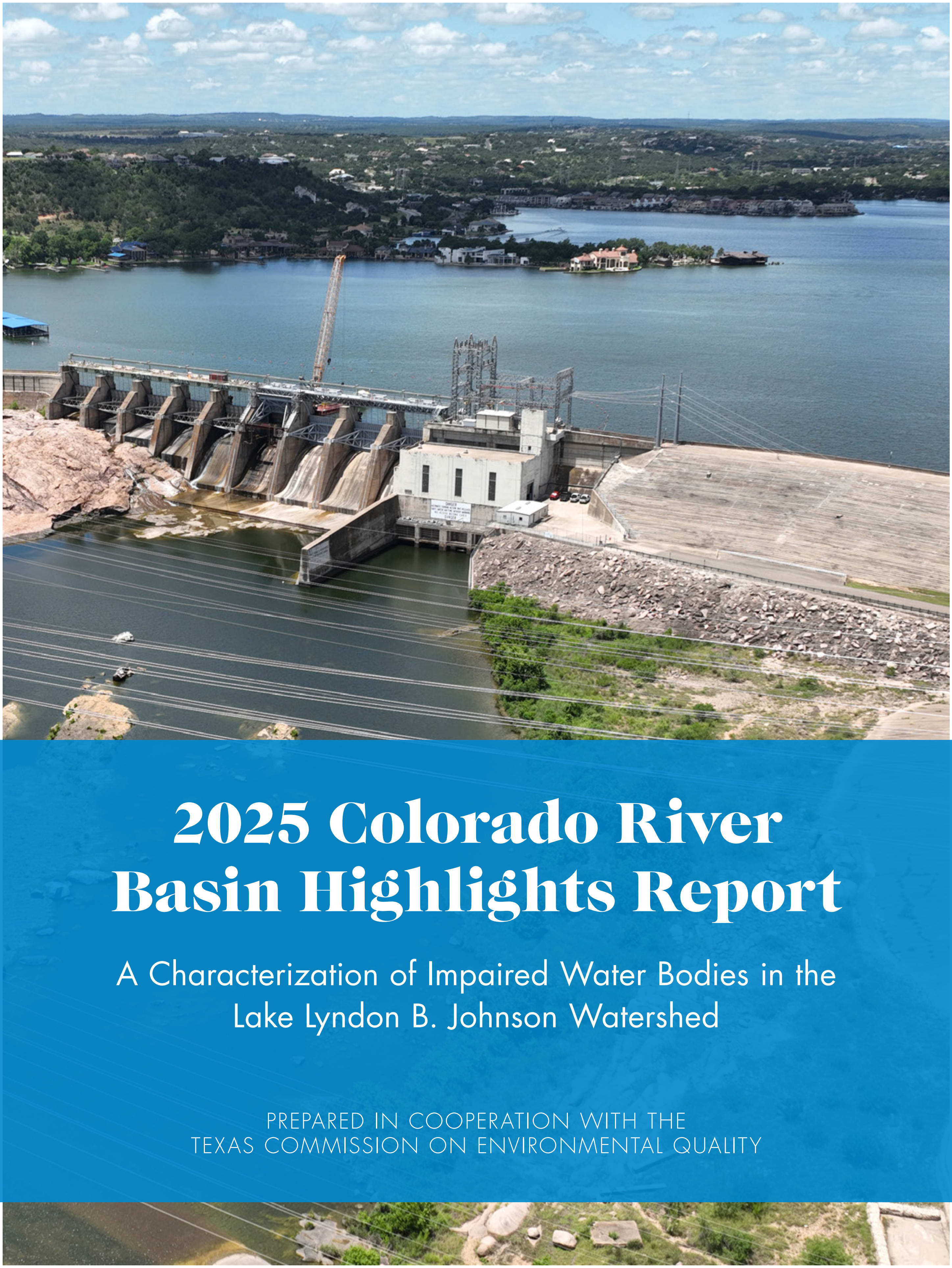

2025 Colorado River Basin Highlights Report

A Characterization of Impaired Water Bodies in the Lake Lyndon B. Johnson Watershed

PREPARED IN COOPERATION WITH THE
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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Acronyms and Abbreviations

AMD	Acid Mine Drainage
BMPs	Best Management Practices
cfs	cubic feet per second
CFU/100 mL	colony forming units per 100 mL
chl-*a*	chlorophyll *a*
COA	City of Austin
CRP	Clean Rivers Program
EPA	Environmental Protection Agency
FM	Farm-to-Market Road
HLWO	Highland Lakes Watershed Ordinance
IR	Texas Integrated Report of Surface Water Quality
LBJ	Lyndon B. Johnson
LCRA	Lower Colorado River Authority
LRWA	Llano River Watershed Alliance
m	meters
mg/L	milligrams per liter
MPN	most probable number
msl	mean sea level
NH_3	Ammonia
NO_3	nitrate
NO_2	nitrite
OSSF	On-Site Sewage Facilities
QAPP	Quality Assurance Project Plan
SH	State Highway
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TKN	total kjeldahl nitrogen
TLAP	Texas Land Application Permits
TMDL	Total Maximum Daily Load
TP	total phosphorus
TPWD	Texas Parks and Wildlife Department
TV	Travis County
TWDB	Texas Water Development Board
TSWQS	Texas Surface Water Quality Standards
UCRA	Upper Colorado River Authority
USGS	United States Geological Survey
WPP	Watershed Protection Plan
µg/L	micrograms per liter

Introduction

About the Clean Rivers Program

The Texas Clean Rivers Program (CRP) provides a foundation for partnerships between the Texas Commission on Environmental Quality (TCEQ), river authorities, local governments, industries and citizens. The program began in 1991 to provide funding for water quality monitoring and comprehensive watershed management on a local level. TCEQ and CRP partners routinely collect water quality data from more than 1,800 sampling locations. TCEQ and others use the data from these sampling locations to establish wastewater permit limits and Texas Surface Water Quality Standards, and to evaluate water quality, identify emerging issues, and implement strategies to address identified concerns.

In the Colorado River basin, the Lower Colorado River Authority (LCRA) and Upper Colorado River Authority (UCRA) implement the program in their respective areas (Figure 1). The LCRA, UCRA, City of Austin, Travis County, TCEQ and U.S. Geological Survey (USGS) perform monitoring. Each agency collects and analyzes samples according to a Quality Assurance Project Plan (QAPP), which ensures comparability. This collaborative approach enables the CRP to maintain a robust and up-to-date database of water quality information, facilitating informed decision-making and resource management.

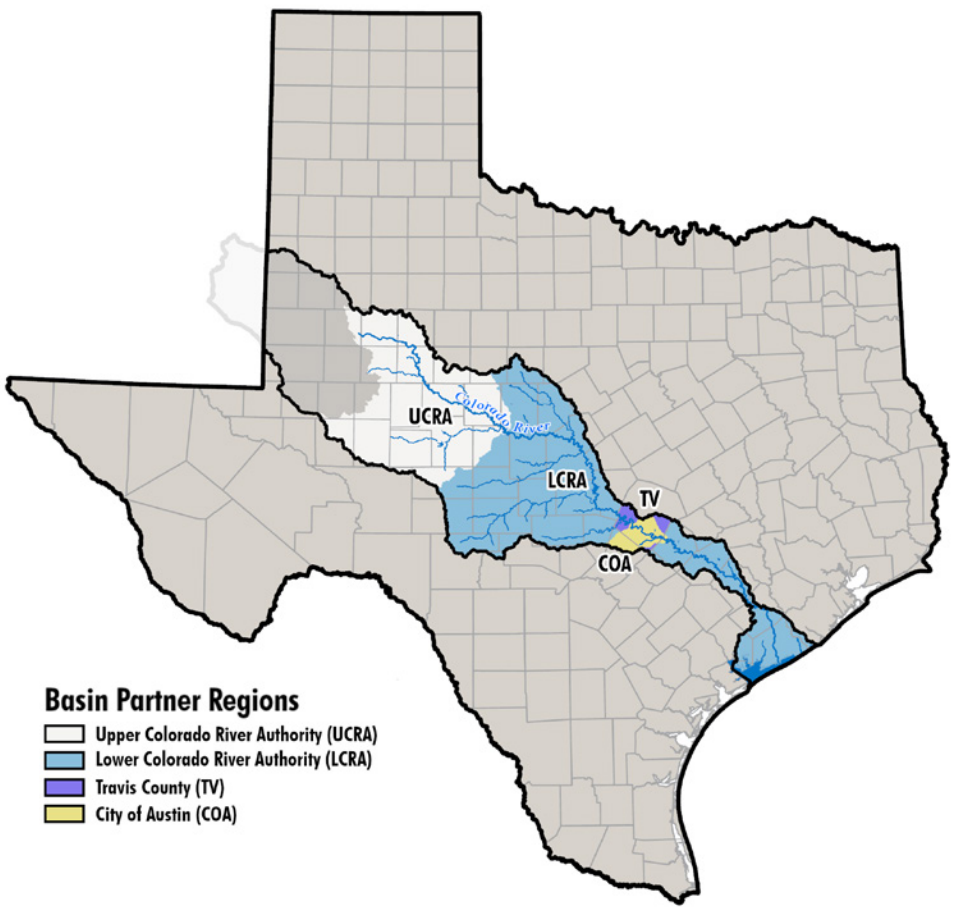

Figure 1. *Clean Rivers Program Partner Regions.*
Note that the grey area of the basin above UCRA's jurisdiction does not contain perennial waterways and is therefore not monitored under CRP.

Rationale and Format for the 2025 Basin Highlights Report

The 2024 Texas Integrated Report of Surface Water Quality

Every two years, the TCEQ evaluates waterbodies in the state against criteria defined in the Texas Surface Water Quality Standards (TSWQS). The TCEQ publishes the results online as the Texas Integrated Report of Surface Water Quality (IR) and submits the report to the Environmental Protection Agency (EPA). The TCEQ follows Sections 305(b) and 303(d) of the Federal Clean Water Act for data evaluation and reporting. After the evaluation is completed, all water bodies are noted as supporting or not supporting the TSWQS and placed into one of five categories (Appendix A). Category 5 constitutes the 303(d) List of Impaired Waters where available data indicate that at least one designated use is not being supported, and a Total Maximum Daily Load (TMDL) is needed. Waterbodies under the Category 4 305(b) List indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.

On Nov. 13, 2024, the EPA approved the 2024 IR. The IR assessed data collected between Dec. 1, 2015, and Nov. 30, 2022. If a criterion was not attained, the associated use was identified as impaired. The 2024 IR identifies 15 water bodies in the Colorado River basin that have at least one impairment in an assessment unit (Table 1).

The 2024 Integrated Report – Texas 303(d) List (Category 5) can be found here:
https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-303d

Basin Highlights Report Watershed Characterization Format

The LCRA submits an annual Basin Highlights Report or a Basin Summary Report every fifth year to the TCEQ. The Basin Highlights Report format rotates on an annual basis to cover various topics on the CRP and impaired segments throughout the Colorado River basin.

The 2025 Basin Highlights Report Watershed Characterization focuses on impaired water bodies identified in the 2024 IR in the Lake Lyndon B. Johnson (LBJ) Watershed. The goal of this report is to describe key source(s) of pollutants that are likely to impact water quality. This document serves as a resource for the TCEQ and other stakeholders to use when making conservation and management decisions.

This report will discuss water quality data, land use and communication with monitoring agencies and local stakeholders to address water quality concerns and impairments. The goal of this watershed characterization report is to help prioritize monitoring efforts and restorative measures in the Lake LBJ watershed.

For information on past LCRA Basin Highlights Reports, visit:
https://www.lcra.org/water/quality/texas-clean-rivers-program/resources-and-publications/

The 2025 Basin Highlights Report will discuss the following headings for each Segment:

- **Segment Description** – Describes the segment, assessment unit boundaries contained in each segment, historically monitored sites and site(s) believed to be responsible for the impairment or interest.
- **Hydrologic Characteristics** – Discusses streamflow variability, reservoir dynamics, seasonality of flow, and typical flow trends.
- **Land Use and Natural Characteristics** – A description of the land surrounding the impaired segment based on USGS National Land Cover Database aerial imagery and knowledge of the area.
- **Description of Water Quality Issue** – Identifies why the water body is listed and when it first appeared on the 303(d) List or why it is an area of interest. Includes the number of samples, parameter(s) of concern or impairment, assessment results and the appropriate state standards for comparison.
- **Potential Cause of Water Quality Issue** – Identifies possible causes of the impairment based on land use, communication with monitoring entities, agency staff and CRP water quality advisory committee members.
- **Potential Stakeholders** – Lists companies, agencies or organizations that have a vested interest in the impairment and that may serve as stakeholders.
- **Actions Taken** – Identifies actions taken by the TCEQ or CRP partners since the water body was first placed on the 303(d) List.
- **Recommended Actions** – Proposed next steps based on potential causes of impairment or interest, number of years on the 303(d) List, quality of listing data and knowledge of the site to help the water body attain Texas Surface Water Quality Standards.
- **Ongoing Projects** – Describes current or future projects that will occur in the segment (e.g., TMDLs, special studies, NPS projects, etc.)
- **Maps** – Maps and aerial imagery that define land uses, segments and other boundaries, monitoring sites, permitted discharges and Texas Land Application Permits (TLAPs).
- **Images** – Photographic images of the watershed and areas of interest.

Table 1. *Impaired Water Bodies in the Colorado River Basin on the 2024 303(d) List*

CRP Agency	Segment ID	Waterbody	County	Assessment Unit	Impairment	Year First Listed	Category
UCRA	1411	E.V. Spence Reservoir	Coke	1411_01	Chloride in water	2014	5b
				1411_02	Bacteria in water (Recreation Use)	2022	5c
					Chloride in water	2014	5b
	1416A	Brady Creek	San Saba, McCulloch	1416A _03	Depressed dissolved oxygen in water	2004	5r
	1421	Concho River	Concho, Tom Green	1421_08	Depressed dissolved oxygen in water	2008	5c
	1426	Colorado River Below E. V. Spence Reservoir	Runnels, Coke	1426_01	Sulfate in water	2024	5b
				1426_02	Sulfate in water	2024	5b
				1426_03	Sulfate in water	2024	5b
				1426_04	Sulfate in water	2024	5b
				1406_05	Excessive algal growth in water	2022	5c
				1406_06	Excessive algal growth in water	2022	5c
TCEQ	1419	Lake Coleman	Coleman	1419_01	Excessive algal growth in water	2022	5c
	1412	Colorado River Below Lake J.B. Thomas	Coke, Scurry	1412_02	Bacteria in water (Recreation Use)	2008	5c
				1412_03	Bacteria in water (Recreation Use)	2008	5c
	1412B	Beals Creek	Mitchell, Howard	1412B_03	Bacteria in water (Recreation Use)	2010	5b
LCRA	1402A	Cummins Creek	Colorado	1402A_01	Impaired fish community in water	2002	5c
					Impaired macrobenthic community in water	2002	5c
	1402C	Buckners Creek	Fayette	1402C_01	Depressed dissolved oxygen in water	2010	5c
	1406	Lake LBJ	Burnet, Llano	1406_01	Excessive algal growth in water	2022	5c
				1406_02	Excessive algal growth in water	2022	5c
				1406_03	Excessive algal growth in water	2022	5c
				1406_04	Excessive algal growth in water	2022	5c
				1406_05	Excessive algal growth in water	2022	5c
				1406_06	Excessive algal growth in water	2022	5c
	1407A	Clear Creek	Burnet	1407A_01	Aluminum in water	2010	5c
					Copper in water	2018	5c
					Nickel in water	2014	5c
					Sulfate in water	2010	5c
					Total dissolved solids in water	2010	5c
					Zinc in water	2014	5c
					pH	2010	5c
	1416	San Saba River	San Saba, Schleicher	1416_01	Bacteria in water (Recreation Use)	2008	5c

CRP Agency	Segment ID	Waterbody	County	Assessment Unit	Impairment	Year First Listed	Category
TV	1427	Onion Creek	Travis	1427_03	Sulfate in water	2014	5c
				1427_04	Sulfate in water	2014	5c
COA	1429C	Waller Creek	Travis	1429C_01	Bacteria in water (Recreation Use)	2004	5c
					Impaired macrobenthic community in water	2002	5c
TCEQ	1402H	Skull Creek	Colorado	1402H_01	Depressed dissolved oxygen in water	2008	5c

Category 5b: A review of the standards for the water body will be conducted before a management strategy is selected.

Category 5c: Additional data and information will be collected or evaluated before a management strategy is selected.

Category 5r: A Watershed Protection Plan is under development or accepted by EPA for this parameter.

Overview of the Lake LBJ Watershed

The headwaters of the Colorado River begin in far west Texas and a small portion of New Mexico. The river then merges with Pecan Bayou and the Concho River and eventually flows into Lake Buchanan, which is the first reservoir in a series of several impoundments referred to as the Highland Lakes. Downstream of Lake Buchanan is Inks Lake, Lake LBJ, Lake Marble Falls, Lake Travis, Lake Austin and Lady Bird Lake. Below Lady Bird Lake and Longhorn Dam in Austin, the river flows without any major impoundments until it reaches Matagorda Bay.

The focus of this report is on Lake LBJ and its tributaries, including Inks Lake.

Lake LBJ Watershed

The Lake LBJ watershed begins where the Colorado River is released from Buchanan Dam in Burnet and Llano counties. Immediately below Buchanan Dam, the river flows into the headwaters of Inks Lake, a pass-through reservoir with a relatively short detention time. Below Inks Dam, the river flows about 10 miles to the community of Kingsland, where it merges with the Llano River before flowing into Lake LBJ. The 5,000-square-mile watershed is entirely within the Edwards Plateau. Steep hills with rock and limestone substrate create clear, cool, fast-flowing rivers like the Llano and James rivers. Perennial streams in the watershed are spring-fed and typically more alkaline because of the limestone geology.

Boating on Lake LBJ

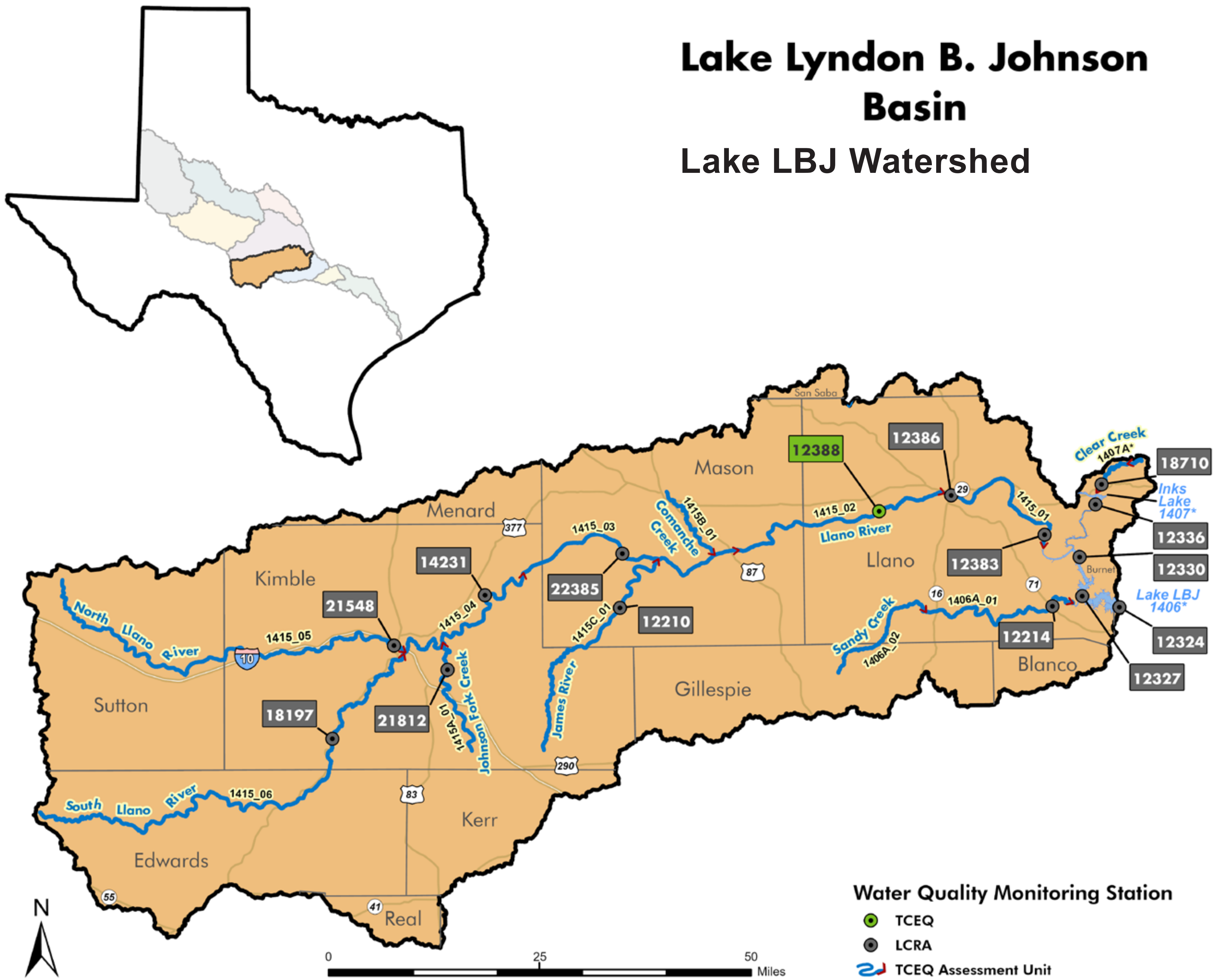

Figure 2. *Lake Lyndon B. Johnson Basin Map. *See Figure 3 for Lake LBJ and Figure 11 for Inks Lake and Clear Creek assessment units.*

Watershed Characterizations by Segment

Segment 1406: Lake Lyndon B. Johnson

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Impairment: excessive algal growth in water

Segment Description

Lake LBJ is impounded from the Alvin Wirtz Dam in Burnet County to Roy Inks Dam on the Colorado River in Burnet and Llano Counties and to a point immediately upstream of the confluence of Honey Creek on the Llano River. The LCRA monitors Lake LBJ at Stations 12324, 12327 and 12330 (Table 2). Station 12324, located near the Wirtz Dam, is the only station in Segment 1406 that is assessed in the Reservoir Nutrient Assessment of the Texas IR.

Table 2. *1406 Segment and Assessment Unit Descriptions*

Seg ID	Seg Name	Segment Description	AU ID	AU Description	Station ID
1406	Lake Lyndon B. Johnson	From Alvin Wirtz Dam in Burnet County to Roy Inks Dam on the Colorado River arm in Burnet/ Llano County and to a point immediately upstream of the confluence of Honey Creek on the Llano River arm in Llano County, up to the normal pool elevation of 825.6 feet above mean sea level (feet msl)	1406_01	From Alvin Wirtz Dam upstream to the Pecan Creek arm	12324
			1406_02	From the Pecan Creek arm upstream to the Station Creek/Dry Creek arm	12327
			1406_03	From the Station Creek/Dry Creek arm upstream to the Llano River arm	12330
			1406_04	Llano River arm	12331*
			1406_05	From the confluence with the Llano River arm upstream to the Williams Creek confluence	12333*
			1406_06	From the Williams Creek confluence upstream to Roy Inks Dam	No Stations

**LCRA historic monitoring station*

Lake LBJ in Horseshoe Bay, TX

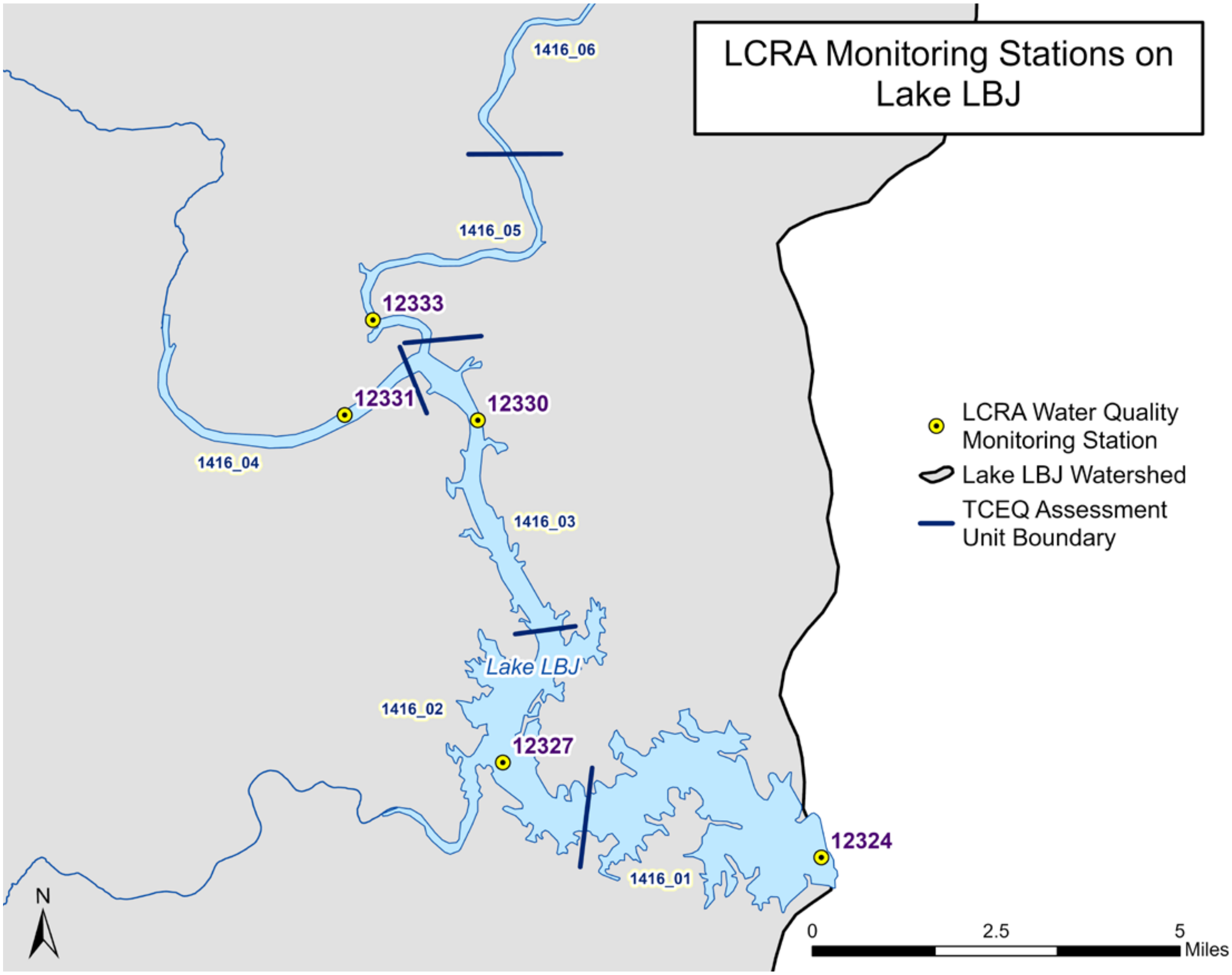


Figure 3. *Map of Lake LBJ displaying LCRA water quality monitoring stations 12324, 12327, 12330, 12331 and 12333.*

Hydrologic Characteristics

Lake LBJ is part of a chain of reservoirs in the Highland Lakes on the Colorado River. The reservoir was completed in 1951 to supply hydroelectric power and to serve as a cooling reservoir for the Thomas C. Ferguson Power Plant. According to the 2020 Volumetric and Sedimentation Survey by the Texas Water Development Board (TWDB), Lake LBJ has a capacity of 131,618 acre-feet and a surface area of 6,432 acres at conservation pool elevation (825.00 feet above mean sea level (msl)). The operating water level is maintained at around 825.4 feet above msl, which is controlled by discharges from Lake Buchanan and Inks Lake dams into Lake LBJ and downstream releases from Wirtz Dam into Lake Marble Falls. Major tributaries flowing into the reservoir include the Llano River and Sandy Creek.

Land Use and Natural Characteristics

The drainage area of the lake is 36,290 square miles. Granite Shoals, Sunrise Beach, Horseshoe Bay and Kingsland are growing communities that surround the lake. Development around the lake has the potential to impact water quality through increased impervious cover and runoff of pollutants. LCRA has a Highland Lakes Watershed Ordinance (HLWO) that regulates and permits development in the Highland Lakes region and an On-Site Sewage Facilities (OSSF) inspection program that includes the inspection and permitting of OSSF systems near the Highland Lakes. These two programs help reduce the impact of development on water quality in the Lake LBJ watershed and throughout the Highland Lakes.

Land cover throughout the Lake LBJ watershed is comprised of mainly shrubland, followed by forested areas with trees such as ashe juniper, oak and/or mesquite. The watershed also has scattered grasslands and rural development (Figure 4). Most development is near the lake from the growing communities of Granite Shoals, Sunrise Beach, Horseshoe Bay and Kingsland. Table 3 shows the changes in land cover across the watershed from 2014 to 2023, which is the most current National Land Cover Database available at the time of publication. Small changes in the land cover type are observed, however there are no significant changes over this time period.

On-Site Sewage Facility (OSSF) Ordinance

On-site sewage facilities or septic systems are an integral part of rural America. They can be an efficient way to remove household waste and protect the environment when properly designed and maintained. In 1971, TCEQ delegated regulatory authority of OSSF systems in the Highland Lakes to LCRA. Since then, LCRA has regulated the installation and operation of OSSF systems on properties within a 2,200-foot zone around the upper Highland Lakes and a 2,000-foot zone around Lake Travis, encompassing portions of Travis, Burnet and Llano counties. This oversight ensures the best available technology is used to treat septic wastes so pollutants such as bacteria, phosphorus and nitrogen don't leach into surface water. In 2024, the OSSF program performed over 3,200 permit actions including 980 construction inspections and 482 construction permits issued.

Highland Lakes Watershed Ordinance (HLWO)

Stormwater runoff carries pollution — pesticides, soil, nutrients, toxics and other residues from everyday human activities. LCRA actively manages stormwater runoff around the Highland Lakes through the HLWO. Through a permitting process, the ordinance requires developers to stabilize land and minimize sediment migration. Water quality is protected by limiting stormwater runoff, creating buffer zones, and installing erosion and sediment controls. In 2024, the HLWO program conducted 2,023 field inspections and issued 44 permits.

Highland Lakes Dredge and Fill Ordinance (HLDO)

Effective Jan. 1, 2022, dredge and fill activities on the Highland Lakes are regulated under the HLDO. During 2024, there were a total of 38 dredge and fill notifications for the program. For more information about this ordinance, visit www.lcra.org/hldo.

Lake LBJ Watershed Land Cover Type

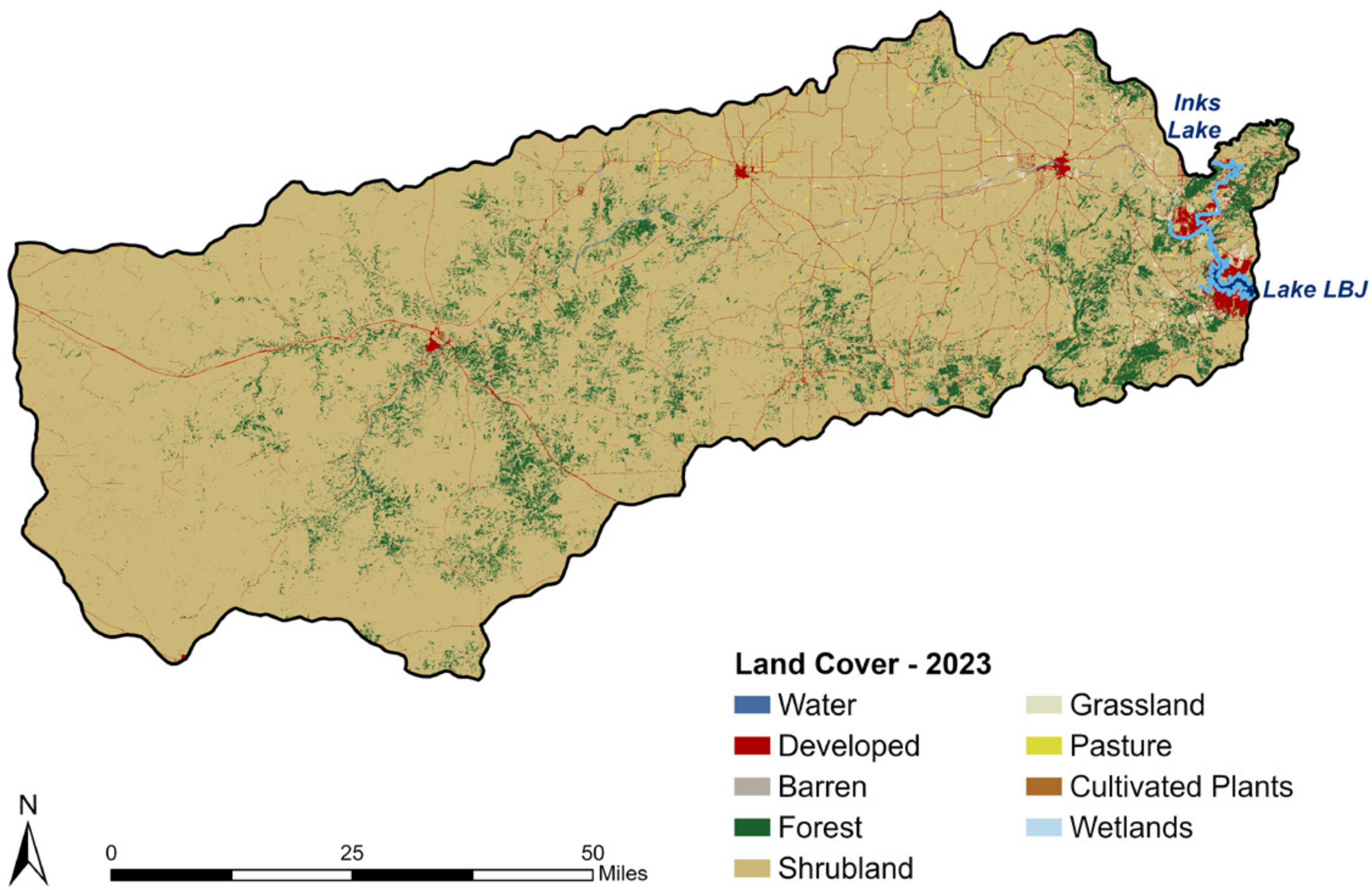


Figure 4. *Lake Lyndon B. Johnson Watershed Land Cover Map. Data is from the 2023 National Land Cover Database.*

Table 3. *Land cover change from 2014 to 2023 for the Lake Lyndon B. Johnson watershed*

Land Cover Type	2014 Land Cover (Acres)	2023 Land Cover (Acres)	Percent Change Between 2014 and 2023
Water	9,917	9,597	-3.3%
Developed	61,422	64,301	4.7%
Barren	2,879	3,199	11.1%
Forest	272,240	263,923	-3.1%
Shrubland	2,820,295	2,827,653	0.3%
Grassland	21,753	20,154	-7.4%
Pasture/Hay	5,118	5,118	0%
Cultivated Crops	3,838	3,518	-8.3%
Wetlands	1,599	1,599	0%

Description of Water Quality Issue

The 2024 Integrated Report – Supplemental Data for Reservoir Nutrient Assessment published the most recent assessment of Station 12324 (Table 4). The median chlorophyll-*a* value of 11.4 (μg/L) exceeded the criteria of 10.29 (μg/L), which resulted in continued impairment for excess algal growth in Lake LBJ. This impairment was first listed on the 303(d) List in 2022, when TCEQ developed Category 5n for waterbodies which did not meet chlorophyll-*a* criteria making it possible for reservoirs to be listed for this impairment; however, chlorophyll-*a* data from Station 12324 has exceeded the criteria established in the Reservoir Nutrient Assessments since its inception in 2016.

For more information on the 2024 IR – Supplemental Data For Reservoir Nutrient Assessment, visit: https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-nutrients

Table 4. *Reservoir Nutrient Assessment of Segment 1406 – Lake Lyndon B. Johnson*

SEGMENT 1406 – LAKE LYNDON B. JOHNSON			
Parameter	**Criteria Threshold**	**Samples Assessed**	**Median**
Chlorophyll-*a* (μg/L)	10.29 (μg/L)	52	11.4 (μg/L)
Secchi Depth (m)	1.23 (m)	52	1.5 (m)
Total Nitrogen (mg/L)	0.8 (mg/L)	51	0.57 (mg/L)
Total Phosphorous (mg/L)	0.03 (mg/L)	52	0.01 (mg/L)

Chlorophyll-*a*

Chlorophyll-*a* is a key pigment found in all photosynthetic organisms and is widely used as an indicator of water quality in aquatic ecosystems as a means of monitoring the amount of phytoplankton suspended in the water column. Phytoplankton are a type of suspended microscopic algae. The concentration of chlorophyll-*a* serves as a proxy for algal biomass, helping to assess the productivity and trophic status of a water body. High levels of chlorophyll-*a* often indicate eutrophication, a process driven by excess nutrients that can lead to harmful algal blooms, oxygen depletion and declines in water quality. Eutrophication of a water body is often noted as the trophic status with oligotrophic, mesotrophic, eutrophic and hyper-eutrophic categories ranging from low productive systems to high productive systems respectively. Monitoring chlorophyll-*a* provides valuable insights into ecosystem health by using it to track primary production, nutrient loading and overall water clarity.

A chlorophyll-*a* concentration of 10 μg/L can be used as a threshold for classifying a water body as either oligotrophic or mesotrophic. The trophic status of Lake LBJ reflects oligotrophic conditions (clear, low productive) from December through April based on average chlorophyll-*a* data while the reservoir reflects mesotrophic conditions the remainder of the year (Figure 5).

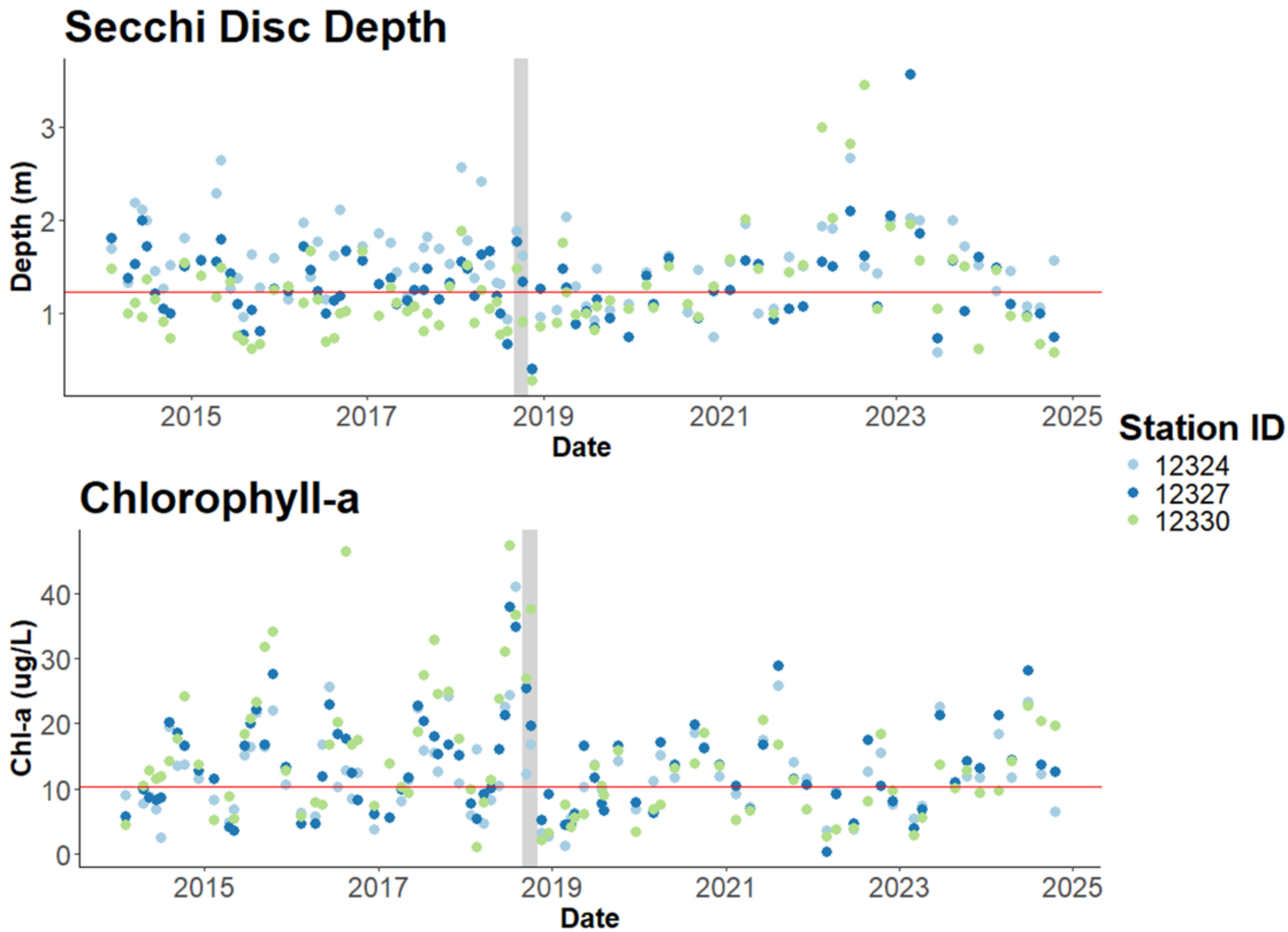


Figure 5. *Secchi disc depth (m) and chlorophyll-a (µg/L) collected at Lake LBJ Stations 12324, 12327 and 12330. The vertical gray bar marks a major flood in 2018. The red lines indicate the Texas Surface Water Quality criteria for each parameter, 1.23 m for Secchi disc depth and 10.29 µg/L for chlorophyll-a.*

Secchi Disc Depth

Secchi disc depth is a measure of transparency of the water. It is measured using a 20-cm diameter Secchi disc with alternating black and white quadrants. The disc is lowered into the water of a lake until it can no longer be seen by the observer. This depth of disappearance, called the Secchi depth, is what is recorded as a measurement of transparency, or water clarity.

Transparency can be affected by the color of the water and the amount of phytoplankton and sediments suspended in the water. Transparency decreases as color, suspended sediments or phytoplankton abundance increases. Transparency can be affected by the amount of plant nutrients coming into the lake from sources such as sewage treatment plants, septic tanks, and lawn and agricultural fertilizer. Suspended sediments often come from sources such as resuspension from the lake bottom, construction sites, agricultural fields and urban storm runoff.

Transparency is an indicator of the impact of human activity on the land surrounding the lake. If transparency is measured through the season and from year to year, trends in transparency may be observed. Transparency can serve as an early warning that activities on land are having an effect on a lake. Figure 5 shows Secchi disc depth alongside chlorophyll-*a* in Lake LBJ. On average, water clarity tends to be lowest in the hot summer months across all sites, which is when chlorophyll-*a* levels (and therefore phytoplankton abundance) are at their highest. Transparency is typically higher at site 12324 near the dam and decreases at upstream sites. Inversely, chlorophyll-*a* is lowest near the dam and then increases at upstream sites, with site 12330 below the Llano River confluence having the highest levels.

Trend analysis for the past 10 years show minimal changes in chlorophyll-*a* and Secchi disc depths at monitoring stations 12324, 12327 and 12330. Significant changes in overall average values of chlorophyll-*a* and Secchi disc depth have not been observed from 2014 to 2024 in Lake LBJ. However, the observed values are still frequently above the Texas Surface Water Quality criteria thresholds. Notable changes in chlorophyll-*a* and Secchi disc patterns are observed immediately before, during and after the 2018 flood. Storm runoff during this historic event moved large amounts of water through Lake LBJ. Chlorophyll-*a* values remained lower on average in 2019 and 2020 before slowly rising again.

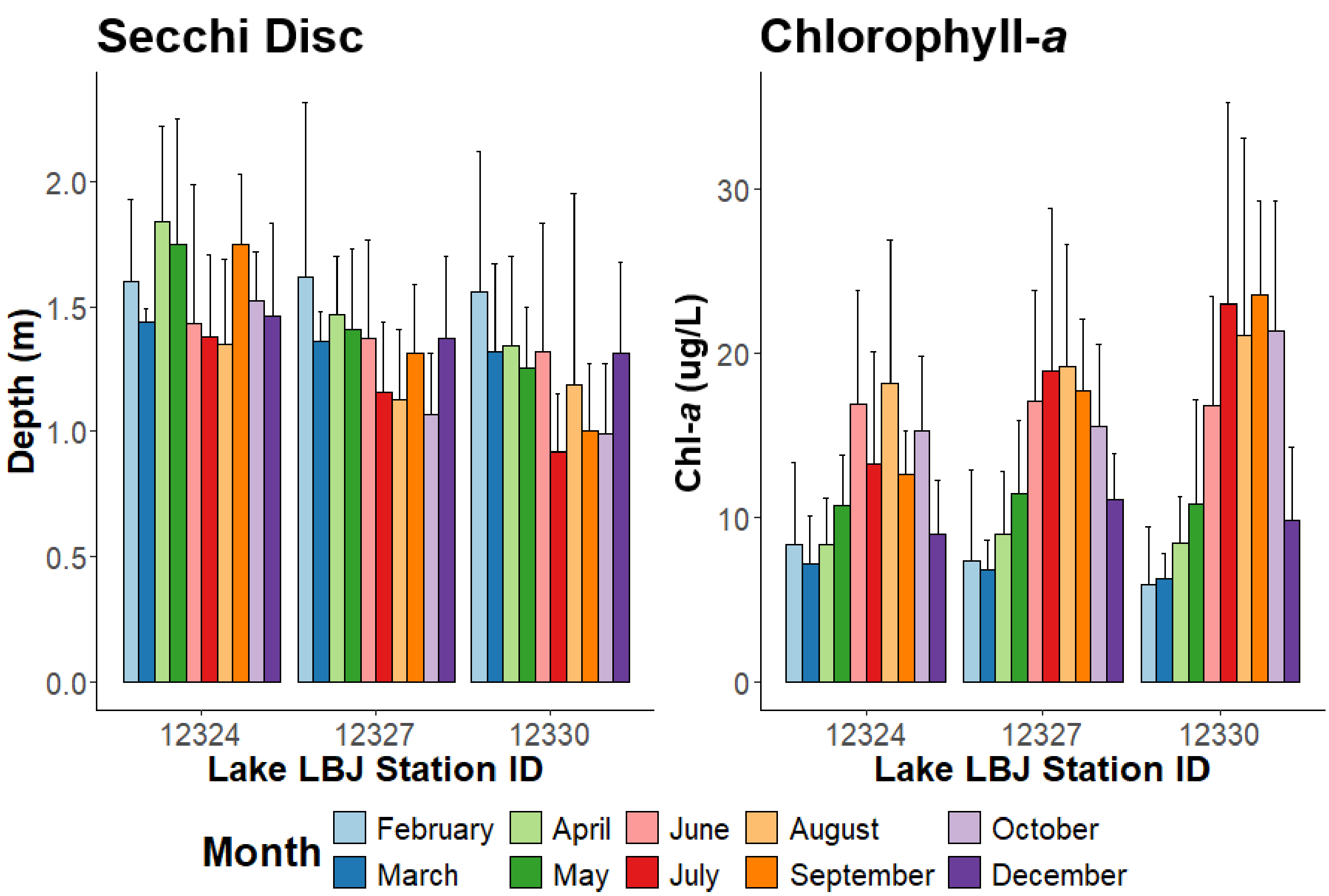


Figure 6. *Secchi disc depth (m) and chlorophyll-a (µg/L) collected at Lake LBJ Stations 12324, 12327 and 12330. The bars represent monthly averages from Feb. 4, 2014, to Oct. 17, 2024. Standard error lines, shown as black lines above the monthly average bars, represents the variability of data for monthly Secchi disc depth and chlorophyll-a values.*

Potential Cause of Water Quality Issue

Development and Anthropogenic Factors

Although a largely rural watershed, the land use immediately surrounding Lake LBJ is predominately residential. The shoreline is lined with homes, and the lakes relatively stable water levels make it a popular destination for boating, fishing and other water activities. In addition to residential development, the area supports various commercial establishments including marinas, restaurants and retail stores. Urbanization and land development can contribute to water quality degradation through increased pollutant loading.

Impervious surfaces such as roads, buildings and parking lots prevent rainwater from infiltrating into the ground where it can be filtered. Instead, it rapidly flows over these surfaces collecting sediment and pollutants and transporting them to the creeks and tributaries into Lake LBJ.

In October 2018, a significant flood occurred in Central Texas that impacted the Llano River and Lake LBJ. Floodwaters scoured riverbeds and banks and carried sediments into Lake LBJ which resulted in a significant sediment loading event.

Fertilizers applied to lawns and gardens, pet waste, leaking wastewater infrastructure and leaf/lawn clippings placed near or in the lake can contribute to excess nutrients, leading to excessive algae growth and therefore higher chlorophyll-*a* levels. Pathogens from pet waste or any failing septic systems can introduce harmful bacteria and viruses to water bodies, increasing health risks for humans. These pollutants can be carried by stormwater runoff into Lake LBJ.

As development around Lake LBJ continues, managing stormwater runoff, preserving and restoring natural buffers, and implementing best management practices for land use will be essential in mitigating water quality decline.

Reservoir Age

The Highland Lakes reservoirs are impoundments on the Colorado River. All rivers naturally transport sediments and nutrients. However, when the flow velocity and energy of the water is reduced through impoundment, the majority of sediments are trapped in the reservoir rather than continuing downstream. Over time, sediment deposits will gradually displace the reservoir storage capacity and increase its internal loading of nutrients. This process is referred to as eutrophication - the gradual nutrient enrichment of a reservoir over time. Through programs like the Highland Lakes Watershed Ordinance and the On-Site Sewage Facilities inspection program, LCRA works to reduce the amount of nutrients and sediment entering the Highland Lakes; however, it is inevitable that reservoirs will continue to sequester nutrients and sediments across time. The internal cycling of these nutrients will continue to impact water quality as a reservoir ages.

Chlorophyll-*a* Relationship with Nutrients

Excessive algal growth can occur when light and temperature conditions are favorable and there is a source of nutrients. Primary nutrients for algal growth include nitrogen and phosphorus, especially in the forms of nitrate and orthophosphorus, which can be taken up by algae and used as a food source. In Lake LBJ, nutrient data is collected near the surface of the water and at a depth close to the bottom of the reservoir. Nutrient concentrations are typically higher in the bottom samples (Figure 8). However, these nutrients are typically not available to be used by phytoplankton (floating algae), because the phytoplankton grow closer to the surface of the water where sunlight is available for photosynthesis.

Nitrate concentrations at the surface are highest in the winter months when phytoplankton are not as active due to colder water temperatures and therefore not utilizing all of the nitrate. In spring and summer months, when the chlorophyll-*a* numbers start to rise, the nitrate concentrations at the surface are lower, likely because it is being taken up by either algae or aquatic vegetation. When nitrate concentrations are in excess at the surface, the phosphorus can oftentimes be the limiting nutrient for certain algal growth. As a result, small increases in phosphorus can lead to large increases in algal biomass and chlorophyll-*a* concentrations. Phosphorus concentrations at the bottom of Station 12324 track well with chlorophyll-*a* concentrations in this section of the reservoir. Higher levels of phosphorus at the bottom of the reservoir during the warmer months coincide with higher concentrations chlorophyll-*a* in the warmer months (Figure 8).

Example of planktonic algae

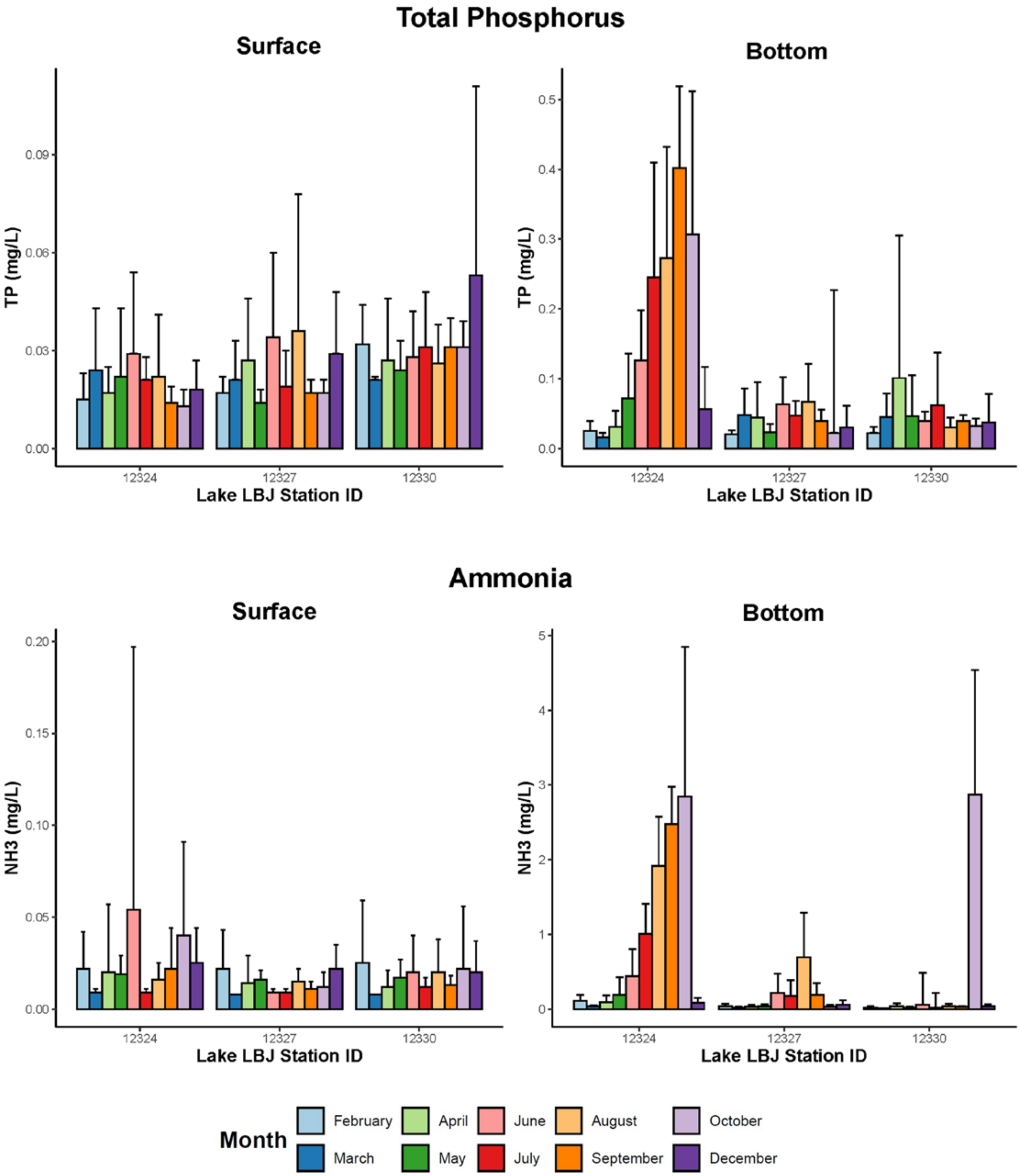


Figure 7. *Total phosphorus and ammonia (NH3) concentrations collected at the surface and bottom of Lake LBJ Stations 12324, 12327 and 12330. The bars represent monthly averages from Feb. 4, 2014, to Oct. 17, 2024. Standard error lines, shown as black lines above the monthly average bars, represents the variability of data. Note that the scale for total phosphorus and ammonia graphs are different for the surface and bottom samples.*

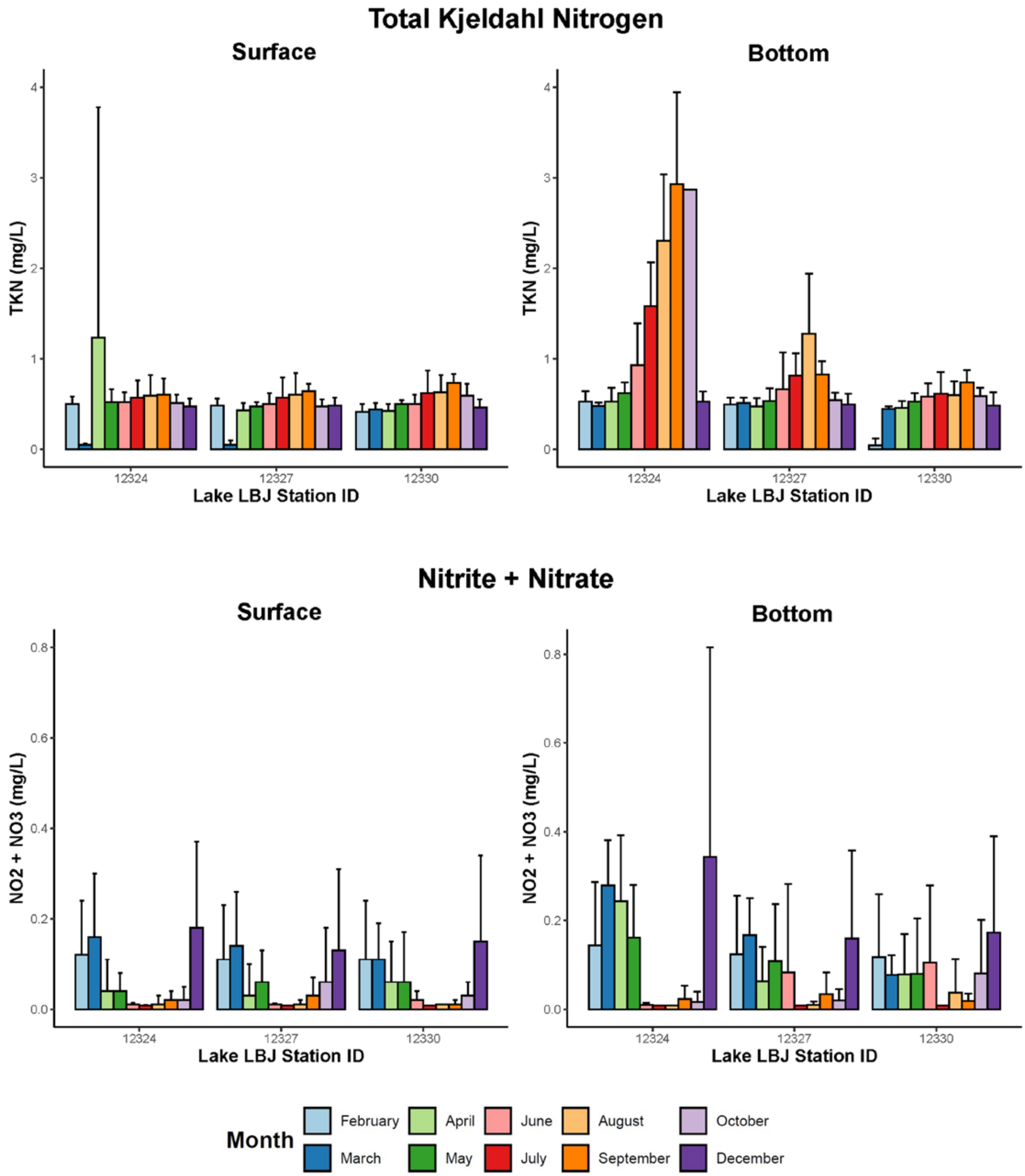


Figure 8. *Total kjeldahl nitrogen (TKN) and nitrite + nitrate (NO2 + NO3) concentrations collected at the surface and bottom of Lake LBJ Stations 12324, 12327 and 12330. The bars represent monthly averages from Feb. 4, 2014, to Oct. 17, 2024. Standard error lines, shown as black lines above the monthly average bars, represents the variability of data.*

Zebra Mussels

Another factor that has influenced the water quality in Lake LBJ is the introduction of zebra mussels. Invasive zebra mussels (*Dreissena polymorpha*) were first discovered in the Colorado River basin in 2017 in Lake Travis. In 2019, lakes LBJ and Marble Falls were classified as infested with zebra mussels by TPWD after all life stages of the organism were discovered in each reservoir during LCRA monitoring events. Once established in a water body, zebra mussels have the potential to impact natural ecosystems by excessively filtering water, transferring nutrients from the water column to the lake bottom. They also impact the recreation and utility industries because they attach to hard surfaces such as docks, buoys, pumps and pipes. Zebra mussels are also known to increase water clarity via filter feeding. This can be a positive aesthetic consequence of the mussel's invasion but increases in water clarity can increase aquatic plant growth by allowing sunlight to penetrate to greater water depths, increasing the amount of suitable area aquatic plants can grow in a waterbody. Unfortunately, there is no known management solution to eradicate zebra mussels from large lakes or reservoirs.

Zebra mussels

Aquatic Vegetation

Aquatic vegetation provides important habitat for fish, aquatic insects, turtles and other native wildlife. In addition, the plants help stabilize sediment at the bottom of waterways and serve as a food source for numerous organisms. Aquatic vegetation grows by utilizing nutrients in the water and sediments.

Lake LBJ is home to a wide variety of native aquatic plants. However, the reservoir also has a relatively long history of excessive growth of non-native invasive species specifically, hydrilla (*Hydrilla verticillata*), Eurasian watermilfoil (*Myriophyllum spicatum*) and water hyacinth (*Pontederia crassipes*). Lakeside communities and property owners may manage nuisance aquatic plants with a permit from TPWD. Under the State Aquatic Vegetation Plan, TPWD regulates the management of aquatic vegetation in public waterways. Anyone wishing to conduct management activities in public water must first submit an Aquatic Vegetation Treatment Proposal for review by TPWD and local controlling entities such as LCRA.

The amount of aquatic vegetation in the lake fluctuates based upon a variety of factors, including inflows, temperature fluctuations, sediment influx, pollution loading events and prevalence of zebra mussels in any given place and time throughout the year. In 2024, 116 treatment proposals were submitted by public individuals or contractors for chemical treatment or physical management of aquatic vegetation in Lake LBJ, an increase of 51% from the previous year. Chemical treatment and physical management of invasive aquatic vegetation can help alleviate nuisance growth in reservoirs. However, these methods are not a permanent solution. Excessive aquatic vegetation growth can be indicative of water with high nutrient concentrations such as nitrogen and phosphorus, which are found in fertilizers commonly used on lawns.

In 2024, LCRA announced two programs to assist lakeside property owners in managing nuisance aquatic vegetation in Inks Lake, Lake LBJ and Lake Marble Falls.

- A treatment zone schedule to consolidate efforts of lakeside property owners wanting to remove or treat nuisance aquatic vegetation on Inks Lake, Lake LBJ and Lake Marble Falls. The program divides property on the three lakes into separate zones and limits application of herbicides to specific time periods.

- A rebate program offering up to 50% of the project cost, to a maximum of $7,500 per applicant, for municipalities, counties and homeowners/property owners associations that manage invasive aquatic vegetation on Inks Lake, Lake LBJ or Lake Marble Falls.

Eurasian watermilfoil

LCRA manages hydrilla and water hyacinth on the Highland Lakes when the plants have the potential to impact LCRA dam or power plant operations. LCRA does not manage Eurasian watermilfoil and other vegetation that does not pose a threat to LCRA infrastructure operations.

Aquatic vegetation can serve as a sink for excess nutrients by absorbing and storing nitrogen and phosphorus from the surrounding water, helping to reduce nutrient pollution. However, when aquatic plants die and decompose, they release the stored nutrients back into the water column. Physical removal of the plants helps to break this cycle and lower nutrients in the reservoir, but it is a challenging task to do on a large scale and it must be done cautiously to not spread any fragments of hydrilla or Eurasian watermilfoil.

For more information on the State Aquatic Vegetation Plan visit:
https://texas-sos.appianportalsgov.com/rules-and-meetings?$locale=en_US&interface=VIEW_TAC_SUMMARY&recordId=209320

More information about managing and obtaining permits for aquatic vegetation management can be found at www.lcra.org/waterweeds.

Potential Stakeholders

- LCRA
- TPWD
- TCEQ
- Lake LBJ residents
- Inks Lake residents
- Llano River watershed residents

Actions Taken

- LCRA Water Quality Protection aquatic scientists have initiated a study to better understand the source of nutrients for benthic algae and the potential correlation to toxic algae production. For more information on algae in the Highland Lakes visit www.lcra.org/algae.

- In 2024, LCRA mailed "Keep Lakes Clean Not Green" printed flyers to every lakeside property owner on lakes Inks, LBJ and Marble Falls. A copy of the flyer can be found here: www.lcra.org/download/minimizing-nuisance-aquatic-plants-guide/?wpdmdl=28022

- LCRA Water Quality Protection staff has continued to administer the OSSF and HLWO programs. In addition, LCRA's HLDO regulates dredge and fill activities on the Highland Lakes. These water quality programs help to control the amount of nutrients and sediment entering the creeks, rivers and reservoirs in the Lake LBJ watershed.

- The LCRA Colorado River Watch Network continues to support and train citizen volunteers to collect water quality data in the Lake LBJ watershed. For more information, visit www.lcra.org/water/quality/colorado-river-watch-network/.

- The Llano River Watershed Alliance continues to implement the Watershed Protection Plan and educate citizens living in the Llano River watershed on issues concerning water quality of the Llano River and its tributaries. For more information visit www.llanoriver.org.

Recommended Actions

- Additional outreach to educate residents in the Lake LBJ watershed on topics of water quality protection and decreasing nutrient loading into the waterways.

- Continued monitoring of water quality at existing Clean Rivers Program sites and Colorado River Watch Network sites.

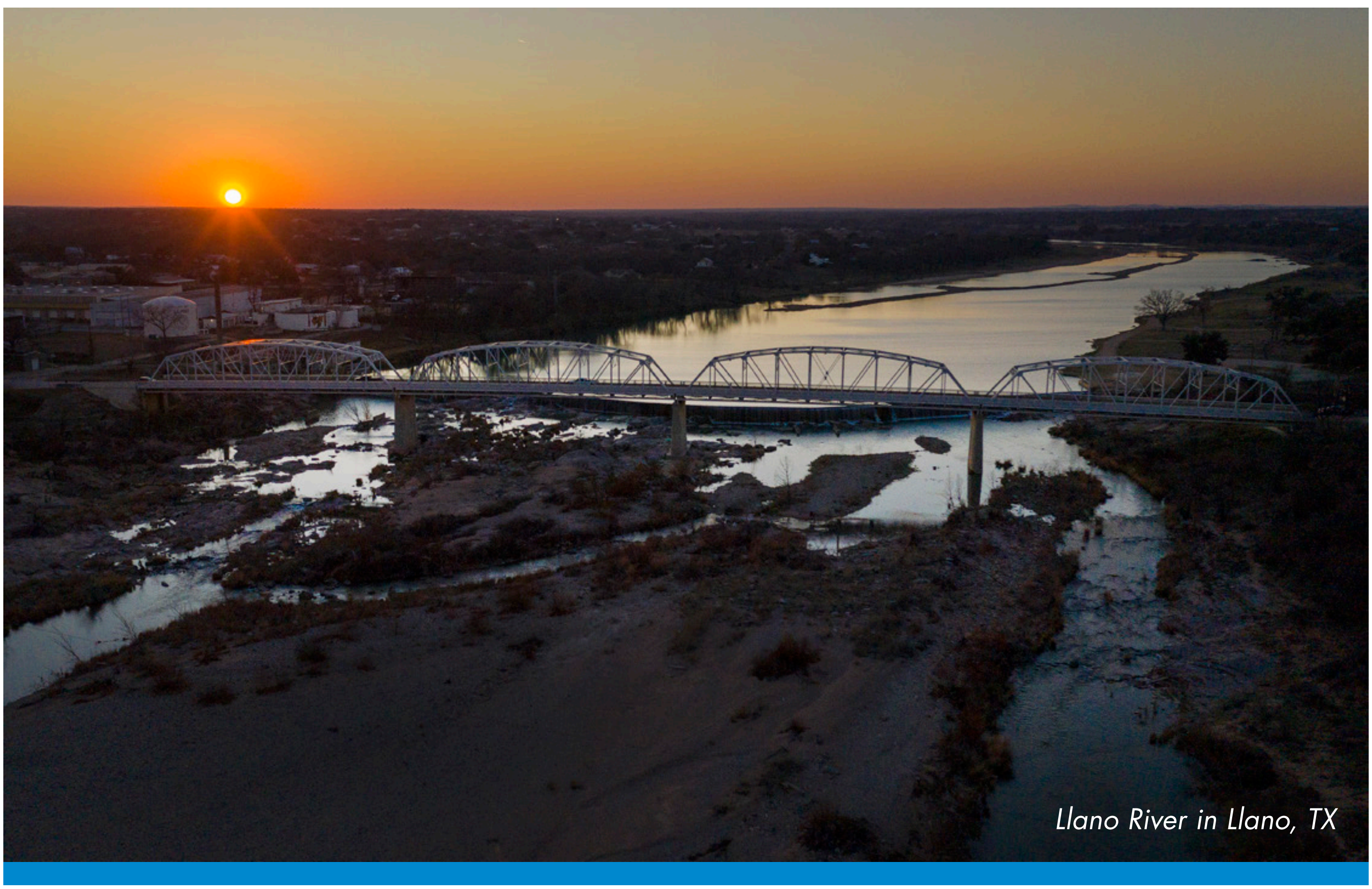
Ongoing Projects

The Llano River Watershed Protection Plan (WPP) is a comprehensive strategy developed to preserve the health and sustainability of the Upper Llano River ecosystem. The plan addresses various threats, including loss of spring flow due to aquifer withdrawals, land fragmentation, loss of riparian habitat, and the spread of invasive species. It emphasizes proactive, holistic aquatic ecosystem conservation and protection, aligning with the EPA's Healthy Watersheds Initiative.

The Llano River Watershed Alliance (LRWA) is a group of landowners and stakeholders dedicated to preserving and enhancing the Llano River watershed. Their mission focuses on encouraging land and water stewardship through collaboration, education and community participation. The LRWA plays a pivotal role in implementing the WPP by coordinating with local communities, providing technical assistance and securing resources to support conservation efforts.

Through the combined efforts outlined in the WPP and the initiatives led by the LRWA, the upper Llano River continues to support diverse aquatic and terrestrial ecosystems, as well as numerous recreational opportunities. Ongoing projects include managing invasive species, promoting sustainable land use practices and conducting educational outreach to foster community involvement in watershed stewardship.

For more information on the Llano River Watershed Alliance and their initiatives, visit: https://www.llanoriver.org/



Llano River in Llano, TX

Segment 1407A: Clear Creek

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Impairment: aluminum, copper, nickel, sulfate, total dissolved solids (TDS), zinc and pH

Segment Description

The Clear Creek watershed, located on the northeast side of Inks Lake in Burnet County, is approximately 13 square miles. The creek is about 4.5 miles long, beginning at the confluence with Inks Lake upstream to FM 2341. LCRA monitors Clear Creek at Station 18710 which is in Segment 1407A_01 from the confluence with Inks Lake upstream to FM 2341.

Table 5. *1407A Segment and Assessment Unit Descriptions*

Seg ID	Seg Name	Segment Description	AU ID	AU Description	Station ID
1407A	Clear Creek	From the confluence with Inks Lake in Burnet County west of Burnet upstream to a point 2 mi (3.2 km) west of FM 2341 near Potato Hill northwest of Burnet	1407A_01	From the confluence with Inks Lake upstream to FM 2341	18710
			1407A_02	FM 2341 upstream to headwaters near Potato Hill	No Stations

Hydrologic Characteristics

Clear Creek flows intermittently with pools from the confluence of Inks Lake upstream to FM 2341 (1407A_01) and intermittently from FM 2341 upstream to headwaters near Potato Hill (1407A_02). An intermittent stream is a type of waterway that flows only during certain times of the year, typically in response to seasonal precipitation, snowmelt or groundwater contributions. Unlike perennial streams, which maintain continuous flow year-round, intermittent streams experience periodic drying when water inputs decrease. Inconsistent flushing and evaporation may result in an accumulation of pollutants during dry periods. Evaporation can concentrate dissolved minerals and salts in the remaining water, leading to elevated TDS and nutrients. Additionally, dry periods can lead to a concentration of acidic or basic substances which can affect the solubility of metals and toxicity of pollutants. In the case of Clear Creek, the presence of exposed tailings piles – residual materials from the mining operations – likely exacerbates these water quality issues.

Land Use and Natural Characteristics

The Clear Creek watershed is rural and comprised mostly of undeveloped, forested land and brush. A tailings pile from an abandoned graphite mine is the source of impairments. Southwestern Graphite began mining operations at the current Greensmiths Inc. site in 1915. The facility produced and refined graphite ore intermittently between 1915 and 1978. Mining stopped in 1978, but Southwestern Graphite continued to process imported ore at the site until the late 1980s. The process required using water from the Colorado River, and later from Inks Lake. After using the water to float graphite from the ore, Southwestern Graphite treated the water and discharged it into Clear Creek where it flowed back into Inks Lake. The parent material from which the graphite was extracted now sits in two tailing piles covering a combined 31 acres on the banks of Clear Creek. In 2000, Greensmiths Inc. purchased the facility and began using reclaimed tailings materials as a soil amendment to landscape golf courses.

Tailings material is sold in bulk to landscaping, farmers and construction companies. The University of Arizona and the Bureau of Economic Geology are conducting studies to determine potential economic value of re-processing the tailings.

Description of Water Quality Issue

The TCEQ first placed Clear Creek on the 2010 303(d) List of impairments for not supporting general use (pH, TDS, sulfate) and aquatic life use (aluminum in water) in 2010. In 2014, assessed data indicated high levels of zinc and nickel in water, and those constituents were added to the 303(d) List. Cadmium in water was first listed as a concern in the 2014 IR. Copper in water was first listed as an impairment in the 2018 IR. Metals in water were not assessed in the 2024 IR due to a gap in metals in water sampling from 2014 to 2022. However, these impairments are carried forward and remain on the 303(d) List.

Table 6 lists the current impairments and concern for general use (pH, TDS, and sulfate) and aquatic life use (aluminum, zinc, nickel, copper, and cadmium) with the Texas Surface Water Quality criteria and mean results. A majority of Table 6 displays data from the 2014 IR (data from Dec. 1, 2005, to Nov. 30, 2012) where the greatest number of samples were assessed.

Table 6. *Parameters Causing Impairments in Clear Creek – 2014 Integrated Report*

Parameter	Number of samples assessed	Number of times criteria was exceeded	Criteria	Mean results
pH	35	27	6.5	NA
TDS (mg/L)	35	NA*	600.00 (mg/L)	1,158.12 (mg/L)
Sulfate (mg/L)	33	NA*	100.00 (mg/L)	1,132.37 (mg/L)
Aluminum in water (acute) (µg/L)	15	8	991.00 (µg/L)	10,212.23 (ug/L)
Zinc in water (chronic) (µg/L)	15	NA	194.40 (µg/L)	224.69 (µg/L)
Nickel in water (chronic) (µg/L)	21	NA	85.51 (µg/L)	110.38 (µg/L)
Copper[1] in water (chronic) (µg/L)	10	1	15.65 (µg/L)	17.27 (µg/L)
Cadmium[2] in water (chronic) (µg/L)	4	1	0.37 (µg/L)	10.75 (µg/L)

** Averages are assessed. Individual data points are not compared to criteria.*

[1] Copper values are from the 2020 IR.

[2] Cadmium is a concern in the 2014 IR.

General and Aquatic Life Use

A majority of Clear Creek Station 18710 data points for pH, TDS and sulfate values do not support the general use criteria set by the Texas Surface Water Quality Standards (Figure 10). For pH, values less than 6.5 do not meet the criteria standard. Criteria standards are not met for TDS and sulfate for values greater than 600.00 mg/L and 100.00 mg/L, respectively. These parameters are interconnected as acidic conditions, sulfate-rich sources and elevated TDS can collectively degrade water quality overtime.

Total dissolved solids refer to the combined content of all inorganic and organic substances dissolved in water, including minerals, salts, metals, cations and anions. Common constituents of TDS are inorganic salts such as calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates. Water naturally dissolves these substances as it comes into contact with minerals and other materials. In natural environments, sulfates are found in soil and rock formations. Industrial processes, such as mining, generate sulfate-rich waste which can contribute to elevated sulfate levels in water. As water percolates through these materials, it dissolves sulfate minerals, introducing them into groundwater and surface water systems.

In the case of Clear Creek, stormwater infiltrating through the tailings pile reacts with pyrite, an iron sulfide mineral, and creates sulfuric acid, a strong, corrosive acid, and iron oxide. The oxidation of sulfide minerals leads to high sulfate content in water and elevated TDS levels as dissolved minerals accumulate. These acidic conditions increase the solubility of metals which leach into the creek, likely resulting in the elevated metals in water.

Aluminum, copper, nickel and zinc often exceeded their respective criteria from 2007 to 2014 (Figure 11). There appears to be a similar trend among these parameters where their concentrations are closer to meeting their criteria in recent years. This trend could be explained by the implementation of best management practices (BMPs). Greensmiths Inc. constructed a stormwater diversion system in 2012, and a leachate collection trench and containment sump in 2014. These recent BMPs might be responsible for improving the impaired metals in water in Clear Creek. However, there is not enough new data to make an assessment. Monitoring will continue to better understand these impairments.

Figure 9. *Photographs of Clear Creek Station 18710 site conditions when wet (left) on April 23, 2024, and dry (right) on Feb. 12, 2025.*

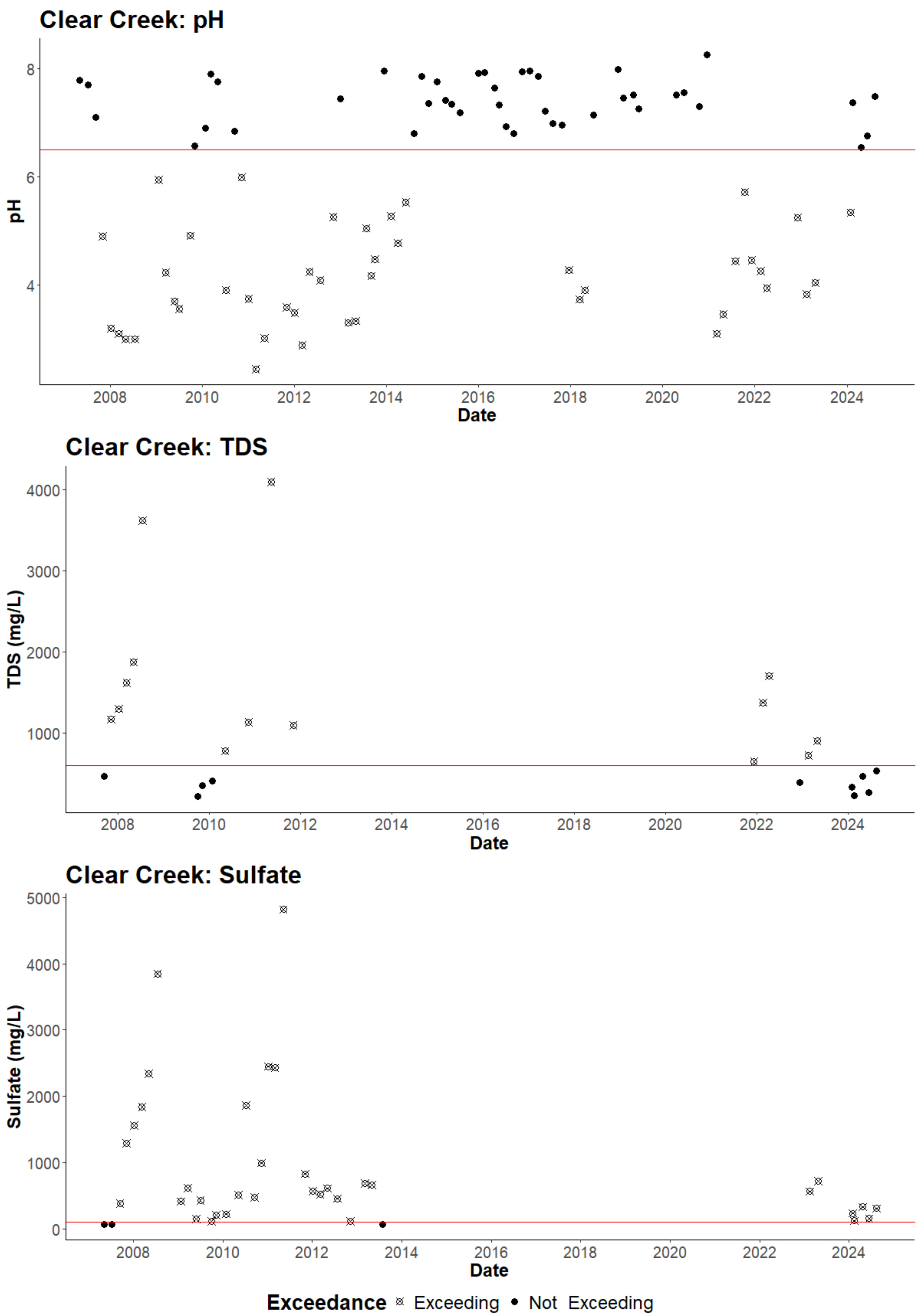

Figure 10. *pH, total dissolved solids (TDS) (mg/L) and sulfate (mg/L) concentrations at Clear Creek Station 18710 from May 7, 2007, to Nov. 15, 2024. The red lines indicate the Texas Surface Water Quality criteria for each parameter. Values that exceed the criteria are represented with an open square containing an x. Values that do not exceed the criteria are represented with a solid circle.*

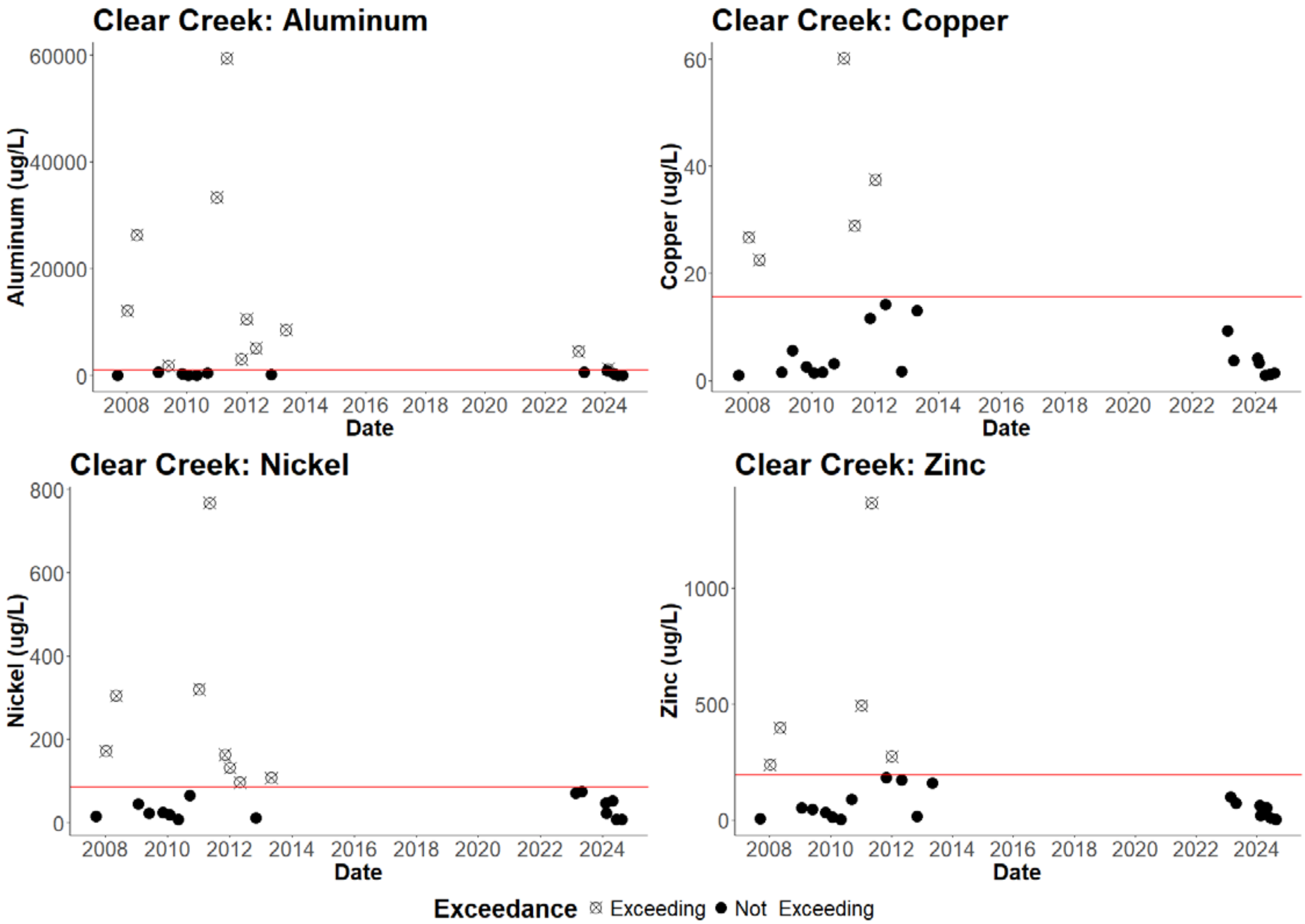

Figure 11. *Aluminum (μg/L), copper (μg/L), nickel (μg/L) and zinc (μg/L) concentrations at Clear Creek Station 18710 from May 7, 2007, to Nov. 15, 2024. The red lines indicate the Texas Surface Water Quality criteria for each parameter. Values that exceed the criteria are represented with an open square containing an x. Values that do not exceed the criteria are represented with a solid circle.*

Potential Cause of Water Quality Issue

Clear Creek Station 18710 is located about 1.5 miles downstream of the tailings pile. Stormwater infiltrating through the tailings pile creates acidic leachate which drains into Clear Creek. This process called acid mine drainage (AMD) is typically caused by the oxidation of sulfide minerals when they are exposed to air and water. This production of sulfuric acid, which lowers the pH of surrounding water and dissolves heavy metals making them more bioavailable and toxic to aquatic life. Unlike organic pollutants, heavy metals do not degrade over time, making them persistent environmental contaminants. AMD is a major environmental issue, especially in abandoned mines, as it can persist for decades or even centuries. It leads to severe water pollution, harming ecosystems and posing risks to human health. Mitigation strategies for AMD include neutralization with alkaline materials such as limestone, constructed wetlands and microbial remediation to reduce acidity and metal contamination.

Clear Creek contributes flow intermittently to the middle section of Inks Lake near SH 29. Although Clear Creek has impairments for pH, TDS, sulfate and metals in water, Inks Lake continues to meet all Texas Surface Water Quality criteria at downstream Station 12336 near Inks Dam.

Potential Stakeholders

- Greensmiths Inc.
- LCRA
- TCEQ

Actions Taken

- In 2004, LCRA worked with TCEQ and Greensmiths Inc. to help secure a permit that would treat leachate onsite and eliminate discharges to the stream.

- In 2007, LCRA established a water quality monitoring site on Clear Creek. Station 18710 is about 1.5 miles downstream of Greensmiths Inc.

- In 2010, Greensmiths Inc. engineered an industrial disposal plan to allow on-site treatment and eliminate discharges to the stream. LCRA reviewed and commented on the application for an industrial disposal permit from TCEQ.

- TCEQ issued a no-discharge permit in December 2010.

- A TCEQ inspection in July 2012 resulted in an enforcement order for unauthorized discharge. A draft Compliance Agreement was sent to the Permittee. The Compliance Agreement was not finalized between the TCEQ and the Permittee.

- Greensmiths Inc. efforts to meet the proposed Compliance Agreement goals included the construction of a stormwater diversion channel, regrading the tailings pile tailings pile areas, monitored tailings pile surface and seepage rates, and installation of a Leachate Management System. Data collection by the contracted engineering firm indicated improving conditions in Clear Creek.

- A TCEQ inspection was conducted in April 2017 to evaluate Texas Land Application Permit (TLAP) WQ0000350000 compliance. Greensmiths Inc. was determined to not be meeting permit conditions and not implementing special provisions. The TLAP coverage expired on December 1, 2019.

- A TCEQ investigation was conducted in December 2023 to evaluate site conditions. Violations were alleged regarding failure to obtain authorization to discharge stormwater associated with industrial activity, failure to prevent an unauthorized discharge of leachate from a graphite mine tailings pile to water in the state, and failure to prevent a discharge of pollutants into Inks Lake water quality area. Greensmiths Inc. has been granted an extension until Aug. 1, 2025, to explore remediation options.

- Monitoring by the TCEQ and LCRA is ongoing to determine if BMPs have effectively contained stormwater to prevent contaminated runoff.

Recommended Actions

- Continue regular inspections of the Greensmiths Inc. facility.
- Greensmith Inc. will be required to cease the discharge of tailing pile leachate or obtain the appropriate wastewater permit for the discharge.
- Continue monitoring at Station 18710.
  - There are currently not enough data points to assess the most recent data. Clear Creek has intermittent flows and Station 18710 is often dry which makes monitoring a challenge. LCRA and TCEQ will continue to monitor this site and focus on stormwater collections when possible to collect data.

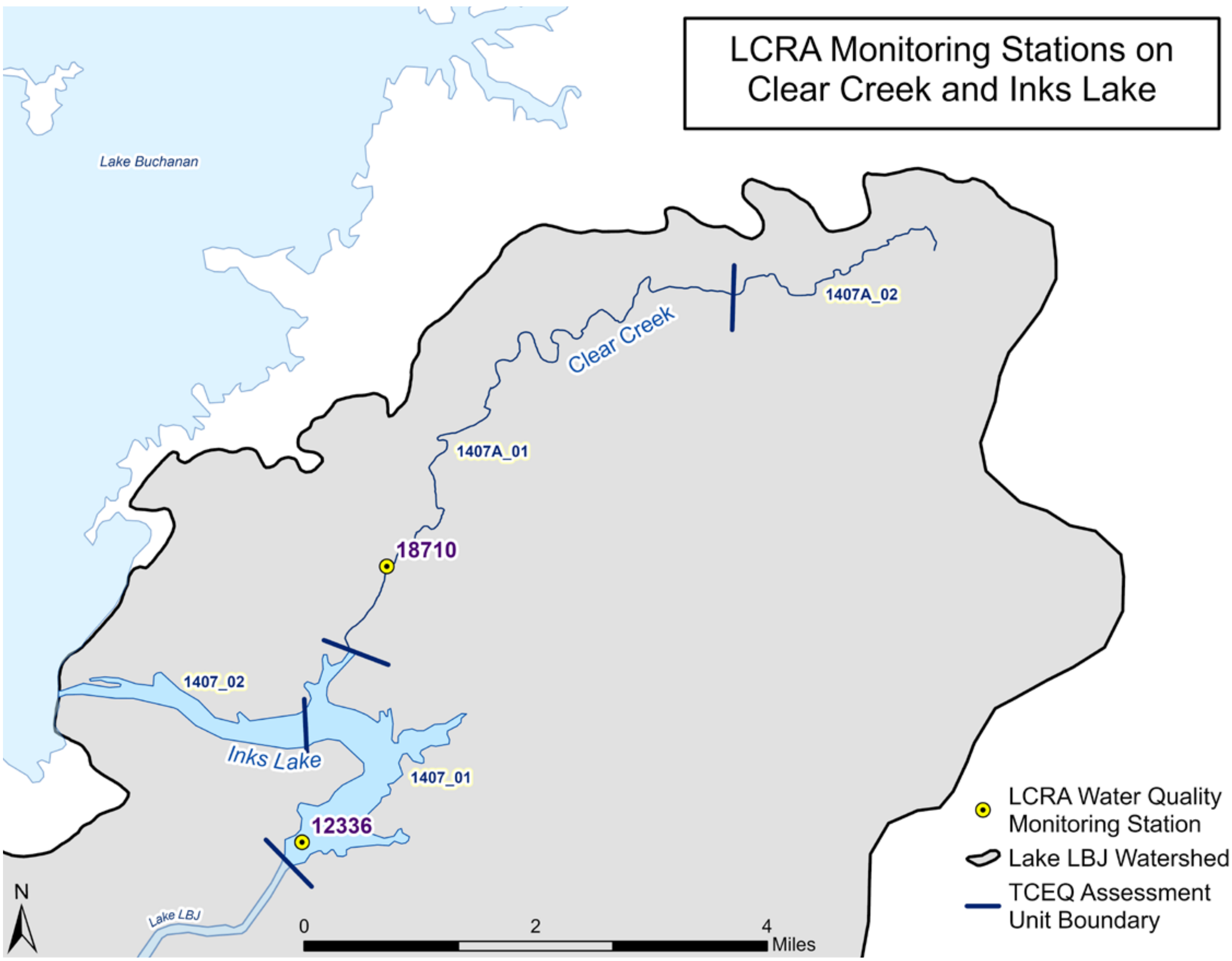

Figure 12. *Map of Clear Creek and Inks Lake displaying LCRA water quality monitoring stations 18710 and 12236, respectively.*

Appendix A

Texas Integrated Report Assessed Waterbody Categories

- **Category 1:** All designated uses are supported, no use is threatened.
- **Category 2:** Available data and/or information indicate that some, but not all of the designated uses are supported.
- **Category 3:** There is insufficient or unreliable available data and/or information to make a use support determination.
- **Category 4:** Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.
  - **Category 4a:** A state developed TMDL has been approved by the EPA or a TMDL has been established by the EPA for any water-pollutant combination.
  - **Category 4b:** Other required control measures are expected to result in the attainment of an applicable water quality standard in a reasonable period of time.
  - **Category 4c**: The impairment or threat is not caused by a pollutant.
- **Category 5:** Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.
  - **Category 5a:** A TMDL is underway, scheduled or will be scheduled.
  - **Category 5b:** A review of the water quality standards for the water body will be conducted before a management strategy is selected.
  - **Category 5c:** Additional data and information will be collected or evaluated before a management strategy is selected.
  - **Category 5n:** Water body does not meet its applicable chl-a criterion, but additional study is needed to verify whether exceedance is associated with causal nutrient parameters or impacts to response variables.
  - **Category 5r:** A WPP is under development or accepted by the EPA for this parameter.

Appendix B

Colorado River basin segments delisted on the 303(d) List in the 2024 Integrated Report

Table 7. *Colorado River basin segments delisted the 303(d) List in the 2024 IR*

Assessment Unit	Waterbody	Use Impaired	Parameter	Reason Delisted
1403A_04	Bull Creek	Aquatic Life Use	Dissolved Oxygen	Recent data meets criteria
1405_01, 1405_02	Lake Marble Falls	General Use	Excessive algal growth in water	Recent data meets criteria
1429_01, 1429_02	Lady Bird Lake	General Use	Excessive algal growth in water	Recent data meets criteria

Appendix C

Summary of Texas Surface Water Quality Standards

The TCEQ protects water quality by establishing Texas Surface Water Quality Standards for water bodies of the state. The standards are made up of two components: designated uses and criteria. Designated uses are purposes for water, including general use, aquatic life use, contact recreation and public water supply. Criteria are usually numeric (sometimes narrative) limits used to compare water quality data or conditions. Common designated uses and their associated criteria are described as follows:

- **General Use** – The category was created to protect overall water quality. Temperature, pH, chloride, sulfate and TDS criteria are used to gauge support for this use. Numeric criteria for these parameters vary among water bodies in the Colorado River basin.

- **Aquatic Life Use** – The TCEQ has established different criteria (Tables 8-9) to determine support for aquatic life in freshwater. For aquatic life use, there are four subcategories: exceptional, high, intermediate and limited. As a general rule, all perennial streams are assumed to have a high aquatic life use designation.

Table 8. *Fish Aquatic Life Use Criteria based on Texas Surface Water Quality Standards*

FISH AQUATIC LIFE USE				
Ecoregion	Exceptional	High	Intermediate	Limited
24	≥ 43	37-42	35-36	< 35
25	≥ 36	34-35	24-33	< 24
26	≥ 36	34-35	24-33	< 24
27	≥ 49	41-48	35-40	< 35
29	≥ 49	41-48	35-40	< 35
30	≥ 52	42-51	30-41	< 30
31	≥ 42	37-41	25-36	< 25
32	≥ 49	41-48	35-40	< 35
33	≥ 52	42-51	36-41	< 36
34	≥ 49	39-48	31-38	< 31
35	≥ 52	42-51	36-41	< 36

Table 9. *Benthic Community and Habitat Aquatic Life Use Criteria based on Texas Surface Water Quality Standards*

Level of Aquatic Life Use Attainment	**Dissolved Oxygen Criteria** 24-hour average/ minimum (mg/L)	**Benthic Community Index Score**	**Habitat Index Score**
Exceptional	6.0/4.0	>36	26-31
High	5.0/3.0	29-36	20-25
Intermediate	4.0/3.0	22-28	14-19
Limited	3.0/2.0	<22	<14

- **Contact Recreation** – This use refers to a water body's existing, designated, presumed and attainable use for physical contact, such as swimming. The standard (Table 10) for contact recreation is a measure of bacteria levels. In freshwater, the indicator is Escherichia coli bacteria, though fecal coliform bacteria were used as indicators until the early 2000s. In saltwater and coastal areas, Enterococci bacteria are used as the indicator. Units of measure for bacteria test results may be reported in most probable number (MPN).

Table 10. *Bacteria Criteria for Primary Contact Recreation based on Texas Surface Water Quality Standards*

Bacteria	**Geometric Mean Criteria (CFU/100mL)**	**Single Sample Criteria (CFU/100mL)**
E. coli	126	399
Enterococcus	35	104

- **Public Water Supply** – This use is evaluated by assessing finished drinking water and/or surface water conditions. Finished drinking water is assessed for toxic contaminants at the point of entry to distribution systems. Finished drinking water also is assessed for elevated levels of dissolved minerals: chloride, sulfate and TDS, which have criteria of 300, 300 and 1000 mg/L, respectively. These criteria for dissolved solids are applied statewide and were developed to ensure water supply utilities could treat and deliver water free of taste and odor.

Appendix D

TX HB1688 | 2023-2024 | 88th Legislature | Reporting

In the 88th Texas Legislative session, House Bill 1688 amended Section 26.551 of the Texas Water Code by adding a provision to designate the South Llano River in Kimble County as the "Coke Stevenson Scenic Riverway". This designation now occurs alongside the John Graves Scenic Riverway that is located in the Brazos River basin. The bill states that LCRA, TCEQ and TPWD will work together to visually inspect the riverway from both the surface and from aircraft and test water samples from this section of the South Llano River at least once in a winter month and at least once in a summer month. The subchapter directing these activities expires Sept. 1, 2027.

LCRA, TCEQ and TPWD met in spring 2024 at the LCRA Coordinated Monitoring Meeting to discuss coordination of House Bill 1688. Conclusions are as follows:

1. Inspections:
   a. "aircraft" inspections: TPWD will be conducting flyovers twice/year and is overseeing the scheduling of these events and inviting TCEQ and LCRA.
   b. "surface" inspections: staff from all three agencies are coordinating bi-annual kayak/canoe trips down this stretch of river to visually survey.
2. Testing of water samples: Under the Clean Rivers Program, LCRA conducts testing in the designated Coke Stevenson Scenic Riverway at the following locations. This data will be displayed at https://waterquality.lcra.org/.
   a. existing: LCRA has been conducting water quality monitoring on the mainstem South Llano River in Kimble County since 2002. Currently, LCRA is sampling 4 times/year at TCEQ Station 18197 - South Llano River approximately 10 miles upstream of South Llano River State Park 204 yards upstream of second US 377 crossing..
   b. additional: LCRA added monitoring at Cedar Creek at W. Ranch Rd 2169 in Junction (new TCEQ Station 22494 created). Monitoring at this site began in fiscal year 2025 with a frequency of four times per year for core water quality data, bacteria and flow.
3. Reporting on activities related to HB 1688 will take place in the annual Clean Rivers Program Basin Highlights Reports drafted and published by LCRA.

Surface Inspection Report from July 30, 2024

Environmental scientists from LCRA, TCEQ and TPWD surveyed the South Llano River in Kimble County on July 30, 2024, to document any unpermitted activities, as well monitor the biological diversity of this section. Surveyors collected data starting on Paint Creek Ranch near the Kimble County line to the State Loop 481 bridge in Junction. A variety of live mussel species were found through qualitative sampling, including the federally endangered Texas Fatmucket and the rare Hill Country Creeper. Data on intake/discharge pipes and construction below the ordinary high water mark was documented. All instances appear to be related to recreational access and domestic and livestock water rights withdrawals at this time. A flood within the week prior to the survey created some obstacles to navigation that were also documented. Overall, the biodiversity and health of the river is outstanding.

A winter survey was scheduled twice in January. However, weather and flows were not suitable for the survey. As of this writing, staff from all three agencies have scheduled to survey the river surface via kayak on March 6, 2025.

Aircraft Inspection Report from Dec. 11, 2024

Environmental scientists from TCEQ and TPWD surveyed the South Llano River in Kimble County via helicopter on Dec. 11, 2024, to document any unpermitted activities. Prior to the survey, TCEQ staff conducted a desktop survey using Google Earth Pro and identified four potential aggregate production operations. All four areas of concern were surveyed from the air and appeared to be inactive and none of the sites were holding water. Geolocational data for each site was submitted to the TCEQ San Angelo Regional Office for further investigation.