2023 CYPRESS CREEK BASIN HIGHLIGHTS REPORT

SPECIAL CONTRIBUTIONS:

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University of Houston – Clear Lake

A Tribute to the Western Chicken Turtle in Texas

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Big Cypress Bayou Bio-Blitz Studies

Tim Bister, Texas Parks and Wildlife Department

Invasive Aquatic Species Update

Cover photo: Station 16458 - Big Cypress Creek downstream of the confluence with Greasy Creek

FOREWORD

The Clean Rivers Program (CRP) is a water quality monitoring, assessment, and public outreach program administered by the TCEQ and funded by state collected fees. The Northeast Texas Municipal Water District (NETMWD) coordinates the CRP for the Cypress Creek Basin. As a participant in the Clean Rivers Program, NETMWD submits its Basin Highlights Report to the TCEQ and CRP partners.

This report and others submitted throughout the State are used to develop and prioritize programs that will protect the quality of healthy waterbodies and improve the quality of impaired waterbodies. Under the CRP, biologists and field staff collect water quality and biological samples, field parameters and measure flow at sites throughout the Cypress Creek Basin.

Monitoring and analysis are the basis for maintaining good water quality within the Cypress Creek Basin. Within a cooperative program directed by the NETMWD, these activities are an integral part of the State's Clean Rivers Program. Cypress Creek Basin CRP stakeholders include:

- Caddo Lake Institute
- U. S. Steel Tubular Products, Inc.
- Northeast Texas Community College
- Luminant
- Pilgrim's Pride Corporation
- AEP SWEPCO
- Titus Co. Fresh Water Supply District #1
- City of Marshall
- Texas Parks and Wildlife Department
- United States Geological Survey
- Franklin County Water District
- East Texas Baptist University

NETMWD contracts with Water Monitoring Solutions, Inc. (WMS) to fulfill the sampling and reporting requirements of the CRP.

GET INVOLVED!

Each spring, NETMWD provides a venue for local stakeholders to learn about water quality issues affecting their region and to provide input on projects in their communities. The Cypress Creek Steering Committee meetings allow stakeholders to have input on addressing water quality concerns and to prioritize water quality monitoring within the Cypress Creek Basin. NETMWD and its Clean Rivers Program partners continue to reach out to the public to educate and help resolve local water quality issues. Members of the public, water supply corporations, permitted dischargers, councils of government, and city and county officials are invited annually to become steering committee members. A CRP Steering Committee meeting was held in March 2022 at the NETMWD executive offices in Hughes Springs. Topics included Aquatic Invasive Species report, updates on the Western Chicken Turtle and Alligator Snapping Turtle studies, Neches and Cypress Basin Watershed Restoration Program, update on the Total Phosphorus Load Agreement, and a discussion of the Cypress Creek Basin Highlights Report.

NETMWD plans and coordinates monitoring efforts with other basin entities, the TCEQ monitoring staff, Caddo Lake Institute, and other interested participants annually within the Cypress Creek Basin. All entities collecting water quality data in the Cypress Creek Basin are encouraged to coordinate their efforts with the NETMWD and participate under the NETMWD Quality Assurance Project Plan.

Visit NETMWD to join the Clean Rivers Program Steering Committee or contact Robert Speight at 903-639-7538 or rspeight@netmwd.org.

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LIST OF ACRONYMS AND ABBREVIATIONS

ALM	Aquatic Life Monitoring
AU	Assessment Unit
cfs	Cubic feet per second (measurement of stream flow)
CN	Concern for non-attainment of water quality criterion
CS	Concern for screening level
CR	County Road
CRP	Clean Rivers Program
DO	Dissolved Oxygen
FM	Farm-to-Market Road
FY	Fiscal Year
IR	2022 Integrated Report
mg/L	milligrams per liter
MPN/100 mL	Most Probable Number per 100 milliliters (bacteria measurement units)
NETMWD	Northeast Texas Municipal Water District
NS	Non-support of water quality criterion
PCB	Polychlorinated biphenyls
SH	State Highway
s.u.	standard units (measurement of pH)
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
TPLA	Total Phosphorus Load Agreement
TPWD	Texas Parks and Wildlife Department
USFWS	United States Fish and Wildlife Service
WMS	Water Monitoring Solutions, Inc.
WWTP	Wastewater Treatment Plant
§303(d) List	Impaired water bodies in Section §303(d) of the Federal Clean Water Act
µg/L	micrograms per liter

INTRODUCTION

The Texas Clean Rivers Program (CRP) is a statewide water quality monitoring and assessment program that provides funding and resources for regional watershed protection efforts. The program is administered by the Texas Commission on Environmental Quality (TCEQ) in partnership with river authorities and other regional governments with the goal of maintaining and improving water quality in each river basin in the state.

As the coordinating agency in the Cypress Creek basin, the Northeast Texas Municipal Water District (NETMWD) works with federal and state agencies, municipalities, water suppliers, and private companies to accomplish water quality monitoring and watershed protection objectives. Monitoring priorities are established through stakeholder input and coordination with other organizations working in the basin. Water quality sampling regimens are established though an annual Coordinated Monitoring Meeting with the objective of ensuring that resources and efforts are not duplicated or overlapped. Coordinating entities in attendance often include the TCEQ, Caddo Lake Institute, Texas Parks and Wildlife Department (TPWD), U. S. Geological Survey, Texas State Soil and Water Conservation Board, and Texas A&M University – Agrilife/ Texas Water Resources Institute.

Most years, a Basin Highlight Report is authored, presented at stakeholder meetings, and posted to the NETMWD website. The report is typically of a non-technical nature intended to provide a high-level overview of issues that may affect water quality within the basin.

Figure 1: Clean Rivers Program Steering Committee Meeting, March 24, 2022

THE CYPRESS CREEK BASIN

The Cypress Creek watershed encompasses approximately 6,000 square miles. Its major tributaries – Big Cypress Creek, Little Cypress Creek, James' Bayou, Harrison Bayou, and Black Cypress Bayou – drain into Caddo Lake on the Texas/Louisiana border. The watershed has a diverse ecology. The headwaters of Big Cypress Creek, above Lake Cypress Springs, is intermittent. Releases into Big Cypress Creek from Lake Bob Sandlin runs through flat to rolling terrain surfaced by sandy and clay loams that support water-tolerant hardwoods, conifers, and grasses before entering Lake O' the Pines. Below Lake O' the Pines, Big Cypress Creek (Bayou) flows into Caddo Lake through bottomland thick with hardwood and cypress trees.

The watershed originates in the southern portions of Hopkins and Franklin Counties. Headwaters flow south eastwardly into Camp, Titus, Morris, Cass, Marion, and Harrison Counties. Reservoirs in the basin include Monticello Reservoir, Lake Cypress Springs, Lake Bob Sandlin, Lake Gilmer, Lake Daingerfield, Ellison Creek Reservoir, Lake O' the Pines, and Caddo Lake. The major tributaries of Caddo Lake include Big Cypress Creek, Little Cypress Creek (Bayou), Black Cypress Bayou, James Bayou, and Harrison Bayou. The basin experienced a pervasive drought that began around 1999 and extended through 2014. During this period, the drought was punctuated with large rainfall events. In 2011 and 2012, the drought reached comparable levels with the drought of record from the 1950's. This drought was followed by near-historic flooding in 2015 and 2016 which ended the drought.

Much of the basin experienced some level of drought in 2022, especially from January through March and throughout the summer. Figure 2 presents the U.S. Drought Monitor data for the basin in 2022. The drought monitor is updated weekly and reports the percent of the area in the five stages of drought: D0 – abnormally dry; D1 – moderate drought; D2 – severe drought; D3 – extreme drought; and D4 – exceptional drought.

Rainfall records at the Fort Sherman Dam (Lake Bob Sandlin), located in the upper portion of the basin, have been maintained since its completion in 1978. Over the past forty-four years, annual precipitation has averaged around 52 inches. However, from 1979 to 1998, the average was 54 inches per year, as compared to 50 inches from 1999 through 2021. During the 1999 - 2014 drought, an annual average of 48 inches of rain was recorded. At slightly over 25 inches of precipitation, 2005 was the driest year on record and was also the first year that no water was released from Lake Bob Sandlin since its completion. In 2022, the area received slightly below average rainfall at 46 inches with August being the wettest month at slightly less than eight inches of precipitation.

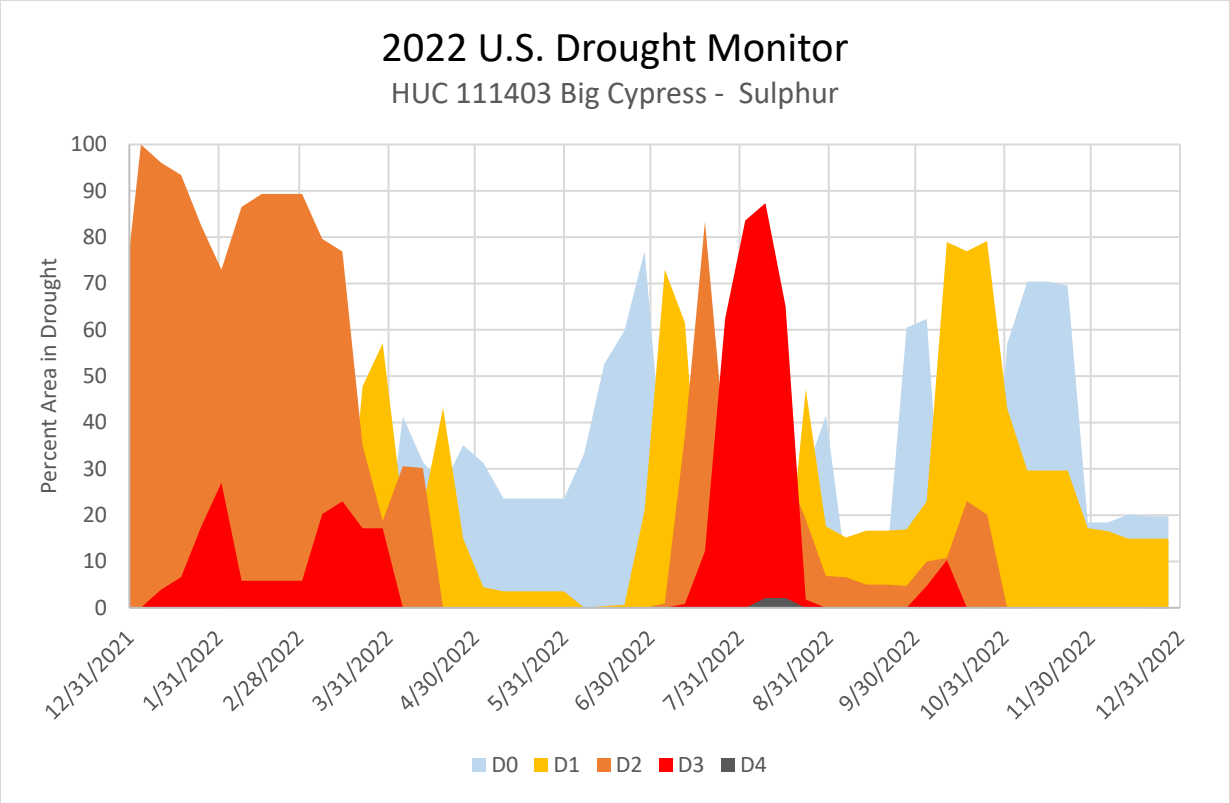

Figure 2: U.S. Drought Monitor, 2022

Releases from Lake Bob Sandlin play an important role in the water quality of Big Cypress Creek and Lake O' the Pines. In addition to providing stream flow in Big Cypress Creek, the high-quality water from Lake Bob Sandlin helps to offset the nutrient-laden discharges from wastewater treatments plants in the Lake O' the Pines watershed. There are no instream flow requirements in Big Cypress Creek, so water is only released by the Titus County Freshwater Supply District #1 to maintain the freeboard of the Fort Sherman Dam. In 2022, there was not enough precipitation to necessitate any releases from Fort Sherman Dam. In fact, no water was released from the reservoir from July 2021 through the end of 2022. This was the first year that no water was released from Lake Bob Sandlin since 2014.

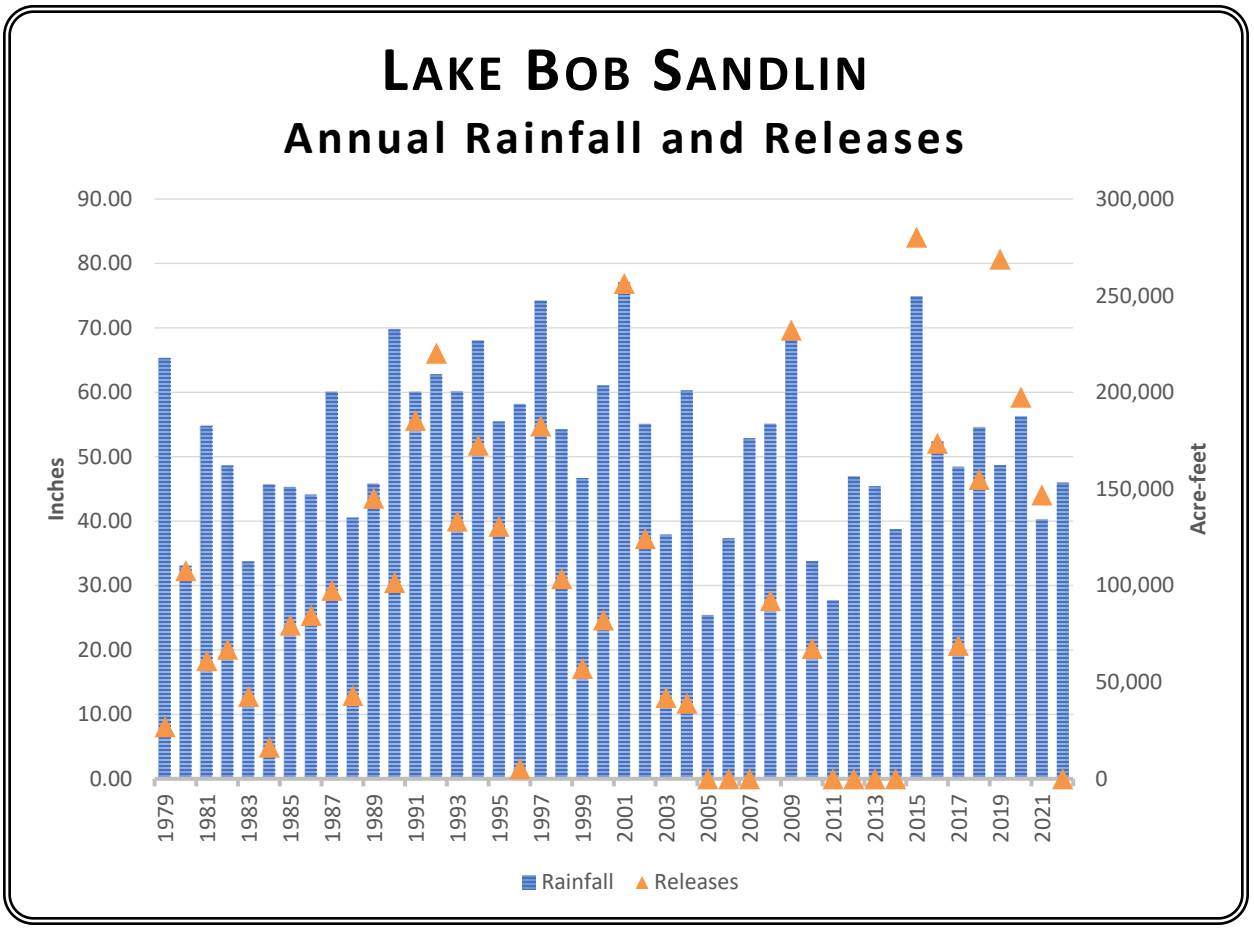

Figure 3: Graph of annual rainfall and releases form Lake Bob Sandlin

The remainder of the 2023 Cypress Creek Basin Highlights Report discusses the following topics:

- *2022 Texas Integrated Report*
- Species of Concern
- Aquatic Life Monitoring Studies
- Invasive Aquatic Species

The *2022 Texas Integrated Report* section of this report details the TCEQ assessment of water quality for all watersheds in the Cypress Creek Basin. A discussion of the Aquatic Life Monitoring studies section discusses biological monitoring studies being performed by NETMWD and WMS through the Clean Rivers Program and by the TPWD River Studies section. The Species of Concern section discusses potentially threatened or endangered species in the basin, while the Invasive Aquatic Species section reports on the results of the invasive vegetation surveys performed by the TPWD in 2022 along with their activities to treat and control these non-native species.

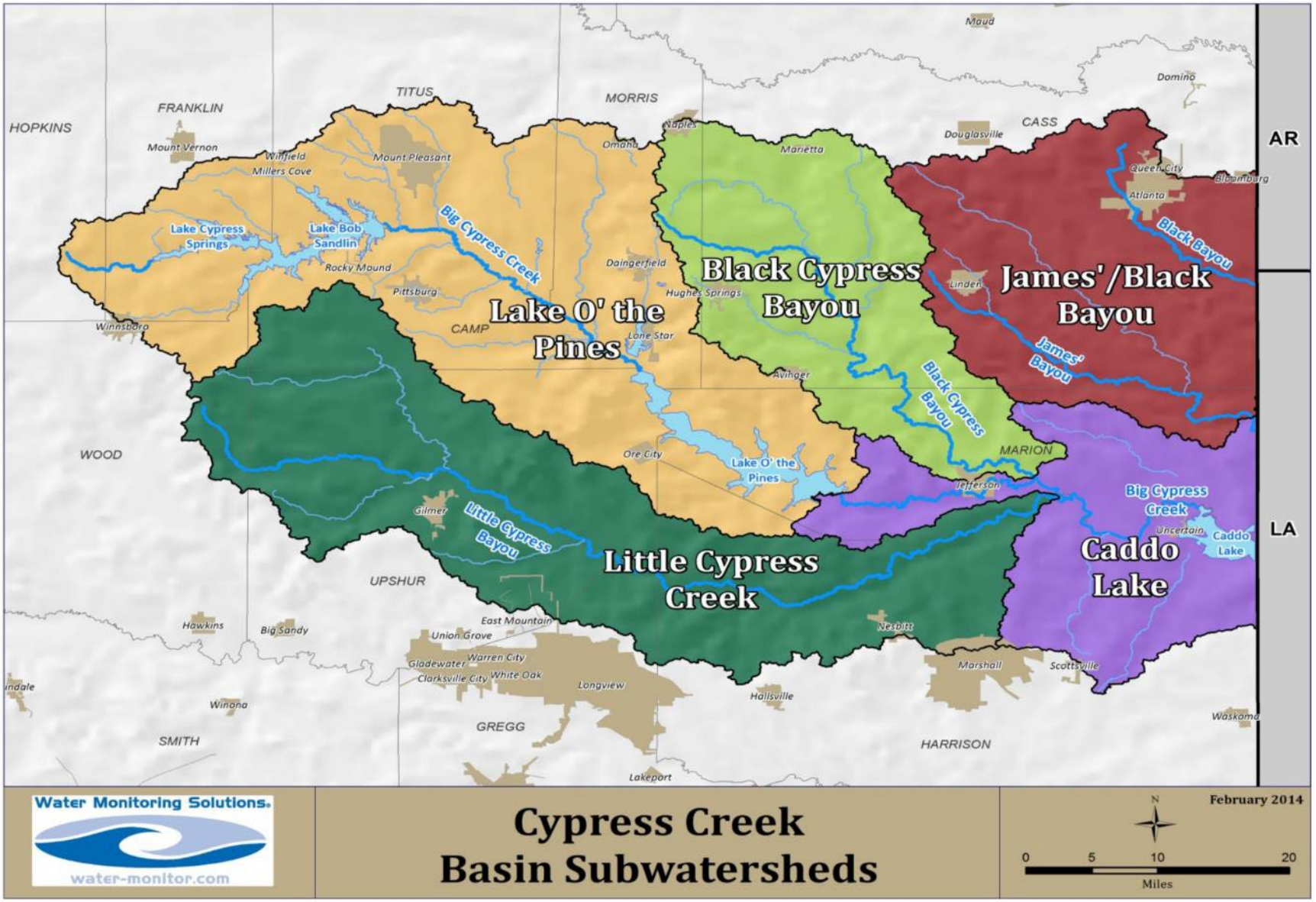

Figure 4: Map of the Cypress Creek Basin watersheds

WATER QUALITY MONITORING

Water quality monitoring and reporting is the heart of the CRP program. NETMWD / WMS and TCEQ Region 5 – Tyler routinely collect water quality data. Monitoring is conducted at 45 sites located in all ten designated segments and nineteen unclassified segments within the Cypress Creek basin. The Coordinated Monitoring Schedule is presented at the end of each segment discussion.

Clean Rivers Program partners collect monitoring data following a TCEQ-approved Quality Assurance Project Plan. The project plan references procedures and methods for sample collection and handling. The TCEQ Surface Water Quality Monitoring team have produced two procedures manuals that detail the methods for collecting water, sediment, and biological samples. All CRP partners follow these methods of data collection and quality assurance.

The resulting data are submitted to the TCEQ for inclusion in the state water quality database - Surface Water Quality Monitoring Information Systems. After a thorough review and approval by TCEQ, these data are made available for public access via the NETMWD and TCEQ websites. These data are used by the TCEQ to assess the basin.

Physical and chemical measurements of water quality are typically made at each station. Common parameters include dissolved oxygen, pH, suspended sediments, nutrients, bacteria, and stream flow or lake level. Biological assessments, or Aquatic Life Monitoring (ALM), include the collection of fish, aquatic insects, and habitat assessments to assess the overall health of streams. Water quality monitoring is often described in general terms of field parameters, conventional laboratory parameters, diel studies (data collected over a 24-hour period), stream flow, and biological assessments.

For the 2022 assessment, the TCEQ evaluated 49 classified and unclassified water bodies in the basin. The results reported in the *2022 Texas Integrated Report* (2022 IR) indicated that over half of the water bodies evaluated did not meet surface water quality standards for one or more parameters. Figure 5 details the segments and parameters shown on the *2022 Texas §303(d) List*. The §303(d) List identified nine classified and twelve unclassified water bodies that were non-supporting of water quality criteria. Low concentrations of dissolved oxygen, high levels of bacteria, and mercury in fish tissue were the most common impairments. Details about these impairments and water quality concerns are discussed within the segment narratives that follow this section of the report.

The *2022 Texas §303(d) List* for the Cypress Creek Basin includes the impairments shown in the table below:

Segment ID	Description	Parameter
0401	Caddo Lake	Mercury in fish tissue
		DO
0401A	Harrison Bayou	DO, *E. coli*
0402	Big Cypress Creek below Lake O' the Pines	Mercury in fish tissue
		DO
0403	Lake O' the Pines	High pH, DO
0404	Big Cypress Creek below Lake Bob Sandlin	*E. coli*
0404A	Ellison Creek Reservoir	Sediment Toxicity (LOE)
		Dioxin in fish tissue
		PCBs in fish tissue
0404B	Tankersley Creek	*E. coli*
0404C	Hart Creek	*E. coli*
0404E	Dry Creek	*E. coli*
0404F	Sparks Branch	*E. coli*
0404J	Prairie Creek	DO
0404N	Lake Daingerfield	Mercury in fish tissue
0405	Lake Cypress Springs	High pH
		Nutrient Reservoir Criteria
0405A	Big Cypress Creek	DO, *E. coli*
0406	Black Bayou	DO, *E. coli*
0407	James' Bayou	DO, *E. coli*
0409	Little Cypress Bayou	DO, *E. coli*
0409A	Lilly Creek	*E. coli*
0409B	South Lilly Creek	DO, *E. coli*
0410	Black Cypress Bayou	Mercury in fish tissue
		Copper, Lead in water
		DO
0410A	Black Cypress Creek	*E. coli*

Figure 5: Table of Impairments in the Cypress Creek Basin

The water bodies shown in Figure 6 were newly added to the *2022 Texas §303(d) List* for the parameters shown.

Segment ID	Description	Parameter
0401A	Harrison Bayou	*E. coli*
0404F	Sparks Branch	*E. coli*
0409B	South Lilly Creek	DO

Figure 6: Water bodies added to the Texas §303(d) List in 2022

The dissolved oxygen impairment for Hughes Creek (Segment 0402B) was removed from the 303(d) List. After reviewing information from station 16936, located at the State Highway (SH) 155 crossing, the TCEQ assessors determined that the site was not representative of the stream. Routine monitoring in Hughes Creek was moved to station 22321 at County Road (CR) 2985 in October 2021.

The following discussion provides definitions of the common field and conventional laboratory parameters.

FIELD PARAMETERS

Field parameters include those obtained using a water quality sonde such as temperature, dissolved oxygen, pH, specific conductance (sometimes referred to as "temperature-compensated conductivity"), and salinity. Other field parameters include transparency, stream flow, air temperature, and general field observations.

Temperature – Water temperature affects the oxygen content of the water, with warmer water unable to hold as much oxygen. When the water temperature is too cold, cold-blooded organisms may either die or become weaker and more susceptible to other stresses, such as disease or parasites. Colder water can be caused by reservoir releases. Warmer water can be caused by removing trees from the riparian zone, soil erosion, or use of water to cool manufacturing equipment.

Dissolved Oxygen (DO) – The concentration of dissolved oxygen is a characteristic of water that correlates with the occurrence and diversity of aquatic life. A water body that can support diverse, abundant aquatic life is a good indication of high-water quality since all aerobic aquatic organisms require oxygen to live. Modifications to the riparian zone, decreases in stream flow, increases in water temperature, increases in organic matter, bacteria, and over abundant algae may lead to lower DO concentrations in water.

Specific Conductance – Conductivity is a measure of the water body's ability to conduct electricity and indicates the approximate levels of dissolved salts, such as chloride, sulfate, and sodium in the stream. Elevated concentrations of dissolved salts can impact the water as a drinking water source and as suitable aquatic habitat.

Salinity – Salinity is commonly calculated by the water quality sonde using an algorithm based upon conductivity and temperature and is typically only recorded at coastal and tidally influenced stations. Salinity plays a role in determining estuarine sites and the composition of saline water diluted by freshwater from streams and rivers.

pH – pH is a measure of the acidity or basicity of a solution. The pH scale is a logarithmic (base 10) scale. A change of one pH unit means that the water has become ten times more acidic or basic. Most aquatic life is adapted to live within a relatively narrow pH range, but tolerant species can adjust to varying pH ranges. However, pH levels below 4 (acidity of orange juice) or above 12 (basicity of ammonia) are lethal to most fish species. Industrial and wastewater discharge, runoff from quarry operations, and accidental spills are examples of factors that

can change the pH composition of a water body. For many water bodies in East Texas, the pH tends to be naturally low (acidic) due to soil composition.

Figure 7: Sample bottles and instruments used to measure field parameters

Transparency – Transparency is measured using a secchi disk. It is a measure of the depth to which light is transmitted through the water column and thus the depth at which algae and aquatic plants can grow. Transparency is an important secondary parameter for assessing eutrophication, a natural aging process in lakes and reservoirs, and for identifying long-term trends in water clarity.

Stream Flow – Flow is an important parameter affecting water quality. Low flow conditions, common in the warm summer months, create critical conditions for aquatic organisms. At low flows, the stream has a lower assimilative capacity for waste inputs from point and non-point sources. Streams have critical low flows calculated by TCEQ. When stream flows drop below these (known as 7Q2) calculations, some water quality standards do not apply. For example, low DO is often a result of low flows. As a result, flow is often evaluated in conjunction with DO by the assessors to determine if a site is meeting its Aquatic Life Use designation.

CONVENTIONAL LABORATORY PARAMETERS

Laboratory analysis of "conventional" parameters generally includes solids, salts, nutrients, and bacteria. Conventional parameters analyzed by a laboratory include:

Solids: Total Suspended Solids and Total Dissolved Solids – High solids may affect the aesthetic quality of the water, interfere with washing clothes, and corrode plumbing fixtures. High total dissolved solids in the environment can also affect the permeability of ions in aquatic organisms. Mineral springs, carbonate deposits, salt deposits, and sea water intrusion are sources for natural occurring high concentration solids levels. Other sources can be attributed to oil and gas exploration, drinking water treatment chemicals, storm water and agricultural runoff, and point/non-point wastewater discharges. Elevated levels of dissolved solids such as chloride and sulfate can cause water to be unusable, or simply too costly to treat for drinking water uses. Changes in dissolved solids concentrations also affect the quality of habitat for aquatic life.

Total Hardness – Hardness is a composite measure of ions in water and is primarily composed of calcium and magnesium. The hardness of the water is critical due to its effect on the toxicity of certain metals. Higher hardness concentrations in the receiving stream can result in reduced toxicity of heavy metals.

Chloride – Chloride is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can disrupt osmotic pressure, water balance, and acid/base balances in aquatic organisms which can adversely affect survival, growth, and/or reproduction. Natural weathering and leaching of sedimentary rocks, soils, and salt deposits can release chloride into the environment. Other sources can be attributed to oil and gas exploration and storage, wastewater discharges, landfill run off, and saltwater intrusion.

Sulfate – Effects of high sulfate levels in the environment have not been fully documented; however, sulfate contamination may contribute to the decline of native plants by altering chemical conditions in the sediment. Due to abundance of elemental and organic sulfur and sulfide mineral, soluble sulfate occurs in most natural waters. Other sources are the burning of sulfur-containing fossil fuels, steel mills, wastewater treatment plant discharges, and fertilizers.

***E. coli* (Bacteria) –** Occurring naturally in the digestive system of warm-blooded animals, *Escherichia coli* (*E. coli*) bacteria are commonly found in surface water. Although not all bacteria are harmful to human beings, the presence of is an indication of recent fecal matter contamination, and that other pathogens dangerous to human beings may be present. Bacteria are measured to determine the relative risk of contact with pathogens through swimming or

other contact recreation activities. Sources may include inadequately treated sewage; waste from livestock, pets, waterfowl, and wildlife; or malfunctioning/failing septic systems.

Chlorophyll *a* – High levels of chlorophyll can indicate algal blooms, decrease water clarity, and cause swings in pH and dissolved oxygen concentrations due to photosynthesis and respiration processes. An increase in nutrients can lead to excessive algal production. Chlorophyll *a* concentrations are used as an indication of eutrophication in lakes and reservoirs.

Nutrients (Ammonia, Nitrate, Phosphorus) – Nutrients are essential for life. However, elevated nutrients can cause excessive growth in aquatic vegetation and may lead to algal blooms. Bloom conditions may cause wide variations in pH and dissolved oxygen within a water body. Common sources of nutrient pollution are treated effluent, malfunctioning septic systems, and agricultural runoff. Soil erosion and runoff from farms, lawns, and gardens can add nutrients to the water. Some nutrient loading may also occur naturally through biotic decomposition. In aquatic systems, when plants and algae die, the bacteria that decompose them use oxygen, thereby reducing the amount of dissolved oxygen in the water column which may lead to fish kills and decreased species diversity.

Elevated amounts of nitrogen in the environment can adversely affect fish and invertebrate reproductive capacity and reduce the growth of young. High levels of nitrite can produce nitrite toxicity, or “brown blood disease.” Excess nitrate can contribute to Blue Baby Syndrome in humans, a disease which reduces the ability of blood to transport oxygen throughout the body.

Ammonia is excreted by animals and is produced during the decomposition of organic matter. Municipal and industrial wastewater treatment plant discharge is another common source of ammonia.

Phosphorus is one of the most abundant elements on the planet; however, most natural phosphate compounds are very insoluble and not biologically available. Most water bodies are phosphorus-limited, meaning that algal production is limited to the amount of soluble phosphorus available in the water column. Common contributors of soluble phosphorus are non-point sources such as human and animal waste as well as commercial fertilizers. Commercial fertilizers are a more soluble form that can readily be used by plants, but this property also makes the phosphorus more susceptible to runoff.

Organics - Toxic substances from pesticides and industrial chemicals pose the same concerns as metals. Polychlorinated biphenyls (PCBs), for example, are industrial chemicals that are

toxic and probably carcinogenic. Despite being banned in the United States in 1977, PCBs remain in the environment, and they accumulate in fish and human tissues when consumed.

Metals – High concentrations of metals such as cadmium, mercury, and lead pose a threat to drinking water supplies and human health. Eating fish contaminated with metals can cause these toxic substances to accumulate in human tissue and organs, posing a long-term significant health threat. Bioaccumulation of mercury in the edible tissue of many fish species to the point of becoming a human health concern has prompted the Texas Department of State Health Services to issue fish consumption advisories around the Basin. Mercury in edible tissue has been identified in fish tissue in water bodies throughout East Texas.

Fiscal Year 2023

The Clean Rivers Program is funding quarterly sampling for field and laboratory parameters at eleven stations. Three stations are monitored for field parameters and stream flow each quarter while diel sampling is conducted at three stream stations each quarter. In addition, the TCEQ funded a special study in Lake Cypress Springs. For this study, diels and water quality samples are being collected monthly at four stations. Aquatic Life Monitoring is being performed in six streams. Aquatic Life Monitoring is comprised of biological, physical habitat, stream flow, and diel sampling methods to assess the overall health of the stream. Monitoring activities will be conducted during the non-critical and critical periods of 2023. The non-critical period sampling will be performed between March 15 and June 30, while the Critical Period extends from July 1 to September 30.

The following pages include a map of the Fiscal Year (FY) 2023 Cypress Creek CRP routine and diel monitoring stations. For a full list of stations monitored by both TCEQ Region 5 and the NETMWD/WMS CRP, visit the Coordinated Monitoring Schedule.

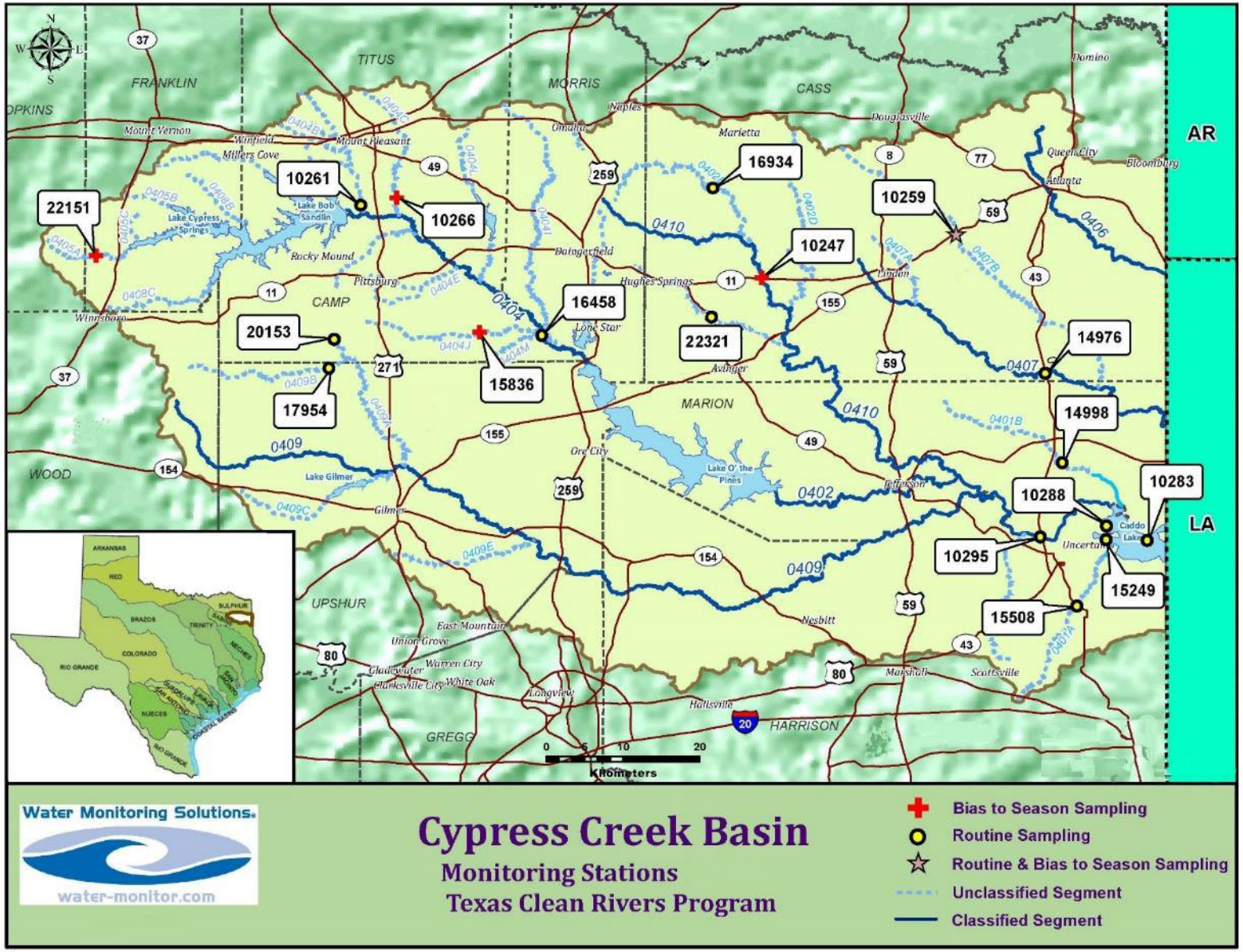

Figure 8: Map of the Cypress Creek Basin watershed

LAKE O' THE PINES WATERSHED

Segment narratives for the Lake O' the Pines watershed begins in the headwaters of Big Cypress Creek and follows the waterway into Lake O' the Pines. Population centers include Mt. Pleasant (pop. 16,273), Pittsburg (pop. 4,707), Daingerfield (pop. 2,460), and Ore City (pop. 1,204).

The watershed is composed of four primary segments:

- Segment 0405 Lake Cypress Springs
- Segment 0408 Lake Bob Sandlin
- Segment 0404 Big Cypress Creek below Lake Bob Sandlin
- Segment 0403 Lake O' the Pines

Major tributaries to Lake O' the Pines include Big Cypress Creek (0404), Tankersley Creek (0404B), Hart Creek (0404C), Dry Creek (0404E), Sparks Branch (0404F), and Prairie Creek (0404J). Reservoirs in the Lake O' the Pines Watershed include Lake O' the Pines (0403), Ellison Creek Reservoir (0404A), Welsh Reservoir (0404D), Lake Dangerfield (0404N), Lake Cypress Springs (0405), Lake Monticello (0408A), and Lake Bob Sandlin (0408).

Figure 9: Stream flow measurement at station 15260 in Segment 0405A

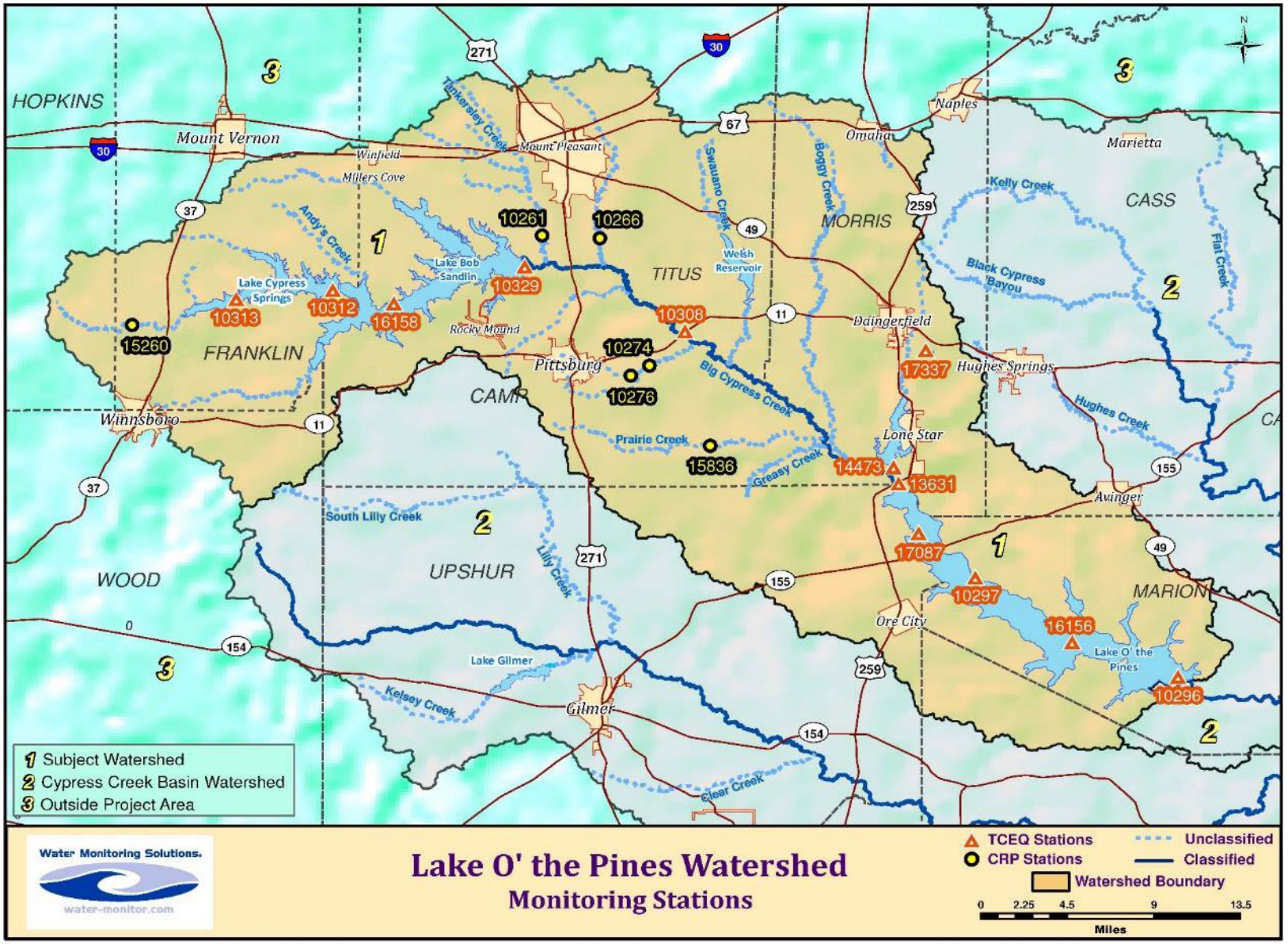

Figure 10: Map of the Lake O' the Pines watershed

SEGMENT 0405 – LAKE CYPRESS SPRINGS

Segment 0405 includes the uppermost reach of Big Cypress Creek and Lake Cypress Springs. The riparian zone of the headwaters of Big Cypress Creek is primarily agricultural including dairy, poultry, cow/calf operations, and hay meadows.

UNCLASSIFIED SEGMENT 0405A – BIG CYPRESS CREEK

Big Cypress Creek originates in Hopkins County near the Franklin County line and flows southeast into Lake Cypress Springs. The current is assesment is based upon data collected at station 15260, located on SH 37 between Mount Vernon and Winnsboro, and from station 22151, located upstream on County Road SW 3170. Regular sampling at station 15260 began in FY 2009. Segment 0405A was listed as impaired in the *2022 Texas §303(d) List* for bacteria and dissolved oxygen. The geometric mean of the bacteria samples collected during the assessment period was 583 MPN/100 mL, well over the 126 MPN/100 mL geometric mean criterion. About 10 percent of the dissolved grab samples fell below the 2 mg/L criterion with an average of 1.0 mg/L.

The 2022 IR also included a concern for screening level for dissolved oxygen and chlorophyll *a*. Eighteen percent of the dissolved oxygen grab samples were below the 3.0 mg/L screening level. All but three of the seventeen chlorophyll *a* results exceeded the screening level of 14.1 µg/L with an average of 30.78 µg/L.

Due to the typically low flow conditions at the SH 37 location, low dissolved oxygen values were often obtained during periods of low flow. Stream flow under 1 cubic feet per second (cfs) was reported for over one-third of the site visits, and less than 2 cfs were measured at nearly half. Discussions about the representativeness of station 15260 were held at coordinated monitoring meetings. After reviewing historical data, the Coordinated Monitoring Committee agreed to move the station upstream to a site that had more representative conditions to address the DO impairment. Diel monitoring at station 22151 at CR 3170 commenced in FY 2019. Out of seven diels conducted during the assessment period, only one event, conducted in October 2019, did not meet the 24-Hour DO Average and Minimum criteria. A flow measurement of 0 cfs was reported for this diel. Of interest, dissolved oxygen met its criteria even when the stream was flowing at only 0.1 cfs. Similar results have been found for diels conducted in 2021 and 2022.

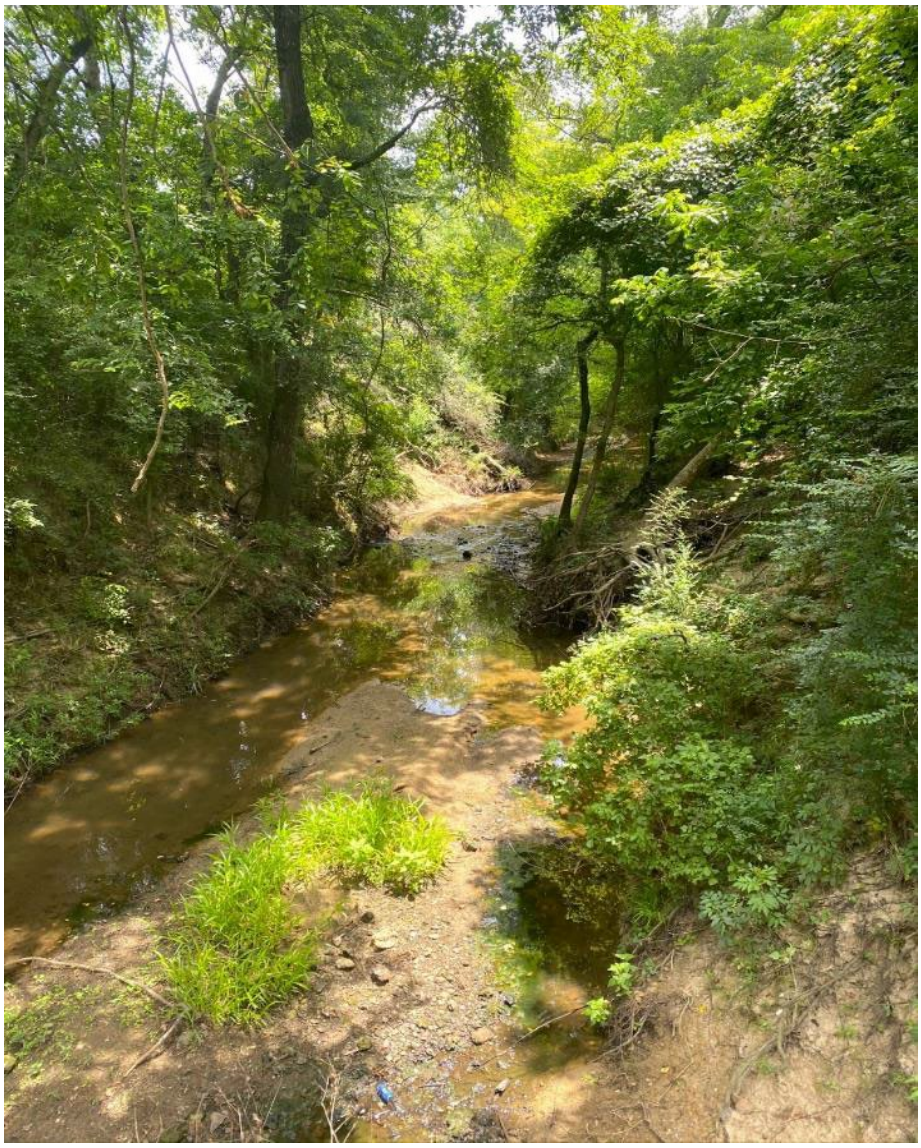

Figure 11: Station 22151 - Big Cypress Creek at CR 3170

UNCLASSIFIED SEGMENT 0405B – PANTHER CREEK

Panther Creek rises near Purley in Franklin County. The stream, which is intermittent in its upper reaches, originally ran southeast for 6.5 miles to it confluence with Big Cypress Creek before Lake Cypress Springs was impounded in 1970. The 2022 IR showed a concern for impaired habitat. No sampling has been conducted in this stream since 2002, and none is presently scheduled.

SEGMENT 0405 – LAKE CYPRESS SPRINGS

Lake Cypress Springs is located in Franklin County, south of the City of Mount Vernon. The popular recreational reservoir is managed by the Franklin County Water District. The watershed is primarily rural, though many new homes have been constructed along the shoreline over the past decade. The Franklin County Dam has a fixed spillway structure, so water is discharged only when the lake level exceeds the normal conservation pool of 378 feet mean sea level. Water exiting the spillway flows directly into Lake Bob Sandlin.

All three assessment units (AU) were included on the *2022 Texas §303(d) List* for high pH and excessive algal growth. Over twenty-one percent of the surface pH measurements made during the assessment period exceeded the 8.5 s.u. criterion. The median of all exceedances was 8.9 s.u. with a maximum value of 9.2 s.u. at station 10313. All high pH values were obtained during the warm months of the year. Current data indicate that the high pH impairment will continue into future assessments.

Nutrient concentrations tended to be relatively low throughout the reservoir during the assessment period. Only nine out of 66 ammonia samples were reported above the detection limit with a maximum of 0.37 mg/L. While less than half of the nitrite-nitrate samples were detected, the mean of the reportable samples was 0.36 mg/L with a maximum value of 0.72 mg/L. Out of the 64 total phosphorus samples reported, twenty were below the detection limit. The mean of all measured samples was 0.05 mg/L with a maximum of 0.13 mg/L.

The *2022 Texas Integrated Report* classified Lake Cypress Springs as eutrophic and ranked the reservoir in the top forty percent of reservoirs statewide for chlorophyll *a* despite having relatively low nutrient concentrations. The mean concentration of the chlorophyll *a* samples was 28.8 µg/L with most of the high results collected at the mid-lake station, 10313.

In eutrophic reservoirs, algae and other primary producers consume the available carbon dioxide during the process of photosynthesis. Once the available carbon dioxide is exhausted, a carbon dioxide molecule will be broken away from the weak bond of carbonic acid, thereby increasing the pH in the water column. After sunlight is no longer available for photosynthesis, carbon dioxide released through respiration, will bond with hydrogen to form carbonic acid, thereby decreasing pH. This pH cycling phenomenon can be assumed in Lake Cypress Springs since all of the grab samples were collected between 10 AM and 2 PM, the peak hours of primary productivity. However, without diel data, pH cycling cannot be demonstrated, nor the pH range calculated. This pH cycling is especially pronounced in waters with low alkalinity, such as that of Lake Cypress Springs and other reservoirs within the Cypress Creek Basin.

While DO concentration (mg/L) is used for assessment purposes, DO percent saturation is a more useful indicator of phytoplankton productivity. In the *2019 Cypress Creek Basin Summary Report*, DO percent saturation values were compared with the high pH readings in Lake Cypress Springs. All but one of the high pH measurements coincided with dissolved oxygen saturation values above 100 percent saturation. The correlation coefficient between pH and DO percent saturation was very high at 0.81 for all samples analyzed.

To better understand the nutrient impairment, the TCEQ funded a special study of Lake Cypress Springs. Monthly sampling commenced in September 2022 and is scheduled to continue through August 2023. Laboratory samples are being collected for nutrients and chlorophyll in all three assessment units and at station 20346, located in the west end of the reservoir. Field parameters and diels are also being collected in each assessment unit. The results of the special study will be presented in a future basin highlights report.

TCEQ Region 5 is scheduled to collect bacteria, conventionals, and field parameters on a quarterly basis at stations 10312 near the dam and at 10313 at Farm to Market road (FM) 115.

Figure 12: Station 17548 – Panther Creek arm of Lake Cypress Springs

SEGMENT 0408 – LAKE BOB SANDLIN

Lake Bob Sandlin is located immediately below Lake Cypress Springs and Lake Monticello, located in the upper reaches of the reservoir. Completed in 1977, the Fort Sherman Dam impounds over 8,700 surface acres with a capacity of almost 191,000 acre-feet of water. The reservoir is a popular recreational and fishing lake and is regulated by the Titus County Freshwater Supply District #1. In recent years, many new homes have been constructed along the shoreline.

The 2022 IR showed that Lake Bob Sandlin was one of the least polluted reservoirs in the state. The reservoir ranked in the top 8 percent for the least amount of phosphorus, top 15 percent for the highest water clarity, and top 30 percent for the lowest concentration of chlorophyll *a*.

There were no impairments or concerns for Lake Bob Sandlin shown in the 2022 IR. Unlike Lake Cypress Springs, chlorophyll *a* concentrations were typically low throughout the assessment period with only two out of 63 samples reported above the 26.7 µg/L screening level. Both high values were obtained in July 2019 with 32.5 µg/L at station 16158 and 50.1 µg/L at station 10329.

Nutrient concentrations were also very low during the assessment period with half of the nitrate and over sixty percent of all total phosphorus samples reported below their respective detection limits while less than fifteen percent of ammonia samples were measurable. Five nitrate samples exceeded the 0.37 mg/L screening level with a mean of 0.42 mg/L. A single ammonia result of 0.27 mg/L was reported over the 0.11 mg/L screening level while none of the total phosphorus samples exceeded the screening level of 0.2 mg/L.

Unlike Lake Cypress Springs, pH fell within the criteria during the assessment period in all but two out of 66 surface readings. Both high pH results were 9.1 s.u. and were observed at station 16158 in July 2017 and at station 10329 in September 2017.

Quarterly samples for bacteria, conventionals, and field parameters are scheduled to be collected by TCEQ Region 5 at stations 16158 (FM 21) and 10329 (dam) in 2023.

Figure 13: Lake Bob Sandlin at Titus County Freshwater Supply District Boat Ramp 1 near the Fort Sherman Dam

Water released from the Fort Sherman Dam enters Big Cypress Creek. These releases highly influence the water quality in Big Cypress Creek and Lake O' the Pines. Since there are no in-stream flow requirements, water is only released from the reservoir to maintain freeboard. A total of 939,956 acre-feet of water was released from the reservoir from 2000 through 2014. Due to the pervasive drought, there were zero releases during seven of those fifteen years causing the stream flow of Big Cypress Creek to become dominated by effluent flows.

Due to flooding, a record amount of water was released from the Fort Sherman Dam in 2015 at more than 280,000 acre-feet. An additional 150,000 acre-feet was released by the end of April 2016. This amount of water could fill Lake Bob Sandlin more than twice. Almost 1.3 million acre-feet were released between 2015 and 2021 which represents about thirty percent of all water discharged from Lake Bob Sandlin since its completion in 1979. However, drought conditions from the summer of 2021 through 2022 resulted in no water being released between July 2021 and the end of 2022.

SEGMENT 0404 – BIG CYPRESS CREEK BELOW LAKE BOB SANDLIN

Segment 0404 is the most urban-influenced segment in the Cypress Creek basin. Population centers include Mount Pleasant, Pittsburg, and Daingerfield. The segment begins at the release from Fort Sherman Dam on Lake Bob Sandlin and continues about 60 kilometers (38 miles) to the headwaters of Lake O' the Pines. Stream flow in this reach of Big Cypress Creek is highly influenced by releases from Lake Bob Sandlin. During periods of drought or low flow, the stream flow is primarily composed of treated municipal and industrial wastewater effluent.

There are eight permitted wastewater treatment plants in the Lake O' the Pines watershed, with half of the plants located in Segment 0404. The two largest plants are the City of Mount Pleasant and Pilgrim's Pride, permitted at 3.0 million gallons per day each. Both plants are located near the City of Mount Pleasant. Pilgrim's Pride discharges into Segment 0404B – Tankersley Creek and the City of Mount Pleasant discharges into Segment 0404C – Hart Creek. The City of Pittsburg operates two plants with one on Segment 0404E - Dry Creek and another on Segment 0404F - Sparks Branch. The remaining plants in the Lake O' the Pines watershed include the cities of Daingerfield, Lone Star, Omaha, and Ore City.

LAKE O' THE PINES TMDL IMPLEMENTATION

Excessive nutrient inputs into the reservoir from both point and non-point sources have long been a concern for Lake O' the Pines stakeholders. In 2000, the TCEQ found that dissolved oxygen levels in Lake O' the Pines were less than optimal for supporting fish and other aquatic species. While the amount of dissolved oxygen in water fluctuates naturally, human activities can cause unusually or chronically low dissolved oxygen levels. A Total Maximum Daily Load (TMDL) was implemented to reduce oxygen-demanding substances to improve water quality conditions for aquatic life. The study determined that a 56 percent reduction in phosphorus entering the reservoir was needed to improve dissolved oxygen concentrations in the reservoir. In 2013 and 2014, stakeholders reviewed the 2008 TMDL Implementation Plan and completed a revised Implementation Plan to continue their efforts in improving its water quality.

Through the revised TMDL Implementation Plan, a group permit for phosphorus was issued to all wastewater treatment plants located in the Lake O' the Pines watershed. This permit, known as the Total Phosphorus Load Agreement (TPLA), is an agreement between NETMWD and entities operating permitted wastewater treatment plants. The TPLA was the first of its kind in the State of Texas.

The TMDL program worked with the TCEQ Water Quality Division through the Water Quality Management Plan update process to specify permit limits and other permit language for these eight permittees. While the total allocation of phosphorus from these point sources has remained the same; the individual allocations were different than originally allocated in the TMDL Implementation Plan. This change is reflected in the current versions of their permits. In 2012, Pilgrim's Pride agreed to take on the full phosphorus reduction required to meet the TMDL. This meant that its allowable annual discharge is much lower than what appears in the TMDL Implementation Plan and in the TPLA, while the allowable allocations for the seven municipal permittees are now higher (matching their observed amounts in the original TMDL) than in the Implementation Plan and in the TPLA.

Note that only Pilgrim's Pride WWTP has a phosphorus permit limit. The seven municipal permittees are all required to sample and report their phosphorus discharges. Their allocated amounts are noted in the "Other Requirements" section of their permits, with wording stating that their permits can be amended to include those numbers as permit limits if the group fails to meet the phosphorus goal of the TPLA.

Permitted Discharger	Allocation (Kilograms of Phosphorus)	2021 Discharge (Kilograms of Phosphorus)	Difference (Kilograms of Phosphorus)
Daingerfield	500	265	(235)
Lone Star	500	515	15
Mt. Pleasant	2,300	849	(1,451)
Omaha	300	207	(93)
Ore City	1,000	416	(584)
Pilgrim's Pride	20,000	3,875	(16,125)
Pittsburg/Dry Creek	600	74	(526)
Pittsburg/Sparks Branch	1,800	278	(1,522)
Total	**27,000**	**6,479**	**(20,521)**

Figure 14: TPLA Total Discharges in 2021 (Kilograms of Phosphorus)

In 2021, about one-fourth of the permitted phosphorus allocation was discharged into the watersheds entering Lake O' the Pines. With the exception of the City of Lone Star, all permittees successfully met its phosphorus allocation that year. Although the City of Lone Star has never met its annual phosphorus allocation limit, their phosphorus discharge has steadily declined since the inception of the TPLA. In 2015, Lone Star discharged 1,388 kilograms of phosphorus. By 2021, their contribution had declined to 515 kilograms, slightly over its 500-kilogram allocation.

The TPLA allocated Pilgrim's Pride Wastewater Treatment Plant (WWTP) an annual discharge limit of 20,000 pounds of phosphorus. In 2014, the plant discharged more than double that amount at 45,813 kilograms. That year, a multi-million-dollar upgrade to the Pilgrim's Pride WWTP was initiated which was completed in April 2015. In 2021, the WWTP released a total of about 3,875 kilograms of phosphorus, or less than one-fifth of its permitted allocation.

Stakeholders also specified voluntary actions aimed at reducing non-point source contributions, such as stormwater runoff, were necessary to achieve the goals of the TMDL. Technical and financial programs were created for agricultural producers; and local/county programs were created to address on-site sewage facilities, marine sanitation, and education.

It should be noted that the TPLA permit is scheduled for renewal in 2023.

The 2022 IR showed concerns for nitrate in both assessment units of Segment 0404, Big Cypress Creek below Lake Bob Sandlin, and for chlorophyll *a* in the lower reach of the stream. The 2022 IR had concerns for nitrate and chlorophyll *a* in Segment 0404B - Tankersley Creek and for nitrate in Segment 0404C - Hart Creek. Nitrate concerns were also identified in 0404E – Dry Creek and in 0404F – Sparks Branch. It should be noted that each of these streams are receiving waters for wastewater treatment plants located in Mount Pleasant and Pittsburg and are significant contributors to upper reaches of this segment of Big Cypress Creek.

Station 10310 at US 271 and station 10308 at SH 11 are routinely monitored in the upper assessment unit of Big Cypress Creek while stations 16458 (near the confluence with Greasy Creek) and 13631 at US 259 represent the lower assessment unit. Station 10310 is located downstream of the confluence with Tankersley Creek while Station 10308 is after the confluence with Hart Creek and Walkers Creek.

The bacteria impairment in the upper assessment unit of Segment 0404 was first listed in 2002. The geometric mean of the *E. coli* samples collected during the assessment period was 215.7 MPN/100 mL exceeding the 126 MPN/100 mL geometric mean criterion.

Nitrate and chlorophyll *a* were included as concerns in this segment in the 2022 IR. High nitrate was a concern in both assessment units. All but seven of the 88 nitrate samples collected in the upper assessment unit exceeded the 1.95 mg/L screening level with a mean of 19.09 mg/L. For the lower assessment unit, about 34 percent of all nitrate results exceeded the screening level with an average of 6.92 mg/L. Since the Pilgrim's Pride wastewater treatment plant upgrade was completed in early 2015, total phosphorus results have noticeably declined with most results falling below the screening level of 0.69 mg/L. As a result, total phosphorus was no longer included as a concern in the 2022 IR.

The high nutrient concentrations in Big Cypress Creek resulted in a concern for chlorophyll *a* in the lower assessment unit. About thirty percent of the chlorophyll values exceeded the 14.7 µg/L screening level with an average of 34.6 µg/L. The excessive nutrients continued into Lake O' the Pines and have also degraded its water quality. These effects are discussed in further detail in the Lake O' the Pines section of the report.

In 2023, TCEQ Region 5 is scheduled to monitor quarterly at stations 10308 (SH 11) and 13631 (US 259) for flow, bacteria, and for field and conventional laboratory parameters. NETMWD/WMS samples quarterly for flow, bacteria, and for field and conventional laboratory parameters at station 16458 located below the confluence with Greasy Creek.

Figure 15: Stream flow measurement at station 16458 in Big Cypress Creek

The table below details impairments (NS), concerns for near non-attainment (CN), and concerns for screening level (CS) for Segment 0404 as shown in the *2022 Texas Integrated Report*.

Segment AU	Description	Parameter	Support
0404_01	Big Cypress Creek from Lake O' the Pines upstream 24 km	Chlorophyll *a*	CS
		Nitrate	CS
0404_02	Big Cypress Creek upstream 37.2 km	*E. coli*	**NS**
		Nitrate	CS
0404A	Ellison Creek Reservoir	Sediment Toxicity (LOE)	**NS**
		Cadmium, Iron, Zinc	CS
		Nickel, Manganese, Lead	CS
		PCBs and dioxin in fish tissue	**NS**
0404B	Tankersley Creek	Habitat; Benthos	CS
		E. coli	**NS**
		Nitrate; Chlorophyll	CS
		DO screening level	CS
0404C	Hart Creek	*E. coli*	**NS**
		Nitrate	CS
0404E	Dry Creek	*E. coli*	**NS**
		Nitrate	CS
0404F	Sparks Branch	*E. coli*	**NS**
		Nitrate	CS
0404J	Prairie Creek	DO 24-HR Avg.	**NS**
		DO 24-HR Min.	**NS**
0404K	Walkers Creek	*E. coli*	CN
0404N	Lake Daingerfield	Mercury in fish tissue	**NS**, CS
0404O	Dragoo Creek	*E. coli*	CN
0404S	Unnamed Tributary to Big Cypress Creek	DO Grab	CS
		E. coli	CN
0404T	Prairie Branch	DO Grab	CN, CS
		E. coli	CN
0404U	Evans Creek	*E. coli*	CN
0404V	Hayes Creek	DO Grab	CS
		E. coli	CN

Figure 16: Table of the 2022 Texas Integrated Report for Segment 0404

UNCLASSIFIED SEGMENT 0404B – TANKERSLEY CREEK

Tankersley Creek arises in Titus County northwest of the city of Mount Pleasant. The stream flows in a southeasterly direction for approximately two miles before it enters Tankersley Lake. Downstream of the impoundment, the stream flows about eight miles to its confluence with Big Cypress Creek at the Titus-Camp County line. Tankersley Creek is the receiving water for the Pilgrim's Pride wastewater treatment plant, located on FM 127, west of Mount Pleasant.

Tankersley Creek was first listed as impaired for bacteria in 2000, and the impairment has continued in the 2022 IR. The geometric mean was 290 MPN/100 mL, more than double the criterion of 126 MPN/100 mL. Due to the impairment, a bacteria study, *The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)*, was funded by the Texas State Soil and Water Conservation Board. The study was conducted from 2009 through 2011 and included a Recreation Use Attainability Analysis. The purpose of this study was to determine if primary contact recreation was the appropriate use designation of the stream. The results were submitted to the TCEQ which will be used to determine the best strategy to address the impairment.

Routine conventional laboratory parameters sampling resumed at station 10261 at FM 3417 in FY 2013 since only a few samples had been collected in this reach. Prior to upgrading the Pilgrim's Pride wastewater treatment plant, phosphorus results regularly exceeded the 0.69 mg/L screening level with an average concentration of 3.37 mg/L, or about five times the screening level. Since the plant upgrades were completed in the spring of 2015, the mean result was 0.37 mg/L with less than ten percent of samples exceeding the screening level. As a result, the concern for the total phosphorus screening level that had been shown in previous assessments did not continue into the 2022 IR. However, the concern for nitrate continued and a concern for chlorophyll *a* was added to the 2022 IR.

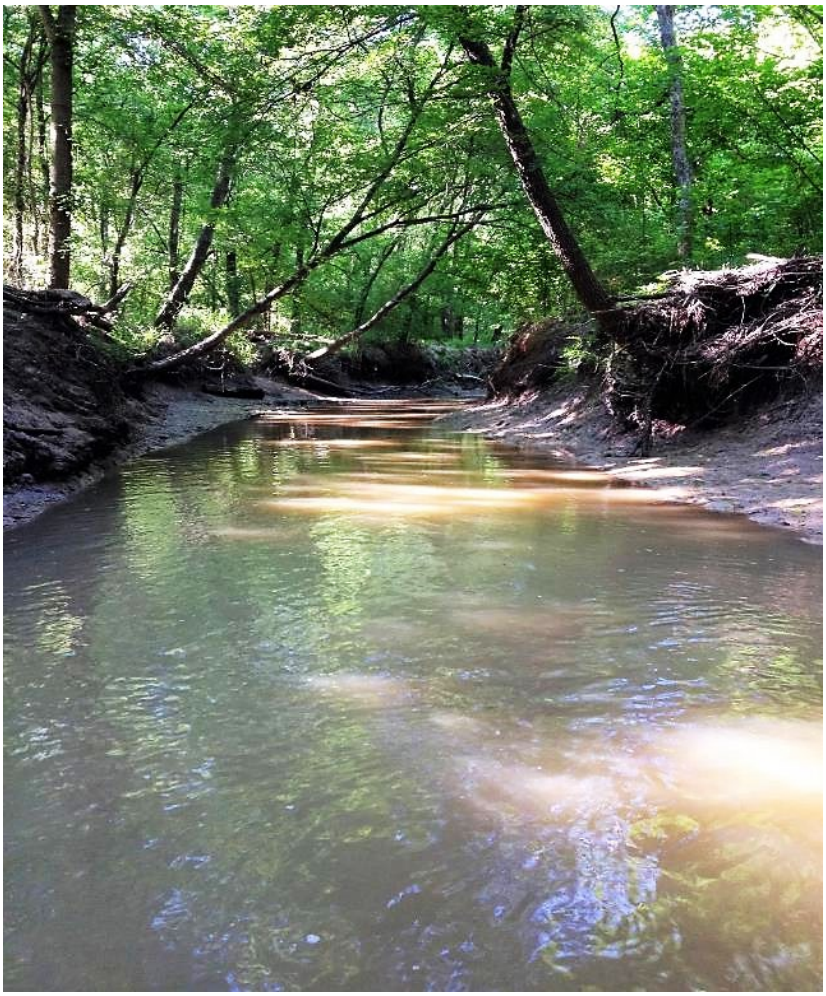

Figure 17: Tankersley Creek at station 10261

Due to high nitrate and sulfate results collected previously, special studies of these parameters were funded by CRP in 2018 and 2019. Monthly samples for sulfate, ammonia, nitrite, nitrate, total Kjeldahl nitrogen, and total phosphorus were collected at three stations in Tankersley Creek to identify potential sources. The nitrate special study monitoring began in July 2018 and was completed in June 2019. The sulfate special study began in November 2019 and continued through October 2020. The results of both studies showed that the Pilgrim's Pride plant was the primary contributor of these constituents; however, none of the sample results exceeded the plant's permit limits. Results of both studies were detailed in the *2021 Cypress Creek Basin Highlights Report*.

Concerns for DO grab screening level and for chlorophyll *a* are new to the 2022 IR. Eight out of 62 grab samples fell below the 5 mg/L screening level with a mean of 4.0 mg/L. Six of the twenty chlorophyll *a* results reported in the assessment period exceeded the 14.1 µg/L screening level with a mean of 18.95 µg/L. Three of the exceedances were collected in 2016 while the highest value of 24.8 µg/L was collected in August 2019.

The Integrated Report showed concerns for impaired habitat and benthic communities. Aquatic Life Monitoring (ALM) was conducted in Tankersley Creek in 2020 and 2021. Since the assessment period ended in 2020, only half of the four monitoring events were considered in the 2022 IR. Although habitat and benthos scored in the intermediate range at 18.3 and 25, respectively, fish scored in the high category with a mean value of 50. Due to the use of state-wide scoring metrics, habitat often scores in the intermediate range for East Texas streams. A detailed summary of all four monitoring events was discussed in the *2022 Cypress Creek Basin Highlights Report*.

Station 10261 is monitored quarterly monitoring for flow, bacteria, and for field and conventional parameters by NETMWD/WMS in 2023.

UNCLASSIFIED SEGMENT 0404C – HART CREEK

Hart Creek, an unclassified water body, rises 4.5 miles north of Mount Pleasant and runs southeast for twelve miles to its confluence with Big Cypress Creek. It receives surface drainage from two small tributaries to the east of Mount Pleasant, Hayes Creek and Evans Creek. The City of Mount Pleasant WWTP outfall is located on Hart Creek approximately 2 kilometers upstream of station 10266, located on County Road 4550.

The *2022 Texas Integrated Report* included an impairment in Hart Creek for bacteria. The geometric mean was 404 MPN/100 mL, more than three times the criterion of 126 MPN/100 mL. Hart Creek was first identified as not meeting the water quality standard for bacteria in 2006. Data collected since the last assessment indicated that bacteria concentrations on Hart Creek continued to exceed the criterion. Due to the impairment, Hart Creek was included in the contact recreation study and recreational use attainability analysis funded by the Texas State Soil and Water Conservation Board. The TCEQ will use information obtained from a bacteria study, completed in 2011, to determine the best management strategy to address this impairment.

The 2022 IR also showed a concern for nitrate. Routine conventional laboratory parameters sampling resumed at station 10266 at CR 4550 in FY 2013. Prior to 2013, the last sample results available were collected in 2003. Almost forty percent of the results assessed exceeded the 1.95 mg/L screening level with the highest result of 10.9 mg/L collected in October 2017. The mean nitrate concentration for samples that exceeded the screening level was 6.17 mg/L.

Due to the high nitrate concentrations, Hart Creek was included as part of the nitrate special study. Monthly samples for ammonia, nitrite, nitrate, total Kjeldahl nitrogen, and total

phosphorus were collected at two stations in Hart Creek to identify potential sources. Monitoring was conducted at station 10272 (SH 49) and at station 10266 (CR 4550). The special study monitoring was completed in June 2019. The results of the study were detailed in the *2021 Cypress Creek Basin Highlights Report*. Unlike Tankersley Creek, all total phosphorus samples were reported below the 0.69 mg/L screening level with a mean of 0.21 mg/L.

Two biological monitoring events were conducted in Hart Creek in 2022. The preliminary findings are discussed in the next section of the report. In addition to conducting two more ALM events, NETMWD/WMS is scheduled to collect samples for flow, bacteria, field, and conventional parameters twice at station 10266 (CR 4550) in 2023.

Figure 18: Fish identification and enumeration in Hart Creek

UNCLASSIFIED SEGMENT 0404E – DRY CREEK

The headwaters of Dry Creek are located south of Pittsburg, Texas. The stream serves as a receiving water for the City of Pittsburg wastewater treatment plant. Dry Creek flows toward the east to its confluence with Big Cypress Creek in northeast Camp County. Sampling in Dry

Creek was conducted at station 10274 at McMinn Road. The riparian zone of the property immediately upstream and downstream of the bridge crossing is improved pasture and is used for grazing cattle. Cattle were noted to be in the stream during several monitoring events which likely affect its water quality.

Dry Creek is impaired for *E. coli* and has a concern for nitrate in the 2022 IR. Fifteen sampling events were conducted at station 10274 at McMinn Road from the summer of 2015 through August 2018. The *E. coli* results had a geometric mean of 492 MPN/100 mL while nitrate exceeded the 1.95 mg/L screening level nine times with a mean of 6.86 mg/L. None of the total phosphorus or chlorophyll *a* results exceeded the screening levels. Two high ammonia samples were reported with a mean of 0.51 mg/L.

The stream has not been sampled since 2018, and no monitoring is scheduled in 2023.

UNCLASSIFIED SEGMENT 0404F – SPARKS BRANCH

Sparks Branch is a tributary of Dry Creek and is also a receiving water for the City of Pittsburg wastewater treatment plant. There is little riparian vegetation along the stream as land in the Sparks Branch watershed is intensively used for improved pastures and grazing. Cattle were noted to be in the stream which likely affect its water quality.

Ten monitoring events were conducted from April 2016 through August 2018 at station 10276 at CR 4220. The *2022 Texas Integrated Report* showed an impairment for *E. coli* and a concern for nitrate. The bacteria results were very high with a geometric mean of 613 MPN/100 mL while sixty percent of the nitrate samples were above the screening level with a mean of 10.39 mg/L. None of the ammonia and one total phosphorus samples exceeded their screening levels.

The stream has not been sampled since 2018, and no monitoring is scheduled in 2023.

UNCLASSIFIED SEGMENT 0404J – PRAIRIE CREEK

Prairie Creek is an intermittent stream that flows along the southern border of Camp County before its confluence with Big Cypress Creek. The Lake O' the Pines Implementation Plan workgroup identified 24-Hour dissolved oxygen monitoring as a priority for this watershed to evaluate potential impacts on loadings into the reservoir.

Due to a concern for dissolved oxygen shown in previous assessments, diel sampling began in FY 2017 at station 15386 at FM 557. The stream was shown as impaired in the *2022 Texas §303(d) List* for non-attainment of the 24-Hour dissolved oxygen average and minimum criteria. Three of the sixteen diels conducted during the assessment period fell below the 3 mg/L criterion for 24-Hour dissolved oxygen average while four results did not meet the 24-Hour

dissolved oxygen minimum criterion of 2 mg/L. A flow rate of 0 cfs was reported for all the diels that did not meet the criteria.

Four diels and two ALM events are scheduled to be conducted by NETMWD/WMS at station 15836 in 2023.

UNCLASSIFIED SEGMENT 0404K – WALKERS CREEK

Walkers Creek arises in Camp County northwest of Pittsburg. The stream flows generally to the northeast to its confluence with Big Cypress Creek. Walkers Creek was included in the contact recreation study from 2009 to 2011. The bacteria study results were below the criterion indicating that the stream supported its contact recreation designation. However, a concern for *E. coli* was shown for this stream as a carry-over from previous assessments since no data were evaluated during the assessment period. Due to meeting its stream standards, stakeholders agreed to discontinue monitoring at this water body in FY 2013 to address impairments and concerns elsewhere within the basin. No monitoring is currently scheduled in 2023.

UNCLASSIFIED SEGMENT 0404O – DRAGOO CREEK

UNCLASSIFIED SEGMENT 0404S – UNNAMED TRIBUTARY OF BIG CYPRESS CREEK

UNCLASSIFIED SEGMENT 0404T – PRAIRIE BRANCH

UNCLASSIFIED SEGMENT 0404U – EVANS CREEK

UNCLASSIFIED SEGMENT 0404V – HAYES CREEK

These unclassified water bodies are intermittent tributaries to Tankersley, Hart, and Big Cypress Creeks and were included as part of *The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)*. No samples have been collected in these streams since the study was completed in 2011. The 2022 IR showed concerns for *E. coli* and depressed dissolved oxygen as a carry-forward from previous assessments since no data were collected during the current assessment period. No monitoring is scheduled in these water bodies in 2023.

UNCLASSIFIED SEGMENT 0404A – ELLISON CREEK RESERVOIR

Ellison Creek Reservoir (sometimes called Lake Lone Star) is located due west of Lone Star in southern Morris County. The drainage area of the Ellison Creek watershed is thirty-seven square miles, and the reservoir has a surface area of approximately 1,516 acres. The reservoir

provides process water and cooling water for U. S. Steel Company and the Southwest Gas and Electric Company Power Plant. Water discharged from Ellison Creek Reservoir flows into Big Cypress Creek immediately above US 259 near the headwaters of Lake O' the Pines.

Ellison Creek Reservoir was included on the *2022 Texas §303(d) List* for PCBs and dioxin in fish tissue, and for sediment toxicity. The *2022 Texas Integrated Report* showed concerns for screening levels for cadmium, iron, lead, manganese, nickel, and zinc in sediment. Sediment samples were last collected in June 2005. All sediment samples were collected at station 14473 near the dam and greatly exceeded the screening limits. Although sediment samples are needed to address the concerns, no sediment sampling is scheduled during 2023.

TCEQ Region 5 monitors at station 14473 quarterly for dissolved metals in water and field parameters. Approximately 22 dissolved metals samples were collected during the assessment period. None of the cadmium or zinc results were above the detection limit while only three lead and nickel samples were detected. Approximately half of the iron samples were detected with an average of 47.3 µg/L while manganese had a mean of 4.62 µg/L.

Figure 19: Sunset over Lake Lone Star Park

UNCLASSIFIED SEGMENT 0404N – LAKE DAINGERFIELD

Lake Daingerfield is an eighty-acre reservoir which was completed in 1935 as a Civilian Conservation Corps project. Water released from Lake Daingerfield flows into Brutons Creek and then into Ellison Creek Reservoir. This segment was included on the *2022 Texas §303(d) List*

for non-support and concern for the screening level of mercury in fish tissue. A fish consumption advisory is in effect for the entire reservoir.

Lake Daingerfield has good water quality. None of the sixteen ammonia, nitrate, or chlorophyll samples exceeded their screening levels during the assessment period. One total phosphorus sample of 0.42 mg/L was reported over the 0.2 mg/L screening level. Region 5 monitors at station 17337 (Lake Daingerfield at Headwaters in Daingerfield State Park) quarterly for conventional parameters, bacteria, and field parameters.

Figure 20: Headwaters of Lake O' the Pines at US 259

SEGMENT 0403 – LAKE O' THE PINES

The Lake O' the Pines watershed encompasses approximately 885 square miles. The lower portion of the watershed lies within the Pineywoods Ecoregion and is composed of hardwood and pine forests. The upper portion, near Lake Bob Sandlin, is in the Post Oak Savanah Ecoregion which is comprised of patches of oak woodlands interspersed with grasslands. The watershed is rural. Land is predominantly used for agriculture, including silviculture, poultry, and cattle.

Lake O' the Pines, which is about 18,700 surface acres, was created for flood control after the historic flooding of the City of Jefferson in 1945. The reservoir was authorized by the U.S. Congress through the Flood Control Act of 1946. Construction of the Ferrell's Bridge Dam on Big Cypress Bayou was completed in 1959. Despite historic rainfall in 2015 and in early 2016, Lake O' the Pines performed its primary function and prevented the City of Jefferson from flooding. Through controlled water releases, over one million acre-feet of water was discharged from the reservoir between January and August 2016 which is enough water to fill Caddo Lake nearly seven times.

Releases from the two gates in the control structure vary from a minimum of 5 cfs to a maximum of 3,000 cfs. The storage capacity of the reservoir is 254,000 acre-feet. Lake O' the Pines provides water for eight cities and towns, numerous rural water districts, a steel manufacturer, and electricity generators. In addition to recreation and tourism, the reservoir is an important resource to the timber industry as well as to agricultural enterprises such as poultry, dairy, and cattle operations.

Segment 0403 - Lake O' the Pines is divided into four assessment units:

- AU 0403_01 Lower 5,000 acres near the dam
- AU 0403_02 Middle 5,000 acres
- AU 0403_03 Middle 5,000 acres below State Highway 155
- AU 0403_04 Upper 3,700 acres above State Highway 155

The *2022 Texas §303(d) List* identified the three lower assessment units as impaired for high pH. The high pH impairment was due to pH samples exceeding the 8.5 s.u. criterion during the assessment period. For AU 0403_01, fourteen percent of the pH readings were high while 21 percent of the measurements in AU 0403_02 and 27 percent in AU 0403_03 exceeded the 8.5 s.u. criterion.

The *2022 Texas Integrated Report* defined Lake O' the Pines as an eutrophic reservoir and ranked it in the top twenty percent out of 139 Texas resevoirs for elevated chlorophyll.

Although chlorophyll was not shown as concern in the 2022 IR for the three lower assessment units, data collected during the assessment period revealed many elevated chlorophyll results. Approximately half of all samples collected in the three assessment units exceeded the 26.7 µg/L screening level. The mean of the exceedances was 42.3 µg/L.

For the headwaters assessment unit, AU 0403_04, the 2022 IR included an impairment for 24-Hour DO along with a concern for DO grab screening level. The 24-Hour DO impairment was a carry-forward from previous assessments since no diel studies have been performed in this assessment unit since 2002. Four of the 26 DO grab samples fell below the 5.0 mg/L screening criteria with a mean of 3.66 mg/L. Unlike the other assessment units, none of the pH values exceeded the criterion. However, sixteen percent of nitrate and twelve percent of the total phosphorus results were reported over their screening levels while a third of the chlorophyll samples were high. The mean of the chlorophyll exceedances was more than twice the screening level at 56.83 µg/L.

A review of all pH data collected in Lake O' the Pines from 1998 through 2018 for the *2019 Cypress Creek Basin Summary Report* revealed statistically signficant increasing pH trends in the two middle assessment units of the reservoir. A decreasing trend for transparency was identified in the lower assessment unit (AU 0403_01). Since chlorophyll had been increasing at a statistically significant rate in the 2009 and 2014 basin summary reports, the decreasing transparency trend was possibly a result of increased algal production.

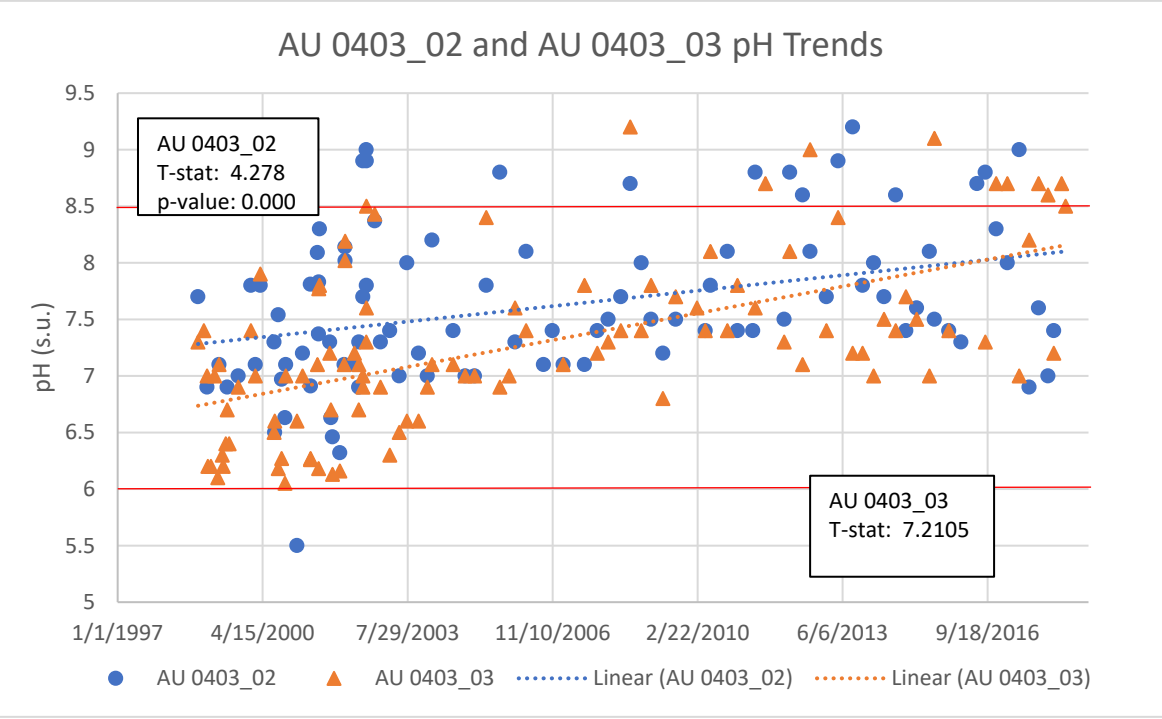

Figure 21: Increasing pH Trends in the Middle Assessment Units

The report also revealed that high pH readings had been rare prior to 2010. Historically, only one pH value was reported above the 8.5 s.u criterion from 1973 through 2009 in AU 0403_01. The report demonstrated that all high pH measurements collected since 2010 corresponded with super-saturated dissolved oxygen. A strong statistical correlation between all pH and dissolved oxygen percent saturation was identified.

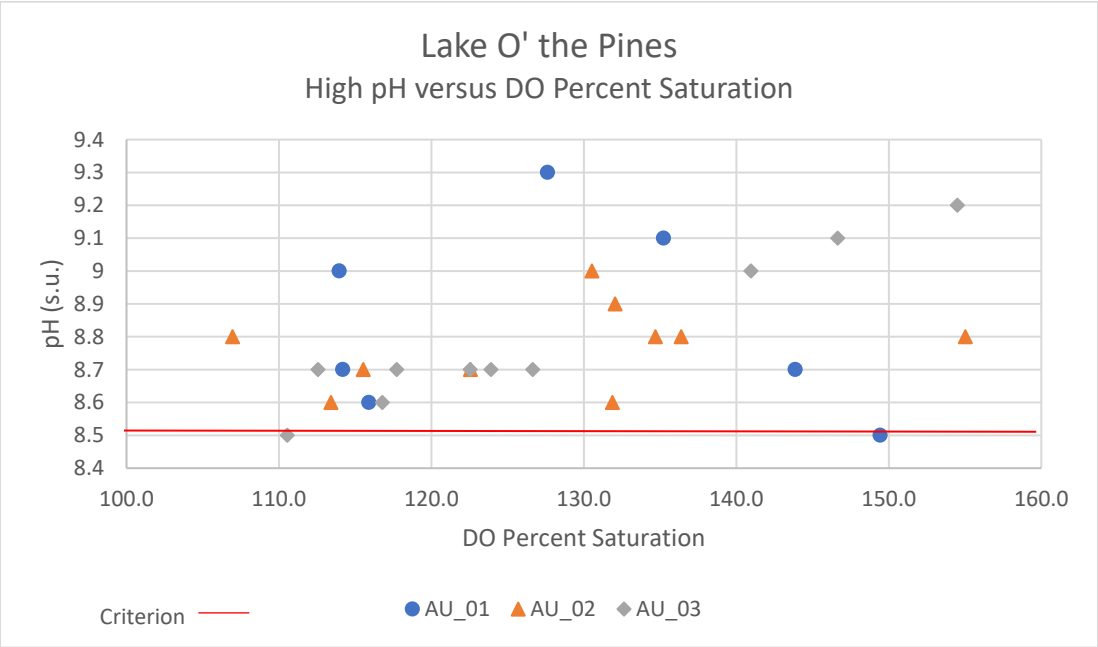

Figure 22: High pH versus DO Percent Saturation

In eutrophic reservoirs, algae (phytoplankton) consume available carbon dioxide during the process of photosynthesis. Once the available carbon dioxide is exhausted, carbon dioxide will be broken away from carbonic acid, thereby increasing the pH in the water column. When sunlight is not available for photosynthesis, carbon dioxide, released through respiration, will bond with available hydrogen ions to reform carbonic acid, thereby lowering the pH. Since oxygen production is a by-product of photosynthesis, dissolved oxygen saturation can serve as a surrogate indicator for chlorophyll sample analysis.

The combination of elevated chlorophyll and super-saturated dissolved oxygen supported the assumption that the high pH readings were a direct result of phytoplankton productivity since all of the data reported were grab samples collected between 10 AM and 2 PM, the peak hours of primary production. The report suggested that diel pH cycling was likely to be occurring; however, no recent diel data were available for review to test the hypothesis. Due to the pH impairments and data needs in order to validate these assumptions, two special studies were funded by the CRP. A Continuous Water Quality Monitoring Special Study incorporated the use of two continuous water quality monitoring stations located in the upper portion of the reservoir. The monitor at US 259 was used to represent AU 0403_04 while the NETMWD intake

station represented AU 0403_03. A Diel Special Study incorporated targeted diel monitoring in the lower assessement units. Data collected at the City of Longview intake represented AU 0403_02 and the Dam station represented AU 0403_01. A complete discussion of these studies are available in the *2022 Cypress Creek Basin Highlights Report*.

The continuous monitoring sondes revealed that pH did not exceed the 8.5 s.u. criterion very often. At the US 259 station, pH was reported above 8.5 s.u. in less than 0.11 percent of the measurements while the NETMWD intake was above the criterion in 1.22 percent of the readings. Most high pH values measured by the continuous water quality monitors were recorded in the warm weather months. The warm weather months also exhibited the greatest diel range between minimum and maximum pH. The highest monthly pH range at the US 259 station was 2.4 s.u. while it was 3.1 s.u. at the NETMWD intake. These pH ranges occurred in June and July 2020 at both stations.

For the Diel Special Study, high pH was most commonly obtained at the City of Longview intake (AU 0403_02), exceeding the criterion in over 36 percent of all samples collected while pH at the dam was high in approximately 31 percent of the readings. The greatest percentage of high pH values were collected during the July 26, 2021 deployments where the City of Longview intake and Dam stations exceeded the criterion in over 94 percent and 85 percent of the readings, respectively. The only deployment where none of the pH values exceeded the criterion at either station was the August 25, 2020 study.

The studies suggested that there is a close relationship between DO percent saturation and pH throughout the reservoir. Most high pH results were collected at a super-saturated dissolved oxygen saturation. Further, DO percent saturation and pH correlated well at both continuous monitoring stations as well as at both diel stations. A comparison of the data collected at the NETMWD intake continuous monitor with the diel data from the City of Longview intake and Dam stations revealed that DO percent saturation and pH were almost perfectly correlated with the mean coefficients ranging from 0.93 at the NETMWD intake to 0.95 at Dam station and 0.96 at the Longview intake.

The results of these special studies indicated that the high pH impairments in Lake O’ the Pines are a result of eutrophication. This assertion is supported by the study findings which showed that all high pH values were obtained when dissolved oxygen was super-saturated; the high pH readings primarily occurred during warm weather months; and pH correlated closely with dissolved oxygen saturation. These conditions will likely continue due to nutrient enrichment in the contributing watershed to the reservoir. TCEQ Region 5 is scheduled to collect quarterly field parameters, bacteria, and conventionals samples at stations representing all four assessment units in 2023.

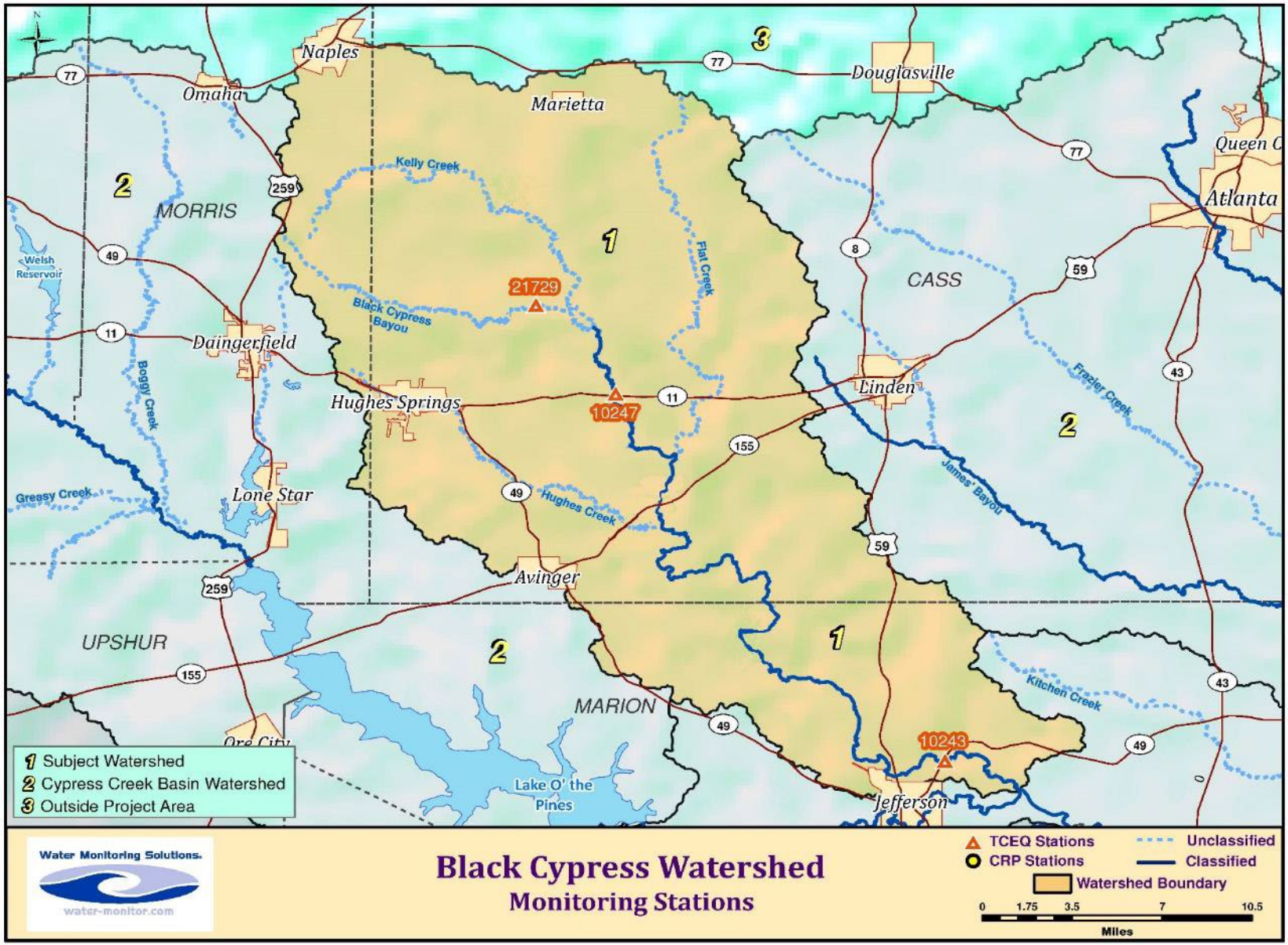

Figure 23: Map of Black Cypress Bayou watershed

SEGMENT 0410 – BLACK CYPRESS CREEK (BAYOU)

Black Cypress Bayou was formerly designated as Segment 0402A, an unclassified water body. Segment 0410 became a classified water body in the most recent Texas Surface Water Quality Standards revision and is shown as Segment 0410 in the *2022 Integrated Report*. The segment boundary begins at the confluence with Big Cypress Creek and goes upstream to FM 250. Segment 0410 includes four assessment units along with the unclassified water body 0410A which is intermittent with perennial pools.

Figure 24: Station 10245, Black Cypress Creek at US 59

Segment 0410 was included on the *2022 Texas §303(d) List* for copper and lead in water, dissolved oxygen, and mercury in fish tissue. The lowest assessment unit, AU 0410_01, was impaired for copper, although this impairment was based upon limited data. None of the ten dissolved copper samples collected during the assessment period exceeded their acute and chronic criteria of 2.29 µg/L with a mean of all samples of 0.85 µg/L. At present, the source of copper has not been identified. Except for one total phosphorus and chlorophyll *a* sample, all other parameters collected during the assessment period met their associated criterion or screening level. The phosphorus result of 0.71 mg/L was only slightly above the screening level of 0.69 mg/L. A single chlorophyll sample exceeded the 14.1 µg/L screening level with a value of 20.1 µg/L. The TCEQ R5 samples quarterly for conventional laboratory, bacteria, and field parameters at station 10243 at SH 49.

Routine sampling in AU 0410_02, station 10244 near Berea, resumed in FY 2015 and continued through FY 2021. The assessment unit had an impairment for 24-Hour dissolved oxygen average in the 2022 IR. The impairment was based upon three out of fourteen diel studies not meeting the 5 mg/L criterion. These low results occurred during the summer months. The assessment unit also showed a concern for near non-attainment of the bacteria criterion with a geometric mean of 299 MPN/100 mL. These results were based upon limited data so a full assessment could not be completed. Due to difficulty accessing the site during wet weather, sampling was discontinued at this station at the end of FY 2021.

Pruitt Lake, AU 0410_03, was shown as impaired for copper and lead in water. The copper impairment had been removed from this assessment unit in the 2020 Integrated Report. However, four out of thirteen samples exceeded the 0.66 µg/L criterion in the 2022 IR. The mean of the exceedances was 0.99 µg/L. Out of fourteen samples, a single lead result of 0.43 µg/L exceeded the 0.40 µg/L criterion. Pruitt Lake was also impaired for mercury in fish tissue. No monitoring is currently being conducted in Pruitt Lake in 2023.

The uppermost reach of Black Cypress Creek, AU 0410_04, remained impaired for dissolved oxygen grab minimum in the 2022 IR. It should be noted that none of the 21 dissolved oxygen measurements made during the assessment period fell below the 4 mg/L criterion while only one sample did not meet the DO grab screening level of 5 mg/L. NETMWD/WMS commenced diel monitoring by at station 10247 at SH 11 in October 2020 to address the DO impairment. Nine diels have been completed as of October 2022. Apart from the July 2022 event, all others have met the 24-Hour DO Average and DO Minimum criteria. The stream flow of 0 cfs was reported for the July 2022 diel. Diel monitoring by NETMWD/WMS continues through 2023 at station 10247 while the TCEQ R5 samples quarterly for conventional laboratory, bacteria, and field parameters.

Figure 25: Station 10247 - Black Cypress at SH 11

UNCLASSIFIED SEGMENT 0410A BLACK CYPRESS CREEK

Segment 0410A is an intermittent reach of Black Cypress Creek. It extends from Kelly Creek upstream to FM 250. The *2022 Texas §303(d) List* showed an impairment for bacteria. The geometric mean of the twenty *E. coli* samples analyzed during the assessment period was 285 MPN/100 mL, well above the 126 MPN/100 mL criterion. The reach had previously been impaired for dissolved oxygen, but sampling results met the criterion during the current assessment period. However, it should be noted that five of the 23 DO grab samples did not meet the criterion of 3.1 mg/L with a mean of 2.18 mg/L. In 2023, the TCEQ R5 samples quarterly for conventional laboratory, bacteria, and field parameters at station 21729, located at CR 2924 near Hughes Springs.

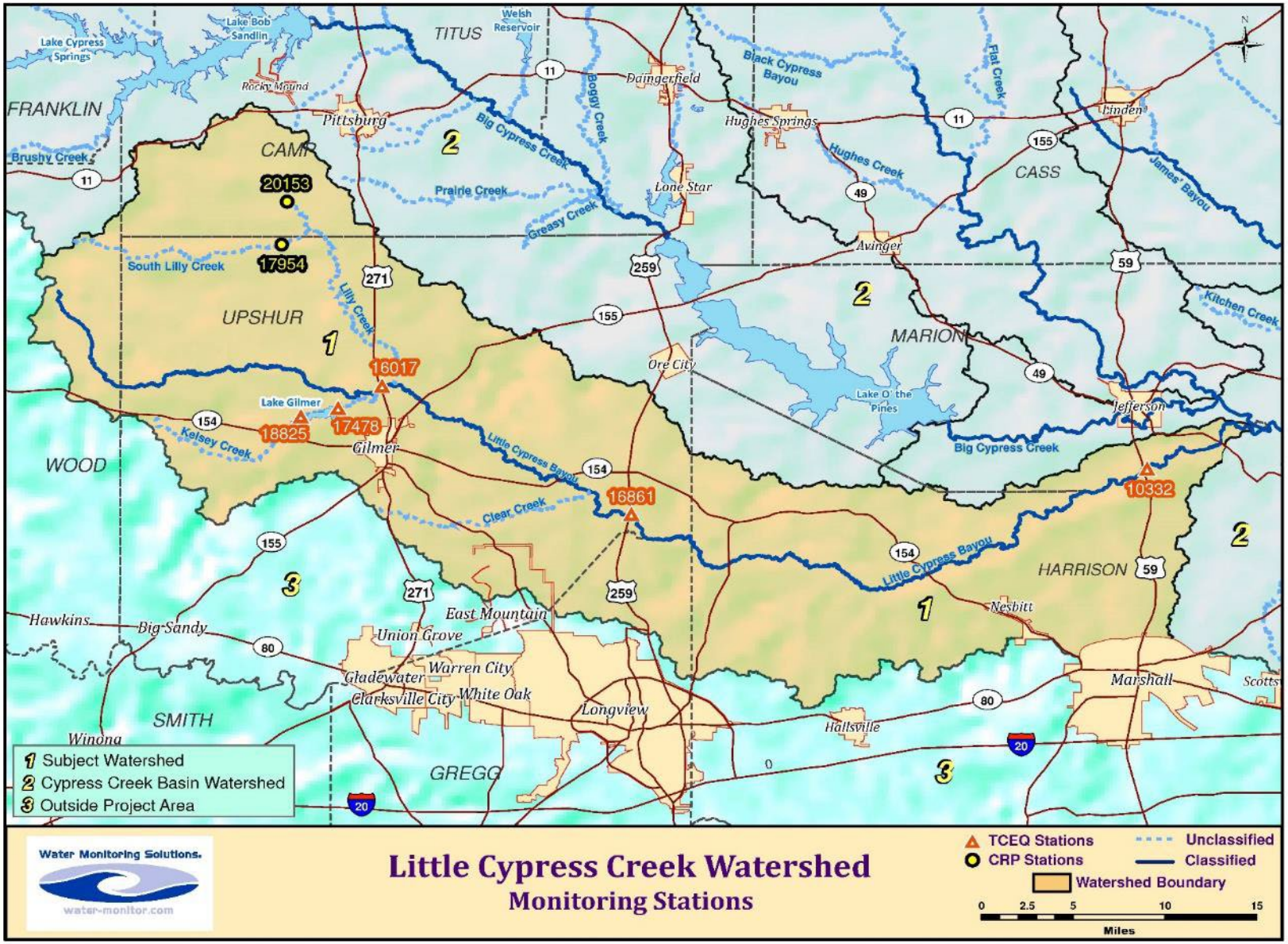

Figure 26: Map of Little Cypress Creek watershed

SEGMENT 0409 – LITTLE CYPRESS CREEK (BAYOU)

Little Cypress Bayou emerges in the Pineywoods near FM 2088 in Wood County. The approximately 163-kilometer (105 miles) bayou forms much of the southern boundary of the Cypress Creek Basin, and joins Big Cypress Creek east of Jefferson.

The Little Cypress Creek segment was identified as impaired for low levels of dissolved oxygen in 2000 and for elevated bacteria in 2006. These impairments were included in the *2022 Texas §303(d) List*.

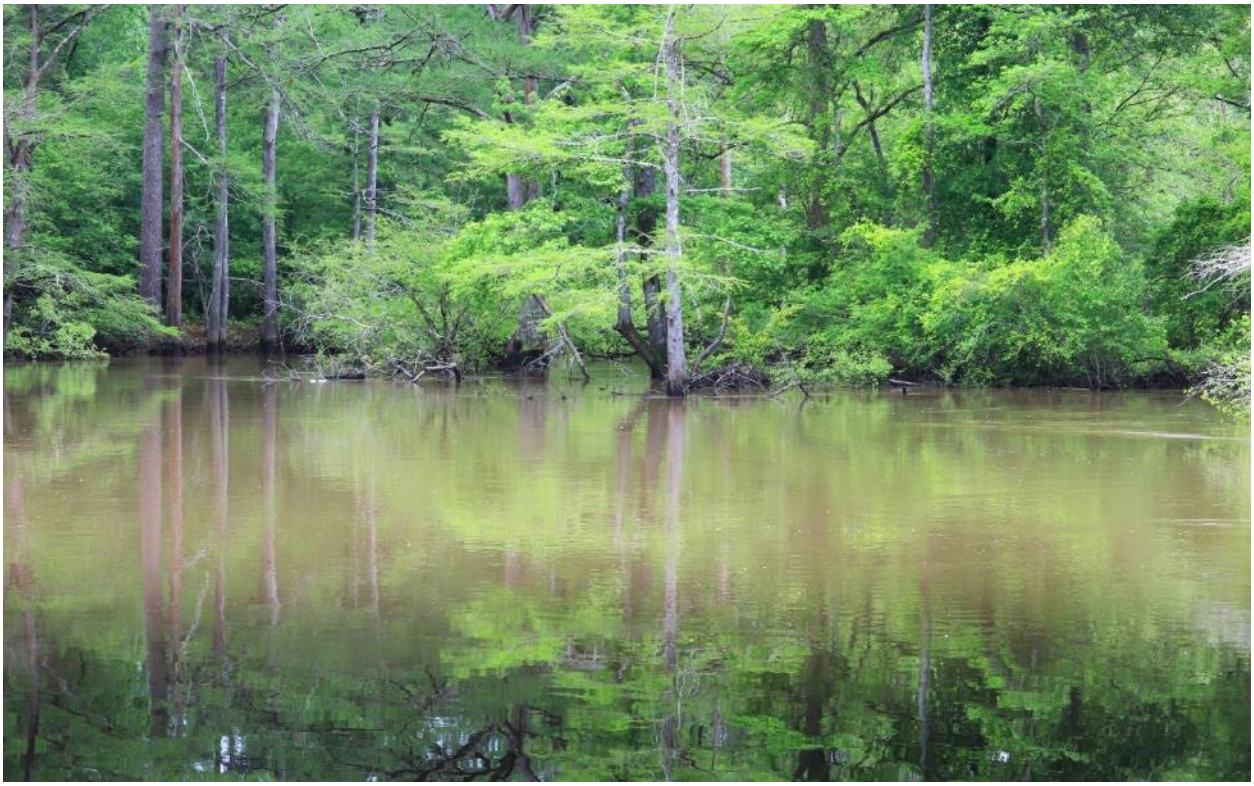

Figure 27: Little Cypress Creek at station 10331

The lower 41 kilometers of Little Cypress Creek, from the confluence with Big Cypress Creek on the Harrison/Marion County line to Lawrence Creek, encompasses AU 0409_01. The reach is impaired for non-support of the 24-Hour DO Average and DO Minimum criteria. Since the impairment had been a carry-forward from previous assessments, diel studies resumed in October 2016. Half of the fourteen diels completed during the assessment period failed to meet the 24-Hour DO Average criterion of 5 mg/L while five fell below the 4 mg/L 24-Hour DO Minimum criterion. Due to several events not meeting the criteria, the Coordinated Monitoring Committee decided to discontinue diel studies in 2021.

Two chlorophyll samples collected during the assessment period exceeded the screening level of 14.1 µg/L with a mean of 15.75 µg/L. TCEQ Region 5 collects field parameters, flow, bacteria, and conventional laboratory parameters quarterly at station 10332 at US 59.

The 29.2-kilometer reach extending upstream of Lawrence Creek, AU 0409_02, was on the *2022 Texas §303(d) List* for not supporting the 24-Hour DO Average and DO Minimum criteria. The reach is also impaired for *E. coli* bacteria. These impairments are carried-forward from previous assessments; no data were collected in this reach during the assessment period. All monitoring data in the assessment unit were collected at station 15773, located at FM 450. Sampling at this station was discontinued in 2012 after TCEQ staff determined that the location was not representative of the hydraulic conditions. Another suitable station has yet to be identified. Until sampling is resumed within the assessment unit, these impairments will likely continue into future assessments.

The upper-middle reach of Little Cypress Creek extends 52.2 kilometers upstream to the confluence with Kelsey Creek. This reach is impaired for bacteria with a geometric mean of 206 MPN/100 mL based upon twenty samples. One ammonia sample of 0.88 mg/L exceeded the 0.33 mg/L screening level. All other parameters met their criteria and screening levels. In 2023, the TCEQ Region 5 is scheduled to collect field, flow, bacteria, and conventional laboratory parameters quarterly at station 16861 at US 259.

The uppermost reach of the segment extends from the headwaters near FM 2088 in Wood County downstream 41.1 kilometers. The assessment unit was included on the *2022 Texas §303(d) List* for not supporting the *E. coli* criterion. The geometric mean of the 50 bacteria samples collected during the assessment period was 432 MPN/100 mL, more than triple the 126 MPN/100 mL criterion. Two ammonia samples with a mean of 0.57 mg/L exceeded the 0.33 mg/L screening level. All other parameters collected during the assessment period met their criteria and screening levels. The TCEQ R5 monitors this reach quarterly for field, flow, conventional, and bacteria at station 16017 at US 271 in 2023.

UNCLASSIFIED SEGMENT 0409A – LILLY CREEK

Lilly Creek, an intermittent stream, originates two miles west of Pine in Camp County and flows southeast for nine miles to its confluence with Little Cypress Creek. Flow severity is often reported as Low or No Flow during site visits. Lilly Creek was impaired for bacteria in the *2022 Texas §303(d) List*. The geometric mean of the 23 *E. coli* samples was 280 MPN/100 mL. Concerns for dissolved oxygen grab and chlorophyll screening levels were also shown in the 2022 IR. Four samples out of 25 DO samples fell below the 3.0 mg/L screening level with a mean of 1.6 mg/L. No flow was reported for flow severity on the date of the low DO readings. Over a third of the chlorophyll sample results exceeded the screening criterion of 14.1 µg/L with a

mean of the exceedances of 28.3 µg/L. In 2023, quarterly sampling is conducted at station 20153 at FM 556 for bacteria, flow, and field parameters by NETMWD/WMS.

UNCLASSIFIED SEGMENT 0409B – SOUTH LILLY CREEK

South Lilly Creek is an unclassified water body that extends from its confluence with Lilly Creek to FM 1647 in Upshur County. The stream is intermittent, the watershed has no population centers, and is comprised of improved pastures and forested land. Much of riparian vegetation along the stream has been removed and cattle commonly have direct access to the stream.

South Lilly Creek was first identified as impaired for bacteria in 2006. The impairment continued into the 2022 IR. Twenty-one bacteria samples collected during the assessment period had a geometric mean of 454 MPN/100 mL, well above the 126 MPN/100 mL criterion.

A Recreational Use Attainability Analysis was conducted in South Lilly Creek by the Texas Institute for Applied Environmental Research in 2016 (*Texas Institute for Applied Environmental Research, 2017*). No recreational use of the stream was observed during the study period, and landowner interviews indicated that the stream was not used for contact recreation. Barriers to recreational use included access to the stream limited to road crossings, barbed wire fencing, logjams, thick vegetation, and venomous snakes. As a result of the study, TCEQ may choose to apply a secondary contact recreation standard.

Concerns for DO grab samples are shown in the 2022 IR. Four of the 23 DO readings fell below the 3 mg/L criterion and 2 mg/L screening level with a mean of 1.18 mg/L. No flow was reported for flow severity on the date of these four low DO readings.

Although not shown as a concern in the 2022 IR, five ammonia samples exceeded the 0.33 mg/L screening level with a mean of the exceedances of 2.09 mg/L. Three chlorophyll results exceeded the screening level with a mean of 17.17 µg/L while one nitrate and total phosphorus sample were reported over the screening level at 2.17 mg/L and 0.89 mg/L, respectively.

In 2023, NETMWD/WMS conducts quarterly monitoring for field parameters, flow, and bacteria at station 17954 at FM 2454 south of Pittsburg.

Figure 28: Station 17954 - South Lilly Creek at FM 2454

UNCLASSIFIED SEGMENT 0409D – LAKE GILMER

Lake Gilmer is located in central Upshur County. The reservoir was constructed in 2001 and covers approximately 1,010 surface acres. There were no concerns or impairments shown in the 2022 IR. Fourteen of the 49 chlorophyll *a* samples exceeded the 26.7 µg/L screening level with a mean of 40.81 µg/L. Three ammonia and four nitrate values exceeded their screening levels of 0.11 mg/L and 0.37 mg/L. The mean of the nitrate exceedances was 0.57 and ammonia was 0.27 mg/L.

Quarterly monitoring is conducted by the TCEQ Region 5 at stations 17478 (dam) and 18825 (FM 852) for conventional, bacteria, and field parameters.

UNCLASSIFIED SEGMENT 0409E – CLEAR CREEK

Clear Creek, located in Upshur County, is a small tributary to Little Cypress Creek. The 2022 IR shows a concern for non-attainment for impaired benthic community along with a concern for screening level for habitat. Biological monitoring was conducted in Clear Creek at station 18590 (Bobwhite Road) in June and August 2006. The mean benthic score was 19, well below the criterion of 29. The habitat quality index was 15 which is considered limited. No monitoring is scheduled in Clear Creek in 2023, but may be considered for future biological studies.

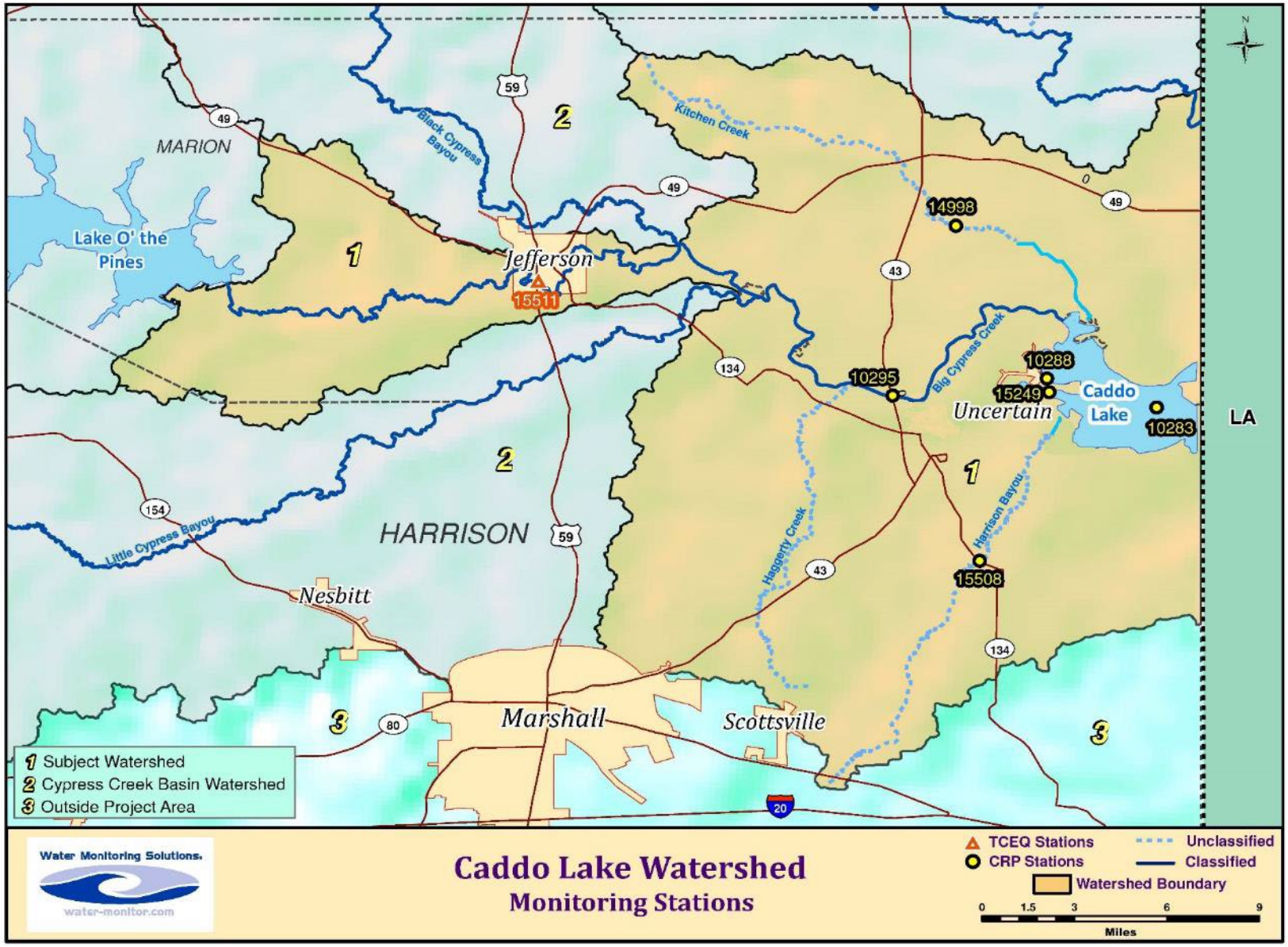

Figure 29: Map of Caddo Lake watershed

CADDO LAKE WATERSHED

The Caddo Lake and its watershed straddles the Texas and Louisiana border. It is in the rolling terrain of the Pineywoods Ecoregion. The landscape is a mix of rich bottomlands and pine and oak forests with scattered areas of cropland, planted pastures and native pastures. Caddo Lake has a surface area of approximately 26,800 acres with approximately half of the water body located within each state. Texas encompasses approximately 358 square miles of the 2,700 square-mile drainage basin. Caddo Lake and much of the surrounding watershed are swampland with shallow waters and towering bald cypress trees.

Urban development is sparse. The largest city is Jefferson, with a population of about 2,400. The land is predominantly used for agriculture, including forestry, poultry, and cattle production. Major tributaries include Black Cypress Bayou (0410), Little Cypress Bayou (0409), Kitchen Creek (0401B), Haggerty Creek (0401C), and Big Cypress Creek below Lake O' the Pines (0402). Black Cypress and Little Cypress Bayous are discussed in their respective sections.

Figure 30: Dr. Roy Darville sampling on Caddo Lake

SEGMENT 0402 – BIG CYPRESS CREEK (BAYOU) BELOW LAKE O' THE PINES

Segment 0402 is the portion of Big Cypress Creek that flows between Ferrell's Bridge Dam forming Lake O' the Pines and Caddo Lake. This segment is generally deep, wide, and supports heavy recreational use including boating and camping activities. The Big Cypress Creek watershed contains over five thousand acres of bottomland hardwood forest dominated by cypress swamps. Because of the uniqueness of the habitat, the TPWD has designated it an important recovery area for the state-threatened paddlefish.

Segment 0402 was identified in the *2022 Texas §303(d) List* as having elevated mercury in fish tissue, and the Department of State Health Services fish consumption advisory extends across the entire segment.

Assessment Unit 0402_01 is a 15 km reach of Big Cypress Creek between Caddo Lake and Haggerty Creek and has a concern for chlorophyll. Five of the fourteen results assessed exceeded the 14.1 µg/L screening level with a mean of 19.3 µg/L. Seven of 81 DO grab samples fell below the 5.0 mg/L screening level with a mean of 4.36 mg/L. All other samples obtained during the assessment period met their criteria and screening levels. Quarterly monitoring for conventional laboratory, bacteria, and field parameters is conducted at station 10295 at SH 43 by NETMWD/WMS.

Big Cypress Creek between Haggerty Creek and the confluence with Black Cypress Bayou (AU 0402_02) was first listed for depressed dissolved oxygen in 2010. The impairment was based upon one of the four monitoring events failing to meet the 5.0 mg/L 24-Hour DO Average criterion. The low measurement of 4.9 mg/L was collected in July 2010. At present, no sampling is being conducted in this reach. All sampling was discontinued in 2012. Access to the stream at this station ended after a change in property ownership. Other potential monitoring locations within this reach either pose safety concerns or are not representative of the assessment unit. Note that monitoring at station 16254, the City of Marshall water intake, was discontinued after FY 2009 due to the determination that the site was not representative of the assessment unit. The impairment will likely continue into future assessments until a suitable station is located.

Figure 31: Photo of Big Cypress Creek at station 10295 (AU 0402_01)

The portion of Big Cypress Creek between the confluences with Black Cypress Bayou and upstream to French Creek comprises AU 0402_03. Apart from mercury in fish tissue, there were no impairments in this reach. The 2022 IR showed a concern for impaired macroinvertebrate community. Biological sampling by CRP was last conducted in May 2007. The benthic organisms had a score of 24, falling below the 29 criterion. Critical period monitoring was not performed that year due to high water levels in the stream. Studies have been conducted by TPWD in this reach and are discussed in the biological section of the report.

Five of the nineteen chlorophyll results exceeded the 14.12 µg/L screening level with a mean of 20.72 µg/L. One DO grab value of 4.6 mg/L fell below the 5.0 mg/L screening level while one total phosphorus result exceeded the 0.69 mg/L screening level at 1.75 mg/L. All other samples met their criteria and screening levels. In 2023, quarterly monitoring for bacteria, conventional laboratory, and field parameters is being conducted by TCEQ at station 15511 at US 59.

Except for mercury in fish tissue, there were no concerns or impairments in AU 0402_04, the 13 km reach between French Creek and Lake O' the Pines. No samples were collected in this reach during the assessment period, and no sampling is scheduled in 2023.

Unclassified Segment 0402B Hughes Creek

Hughes Creek is a tributary of Black Cypress Bayou. An impairment for DO grab minimum for Hughes Creek was removed from the 303(d) List. The Coordinated Monitoring Committee determined that station 16936 at SH 155 was not representative and discontinued sampling at this location in 2020. Due to the station not being representative of the hydraulic conditions, the TCEQ removed the DO impairment from the 303(d) List in the 2022 IR. Quarterly sampling for field parameters and flow is being conducted by NETMWD/WMS at station 22321, located at CR 2985 northwest of Avinger.

Unclassified Segment 0402E Kelley Creek

Like Hughes Creek, Kelley Creek is also a tributary to Black Cypress Bayou. The 2022 IR included a concern for dissolved oxygen screening level. Five of the seventeen samples assessed fell below the 5.0 mg/L grab screening level with a mean of 3.72 mg/L. One DO grab sample value of 2.8 mg/L failed to meet the DO grab minimum criterion of 3.0 mg/L. NETMWD/WMS measures field parameters and flow quarterly at station 16934 at FM 250.

Figure 32: Station 16934 - Kelley Creek at FM 250

SEGMENT 0401 – CADDO LAKE

Caddo Lake is impounded by Caddo Dam in Caddo Parish, Louisiana. The uppermost portion of the lake extends into Harrison and Marion Counties in East Texas. Believed to have been formed by a log jam in the Red River, Caddo Lake was one of the largest natural lakes in the South before it was dammed in 1914. The upper half of the lake is shallow and swamp-like creating an unique and diverse ecosystem that is one of the best examples in the southern United States of a mature Bald Cypress forest. In recent years, it has been invaded by nonnative plants such as Hydrilla, water hyacinth (*Eichhoria crassipes*), and giant salvinia (*Salvinia molesta*). Efforts to control these invasive species are discussed later in this report.

In 1998, the Texas Department of State Health Services issued a fish consumption advisory for Caddo Lake due to high levels of mercury in fish tissue. As a result, all assessment units of Caddo Lake were listed for mercury in fish tissue in the *2020 Texas §303(d) List*.

Due to its shallow, swamp-like conditions, the most common water quality impairment in Caddo Lake was for low dissolved oxygen. Invasive aquatic plants often cover the entire surface of the arms of the lake, especially in the warm weather months, preventing sunlight from entering the water column and exacerbating the low dissolved oxygen problems.

Figure 33: Caddo Lake at station 10288 - Goose Prairie

Low dissolved oxygen values, especially during the warm months, are commonly reported in the Harrison Bayou arm (AU 0401_02), Goose Prairie arm (AU 0401_03), Clinton Lake (AU 0401_05), and mid-lake near Uncertain (AU 0401_07). Approximately one-third of the surface dissolved oxygen grab samples collected in these assessment units were reported below the screening level or criterion. Despite low dissolved oxygen in these areas, none of the samples collected during the assessment period at the mid-lake station 10283 fell below the dissolved oxygen criterion of 3 mg/L. The following graph of the surface DO grab samples collected between 2010 and 2018 showed that most low DO values were obtained during the warm weather months in these assessment units.

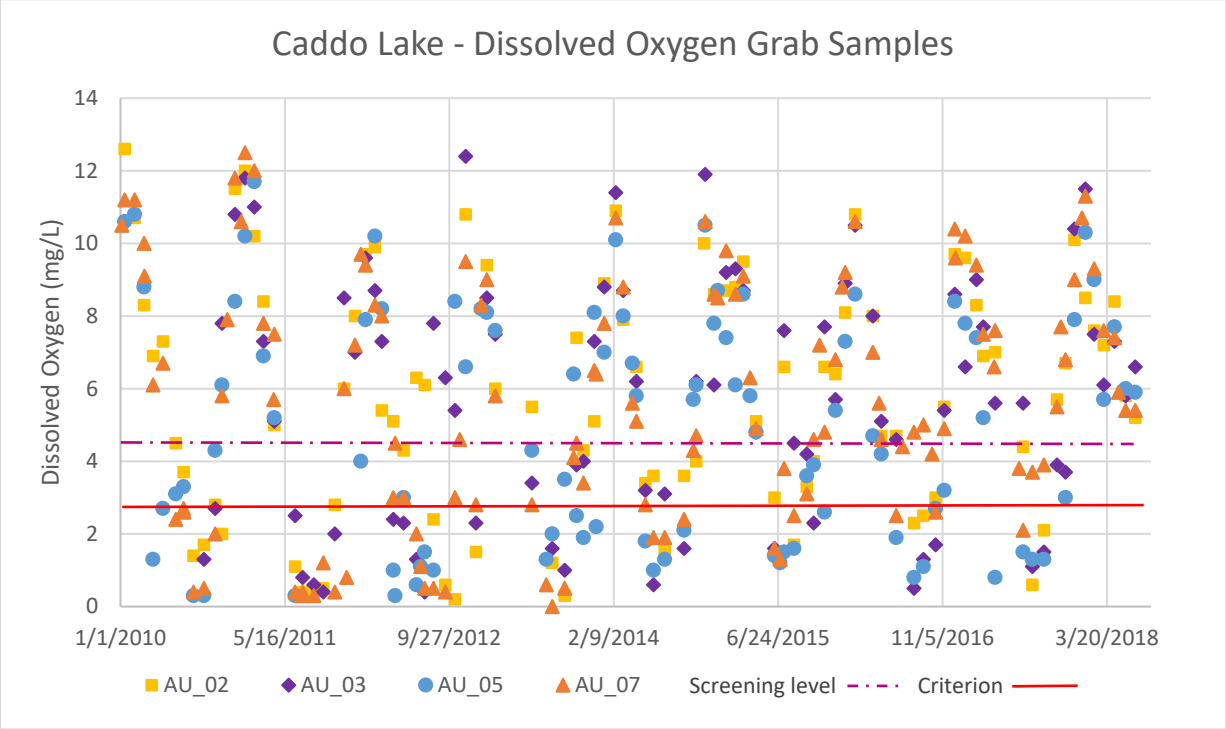

Figure 34: Graph of surface DO grab samples in Caddo Lake

The Harrison Bayou arm, Clinton Lake, and the mid-lake near Uncertain assessment units were impaired for not meeting the 24-Hour DO Average and 24-Hour DO Minimum criteria of 5 mg/L and 3 mg/L, respectively. It should be noted that these listings were carried forward from previous assessments into the *2022 Texas §303(d) List*. The Coordinated Monitoring Committee agreed to discontinue diel studies in Caddo Lake in 2009. Although numerous diel events had been conducted during the previous decade, these studies yielded similar low dissolved oxygen results and were possibly reflective of the natural oxygen cycles in the arms of Caddo Lake. As a result, stakeholders recommended that the limited CRP resources be directed elsewhere within the basin.

Impairments and concerns for DO grab readings were commonly found in the shallow assessment units of Caddo Lake. The Harrison Bayou Arm, AU 0401_02, showed a concern for the DO grab screening level. Approximately 32 percent of the DO grab readings were below the screening level of 5.0 mg/L with a mean of 3.22 mg/L. AU 0401_03, Goose Prairie Arm, is impaired for DO Grab minimum concentration. Ten of the 78 dissolved oxygen readings reported during the assessment period were below the 3 mg/L criterion with an average of 1.36 mg/L. Twenty-seven of the DO values fell below the DO Grab screening level of 5 mg/L. Clinton Lake, AU 0401_05, had a concern for the DO grab screening level with forty percent of the surface DO readings falling below the screening level while about a quarter of the DO values failed to meet the 3.0 mg/L DO grab criterion.

The mid-lake near Uncertain assessment unit, AU 0401_07, also showed a concern for the DO Grab screening level with 35 percent of DO values falling below the screening level while sixteen percent failed to meet the DO grab minimum criterion. It should be noted that fifteen percent of the total phosphorus results exceeded the 0.2 mg/L screening level with a mean of 0.36 mg/L while one nitrate value of 1.39 mg/L exceeded the 0.37 mg/L screening level. These were the only nutrient results to exceed the screening level at any station monitored during the assessment period.

The 2022 IR included a concern for screening level for iron in sediment in the lower 5,000 acres. This concern was a carry-forward from previous assessments as no sediment data were collected during the assessment period and no sediment sampling is currently scheduled.

Caddo Lake is monitored quarterly by NETMWD/WMS at stations 10283 (mid-lake), 10288 (Goose Prairie), and 15249 (Uncertain) for bacteria, conventional laboratory, and field parameters.

UNCLASSIFIED SEGMENT 0401A – HARRISON BAYOU

Harrison Bayou (0401A) is a tributary of Caddo Lake. The intermittent stream is approximately 14 miles long and extends from its confluence with Caddo Lake toward the southwest to a point just upstream of FM 1998, east of Marshall, Texas. Monitoring is conducted at station 15508 at FM 134 south of Karnack. Despite being relatively deep, field staff often report low or no flow at this station.

Harrison Bayou was shown as impaired for low dissolved oxygen in 2000 and was included in the *2022 Texas §303(d) List* for not meeting the 24-Hour DO Average and 24-Hour DO Minimum criteria. These impairments were carried forward from previous assessments as no diels were conducted during the assessment period. The reach also has a concern for the DO grab

screening level. Nine of thirty DO grab samples fell below the 5.0 mg/L DO screening level with an average of 2.9 mg/L while eight failed to meet the 4.0 mg/L DO grab minimum criterion.

Quarterly monitoring is conducted at station 15508 for flow, bacteria, conventional laboratory, and field parameters by NETMWD/WMS.

UNCLASSIFIED SEGMENT 0401B – KITCHEN CREEK

Kitchen Creek is an unclassified water body and a tributary of Caddo Lake. The stream crosses SH 49 near Smithland and drains into Clinton Lake east of Goat Island. There were no impairments of concerns shown in the 2022 IR for this waterbody. Unlike Harrison Bayou, all DO readings met the DO grab minimum criterion while one out of sixteen readings fell below the 3.0 screening level. Kitchen Creek is monitored quarterly by NETMWD/WMS for field parameters at station 14998.

Figure 35: Station 14998 - Kitchen Creek at CR 3416

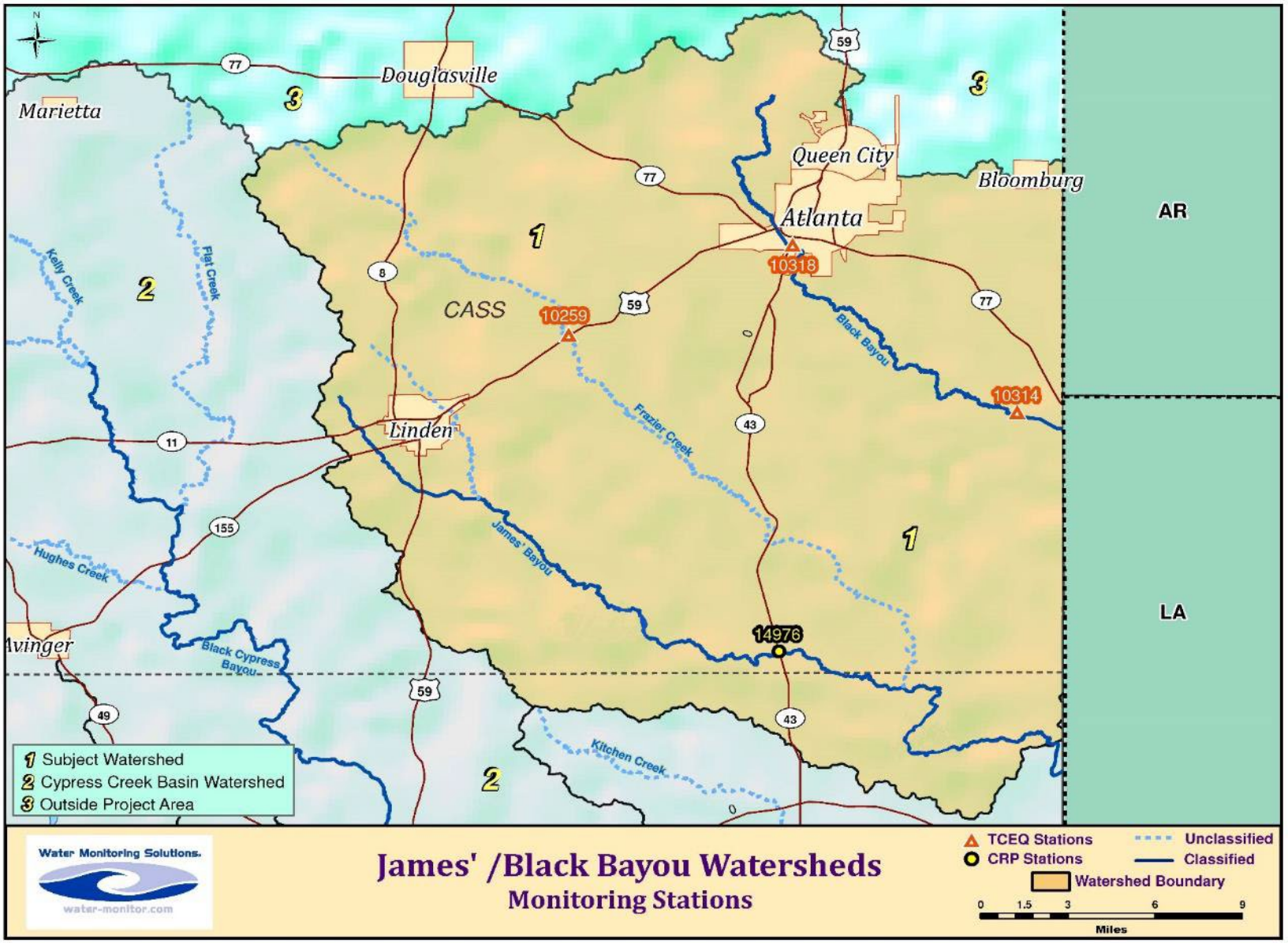

Figure 36: Map of James' Bayou and Black Bayou watersheds

SEGMENT 0406 – BLACK BAYOU

Black Bayou, a relatively small watershed, emerges near Wright Patman Reservoir in northeastern Cass County, flows through Atlanta, Texas and on to the Louisiana border. The stream is intermittent and traverses flat to gently rolling terrain that supports grasses, mixed hardwoods, and pines. Black Bayou is generally a slow, meandering water body with sand and clay loam bottom. During periods of low flow, the stream tends to become stagnant and dissolved oxygen levels decrease under these conditions. As a result, both assessment units of Black Bayou were impaired for depressed dissolved oxygen in the *2022 Texas §303(d) List*.

The upper assessment unit of Black Bayou, AU 0406_02, is a 28.6 km reach that extends from its headwaters downstream to its confluence with Hurricane Creek. The lower assessment unit (AU 0406_01) ranges from Hurricane Creek downstream 19.1 km to the Louisiana state line. Although the entire segment is classified as intermittent with perennial pools, Black Bayou has a high aquatic life use designation. Concerns for impaired benthic macroinvertebrate community are shown in both assessment units while concerns for fish and habitat are included for AU 0406_01 in the 2022 IR. Aquatic Life Monitoring was conducted in Black Bayou in September and October 2012 and in May and July 2014. Despite being the most downstream site and located below the City of Atlanta WWTP outfall, station 10314 was either completely dry or had only small pools during every sampling event except for May 2014.

Figure 37: Station 10314 – Black Bayou at CR 4659 in May 2014 (left) and July 2014 (right)

The upper assessment unit was shown as impaired for *E. coli* with a geometric mean of 176 MPN/100 mL. There are no permitted dischargers and very limited development within this reach of the stream suggesting that the high bacteria values are possibly due to non-point sources such as livestock and wildlife. The lower assessment unit shows a concern for non-attainment for bacteria, but since only seven samples were reported during the assessment period, a full assessment could not be completed. A Recreation Use Attainability Analysis may be considered to address the bacteria impairment.

Quarterly sampling for flow, bacteria, conventional, and field parameters are being collected by TCEQ at stations 10314 (CR 4659) and 10318 (SH 43) in 2023.

SEGMENT 0407 – JAMES' BAYOU

James' Bayou originates west of Linden and stream flows toward the southeast through pine and hardwood forests before crossing the Louisiana border to ultimately flow into Caddo Lake. The segment is classified as intermittent with perennial pools and has a high aquatic life use designation. James' Bayou is divided into two assessment units with the upper unit (AU 0407_02) extending from its headwaters to the confluence with Bear Creek near the CR 1779 crossing. The lower assessment unit, AU 0407_01, runs 31.6 km from Bear Creek to the Louisiana state line.

Since 2000, the upper assessment unit of James' Bayou has been impaired for not meeting the 24-Hour DO Average and Minimum criteria. From 2015 through 2018, WMS conducted 24-Hour dissolved oxygen monitoring four times per year to address the DO impairments. Out of eleven studies, two of the results fell below the 24-Hour DO Average criterion while four were reported below the 24-Hour DO Miniumum criterion. Most of the low 24-Hour DO occurred in the month of July. All of the low values were reported along with a stream flow measurement of 0 cfs. However, these impairments continued into the *2022 Texas §303(d) List*.

The lower assessment unit remains impaired for bacteria with a geometric mean of 194 MPN/100 mL based upon 26 samples. The upper assessment unit met the bacteria criterion.

The 2022 IR showed a concern for benthic macroinvertebrate community in both reaches along with a concern for habitat in the lower reach. The concern in AU 0407_02 was a carry-forward from previous assessments since no biological monitoring was performed during the assessment period. Four ALM events were conducted in AU 0407_01 in 2016 and 2017 at station 14976. Both the mean benthic and habitat scores fell into the intermediate range while

fish scored in the high category. A complete discussion of biological monitoring in James' Bayou was presented in the *2019 Cypress Creek Basin Summary Report*.

Figure 38: Station 14976 - James' Bayou at SH 43

NETMWD/WMS samples for flow, bacteria, conventional laboratory, and parameters on a quarterly basis at station 14976 at SH 43.

UNCLASSIFIED SEGMENT 0407B –FRAZIER CREEK

Frazier Creek is an unclassified water body that originates near US 59 in Cass County and flows southeast for 38.6 kilometers to its confluence with James' Bayou in Marion County. Frazier Creek has a relatively low level of human disturbance, serves as an ecoregion reference stream for the watershed, and is considered a Least Disturbed Stream.

Frazier Creek had no concerns or impairments shown in the 2022 IR. Previous integrated reports had concerns for dissolved oxygen; however, all samples collected during the current assessment period met the criteria and screening levels.

Since the watershed serves as an ecoregion reference stream and since TCEQ R5 discontinued sampling in this stream in 2018, the Coordinated Monitoring Committee decided to include Frazier Creek in the sampling schedule in 2022. Monitoring included bacteria, conventional, and field parameters along with biological monitoring. One ALM event was conducted in June 2022, but a second round could not be performed since the stream was dry throughout the critical period. The preliminary findings are discussed in the next section of the report.

In addition to conducting two more ALM events, NETMWD/WMS is scheduled to collect samples for flow, bacteria, conventional, and field parameters quarterly at station 10259 (US 59) in 2023.

Figure 39: Station 10259 - Frazier Creek at US 59

BIOASSESSMENTS AND SPECIES OF CONCERN

Currently, the following species found in the Cypress Creek Basin are being studied by the U. S. Fish and Wildlife Service for possible listing as Threatened and Endangered Species:

- **Alligator Snapping Turtle**
- **Western Chicken Turtle**
- **Louisiana Pigtoe Mussel**
- **Kisatchie Painted Crawfish**

This section also discusses threatened and endangered species listed by the TPWD, bioassessments conducted in the basin by TPWD River Studies, Aquatic Life Monitoring studies being performed by NETMWD/WMS, and invasive species and measures taken by the TPWD to control these species.

RARE, THREATENED, AND ENDANGERED SPECIES

Rare, Threatened, and Endangered species are taxa that are listed on the state and/or federal level. Endangered species are at serious risk of becoming extinct, while Threatened species are organisms that are likely to become endangered in the near future. On the state level, TPWD also includes species that are considered Imperiled or Vulnerable of becoming Threatened.

The TPWD maintains a list of state and federally listed rare, threatened, and endangered species. There are currently eleven aquatic species in the Cypress Creek Basin that are listed as threatened or imperiled by the State of Texas including nine fish, six mollusk, one crustacean, and two reptile species.

The statewide list of aquatic threatened (T) and imperiled (S) species in the Cypress Creek Basin is shown below. Imperiled species are identified as S1 – Critically Imperiled, S2 – Imperiled, and S3 – Vulnerable.

Taxon	Scientific Name	Common Name	State Listing
Fish	*Pteronotropis hubbsi*	bluehead shiner	T
	Percina maculata	blackside darter	T
	Erimyzon claviformis	western creek chubsucker	T
	Polyodon spathula	paddlefish	T
	Notropis maculatus	taillight shiner	S1
	Notropis chalybaeus	ironcolor shiner	S3
	Ammocrypta clara	western sand darter	S3
	Notropis atrocaudalis	blackspot shiner	S3
	Notropis sabinae	Sabine shiner	S3
Mollusk	Pleurobema riddellii	Louisiana pigtoe	T
	Lampsilis satura	sandbank pocketbook	T
	Potamilus amphichaenus	Texas heelsplitter	T
	Lampsilis satura	sandbank pocketbook	T
	Obovaria arkansasensis	southern hickorynut	T
	Fusconaia askewi	Texas pigtoe	T
Crustacean	*Orconectes maletae*	Kisatchie painted crawfish	S2
Reptile	*Macrochelys temminckii*	alligator snapping turtle	T
	Deirochelys reticularia miaria	western chicken turtle	S2, S3

Figure 40: Threatened and Imperiled aquatic species in the Cypress Creek Basin

Threatened fish species include the bluehead shiner (*Pteronotropis hubbsi*), blackside darter (*Percina maculate*), western creek chubsucker (*Erimyzon claviformis*), and the paddlefish (*Polyodon spathula*). The only critically imperiled fish is the taillight shiner (*Notropis maculatus*) while vunerable species are the ironcolor shiner (*Notropis maculatus*), western sand darter (*Ammocrypta clara*), blackspot shiner (*Notropis atrocaudalis*), and Sabine shiner (*Notropis sabinae*).

BIG CYPRESS BIO-BLITZ STUDIES

By Stephen Curtis, Texas Parks and Wildlife Department – River Studies

Texas Parks & Wildlife Department partnered with the Fishes of Texas at the University of Texas at Austin to conduct a bioassessment in the lower Red River, Sulphur River, and upper Cypress Creek basins in Northeast Texas. Two aquatic bioassessment study areas and fifty supplemental collection sites were sampled across thirteen counties during the fall of 2019 and fall of 2020.

The bioassessment study area included one site on Big Cypress Bayou at Couch Mountain Ranch where water quality, fish, mussels, benthic macroinvertebrates, riparian area, and stream health were collected. Fish were collected from fifty supplemental sites and all crayfish were documented. In addition to the Couch Mountain station (identified as B in the following map), three supplemental sites were monitored in the Cypress Creek Basin including two additional stations in Big Cypress Creek (#48 and #49 on the map) and one in Kelsey Creek below Lake Gilmer (#50).

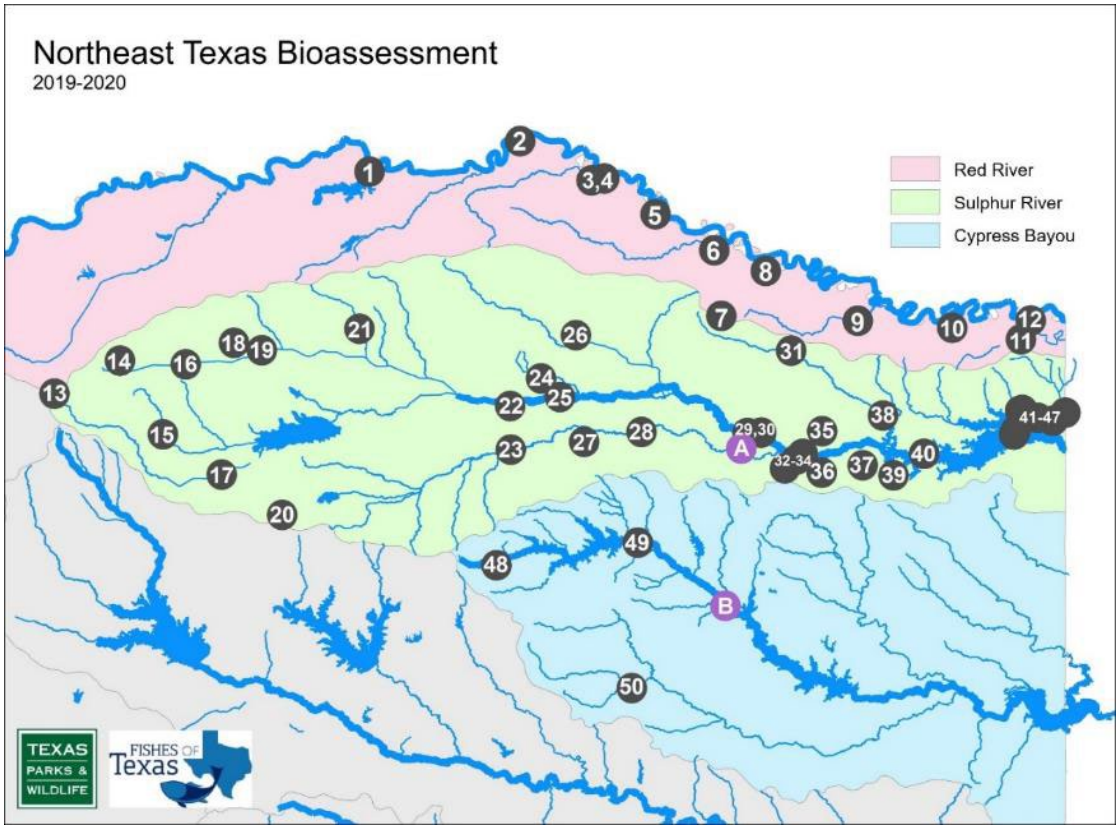

Figure 41: Locations of Northeast Texas Bioassessment data collection sites in the lower Red River, Sulphur River, and upper Cypress basins that were sampled in 2019 - 2020.

For the Big Cypress Creek at Couch Mountain bioassessment study site, fish were collected from all available habitat types by seining and backpack electrofishing. Expanding upon TCEQ sampling protocols, a minimum of ten seine hauls and 900 seconds of backpack electrofishing were conducted at each location until no new species were collected. For supplemental fish collection sites, appropriate gear types were chosen based on available habitat at each site and included sampling equipment such as seines, backpack electrofishing, trammel nets, gill nets, and frame nets.

Most large fish captured were identified, photographed, measured, and released. All other smaller specimens were identified in the field and individual representatives of each species were either photographed or retained as voucher specimens. Photographs of representative vouchers for each site can be found online at the iNaturalist Fishes of Texas Project. Voucher specimens were fixed in 10 percent formalin and taken back to the laboratory for identification (Hubbs et al. 2008) before being deposited in the Biodiversity Collections at the University of Texas at Austin. These data will be made available online through the Fishes of Texas Project (Hendrickson and Cohen 2015).

Figure 42: Assortment of photos from TPWD River Studies Bioassessments in Northeast Texas

Overall, a total of 951 individuals from 47 species and twelve families of fish were documented across all sampling sites in the basin. Fish species richness by site ranged from sixteen in Kelsey Creek to 32 species in Big Cypress Creek at US 271. A total of 22 spotted sucker (*Minytrema melanops*), a Species of Greatest Conservation Need, were collected in Big Cypress Creek at Couch Mountain and at SH 37 sites while one state-threatened species, Blackside Darter (*Percina maculate*), was collected in Big Cypress Creek at US 271. Several fish species that offer angling opportunities such as Spotted and Largemouth bass; Common Carp; Blue, Channel and Flathead catfish; White and Black crappie, and multiple species of sunfish were collected across the basin.

On average, 238 individuals representing 25 taxa were collected at all four stations. With 32 species collected, the greatest number of fish taxa were found in Big Cypress Creek at US 271 followed by 31 taxa at the Couch Mountain site. The most individuals, with 324, were collected in Big Cypress Creek at SH 37, located above Lake Cypress Springs. The most common species captured across the basin were longear sunfish (*Lepomis megalotis*) and bluegill (*Lepomis macrochirus*) at 79 individuals, followed by the Western mosquitofish (*Gambusia affinis*) at 73 and the bullhead minnow (Pimephales vigilax) with 70.

This study updated fish occurrence records for four sites across the Cypress Creek Basin. This information will be used in conservation planning by TPWD for their Native Fish Conservation Areas initiative (Birdsong et al. 2019). A final report summarizing this effort along with additional data collected during these events will be published in a report as part of TPWD's River Studies Report Series.

A complete list of taxa collected at these locations is included in the appendix.

A Tribute to the Western Chicken Turtle in Texas

By Mandi Gordon, Environmental Institute of Houston at the University of Houston – Clear Lake

Three years ago, we began searching for a small, ephemeral wetland dwelling freshwater turtle species that many in east Texas had never heard of – the Western Chicken Turtle (*Deirochelys reticularia miaria*). Over the years, I've heard the same question: "Why do they call it a chicken turtle?" While a few suggestions for how the chicken turtle got its name have been made, some of them are more plausible than others. For example, some have suggested that the term "chicken" derives from the taste of its meat (have you ever heard the term "it tastes like chicken"?). But it's hard to believe that enough meat comes from such a small bodied organism – at their maximum size, they are generally the size of a dinner plate – that this was common enough to make it withstand history. Others have posited that the common name is derived from the resemblance of the reticulate pattern on the carapace being representative of chicken wire. While this seems more reasonable, when you consider that the species was originally named in 1801 and chicken wire wasn't invented until the mid-19th century, it's hard to be sure. A third suggestion has been that, when the Chicken Turtle extends its long, characteristic neck, it resembles that of a defeathered chicken neck. To me, this may be the most likely explanation, but with over 200 years between the original naming of the species and now, we may never really be sure. One thing we can be sure of, the Western Chicken Turtle can be found in east Texas.

Previous state-wide surveys of the chicken turtle resulted in very few observations; not by any fault of the researchers or their methods, but more-so due to the species' ability to elude observation and capture. While some species, like the Red-eared Slider (*Trachemys scripta elegans*) are so plentiful, they'll live in a hole if you dig one (I'm being hyperbolic here, but I don't doubt this scenario happening), the Western Chicken Turtle appears to be shyer than most other endemic species. How then, do you not only find a species with less than 100 verified reports in the past 100 years, but also do so over an area as large as east Texas? We had to think "outside the box". Over the past three years, we have applied multiple field sampling techniques to determine the distribution and habitat associations of this cryptic species. I called it the "spaghetti method" – we threw a bunch of "noodles" (e.g., field protocols) against the "wall" to see what "stuck". We tested five methods of environmental DNA protocols. We used detector dogs. We looked for them with binoculars and by cruising along roadways. We set traps, we installed game cameras, we even flew drones over habitats to see if this elusive species could be spotted using near-infrared technology. All in all, we ended up testing 14 protocols; turns out, almost every method we tried "stuck". We were able to confirm the presence of Western Chicken Turtles at four sample areas where they were known to occur – an important step to testing novel sampling protocols. We also confirmed

presence in four more areas where the species was suspected to occur, but had not been confirmed, including northeast Texas.

Much of our success is due to the efforts put forth by previous researchers. Pioneers in chicken turtle population monitoring, like J. Whit Gibbons and Kurt Buhlmann from the eastern extent of the chicken turtle's range, are responsible for the majority of our understanding about the species life history. Experts from Texas, like Brandon Bowers, Wade Ryberg, Toby Hibbitts, and Danielle Walkup at the Natural Resources Institute at Texas A&M University and Paul Crump from the Texas Parks and Wildlife Department are responsible for much of what we know about how the western subspecies moves within and between habitats and are collecting important data related to best practices for population monitoring and reproduction. With so many people dedicating years, even decades, of their lives to research on this species, the inevitable question arises – why do we care? What is it about the chicken turtle that makes so many agencies (from state wildlife, conservation, and protection agencies throughout the species range all the way to the U.S. Fish and Wildlife Service) so concerned about understanding its presence, distribution, and survival?

As part of the southeastern United States, east Texas hosts some of the most biologically diverse habitats in the world. Biodiversity is an important factor in maintaining the balance between humans and their environment. As humans expand into new areas, building impervious surfaces like concrete roads, dams to create reservoirs, or cultured fields to support the needs of an expanding human population, understanding how human alterations impact species which have survived in these areas for centuries is critical to our ability to coexist with nature. By understanding where certain species occur, what types of habitats they use, and how they use these habitats to survive, we can intelligently advance and plan future land development in ways to maintain the integrity of our natural biodiversity. The Western Chicken Turtle has been petitioned for protections under the Endangered Species Act, primarily due to habitat loss or fragmentation, and the Species Status Assessment is due for public review in 2024. In order for the U.S. Fish and Wildlife Service to make an educated decision on whether or not to protect the species under the Endangered Species Act, we need to understand what the current status is for the species. While our three-year assessment of the Western Chicken Turtle was successful in validating 13 of the 14 detection methods we used, we did not see chicken turtles in high numbers. Overall, our efforts resulted in a combined total of 36 observations or reports in only 10 locations, which represents only 15.2 percent of all our survey areas. What do these low numbers mean for the future of the species? Are our limited number of observations an indicator of a dwindling population in east Texas, or does it confirm that this species is very good at doing exactly what it's done for decades – hiding from plain sight? These are questions we may not be able to answer right now, but as we collect more information, we may be able to answer them in the future.

As we wrap up with this project, I reminisce about the day I received a call from Randy Rushin, long-time partner of the Environmental Institute of Houston and the University of Houston-Clear Lake. Less than 24-hours after I presented about our Western Chicken Turtle project to an audience of Clean Rivers Program stakeholders in northeast Texas (introducing many of them to the species for the first time), I answered my phone to an obviously tickled Randy: "Remind me how to identify a chicken turtle?" My response was along the lines of, "Are you [messing] with me right now?" (I can't repeat exactly what I said), but, low and behold, after a few texted photos, we were able to confirm that Randy had just happened to walk out on his patio at the end of a long day and spot a rare specimen. I think this accurately represents the importance of researchers developing partnerships with private landowners and stakeholders. These partnerships are integral in the collection of holistic and pertinent data for the conservation of species in Texas.

This work was funded by the Texas Comptroller of Public Accounts Natural Resources Program and Sabine River Authority of Texas. None of this work would be possible without our project partners, especially J.J. Apodaca with Tangled Bank Conservation and Laura Speight of SP8 Ecoservices. Numerous graduate students, field technicians, and field volunteers were responsible for endless days in the heat, humidity, and clouds of mosquitoes which run rampant in east Texas. For questions related to this project or others, please contact Mandi Gordon (gordon@uhcl.edu; 281-283-3794). More information about the Environmental Institute of Houston at the University of Houston-Clear Lake can be found online at eih.uhcl.edu, including copies of the final reports for our state-wide assessment of the Western Chicken Turtle.

Figure 43: Examples of Western Chicken Turtles (WCT; Deirochelys reticularia miaria) observed during state wide assessments. Top left: dead WCT salvaged during preliminary canid scent surveys (CSS) (photo credit: M. Gordon). Top right: basking WCT observed during binocular assisted visual surveys (BAVS) (photo credit: J. Welch). Middle left: live WCT detected and captured during a CSS (photo credit: D. DeChellis). Middle right: swimming WCT observed during drone surveys using the Mavic 2 Enterprise Dual (Drone$_{M2}$). Bottom left: WCT found crossing the road and reported to our citizen-science based online reporting tool (ORT; photo credit: T. Bowman). Bottom right: WCT found crossing a drag strip and reported to the ORT (photo credit: B. Pachar).

LOUISIANA PIGTOE MUSSEL

The Northeast Texas Municipal Water District has long recognized the importance and value of biological monitoring in the Cypress Creek Basin. The NETMWD has performed aquatic life monitoring in numerous watersheds over the years to gain an understanding of the biological integrity of the streams within the Basin. At present, over thirty stations have been studied.

Freshwater mussels play an important role in aquatic ecosystems. They provide a food source for many organisms, and as filter feeders, help clean the waters in which they reside by collecting organic particulate, bacteria, and algae, as well as accumulating contaminants in their soft tissues. Because they have limited mobility and are typically long-lived, freshwater mussels are sensitive to changes in their environment and can serve as bioindicators of water quality. Unfortunately, severe declines in freshwater mussel populations have been recently documented.

The decline of freshwater mussel populations has become an important focus for research over the past decade as fifteen Texas species are being considered for listing as threatened or endangered. Current literature suggests that of the three East Texas species under consideration in the ongoing U.S. Fish and Wildlife (USFWS) Species Status Assessment, the Louisiana pigtoe (*Pleurobema riddellii*) is found in the Cypress Creek Basin. The Louisiana pigtoe occurs only in stream and river habitats with low to moderate flow and with silty sand, clay, and sand with gravel substrates. They are often relatively small, but individuals about five inches in length have been collected in Texas.

The USFWS has recently engaged river authorities and water districts to review and comment on the proposed listings of these East Texas species for the current Species Status Assessment (SSA). However, responding to the request is difficult as there is a limited amount of sampling data available in the literature in this area of the state.

At present, TCEQ has not established a mussels sampling protocol; however, all collection methods include tactile sampling, meaning that the sampler must reach into the sediments and feel for the mussels. Depending upon the depth of the water body, sampling may require the use of snorkels and/or diving gear. Since most waters in East Texas are tannin-laden, visibility is often very limited. As a result, mussels sampling is typically labor-intensive and time-consuming.

Fish play a significant role in the life-history of freshwater mussels, as the larvae (glochidia) of most species become encysted on their fish hosts. Research suggests that glochidia will only successfully attach to specific fish species. Glochidia that fail to attach to a suitable host or attach to the wrong location will die. The glochidia will implant into the host fish and develop

into juvenile mussels over a period of weeks to months. Once fully developed, the juvenile mussel detaches from the host fish and matures on the stream bed. The dispersal of most mussels is dependent upon the distribution of suitable host fish, and therefore, the distribution of a mussel species is likely heavily influenced by the effectiveness and breadth of host fish utilized (Schwalb *et al*. 2013).

In a 2018 study of wild-caught East Texas fishes (Marshall, et. al.), the Louisiana pigtoe glochidia were found at low prevalence and intensities suggesting that the conservation status of the mussel is strongly influenced by its ability to successfully encounter and attach to a suitable host fish. Glochidia were only found on the Blacktail Shiner (*Cyprinella venustra*), Bullhead Minnow (*Pimephales vigilax*), and Red Shiner (*Cyprinella lutrensis*) making them suitable host species (Ford and Oliver, 2015; Ford, Plants-Paris, Ford, 2020).

Due to this relationship, sampling fish populations and abundance in streams may be used as an indicator for the potential presence or absence of the Louisiana pigtoe. If these host fish species are not present, or not present in relative abundance, then the Louisiana pigtoe is less likely to be found at this location. In this way, the fish sampling data can be used to prioritize watersheds for mussels sampling efforts in order to use mussels sampling funds efficiently.

A review of the TCEQ database showed that these potential host fish species have been collected in several streams within the Cypress Creek Basin, although in very low abundance. However, the sampling effort in Tankersley Creek in 2020 and 2021 indicated that the present techniques and electrofishing technology may yield better sampling efficiencies than that of past decades. The Tankersley Creek results indicated that the host fish species for the Louisiana pigtoe were in relative abundance at this station.

More information about state-threatened freshwater mussels and ongoing studies for species of concern is available at the US Fish and Wildlife Service website.

Figure 44: Louisiana pigtoe (Pleurobema riddellii) photo by US Fish & Wildlife Service

KISATCHI PAINTED CRAWFISH

Crayfish, in general, are keystone species that may indicate the health of a watershed, and nearly half of crayfish species are vulnerable, threatened, or endangered. The Kisatchie painted crayfish (*Faxonius maletae)* has few historical records and is believed to be restricted to the Kisatchie Bayou and Bayou Teche watersheds in Louisiana and the Cypress Creek watershed in Texas. Historical collecting locations were obtained from TPWD, and recent field surveys determined that the Kisatchie painted crayfish was absent from 60 percent of its historical range in Texas. It is characterized by an olive carapace or hard, upper shell and the red marks on the chelae (claws), legs, and above the eyes. The size of Kisatchie painted crayfish appears to be influenced by water depth. Individuals found in deep water have been documented to reach lengths of 101.6 mm, while those found in shallow water rarely reach lengths over 50.8 mm.

Little is known about the habitat requirements of the Kisatchie painted crayfish. They were historically collected in freshwater streams with sand, gravel, mud, or silt; however, the Texas habitat tended to be more stagnant and muddier than in Louisiana. The Kisatchie painted crayfish may prefer streams with varying water depth, heavy leaf litter, and cobble-lined stream bottoms.

In 2021, researchers from Stephen F. Austin State University collected and confirmed the identification of Kisatchie painted crawfish in Prairie Creek, a tributary of Big Cypress Creek. In August 2022, NETMWD and WMS staff collected six individuals in Hart Creek while both seining and electroshocking. Three individuals were collected in 2021 by Texas Tech researchers in Little Cypress Creek and its tributaries.

Figure 45: Kisatchie painted crayfish (Faxonius maletae) collected by NETMWD and WMS staff in Hart Creek

Information regarding these species of concern is also available at the NETMWD and USFWS websites. If you see an individual that you suspect is one of these species, please take a photo and contact the NETMWD at 903-639-7538. Please include the date, time, and location of the sighting.

Figure 46: Western chicken turtle detected by Laura Speight's dog, Raine (left); western chicken turtle observed near the author's home (right)

In August 2022, the USFWS recognized the NETMWD as the 2021 FWS Partner of the Year for their commitment to conserving, protecting, and enhancing wildlife in the Cypress Creek Basin.

This recognition was a result of their assistance and collaboration in relocating and monitoring 27 alligator snapping turtles that had been captured by illegal traffickers.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Post Office Box 1306
Albuquerque, New Mexico 87103

In Reply Refer To:
FWS/R2/ARD-EA/077565

Mr. Walt Sears
North East Texas Municipal Water District
4180 FM250
Hughes Springs, Texas 75656

Dear Mr. Sears:

Congratulations on your selection as a 2021 FWS Partner of the Year! This award recognizes external partners who have made significant contributions to the U.S. Fish and Wildlife Service mission accomplishment in the Southwest Region and was presented during a recent ceremony here in Albuquerque.

In June 2021, you joined with Service employees and 17 other partners to facilitate repatriation of 27 alligator snapping turtles to their home waterways in East Texas, five years after Law Enforcement Officers seized them from illegal traffickers. This collaborative, public-private re-wilding effort leveraged innovative technologies and set a standard for community-grounded conservation. In addition to providing for the survival of the confiscated turtles, the work contributed to public awareness of the species and threats to its existence.

Partnerships are essential to our ability to conserve, protect and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. We are grateful to count you among our valued partners in the Southwest Region.

Sincerely,

AMY LUEDERS

Digitally signed by AMY LUEDERS
Date: 2022.08.31 13:12:57 -06'00'

Regional Director

Figure 47: NETMWD received 2021 USFWS Partner of the Year

AQUATIC LIFE MONITORING

The TSWQS establishes the criteria for water quality conditions that need to be met in order to support and protect designated uses as detailed in Title 30 Texas Administrative Code, Chapter 307. To evaluate support of existing Aquatic Life Uses, the TCEQ established an index period, representing the warm-weather seasons, during which most bioassessments of aquatic assemblages in freshwater river and stream systems should be conducted. Bioassessment sampling for freshwater streams must be conducted during the index period of March 15 to October 15. A subset of the samples should be collected during critical conditions (July 1–September 30) when minimum stream flows, maximum temperatures, and minimum DO concentrations typically occur in Texas streams. These data help determine whether the criteria set for the designated uses are being met and maintained when streamflow is at or above critical low flow. The assessors work under the assumption that criteria met under these conditions would also be met during other seasons when expected stream flow is greater and water temperatures are lower.

The index period was established to:

- Minimize year-to-year variability resulting from natural events.
- Maximize gear efficiency.
- Maximize accessibility of targeted assemblages.
- Ensure that a portion of the samples is collected during critical low-flow and temperature conditions.

Aquatic Life Monitoring consists of collecting and evaluating habitat observations, fish species, and benthic macroinvertebrate organisms. Water quality parameters and stream flow measurements accompany these data. Habitat analysis includes the measurement of stream width, depth, bank slope, and tree canopy at five to six transects throughout the stream reach. Observations such as bed substrate type(s), erosion potential, instream cover, riparian vegetation, and riparian buffer width are recorded.

Due to low prevalence of riffles in East Texas streams, benthic macroinvertebrates are most often collected using a five-minute kicknet technique with a D-frame net. The kicknet technique consists of sweeping the net for five minutes over habitat such as aquatic macrophytes, overhanging vegetation, root mats, undercut banks, leaf packs, and woody debris. The sample is placed on a sorting tray and up to 200 invertebrates are collected and placed in ethanol. The organisms are then identified and enumerated in the laboratory.

Fishing is conducted using both seining and electroshocking techniques. At least six seine hauls of ten meters each are performed. Woody debris, snags, Cypress knees, and logjams frequently obstruct the seine net in East Texas streams so seine hauls of less than ten meters are not

uncommon. As a result, ALM studies in the Cypress Creek Basin often have more than six seine hauls. The electroshocking method is non-lethal and is used to stun and turn fish. Shocking is performed for a minimum of 900 seconds or until no new species are collected. During collection, fish are netted and placed in an aerated bucket. Unless requiring a microscope for identification, all fish are returned to the stream after identification, enumeration, and voucher photos are taken.

Figure 48: Electrofishing (left) and seining (right)

Once collected, these data are processed and scored using a set of metrics specific to the ecoregion where the stream is located. It should be noted, however, that habitat is scored using state-wide metrics. Up until recently, benthic analysis was also scored on state-wide metrics while fish have used regionalized metrics for over two decades. The results of these analyses are then categorized as Exceptional, High, Intermediate, or Limited.

Bioassessments of benthic organisms often fall into the Intermediate category in the Cypress Creek Basin (Crowe and Bayer, 2005, Rogers and Harrison, 2007). One might infer that impaired water quality is negatively affecting benthic diversity; however, the benthic population is diverse with over 285 species collected in the Basin. Impaired water quality that negatively affects the benthic community should also negatively impact the fish community. Biological monitoring results indicate this is not the case in the Cypress Creek Basin. Rather, state-wide scoring metrics may not accurately reflect the benthic populations in the basin.

The average habitat score of the basin is on the borderline of Intermediate and High. Some components of the statewide habitat assessment metrics include the number of riffles, types of substrate, and emergent vegetation. Many streams in the basin will have an artificially reduced HQI score due in part to these metrics (Crowe and Hambleton, 1998). Most perennial streams

in East Texas function as glide/pool rather than as riffle/run. Streams typically have low velocity and due to the murkiness of the water, it is often difficult to determine where a pool begins and ends without making stream width and depth measurements. Riffles are not common in the basin and are mostly found in the western portion of the basin. When riffles are present, they are usually found in small, intermittent streams that often become completely dry without pools during extended periods of drought.

While it is common to find aquatic plants along stream margins, due to the high turbidity, erosional sediments and heavy tree canopy, emergent macrophytes are seldom encountered within the stream channel. Even though the riparian zone may be natural and show few, if any, signs of human impact, the habitat may still score in the Intermediate range. For example, Frazier Creek is considered an ecoregion reference stream and has been classified as a "Least Disturbed Stream" (Bayer et al., 1992; Linam et al., 1999). Due to these designations, one would expect HQI scores for Frazier Creek to be in the High or Exceptional categories. However, the assessors scored the habitat at 18.5 (Intermediate) during both monitoring events in 2003. While habitats such as riffles and emergent vegetation are important to supporting diverse biota, an ecoregion-specific habitat assessment would better describe streams within the Cypress Creek Basin especially when considering that the least impacted reference sites should represent realistic, attainable conditions for aquatic ecosystems (Omernik, 2014).

Figure 49: Bullhead minnow, Pimephales vigilax (top) and Blacktail shiner, Cyprinella venusta (bottom)

A review of the TCEQ database showed that the host fish species of the Louisiana pigtoe mussel have been collected in several streams within the Cypress Creek Basin, although mostly in low abundance. However, the sampling efforts in Tankersley Creek in 2020 and 2021 suggested that

the current fishing protocols and latest electrofishing technologies may yield better sampling efficiencies than those of previous decades. For example, out of the four sampling events conducted in Tankersley Creek in 1997, 1998, and 2003, a combined total of 18 individuals from the host species were collected. The June 2021 effort alone yielded 209 individuals. These results suggested that stations last sampled in the late 1990's and early 2000's should be reevaluated to provide a better representation of the overall health of the biotic community.

The NETMWD identified six priority watersheds that are suspected to support the Louisiana pigtoe mussel along with the other species of concern discussed in the previous section. Five of these streams are in Segment 0404 and are tributaries to Big Cypress Creek. The most recent biological data from these five streams were collected in 2003.

The Coordinated Monitoring Committee agreed that ALMs should be performed in Hart Creek and Frazier Creek in 2022 and 2023. In July 2022, the TCEQ CRP awarded the NETMWD with funding to support ALM studies in four additional watersheds that are tributaries to Big Cypress Creek above Lake O' the Pines. In addition to gathering the information needed to assess whether the streams met their Aquatic Life Use designations, the results of these studies will also assist in identifying and prioritizing streams for potential Louisiana pigtoe mussel sampling in the future. Monitoring will be conducted during the index and critical periods of 2023 in these priority streams:

Segment	Description
0404	Big Cypress Creek
0404C	Hart Creek
0404J	Prairie Creek
0404I	Swauano Creek
0404L	Boggy Creek
0404M	Greasy Creek
0407B	Frazier Creek

Figure 50: Aquatic Life Monitoring watersheds in FY 2022 - 2023

As discussed in the previous section, mussels sampling is often very labor-intensive and time-consuming. However, fish data can be used to evaluate the prevalence and abundance of known host species of the Louisiana pigtoe. If the host species are not collected or few individuals are observed, then one can assume that the Louisiana pigtoe mussel is unlikely to be found in the watershed. The results of these bioassessments will assist the NETMWD in prioritizing watersheds for future mussel studies, thereby using their funds more efficiently and effectively.

Since drought conditions were prevalent throughout the summer and fall of 2022, some of the scheduled monitoring was not performed. Critical period sampling was not conducted in Frazier Creek and Prairie Creek since both streams were dry. No sampling was conducted in Swauano Creek because it was dry during the entire monitoring period. Bioassessments were completed in Hart Creek, Boggy Creek, and Greasy Creek during the index and critical periods.

SEGMENT 0404C - HART CREEK

Hart Creek arises near CR 1635, north of interstate 30 and generally travels along the eastern border of the City of Mount Pleasant. The stream traverses through a mostly rural area with improved pastures and forested land. The City of Mt. Pleasant WWTP, which is permitted to discharge up to three million gallons per day, is located approximately 0.34-mile upstream of the monitoring station. Biological sampling was conducted at station 10266 at CR 4550 in June and August 2022. Due to discharges from the WWTP, Hart Creek had flows of approximately 2.5 cfs during both events.

Figure 51: Station 10266 - Hart Creek at CR 4550

The habitat results were on the border between the Intermediate and Limited categories while the benthos fell into the Intermediate classification using both the state-wide and regionalized

scoring metrics. Despite the low habitat scores, fish populations scored in the Exceptional category during both sampling events. A combined total of 325 individuals representing 28 fish taxa were collected in the stream. While seining and electrofishing during the August event, six Kisatchie painted crawfish were collected. Photos were taken of the individuals before returning them to the stream. The identification was confirmed by TPWD River Studies staff.

Eight individuals from six darter species were collected including the cypress darter (*Etheostoma proeliare*), redfin darter (*Etheostoma whipplei*), dusky darter (*Percina sciera*), and logperch (*Percina caprodes*). The Louisiana pigtoe host fish species of bullhead minnow (*Pimephales vigilax*) and blacktail shiner (*Cyprinella venusta*) were identified and represented a combined 36 percent of all individuals collected in the stream. Coupled with the sandy loam stream bed of Hart Creek, these preliminary results indicate that Hart Creek may be a good candidate for future mussels sampling.

Figure 52: Station 15895 – Boggy Creek at SH 49

SEGMENT 0404I - BOGGY CREEK

Boggy Creek is classified as intermittent with perennial pools and has an Aquatic Life Use designation of limited. The stream travels through mostly unpopulated and forested lands from its origination near the City of Omaha to its confluence with Big Cypress Creek west of Ellison Creek Reservoir.

Sampling at station #15895 at SH 49 was conducted on August 6 for the critical period and on September 30, 2022 for the index period. The stream was intermittent during both monitoring events but had water throughout the majority of the 200-meter reach. Due to being intermittent, dissolved oxygen was extremely low with 0.6 mg/L in August and 1.5 mg/L in September.

Despite the low DO readings, the fish were abundant, diverse, and scored in the High category during both events. Habitat scored as Intermediate while the benthos scored in the Limited category using both state-wide and regionalized metrics. Twenty-four taxa and 493 individuals were collected in 2022 in Boggy Creek. Although none of the Louisiana pigtoe host fish species were collected, a spotted sucker (*Minytrema melanops*), a species of greatest conservation need, was captured. Four slough darters (*Etheostoma gracile*), one bluntnose darter (*Etheostoma chlorosomum*), one white crappie (*Pomoxis annularis*), four black crappies (*Pomoxis nigromaculatus*), along with six species of sunfish including a flier (*Centrarchus macropterus*).

Figure 53: Spotted sucker (Minytrema melanops) – top; Bluntnose darter (Etheostoma chlorosomum) - bottom

SEGMENT 0404M - GREASY CREEK

Greasy Creek is classified as intermittent with perennial pools and has a limited Aquatic Life Use designation. Apart from the Lafayette community near its headwaters, the watershed of Greasy Creek is almost entirely forested and unpopulated. Monitoring was conducted at station #16016 at FM 557 on August 6 for the critical period and on September 30, 2022, for the index period. The study reach had been channelized at some point in the distant past, and the entire reach had mostly uniform width, depth, and substrate. Although there was no flow, water was connected the entire length. Due to being intermittent, dissolved oxygen was extremely low with 0.7 mg/L in August and 3.5 mg/L in September.

Although DO readings were very low, the fish scored in the High category during both events. Due to the stream channelization, the habitat scored as Limited; however, the benthos scored in the Intermediate category using both state-wide and regionalized metrics. Over two hundred individuals from twenty taxa were collected during both events combined. Only seven bullhead minnows (*Pimephales vigilax*) were identified while none of the other Louisiana pigtoe host fish species were collected. A single spotted sucker (*Minytrema melanops*) was captured during the September event. Three bluntnose darters (*Etheostoma chlorosomum*) and two logperch (*Percina caprodes*) were collected. Other species collected include six black crappies (*Pomoxis nigromaculatus*), a freckled madtom (*Noturus nocturnus*), and two channel catfish (*Ictalurus punctatus*).

Figure 54: Station 16016 - Greasy Creek at FM 557

SEGMENT 0404J - PRAIRIE CREEK

The headwaters of Prairie Creek are located south of Pittsburg and travel through developed areas in the upper reaches near US 271. The stream traverses over mostly unpopulated forested land interspersed with some improved pastures for the remainder of its journey to the confluence with Big Cypress Creek. Prairie Creek is classified as intermittent with perennial pools and has a limited Aquatic Life Use designation. Index period monitoring was conducted at station #15836 at FM 557 on October 21, 2022. The study reach had been entirely dry through September; however, enough rain fell in early October to reconnect the stream to Big Cypress Creek for a couple of weeks allowing fish to move upstream to the study area. Although there was no flow, water was connected through most of the study reach.

Due to being intermittent, dissolved oxygen was extremely low at 1.2 mg/L. Similar to the other intermittent stations with low DO, the fish scored in the High category. The habitat was much more diverse than Greasy Creek and scored as Intermediate while the benthos scored in the Intermediate category using state-wide metrics and Limited with regionalized metrics.

Figure 55: Station 15836 - Prairie Creek at FM 557

Almost three hundred individuals from nineteen taxa were collected during this single event. More individuals were collected in this event than in both events combined in Greasy Creek and nearly as many as Hart Creek combine. Five bullhead minnows (*Pimephales vigilax*) were captured, but none of the other Louisiana pigtoe host fish species were identified. A single

spotted sucker (*Minytrema melanops*) was also captured in Prairie Creek. One bluntnose darter (*Etheostoma chlorosomum*) and one Cypress darter (*Etheostoma proeliare*) were collected. Other species collected include five orangespotted sunfish (*Lepomis humilis*), two pugnose minnows (*Opsopoeodus emiliae*), and two largemouth bass (*Micropterus salmoides*).

Research studies being conducted in Prairie Creek and Big Cypress Creek by Dr. Carmen Montana at Stephen F. Austin State University were discussed in the *2022 Cypress Creek Basin Highlights Report*. The project is designed to understand spatial connectivity of waterways and the organization of fish communities. Surveys were conducted in September 2021 at five sites in or associated with Big Cypress Creek. Overall, they recorded 439 individuals from 35 fish species including the spotted sucker (*Minytrema melanops*) and the ironcolor shiner (*Notropis chalybaeus*) which are both species of greatest conservation need. They also collected and verified the identification of the Kisatchie painted crawfish. Their work continued into 2022 but results were not available at the time of this writing.

SEGMENT 0407B – FRAZIER CREEK

As discussed in the previous section, Frazier Creek is considered a least disturbed stream and an ecoregion reference stream due to its watershed having very little impact from development or human influence. The stream is divided into two assessment units with the upper unit extending from its headwaters east of SH 8 and south of Douglassville for fifteen miles to US 59. The lower assessment runs 24 miles from US 59 to the confluence with James Bayou. The watershed of the stream is almost entirely unpopulated consisting of forested land interspersed with a few small tracts of improved pastures. Both assessment units of Frazier Creek are classified as intermittent with perennial pools and have Aquatic Life Use designations as limited.

Index period monitoring was conducted in June 2022 at station #10259 at US 59. Critical period sampling was not performed due to the study reach being dry through September. Despite a very low stream flow of 0.4 cfs, the dissolved oxygen was relatively high. The 24-Hour DO average was 5.0 mg/L with a 24-Hour DO minimum of 4.8 mg/L.

The results of the event resulted in the fish and benthos scoring in the High category despite habitat scoring on the borderline between Limited and Intermediate. Seventeen fish species and 111 individuals were collected during this sampling. No Louisiana pigtoe host fish species were identified; however, a spotted sucker (*Minytrema melanops*) and three striped shiners (*Luxilus chrysocephalus*) were collected. Four darter species were captured including two bluntnose darters (*Etheostoma chlorosomum*) and two dusky darters (*Percina sciera*).

INVASIVE AQUATIC SPECIES UPDATE

By: Tim Bister, Texas Parks and Wildlife Department

Invasive aquatic vegetation remains a threat to reservoirs in the Cypress Creek Basin, and the TPWD is actively managing these species. Although the region experienced much lower than average temperatures during the February 2021 winter storm and reduced some level of plant coverage, no invasive aquatic plant species were eradicated from the reservoirs in the Cypress Creek Basin. The following is a summary of invasive aquatic plant coverage and management of the public reservoirs in the basin in 2022:

Lake Cypress Springs has remained relatively free of invasives. Hydrilla has not been detected in many years.

Lake Bob Sandlin also had a low amount of invasive vegetation in 2022. Alligatorweed and water hyacinth were documented at very low levels of coverage.

Lake O' the Pines had water hyacinth present in 2022 with less than one acre of coverage. Hydrilla coverage increased from 517 acres in 2021 to 1,444 acres in 2022. The most problematic invasive aquatic plant in Lake O' the Pines is giant salvinia. Coverage of salvinia increased from 39 acres in 2021 to 279 acres in 2022. However, this is likely an underestimate because of the complexity of habitat in the upper end of the reservoir and the difficulty in accessing all areas during the annual survey. USACE, NETMWD, and TPWD have continued efforts to manage giant salvinia with herbicide treatments.

Gilmer Reservoir had less than one acre of alligatorweed and 198 acres of hydrilla during the 2022 survey, but hydrilla growth had rebounded by the fall. Giant salvinia was discovered at the boat ramp on December 14, 2021 and was treated by TPWD. There have been numerous giant salvinia infestations in past years that were successfully eradicated.

Lake Welsh contained 87 acres of hydrilla and 6 acres of alligatorweed. Alligatorweed flea beetles were released in spring 2021 to help control the growth of the invasive plant.

Ellison Creek Reservoir (Lone Star Lake) had an estimated 375 acres of hydrilla in 2022 which was an increase from 21 acres in 2021. There were five acres of alligatorweed. Giant salvinia coverage was eight acres in 2022 and is being managed with applications of herbicide by TPWD.

New Mount Pleasant City Lake (Town Lake) had approximately three acres of giant salvinia and was treated in 2022. TPWD has been conducting herbicide applications and will continue to monitor and manage the infestation.

Caddo Lake was surveyed during September 2022. TPWD documented the presence of hydrilla (2,174 acres), water hyacinth (224 acres), alligatorweed (14 acres), Indian hygrophila (26 acres), crested floating heart (655 acres), and giant salvinia (3,033 acres). Herbicide treatments were conducted on 9,247 acres of giant salvinia in 2022 compared to 3,559 acres in 2021 and 7,862 acres in 2020. Giant salvinia weevils were also used as part of an integrated management approach. During 2022, the Caddo Biocontrol Alliance released 48,085 weevils and TPWD released 91,972.

INVASIVE CARP (BIGHEAD AND SILVER CARP)

Invasive carp (Bighead and Silver Carp) are a threat to native Texas ecosystems. These fish grow to large sizes and feed on zooplankton. They can outcompete native species that also feed on zooplankton and are a highly prolific species whose population numbers can expand rapidly.

Silver Carp are known to jump out of the water when startled, which poses a danger to boaters that may be hit by these large jumping fish. To learn more about these invasive species, TPWD has been working with Oklahoma Department of Wildlife Conservation, Arkansas Game and Fish Commission, U. S. Fish and Wildlife Service, and researchers from Auburn University and Texas Tech University to assess invasive carp populations in the Red River system, which includes the Sulphur River and other Texas tributaries of the Red River. Invasive carp have been in the Red River since 1998.

Bighead carp were documented in the Sulphur River below Lake Wright Patman as early as 2011. Because the river is free flowing from the Lake Wright Patman dam downstream to the Red River, invasive carp can freely swim upstream.

The first Bighead Carp was reported in Big Cypress Bayou below the Lake O' the Pines spillway during fall 2010. It is suspected that Bighead Carp were able to swim upstream from the Red River and Twelve Mile Bayou into Caddo Lake during the winter 2009/2010 flood event. In 2011, several more specimens were removed from the system when USACE dewatered the spillway. To date, no additional invasive carp have been documented in Big Cypress Bayou or Caddo Lake.

Figure 56: Lynn Wright (TPWD) holding bighead carp collected in the Sulphur River on 7-10-2012

Young invasive carp species can be easily confused with gizzard shad, which are commonly collected as baitfish. To help prevent the spread of invasive carp, it is unlawful to transport live, non-game fishes from the Red River below Lake Texoma downstream to the Arkansas border, Big Cypress Bayou downstream of Ferrell's Bridge Dam on Lake O' the Pines (including the Texas waters of Caddo Lake), and the Sulphur River downstream of the Lake Wright Patman dam. Nongame fishes collected from these waters may be used as live bait only in the water bodies where they were collected.

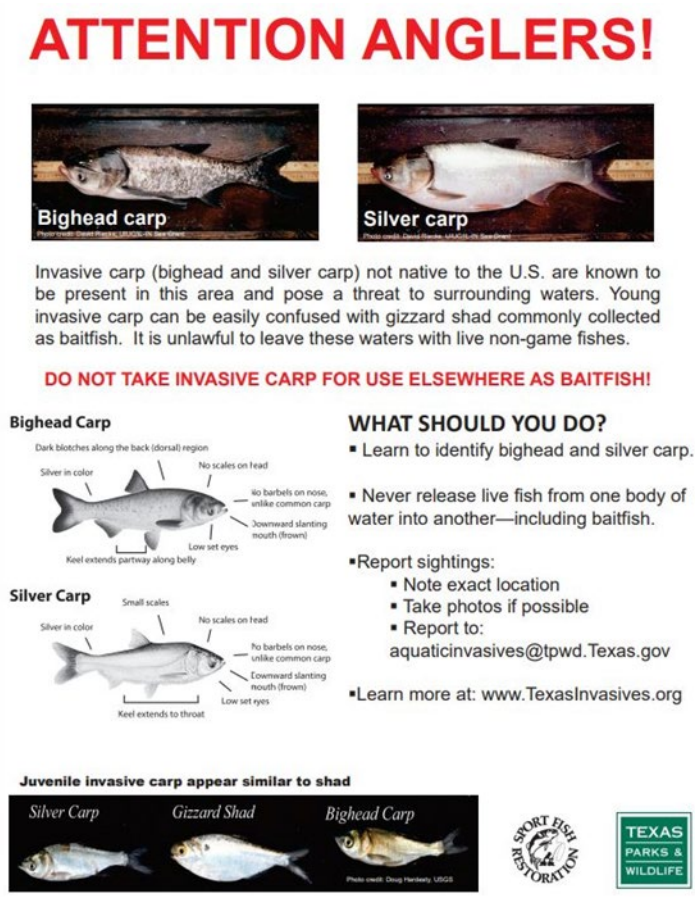

Figure 57: TPWD Invasive Carp Warning Sign

Figure 58: Bighead carp removed from the Lake O' the Pines spillway during dewatering in May 2011.

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APPENDIX

	Sample Date	10/7/2019	11/1/2020	10/16/2020	10/16/2020
	Site Number	B	48	49	50
Scientific Name	**Common Name**	**Couch Mtn.**	**SH 37**	**US271**	**Kelsey Crk**
Lepisosteus oculatus	Spotted Gar		1		
Dorosoma cepedianum	Gizzard Shad	4	4	4	2
Dorosoma petenense	Threadfin Shad		5	18	1
Cyprinella venusta	Blacktail Shiner	2			
Cyprinus carpio	Common Carp			1	1
Hybognathus hayi	Cypress Minnow	1		1	
Lythrurus fumeus	Ribbon Shiner	18			
Lythrurus umbratilis	Redfin Shiner		4	1	
Notemigonus crysoleucas	Golden Shiner	3	16	16	
Notropis atherinoides	Emerald Shiner			15	
Notropis texanus	Weed Shiner	21			
Pimephales vigilax	Bullhead Minnow	33		37	
Ictiobus bubalus	Smallmouth Buffalo			3	
Ictiobus cyprinellus	Bigmouth Buffalo			3	2
Minytrema melanops	Spotted Sucker	9	13		
Ameiurus melas	Black Bullhead		32	2	
Ameiurus natalis	Yellow Bullhead	1		2	
Ictalurus punctatus	Channel Catfish	5		1	2
Noturus gyrinus	Tadpole Madtom	4			
Pylodictis olivaris	Flathead Catfish	1			
Esox americanus	Redfin Pickerel	2	2	1	
Aphredoderus sayanus	Pirate Perch	21	9	6	
Labidesthes sicculus	Brook Silverside	5	57	7	
Fundulus blairae	Western Starhead Topminnow				1
Fundulus chrysotus	Golden Topminnow				5
Fundulus notatus	Blackstripe Topminnow	30	17	14	4
Gambusia affinis	Western Mosquitofish		33	38	2
Morone mississippiensis	Yellow Bass				3
Centrarchus macropterus	Flier	15		5	
Lepomis gulosus	Warmouth	6	20	5	
Lepomis humilis	Orangespotted Sunfish	8		17	

	Site Number	B	48	49	50
Scientific Name	**Common Name**	**Couch Mtn.**	**SH 37**	**US271**	**Kelsey Crk**
Lepomis macrochirus	Bluegill	26	33	10	10
Lepomis marginatus	Dollar Sunfish	3			7
Lepomis megalotis	Longear Sunfish	44	12	23	
Lepomis microlophus	Redear Sunfish	7	2		8
Lepomis miniatus	Redspotted Sunfish	1		1	1
Micropterus punctulatus	Spotted Bass	2			
Micropterus salmoides	Largemouth Bass	11	10		4
Pomoxis annularis	White Crappie		22	7	
Pomoxis nigromaculatus	Black Crappie	8	12	7	2
Etheostoma asprigene	Mud Darter	5		2	
Etheostoma chlorosoma	Bluntnose Darter		14	15	
Etheostoma gracile	Slough Darter	1	3	4	
Etheostoma histrio	Harlequin Darter	1			
Etheostoma proeliare	Cypress Darter		3	2	
Percina caprodes	Logperch	4		1	
Percina maculata	Blackside Darter			1	
	Number of Individuals	302	324	270	55
	Number of Species	31	22	32	16