EXECUTIVE SUMMARY

Beneficial Use Monitoring Program Goal:

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

The Beneficial Use Monitoring Program exists as a result of the vital economic and social importance of Oklahoma's lakes, streams, wetlands, and aquifers and the associated need for their protection and management. The data contained in this report is scientifically defensible and has been collected and analyzed following procedures outlined in Use Support Assessment Protocols (USAP), developed by Oklahoma Water Resources Board with input and concurrence of Oklahoma's other environmental agencies. Specifically, USAPs establish a consistent method to determine if beneficial uses assigned for individual waters through Oklahoma Water Quality Standards (WQS) are being supported. The legitimacy of data analyzed following protocols other than those outlined in the USAP (or the Oklahoma Continuing Planning Process (CPP) document where the USAP is silent) for use support determination is not appropriate. If the BUMP report indicates that a designated beneficial use is impaired, threatened, or otherwise compromised, measures must be taken to mitigate or restore the water quality.

The Oklahoma Water Resources Board (OWRB) has worked diligently to follow the guidelines outlined in the USAP. Recommendations in this report should be consistent with recommendations for the state's 303(d) list. Although certain inconsistencies do exist, every effort has been taken to assure compatibility between the BUMP Report and the 303(d) list. Issues regarding stream/lake segmenting additional data from non-BUMP sources and unique non-representative conditions all affect the impairment decision-making process

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

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

The specific objectives of the BUMP are to detect and quantify water quality trends, document and quantify impairments of assigned beneficial uses, and identify pollution problems before they become a pollution crisis. This report interprets current Oklahoma Lake data collected as part of the comprehensive, long-term program. As the program has matured, the BUMP report has become one of the most important annually published documents in Oklahoma.

BENEFICIAL USE MONITORING PROGRAM COMPONENTS

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

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

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

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

- **Fixed Station Lakes Monitoring** - Quarterly sampling (approximately once every 90 days) of approximately 40-45 lakes annually is currently occurring. In general, a minimum of three stations per reservoir, representing the lacustrine zone, transitional zone, and riverine zone, are designated for sampling at each lake, with additional sites sampled as needed. Additional water quality parameters and lake sites were added to the lake sampling program in 2001 to aid in making use support determinations.

- **Fixed Station Groundwater Monitoring** - Limited monitoring as part of this task has occurred in the program. Results of monitoring are presented in this report. OWRB staff has

made recommendations in this report related to the scope and magnitude of groundwater monitoring activities that the state should pursue in the future. Any proposed groundwater monitoring efforts will be coordinated with the Oklahoma Department of Environmental Quality (ODEQ).

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

PROGRAM HISTORY/OVERVIEW

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

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

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

Results of Lakes Sampling Efforts

Data was collected by the OWRB on a quarterly basis for 41 lakes in 2006-2007. Forty-three lakes were selected for monitoring, however due to drought conditions; staff was unable to launch a boat on 2 of the lakes. For the current sample year, data was collected from the October of 2006 through August of 2007. The results of the sampling efforts are summarized below. As shown in Figure 1, 10% of lakes sampled were determined to have serious water quality nutrient concerns based upon their classification as hypereutrophic reservoirs. Lakes classified as hypereutrophic have the potential for beneficial use impairments due to low dissolved oxygen concentrations, taste and odor problems, nutrient inputs, excessive productivity, and general lake aesthetics. Hypereutrophic waters are adversely impacted primarily by excessive nutrients and primary productivity and should be monitored intensively in the future to document the presence or absence of "beneficial use impairments." Sixty-one percent of the lakes sampled were classified as eutrophic, characterized by high primary productivity and nutrient rich conditions. A eutrophic lake also has the potential for beneficial use impairments, though the potential is less than for hypereutrophic waters. Mesotrophic waters have a small potential for beneficial use impairments and overall are representative of good water quality, low to moderate levels of nutrients, and productivity. Of the lakes sampled, 27% were classified as mesotrophic. Oligotrophic waters have very low levels of primary productivity and usually low concentrations of nutrient constituents. In Oklahoma, oligotrophic waters are either very clear waters with little nutrient inputs and genuinely good water quality conditions, or the waters are very turbid with poor water clarity with the absence of sufficient ambient light inhibiting lake productivity. Only one of the 41 lakes sampled was classified as oligotrophic. Based on the results for trophic state index calculations, 71% of the waters sampled were exhibiting high to excessive levels of primary productivity and nutrient rich conditions characteristic of eutrophic and hypereutrophic waterbodies.

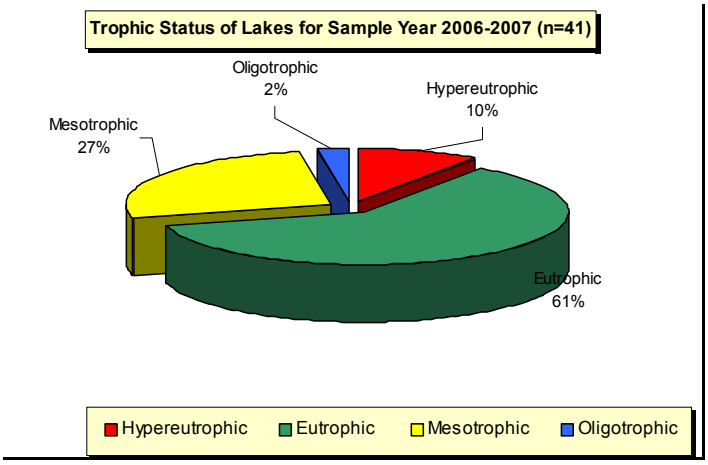

Figure 1. Trophic Status of Lakes Sampled in 2006-2007

The distribution changes somewhat when the lake surface acres for each reservoir are classified into the corresponding trophic status. Results in Figure 2 are different than Figure 1, indicating the lakes classified as eutrophic were larger in surface acres than the lakes classified as mesotrophic and hypereutrophic. When you look at lake trophic status broken out by the number of lake surface acres in each trophic state category, 86% of all surface acres

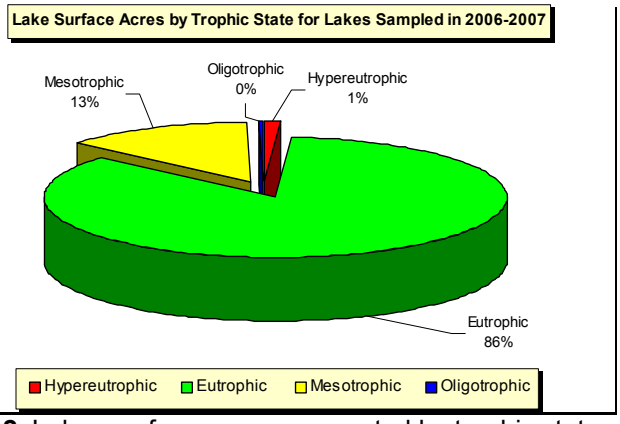

Figure 2. Lakes surface acres segregated by trophic state.

sampled were eutrophic, 13% were mesotrophic, 1% were hypereutrophic, and 0% were oligotrophic. Two of the largest reservoirs sampled in 2006-2007 were classified as eutrophic (Eufaula and Ft. Gibson), which skewed the surface acres percentages heavily towards the eutrophic category. In general, the larger reservoirs in the state have more extensive watersheds and are generally deeper than smaller lakes, which increase the likelihood of beneficial use impairments being present since a larger surface area is available. During stratification, the larger/deeper reservoirs have a greater portion of the water column that becomes anoxic for long periods of time, which also increases the potential for nutrient release from sediments. It is obvious that many reservoirs in Oklahoma are experiencing adverse environmental impacts. However, with the available data it is not possible to adequately assess if lakes are meeting their assigned beneficial uses as they relate to nutrients. At this time 24 lakes have been identified by the OWRB as "Nutrient-Limited Watersheds" (NLW) in the WQS and efforts should be taken to definitively determine if NLW waters are meeting their uses through initiation of a Nutrient Impairment Study to definitively determine the presence or absence of nutrient impairments in our NLW lakes. NLW are lakes with a TSI ≥ 62, based on Carlson's trophic state classification system and using chlorophyll-a as the trophic state indicator. Lakes sampled as part of the BUMP, their trophic status, and potential threats or impairments are listed in Table 1.

Table 1. Lakes Sampled by the BUMP with Associated Use Attainment Status.

LAKE NAME	COUNTY	W.Q. SEGMENT #	LAST YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
AMERICAN HORSE	BLAINE	520620	2003-2004	D.O.				
ARBUCKLE	MURRAY	310800	2004-2005	D.O.				
ARCADIA	OKLAHOMA	520710	2006-2007		CHLOR-A			
ARDMORE CITY	CARTER	310800	2006-2007	D.O.				
ATOKA	ATOKA	410400	2006-2007	TURBIDITY				TRUE COLOR
BELLCOW	LINCOLN	520700	2003-2004	D.O.				
BIRCH	OSAGE	121300	2006-2007	D.O.				TRUE COLOR
BIXHOMA	WAGONER	120410	2005-2006	D.O.				
BLUESTEM	OSAGE	121300	2005-2006	D.O. TURBIDITY				
BOOMER	PAYNE	620900	2004-2005	TURBIDITY				
BROKEN BOW	MCCURTAIN	410210	2005-2006	PH D.O.				
BRUSHY CREEK	SEQUOYAH	220200	2003-2004	PH		ENT.		
BURTSCHI◘	GRADY	31082002	2005-2006	PH				NLW
CANTON	BLAINE	720500	2005-2006	TURBIDITY				
CARL ALBERT	LATIMER	410310	2003-2004					
CARL BLACKWELL	PAYNE	620900	2004-2005	TURBIDITY	CHLOR-A			
CARTER	MARSHALL	310800	2003-2004					
CEDAR (MENA)	LEFLORE	410210 410300	2005-2006	D.O. PH				

LAKE NAME	COUNTY	W.Q. SEGMENT #	LAST YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
CHANDLER	LINCOLN	520700	2004-2005					
CHICKASHA◘	CADDO	310830	2006-2007	D.O.			Sulfates	NLW
CLAREMORE	ROGERS	121500	2005-2006		CHLOR-A			NLW
CLEAR CREEK	STEPHENS	310810	2006-2007					
CLEVELAND CITY	PAWNEE	621200	2006-2007	D.O.				
CLINTON◘	WASHITA	310830	2003-2004	TURBIDITY	CHLOR-A	ENT.		TRUE COLOR NLW
COALGATE CITY	COAL	410400	2006-2007	D.O. TURBIDITY				TRUE COLOR
COMANCHE	STEPHENS	311300	2004-2005					
COPAN	WASHINGTON	121400	2004-2005	TURBIDITY D.O.	CHLOR-A			TRUE COLOR
CROWDER	WASHITA	310830	2005-2006		CHLOR-A			NLW
CUSHING MUNICIPAL	PAYNE	620900	2006-2007	TURBIDITY				TRUE COLOR
DAVE BOYER (WALTERS)	COTTON	311300	2003-2004	TURBIDITY				TRUE COLOR
DRIPPING SPRINGS	OKMULGEE	520700	2006-2007	D.O. TURBIDITY				TRUE COLOR
DUNCAN	STEPHENS	310810	2006-2007					TRUE COLOR
EL RENO◘	CANADIAN	520530	2006-2007	TURBIDITY				TRUE COLOR NLW
ELK CITY	BECKHAM	311500	2005-2006					NLW
ELLSWORTH	COMANCHE	311300	2006-2007	D.O. TURBIDITY				TRUE COLOR
ELMER THOMAS	COMANCHE	311300	2006-2007	pH				
ETLING, CARL◘	CIMARRON	720900	2003-2004	TURBIDITY pH				NLW
EUCHA●	DELAWARE	121600	2006-2007	D.O.	CHLOR-A			NLW
EUFAULA	HASKELL	220600	2006-2007	D.O. TURBIDITY				TRUE COLOR
FAIRFAX CITY	OSAGE	621200	2006-2007	D.O.				
FORT COBB	CADDO	310830	2005-2006	TURBIDITY	CHLOR-A			NLW
FORT GIBSON	CHEROKEE	121600	2006-2007	D.O.				NLW
FORT SUPPLY†	WOODWARD	720500	2005-2006	TURBIDITY	CHLOR-A			NLW
FOSS	CUSTER	310800 310810 310820 310830 310840	2004-2005					
FREDERICK	TILLMAN	311310	2006-2007	TURBIDITY				TRUE COLOR
FUQUA	STEPHENS	310810	2006-2007					
GRAND LAKE	MAYES	121600	2005-2006	D.O.				
GREAT SALT PLAINS	ALFALFA	621010	2005-2006	TURBIDITY			SULFATES & CHLORIDES	NLW

LAKE NAME	COUNTY	W.Q. SEGMENT #	LAST YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
GREENLEAF	MUSKOGEE	120400	2005-2006	D.O.	CHLOR-A			
GUTHRIE◘	LOGAN	620910	2005-2006		CHLOR-A			NLW
HEALDTON CITY	CARTER	311100	2005-2006					
HEFNER	OKLAHOMA	520520 520530	2005-2006	D.O.				
HENRYETTA♦	OKMULGEE	520700	2004-2005	TURBIDITY				TRUE COLOR
HEYBURN	CREEK	120420	2004-2005	D.O. TURBIDITY		ENT.		TRUE COLOR
HOLDENVILLE	HUGHES	520800	2006-2007	D.O. pH	CHLOR-A			
HOMINY MUNICIPAL	OSAGE	121300	2006-2007	D.O.				
HUDSON	OSAGE		2005-2006	D.O.				
HUDSON	MAYES	121600	2006-2007					
HUGO	CHOCTAW	410300	2004-2005	TURBIDITY				TRUE COLOR
HULAH	OSAGE	121400	2004-2005	TURBIDITY				NLW
HUMPHREYS	STEPHENS	310810	2006-2007	D.O.	CHLOR-A			
JEAN NEUSTADT	CARTER	310800	2006-2007	D.O.				
JOHN WELLS	HASKELL	220200	2005-2006					
KAW	OSAGE	621210	2004-2005	TURBIDITY D.O.				
KEYSTONE	TULSA	621200 620900	2005-2006	TURBIDITY			SULFATES & CHLORIDES	
KONAWA	SEMINOLE		2004-2005					
LANGSTON	LOGAN	620900	2003-2004					
LAWTONKA	COMANCHE	311300	2006-2007	D.O.	CHLOR-A			
LIBERTY	LOGAN	620910	2005-2006	TURBIDITY	CHLOR-A			
LLOYD CHURCH	LATIMER	220100	2005-2006	D.O. pH				TRUE COLOR
LONE CHIMNEY	PAWNEE	621200	2003-2004					
LUGERT-ALTUS	GREER	311500 311510	2004-2005	TURBIDITY				
MAYSVILLE/WILEY POST	MCCLAIN		2004-2005	TURBIDITY				TRUE COLOR
MCALESTER	PITTSBURG	220600	2004-2005					TRUE COLOR
MCGEE CREEK	ATOKA	410400	2006-2007	D.O. pH				
MCMURTRY	NOBLE	620900	2004-2005	TURBIDITY				
MEEKER	LINCOLN	520700	2005-2006	TURBIDITY				
MURRAY	LOVE	311100	2005-2006	D.O.				
NANIH WAIYA	PUSHMATAHA		2004-2005					
NEW SPIRO◘	LEFLORE	220100	2005-2006	pH	CHLOR-A			NLW

LAKE NAME	COUNTY	W.Q. SEGMENT #	LAST YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
OKEMAH	OKFUSKEE	520700	2006-2007	D.O. TURBIDITY		ENT		TRUE COLOR
OKMULGEE	OKMULGEE	520700	2006-2007	D.O.				TRUE COLOR
OOLOGAH	ROGERS	121510	2004-2005	TURBIDITY D.O.				
OVERHOLSER ◘	OKLAHOMA	520520 520530	2005-2006	TURBIDITY				NLW TRUE COLOR
OZZIE COBB	PUSHMATAHA	410300	2004-2005	pH				NLW
PAULS VALLEY CITY	GARVIN	310810	2004-2005	TURBIDITY				TRUE COLOR
PAWHUSKA	OSAGE	121600	2004-2005					
PAWNEE	PAWNEE	621200	2006-2007		CHLOR-A			
PERRY	NOBLE	621200	2006-2007	TURBIDITY				TRUE COLOR
PINE CREEK	MCCURTAIN	410210	2003-2004	D.O. TURBIDITY pH				
PONCA	KAY	621200	2004-2005	D.O.	CHLOR-A			
PRAGUE CITY	LINCOLN	520510	2004-2005					
PURCELL	MCCLAIN	520610	2004-2005	TURBIDITY				
RAYMOND GARY	CHOCTAW	410300	2004-2005	D.O. TURBIDITY				TRUE COLOR
R.C. LONGMIRE	GARVIN	310810	2004-2005	D.O.				
ROBERT S. KERR	SEQUOYAH	220200	2004-2005	TURBIDITY				
ROCK CREEK	CARTER	310800	2006-2007	D.O.				
ROCKY (HOBART) ◘	WASHITA	311500	2006-2007	TURBIDITY				NLW
SAHOMA	CREEK	120420	2005-2006	D.O.				
SARDIS	PUSHMATAHA	410310	2004-2005	D.O. TURBIDITY				TRUE COLOR
SHAWNEE TWIN # 1	POTTAWATOMIE	520510	2005-2006	D.O.				
SHAWNEE TWIN # 2	POTTAWATOMIE	520510	2003-2004					
SHELL	OSAGE	120420	2005-2006	D.O.				
SKIATOOK	OSAGE	121300	2006-2007	D.O.				TRUE COLOR
SOONER	PAWNEE		2006-2007	D.O.			CHLORIDES SULFATES TDS	
SPAVINAW ●	MAYES	121600	2006-2007	D.O.	CHLOR-A			NLW
SPORTSMAN	SEMINOLE	520500	2004-2005	TURBIDITY				TRUE COLOR
STANLEY DRAPER	CLEVELAND		2005-2006	D.O.				
STILWELL CITY	ADAIR	220200	2005-2006	D.O.				
STROUD	CREEK	520700	2005-2006	D.O.			SULFATES & CHLORIDES	
TALAWANDA # 1	PITTSBURG	220600	2004-2005	D.O. pH				

LAKE NAME	COUNTY	W.Q. SEGMENT #	LAST YEAR SAMPLED	FWP	PPWS	PBCR	AG	AES
TALAWANDA # 2	PITTSBURG	220600	2004-2005	pH				
TAYLOR (MARLOW)	GRADY	310840	2004-2005					NLW
TECUMSEH	POTTAWATOMIE	520510	2003-2004					
TENKILLER FERRY◘	SEQUOYAH	121700	2005-2006	D.O.	CHLOR-A			NLW
TEXOMA	BRYAN	311100 310800	2004-2005	D.O. TURBIDITY				TRUE COLOR
THUNDERBIRD◘	CLEVELAND	520810	2006-2007		CHLOR-A			NLW
TOM STEED◘	KIOWA	311500	2006-2007	TURBIDITY	CHLOR-A			
VANDERWORK	WASHITA	310830	2003-2004					NLW
VINCENT, LLOYD	ELLIS	720500	2004-2005	D.O.				
W.R. HOLWAY	MAYES		2006-2007	D.O.				
WAURIKA	JEFFERSON	311210	2004-2005	TURBIDITY	CHLOR-A			
WAXHOMA	OSAGE		2005-2006	D.O.				
WAYNE WALLACE	LATIMER	220100	2004-2005					
WEBBERS FALLS	MUSKOGEE	121400	2005-2006					
WES WATKINS	POTTAWATOMIE	520510	2005-2006					
WETUMKA	HUGHES		2006-2007	D.O.				TRUE COLOR
WEWOKA	SEMINOLE	520500	2006-2007	Turbidity D.O.				TRUE COLOR
WISTER♣	LEFLORE	220100	2004-2005	D.O. TURBIDITY	CHLOR-A			NLW TRUE COLOR
YAHOLA●	TULSA	121300	1998-1999					

† Lake Listed Based Upon 1995 U.S. Army Corps. Of Engineers Intensive Study

♣ Lake Listed Based Upon OWRB Phase I Clean Lakes Study

♦ Lake does not fit classic definition of oligotrophy. Inorganic particulates are limiting biological productivity

● Lake was not assessed through the BUMP, but through another OWRB project

◘ These Lakes will be recommended for NLW listing as part of the next WQS revision process

IMPAIRMENT CODES		
NS = NOT SUPPORTING	PS = PARTIALLY SUPPORTING	

ACRONYMS	
NLW = NUTRIENT LIMITED WATER	D.O. = DISSOLVED OXYGEN
ENT. = ENTEROCOCCI BACTERIA	

ASSIGNED WQS BENEFICIAL USES	
FWP = FISH & WILDLIFE PROPAGATION	AES = AESTHETICS
PPWS = PUBLIC & PRIVATE WATER SUPPLY	AG = AGRICULTURE
PBCR = PRIMARY BODY CONTACT RECREATION	