Proposed Wetland Water Quality Standards

Staff Report

Oklahoma Water Resources Board

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Introduction

Water quality standards define the goals for a waterbody and work to safeguard human health and aquatic life by establishing provisions to limit pollution to lakes, rivers, and wetlands. The Oklahoma Water Resources Board (OWRB) is the state agency responsible for promulgating water quality standards to ensure water quality protection across the state. Oklahoma has long recognized the importance of wetland waterbodies and in response to legislative direction developed the 1996 Comprehensive Wetlands Conservation Plan, which set the goal to *"… conserve, enhance, and restore the quantity and biological diversity of all wetlands in the state."* This plan was recognized by then Governor Keating, and Oklahoma's sister environmental agencies have continued working together in support of this goal. Wetland water quality standards are a fundamental building block to achieving this goal. Wetland standards will serve to protect and improve the state's wetlands by providing a measure against which to assess condition and plan mitigation and restoration activities. Wetland water quality standards will also provide a transparent and consistent foundation for future development of other wetland related policies and technical procedures.

This staff report provides an overview of wetland science, which is the foundation for the wetland water quality standards, highlights current statewide wetland projects, and presents the proposed wetland water quality standards.

Overview of Wetland Science

Wetlands are the link between terrestrial and aquatic environments; they are transition areas characterized by unique hydrology, soils, vegetation and rich biodiversity. Wetland systems can differ greatly because of regional and local differences in soils, topography, climate, hydrology, vegetation, water chemistry, and other factors. However, all wetlands have three interconnected components that compose the foundation of wetland ecosystems and distinguish wetlands as not fully terrestrial and not fully aquatic environments (Figure 1) (Mitsch and Gosselink, 2007). The discussion below presents an overview of wetland hydrology, physiochemical environment, and biota.

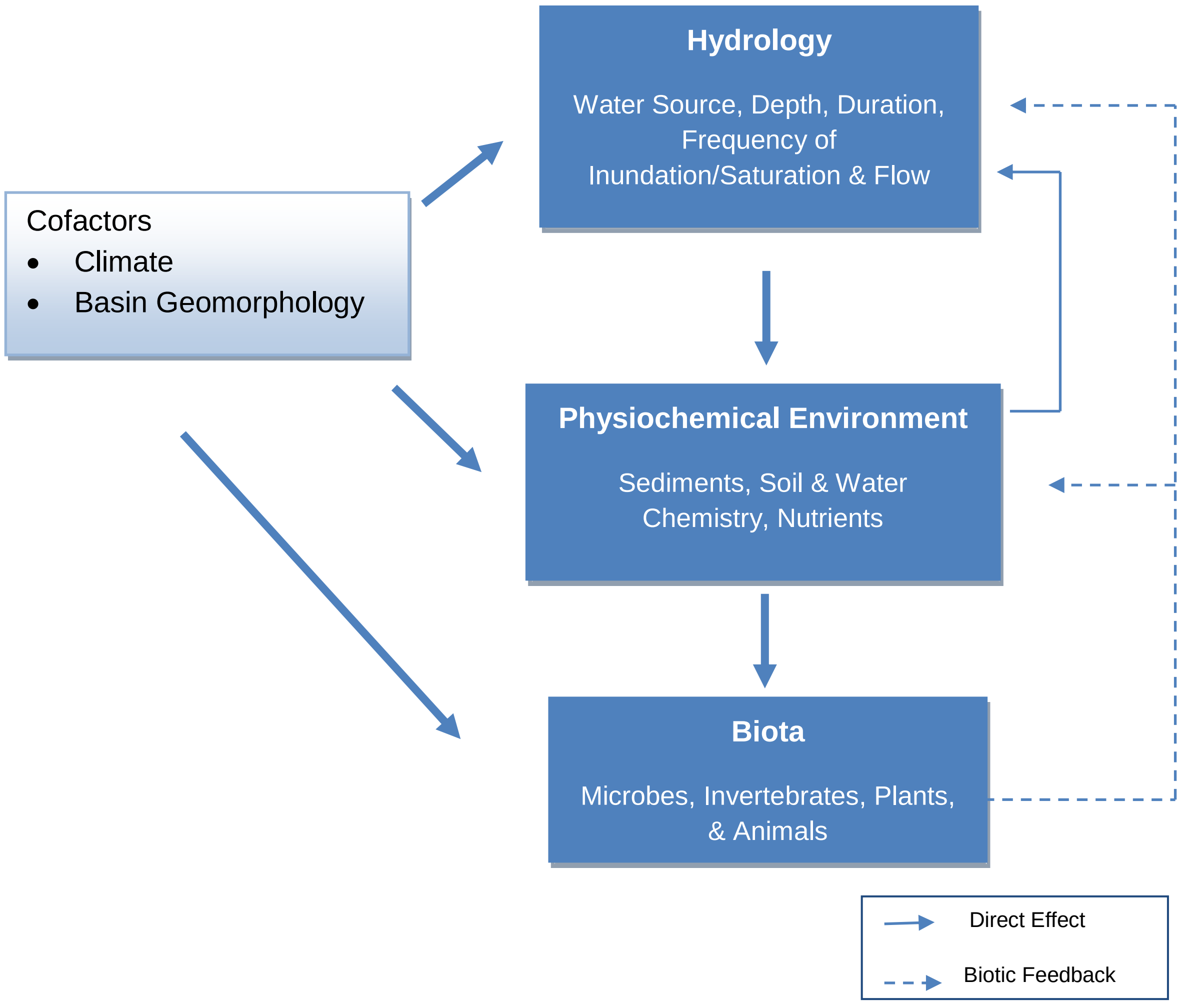

Figure 1 Conceptual diagram of wetland components

Wetland Hydrology

The hydrology of a wetland forms the distinct physiochemical environment and a markedly different ecosystem from both terrestrial and deepwater aquatic habitats. In fact, hydrology is the single most important factor in the establishment and maintenance of various wetland types and wetland processes (Mitsch and Gosselink, 2007). Key elements of wetland hydrology include: water source, hydroperiod (depth, duration, and frequency of inundation/soil saturation), and hydrodynamics (direction and velocity of water flow).

Generally, there are three water sources for wetlands in Oklahoma 1) precipitation, 2) surface flow, and 3) groundwater and the relative importance of the water source is different for different wetland types. For example, while precipitation is an important water source for all wetland types it is particularly important for playa lakes.   Playa lakes, found throughout the High Plains Ecoregion, are ephemeral wetlands that fill with water after spring rainstorms (USEPA, 2013). A playa lake wetland's ability to store seasonal precipitation is essential in an ecoregion that receives little rainfall and often lacks permanent rivers or streams. Wetlands also receive surface water flow from several sources including overland flow, stream flow, and seasonal or episodic flood flows (USGS, 1999). Riparian wetlands located in floodplains adjacent to rivers and streams are heavily influenced by flooding events in the basin. Groundwater recharge and discharge also plays a role in wetland hydrology. Depending on landscape position and soil permeability wetlands can work to recharge groundwater levels or discharge groundwater to streams helping to maintain base flow and mitigate flooding (Wright, 2006, USGS, 1999).

Hydroperiod is the pattern of a wetland's water level and duration and frequency of inundation. Different types of wetlands are characterized by different hydroperiods. For example, coastal wetlands can exhibit daily fluctuations associated with tidal influence, whereas inland wetlands reflect the effects of seasonal events such as spring rains and intermittent storm events (USDA Forest Service, 1995). The graph below presents an example wetland hydrograph for an inland wetland.

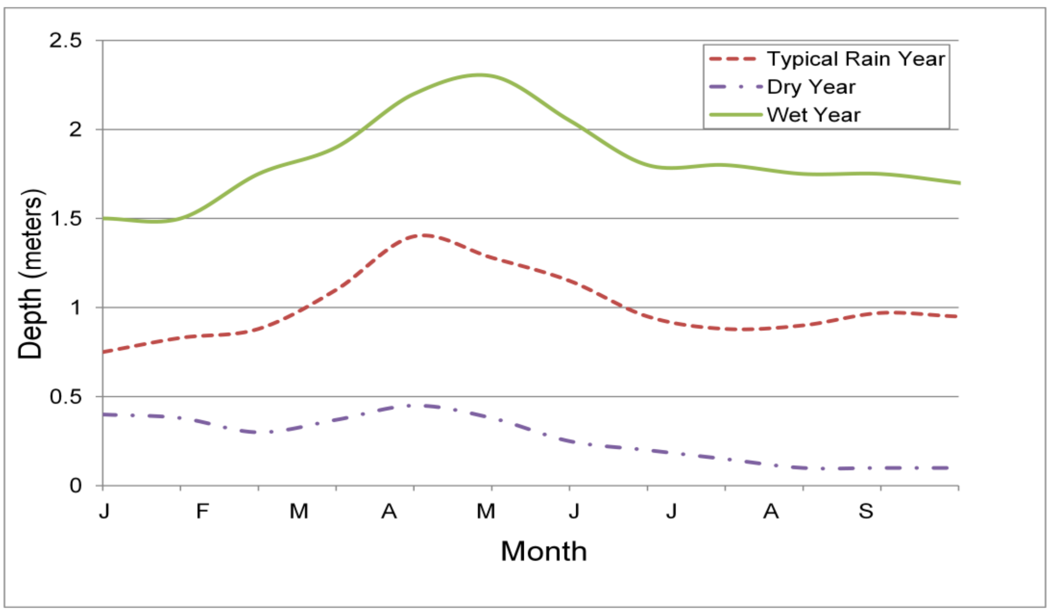

Figure 2 Example wetland hydrograph

The hydroperiod for a wetland is not the same each year; the hydroperiod will vary in association with climate and other conditions (Mitsch and Gosselink, 2007). In fact, the water level in most wetlands is generally not stable and fluctuates considerably due to a myriad of factors including, water inflow and outflow, landscape position, geology, soils, and vegetation (USDA Forest Service, 1995). The graphs below present measured water depths at two different oxbow lake wetlands in Oklahoma; these waterbodies were monitored as part of the OWRB Oxbow System Assessment and Protocol Development project (Figure 3 & 4). An oxbow is a U shaped waterbody that is formed when a meander from the main stem of a river is cut off and a new waterbody is formed (OWRB, 2010). Oxbow 273, located in Pottawatomie County, had a relatively stable hydroperiod between September 2010 and May 2012; whereas, oxbow 413, located in Osage County, experienced dramatic depth fluctuations during the same time period.

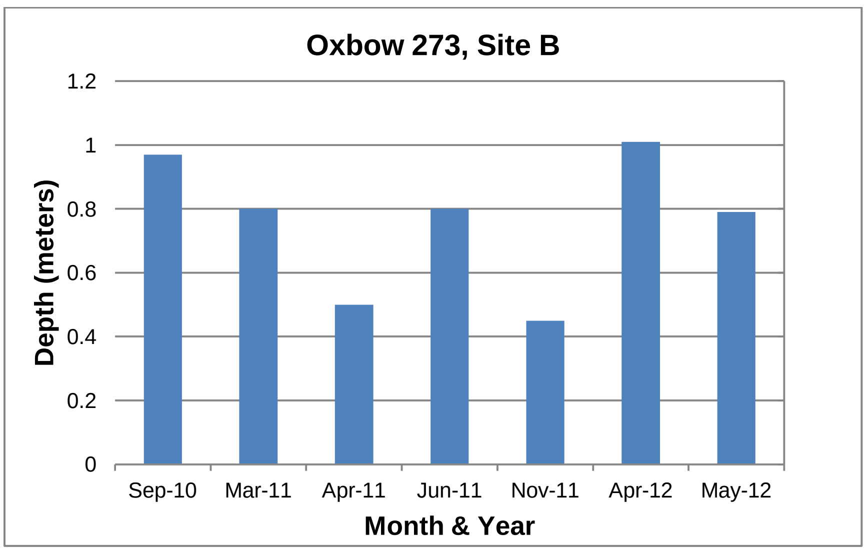

Figure 3 Depth measurements at oxbow 273

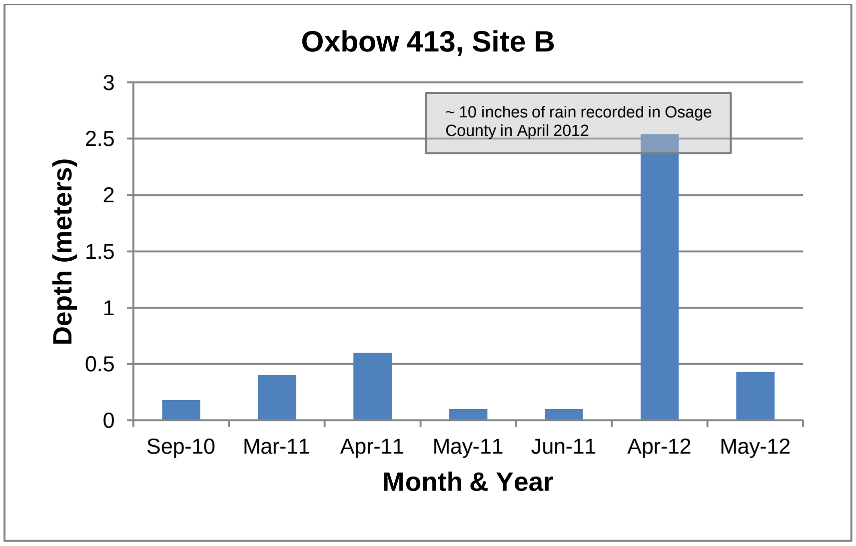

Figure 4 Depth measurements at oxbow 413

Figure 5 Oxbow 413, dry conditions (August 2011)

Figure 6. Oxbow 413, wet conditions (March 2011)

The photos above show oxbow 413 under dry and wet conditions (Figure 5 & 6).

Wetland hydrodynamics can be thought of as the water's ability to do physical work, that is to transport sediment, flush sediment pore water, and fluctuate vertically (Brinson, 1993). Wetland hydrodynamics are particularly important in the exchange of material between the wetland and adjacent terrestrial and aquatic ecosystem (USEPA, 2008). The pathway for hydrologic flows from wetlands to other waterbodies may be unidirectional or bidirectional. Unidirectional flows occur from an up gradient wetland area to a down gradient waterbody. Bidirectional flows occur between wetlands and adjacent waterbodies in the same floodplain; that is the wetland and the other waterbody are connected via the lateral movement of water. Additionally, wetland hydrologic flows may include vertical or horizontal groundwater flows. The ability of a wetland to act as a source, sink, and transformer of material is related to the wetland's hydrodynamics. For example, wetlands intercept sediment, inorganic and organic material from adjacent systems as water passes through them and subjects these materials to biological and or chemical processes (USGS, 1999). Thus, the quality of water leaving a wetland is often markedly different than the quality of water entering the wetland.

Wetland Physiochemical Environment

The physiochemical environment includes both chemical and physical properties[1] which influence other wetland components (Figure 1). There is a strong relationship between wetland soil chemistry and wetland biota because microbial processes mediate the chemical reactions.

[1] Examples of chemical properties include oxygen availability and related chemistry, nutrient availability, and pH. Examples of physical properties include soils, sediment transport, and sediment accumulation.

It is beyond the scope of this document to present the details of wetland biogeochemistry; however, it is noted that many distinguishing wetland soil characteristics are the result of microbial processes and oxidation reduction reactions. The section below describes wetland soils and key characteristics.

Wetland soils

Wetland soils are described as hydric soils and are defined as a "*soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part"* (NRCS, 2010). There are two types of wetland soils 1) organic soils and 2) mineral soils and each soil type has different features. Organic soils develop under conditions of prolonged (nearly continuous) saturation and/or inundation and generally have low bulk density, high water holding capacity, and low nutrient content (US ACOE, 1987, USEPA, 2008c). Almost all organic soils are hydric soils and are commonly referred to as peat or muck and are composed of decaying plant material (Mitsch and Gosselink, 2007, US ACOE, 1987). Hydric mineral soils have greater amounts of sand, silt, and clay and are often noted to develop distinguishing characteristics as a result of extend periods of inundation and/or saturation. There are several indicators to determine if a given soil is in fact a hydric soil; three indicators related to color are described below.

Gleyed Soils

Soils that are saturated for a long time will develop reducing conditions and elements such as iron (Fe) and manganese (Mn) are converted from oxidized forms (Fe^{3+} and Mn^{3+} or Mn^{4+}) to reduced forms (Fe^{2+} and Mn^{2+}) (Mitsch and Gosselink, 2007). This change in the oxidation state can be observed by the development of black, gray, or blue-gray soil color. Under non-saturated conditions iron and manganese oxides give soils typical colors such as, red, brown, black, or yellow; however, when these elements become reduced they also become soluble and are leached out of the soil leaving behind the natural color (black or gray) of the soil parent material.

Oxidized Root Channels

Many wetland plants have the ability to transport oxygen from above-ground stems and leaves to below-ground roots and oxygen that is not utilized by the plant will diffuse into narrow soil channels surrounding the roots (Mitsch and Gosselink, 2007). This limited amount of oxygen creates narrow areas where iron in the soil will become oxidized. These oxidized channels can be observed as thin reddish traces through an otherwise dark soil matrix.

Mottles

Wetlands that are subjected to seasonal flooding or various wet dry cycles may develop mottles. Mottles are defined as spots of contrasting color (US ACOE, 1987). Mottles can be observed as orange/reddish-brown (due to iron) or dark reddish-brown/black (due to manganese) spots throughout a gray soil matrix suggesting intermittently oxic conditions in a typically reduced environment (Mitsch and Gosselink, 2007).

Problematic Hydric Soils

The Army Corps of Engineers (ACOE) wetland delineation manuals describe *problematic* hydric soils this term identifies soils that are hydric soils even though they do not exhibit given indicators. A problematic hydric soils situation applicable to Oklahoma is the existence of red parent material. Soils are formed from their parent material and if the parent material itself is marked by a red color it will mask the key hydric soil color changes due to iron and/or manganese oxidation reduction reactions (US ACOE, 2010). Other problematic hydric soils can be those that are alkaline in nature. Alkaline conditions retard iron and manganese from entering into solution and thus soils can retain their original colors. In the Great Plains region it is commonly the salt content of the soil creating the alkaline conditions (US ACOE, 2010).

The identification of a problematic hydric soil requires additional supporting information such as, waterbody landscape position and hydrology. The ACOE wetland delineation manuals include specific procedures for problematic hydric soils.

Wetland Biota

Hydrophytic Vegetation

Hydrophytic or *water loving* vegetation are those wetland plants that have adapted to growing in the stressful, low oxygen, or anoxic conditions associated with prolonged saturation or flooding. For example, a key structural adaption in vascular plants is the development of air space (aerenchyma) in stems and roots. These air spaces allow oxygen to diffuse from the parts of the plant exposed to oxygen to the roots and thereby meet the roots respiratory demands even though they are in an anoxic environment (Mitsch and Gosselink, 2007). In fact, up to 60 % of the volume of the roots of wetland plants may consist of air spaces (Mitsch and Gosselink, 2007). In addition to morphological adaptations, hydrophytic vascular plants have also developed complex physiological adaptations. Physiological adaptations can include pressurized gas flow, decreased water uptake, altered nutrient adsorption, sulfide avoidance, and anaerobic respiration (Mitsch and Gosselink, 2007).

Plant species vary in their tolerance of wetland conditions. The following are indicator categories used to designate a plant's preference to occur in a wetland or upland area (Table 1). These indicator categories are part of the 2012 National Wetland Plant List developed by U.S. Army Corps of Engineers, Fish and Wildlife Service, Natural Resource Conservation Service (NRCS), and EPA. (National Wetland Plant List, 2012).

Table 1 Indicator categories identifying plant preference to occur in a wetland

Indicator Status	Designation	Comment
Obligate Wetland	Hydrophyte	Almost always occur in wetlands
Facultative Wetland	Hydrophyte	Usually occur in wetlands, but may occur in non-wetland
Facultative	Hydrophyte	Occur in wetlands and non-wetlands
Facultative Upland	Nonhydrophyte	Usually occur in non-wetlands, but may occur in wetlands
Obligate Upland	Nonhydrophyte	Almost never occur in wetlands

Factors other than site wetness will affect the overall plant community development including, regional climate, local weather, topography, soils, nutrients, and current or historical plant distribution (US ACOE, 1987). Thus, the range and wetland association of hydrophytic plants can vary with region. The National Wetland Plant List defines regional areas and plants may transition between indicator statuses depending on the region (National Wetland Plant List, 2012). For example, black willow is identified as a facultative wetland species for the Great Plains Region and an obligate wetland species in the Eastern Mountains and Piedmont Region. Conversely, the broadleaf cattail is identified as an obligate wetland species throughout the United States (USDA NRCS n.d.).

Wetland Wildlife

Wetlands provide essential habitat and food for numerous wildlife species including birds, mammals, reptiles, amphibians, and fish. A diverse assemblage of terrestrial, aquatic, and benthic invertebrates affect decomposition, nutrient cycling, and primary production in wetlands, along with their role in several different species' food webs. Wetlands are preferred habitats for so many different animals because they have complex food chains that support numerous species and the dense vegetation provides good nesting conditions and protection from predators. Fish and wildlife use wetlands habitats differently depending on the species. Some species rely on wetlands for their entire lives or for critical breeding periods; these species are characterized as wetland dependent. Other species utilize wetlands temporarily or intermittently, generally for feeding (USEPA, 2008c). For example, wetlands provide permanent habitat for wood ducks and beaver and are feeding areas for raccoons and white-tailed deer (OK Department of Wildlife Conservation n.d., NRCS, 2001).

Wetlands are important habitats for birds; birds rely upon them for feeding, resting, nesting, breeding, and rearing young. About one-third of North American bird species rely on wetlands for food, shelter, and breeding (USGS, 1999). The Mid-winter Waterfowl Survey, which is conducted jointly between the U.S. Fish and Wildlife Service and state partners, including the Oklahoma Department of Wildlife Conservation, is a nationwide effort to survey waterfowl in areas of major concentration on their wintering grounds. The survey is the primary source of data for population trends[2] on migrating waterfowl species on wintering grounds. Oklahoma is part of the Central Flyway and the Oklahoma Department of Wildlife Conservation reported a minimum 400,000 and a maximum 786,000 waterfowl wintering on Oklahoma waterbodies between 2000 and 2012 (Figure 7).

[2] Information collected is an index of abundance and provides population trend information not an estimate of population size.

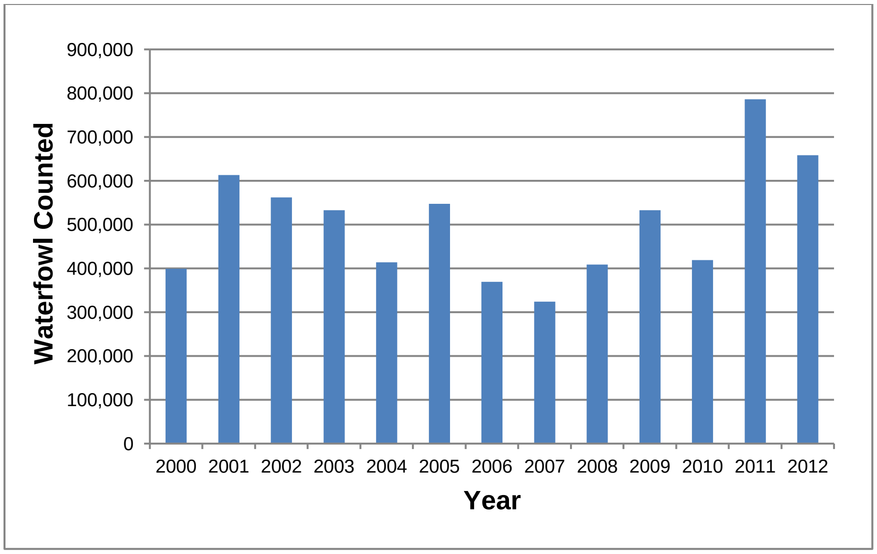

Figure 7 Oklahoma mid-winter waterfowl survey 2000 - 2012

Amphibians are very closely associated with water and wetlands. Most frogs and toads and many salamanders lay their eggs in water or moist soil, have an aquatic larvae stage, and some then inhabit nearby upland habitats as adults (Solomon et al, 1996). Among amphibians breeding in wetland habitats different species select different wetland types based on hydrologic characteristics (i.e. hydroperiod, current velocity etc…). For example, some salamander species and small frogs prefer to breed in the standing water of temporary ponds whereas, bull frogs select permanent ponds (USEPA, 2002). Wetlands can also serve as habitat for reptiles that are able swimmers including, turtles, water snakes, and alligators (USEPA, n.d.).

Wetlands also provide food, shelter, and nursery areas for freshwater fish species. Fish are often found in lacustrine fringe wetlands, which are adjacent to lakes and where the wetland water level is maintained by the lake elevation (UA ACOE, 2008). An evaluation of lacustrine wetland habitat can be made using the U.S. Fish and Wildlife Service Habitat Evaluation Procedures (HEP) (1980). HEP is a method to document the quality and quantity of habitats for various wildlife, including fish. The HEP method and model results represent the capacity of a particular habitat to support a target species. OWRB staff applied the HEP method at Ft. Cobb Lake to evaluate the impact of improved lacustrine wetland vegetation on game fish species known to be present in the lake. The HEP model showed that increased lacustrine wetland vegetation improved the habitat suitability for all fish species (black crappie, blue gill, largemouth bass, channel catfish, and walleye) modeled (OWRB, 2013). The impact of increased vegetation was greatest for blue gill, largemouth bass, and crappie, which were the most reliant on vegetative cover for habitat (OWRB, 2013). Additionally, OWRB conducted a fish survey as part of a project that established floating wetlands at Eucha Lake; thirteen of the seventeen species know to occur in the lake were collected from around and under the floating wetlands (OWRB Eucha Lake final Report). Overall, largemouth bass and blue gill dominated the collection and the wetland area had a high recruitment for young-of-the-year fish (OWRB, 2013b).

Wetland Classification

Due to the diversity of wetland waterbody types, classification schemes have been developed to group similar types together for both research and management purposes. Two important wetland classification systems that have been used nationwide include the *Classification of Wetlands and Deepwater Habitats* developed by the U.S. Fish and Wildlife service and the *Hydrogeomorphic (HGM) Wetland Classification* system developed by the Army Corps of Engineers. These classification systems are summarized below.

Classification of Wetlands and Deepwater Habitats

The U.S. Fish and Wildlife Service published the *Classification of Wetlands and Deepwater Habitats of the United States* in 1979; the primary author of this document was Lewis Cowardin and often this classification approach is referred to as the Cowardin system. In the Cowardin system, wetlands are classified according to plants, soils, and frequency of flooding. This classification system has become the standard system for the Fish and Wildlife Service and is the basis for the National Wetland Inventory (NWI) monitoring and mapping efforts. The NWI maps for Oklahoma are available on the OWRB website (see references for link). The Cowardin system identifies five major types of wetland systems 1) marine, 2) estuarine, 3) riverine, 4) lacustrine, and 5) palustrine. The wetland systems are further defined and described by an additional ten subsystems and various classes. (Cowardin et al. 1979).

Hydrogeomorphic Classification for Wetlands

The HGM system was developed for the ACOE in order to support their responsibilities under Section 404 of the Clean Water Act and evaluate wetland function. The HGM approach classifies wetlands based on geomorphic setting (i.e. location of the wetland in the landscape), water source, and hydrodynamics. (Brinson, 1993). The HGM approach groups wetlands into seven different classes (Table 2) and each class may have a number of subclasses. The HGM approach also addresses regional wetland classification through the use of Regional Guidebooks. Currently, the HGM approach is being used to classify wetlands in Oklahoma.

Table 2 HGM wetland class and corresponding descriptive information

Wetland Class	Geomorphic Setting	Dominant Water Source	Dominant Hydrodynamics
Depressional	Depressional wetlands occur in areas of topographic depression that allow for the accumulation of surface water.	surface water runoff and return flow from groundwater	Vertical
Riverine	Riverine wetlands occur in floodplains and riparian corridors in association with stream channels	Overbank flow from river channel	Bidirectional and horizontal
Mineral Flats	Mineral soil flats are most common on interfluves, extensive relic lake bottoms, or large floodplain terrace where the dominate source of water is precipitation.	Precipitation	Vertical
Organic Flats	Organic soil flats also commonly occur on interfluves, but their elevation and topography are controlled by the accretion of organic matter. They may also occur where depressional areas of filled with peat and become flat.	Precipitation	Vertical
Lacustrine Fringe	Lacustrine fringe wetland are adjacent to lakes and the lake level maintains the wetland water table	Overbank flow from lake	Bidirectional and horizontal
Slopes	Slope wetlands are found in association with the discharge of groundwater to the land surface or areas with overflow and no cut channel. They normally occur of sloping land; the slope can be slight or steep.	Return flow from groundwater	Unidirectional and horizontal
Tidal Fringe	Tidal fringe wetlands occur along coastal areas and are subject to the influence of sea level.	Overbank flow from estuary	Bidirectional and horizontal
Information adapted from ACOE website Hydrogeomorphic Approach for Assessing Wetland Functions			

Wetland Functions

Wetlands inherently provide a variety of functions within a watershed and these functions are closely tied to the interconnected components - hydrology, physiochemical, and biota - discussed above. Wetland functions can be lumped into three groups 1) habitat, 2) hydrology, and 3) water quality. Wetlands may be best known for their habitat functions, which benefit aquatic, terrestrial, and avian species. In fact, more than one-third of US threatened and endangered species are wetland dependant and nearly one-half use wetlands at some point in their lives (USEPA, 2012). In addition to habitat services described in the Wetland Wildlife Section above, wetlands are often key habitats for migratory animals and provide wildlife corridors (Wright, 2006).

Additionally, wetlands provide the functions of flood protection and erosion reduction. Wetlands are able to capture and then slowly release floodwaters thereby reducing peak flood flows and preventing damaging downstream floods (USGS, 1999). A portion of the floodwaters detained in the wetland may serve to recharge groundwater or return slowly to the river channel and contribute to maintaining base flow after the flood event (ACOE, 2010b). Particularly in urban areas, wetlands can counteract the increased runoff from impervious surfaces (USEPA Region 5, 2013). At the same time that wetlands are reducing peak flood flows their plants and roots are holding soils in place and absorbing energy, which slows currents, reduces erosion, and increases sediment deposition.

Wetlands also work to assimilate or transform pollutants by acting as natural filters, which results in the discharge of higher quality water downstream. In particular, wetlands have the ability to transform nutrients between organic and inorganic forms through biogeochemical processes and transfer nutrients between ecosystem components (ACOE 2010b). The basic example is inorganic nutrients in the soil support the wetland plant community which in turn provides habitat for the animal community. Wetlands also help improve water quality by addressing other pollutants such as suspended solids, metals, and pathogens (NCSU n.d.).

Oklahoma Wetland Programs

Wetland Program Plan

The Oklahoma Conservation Commission (OCC) is Oklahoma's lead agency for wetland planning and in 1996, as directed by the legislature, published *Oklahoma's Comprehensive Wetlands Conservation Plan*. The *Comprehensive Wetlands Conservation Plan* provided the state with a focused strategy for wetland conservation and management and recognized that there are shared responsibilities between local, state, and federal agencies as well as individual landowners and environmental organizations. The plan identifies that Oklahoma's goal for a comprehensive wetland strategy is "*to conserve, enhance, and restore the quantity and biological diversity of all wetlands in the state."*

OCC has updated the wetland plan since 1996; the current document is the 2013 - 2018 Wetland Program Plan. This plan was prepared by both OCC and the Oklahoma Wetlands Technical Work Group and reflects input from a variety of stakeholders who participate in the Wetland Work Group. This plan updated the original objectives presented in the 1996 *Comprehensive Wetlands Conservation Plan* and is organized around five core elements 1) Monitoring and Assessment, 2) Regulation, 3) Voluntary Restoration and Protection, 4) Water Quality Standards, 5) Education and Outreach. The plan presents an objective and specific activities for each core element, which are designed to advance the overall program. The Wetland Program Plan serves as an umbrella document to coordinate wetland activities and programs within the state. The section below highlights various wetland projects.

Wetland Monitoring, Assessment, & Restoration

Wetlands Status & Trends Reports & National Wetland Condition Assessment

Historically, wetland areas were not a desirable or valuable landuse and their important ecological and hydrologic functions where largely unrecognized. As a result, millions of acres of wetlands in the United States were drained, filled, and converted to other landuses. In 1986 Congress enacted the *Emergency Wetlands Resources Act,* which recognized that wetlands are a nationally important resources and that wetland resources have been affected by human activities. Additionally, Congress directed the U.S. Fish and Wildlife Service to document the historical loss of wetlands in the United States and report on wetland status and trends at 10-year intervals. Oklahoma is reported to have lost about 67% or 1.9 million acres of historic wetland areas (Dahl, 1990). However, the most recent Wetland Status and Trends Report estimated a small nationwide net gain in freshwater wetland area. The slight acreage increase was largely driven by the increase in freshwater ponds; while, other wetland types such as, forested wetlands decreased (Dahl, 2011). Oklahoma is reported to have added hundreds of freshwater ponds between 2004 and 2009 (Dahl, 2011).

The National Wetland Inventory and Status and Trends Reports, prepared by the Fish and Wildlife Service, provide reliable information on the acreage extent of wetlands; however, these reports do not provide any information on wetland quality or condition. Therefore, EPA in collaboration with Fish and Wildlife Service and other state and federal partners initiated the first-ever National Wetland Condition Assessment (NWCA) in 2011. The NWCA sampling design is a probability-based network that will provide statistically valid estimates of wetland ecological condition (EPA, 2013b). The Oklahoma Conservation Commission participated in the NWCA on behalf of the state of Oklahoma.

Conservation Commission staff conducted field monitoring and sampling at twelve sites with two sites revisited for quality assurance purposes during the summer of 2011. General assessments included vegetation, buffer characteristics, and soil profiles on all sites. Additionally, soil samples, soil isotopes, soil enzymes, and vegetation quality assurance samples were collected on all twelve and both revisit sites as well. Presumably due to drought conditions, surface water was not present at eleven sites and samples of water, algae identification, and algal toxicity were only collected at one site. All samples were collected, handled, and shipped to the designated laboratory for analysis in accordance with the NWCA Field Operations Manual (OCC staff memo, 2013). Currently, multiple laboratories are analyzing the thousands of samples collected nationwide during the NWCA field season. This data will be evaluated and summarized to report on the condition of various wetland types and report on wetland condition within ecoregions (EPA, 2013b). EPA expects draft reports to be available for review in 2014 (EPA, personal communication).

Oxbow System Assessment and Protocol Development

Oxbows are unique waterbodies that have attributes of both lakes and wetlands. An oxbow is a U shaped waterbody that is formed when a meander from the main stem of a river is cut off and a new waterbody is formed (OWRB, 2010). In order to learn more about Oklahoma's oxbows and address the dearth of oxbow data, OWRB, Oklahoma Conservation Commission, and Oklahoma State University (OSU) began working together to assess oxbows under a three phase study (OWRB, 2010). Phase I of the study created an inventory of oxbow systems in Oklahoma and using landscape level assessment identified oxbows to be monitored and assessed as part of Phase II.

The oxbow study Phase II focused on the collection of necessary data for intensive oxbow site assessments and included the application/evaluation of several different assessment protocols. Currently, the OWRB Beneficial Use Monitoring Program (BUMP) monitors lakes and rivers across the state and employs the Use Support Assessment Protocols (USAP) (OAC 785:46-15-1-14) to determine beneficial use attainment or nonattainment. The USAPs were designed for lakes and rivers; their applicability to oxbows, which can display characteristics reflective of both lakes and wetlands, is unknown. Thus, a key question for the Phase II and III portion of the study was to evaluate the applicability of current USAPs for oxbows. Results to date indicate that under the USAPs no oxbow was found to be attaining all beneficial uses; however, data also indicate that it is likely that this is due to the fact that oxbow condition may be more correctly assessed in the context of a wetland waterbody type as opposed to a lake waterbody type (OWRB, 2013c). Phase III of the study will further analyze data and provide recommendations on protocols to assess oxbow systems as well as other wetland waterbody types. Additionally, Phase III will report on the overall condition of oxbows statewide and present assessment methods for additional wetland types.

Development of Reference Condition Candidate Pool for Oklahoma Oxbow Wetlands

Lakes and Special Studies staff of the OWRB are conducting a research project to determine reference condition for Oklahoma oxbow wetlands. The objective of this project is to identify and characterize a set of candidate oxbows best suited to represent reference condition. This study will encompass oxbows statewide subdivided by ecoregions. Oxbow reference candidates will be ranked and selected by the absence, or minimal presence, of landscape scale stressors with 90 oxbows being selected as potential candidates for characterizing oxbow reference condition. The 90 candidate oxbows will be further investigated with field sampling. Field investigations will include condition assessment methods, vegetation surveys, and water quality sampling for nutrients, metals, and ambient sediment toxicity. Establishing reference condition not only for oxbows, but all of Oklahoma's wetland waterbodies is critical because it provides an objective basis for evaluating wetland condition and setting ecological expectations.

Development of Wetland Rapid Assessment Methods

The development of a wetland rapid assessment method for Oklahoma is identified as a state priority in the Wetland Program Plan and is currently underway. The wetland rapid assessment method is being cooperatively developed with related projects conducted by the Oklahoma Conservation Commission, OWRB, and OSU. The purpose of a wetland rapid assessment method is to establish a scientifically defensible and repeatable assessment method that can be used to monitor and evaluate the condition of wetlands across Oklahoma.

Wetland Classification

The Oklahoma Conservation Commission and OSU are working collaboratively to apply the HGM wetland classification approach and functional assessment to wetlands in Oklahoma. This work is focused on developing HGM subclassifications for Oklahoma wetlands and is being conducted on a regional basis. This work will support other research projects and the development of wetland assessment methods by grouping wetlands that are expected to have similar functions (Oklahoma Wetlands Program, 2014).

Natural Resource Conservation Service, Wetland Reserve Program

The Natural Resource Conservation Service (NRCS) provides landowners both technical and financial support for wetland restoration efforts through the Wetland Reserve Program (WRP). With few exceptions, most degraded wetland areas are eligible for WRP provided the wetland is restorable and will provide wildlife benefits (NRCS, 2000). Landowners may enter into agreements for permanent easements or 30-year easements. NRCS works to restore overall wetland function and wildlife habitat with every acre enrolled in the program (NRCS, n.d.). In Oklahoma WRP has primarily focused on providing habitat for wildlife and migratory birds; concurrent benefits have been flood water storage, erosion control, and recreation (NRCS, 2000). Since WRP began in 1992, Oklahoma has restored approximately 60,000 wetland acres and continues to enroll degraded acreage and plan restoration (NRCS, personal communication).

Regulatory Programs

Clean Water Act Section 404 Permitting

Section 404 of the Clean Water Act (CWA) establishes a permitting program for the discharge of dredged or fill material into waters of the United States, including wetlands. The ACOE is responsible for day-to-day program administration, including both individual and general permit decisions. The ACOE also conducts or verifies jurisdictional determinations, develops policy/guidance documents, and enforces Section 404 provisions (USEPA, 2013b).

In Oklahoma the ACOE Tulsa District is responsible for 404 Permitting and potential projects are regulated through a permit review process. In general the 404 Permit Program has three key tenets which are incorporated into the permit process; these tenets are 1) avoid impacts to aquatic resources, 2) minimize impacts to aquatic resources, and 3) mitigate for any remaining unavoidable impacts (USEPA, 2004). A permit application must demonstrate that the potential project avoids, minimizes, and mitigates for any impacts to aquatic resources. Those projects with discharges that have potentially significant impacts require an individual permit; individual permit applications are reviewed by the ACOE of in accordance with applicable guidelines. A general permit may be suitable for projects with discharges that will only have minimal adverse effects. General permits are issued by the ACOE on a nationwide, regional, or State basis for a particular category of activities (USEPA, 2004). Activities for which permits may be required include, but are not limited to:

- Placement of fill material.
- Ditching activities when the excavated material is side cast.
- Levee and dike construction.
- Mechanized land clearing.
- Land leveling.
- Most road construction.
- Dam construction.

The ACOE office is responsible for the final determinations of what activities require permits (ACOE, n.d.).

401 Water Quality Certification

In accordance with Section 401 of the Clean Water Act projects to be permitted under Section 404 or other projects, which require federal permits for activities that can result in discharge to any water of the United States, require a Section 401 Water Quality Certification (401 WQC) from the state. The CWA (Section 401(a)(1)) provides states the authority to grant, grant with conditions, deny without prejudice, deny, or waive 401 WQCs. A certification granted with or without conditions, allows the federal permit or license to be issued consistent with certification requirements. Denial of a certification prohibits the federal permit or license from being issued and waiver of a certification allows the federal permit or license to be issued without action by the state (USEPA, 2010).

401 WQCs are issued by the Oklahoma Department of Environmental Quality (ODEQ) for 404 permits and permits issued under Section 10 of the Rivers and Harbors Act by the ACOE and any other federal permits. Because 404 permits may authorize discharges of dredge or fill material into wetland waterbodies the 401 WQC ensures that discharges do not cause unacceptable impacts to wetlands and other aquatic resources (USEPA, 2010). Most 401 WQC are issued with conditions, which ensure that the project will comply with the Oklahoma's Water

Quality Standards (OAC 785:45) and applicable CWA sections. Conditions often include Best Management Practices such as, the use of erosion control measures and fueling and vehicle service activities are conducted at least 100 feet from waterbody.

Proposed Wetland Water Quality Standards

The development of wetland water quality standards is element four in 2013-2018 statewide Wetland Program Plan and the proposed standards presented here were developed consistent with actions outlined in the program plan. The draft wetland water quality standards were developed collaboratively between OWRB staff and the Oklahoma Wetlands Technical Work Group (OWTWG). The OWTWG is composed of state agencies, universities, environmental organizations, local government associations, tribal representatives, and federal agencies. The OWTWG members actively contributing to the development of wetland water quality standards are listed below.

- Oklahoma Conservation Commission
- Oklahoma Department of Environmental Quality
- Oklahoma Corporation Commission
- Oklahoma Department of Agriculture Food and Forestry
- Oklahoma Department of Wildlife Conservation
- Oklahoma Water Resources Board
- Oklahoma State University
- US EPA
- Association of Central Oklahoma Governments
- Indian Nation Council of Government

The Army Corps of Engineers regularly attended OWTWG meetings and provided feedback and information regarding the 404 Permitting Program, as needed.

Additionally, OWRB staff shared information on the development of wetland standards at various organization meetings and solicited input from stakeholders at public meetings of the Oklahoma Wetlands Work Group and the customary informal and formal water quality standards revisions public participation process.

Wetlands are a *water of the state* and are currently protected with the default water quality standards. However, the default standards were developed for lakes and streams and are often not suitable for wetlands; for example, applying the default standards to wetlands can sometimes be overly stringent and erroneously identify healthy wetlands as wetlands in poor condition. Thus, there are both scientific and regulatory challenges with implementing the default standards for wetlands. Moreover, the proposed wetland water quality standards will provide a transparent and consistent foundation for the state's diverse wetland programs

All water quality standards have three components 1) beneficial uses, 2) criteria to protect beneficial uses, and 3) the state's antidegradation policy. The wetland water quality standards will include these three components for wetland waterbodies. Additionally, a definition of wetlands and ecological integrity will be included in the definition section of the Oklahoma Water Quality Standards document. Lastly, necessary implementation provisions will also be incorporated into the standards. The draft regulatory language is presented below and Table 3 presents where the language will be place in Title 785, Chapter 45.

Definitions

Wetland means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Ecological Integrity refers to the ability of an ecosystem to support and maintain natural processes and a diverse community of organisms within the bounds of natural variation.

Beneficial Uses

Wetland Habitat & Biota

Wetland Habitat and Biota includes uses where the water quality, hydrology, and habitat are capable of supporting a wetland-dependent flora and fauna community. Wetland-dependent species may permanently or periodically live in a wetland or utilize a wetland during their life cycle. Species present may shift in accordance with season, hydroperiod, or other abiotic conditions. Typical wetland-dependent species may include, but are not limited to, hydrophytic plants, fish, crustaceans, benthic invertebrates, amphibians, waterfowl, migratory birds, and reptiles.

Flood Protection and Erosion Control

Flood Protection and Erosion Control is the use which addresses the ability of wetlands to collect and temporarily store floodwaters and attenuate peak flow. This results in reduced flooding and minimizes flood damage protecting adjacent and downstream areas. For wetlands along the banks of lakes and rivers, plants and roots serve to stabilize the bank, absorb wave energy, and slow currents thereby reducing erosion and protecting property. Given wetland types may also increase infiltration and groundwater recharge.

Water Quality Enhancement

Water Quality Enhancement is the use which addresses the ability of wetlands to assimilate and or transform pollutants thereby improving water quality in or downstream of the wetland waterbody. The intent of this beneficial use is to recognize the natural capacity of wetlands to remove pollutants. This use does not support natural wetlands being used for the purpose of removing pollutants from a wastewater discharge or knowingly exceeding the assimilative capacity of a natural wetland.

Recreation

Wetlands contiguous with lakes or streams with the beneficial use designation *Primary Body Contact Recreation* are also designated *Primary Body Contact Recreation*.

Wetlands contiguous with lakes or streams with the beneficial use designation *Secondary Contact Recreation* are also designated *Secondary Body Contact Recreation*.

Wetlands not contiguous with lakes or streams with the beneficial use designation *Primary Body Contact Recreation* are designated *Secondary Body Contact Recreation*.

Primary Body Contact Recreation

Direct body contact with the water where a possibility of ingestion exists.

Secondary Body Contact Recreation

Ingestion of water is not anticipated. Associated activities may include boating, fishing, or wading.

Aesthetics

To be aesthetically enjoyable, the surface waters of the state must be free from floating materials and suspended substances that produce objectionable color and turbidity. The water must also be free from noxious odors and tastes, from materials that settle to form objectionable deposits, and discharges that produce undesirable effects or are a nuisance to aquatic life.

Criteria

The following criteria shall be applied to ensure the protection, maintenance or enhancement of wetland waterbodies. Criteria which rely on water in order to be measured are not applicable during periods when surface water is not present.

- The ecological integrity of wetland habitat and biota shall be protected and shall not be altered by human activities beyond what is comparable to that typically present in wetlands of similar type and that also characterizes best attainable ecological condition.

- The hydrology of wetlands, including the extent, duration, and frequency of saturated or ponded conditions shall not be altered by human activities beyond what is comparable to that typically present in wetlands of similar type and that also characterized best attainable hydrologic condition.

- Floating or submerged debris, oil, deleterious substances, or any other material not naturally found in a wetland shall not be present in amounts which may cause adverse impacts on wetland beneficial uses.

- There are many factors that cause natural variation in wetland dissolved oxygen concentrations and pH; however, the dissolved oxygen concentration and pH shall be sufficient to support the Wetland Habitat and Biota beneficial use.

- The daily and seasonal temperature variations that were present before the addition of heat from other than natural sources shall be maintained.

- Wetlands shall not exhibit acute or chronic toxicity.

- Concentrations of substances which are toxic or harmful to human, animal, or plant life shall not be present in amounts which individually or synergistically cause adverse impacts on any wetland beneficial use. Toxic substances shall not be present at levels that will bioaccumulate in wetland-dependent species to levels which are harmful to wetland-dependent species or human health.

    a. Numerical criteria for toxic substances are in Appendix G, Table 2, Columns Acute, Chronic, and Fish Consumption (plus Other Organisms) and Table 3.

    b. For toxicants not presented in Appendix G, Table 2, Columns, Acute, Chronic, and Fish Consumption (plus Other Organisms) and Table 3 other scientifically-defensible methods, the latest scientific information, and or applicable state and or federal policies may be relied upon to determine toxic thresholds.

- Concentrations or loads of suspended or bedded sediments that are caused by human activity shall not impair any wetland beneficial use.

- Primary Body Contact Recreation Criteria

  Criteria are prescribed in 785:45-5-16

- Secondary Body Contact Recreation Criteria

  Criteria are prescribed in 785:45-5-17

- Aesthetics

(a) To be aesthetically enjoyable, the surface waters of the state must be free from floating materials and suspended substances that produce objectionable color and turbidity.

i. Naturally occurring turbidity in wetlands is not considered objectionable.

(b) The water must also be free from noxious odors and tastes, from materials that settle to form objectionable deposits, and discharges that produce undesirable effects or are a nuisance to aquatic life.

ii. Odors associated with naturally occurring conditions in wetlands are not considered noxious odors.

Antidegradation Policy

The existing antidegradation policy (785:45-3) applies to wetland waterbodies.

Implementation Provisions

Regulatory Mixing Zones

Mixing zones in wetlands may be allowed on a case-by-case basis as provided in the sections below.

a) Where dilution is available at critical conditions a mixing zone may be designated. Mixing zones are discretionary and shall be determined on a discharge-by-discharge basis. Additionally, mixing zones may be allowed or denied on a pollutant-by-pollutant basis, which may result in a mixing zone allowance for all, some, or no pollutants in a discharge. The physical, chemical, and biological characteristics of the discharge and receiving wetland shall be considered in determining whether a mixing zone is allowed. In all cases, mixing zones and or dilution allowances shall be limited, as necessary, to protect the integrity of the receiving water ecosystem and waterbody beneficial uses.

b) Before establishing a mixing zone it must first be determined if and how much (if any), receiving water is available to dilute the discharge. Where receiving water for dilution mixing is not available at critical conditions (i.e. surface water is not present in the waterbody) effluent limits shall be based on attaining all applicable water quality criteria at the end-of-pipe and no mixing zone shall be provided. The availability of receiving water for dilution shall be evaluated consistent with waterbody critical season and interannual seasonal variations shall be considered. Additionally, seasonal variations of the effluent shall be accounted for, as appropriate.

Mixing Zone Conditions

c) A mixing zone shall be as small as practicable and overlapping mixing zones in wetlands are prohibited. The following conditions must be met in allowing a mixing zone.

A mixing zone shall <u>not</u>:

- compromise the integrity of the entire waterbody or dominate the receiving waterbody;
- impair any wetland beneficial use;
- cause acutely toxic conditions to aquatic life passing through or residing in the mixing zone;
- interfere with the free movement of fish and or other aquatic life;
- produce floating or submerged debris, oil, or deleterious substances;
- produce objectionable color, odor, taste, or turbidity;
- cause objectionable bottom deposits;
- cause nuisance conditions;
- accumulate pollutants in sediment or biota;
- be allowed for bioaccumulative pollutants;
- be allowed at or near biologically sensitive or biologically important areas (e.g. fish spawning areas or presence of a threatened or endangered species near the outfall or downstream);
- be allowed in situations where an effluent will attract biota
- be allowed at or near any drinking water intake or recreational areas.

Other Considerations

d) Supporting information and assumptions used to establish mixing zones shall be subject to review and revision as information on the nature and impacts of the discharge becomes available. At a minimum, mixing zones are subject to review and revisions along with all aspects of a discharge permit upon permit renewal.

e) Receiving water monitoring at/near the mixing zone boundary shall be conducted, by responsible parties, to document attainment or nonattainment of all applicable water quality criteria and document the impacts (if any) of the mixing zone on the wetland.

f) Mixing zones may be revised or eliminated and outfalls may require relocation, if it is determined that the water quality within the mixing zone adversely affects any existing beneficial uses in the receiving waterbody.

Standards Applicability

- Constructed treatment wetlands.

Constructed treatment wetlands are artificial systems designed and constructed to utilize natural microbial, biological, chemical, and physical processes to treat wastewater and or stormwater in a partially controlled environment. A constructed treatment wetland is part of a treatment train or treatment system for wastewater and or stormwater and water quality criteria do not apply to wastewater and or stormwater contained within the treatment wetland. However, any discharges from a constructed treatment wetland shall meet applicable standards for the downstream receiving waterbody. A treatment wetland shall not be constructed within a water of the state.

- Commercial and Noncommercial Pits

Constructed commercial and noncommercial pits or any other pit used for the handling, storage, or disposal of sediment, soils, drilling fluids, water other fluids, debris, brine, and or other substances produced, obtained, or used in connection with drilling and or operation of a well(s) are defined and regulated by the Oklahoma Corporation Commission.

A commercial, noncommercial, or any other pit shall not be constructed within a water of the state.

- Normal Farming Activities

Consistent with Clean Water Act Section 404 (f) and 40 CFR 232.3, discharges associated with normal farming activities are not subject to water quality standards.

- Prior Converted Cropland

Consistent with Oklahoma statute (Title 27A §1-1-201) prior converted croplands are not subject to water quality standards.

Table 3 Standard components and corresponding location in Oklahoma's Water Quality Standards (Chapter 45)

Component of Standard		Location in Water Quality Standards (Chapter 45)
Definitions	Wetland	785:45-1-2
	Ecological Integrity	
Wetland Beneficial Uses		785:45-5-21 (new section in Subchapter 5)
Wetland Criteria		785:45-5-21 (new section in Subchapter 5)
Antidegradation Policy		785:45-3 (existing policy)
Implementation Provisions	Mixing Zones	785:45-5-26
	Constructed Treatment Wetlands	785:45-5-21 (new section in Subchapter 5)
	Commercial & Noncommercial Pits	785:45-5-21 (new section in Subchapter 5)
	Normal Farming Activities	785:45-5-30 (new section in Part 5 of Subchapter 5)
	Prior Converted Cropland	785:45-5-30 (new section in Part 5 of Subchapter 5)

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