State of Oklahoma

OKLAHOMA SURFACE WATER MONITORING STRATEGY

2003 - 2004

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Acknowledgements

This report was compiled and written by staff with the Oklahoma Water Resources Board with much input and assistance from several agencies including; Oklahoma Conservation Commission, Oklahoma Department of Environmental Quality, Oklahoma Corporation Commission and Office of the Secretary of Environment. This report is intended to be a synopsis of state monitoring activities and outlines Oklahoma's monitoring strategy. The input and review from many individuals on this document was greatly appreciated and resulted in the development of a comprehensive and concise document.

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Executive Summary

Oklahoma Senate Bill 549 in 1999 amended the Oklahoma Environmental Quality Act (27A O.S. 1999) to identify or further clarify responsibilities of the various state environmental agencies. One of the new responsibilities assigned to the Oklahoma Water Resources Board was the submittal of a biennial report to the Oklahoma Legislature discussing the status of water quality monitoring in Oklahoma. It is also required by the United States Environmental Protection Agency (EPA) that Oklahoma submit a document for its review that outlines Oklahoma's holistic water monitoring strategy. The Clean Water Act (CWA) specifies that "the Administrator shall not make any grant under this section (106) to any State which has not provided or is not carrying out as a part of its program- the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to trophic condition), the quality of navigable waters and to the extent practicable ground waters including biological monitoring; and provision for annually updating such data..." (33 U.S.C. Section 1256). This document is the culmination of those two charges and outlines monitoring activities being conducted by the State of Oklahoma and makes recommendations for needed changes or additions to Oklahoma's water quality monitoring initiatives. While recognizing the importance of maintaining and developing a holistic groundwater monitoring effort for the state, the focus of this document is on surface water quality monitoring.

It is widely recognized that there are five primary purposes for water quality monitoring. The Oklahoma Water Quality Monitoring Council ("OWQMC") recognizes these five purposes as:

- determining ***status and trends*** … monitoring and tracking compliance with water quality standards and beneficial uses assigned to waters
- identifying ***causes and sources*** of water quality problems ***and ranking*** them in priority order … confirming water quality problems, assessing the severity of such problems, and identifying contributors and their relative contributions of pollutants
- ***designing and implementing*** water management programs … collecting information vital for predictive modeling and planning
- determining ***compliance and program effectiveness*** … ensuring that program management objectives of the water management programs are accomplished
- responding to ***emergencies*** … assessing the magnitude and duration of water quality impairment from episodic spills, overflows, accidents, etc.

All of the water quality monitoring that occurs in Oklahoma serves to fulfill one or more of the five aforementioned purposes for monitoring. Figure 1 summarizes the relationships among the five types of water quality monitoring, as well as the primary State agency monitoring programs that fulfill those types of monitoring. For a more detailed description of each agency's monitoring program, please refer to the pertinent section of this document. Also refer to Figure 2 for a more thorough listing of the various monitoring efforts throughout Oklahoma.

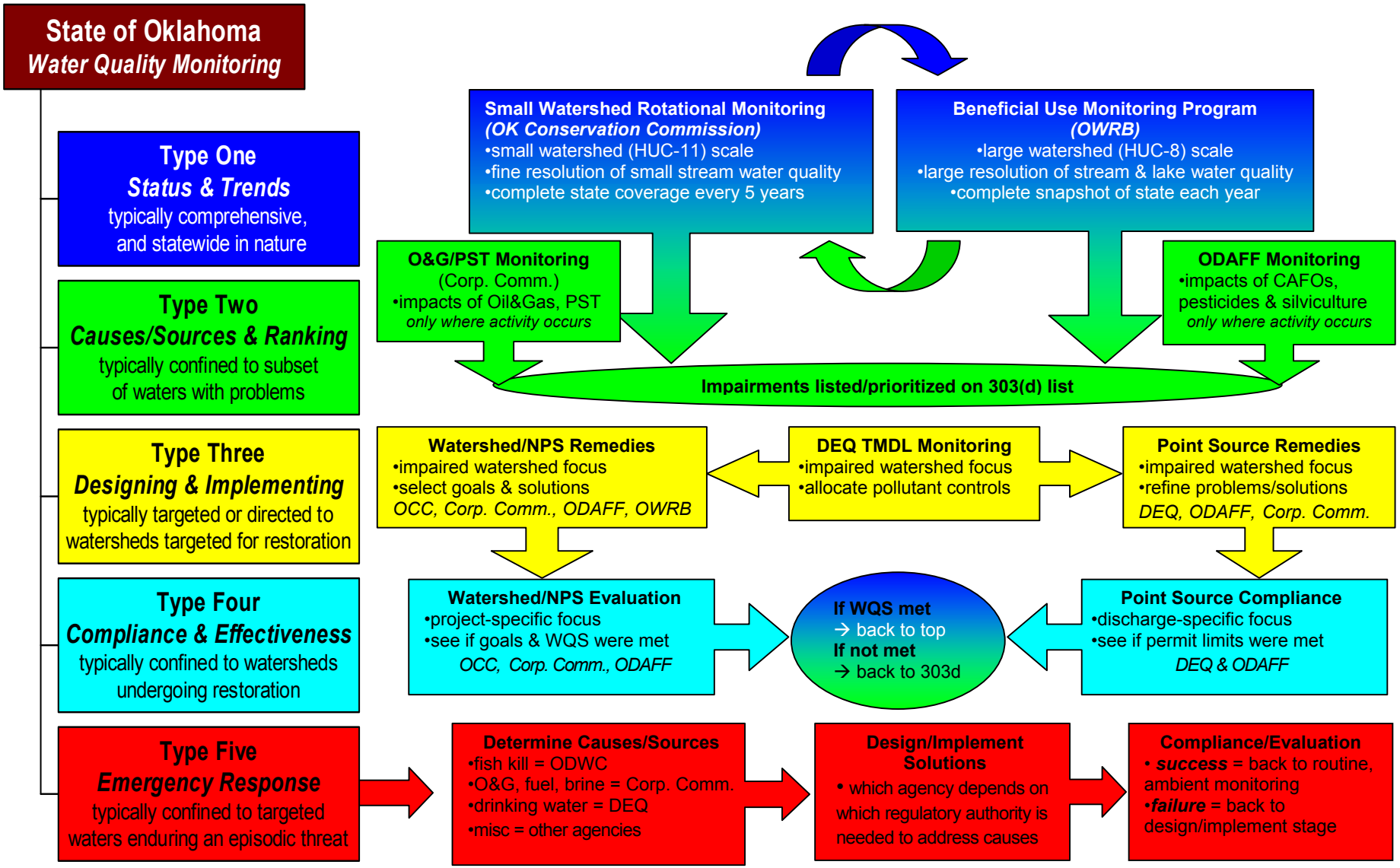

Figure 1. Diagram of the five types of water quality monitoring in Oklahoma, along with the major State monitoring programs that perform such monitoring.

Because water quality monitoring is such a critical component of any water management program, and because data are necessary for every step in the water management process, every state environmental agency with water management responsibilities will necessarily require some level of water quality monitoring. Water quality monitoring is an invaluable tool in identifying and ranking problems, designing solutions, and evaluating success within all of the water management programs carried out by the State. Thus, complete consolidation of water quality monitoring in Oklahoma appears to be difficult without some concomitant consolidation of the State's water management programs.

This report outlines the various activities undertaken by the state to monitor water quality, compile information, establish data quality objectives, analyze environmental data and store data. Numerous state agencies have monitoring programs that are conducted for a variety of purposes. Much of the monitoring being conducted is related to federal programs or federal requirements. The monitoring programs of various state agencies are discussed in detail in the various sections of this document. For a detailed discussion of the state's monitoring programs and activities please refer to the pertinent section.

Oklahoma's monitoring programs, when taken singly, do not meet all of the monitoring objectives outlined by EPA in their guidance document "Elements of a State Water Monitoring and Assessment Program". The EPA guidance outlines 10 key elements that should be part of a states monitoring program. Between the Oklahoma Conservation Commission's (OCC) rotating basin program and Oklahoma Water Resources Board's (OWRB) Beneficial Use Monitoring Program (BUMP), all of the core water quality and biological indicators EPA recommends for monitoring are examined. This allows Oklahoma to make a holistic assessment of a stream or lakes beneficial use attainment in a scientifically sound manner. In addition, the monitoring programs of the Oklahoma Department of Environmental Quality (ODEQ), Oklahoma Corporation Commission (Corp. Comm.) and United States Geological Survey (USGS) all provide core water quality indicator information that is integral to the state's monitoring strategy and allows Oklahoma to make accurate beneficial use support assessment decisions. Oklahoma state agencies will continue to work in partnership to jointly assure the maximum results for every dollar spent on monitoring.

Monitoring Successes

As a state, Oklahoma has made great strides in the water quality monitoring arena over the last 5 years. The ODEQ and OCC have worked to coordinate the OCC Nonpoint Source pollution monitoring network into the Total Maximum Daily Load (TMDL) process so that needed data for the TMDL is collected. In addition, the ODEQ and OWRB are working in a cooperative manner to collect information needed to complete TMDL work on several water bodies. The OWRB and OCC are also working together in a joint cooperative effort to implement a probabilistic monitoring program in Oklahoma. In general, the level of cooperation between the numerous state environmental agencies has resulted in the collection of high quality data to be used in the state's water management process. This has resulted in more efficient and effective management of our water resources. Three factors have been instrumental in fostering the unprecedented level of cooperation between the state environmental agencies.

First, the establishment of the Oklahoma Water Quality Monitoring Council (OWQMC) has provided a forum and venue for the environmental agencies and stakeholders to convene and discuss issues in a productive and proactive manner. The OWQMC has also established

numerous committees to examine specific environmental issues. For instance, a Quality Assurance & Quality Control committee was established where monitoring entities can sit down and discuss ways to ensure that data of sufficient quality is collected to meet the stated objectives of monitoring programs. This has led to the Office of the Secretary of Environment (OSE) transmitting electronic copies of agencies' Quality Assurance Project Plans (QAPP) for review by other environmental agencies before the QAPP is transmitted to Region 6 EPA in Dallas. This activity is just one example of how the Monitoring Council has worked to improve the quality of monitoring conducted in Oklahoma and promoted more agency cooperation.

Secondly, the increased focus on the TMDL program by EPA has resulted in a level of cooperation between the state agencies not previously seen. It was quickly recognized by the ODEQ, which has statutory authority for the TMDL program in Oklahoma, that no one agency had the resources needed to successfully meet the TMDL requirements in the time frame dictated by EPA. This resulted in the ODEQ working cooperatively with its' sister environmental agencies in a proactive and cooperative manner to meet the EPA mandates. The level of cooperation and coordination between the agencies to support the ODEQ TMDL initiative is unprecedented.

Thirdly, the widely recognized problems with the Oklahoma 1998 303(d) list have resulted in several positive benefits to our water quality monitoring initiatives. The OCC has spent a great deal of time and effort conducting monitoring for nonpoint source pollution to refute or verify 303(d) listings. Also, in 1998 the Oklahoma Legislature funded the OWRB $1 million dollars annually to conduct a Beneficial Use Monitoring Program (BUMP) to look at the use support status of our state's waters. In addition other state environmental and local governmental agencies have increased their monitoring efforts to address the recognized shortcomings of the 1998 list. This has resulted in a degree of cooperation and coordination between the ODEQ, OCC, OWRB, Oklahoma Corporation Commission (Corp. Comm.), and local/tribal entities that did not previously exist. The numerous environmental agencies in Oklahoma have worked hard in a proactive and cooperative manner to generate an Integrated Report (formerly the state's 305(b) and 303(d) reports) that is accurate and scientifically defensible.

In general, what Oklahoma does well in the monitoring arena can be summarized as follows.

- A high degree of informal coordination occurs among the various agencies collecting water quality information in Oklahoma. Coordination of efforts results in less duplication of work and allows agencies to leverage resources to gather the desired information needed for decision-making purposes. No one agency has the resources to conduct all of the monitoring necessary to manage our waters. Through better coordination, each agency brings their unique talents and abilities to monitoring efforts so that our resources can be managed to the best extent possible. The Oklahoma Water Resources Board (OWRB), Oklahoma Conservation Commission (OCC) and Oklahoma Department of Environmental Quality (ODEQ) engage in routine informal coordination activities that result in minimal to no duplication of monitoring efforts.

- Recognizing the need to have standardized Beneficial Use Support Assessment Protocols (USAP), the State environmental agencies in 1998 developed agreed upon protocols for data usage and analysis to assess use support for our state's surface waters. This has resulted in agencies collecting and analyzing water quality data in a uniform fashion. The USAP were promulgated into the OWRB rules in 1998 and continue to be refined and developed with time so that appropriate environmental management decisions can be made to protect and preserve our water resources. Oklahoma is a nationally recognized leader on this front.

- Oklahoma conducts a technically sound biological monitoring program that allows us to make sound scientific decisions based on high quality data. The state agencies have uniform protocols for how biological data should be collected and analyzed and work cooperatively to further develop our assessment methodology for biological collections.

- Oklahoma's water quality standards (OWQS) are continually updated and maintained in a transparent process to protect and maintain the water quality of our state's waters.

- In general, the state environmental agencies do technically sound work that can pass the test of scientific and public scrutiny. In addition, the state environmental agencies have greatly improved the public's access and participation in the management of our water resources through public review and participation in the management arena.

- In terms of water quality management, Oklahoma does a very good job of making long-range plans designed to allow us to "succeed". The state environmental agencies work well to cooperatively identify problems and/or issues that need to be addressed now to ensure the success of our agency activities, but in addition, have greatly improved our ability to identify issues for the future and work to lay the groundwork now to address future issues in a proactive manner.

- Oklahoma works well with the United States Geological Survey (USGS) through the water quality cooperative program. The state environmental agencies have developed a good working relationship with our federal partner to collect water quality and quantity information on many of our rivers and streams. This positive working relationship results in the best quality data being collected for the money and resources available.

Recommendations for Improvement

Improvements to the state's monitoring efforts should be pursued to ensure that the best available data is collected with the resources available to allow decisions makers to chart a course for Oklahoma based on solid information. Some recommendations to enhance the state's monitoring efforts are presented for the reader's consideration.

- The coordination process between the state environmental agencies should be more formalized.

- It is recommended that numerical biological criteria continue to be developed and, if possible, the time frame for development should be accelerated. Currently, the OCC is the only state agency conducting a comprehensive fish and macro invertebrate monitoring program to determine beneficial use support on Oklahoma's smaller to mid-size streams. The OWRB conducts biological monitoring (chlorophyll-a) on the states larger lakes looking at use support issues. Additional monitoring should be implemented on Oklahoma's rivers and streams and biological monitoring on lakes should be expanded if practicable. This process is being facilitated by the development of standardized biological monitoring protocols.

- A single comprehensive database to house the state's water quality data would be very beneficial and would certainly facilitate the sharing of information. More effective sharing of information is critical if correct management decisions are to be made. The ODEQ has developed such a database and its utility to the various environmental agencies is being

upgraded to make it a more useful tool for the state environmental agencies and the public. At this time, an effective mechanism for other agencies to get data into the database is currently being developed. It is also anticipated that over the next few years the ability to upload information from the state database to the EPA Storage and Retrieval database (STORET) will become a reality.

- Further work needs to be pursued in the development of Use Support Assessment Protocols (USAP). New protocols need to be developed for all of the beneficial uses and current ones refined. At some point the State will need to continue with the Nutrient USAP for non-Scenic streams and rivers. Currently, these waterbodies can be identified as threatened, but no protocol exists to classify them as impaired. Procedures outlined in the Continuing Planning Process (CPP) document dealing with the integration of information from toxic, bioassay and bioassessment studies need to be further developed and formalized into USAPs. Work on developing sediment impairment USAP is underway.

- More diurnal dissolved oxygen monitoring and sampling for water borne pathogens should be conducted on a widespread basis. OCC is initiating a program during the summer of 2003 to monitor a limited number of streams for pre-dawn dissolved oxygen concentrations. Future plans will be based on the results of this pilot study.

- Metals and organics sampling occurs on a very limited basis. Much more extensive ambient sampling for these types of compounds would be very beneficial to Oklahoma. One confounding factor is the expense involved to monitor for these compounds. OCC evaluates the results of bioassessments to select streams for metals and organics monitoring in order to avoid spending limited resources on streams that have no problems with their biota. The OWRB spends some of their BUMP monies to monitor for metals in streams with plans to expand this effort to lakes in the summer of 2004. Metals and organics monitoring related to fish consumption by humans is an area that could be greatly expanded in the future. The ODEQ currently conducts a fish tissue toxics monitoring program on a limited basis on lakes with monitoring on streams occurring on a very limited basis on a handful of streams. OCC & ODEQ are participating in a national project examining a wide suite of modern toxic chemicals in fish flesh, but this program will end this year. Additional monitoring of this nature is critical if the Fish Consumption beneficial use is to be assessed.

- More work needs to be focused on monitoring our state lake resources. Our lakes are utilized extensively as water supply sources and as recreational outlets for our citizens and visitors to our state. In comparison to the dollars spent monitoring our stream resources, a relatively small amount of money is spent monitoring lakes. It is also necessary that Nutrient Limited Watershed (NLW) impairment studies be conducted on identified lakes to assess if nutrient impairments are present. The OWRB is currently examining the issue of defining exactly what constitutes an NLW Study.

- Oklahoma needs to pursue a probabilistic sampling regime to aid in assessing the status of our state's waters. Fixed sites are necessary to document trends, however, they still leave a large portion of the state's waters unassessed. Fixed station monitoring allows us to assess the condition of a stream for some distance upstream and downstream of the monitoring site and to look at trends or effects of point source discharges, but we still need a method of assessing all of the unassessed water and the ability to make statistically sound estimates regarding water quality. If sites are randomly selected in a stratified manner (Probabilistic Sampling) then statements concerning percentages of various stream and lake classes supporting or not

supporting their beneficial uses can be made, along with statistical confidence estimates. Probabilistic sampling can be very effective at assessing the quality of our waters from a small number of samples and extrapolating to the quality of all of our waters. Sampling of this nature would be a very useful tool for the Integrated reporting process and is a monitoring regime that the U.S. EPA continues to recommend states adopt. This effort is vital for Oklahoma's 305(b) portion of the Integrated Report. It does have limited utility for the state's 303(d) listing process.

A statewide discharge model based on watershed land uses, topography, soil type and moisture and rainfall with daily adjustment based on real time gages is needed to compute loads of pollutants in state streams. A model of this type will provide more accurate loading estimates for many state streams and would save the state much labor cost.

Although there is currently some confusion about which wetlands are a part of Waters of the US, many of Oklahoma's wetlands will definitely fall into this category. It is important that the State identify important wetlands. Funding is currently being sought for this effort.

Resource Needs

A great deal of time and effort is being spent on water quality monitoring, however a significant funding gap does exist if EPA requirements and guidance are to be met. Table 1 lists the state's additional monitoring initiatives that should be pursued with associated fiscal expenditures and resource needs. The initiatives and monies listed below are in **addition** to currently ongoing and funded monitoring efforts.

Table 1. Monitoring initiatives with additional fiscal expenditures and funding needs.

ESTIMATED ADDITIONAL ANNUAL FUNDING NEEDS FOR W.Q. MONITORING IN OKLAHOMA				
	FTE Needs	State $	Federal $	TOTAL
Probabilistic Monitoring Program on Streams	3	$100,000	$250,000	$350,000
Probabilistic Monitoring Program on Lakes	2	$50,000	$100,000	$150,000
Comprehensive Toxics Monitoring Program	2	$75,000	$275,000	$350,000
Groundwater Monitoring Program	1	$30,000	$196,000	$226,000
Standards Refinement			$40,000	$40,000
Develop Wetlands Monitoring Program & Monitoring Methodology	2	$30,000	$135,000	$165,000
TOTAL FTE & Expenditures =	10	$285,000	$996,000	$1,281,000

Introduction

Numerous agencies are engaged in water quality monitoring in Oklahoma for a variety of purposes. Often, monitoring is conducted as part of a federal project and the type of monitoring and duration of monitoring is very strictly outlined as a condition of the grant award. Before any meaningful discussion of monitoring in Oklahoma can begin, it is essential that the reader be aware of the various types of monitoring which occur, the strengths and weaknesses of each type of monitoring, and the reasons why one type of monitoring approach would be favored over another.

The type of monitoring conducted in Oklahoma by various state agencies is predicated on the monitoring objective. For example, if water quality monitoring is required as part of a federal grant, then in most instances the monitoring will be initiated to document water quality concerns or impairments to a specific water body or watershed and for a specific water quality parameter or parameters. In the case of remedial activities the monitoring program will be designed to document the success or failure of the remediation. Regulatory compliance monitoring is conducted with the express purpose of monitoring compliance with a permit or regulation. For general ambient water quality monitoring, a large suite of parameters is often monitored to assess use support for numerous beneficial uses. What this means is that the data quality objectives of the monitoring program will determine the type of monitoring required.

It is very important to understand the concept that a water quality monitoring program with the goal of documenting the effectiveness of Best Management Practices (BMPs) to improve water quality in the Washita River is fundamentally different than a monitoring program designed to look at long-term water quality trends in the Illinois River Basin. The data quality objectives for the two monitoring efforts described above are different because the questions to be answered are different.

Over the past few years heightened interest in the State's 303(d) list and development of Total Maximum Daily Loads (TMDLs), has served to highlight the monitoring efforts of the various state environmental agencies. In general, development and refinement of the 303(d) list has resulted in a greater understanding by all concerned parties that improvements in the state's monitoring initiatives are necessary to better serve the citizens of Oklahoma. In addition, with the development by EPA of the Consolidated Assessment and Listing Methodology Document (CALM) and the publication of guidance on the Elements of a State Monitoring and Assessment Program, guidelines on what elements should be present in a state's monitoring strategy and how data should be collected and analyzed now exist at the national level.

For the 2002 reporting cycle, Oklahoma chose to develop the Oklahoma Integrated Assessment Report, which represents an integration of the 305(b) and 303(d) documents into one document. Through this process a small number of problems were identified. Several key points can be made when discussing the state's water quality monitoring programs:

- Monitoring has historically been conducted by various environmental agencies with the express purpose of meeting federal program requirements and Oklahoma statutory mandates for each agency. This resulted in a fragmented monitoring program for the state.

- Monitoring of our water resources has historically been inadequate to assess the water quality status of much of our resources. In recent years this problem has been

mitigated through increased monitoring by many of the state environmental agencies, however there is room for improvements to be made.

- Due to lack of historical baseline information and consistent protocols for assessing use support, the job of protecting and preserving our water resources has been made much more difficult. It is absolutely essential to understand what "normal" is so that we can confidently identify an "abnormal" water quality condition. Numerous environmental agencies, such as the OCC, ODEQ, Corp. Comm. and OWRB have collected environmental data and worked extensively to identify baseline conditions across Oklahoma. With the development of Use Support Assessment Protocols (USAP), codified into the OWRB rules, consistent protocols now exist. These protocols need to be further refined and new ones developed for all beneficial uses.

- Lastly, little money and effort have been spent on monitoring programs when compared to the monies spent on other aspects of the water quality management arena (i.e. lake and stream restoration, permitting and permit compliance, regulation, etc.). Additional monies need to be spent in the monitoring arena if sound scientific and resource management decisions are to be made.

The efforts of the state's environmental agencies in terms of water quality monitoring have greatly improved over the last 5 years. With funding of the Beneficial Use Monitoring Program (BUMP) at the state level and the increased funding to federal programs such as §106 and §319, a major step has been taken to address some of the monitoring deficiencies discussed above. With the requirement to develop TMDLs for waters listed on the 303(d), Oklahoma and EPA should continue to develop and support monitoring activities for our precious state waters. Financial resources are limited and it is vital that a greater understanding of our water quality conditions be fostered so that monies be spent in areas where adverse water quality impacts are greatest or where our most outstanding water resources are threatened.

Several other tools have been provided to facilitate monitoring in Oklahoma. One such tool being developed is the state environmental database. The database is maintained by the ODEQ to assist the state in managing our data. Another tool at our disposal is the upgrade of the United States Environmental Protection Agency Storage and Retrieval (STORET) database. STORET is a national database that in theory is used to house environmental data collected using federal dollars. STORET does offer some very desirable tools for data collectors and data users. Historically, data has not been entered into STORET due to the difficulty in using the database. In addition, much of the data in STORET did not have any known quality assurance protocols associated with it. In other words, the quality and reliability of the data could not be easily determined. The recent updates to STORET have addressed most of the historical problems associated with the database.

What follows in this document is a brief discussion of the monitoring initiatives currently being conducted by our state agencies in the area of surface water quality monitoring. It is undoubtedly true that in a discussion of water quality monitoring in Oklahoma some program will be left out of the discussion. For example, the Indian Nation Council of Governments (INCOG) and the Association of Central Oklahoma Governments (ACOG) all engage in water quality monitoring to a greater or lesser degree within their areas of authority and expertise. In the interest of brevity, the discussion within this document will focus on state agencies and make recommendations on ways to improve Oklahoma's holistic monitoring initiative. This is not to say that other monitoring programs being conducted are less important, but in general they are more localized in nature and are not conducted on a statewide scale.

Oklahoma Water Quality Monitoring Programs

Oklahoma has numerous agencies that are actively involved in the water quality-monitoring arena. The various agencies with their associated roles in the monitoring arena are presented below in Figure 2.

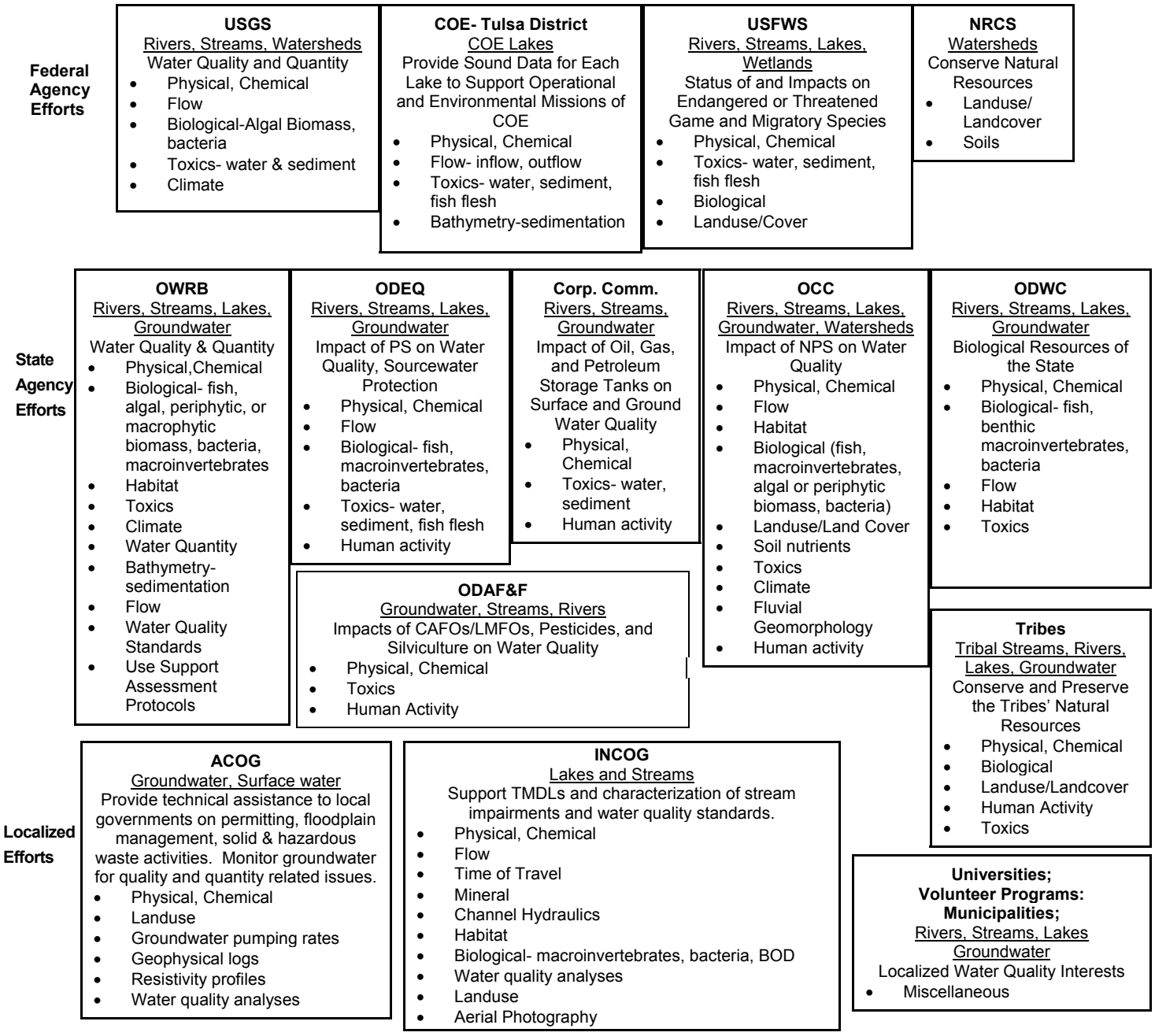

Figure 2. Roles of Oklahoma Governmental Organizations in the Monitoring Arena.

Another way of looking at the various roles of the state environmental agencies for water quality monitoring is presented below in Table 2.

Table 2. State Environmental Agencies Roles in Surface Water Quality Monitoring.

Monitoring Activity	ODEQ	OWRB	OCC	Corp. Comm.	ODAFF	ODWC
NPDES Compliance Monitoring	X					
LMFO/CAFO Compliance Monitoring					X	
Other Compliance Monitoring				X		
Volunteer Monitoring		X	X			
B.U. Support Monitoring	X	X	X	X		
§319 Nonpoint Source Monitoring			X			
Biological Monitoring	X	X	X			
Project Specific Monitoring	X	X	X	X	X	X
Ambient/Historical Monitoring	X	X	X			X
WQS Criteria Development		X				
§314 Lakes Monitoring		X				
Complaint Response	X			X		X
BMP Effectiveness Monitoring			X			
Fish Kills						X
Lakes Toxics Monitoring	X					
TMDL Related Monitoring	X	X	X			
Water Quantity/Quality Interactions	X	X				
Oil & Gas – UST/AST Monitoring				X		

Oklahoma Water Quality Monitoring Agencies

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

The Oklahoma Department of Environmental Quality (ODEQ) conducts certain surface water quality monitoring, in terms of the presence of selected toxic substances in fish tissue, through its Toxics and Reservoirs Program, biotic integrity/aquatic habitat trends, through its Fish Community Biotrend Monitoring Program, and segment-specific pollutant loading characteristics and capacities, through it's Total Maximum Daily Load (TMDL) studies. On a site or segment specific basis, selected surface water quality monitoring may also be conducted as an adjunct to complaint investigations. However, much of the ODEQ surface water and ground water quality monitoring activities are a function of their regulatory programs in Point Source Discharge (OPDES) Permitting, Public Water Supply, Solid Waste Management, Hazardous Waste

Permitting and Corrective Action, Underground Injection Control, Radiation Management, Brownfields Redevelopment and Superfund.

OKLAHOMA WATER RESOURCES BOARD

The Oklahoma Water Resources Board (OWRB) conducts monitoring on surface waters to assess beneficial use support attainment through the "Beneficial Use Monitoring Program" (BUMP). The OWRB assists other state agencies with their monitoring needs through the BUMP (i.e. Oklahoma Corporation Commission, Oklahoma Department of Agriculture Food & Forestry). In addition, the OWRB conducts monitoring on numerous lakes and rivers across the state to diagnose water quality problems, make recommendations for actions or activities which can be implemented to improve water quality, document attainment of pollutant reduction goals, develop criteria for Oklahoma's Water Quality Standards, perform bathymetric mapping, and conduct specific groundwater basin studies. Performance of Use Attainment Analyses (UAAs) is also performed on a limited basis or as needed basis. The OWRB also conducts a volunteer monitoring program, Oklahoma Water Watch. The OWRB and United States Geological Survey (USGS) work together through a cooperative program to conduct flow monitoring and water quality monitoring on many sites across the state. The OWRB also conducts hydrological investigations and groundwater basin studies to assess water quantity needs and water resources available to be put to a beneficial use. The OWRB has conducted numerous groundwater basin studies in cooperation with the USGS looking at the quality of Oklahoma's groundwater resources and assessing the vulnerability of groundwater basins to pollution.

OKLAHOMA CONSERVATION COMMISSION

The Oklahoma Conservation Commission (OCC) monitors rivers and streams across Oklahoma to assess the impacts of nonpoint source (NPS) pollution on our state waters in support of the §319 (h) Nonpoint Source Program. The OCC performs monitoring for four basic reasons: 1) to determine whether a water body is being impacted by NPS pollution, 2) to determine the significant sources of that NPS pollution, 3) to determine whether education, best management practices (BMPs), or other remediation efforts are successful at reducing NPS impacts, and 4) to educate citizens about water quality. To accomplish these goals, OCC collects baseline water quality, habitat, and biological monitoring statewide primarily through a rotating basin sampling program. OCC also collects information on land-use and other activities in a watershed that might be sources of NPS pollution. This data is collected for inclusion in numerous state water quality lists and reports and specifically for the 319 Nonpoint Source Assessment Report. OCC also performs project-specific monitoring to document success of implemented BMPs at improving water quality. The OCC conducts an education and volunteer monitoring program, Blue Thumb. Monitoring of wetlands has not historically occurred at the OCC, but is currently funded and will begin in the summer of 2003.

OKLAHOMA CORPORATION COMMISSION

The Oklahoma Corporation Commission (Corp. Comm.) conducts routine monitoring activities related to the Oil & Gas Industry. This involves soil sampling at spill and other potential pollution case sites, well water sampling near spill and other potential pollution case sites, stream water sampling near spill and other potential pollution case sites, Spring, stream, and other surface water sampling in historic oilfield areas, to determine the overall impact of historical oilfield activity on the waters of the state and sampling to refine dissolved minerals

criteria for selected sub-watersheds. The OWRB BUMP is currently assisting the Corporation Commission with some aspects of their monitoring program.

UNITED STATES GEOLOGICAL SURVEY

The United States Geological Survey conducts monitoring on many rivers and streams across Oklahoma, looking at stream flow and performing water quality research projects. The USGS coordinates with the state of Oklahoma through the Cooperative Program managed by the OWRB.

General Water Quality Monitoring Background Information

In general, the OWRB, OCC, & ODEQ are the entities in Oklahoma that are currently involved in conducting state-wide water quality monitoring programs with a primary focus of assessing beneficial use support. Numerous other state, federal & local agencies are involved to a lesser degree in water quality monitoring in Oklahoma, predominantly on a project specific basis. This report should not be construed as a comprehensive document of **all** water quality monitoring efforts occurring in Oklahoma, just a brief discussion of the major statewide efforts currently being conducted.

Historically in the late 1970's through the late 1990's, little state or federal monies were devoted to conducting routine water quality monitoring. In the last few years with increased federal funding in connection with the §319 nonpoint source program and the §106 program and with state funding of the BUMP, Oklahoma is making great strides in terms of understanding current water quality conditions. This has resulted in more effective identification and prioritization of areas where dollars and manpower should be devoted to protect and preserve our water resources. There is still much work to be done in terms of monitoring and coordinating our efforts, but we have taken a major step in the right direction. However, some problems still remain and should be addressed. Though federal funding for monitoring activities not associated with specific localized project areas has increased, monitoring is still often geared towards statutory authorities and requirements. This sometimes results in a lack of coordination between the various localized water quality monitoring projects. More effective coordination of efforts is still a goal of the various agencies involved in water quality monitoring.

The perception has been that state agencies were not always consistent in their determination of beneficial use support. To address this problem the OWRB has worked with the various state environmental agencies to develop standardized beneficial use support assessment protocols. Through the promulgation into rule of the use support assessment protocols (USAP) developed by the workgroup, a standardized protocol for identifying beneficial use threats or impairments has been developed. This effort is a major step forward in our state monitoring initiative. The USAP will continue to undergo modification and refinement over time. The rule needs flexibility to address more complex water quality problems, use support areas not included in USAP, and changing state/federal priorities.

With the best of programs, there is always room for improvement, and Oklahoma's is no exception. High on the list of potential improvements is securing biological collections from all sites. While the Oklahoma Conservation Commission aggressively conducts biological monitoring on small and mid-size streams, biological monitoring on our lakes and larger streams should be increased or implemented where not currently occurring. This needs to be addressed.

Collection of fish tissue samples for analysis of toxics is certainly an area of water quality monitoring that could be greatly enhanced with an increase of monies for monitoring. The current levels of water quality monitoring are sufficient as a base level of monitoring, but much more extensive monitoring is required to allow Oklahoma to meet our goal of protecting and preserving our water resources and assessing all assigned beneficial uses in the Oklahoma Water Quality Standards (OWQS). Federal funding alone does not currently meet the water quality monitoring needs of Oklahoma. It is envisioned that a joint state and federal initiative is required to accomplish the goal of protecting, preserving and restoring our water resources for the citizens of Oklahoma.

Oklahoma Monitoring Objectives

There are numerous reasons for performing water quality monitoring activities. Oklahoma conducts monitoring for the purposes listed below. This list of objectives should not be construed as inclusive of all monitoring objectives, but it does highlight the primary objectives of ambient and regulatory monitoring programs conducted by most of the state's environmental agencies.

- Determination of beneficial use support status
- Determination of water quality trends for our state's waters
- Identification of pollutant sources
- Regulatory compliance monitoring
- Effectiveness of Best Management Practices

Obviously, different monitoring programs have slightly different data quality objectives. For the OWRB Beneficial Use Monitoring Program, the three primary objectives are beneficial use support assessment, water quality trend status and refinement/development of the OWQS and USAP language. The OCC rotational stream-monitoring network is primarily focused on use support determination, source identification and effectiveness of BMP implementation. The ODEQ conducts monitoring with the objective of source identification, collecting needed data for a TMDL, trend monitoring, and public health issues (e.g. Lakes Toxics Monitoring). Monitoring conducted by the Corporation Commission focuses on beneficial use support. Obviously data is collected by several agencies for compliance monitoring, but monitoring conducted for that purpose is not discussed in this document. This document will focus on surface water ambient monitoring activities that do not directly relate to the permitting process and compliance monitoring.

Oklahoma Monitoring Program Strategy

Oklahoma is currently conducting monitoring through inter-agency cooperative efforts that meet the EPA stated goals of an adequate state monitoring and assessment program. Oklahoma has clear monitoring objectives and has several monitoring approaches currently underway or slated to begin in the near future that meet the monitoring design criteria outlined by EPA. Monitoring programs being conducted by the OCC and OWRB meet the core water quality indicators

required by EPA. Monitoring programs conducted to assess beneficial use support and/or conducted in support of TMDL activities all have EPA approved workplans. Each environmental agency in Oklahoma maintains a database for their information and is working with the ODEQ to get data into STORET. The ODEQ also receives much of the data collected by Oklahoma environmental agencies that they maintain in their database. Oklahoma's environmental agencies are currently working to integrate the National Hydrography Dataset (NHD) into our monitoring activities and expect the NHD to be fully integrated into Oklahoma's monitoring programs within 5 years. As a state we have developed Use Support Assessment Protocols (USAP) that are promulgated into the OWRB rules. The USAP outlines data requirements and appropriate decision criteria for making use support determinations in a consistent and scientifically defensible manner and serves as a model for other states. Oklahoma worked diligently to complete the required Integrated Report in a timely manner with the 2002 Report submitted to EPA in the spring/summer of 2003 and work on the 2004 Report already begun.

Oklahoma is always looking at ways to improve it's monitoring programs through implementation of new monitoring initiatives, through inter-agency cooperative efforts and through better communication and coordination between the numerous agencies that participate in monitoring in Oklahoma. We have identified several monitoring areas that need to be improved or developed in the near future with the implementation of a probability based sampling program a high priority for the state. Implementation of additional sampling on our lakes resources for toxics and bacteria is in the works for toxics or for bacteria it was begun in the summer of 2003. Funding for water monitoring has been supported at the state level through the legislature's funding of the Beneficial Use Monitoring Program (BUMP). The BUMP is funded at $1 Million dollars annually to assess beneficial use support and EPA funds numerous monitoring initiatives through the §106, §319 and §104(b)(3) programs. However, a funding gap to meet EPA requirements does exist. There are currently a small number of monitoring programs in Oklahoma that do not meet all of the guidelines outlined in the Consolidated Assessment and Listing Methodology (CALM) or which are conducted without EPA approved Quality Assurance Project Plans (QAPP). Additional monies and staff are needed to address these programmatic needs. The CALM guidance is very comprehensive and it is suggested that additional federal monies be made available to meet **ALL** of the guidelines outlined in CALM. For example, EPA guidance states that waters cannot be listed as fully supporting unless all beneficial uses have been monitored and shown to be fully supporting. This would necessitate a new level of toxics monitoring not currently being conducted due to lack of funds. Also, what does EPA feel constitutes documentation of a use being fully supported? Is sampling for ¾ of the chemical parameters for a beneficial use sufficient to make a fully supporting determination? How exactly CALM will be implemented by EPA is still unclear at the state level and discussions between EPA and Oklahoma should continue on this topic.

Oklahoma looks forward to working with our state and federal partners to make our monitoring program the most efficient and effective program it can be. Great strides have been made over the past few years in the monitoring arena in Oklahoma with the addition of state dollars into monitoring activities and through new levels of interagency cooperation and coordination to eliminate duplicative efforts. Promulgation of the USAP into rule is also a major step forward for Oklahoma's monitoring programs.

Ambient Surface Water Quality Monitoring Initiatives

Non-point Source Monitoring Program

The Oklahoma Conservation Commission Water Quality (OCCWQ) Program has an extensive monitoring program. While OCCWQ conducts several distinct types of monitoring activities, the overall goal of the program is as follows:

To conserve and improve water resources of the State of Oklahoma through assessment, planning, education, and implementation.

The major types of monitoring performed by OCCWQ are listed below.

1. Ambient Monitoring: Ambient monitoring is routine monitoring, either at fixed or randomly selected sites, conducted to identify potential problems, baseline or natural conditions, or high quality waters. It is the backbone of any statewide monitoring program because the data can be used for so many different purposes. This type of monitoring is the only way the State NPS Program can effectively address the Clean Water Act Section 319 mandate, "to monitor and assess the State's waters for the effects of NPS pollution."

2. Diagnostic Monitoring: Diagnostic monitoring programs often result from ambient monitoring. In systems where ambient monitoring has identified potential NPS problems, a diagnostic monitoring program is established. Diagnostic monitoring involves more in-depth sampling to confirm or refute the suspected problem, identify and pinpoint sources, and more accurately document causes and effects of the specific problem. Monitoring may include land use assessment, modeling, intensive water quality monitoring, and biological assessments to determine relative pollutant input.

3. Implementation Monitoring: Implementation monitoring is performed to determine the effects of best management practices (BMPs) on water quality.

4. Reference Condition Monitoring: Water bodies differ in naturally occurring levels of compounds that are considered pollutants. Most of this naturally occurring variation is due to variability in native plant communities, geology and soils, slope, climate, and other factors related to geography. Likewise, the resident communities of aquatic organisms vary by region for similar reasons. In order to determine whether a stream is polluted or whether its aquatic community is healthy, it is necessary to know what the water quality of the stream and its biological communities should be like. Data collected from reference condition monitoring allows state and federal agencies to make this type of determination.

The OCCWQ collects numerous types of samples including water, soil, air, habitat, and biological samples (fish, benthic macroinvertebrates (aquatic insects), and algae). Water samples are used to determine whether pollutants exist in concentrations high enough to cause water quality problems. Soil samples suggest areas in a watershed where nutrients are likely to

runoff the land surface or percolate into the shallow groundwater during storm events. Air deposition samples (samples of materials deposited from the atmosphere) allow for a differentiation between loadings due to activities on the land in a watershed and those from the atmosphere. Habitat surveys quantify the types of available habitat that determines the nature of the aquatic community that should be present in the stream. Biological samples, when compared to those from a reference stream, can show whether a pollutant is negatively impacting the aquatic community.

All OCCWQ monitoring is conducted following methods and sampling plans established in EPA approved Quality Assurance Project Plans (QAPPs). These QAPPs are subject to peer agency review and approval through the Office of the Secretary of Environment.

ROTATING BASIN PROGRAM

As a method of coordinating the monitoring programs of the various agencies, the State has adopted the Rotating Basin Monitoring Plan. The ODEQ working closely with the OCC has meshed their TMDL activities with the OCC rotational sampling program. The rotational plan divides the state into large basins and calls for future monitoring projects in these basins to be scheduled according to a rotating five-year plan (See Figure 3).

Under the rotational program, sampling begins in a pair of new basins each year and continues for 2 years. The 11th basin requires that one of the rotations have 3 basins in it instead of 2. Sites are located at the lower end of each 11 digit HUC that OWRB does not monitor. At any given time, there will be either 4 or 5 basins being sampled. At the end of the five-year period, sites in each of the 11 basins will have been sampled for 2 of the 5 years, and work will begin on the original basin pair. A list of the parameters sampled for is included in Table 3.

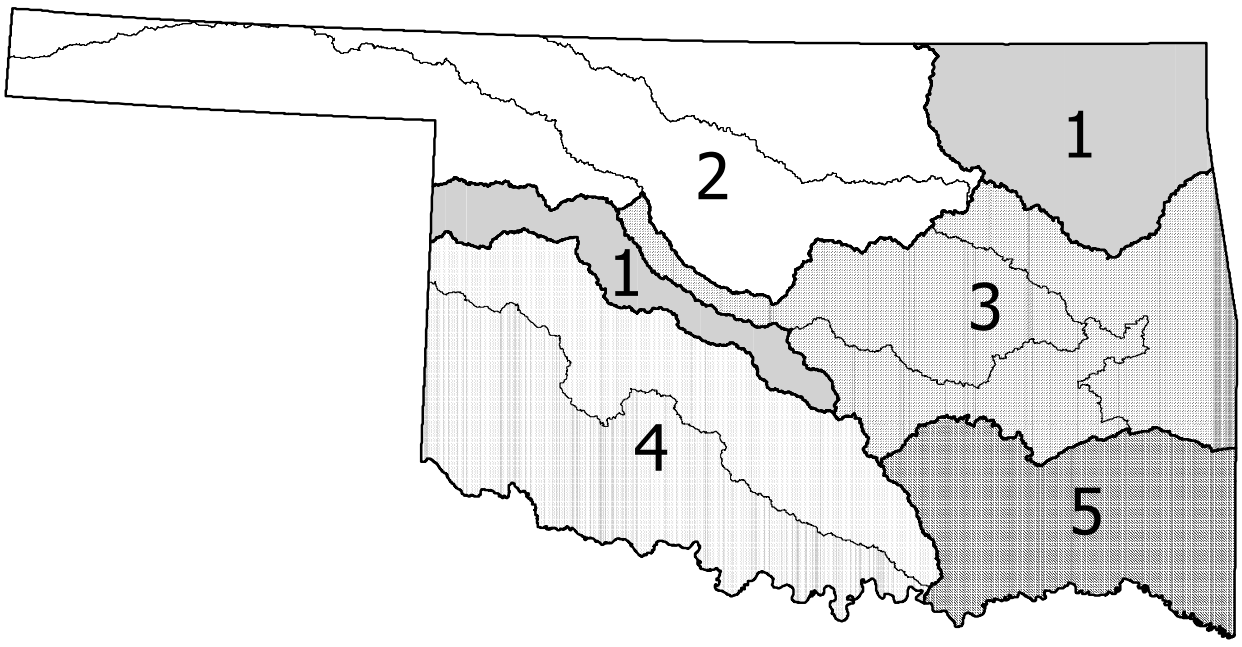

Figure 3. OCC Rotating Basin Sample Program.

Table 3. OCC Rotating Basin Monitoring Parameters.

Sampling Duration	2 years	Parameters Measured	
Number of sites	Variable	Nitrate-Nitrogen Nitrite-Nitrogen Ammonia-Nitrogen Kjeldahl-Nitrogen Orthophosphate Total-Phosphorus Chloride Sulfate BOD_5 Total-Hardness E. Coli Enterococcus	Alkalinity Total Suspended Solids Temperature, water & air pH Instantaneous Discharge Specific Conductance Dissolved Oxygen, absolute & % saturation pre-dawn D.O. if needed Turbidity Toxic metals & pesticides if biotic collections indicate potential problems
Sampling Frequency			
Water samples	10/year/site, evenly spaced		
Fish Collection	1/site		
Macroinvertebrate collection	4/site		
Aquatic Habitat Assessment	1/site plus repeats on selected streams for quality assurance		

Beneficial Use Monitoring Program (BUMP)

The overall program goal of the Oklahoma Water Resources Board's (OWRB) BUMP is "to document beneficial use impairments, detect water quality trends, provide needed information for the Oklahoma Water Quality Standard (OWQS) development and refinement process and to facilitate the prioritization of pollution control activities". The Monitoring Program is composed of five (5) surface water elements or tasks. Tasks conducted as part of the assessment and monitoring program are outlined below. The OWRB has developed a quality assurance and quality control (QAPP) document for all monitoring activities conducted as part of this program. Development of data quality objectives (DQOs) and collection of data sufficient to meet the stated DQOs is essential to program success.

- **Monitoring Rivers & Streams** - The OWRB is currently monitoring approximately one hundred eighty (180) 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 ODEQ state environmental laboratory is used for all laboratory analytical procedures. 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 is located in all of the 8-digit HUCs with the exception of some of the smaller watersheds adjacent to the state line or that do not contain a free flowing stream at some point during the year. After consultation with the other state environmental agencies the OWRB has identified one hundred thirteen (113) fixed stations of which ninety-nine (99) are currently being monitored (See Figure 4).

    - **Rotating Station Monitoring on Rivers & Streams** - Over the life of the BUMP, rotational sampling has occurred on two hundred (200) 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 component are specific for each stream segment monitored. The OWRB works closely with the ODEQ and Oklahoma Corporation Commission to conduct sampling that verifies or refutes 303(d) listings or which collect data to facilitate the development of a TMDL. Targeted monitoring is performed in a cooperative effort with the ODEQ and OCC to avoid duplicative monitoring efforts.

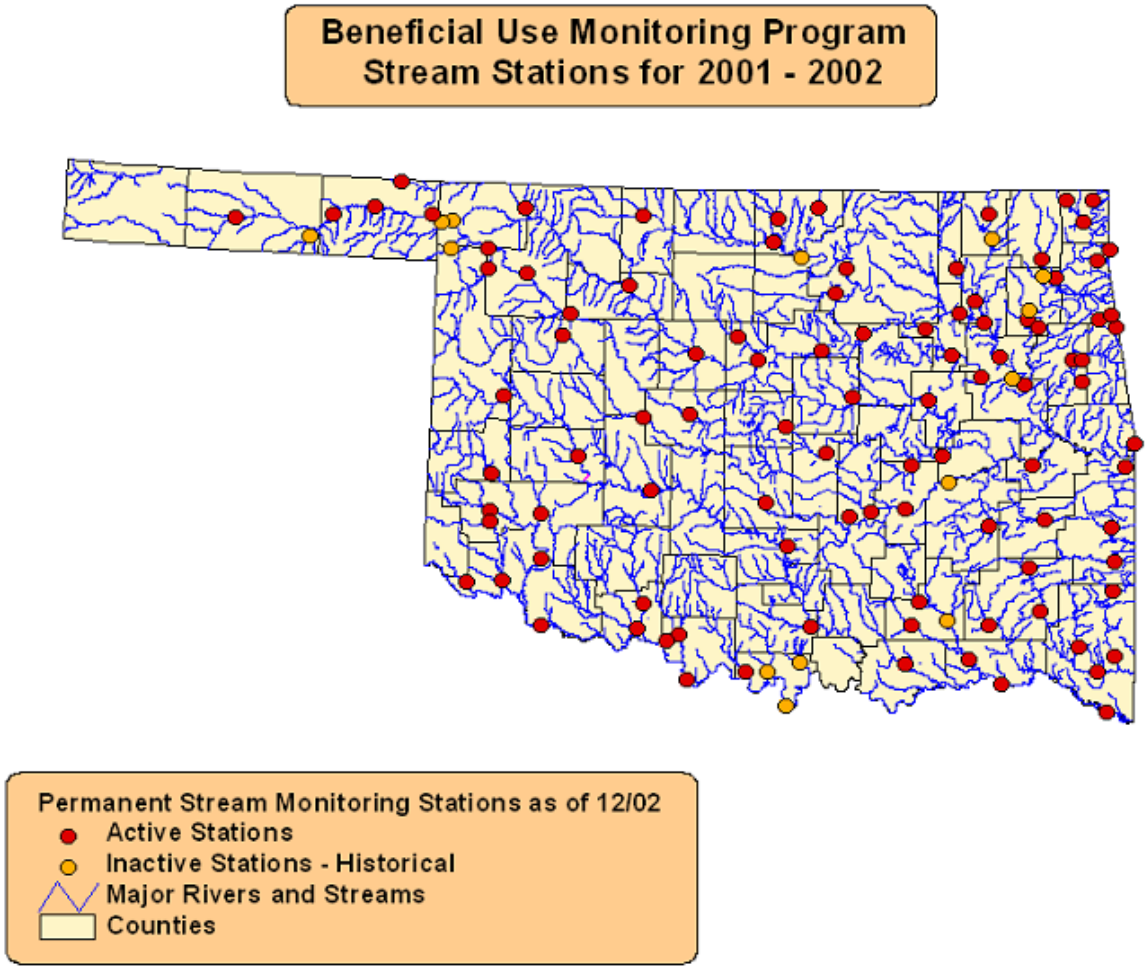

Figure 4. BUMP Stream Monitoring Stations.

- **Fixed Station Load Monitoring** - The OWRB is currently engaged in a cooperative effort with the USGS to conduct flow monitoring at BUMP sites that do not currently have an existing USGS flow gage. This effort focuses on collecting both water quality and quantity information in order to calculate pollutant loads and provides OWRB staff with the data necessary to make a use support determination. This initiative is facilitated through the OWRB's Cooperative Agreement with USGS and various Compact Commission activities. 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 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 occurs 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 sampled every two years (See Figure 5). Data collected consists primarily of water chemistry, nutrients, and chlorophyll-a information. A minimum of three to five stations per reservoir is sampled depending on the size of the reservoir. Stations are located such that they represent the lacustrine, transitional, and riverine zones of the lake. 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 program ability to make use support determinations. Lake trophic status is determined using Carlson's trophic state index (TSI) and chlorophyll-a as the trophic state indicator. Bacteria collections will be initiated on lakes beginning in the summer of 2003. The ODEQ state environmental laboratory is used for all laboratory analytical procedures. In addition, metals collections in the lake water column are slated to begin in the spring of 2004 on a limited basis depending on the availability of funds to support the monitoring effort.

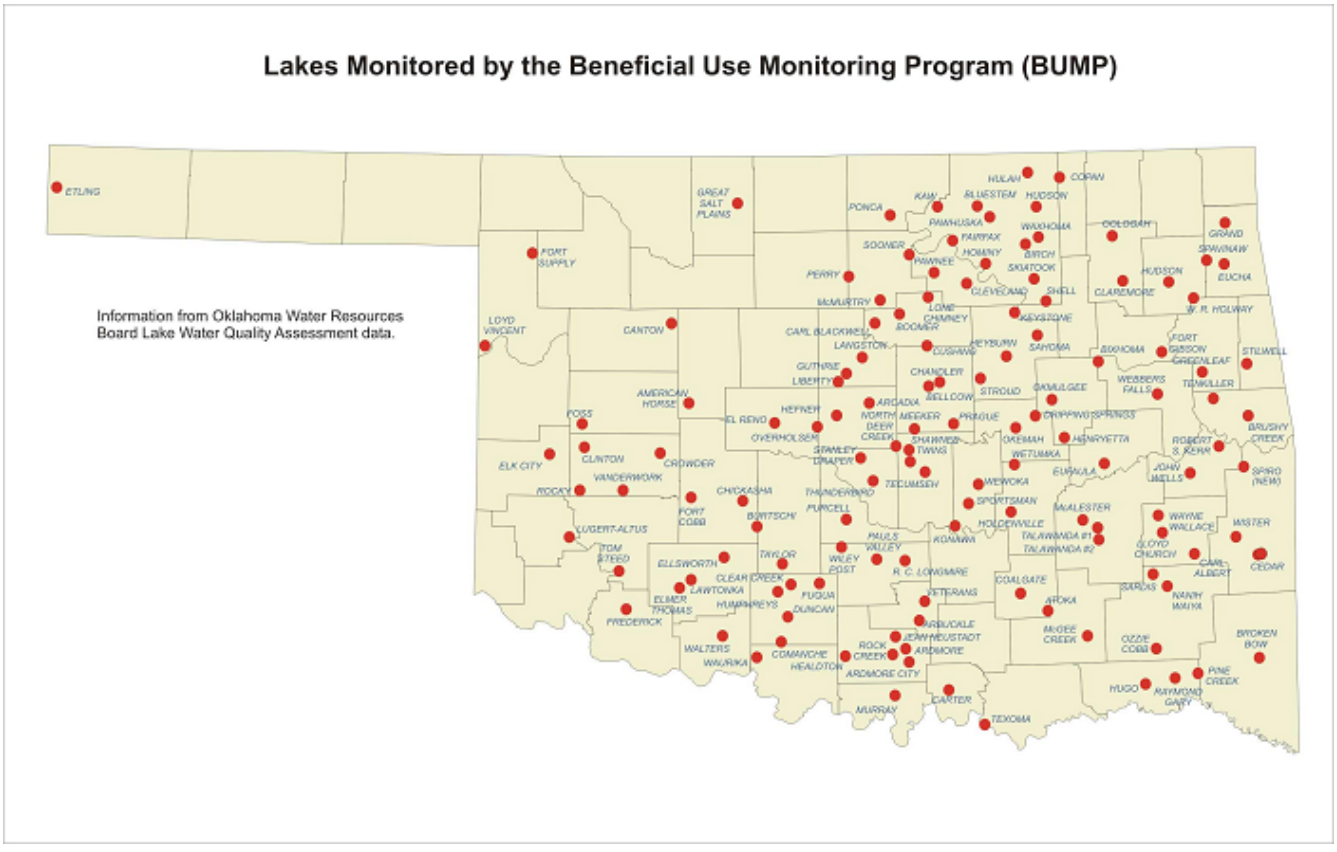

Figure 5. Lakes Monitored by the BUMP.

- **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 due to human activities in the watershed of concern. Some potential causes of beneficial use impairment are: improper beneficial use or criteria (OWRB jurisdiction), point source problems (ODEQ or Oklahoma Department of Agriculture, Food & Forestry), non-point source problems (OCC, Oklahoma Department of Agriculture, Food & Forestry, Oklahoma Corporation Commission, or ODEQ), oil and gas contamination (Oklahoma Corporation Commission), agricultural activities (Oklahoma Department of Agriculture, Food & Forestry), or mining activities (Oklahoma Department of Mines). All monitoring activities are cooperative in nature with the agency with statutory authority assuming the lead role. If waters are not identified for intensive study as part of this task, then monies are reallocated for routine monitoring of beneficial uses.

The lake and stream sample programs collect water quality data on a suite of parameters. See Table 4 for a list of parameters collected on streams and/or lakes. Lakes collect chlorophyll-a, secchi disk depth and true color data that are not generally collected in the streams arena. Lake samplers do not as a matter of course collect bacteria data, though the OWRB has added this parameter to the suite of data collected beginning in the summer of 2003. Total hardness is only collected on lakes when metals samples are being collected. The BUMP will be adding biological collections to the streams portion of the program in the summer of 2003 to assess the Fish & Wildlife Propagation Beneficial Use and to aid in the development of nutrient criteria. Biological sampling will be initiated in ecoregions for which biocriteria have been developed and promulgated into rule. Biological collections will be expanded into other ecoregions in Oklahoma as biocriteria are developed and promulgated into rule. It is the intention of the OWRB to conduct biological monitoring in a comprehensive manner in all ecoregions in Oklahoma that have established biocriteria.

Table 4. OWRB Stream and Lake Monitoring Sample Variables.

SAMPLE VARIABLES		
General Water Quality Variables – Sampled 10 times annually on streams and quarterly on lakes		
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	Chlorophyll-a	True Color
Secchi Disk Depth		
Nutrients – Sampled 10 times annually on streams and 4 times annually on lakes		
*Kjeldahl Nitrogen	Ortho-Phosphorus	Total Phosphorus
*Nitrate Nitrogen	*Nitrite Nitrogen	Ammonia Nitrogen

SAMPLE VARIABLES		
General Water Quality Variables – Sampled 10 times annually on streams and quarterly on lakes		
Metals – Sampled 4 times biannually at a minimum with some site-specific sampling		
Arsenic	Cadmium	Chromium
Copper	Lead	Mercury
Nickel	Selenium	Silver
Zinc	Thallium	
Organics – Site specific sampling		
Analysis of Pesticides, Herbicides, Fungicides, and other organics		
Bacteria – Sampled 5 times annually at a minimum (during recreational season) or 10 times for lakes		
Fecal Coliform	*Escherichia coli*	Enterococci

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

Flow data is collected at all stream sites either using USGS gaging station information or instantaneous flow data is collected on the stream by OWRB personnel following EPA approved protocols.

With the development of biocriteria and their promulgation into rule via the Oklahoma Water Quality Standards (OWQS) process, biological monitoring on streams is being implemented in a limited manner into the program. Full implementation of biological and habitat evaluation into the BUMP will occur as accepted protocols are developed on non-wadable streams. Currently non-wadable streams comprise a significant portion of the stream monitoring being conducted and without EPA guidance available, Oklahoma is developing standardized protocols for waters of this nature. Biological monitoring (other than chlorophyll) on lakes is a long-term goal of the program, but development and promulgation of biocriteria associated with lakes is not something that is expected to occur within the next 3-4 years.

Oklahoma TMDL Program

ODEQ currently has approximately twenty active TMDL projects in various stages of completion (See Table 5). These projects range from various watershed-scale projects such as the Lakes Eucha and Spavinaw nutrient TMDL project to projects targeted at specific impairments, such as the “Unknown Toxicity” project that involves aquatic toxicity monitoring on various water bodies. Many of these projects have been designed as two-phase projects. Phase 1 typically includes monitoring to verify causes of impairment while Phase 2 includes additional monitoring to fill in gaps and support TMDL modeling and decision-making process.

ODEQ also conducts and manages various monitoring and TMDL activities on a smaller, segment-specific scale. These projects are conducted on a case-by-case basis and are designed primarily to address low-flow point source impacts, such as a wastewater treatment plant expansion or relocation.

The 2002 Water Quality Assessment Integrated Report includes a schedule for monitoring all delineated water bodies and, where necessary, developing a TMDL for water bodies. The

schedule is coupled loosely to the Rotating Basin Plan. One of the primary effects this report has on the State's monitoring strategy is the prioritization of water bodies for monitoring. Water bodies previously listed on the State's 1998 303(d) list, but no longer listed as impaired in the 2002 report, have been given a high priority for monitoring to verify impairments. Water bodies listed as impaired in the 2002 report (Category 5) have a separate schedule for TMDL monitoring/development. Wherever possible, state agencies have agreed to target watersheds for monitoring according to the 2002 Integrated Report schedule.

ODEQ monitoring/TMDL projects are conducted primarily through third-party contracts. To date, these contracts have been with either the OCC or the OWRB. Other TMDL-related work has also been contracted to Oklahoma State University. In the near future, ODEQ hopes to establish monitoring and TMDL contracts with other parties, including private sector firms. Active TMDL projects are listed below in Table 5.

Table 5. Currently Funded TMDL Projects in Oklahoma.

Arkansas River Metals	Little River Pesticides
Atoka Lake	North Canadian Pathogens
Basin 6 & 7 Monitoring	Tenkiller Lake/Illinois River
Blue River	TMDL Monitoring for Priority 1 & 2 Streams
Cobb Creek/Ft. Cobb Lake	Turkey Creek (north)
Eucha/Spavinaw	Turkey Creek Pesticides (south)
Grand Lake	Unknown & Total Toxics FY2001 104(b)(3)
Hugo Lake	Washita Above Foss Dam
Illinois River Follow-up	Washita Below Foss Dam
Kiamichi Below Hugo	Wister Lake

In addition to the above activities, ODEQ occasionally conducts *ad hoc* monitoring to address specific issues. These range from complaints related to a specific facility to interstate water quality issues.

Fish Tissue Monitoring – Rotating Lakes Toxics Program

The goal of the Oklahoma's Toxics in Reservoirs program is to protect public health by evaluating levels of commonly found toxic compounds in fish flesh from Oklahoma reservoirs and, when necessary, and in cooperation with other state agencies issuing fish consumption advisories to the public. The program has developed and matured without input of federal money. While federal §106 grant monies are eligible to be used for this type of monitoring (most other states use §106 monies), Oklahoma's program has always been funded by state appropriation. EPA did not issue guidance on fish sampling and analysis until 1993. By that time Oklahoma's program and procedures were well in place.

The program came about after the discovery of fish contaminated by PCBs from the Pryor Creek Arm of Ft. Gibson Reservoir in the late 1970s. It was realized by officials that little was known about the concentrations of toxic metals and organic compounds in the fish of Oklahoma's reservoirs and how their consumption might affect public health.

Beginning in 1979, 50 of the state's largest reservoirs were targeted for the sampling of fish flesh by the Oklahoma State Department of Health (now ODEQ). Seven to nine reservoirs were sampled annually with multiple sites sampled on the bigger reservoirs. Samples of fish fillets were analyzed for mercury and several common organic pesticides known to be carcinogenic. Concentrations were compared to FDA recommended levels for the consumption of fish flesh. If levels consistently exceed the FDA Action Level, a consumption advisory was issued relative to the affected area and species.

The Toxics in Reservoirs program has evolved and continues to be refined. Streams where known contamination problems exist have been added. Risk-based consumption advisories levels are now utilized that protect sensitive populations while still allowing some consumption instead of the consumption prohibition advisories that were originally issued. As EPA updates risk levels for contaminants, ODEQ risk assessment staff evaluate consumption advisory levels appropriately, balancing the health benefits of eating fish with the risk associated with consuming harmful contaminants.

Table 6 below lists the ODEQ contaminant analytes and their associated consumption advisory levels.

Table 6. Contaminants analyzed for with associated advisory levels.

Contaminant	Screening Value to Trigger Increased Monitoring (mg/kg)	Limited Consumption Advisory Value to Protect Vulnerable Populations (mg/kg)	General Consumption Prohibition Value (mg/kg)
Aldrin	0.006	0.006	0.006
Chlordane	0.225	0.300	0.500
DDT	2.250	3.000	5.000
Dieldrin	0.012	0.012	0.012
Endrin	1.500	2.000	2.000
Heptachlor	0.150	0.200	0300
Mercury	0.75	1.00	1.50
PCBs	0.750	1.000	2.000
Toxaphene	3.750	5.000	8.000

Three general categories of fish are targeted for collection and analysis to ensure that the species analyzed are those most susceptible to the bioaccumulation of toxics and most frequently consumed. The three categories of fish and examples of species are:

1. Predator species – largemouth, white, striped, or hybrid bass, walleye, or flathead catfish
2. Bottom feeders – channel or blue catfish
3. Rough fish – largemouth or smallmouth buffalo, carp or river carpsucker

Since the intent of the program is to measure toxics in fish flesh, a variety of methods are used to obtain samples. These may include gill nets, seines, trotlines, electrofishing, rod and reel, and angler surveys. ODEQ has a working agreement with the Oklahoma Department of Wildlife Conservation (ODWC) to collect fish in conjunction with their fish survey activities. ODWC generally uses electrofishing collection methods. ODEQ supplements these collections, when necessary, with fish collected by gill net or seine. Fish are composited according to size and species for analysis.

Each category of fish for a given water body is analyzed to provide the best screening tool for contaminants. Screening level concentrations are used to determine potential problems and if other samples and species need to be analyzed. Screening levels are set at 75% of the lowest level for which a consumption advisory would be issued. If, during routine sampling, screening values are exceeded, samples are recollected as soon as practicable with emphasis on collecting the species and categories of fish that showed contamination. As long as sample results for a site remain above screening levels, that site is re-sampled annually for the species and categories showing contamination.

Consumption advisories may be issued for a particular species or a general category of fish, e.g.: predator species. Consumption advisories may also be issued within size ranges, e.g.: largemouth bass greater than 14" in length. If data indicates, advisories may also be issued for larger geographical areas.

Consumption advisories are only issued after sampling indicates contaminant levels that are consistently above ODEQ screening or consumption advisory levels. ODEQ screening and advisory levels are based upon numerical criteria listed in the Oklahoma Water Quality Standards. Generally, this means at least two consecutive sampling events. Advisories are rescinded only after sampling indicates contaminant levels that are consistently below the consumption advisory level. Generally, this means three consecutive sampling events.

Consumption advisories are only issued with the cooperation of the ODWC. In addition, other interested parties are notified and consulted before consumption advisories are issued. These may include other state and federal agencies, tribes, and municipalities.

There is currently one consumption advisory in effect. Pregnant women and children under the age of 7 are encouraged not to eat catfish from Bitter Creek in Jackson County due to DDT and Toxaphene contamination. The general population is encouraged to limit consumption of those fish to 2 meals per month. In addition, 4 other lake and stream sites around the state have exceeded various screening values and will be re-sampled in 2003.

ODEQ is currently evaluating the advisory level for mercury based on changes to EPA risk assessment protocol. The agency is also evaluating the addition of a limited number of contaminants that could be analyzed and reported using the current analytical methods.

Fish Biotrend Monitoring Program

The objective of the Biotrend Monitoring program is to assess trends and changes in the biotic integrity of Oklahoma streams through evaluation of fish community structure. This is accomplished by comparing recently collected sample results to expected ranges based on historic data. The program also provides valuable information to the public as well as state and federal agencies for the management of this important resource.

In 1976 the OSDH (now ODEQ) established the first long-term Biotrend monitoring program in the state of Oklahoma. Initially the program consisted of 12 sampling sites that were sampled once a year. By 1998 the program had expanded to 72 sites sampled 2 to 3 times a year. In addition to these long-term sampling sites for the monitoring of fish communities, a number of intensive studies were conducted. The ODEQ fish community database now contains information on 1,380 sites across the state from 5,688 collections.

Early in the program's life a wide range of biological and physical indicators were monitored: fish, macroinvertebrates, plankton, chlorophyll, aquatic plants and other aquatic vertebrates, as well as water chemistry and habitat evaluations. All elements but the fish community and habitat evaluations have been dropped due to personnel and fiscal constraints.

In 1998 ODEQ revised the Biotrend monitoring program with input from the ODWC, Oklahoma State University and the University of Oklahoma. After examining the list of long-term sampling stations in reference to the major watersheds, several gaps in areal coverage of the state were observed. Several new stations (for a total of 96) were added to the Biotrend monitoring program so that all major watersheds of the state are now represented. At the same time, sampling at each site was reduced from 2-3 times a year to once every 3 years.

Sampling is conducted during the base flow season using various combinations of nylon seines. Standardized sampling protocols ensure that comparable data is collected from site to site and year-to-year. Some of these procedures include:

- Collections are performed at the same location at each site during each sampling trip.
- Sampling areas cover 200 meters of the shoreline.
- The total sampling area covers 2000 square meters.
- All habitats types are thoroughly sampled.
- A uniform effort is expended each visit by sampling for a period of 1.5 hours.
- Attempts are made to perform approximately the same number of seine hauls at each site (20 with each covering approximately l0 m distance).
- Repeat seine hauls are done several times at each site to ensure that the majority of the fish are captured in each habitat.
- All specimens are preserved in the field with 10% formalin to insure a complete sample from each site.
- Preserved samples are taken to the Sam Noble Museum of Natural History (SNMNH) for species identification and enumeration.
- All collections are permanently housed in the SNMNH for reference and further study.

An index of biotic integrity for Oklahoma fish communities was developed by ODEQ to be used in assessment of the biotic integrity of Oklahoma streams. Sixteen attributes are used to determine this biotic integrity. These attributes, called metrics, fall into three categories:

- Species richness (diversity)
- Trophic composition
- Fish abundance and condition

Stream habitat is a critical factor in determining fish community health. ODEQ uses a stream habitat index to determine if habitat is a factor that limits the type and number of fish that can exist in a stream reach. Without this information it cannot be determined if environmental disturbances are affecting the fish community. The stream habitat index consists of fifteen metrics that fall into five categories:

- Watersheds
- Stream banks
- Stream bottom
- Stream morphology and flow
- Other habitat features

Each index rating goes from "excellent" to very poor. The biotic integrity index score is used in conjunction with the stream habitat index to determine if a healthy fish population is present at a site relative to the quality and availability of the habitat.

The results of these collections are compared to ODEQ's long-term database to see if they fall within historic ranges. If it is determined that a detrimental change has occurred, sample frequency is increased to more closely monitor that site. Sampling along the length of a river is scheduled such that no adjacent sites are sampled in the same year. It is felt that given the funding available, this is the most efficient method of determining trends in the fish communities as they relate to environmental disturbances.

The ODEQ Biotrend Monitoring program has provided assistance to many state and federal agencies as well as private citizens by supplying fish community data to help them in their decision making, standard setting, and rule making efforts.

One area associated with the Biotrend program that could be enhanced is that data collection protocols are not consistent with guidelines for making use support assessment decisions. For this reason the information collected has limited data uses. Implementation of data collection procedures that are consistent with other agency agreed upon biological collection standard operating procedures would serve to broaden the scope of use for the collected information.

Volunteer Monitoring Programs – Water Watch & Blue Thumb

Water Watch

The OWRB conducts a volunteer monitoring program on numerous water resources across the state. The volunteer program, Oklahoma Water Watch, was initiated in 1992 and continues to thrive to this day.

As stated above, Oklahoma Water Watch (OWW), the citizen volunteer monitoring program begun by the Oklahoma Water Resources Board (OWRB) in 1992, has flourished since its inception. Starting with a single group, the Grand Lake Association, OWW now has twenty groups with a total membership of over 200 individuals. High schools, colleges, civic groups, and Lake Associations are all represented within its ranks, as are all parts of the state. From Lake Carl Etling in the panhandle to Broken Bow Lake in the southeast, OWW currently has groups on 16 lakes and 6 streams across the state.

Oklahoma Water Watch established five primary goals at its foundation. They are:

- Collect environmental data to determine baseline water quality conditions for Oklahoma's water resources.

- Identify current or potential water quality problems.
- Determine water quality trends.
- Promote citizen participation in protecting, managing, and restoring our water resources.
- Educate the public on basic ecological concepts associated with our water resources.

These goals are currently being met. To date, OWW has accepted more than 3,000 data sheets. Several lakes including Grand, Eufaula, and Tenkiller have multiple years of data that are analyzed for trends. Citizens generally show a genuine interest in learning the limnology behind their watershed and how they can help manage water resources.

Day-to-day management of the program includes scheduling training sessions with new groups and classes, setting up quality control sessions to ensure that quality data is being collected, updating monitors on new program information, handling data collected by volunteers, and making sure that grant obligations are fulfilled. Oklahoma Water Watch monitors are trained to collect physical as well as chemical data to supplement data collected by OWRB professionals. See Table 7 for a list of variables monitored. The OWW program is currently working with volunteers on Grand Lake to initiate a bacteria collection and analysis program using IDEXX instrumentation to assess the lake's primary body contact beneficial use support. The IDEXX methodology is approved by EPA and will provide valuable data that would not otherwise be collected.

Table 7. OWW Volunteer Collected Parameters.

Parameter	Units	Data Type
pH	Standard units	Chemical
Dissolved Oxygen	Milligrams/Liter	Chemical
Orthophosphate	parts per million	Chemical
Nitrate Nitrogen	parts per million	Chemical
Ammonia Nitrogen	parts per million	Chemical
Secchi Disk Depth	Centimeters	Physical
Temperature	°C	Physical
Water Color	Borger Color System	Physical
Cloud Cover	Range	Physical
Wind Speed	Range	Physical
Wind Direction	Range	Physical
Waves	Range	Physical
Aquatic Macrophytes	Range	Physical
Precipitation	Centimeters	Physical
Chlorophyll*	µg/l	Biological
Bacteria*	MPN	Biological

* Chlorophyll and bacteria are monitored on a limited basis

In addition to this routine management, OWW is always looking for ways to recognize and promote volunteers or sending them information on how to apply for grant money.

One of the primary goals of OWW is to determine baseline water quality conditions and trends in Oklahoma's water resources to supplement agency-collected data. In 1998-1999, OWW furthered this goal by giving dedicated in-lake volunteer monitors electronic water quality monitoring sample probes to facilitate lake profiling. Purchase of electronic instrumentation allows monitors to collect in-situ data throughout the lake profile. Data can now be collected for dissolved oxygen, pH, specific conductance and temperature without having to use the standard LaMotte testing procedures. Data collected by volunteers using data collected via EPA accepted procedures are used in the beneficial use support determination process. Volunteer collected data is used by the OWRB in the Integrated Report Process.

Oklahoma Water Watch serves as an integral bridge between the OWRB and local communities. It, along with numerous other citizen programs around the country, is proving that volunteers can collect vital and useful environmental information. It is hoped that OWW will continue to receive financial support into the future so that a quality program can be provided to the citizens of Oklahoma and that an educated and informed public can play a more key role in the management of our water resources for the good of us all.

Blue Thumb

The OCC conducts an education and volunteer monitoring program, "Blue Thumb" with the express purpose of educating the public on water quality issues.

Statewide Blue Thumb

In addition to educational activities and events, a principle activity of the Statewide Blue Thumb program is volunteer monitoring. Trained volunteers collect monthly water quality data (See Table 8). Professional staffs collect benthic invertebrates and fish and perform aquatic habitat evaluations with volunteer assistance. The volunteers also collect samples for pesticide and fecal-coliform bacterial analysis. Data are then interpreted and given back to the volunteers who use it to give presentations to area schools and other groups on different aspects of water quality. Settleable solids samples are collected during runoff events for educational purposes. There are currently active programs in Cherokee, Adair, Delaware, Oklahoma, Tulsa, Hughes, Latimer, Blaine, Cimarron, Texas, Cleveland, Commanche, Creek, LeFlore, Logan, Lincoln, Mayes, Murray, Craig, Osage, Okmulgee, Ottawa, Woodward, Roger Mills, Kay, Pontotoc, Canadian, Payne, Custer, Washita and Pottawatomie Counties.

Table 8. Statewide Blue Thumb Sampling Program.

<table>
<tr><td>Duration of sampling</td><td>Indefinite</td><td colspan="2">Parameters Measured</td></tr>
<tr><td>Number of sites</td><td>15</td><td rowspan="8">Nitrate-Nitrogen
Ammonia-Nitrogen
Orthophosphate
Chloride
Fecal-coliform Bacteria
pH
Temperature, air & water</td><td rowspan="8">Dissolved Oxygen, absolute & % saturation
Secchi Disk Transparency
Chloropyrifos</td></tr>
<tr><td colspan="2">Sampling frequency</td></tr>
<tr><td>Water samples</td><td>12/year/site, evenly spaced</td></tr>
<tr><td>Settleable Solids</td><td>during runoff events</td></tr>
<tr><td>Fish Collection</td><td>1/site every 3rd year</td></tr>
<tr><td>Macroinvertebrate collection</td><td>2/site yearly</td></tr>
<tr><td>Habitat Assessment</td><td>1/site every 3rd year</td></tr>
</table>

Flow Monitoring

The USGS operates and maintains an extensive stream monitoring network for multiple purposes. The streamflow-monitoring network is used for forecasting flood events, for determining base flow, for calculating pollutant loadings (based upon flow data), and the USGS also conducts investigational water quality monitoring at numerous stations across the state. The USGS has a very extensive historical record on many streams across the state. The existence of this historical record is invaluable in the management of our water resources and the continuation of the network in its present form should be preserved if possible.

The USGS streamflow-monitoring program provides hydrologic information needed to help define, use, and manage the State's water resources. The program provides a continuous, well-documented, well-archived, unbiased, and broad-based source of reliable and consistent water data. Because of the nationally consistent, prescribed standards by which the data are collected and processed, the data from individual stations are commonly used for purposes beyond the original purpose for an individual station. Those possible uses include, but are not limited to:

- Characterizing current water-quality conditions
- Providing data for forecasting and managing floods
- Monitoring compliance with minimum flow requirements
- Setting permit requirements for discharge of treated wastewater
- Delineating and managing flood plains
- Magnitude and frequency of floods and droughts
- Operating and designing multipurpose reservoirs
- Designing, operating, and maintaining navigation and recreational facilities
- Allocating water for municipal, industrial, and irrigation uses
- Administering compacts or resolving conflicts on interstate rivers
- Undertaking scientific studies of long-term changes in the hydrologic-cycle

Data for one or more of these purposes are needed at some point in time on virtually every stream in the country, and a data-collection system must be in place to provide the required information. The general objective of the streamflow-monitoring program is to provide information on stream-flow characteristics at any point on any stream. Stream-flow data are needed for immediate decision making, future planning and planning and project design. Data, such as that needed to issue and update flood or drought forecasts, are referred to as "data for current needs". Other data, such as needed for the design of a future bridge or reservoir, are referred to as "data for future or long-term needs". Some data, of course, fit into both classifications; a station that supplies data for flood forecasting also can provide data to define long-term trends and clearly fits both classifications.

In addition to the extensive USGS flow monitoring network, the OCC, OWRB and ODEQ conduct routine flow monitoring on all water quality monitoring sites or sites monitored for TMDL purposes they sample that are not monitored for flow by the USGS. This ensures that flow data is available for all monitoring conducted by the listed agencies to determine beneficial use support has the required flow information to assess support status. Please refer to the appropriate agencies QAPP or SOP documents for a detailed discussion of how flow is determined.

Probabilistic Monitoring

At this time a probabilistic monitoring program is being planned. The OWRB is applying for a 104b(3) grant to fund the first year of a statewide stream probabilistic monitoring program. If funded, OCC will assist with data collection activities. EPA has identified probabilistic monitoring as a high priority item and Oklahoma will pursue this initiative as money and manpower allow. Monitoring sites in Oklahoma have already been selected and staffs with the OWRB, OCC and ODEQ are discussing options for initiating and maintaining a probabilistic stream sampling network. It is anticipated that $250,000 - $300,000 would be required to conduct the stream network. Staff with EPA is working with Oklahoma to try to direct federal monies toward the state to facilitate the implementation of probabilistic monitoring network. Any monitoring being conducted would be a cooperative effort among several state agencies including the OWRB, OCC and ODEQ. It is also Oklahoma's intention to pursue development of a probabilistic monitoring program for our lake resources. Discussions between Oklahoma and Region 6 EPA will continue to pursue development and initiation of this objective. It is anticipated that an additional $200,000 would be required to conduct a lakes probabilistic monitoring program.

Special Studies

Oklahoma Corporation Commission

The Corporation Commission (Corp Comm.) does five types of environmental monitoring:

1. Soil sampling at spill and other potential pollution case sites;
2. Well water sampling near spill and other potential pollution case sites;
3. Stream water sampling near spill and other potential pollution case sites;
4. Spring, stream, and other surface water sampling in historic oilfield areas, to determine the overall impact of historical oilfield activity on the waters of the state; and
5. Sampling to refine dissolved minerals criteria for selected sub-watersheds.

Since 1998 the Oil and Gas Conservation Division has been performing and working with partners on the fourth type of sampling (See Table 9). Many of these samples have been collected by the OWRB's BUMP initiative and analyzed for salinity and minerals by the ODEQ State Environmental Laboratory, with the rest collected by Corp Comm. and either evaluated via field meters or analyzed by ODEQ's lab (for oil) or at the Oklahoma State University Lab in Stillwater (for salinity and minerals). A visual check for petroleum is made every time a stream is sampled.

During 2002, in partnership with the OCC, Corp. Comm. the fifth type of sampling was initiated. OCC Staff collected most of the samples, while Corp Comm. has paid for salinity and minerals analyses at the Oklahoma State University Lab in Stillwater. During 2003 and 2004 Corp. Comm. will be working with OWRB staff using these analyses to refine minerals criteria in specific watersheds.

Table 9. Corporation Commission O&G Surface Water Body Sampling 1996-2002.

Year	#Surface Water Samples	# By OWRB	# By OCC	# By TU ++	# By Corp. Comm.	# Field meter or titration	# Field Turbidity meter	# Dry on day sampled	# Lab analysis	# Total soluble salts @ lab, anions & cations
1996	69				69	9			60	13
1997	73				73	4			69	49
1998	164			45	119	2	7		155	109
1999	1002	664			338	458		13	531	382
2000	669	439			230	297	15	66	291	120
2001	451	134			317	151	4	27	269	135
2002**	369	70	187		112	48		1	320	121
Total	2821	1307	187	45	1282	970	26	108	1717	929

** Data only for the first 5 months of 2002; the part time updating intern position was cut.

++ TU (University of Tulsa) 1998 data is from a study done for the Seminole Nation. TU has supplied more data for 2002, not yet in the database.

For some surface water bodies, only field meter readings and visual observations are performed. Others have both a field and a laboratory test, or only a laboratory analyses. Some samples have more than one parameter analyzed in the lab.

Oil & Gas Conservation Division Surface/Ground Water Interaction Monitoring

Purpose and Plan

For many years the Corp. Comm., Oil and Gas Conservation Division has been taking samples for regulatory enforcement and cleanup purposes near known and suspected spill and pollution sites. This pollution spill case-monitoring program is very site and cause specific, is usually quite localized in scope, and needs little explanation. Most of the discussion, below, is for the 4th and 5th types of environmental monitoring.

It was only in 1998, with the increased interest in the overall environmental effects of oil and gas production and EPA's stepped up efforts regarding the Clean Water Act, that Corp. Comm. O&G, in cooperation with the OWRB's BUMP program, began extensively sampling surface water bodies down stream of oil and gas fields to determine which streams were actually impaired and which were meeting WQS criteria. One monitoring program was aimed at the many streams listed on the 1998 Oklahoma 303d list that were allegedly impaired by oil and gas production related pollution, including petroleum, produced brine, and sediment, that had to be evaluated. A second program was begun to monitor rarely or never before sampled streams in oilfield areas that Corp. Comm. or others suspected had been affected by historic drilling and production activities.

OWRB staff has sampled the majority of the streams in the first program, with Corp. Comm. staff doing the remainder. Corp. Comm. staff did the initial oilfield area sampling for the second program, and referred streams that its initial sampling rounds showed to have possible water quality problems to OWRB for additional sampling. In addition, if Corp. Comm's pollution spill case monitoring program determines that a surface water body has likely suffered extensive impacts from a recent or historic spill, it may also be referred for sampling to determine how far downstream the impacts continue. In three watersheds alleged to be impacted by oil and gas production activities (upstream of Ft. Cobb lake, Stillwater Creek in Payne Co, the Lake Wister watershed), Corp. Comm. has federal §319h funded grant work in progress in cooperation with the Oklahoma Conservation Commission. Our goals were and are to have a completely accurate list of impaired and threatened water bodies by 2004 for the federal 303d list, and to know where state and federal restoration efforts in historic oil and gas producing areas need to be focused.

Oil & Gas Conservation Division Ground Water Monitoring Strategy

The Oil and Gas Conservation Division takes approximately 225 ground water samples per year near known and suspected oil and gas spill sites and in response to complaints from citizens in oil and gas field areas. These are taken in domestic water wells, in pollution monitoring wells, from borings and dug trenches, and from springs and seeps where groundwater emerges at the surface. Water samples are analyzed for salinity, petroleum, metals, or other parameters as appropriate similar to surface water samples.

In addition to being used for determining the correct actions in specific pollution cases and complaints, Corp. Comm. is attempting to utilize this data in conjunction with surface water data

to determine watershed impairments and areas in which corrective action should be taken. For example, many of the salinity-impacted streams found to date have no surface source. Ground water samples taken near some of these streams show that there is a subsurface brine plume, probably the source for the stream's excess salinity. If the source for each brine plume could be determined and remediated, then the plume(s) will no longer carry pollutants to the streams and cause stream impairments.

Corp. Comm. is using its current ground water sampling data for this purpose in a few areas, but does not yet have the funding to undertake extensive sampling near impaired streams to determine the potential groundwater sources for all impaired streams.

Lake Special Studies

The Oklahoma Water Resources Board has been designated by the Oklahoma legislature as the technical lead agency for Clean Lakes work. With this charge, the OWRB provides Lake Diagnostic, Feasibility and Restoration services across the State. The OWRB has conducted numerous Clean Lakes studies in the past with the express objective of diagnosing water quality problems, identifying sources of water quality problems, and conducting remediation activities to restore lake water quality.

Biocriteria Development - Biological Monitoring

In developing the biological assessment thresholds and associated methodology, other state environmental agencies were invited to participate and provided valuable input into the process. A ***universal biological assessment protocol*** was developed in order to provide guidance to agencies and individuals performing any assessment relating to biocriteria. A review by six state and federal agencies as well as a local university produced the final protocol document published by OWRB as Technical Report 99-3. Contained within the protocol are methods for physical and biological assessment of a given stream reach. These methods have been refined over the course of several years and are intended to provide a comparable level of effort for all assessments and collections relating to biocriteria. However, the Executive Summary of the document contains the following disclaimer.

> "The intended application of this protocol is establishment of a uniform biological assessment through which aquatic communities of similar streams can be compared. Any section of the protocol (physical, chemical or biological) is capable of being used separately. However, a complete picture of the biological condition of any given stream necessitates that each section be applied in conjunction with the others. Agencies, universities, independent entities and individuals are not required to employ these protocols for their own projects unrelated to biological criteria. Separate, project-driven or agency-devised protocols are acceptable for other purposes. Only when results are to be used in biological criteria applications related to Oklahoma's Water Quality Standards will these protocols be required."

Development of the proposed biological assessment thresholds involved comparison of reference steams to streams of varying levels of impact. Development of the applicable USAP subchapter containing the proposed thresholds involved merging the approved biocriteria

protocols with the proposed thresholds for the Ouachita Mountain ecoregion. This proposed USAP was put before the biocriteria working group, as well as other staff familiar with the development of previous USAP language, for review and comment prior to this public presentation.

Selection of the ecoregion to begin development of statewide biological thresholds was an unforeseen outcome of another project. In the process of examining the distribution of known faunal collections from across the state, it was noticed that the Ouachita Mountain ecoregion (as determined by Omernick, 1987) contained nearly twice the number of collections as almost any other area of the state. It was decided that, especially for the initial stages of "biocriteria" development, the larger the number of test streams to chose from the better.

One of the few existing references to biocriteria in the WQS (785:45-5-12(e)(5)(A)(1)) allows for comparison of test data to regional reference data from similar waters. This concept, that similar waters with similar habitats and ecological characteristics will contain similar aquatic communities, is a basic tenet of the ecoregion concept. At its most basic level, it suggests that environmental alterations, whether chemical, physical or biological, will be manifest in the aquatic community. Quantification of these aquatic community differences drives biocriteria and is dependent upon the establishment of the "reference condition". Oklahoma's Conservation Commission, a contributing party to this process, developed project-specific "reference streams" under separate grant support based upon chemical and biological factors. OWRB used these streams as the reference condition against which all test streams would be compared.

In order to create the matrix of support levels, it would first have to be determined what those support levels would "look like". In other words, what sort of fish community would be present in different stream types under different impact conditions? As part of OWRB responsibilities, Use Attainability Analyses (UAA's) are performed on certain streams to determine the appropriate Fish & Wildlife Beneficial Use sub-category for the purposes of discharge permitting.

Fluvial Geomorphological Assessments

Fluvial geomorphological monitoring measures the physical dimensions and hydraulics of a stream. By studying the form and relationship of streams to their watershed and climate, a reference database can be compiled that explains the physical dimensions of the stream, the amount of bank material eroding naturally, the nature of substrate materials, and how to repair channels that are not stable. Over 60 fluvial geomorphological assessments were performed in 1999 across the state.

Use Support Assessment Protocols and Quality Assurance/Quality Control Procedures

The Oklahoma Water Resources Board in conjunction with the various state environmental agencies has worked to develop use support assessment protocols (USAP) to ensure that agencies are making use support determinations based on comparable decision criteria. The USAP as it currently exists represents a significant step forward in the states monitoring initiatives and continued development and refinement of the protocols will result in the collection of quality data by all monitoring parties and will hopefully also serve as a template for the state's tribal programs to build upon.

Please see the OWRB web page at http://www.owrb.state.ok.us/util/rules/pdf_rul/Chap46.pdf and review sub-chapter 15 for the full text of the state rule. The rule went through the public participation requirements associated with Oklahoma's OWQS setting process. The rule outlines how use support determinations are to be made and is utilized by all parties making use support determinations. Where the USAP is silent on a use support determination, then Oklahoma's Continuing Planning Process (CPP) Document addresses the issue. Please see the ODEQ web page at: http://www.ODEQ.state.ok.us/WQDnew/pubs/2002_cpp_final.pdf to review the CPP document.

Quality Assurance/Quality Control (QA/QC) Procedures

All data collected by the OWRB, OCC and ODEQ for beneficial use assessment purposes is covered by an EPA approved Quality Assurance Project Plan (QAPP). Oklahoma Adminstrative Code 785:40-15-3(g) requires that written QA/QC methods be in place for a monitoring program to collect data to make a use support determination. If written protocols are not in place, than data should not be used for use support determination.

For detailed information on agency quality assurance and quality control procedures, please contact the appropriate agency for a copy of their QAPP documents and/or their Standard Operating Procedures (SOP) documents.

To review the OWRB SOP document for the BUMP please go the OWRB web address http://www.owrb.state.ok.us/studies/pdf_stu/bump_sopfy01.pdf.

To review the OCC SOP document for their §319 non-point source program please go to their web address located at http://www.okcc.state.ok.us/WQ_SOP.pdf.

Data Management & Storage

Each individual agency doing monitoring maintains a database or spreadsheet that they utilize to store data and facilitate data analysis. By maintaining separate individualized databases or spreadsheets an agency is able to design them such that they facilitate their data needs. However, all of the agencies collecting water quality environmental data are working together with the ODEQ to house all water quality information in a centralized state database easily accessible to the public and data users. Several agencies will continue to maintain a stand-alone database for their own data analysis needs, but all collected information will be forwarded to the ODEQ for inclusion in the State database. A description of each individual agencies data management and storage policies and protocols will not be undertaken in this document, however a description of the centralized database being developed by the ODEQ in cooperation with the other environmental agencies is presented below.

With the passage of §27A-1-4-107 the Oklahoma Legislature designated ODEQ as the repository for all environmental monitoring data collected by state agencies (Added by Laws 1999, c. 413, § 6, effective Nov. 1, 1999). Under this law, ODEQ is required to maintain Oklahoma water quality data in a computerized information system that is accessible to both state environmental agencies and the public. In support of this effort, all state environmental agencies are submitting the results of any water quality monitoring they have performed to ODEQ. This cooperative effort has allowed ODEQ to compile multi-source monitoring data for the state into a centralized database that is accessible to all through web-based applications.

ODEQ's goal is to not just provide access to data but to provide user-friendly tools for utilization of that data as well. It was recognized that achievement of this goal could best be accomplished by utilizing Geographic Information Systems (GIS) technology and the visually oriented tools it provides.

The initial objective of providing access to monitoring data was met with the establishment of the OK Environmental Information System (OK EIMS). This interactive web-based GIS application is available through ODEQ's Water Quality Division's web page at the following site:

www.ODEQ.state.ok.us/WQDnew/wqprogrms.html.

By selecting the Water Quality Data Map Browser (See Figure 6) option users can access the OK EIMS application, which allows users to query Oklahoma water quality monitoring data. In addition to monitoring data, the OK EIMS system will provide information on other items of environmental interest such as activities regulated under environmental programs within the state.

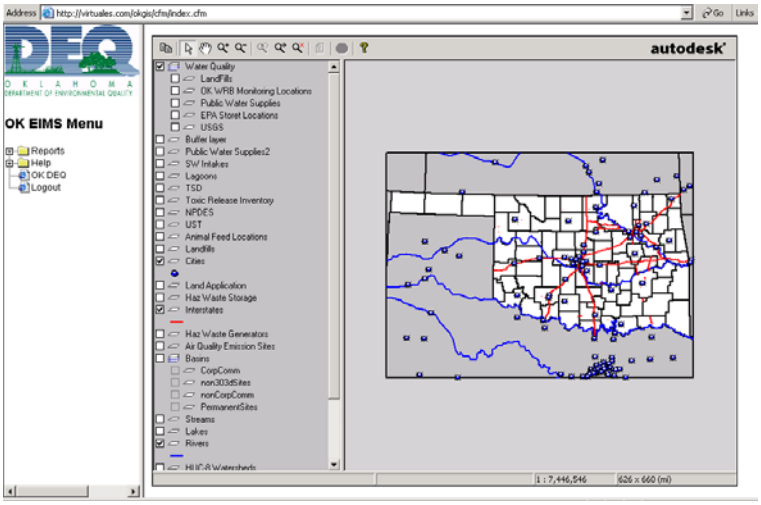

Figure 6. Water Quality Data Map Viewer.

Since the release of OK EIMS, ODEQ has continued efforts to identify user needs and develop new applications and processes that meet those needs; enhancing the ability of data users to efficiently access Oklahoma's water quality monitoring data. Currently, efforts are underway to modify ODEQ's newest interactive web-based GIS application, *"The ODEQ Data Viewer",* (See Figure 7) to provide access to monitoring data. This application has proven to be user-friendly as well as powerful enough to quickly disseminate large amounts of data. The existing application provides access to a wide range of environmental data with the ability to easily query and generate reports on items of interest. It is this interactive ability to display, query, and output large amounts of data that makes this application ideally suited to manage the monitoring data.

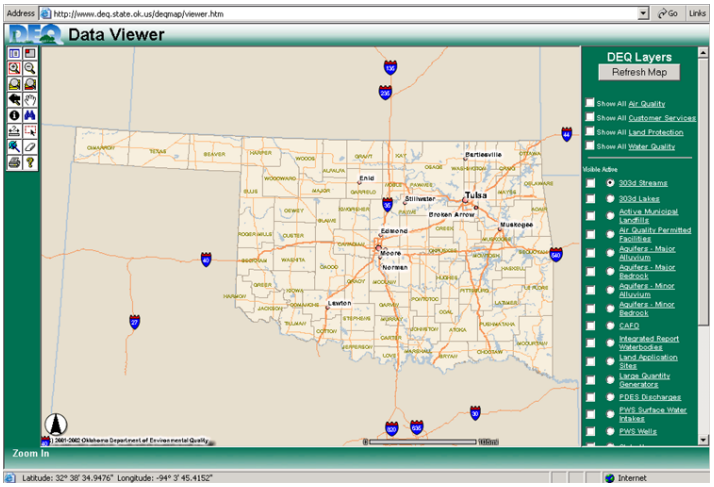

Figure 7. ODEQ Data Viewer.

This existing application can be accessed through ODEQ's main web page at:

www.ODEQ.state.ok.us

By selecting the To See Oklahoma ODEQ GIS Maps option users gain access to a very robust system designed as a platform for content specific applications such as the utilization of water quality monitoring data.

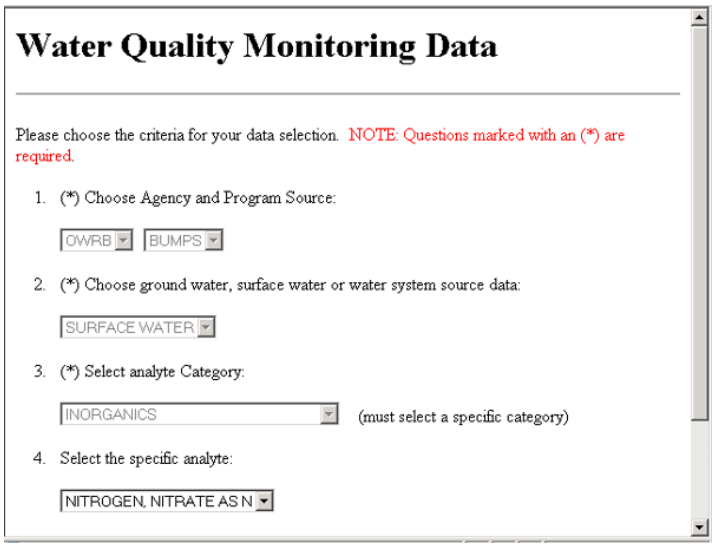

Figure 8. Example Water Quality Monitoring Query.

The revised application will provide a unique query-building tool allowing users to query by data provider, program, sample source, analyte category (i.e. organics), specific analyte, and period of record. In addition to monitoring data, the Data Viewer will continue to provide access to information concerning regulated activities and geographical features relative to environmental issues.

In support of a strategy that not only meets the needs of the state but those of federal programs as well, ODEQ is working towards implementation of a State STORET (Storage and Retrieval) Program. By utilizing the recently revised Modernized STORET application, ODEQ plans to develop and administer a centralized STORET system as the primary repository for Oklahoma's environmental monitoring data.

ODEQ is committed to invest resources towards the development of those applications and processes necessary to effectively manage Oklahoma's monitoring data; however, achievement of this objective will only be realized with continued cooperation and support from all environmental agencies. As a long-term project, additional resources will need to be identified and devoted to this process to ensure success.

Reporting

Oklahoma generates numerous reports dealing with findings associated with our monitoring programs. Oklahoma recently completed the 2002 Integrated Water Quality Monitoring and Assessment Report that has been submitted to Region 6 EPA for approval. Preliminary work has begun on the 2004 Integrated Report. In addition, the OCC and OWRB document beneficial use support findings through the §319 Nonpoint Source Assessment Report and the BUMP Annual Report to the Oklahoma Legislature respectively. All reports are available to the public to informally review and comment on and in the case of the Integrated Report a formal Administrative Procedures Act (APA) public comment and review process is followed. In addition, the USAP document goes through the APA formal review and comment process before being promulgated into rule.

Oklahoma's 2002 Integrated Report can be found at:
http://www.ODEQ.state.ok.us/WQDnew/305b_303d/2002_integrated_report_final.pdf

The latest §319 Nonpoint Source Management Program and Nonpoint Source Assessment Report can be found at: http://www.okcc.state.ok.us/NPSMP_final_draft.pdf

The 2002 BUMP Report can be found at:
http://www.owrb.state.ok.us/studies/reports/bump/2002/bump.php

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10 Required Elements of a State Water Monitoring & Assessment Program