC), warm water aquatic communities (WWAC), cool water aquatic communities (CWAC), and trout fisheries (TF). The prescribed screening level for each of the categories is: HLAC—4.0mg/l (April 1—June 15) and 3.0 mg/L (June 16—May 31); WWAC—4.0mg/l (June 16—October 15) and 5.0 mg/L (October 16—June 15); and CWAC and TF—5.0mg/l (June 1—October 15) and 6.0 mg/L (October 16—May 31). The protocol for short-term average numerical parameters is used to assess the level of support.

Numerical criteria is prescribed for toxicants in WQS 785:45-5-12(g)(6)(G) in a table entitled "Numerical Criteria for Toxic Substances". To determine use support, the protocol for short-term average numerical parameters is used. Sample values must be compared to both acute and chronic criterion. Both criterions need not be exceeded for the variable to be partially supported or not supported.

A numerical range for pH of 6.5 to 9.0 units is prescribed in 785:45-5-12(g)(3) for all aquatic classifications. The protocol for short-term average numerical parameters is used to assess the level of support.

Screening limits are established for turbidity in WQS 785:45-5-12(g)(7)(A)(i) and (iii). CWAC are assigned a criterion of 10 Nephelometric Turbidity Units (NTU), and all other stream communities are assigned a criterion of 50 NTU. The protocol for short-term average numerical parameters is used to assess the level of support. In WQS 785:45-5-12(g)(7)(C), it is stated that numerical criteria for turbidity "apply only to seasonal base flow conditions". Therefore, those measurements that are taken above seasonal base flow are not included in determining support. To determine seasonal base flow, the average discharge for the sampling day is compared to the median flow of the three months surrounding the sampling day. If the station is not part of the USGS stream-flow monitoring program but has an upstream or downstream stream-flow station in close proximity, that station is used to determine whether the station in question is at seasonal base flow. If no proximal stream-flow station exists, stream-flow monitoring stations on other waterbodies that are in close geographical proximity were used to determine whether the station in question is at seasonal base flow. Because discharge data is not yet available from October of 2001 through September of 2002, use support determinations based on turbidity data are provisional and assessments related to turbidity may be subject to change. Therefore, all turbidity assessments are provisional. Changes will be reported in an addendum to this report. Furthermore, to assist staff in the determination of seasonal base flow at stations that do not have continuous discharge measurements, the OWRB is now collecting discharge measurements at all but four of the permanent monitoring stations. To supplement base flow determination staff uses several anecdotal methods. These methods are only used in concert with another method when determining if base flow conditions existed when the sample was taken. In one method, staff determines flow condition visually by noting whether the flow is minimal, light, moderate, high, or stormwater. Also, beginning in 2002, staff began noting the presence or absence of a periphyton line as well as the color and texture of the periphyton. In most instances, if a periphyton line has been established, flow has not exceeded that level in at least seven days.

Fish samples are processed through Oklahoma's Index of Biotic Integrity (O-IBI). The O-IBI incorporates six sample composition metrics and three fish condition metrics. The metrics and scoring protocol for the O-IBI are outlined in Appendix C of OAC 785:46. The total score for the index is compared to biocriteria housed in OAC 785:46-15-5. To date, Oklahoma has not developed a regionally based benthic macroinvertebrate IBI or regional reference conditions for habitat metrics.

Assessment of Primary Body Contact Recreation (PBCR) Support. The PBCR beneficial use utilizes 2 different bacteriological classes and one bacteriological species to assess use support: fecal coliform (FC), *Escherichia coli* (*E. coli*), and enterococci (Ent.). The assessment is performed by using the long-term average numerical protocol to compare to a prescribed geometric mean and by using a modified version of the short-term average numerical protocol to compare each sample to a prescribed screening level. The prescribed geometric means (GM) and screening levels (SL) are: FC—GM of 400 colony forming units/mL (cfu/mL) and SL of 400 cfu/mL; *E. coli*—GM of 126 cfu/mL and SL of 235 cfu/mL in scenic rivers and 406 cfu/mL in all other waters; and Ent.—GM of 33 cfu/mL and SL of 61 cfu/mL in scenic rivers and 406 cfu/mL in all other waters. For *E. coli* and Ent., both the SL (only one sample exceedance is necessary) and the GM must be exceeded for the use to not be supported. If all of the samples meet the SL or the GM is met, the use is supported. In the case of FC, the use may only be supported if the GM is met and no greater than 25% of the sample concentrations exceed the SL. If either the GM is exceeded or greater than 25% of the sample concentrations exceed the SL, the use is not supported for FC. In no instance is the PBCR beneficial use partially supported. Furthermore, PBCR support is only determined from samples collected during the recreational season from May 1 through September 30 of each year. Only one variable needs to violate the assessment protocol for the beneficial use to be not supported.

Assessment of Public and Private Water Supply (PPWS) Support. The PPWS beneficial use utilizes toxicant concentrations to assess use support. For purposes of this report, only metals are considered in the toxicant category. Only one variable needs to violate the assessment protocol for the beneficial use to be partially supported or not supported. Organics are currently being collected at some stations and will be used in the 2003 assessment. In previous reporting years, total coliform bacteria were used to determine use support. This was done in error. The criterion of 5,000 cfu/mL in the WQS is only applied at the water supply intake point and is not to be applied throughout the waterbody.

Numerical criteria for metals is established in WQS 785:45-5-10(1) and (6). The short-term numerical average protocol is used to determine use support for both sets of criterion. If a substance has different numerical criteria listed in both tables, the most stringent criterion takes precedence. Furthermore, criteria in both tables need not be exceeded for the use to be partially supported or not supported.

Assessment of Agriculture (AG) Support. The AG beneficial use utilizes three variables to assess use support: total dissolved solids, chlorides, and sulfates. Numerical criteria for both yearly mean standards and sample standards are located in Appendix F of Oklahoma Administrative Code (OAC) 785:45. The yearly mean standard for each variable is compared to the geometric mean of the samples using a long-term average numerical protocol. The sample standard for each variable is compared to the each sample using a short-term average numerical protocol. Use support assessment for each variable requires a three-step process:

1) The sample standard and yearly mean standard for the six digit management segment which encompasses the monitoring must be located in Appendix F of Oklahoma Administrative Code (OAC) 785:45;
2) The geometric mean of the samples is compared to the yearly mean standard (if the geometric mean exceeds the yearly mean standard, the use is not supported and no further analysis is necessary);
3) If the geometric mean meets the yearly mean standard, the sample standard is compared to each sample and percent exceedance is calculated (depending on the percent exceedance, the variable is supporting, partially supporting, or not supporting). Regardless of the criteria in Appendix F of Oklahoma Administrative Code (OAC) 785:45, if all TDS samples are less than 750 mg/L and all chloride and sulfate samples are less than 250 mg/L, the AG beneficial use is supported. Only one variable needs to violate the assessment protocol for the beneficial use to be partially supported or not supported.

Assessment of Aesthetics Support. With the exception of the numerical criterion of 0.037 mg/L of total phosphorus for Oklahoma scenic rivers and 70 Platinum-cobalt units for true color, the WQS includes only narrative criteria for the aesthetics beneficial use. Furthermore, the USAP only addresses the effect of nutrients and true color. However, narrative criteria in OAC 785:45-3-2(c) requires that nutrients related water quality degradation cannot interfere with the maintenance of any beneficial use protected under OAC 785:46-13-3(a)(1). Because numerical nutrient criteria exists only for scenic rivers, assessments of nutrients on all other rivers and streams do not determine beneficial use support but whether a particular stretch of stream is nutrient-threatened. Therefore, these assessments of nutrients do not utilize any of the default protocols, but revolve around the use of a dichotomous key. The use of the key is a rather involved process and will not be verbally outlined in this report. Please refer to OAC 785:46-15-10 for a detailed discussion of the dichotomous key and how it is apllied for use support determination.

The impact of nutrients on streams is related to the growth of phytoplankton. Phytoplankton are autotrophic which means that when light and consumables such as nutrients are available they can convert energy and grow. The available nutrients are total phosphorus and nitrite and nitrate (utilized as a combined nitrogen concentration). Several factors determine if the level of these compounds pose a threat to the health of the stream. Foremost, the size of the stream must be considered. Smaller streams (3rd order or less) tend to be more susceptible to nutrient impacts and, therefore, smaller concentrations have similar effects as larger concentrations in larger streams (greater than 3rd order). Depending on stream order, USAP has established preset threshold values for total phosphorus and nitrate/nitrite. If the two-year rolling median of the sample values exceeds the threshold, the following confounding factors are considered to determine if the excessive nutrients are threatening the health of the stream. The amount of time the nutrient is resident in the stream is proportional to the impact. Therefore, the slope of the topography around the station must be considered. Furthermore, phytoplankton is light dependent for growth. Consequently, light must be able to able to penetrate the surface of the water. For this reason, water clarity must be measured by using a nephelometric turbidity meter or a Secchi disk. Only turbidity readings taken at seasonal base flow are included when calculating the geometric mean. Logic states that low clarity will limit the impact of phytoplankton on the stream and that high clarity will increase the impact of phytoplankton. On smaller streams, available light is also measured by percent canopy shading. An option to the dichotomous key is the use of Carlson's Trophic State Index (TSI) value (Carlson, 1977) on non-wadeable streams. The mean of sestonic chlorophyll-a data is used to calculate the TSI using the equation: **TSI = 9.81 x ln(chlorophyll-a) + 30.6**. A TSI value of 62 or greater indicates that a nonwadeable waterbody is nutrient threatened.

In 2002, A numerical criterion of 0.037 mg/L of total phosphorus was set for all waterbodies designated as Oklahoma Scenic Rivers. These rivers include the Barren Fork River, Flint Creek, the Illinois River, Lee Creek, Little Lee Creek, and the Mountain Fork River above Broken Bow Reservoir. The current USAP requires that a multi-step process for support determination. First of all, three-month rolling geometrics are calculated for the most immediate 5 years of data available. This data, when possible, should include high flow monitoring events. Once the geometric means are calculated a short-term protocol is used for final assessment. If less than 10% of the three-month geometic means are below 0.037, the station is supporting, but if more than 10% are above the criterion, the station is not supporting.

Assessment of Human Health Support. A new beneficial use was created in 1999 dealing with fish consumption and is housed under the Human Health criteria. The new use deals with fish consumption bans and states that waters that the DEQ has issued a fish consumption ban on will be considered as not supporting it's fish consumption use.

PERMANENT STREAM MONITORING STATION RESULTS & DISCUSSION

The results for the permanent monitoring stations are grouped alphabetically within their home 4-digit USGS sub-basin (Table 3). A map of the state with all of the 4-digit HUC basins is included as to aid the reader in finding a particular water body (Figure 3). Each of these sections has a similar arrangement. Immediately following the tab for a particular sub-basin, there is a 1 or 2-page synopsis of the physical, geographical, and hydrological attributes of the

HUC. Included in this description will be a tabular listing of the stations located within the sub-basin.

Following the HUC description will be a detailed 1-4-page analysis of each station. The analysis includes a physical, geographical, and hydrological description of the site. Directly following the descriptive information, a short narrative is included that verifies that monitoring at the site complied with the data requirements outlined in USAP, or, in some instances, an explanation is offered as to why certain data requirements were not followed. For example, several stations in western Oklahoma go dry during the late spring or early summer. Therefore, the assessments for these stations may not be seasonally representative. Next, a comprehensive assessment of each of the prescribed beneficial uses will be done both in a narrative format and graphically. An all-inclusive assessment of the stations can be found in Table 5. Under certain circumstances, a beneficial use may not be assessed for a variety of reasons. The station may be new or inactivated before adequate data was collected for assessment, data may not be available due to laboratory, field, or equipment error, or sometimes data may not be collected due to monetary or personnel constraints.

Table 5 lists the BUMP permanent ambient trend stream monitoring sites and their associated beneficial uses. Beneficial uses that are not being met are shown in **RED**. Listed next to the support code indicating that the beneficial use was not being met is the variable code which indicates which water quality variable violated the WQS criteria. When reviewing Table 5 it is apparent that an inordinate number of water bodies are deemed impaired due to turbidity and bacteria.

Many waterbodies exceed the turbidity standard of 10 or 50 nephelometric turbidity units. The WQS states that turbidity standards only apply during seasonal base flow conditions. In other words, the criteria should not be applied where normal in-stream conditions exceed the WQS due to natural processes from a high-flow rain event. Several “quick” methods are available to assist in the determination of seasonal base flow including the existence of a periphyton line and visual estimation of the degree of flow. However, to reliably determine base flow, a measurement of stream discharge at the time of sampling is needed. This measurement when used in concert with the “quick” methods described above will give a reliable indication of whether the stream is at, below, or above seasonal base flow conditions. Because the BUMP network encompasses the state’s large rivers and streams, discharge is often obtained by comparing stream stage to a continuously updated rating curve. Due to the intense nature of establishing a reliable rating curve, rated discharges are often provisional for a number of months. Therefore, the determination of the previous year’s base flow and consequently turbidity values available for use support analysis are **provisional** at the publication of this report. As of the beginning of 2002, the OWRB is now gaging all but 4 permanent station locations. Where permanent water-quality monitoring stations were located near a United States Geological Survey (USGS) stream-flow monitoring station, the information collected by USGS is used to determine if a high-flow event exceeding seasonal base flow had occurred at the time of sampling. All other stations are being rated through a cooperative effort between the OWRB Monitoring Section and the USGS. To supplement base flow determination staff use several anecdotal methods. These methods are only used in concert with another method when determining if base flow conditions existed when the sample was taken. In one method, staff determines flow condition visually by noting whether the flow is minimal, light, moderate, high, or stormwater. Also, beginning in 2002, staff began noting the presence or absence of a periphyton line as well as the color and texture of the periphyton. In most instances, if a periphyton line has been established, flow has not exceeded that level in at least seven days.

Of the ninety-nine (99) stations assessed for Primary Body Contact Recreation (PBCR) in this report, eighty-five (85) stations (or 85%) are listed as not supporting due to the exceedance of one or more variable. Several explanations may address this inordinate number of non-supporting stations. Primarily, a valid assumption may be that the assessment of data is reflective of reality in many listings. Of the 88 non-supporting stations, thirty-five (35), or 40%, have multi-variable exceedances. Furthermore, a pattern of consistency can be seen for certain variables at some stations. In other words, exceedances of the applicable screening limits are present in each recreational season during the period of record. Secondly, the high percentage of non-supporting stations may be an artifact of either the WQS criteria and/or the USAP decision-making process. The criteria used to assess PBCR are protective of human health, and rightfully so. However, are all waterbodies assigned PBCR recreated to the same extent? In other words, should the same amount of protection apply to all waterbodies? Currently, Oklahoma has a two-tiered system—lakes/scenic rivers and all others—with more stringent criteria applied to lakes and scenic rivers. It may be prudent to investigate subdividing the "all other" tier into several categories. Additionally, the decision-making process in USAP may be producing some type I errors—assigning non-support status incorrectly. While maintaining the need for protection of human health, the process for assignment and assessment of the PBCR beneficial use needs to be looked over carefully so that water quality management will be become more precise and accurate.

It is also imperative that the state begins refining the minerals criteria found in OAC 45: Appendix F. Many of these management segment values were extrapolated from minimum data and from stations not necessarily representative of the entire management segment. The OWRB has developed a protocol for the development of site-specific minerals criteria. With the data available from the BUMP and other water quality monitoring programs, many of these inconsistent criteria could begin to be refined.

It is essential that Oklahoma quantify impacts in a comprehensive and scientific manner and look for trends in water quality to identify waters that are not meeting their assigned beneficial uses. As a state, we must manage our water resources effectively and direct money to areas in most need of protection or remediation to ensure that we continue to have good quality and sufficient quantity of water to meet our needs well into the 21^{st} century. It is the desire of the Oklahoma Water Resources Board to provide the legislature, the general public and professional water managers with a comprehensive and up-to-date document for their review and approval. Administrative and Technical staff at the OWRB look forward to conducting the Beneficial Use Monitoring Program far into the future and providing the state of Oklahoma with the information it needs to make informed decisions related to the effective management of it's precious water resources.

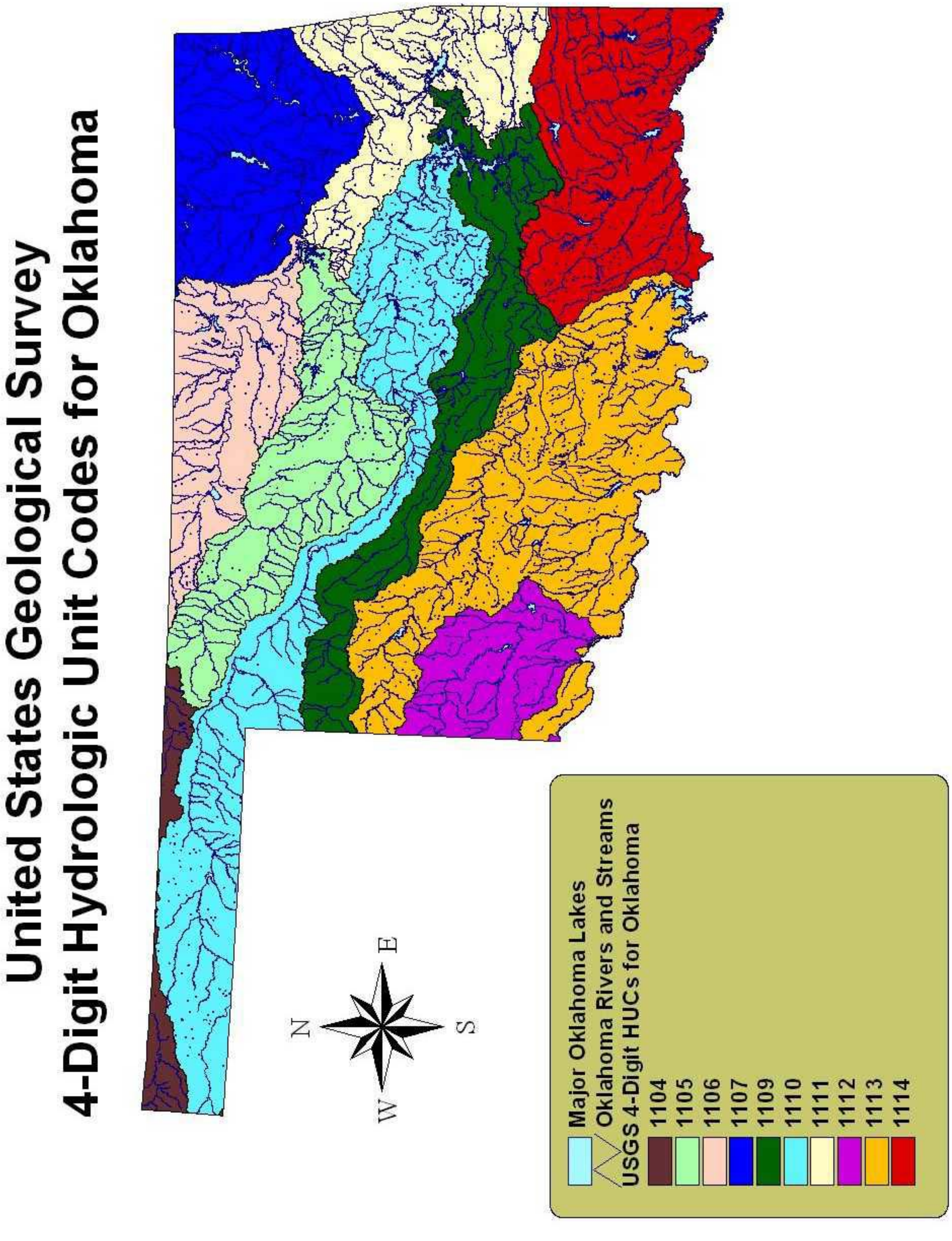

Figure 3. USGS 4-digit HUC basins.

Table 5. Permanent Ambient Trend Monitoring Stations and their Beneficial Use Support Status.

STATION NAME	FWP	PBCR	PPWS	AG	AES
Arkansas River, US 64, Moffett	S	NS (8)	S	S	NT
Arkansas River, SH 104, Haskell	S	S	N/A	NS (10)	NT
Arkansas River, SH 18, Ralston	NS (5)	NS (8)	S	S	NT
Arkansas River, SH 97, Sand Springs	S	S	N/A	S	NT
Arkansas River, US 62, Muskogee	NS (3)	NS (8)	N/A	S	NT
Arkansas River, US 64, Bixby	S	NS (6, 7, 8)	N/A	S	NT
Barren Fork, SH 51, Eldon	S	NS (8)	S	S	NS (14)
Beaver River, off US 64, Guymon	S	NS (6, 7, 8)	S	S	NT
Beaver River, US 83, Turpin	S	NS (6, 7, 8)	N/A	NS (10, 11)	NT
Beaver River, SH 23, Beaver	S	NS (6, 8)	N/A	NS (10, 11)	NT
Beaver River, US 283, Laverne	S	NS (8)	N/A	S	NT
Beaver River, CR N1650, Gate	S	NS (6, 8)	N/A	NS (10, 11)	NT
Beaver River, US 183, Fort Supply	S	NS (8)	N/A	S	NT
Big Cabin Creek, off US 69, Big Cabin	S	NS (7, 8)	S	PS (12)	NT
Bird Creek, SH 266, Port of Catoosa	NS (5)	NS (6, 8)	S	S	NT
Black Bear Creek, SH 18, Pawnee	NS (5)	NS (6, 8)	S	S	NT
Blue River, US 70, Durant	S	NS (8)	S	S	NT
Brushy Creek, off US 270, Haileyville	NS (1, 3, 5)	NS (8)	S	S	NT
Canadian River, SH 2, Whitefield	S	S	S	S	NT
Canadian River, US 183, Taloga	PS (5)	NS (8)	N/A	NS (10, 11)	NT
Canadian River, US 270, Calvin	PS (5)	NS (8)	S	PS (12)	T (17)
Canadian River, US 377, Konawa	NS (3,5)	NS (8)	S	NS (10)	T (17)
Canadian River, US 66, Bridgeport	NS (5)	NS (8)	N/A	S	NT
Canadian River, US 77, Purcell	PS (5)	N/A	N/A	S	T (17)
Caney Creek, off SH 100, Barber	S	S	S	S	NT
Caney River, off US 75, Ramona	NS (3, 5)	NS (8)	S	S	NT
Chickaskia River, US 177, Blackwell	NS (3, 5)	NS (6, 8)	S	S	NT
Cimarron River, off SH 8, near Ames (Orienta)	PS (5)	NS (6, 7, 8)	N/A	NS (10, 11, 12)	NT
Cimarron River, SH 34, Buffalo	S	NS (6, 7, 8)	N/A	NS (10)	NT
Cimarron River, SH 99, Oilton	NS (5)	NS (6, 8)	N/A	S	NT
Cimarron River, US 77, Guthrie	PS (5)	NS (6, 8)	N/A	S	NT

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STATION NAME	FWP	PBCR	PPWS	AG	AES
Cimarron River, US 81, Dover	PS (5)	NS (7, 8)	N/A	NS (10)	NT
Cimarron River, off US 64, Mocane	S	NS (6, 8)	S	NS (10, 11)	NT
Cimarron River, SH 33, Ripley	NS (5)	NS (8)	N/A	S	NT
Cimarron River, US 281, near Waynoka	NS (16)		N/A	NS (10, 11)	NT
Clear Boggy Creek, off US 69, Caney	NS (3, 5)	NS (6, 8)	S	S	NT
Deep Fork River, off SH 16, Beggs	NS (3, 5)	NS (8)	S	S	NT
Deep Fork River, US 377, Stroud	NS (3, 5)	NS (8)	PS (9)	S	NT
East Cache Creek, SH 53, Walters	NS (5)	NS (6, 7, 8)	S	S	NT
Elk Creek, off US 183, Hobart	NS (5)	NS (6, 8)	S	S	NT
Elk River, SH 43, Tiff City (MO)	S	NS (8)	S	S	NT
Elm Fork River, SH 9, Mangum	S	NS (6, 7, 8)	S	S	NT
Flint Creek, US 412, Flint	S	NS (8)	S	S	NS (14)
Fourche-Maline Creek, off US 270, Red Oak	NS (1, 3)	NS (8)	S	S	NT
Glover River, SH 3, Glover	NS (1, 3, 5)	NS (8)	S	S	NT
Honey Creek, off SH 25, Grove	S	NS (8)	S	S	T (15)
Illinois River, US 59, Watts	PS (5)	NS (8)	S	S	NS (14)
Illinois River, US 62, Tahlequah	S	S	S	S	NS (14)
Kiamichi River, off US 271, Tuskahoma	NS (2, 3)	S	S	S	NT
Kiamichi River, SH 63, Big Cedar	NS (3, 4)	NS (8)	S	S	NT
Kiamichi River, US 271, Antlers	NS (2, 3)	NS (8)	S	S	NT
Kiamichi River, SH 109, Fort Towson	PS (5)	NS (8)	S	S	NT
Lee Creek, SH 101, Short	S	NS (8)	S	S	S
Little River, off SH 3, Cloudy	NS (3, 5)	NS (8)	S	S	NT
Little River, off US 70, near Holly Creek	NS (1, 5)		S	S	NT
Little River, SH 56, Sasakwa	NS (3, 5)	NS (8)	S	S	NT
Mountain Fork, SH 4, Smithville	NS (2, 3, 5)	S	S	S	NS (14)
Mountain Fork, US 70, Eagletown	NS (2, 3)	NS (8)	S	S	NT
Mud Creek, SH 32, Courtney	NS (1, 5)	NS (8)	S	S	NT
Muddy Boggy Creek, US 70, Unger	NS (3, 5)	NS (6, 8)	S	S	NT
Muddy Boggy Creek, US 69, Atoka	NS (1, 3, 5)	NS (6, 8)	S	S	NT
Neosho River, off US 66, Commerce	NS (3, 5)	S	S	S	NT
Neosho River, off SH 137, Connor Bridge	PS (5)	S	S	S	NT

STATION NAME	FWP	PBCR	PPWS	AG	AES
Neosho River, SH 82, Langley	S	S	S	S	NT
Neosho River, US 412, Chouteau	S	S	S	S	NT
North Canadian River, Ind. Nat. Tpk., Dustin	NS (3, 5)	NS (6, 8)	S	S	NT
North Canadian River, SH 3E, Shawnee	NS (3, 4, 5)	NS (8)	N/A	S	T (13, 17)
North Canadian River, off US 62, Harrah	PS (5)	NS (6, 8)	N/A	S	T (13, 17)
North Canadian River, US 270, Watonga	S	NS (6, 7, 8)	S	S	NT
North Canadian River, US 281, Seiling	PS (5)	NS (8)	S	S	NT
North Canadian River, US 75, Wetumka	NS (3, 5)	NS (6, 8)	S	S	T (13, 17)
North Canadian River, US 412, Woodward	S	NS (8)	N/A	S	NT
North Canadian River, US 81, El Reno	S	NS (8)	S	S	NT
North Fork of the Red River, US 62, Headrick	S	NS (8)	S	NS (10, 11)	T (17)
North Fork of the Red River, SH 34, Carter	S	NS (8)	S	S	NT
Poteau River, off SH 112, Pocola	NS (3, 5)	NS (8)	S	S	NT
Poteau River, US 59, Heavener	S	S	S	S	NT
Red River, SH 79, Waurika	NS (5)	NS (8)	S	NS (10, 11, 12)	NT
Red River, US 183, Davidson	NS (3, 5)	NS (6, 8)	N/A	NS (10, 11, 12)	T (17)
Red River, US 259, Harris	PS (5)	S	S	S	NT
Red River, US 271, Hugo	PS (5)	NS (8)	S	NS (10, 11)	NT
Red River, US 81, Terral	NS (5)	NS (8)	S	NS (11, 12)	NT
Sager Creek, off US 412, West Siloam Springs	S	NS (8)	PS (nitrates)	S	T (13, 15)
Salt Fork of the Arkansas, SH 58, Ingersoll	NS (5)	NS (6, 7, 8)	S	S	NT
Salt Fork of the Arkansas, US 77, Tonkawa	NS (5)	NS (8)	S	S	NT
Salt Fork of the Red River, SH 34, Mangum	S	NS (8)	S	S	NT
Salt Fork of the Red River, off US 283, Elmer	NS (3)	NS (6, 8)	S	PS (11)	NT
Sandy Creek, SH 6, Eldorado	NS (2, 3, 5)	N/A	N/A	NS (10, 11, 12)	NT
Skeleton Creek, SH 74, Lovell	NS (5)	NS (6, 8)	S	S	NT
Spring Creek, off US 412, Murphy	S	S	S	S	NT
Spring River, off SH 137, Quapaw	NS (2. 3, 5)	NS (8)	S	S	NT
Verdigris River, US 412, Inola	NS (3, 5)	NS (8)	S	S	NT
Verdigris River, SH 10, Lenepah	NS (3, 5)	NS (8)	S	S	NT
Verdigris River, SH 20, Keetonville	PS (5)	NS (8)	S	S	NT

STATION NAME	FWP	PBCR	PPWS	AG	AES
Verdigris River, SH 51, Wagoner	NS (2, 3, 5)	NS (8)	S	S	NT
Washita River, off SH 19, Alex	NS (5)	NS (6, 8)	S	S	NT
Washita River, SH 152, Cordell	NS (5)	NS (6, 7, 8)	S	S	T (17)
Washita River, SH 19, Pauls Valley	NS (5)	NS (8)	S	S	NT
Washita River, SH 33, Hammon	PS (5)	NS (6, 7, 8)	S	S	NT
Washita River, US 177, Durwood	NS (5)	NS (6, 8)	S	S	NT
Washita River, US 281, Anadarko	NS (5)	NS (6, 8)	S	S	NT
West Cache Creek, SH 5B, Taylor	NS (5)	NS (6, 7, 8)	S	PS (11)	NT
Wolf Creek, off US 270, Fort Supply	S	NS (8)	S	S	NT

ASSIGNED WQS BENEFICIAL USES

FWP = Fish & Wildlife Propagation
PBCR = Primary Body Contact Recreation
PPWS = Public and Private Water Supply
AG = Agriculture
AES = Aesthetics

SUPPORT CODES

S—Fully Supporting	PS—Partially Supporting	NS—Not Supporting
N/A—Not Applicable	NT-NotThreatened (Nutrients)	T-Threatened (Nutrients)

WATER QUALITY VARIABLES

1—Dissolved Oxygen	2—Metals (Acute)	3—Metals (Chronic)
4—pH	5—Turbidity	6—Fecal Coliform
7— *Escherichia coli*	8— Enterococci	9—Metals
10— Total Dissolved Solids	11— Chlorides	12— Sulfates
13— Total Phosphorus (TP)	14—TP Ok Scenic River Criterion	15— Nitrite + Nitrate
16—Biocriteria	17—Sestonic Chlorophyll-a (TSI)	