# 2019 TRINITY RIVER AUTHORITY CLEAN RIVERS PROGRAM BASIN HIGHLIGHTS REPORT

# Acknowledgements

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*Cover photo: An old lock and dam structure in the mid-Trinity River near Rosser.*

# Acronyms

AU – Assessment Unit

BS – Biased to Season Sampling

CAFO – Concentrated Animal Feeding Operation

CFS – Cubic feet per second

CN – Concern for Near Non-Attainment

CRP – Clean Rivers Program

CS – Screening Level Concern

DFW – Dallas-Fort Worth

DO – Dissolved Oxygen

EPA – Environmental Protection Agency

FS – Fully Supporting

FY – Fiscal Year

IR – Integrated Report

LCRA – Lower Colorado River Authority

m – Meter

mg/L – milligrams/Liter

MPN/100 mL – Most Probable Number per 100 Milliliters

MPN/100 g – Most Probable Number per 100 grams

NA – Not Assessed

NC – No Concern

NS – Not Supporting

NTMWD – North Texas Municipal Water District

PCB – Polychlorinated Biphenyl

RT – Routine Sampling

TCEQ – Texas Commission on Environmental Quality

TDS – Total Dissolved Solids

TKN – Total Kjeldahl Nitrogen

TN – Total Nitrogen

TP – Total Phosphorous

TRA – Trinity River Authority

TSI – Trophic Status Index

ug/L – micrograms/Liter

USGS – United States Geological Survey

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# Introduction

## The Texas Clean Rivers Program

In 1991, Texas Senate Bill 818 created the Clean Rivers Program (CRP). This program is administered by the Texas Commission on Environmental Quality (TCEQ) and is conducted in each of the major river basins by local planning agencies such as the Trinity River Authority. The CRP is funded, in part, by fees assessed to water and wastewater permits. The goals of the program are to protect the water resources of the state and to maintain and improve water quality.

## Annual Reports

Each year, the local planning agencies produce a Basin Highlights Report which summarizes the CRP activities in their basin. This report may include information on events effecting water quality, a summary of water quality data, and an overview of public outreach activities and special projects. Every fifth year, a greatly expanded Basin Summary Report provides a detailed analysis of water quality data and potential sources, as well as offering recommendations for future basin activities. All past reports are available on TRA's Reports webpage.

## Goals and Objectives of the TRA CRP

The TRA CRP focuses on three main aspects of the program: water quality monitoring, special projects, and public outreach. Routine water quality monitoring data are vital to the success of the CRP. Data are used for regulatory purposes such as setting water quality standards, constructing models for permit limits, and evaluating the health of waterbodies. In the Trinity basin, monitoring is leveraged with the existing programs of several municipalities and other entities. This partnership has allowed TRA to provide much more information to the TCEQ than would be possible with in-house resources.

Special projects are typically short-term sampling activities focused on answering a specific water quality question. Other projects that do not generate water quality data may include in-depth analyses of existing data for various purposes and compilation of historic data sources.

Public outreach and stakeholder engagement involves annually updating the Steering Committee which helps guide the activities of the TRA CRP. Other outreach activities include sponsorship of trash clean-ups and public education events. Education on the importance and protection of Trinity water resources is accomplished via participation in organized public and school events.

# Trinity Basin and Water Quality Characteristics

The Trinity River extends approximately 715 miles and drains about 18,000 square miles of the state before ending at Trinity Bay near Anahuac (see **Figure 1**). A majority of the basin topography is flat to gently rolling. A large portion of the watershed flows through the Blackland Prairies which lends the river its characteristic muddy brown color. This ecoregion is made up of soil types that, while excellent for row crop agriculture, are highly erodible.

The northern portion of the basin is dominated by the Dallas-Fort Worth (DFW) Metroplex. Legacy pollutants, which are banned chemicals that are persistent in the environment, are a concern. Other results of urban life include storm water runoff that is polluted by oil and grease, pesticides, fertilizers, and animal waste. During the summer months, the native flow of the river in this area is reduced to a trickle generally made up of seeps from groundwater and occasional rainfall events. The larger fraction of summer flow is made up of effluent from wastewater dischargers. This allows the river to maintain a habitat far greater in flow and better water quality than historical levels.

The far northern and middle reaches of the basin are characterized by agriculture. These activities can result in elevated nutrient levels from fertilizer use, bacteria from waste from concentrated animal feeding operations (CAFOs), and soil erosion. Many areas of the basin are also experiencing increased oil and gas drilling activities which can have negative impacts on water quality. These impacts can include increased salinity due to runoff containing salts from clay stabilizers in fracking fluid and the co-produced brine water that often results from oil and gas recovery, increased suspended solids due to runoff containing disturbed soils from drilling sites, and the presence of drilling fluid and wastewater due to accidental spill.

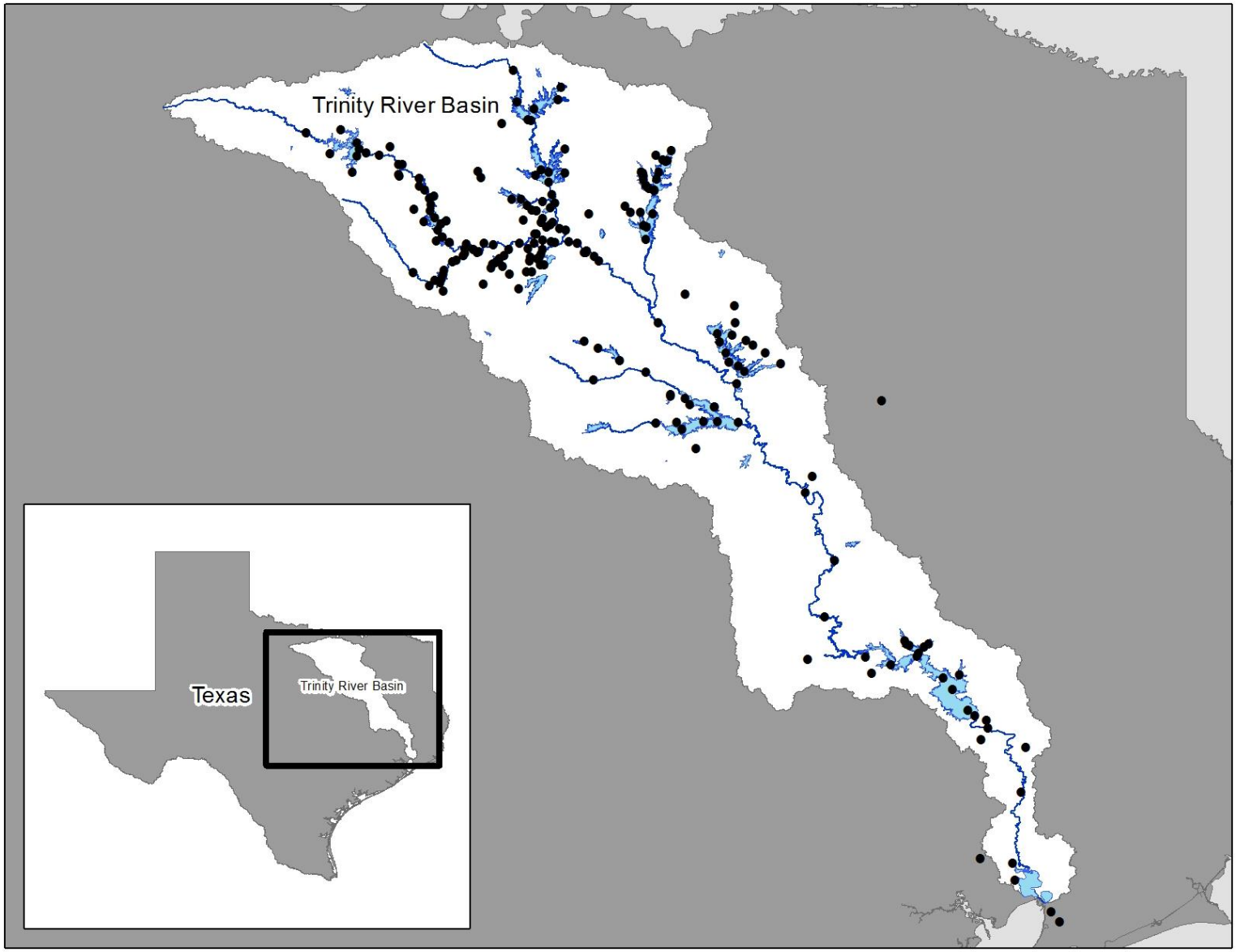


*Figure 1: Trinity River Basin with monitoring stations*

# Public Involvement

The TRA Clean Rivers Program participates in several public involvement activities which range from trash clean-ups to public education events. Public interest in the welfare of local waterbodies is vital to improving water quality in the Trinity Basin.

The TRA Clean Rivers Steering Committee is made up of basin stakeholders and other interested parties, including city officials and the general public. The steering committee provides input and information about water quality that is used to inform the program's monitoring decisions. Annual meetings, which are open to the public, are held to update steering committee members on the activities of the program and to provide a forum to share ideas and concerns. Some of the water quality topics that have been of interest to basin stakeholders over recent years include:

- The Upper Trinity River Flow Discrepancy Study conducted in the FY 2012-2013 biennium to determine stream flow gains and losses along the river from Fort Worth to Grand Prairie,
- Village Creek Sediment Sampling conducted in FY 2014-2015 to characterize sediment chemistry in Village Creek,
- Aquatic Life Monitoring at various locations throughout the basin,
- The PCBs, Dioxins, and Furans in Sediments study conducted in the FY 2016-2017 and FY 2018-2019 bienniums,
- The E. coli in Sediments study to be conducted in the FY 2018-2019 biennium, and
- The White Rock Creek E. coli Source Identification study to be conducted in the FY 2018-2019 biennium.

If you are interested in participating in the Steering Committee, contact the TRA CRP at tra@trinityra.org.

Trash clean-ups are public events that are organized by cities and counties. The TRA CRP helps fund these events which include Trash Bash, Navarro County Clean-Up Day, and Walker County Proud. Volunteers at these events remove many tons of debris from waterbodies and waterways. In addition to the immediate benefit of the waste removal, volunteers become more aware of their impact on local waterbodies.

The Texas Stream Team utilizes a network of trained volunteers to monitor the quality of waterbodies in Texas. The Meadows Center at Texas State University administers this program in cooperation with the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA). The TRA CRP supports this program through funding for replacement supplies in existing kits. For more information about this program, visit the Texas Stream Team website hosted by the Texas State University Meadows Center for Water and the Environment.

In addition to the activities discussed above, the TRA CRP participates in several organized public outreach and education events each year. These range from local Earth Day events to Gator Fest in Anahuac to water quality presentations for elementary school groups. At these events, information is presented on the Trinity basin as well as the Trinity River Authority (see **Figure 2**). Educational materials are supplied in order to teach the public how they can take a personal role in reducing and preventing water pollution.


*Figure 2: Public outreach display at Dallas Earth Day 2016.*

# Routine Water Quality Monitoring

Routine water quality monitoring is being conducted by ten partner entities as well as TRA and, at the time of this report, covers sampling at 197 sites throughout the basin. These partner entities have contributed their monitoring efforts to the Clean Rivers Program and have greatly increased the range of the program in the basin. With the cooperation of these partners, TRA has received a four to one return for each dollar spent on monitoring activities.

There are currently eleven entities monitoring throughout the basin under the TRA Clean Rivers Program. These include the cities of Arlington, Dallas Water Utilities Watershed Management, Dallas Trinity Watershed Group, Fort Worth, Grand Prairie, and Irving, as well as the DFW Airport Environmental Affairs Department, TRA Lake Livingston Project, North Texas Municipal Water District, Tarrant Regional Water District, and Trinity River Authority. These entities currently collect samples at 199 stations. The FY 2019 monitoring schedule is available on the Lower Colorado River Authority Coordinated Monitoring Schedule website. **Figures 3 to 18** show the sampling locations for the FY 2019 routine monitoring. An interactive map of these locations is also available on the LCRA Coordinated Monitoring Schedule website.

The following list is a generalized summary of the parameters included in each parameter group shown in the coordinated monitoring schedule. The specific parameters collected by each entity and the frequency vary.

- **24-Hour DO** – 24-hour deployment summary data for water temperature, dissolved oxygen, pH, and specific conductance
- **Metals in Water** – total and/or dissolved aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, nickel, silver, and zinc
- **Organics in Water** – total petroleum hydrocarbons
- **Conventionals** – Total alkalinity, biochemical oxygen demand, total and dissolved organic carbon, chlorophyll-a, hardness, nitrogen series, phosphorus series, solids, chloride, and sulfate
- **Bacteria** – *E. coli*
- **Flow** – flow severity, instantaneous flow, and flow measurement method
- **Field** – Air and water temperature, dissolved oxygen, pH, specific conductance, drought parameters, Secchi depth, and turbidity

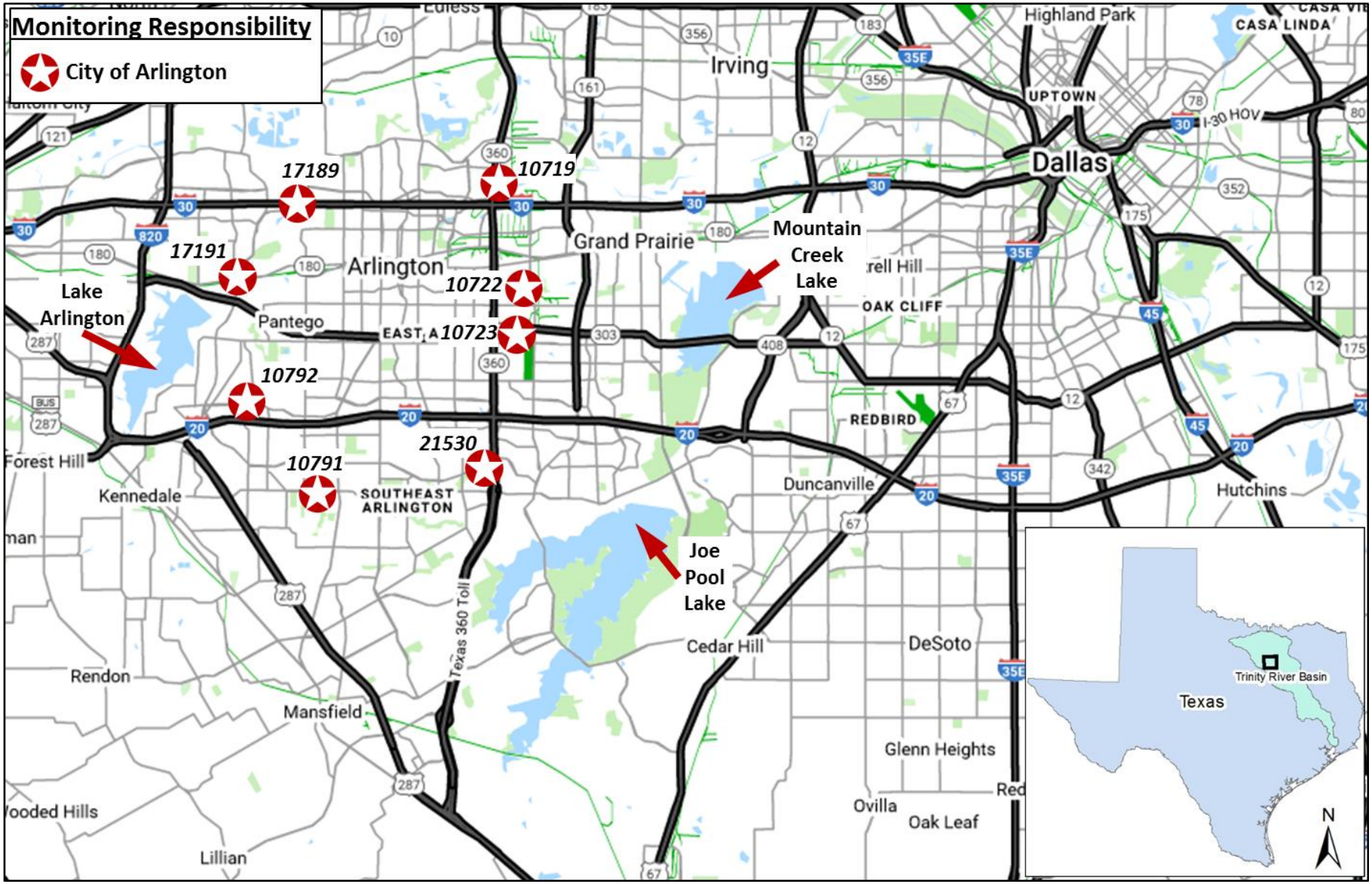


*Figure 3: City of Arlington Monitoring*

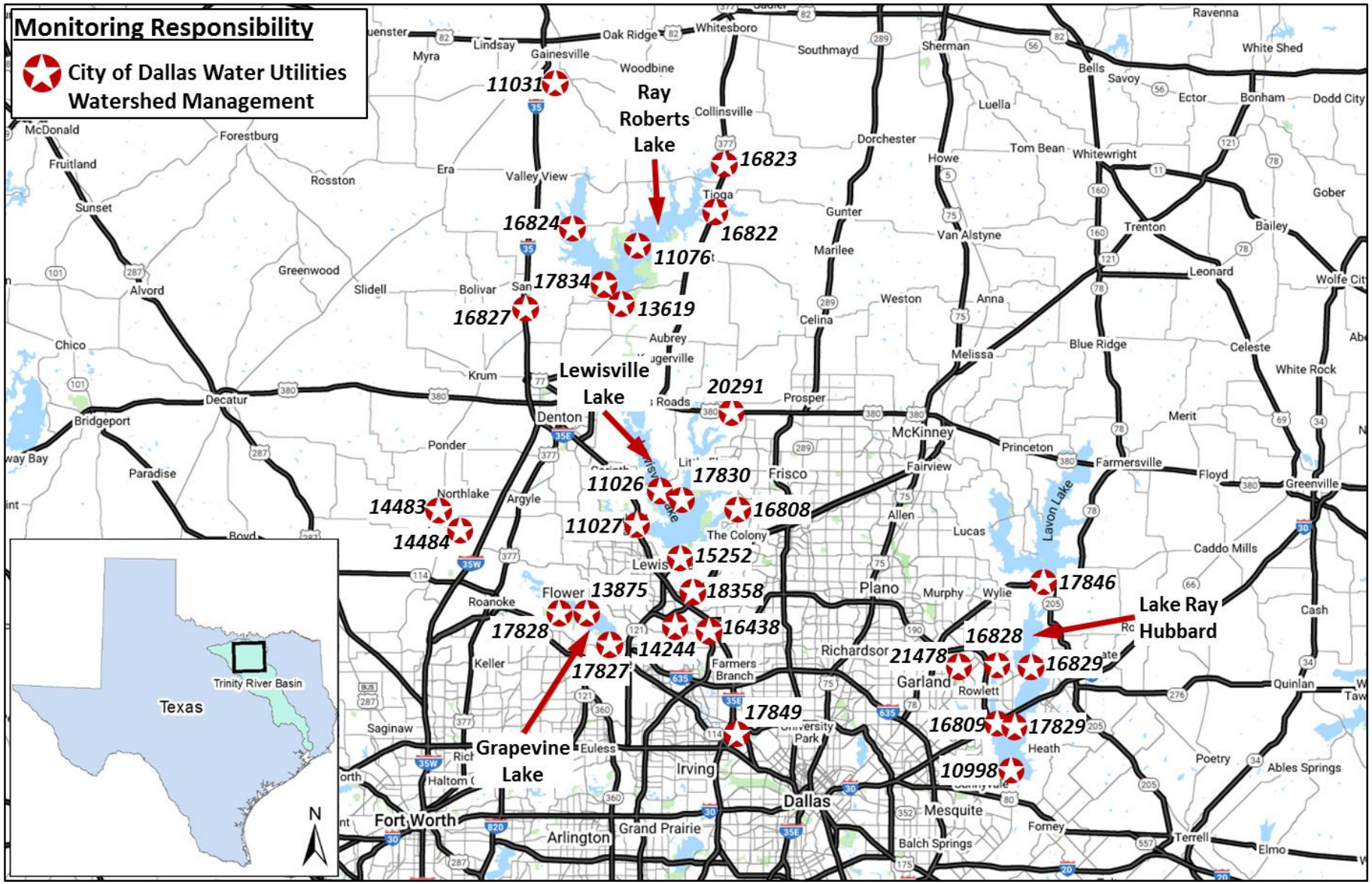


*Figure 4: City of Dallas Water Utilities Watershed Management Monitoring*

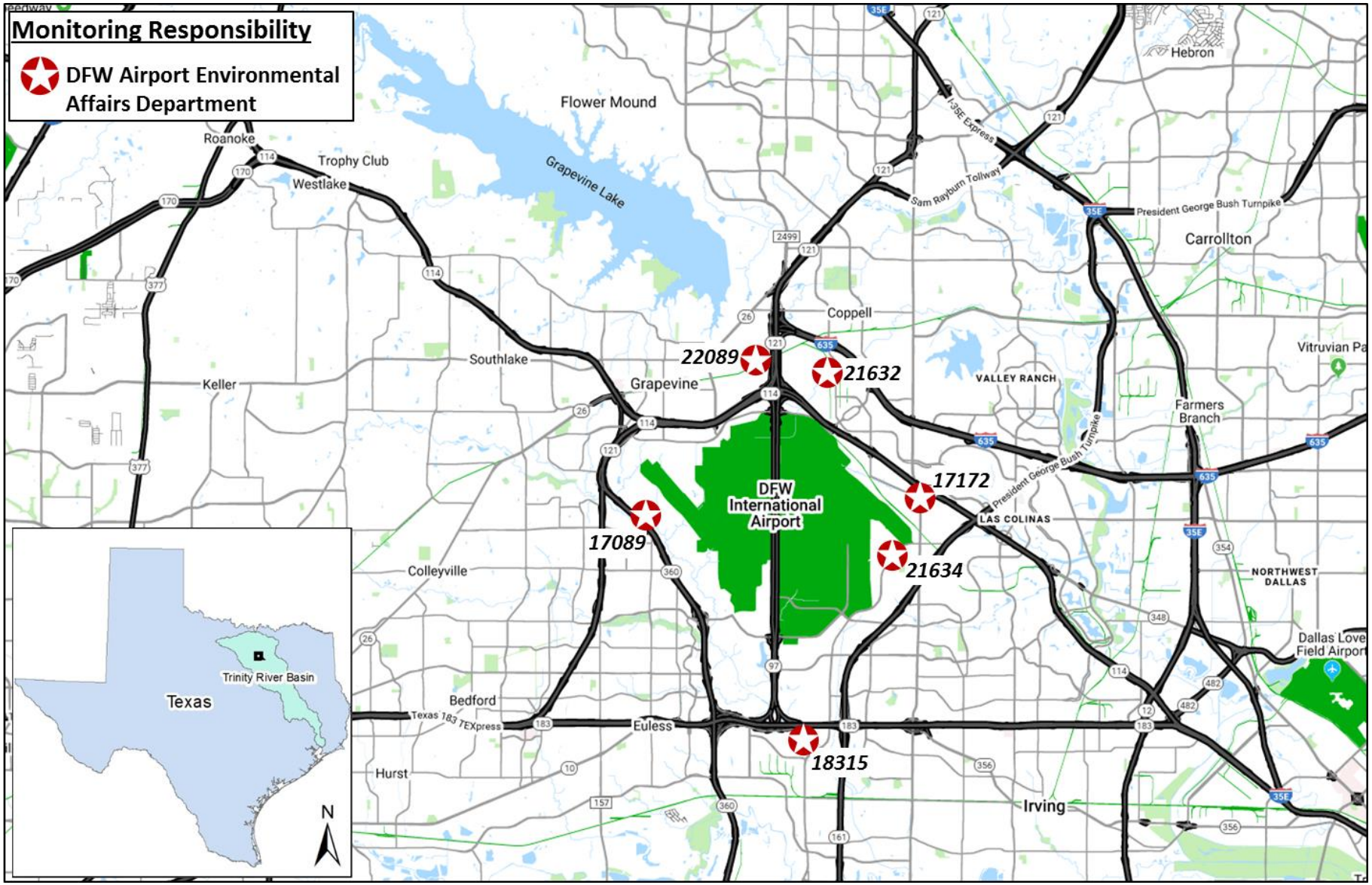


*Figure 5: DFW Airport Environmental Affairs Department Monitoring*

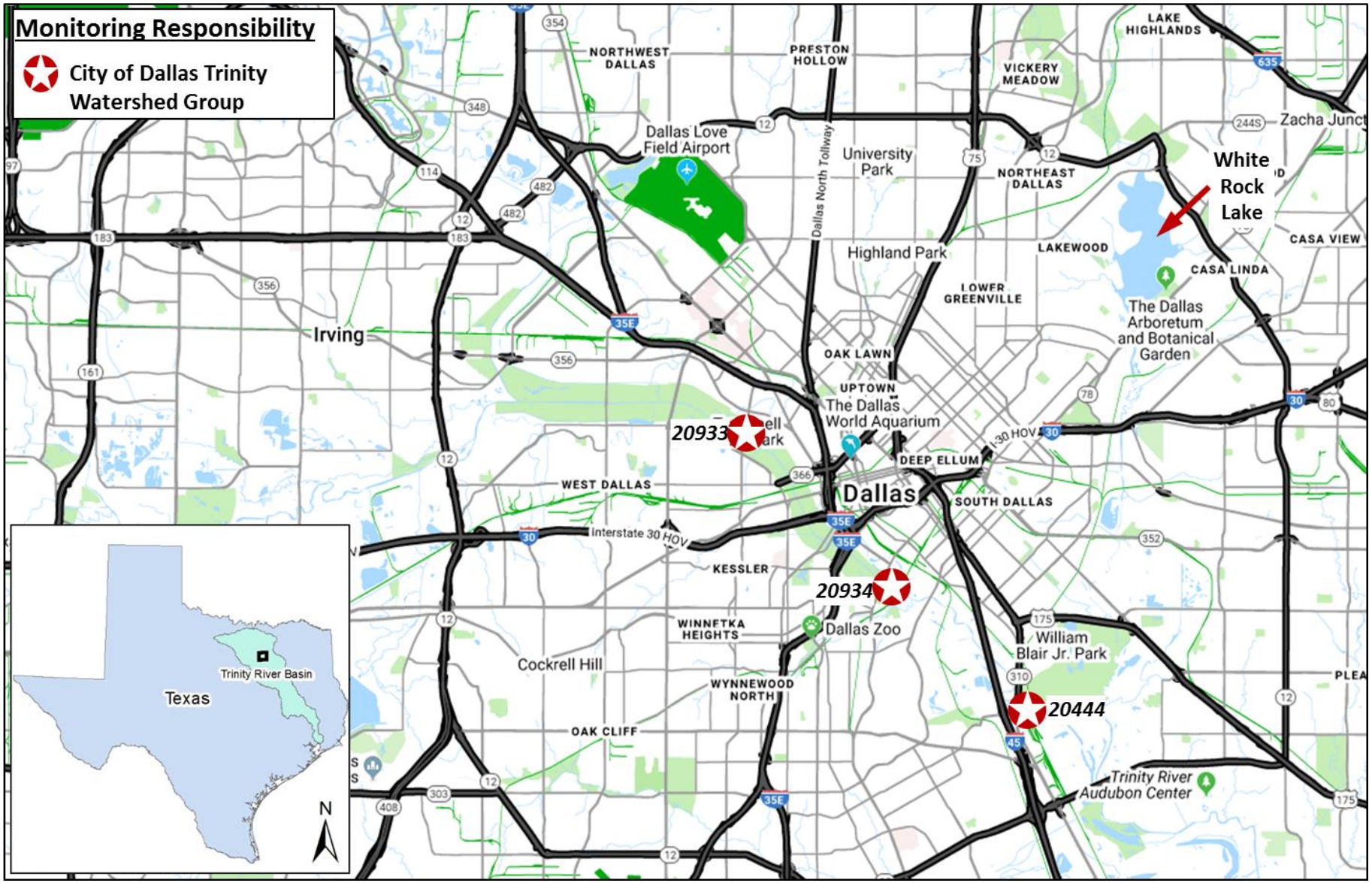


*Figure 6: City of Dallas Trinity Watershed Group Monitoring*

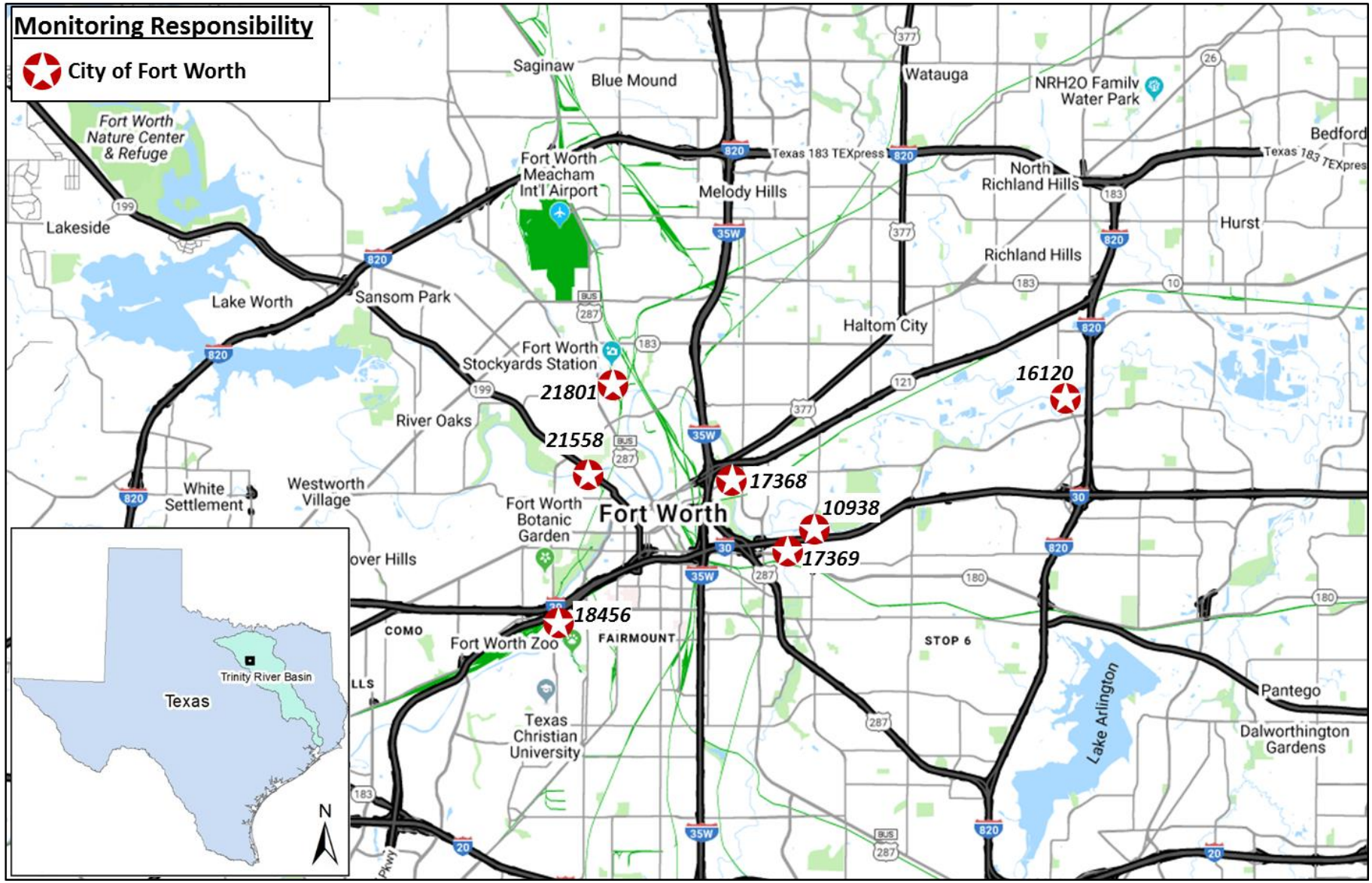


*Figure 7: City of Fort Worth Monitoring*

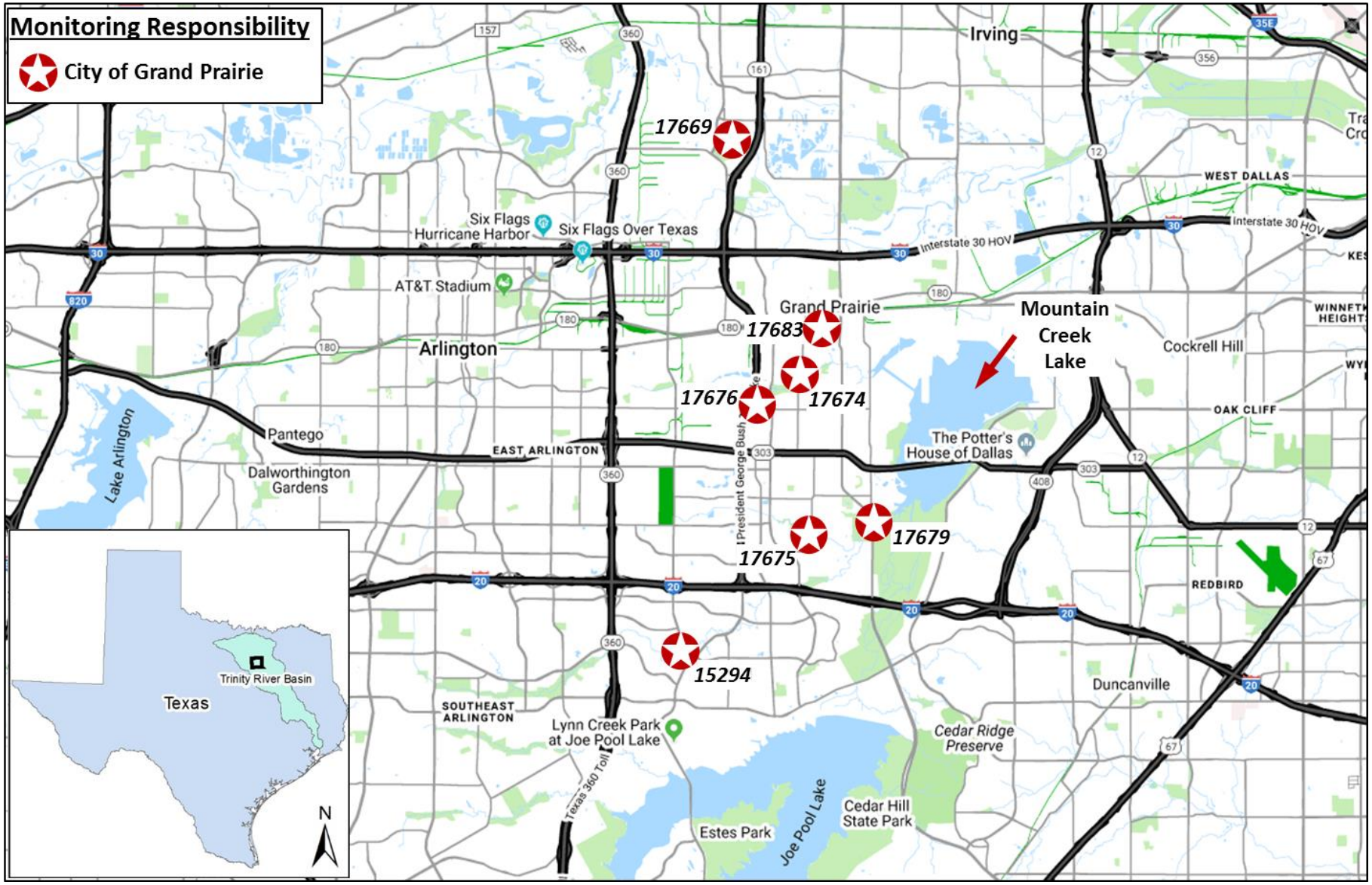


*Figure 8: City of Grand Prairie Monitoring*

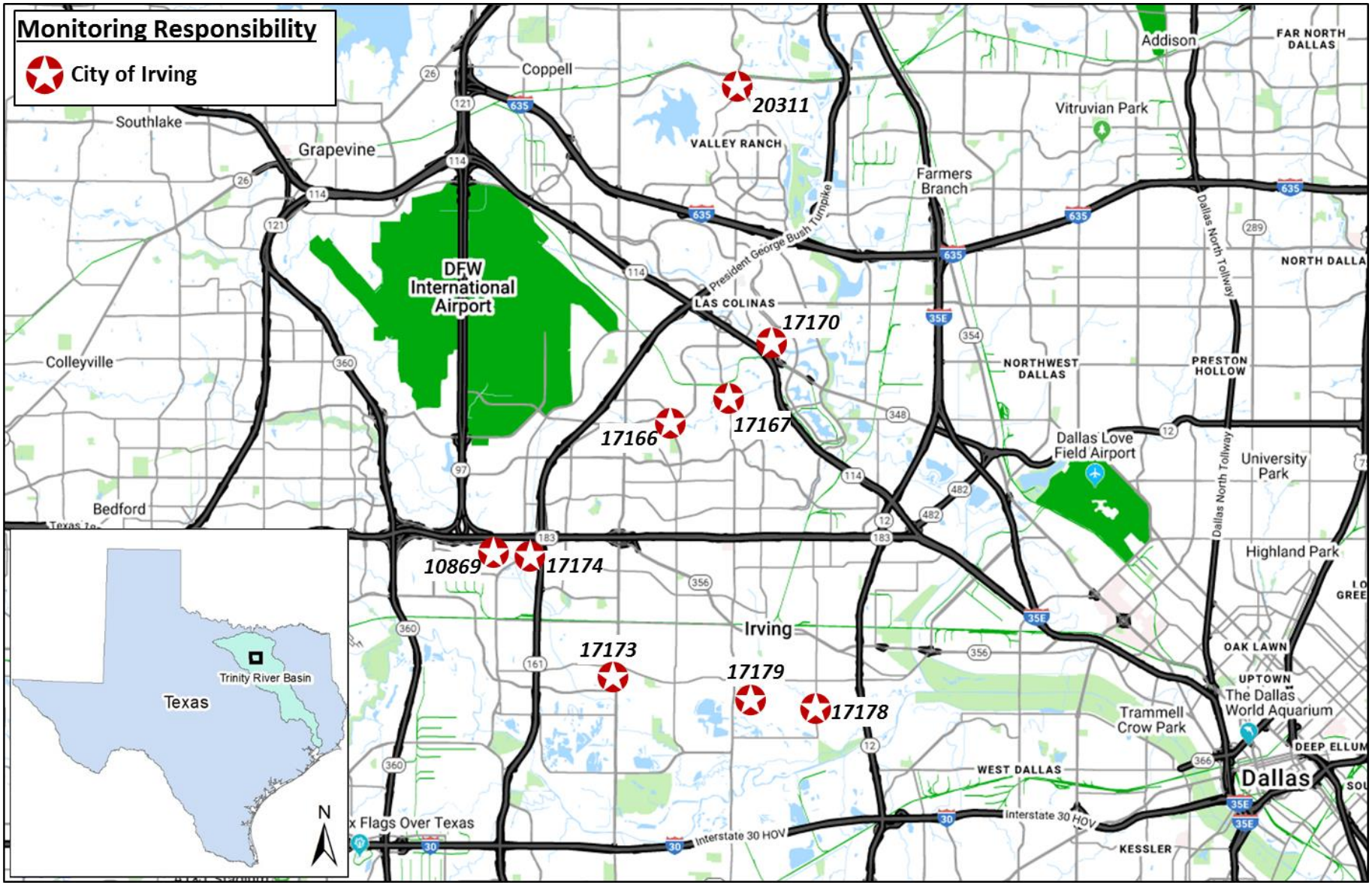


*Figure 9: City of Irving Monitoring*

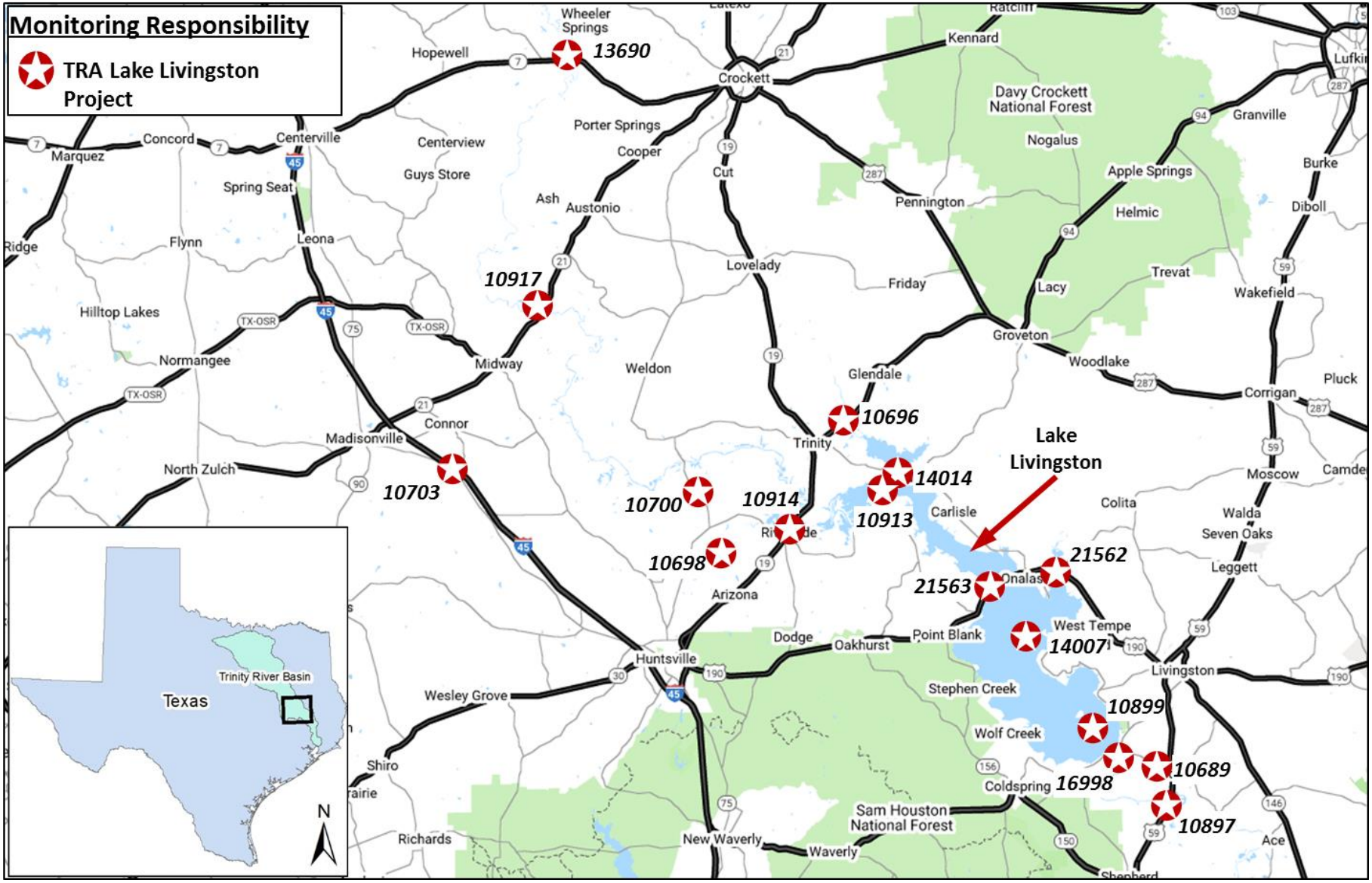


*Figure 10: TRA Lake Livingston Project Monitoring*

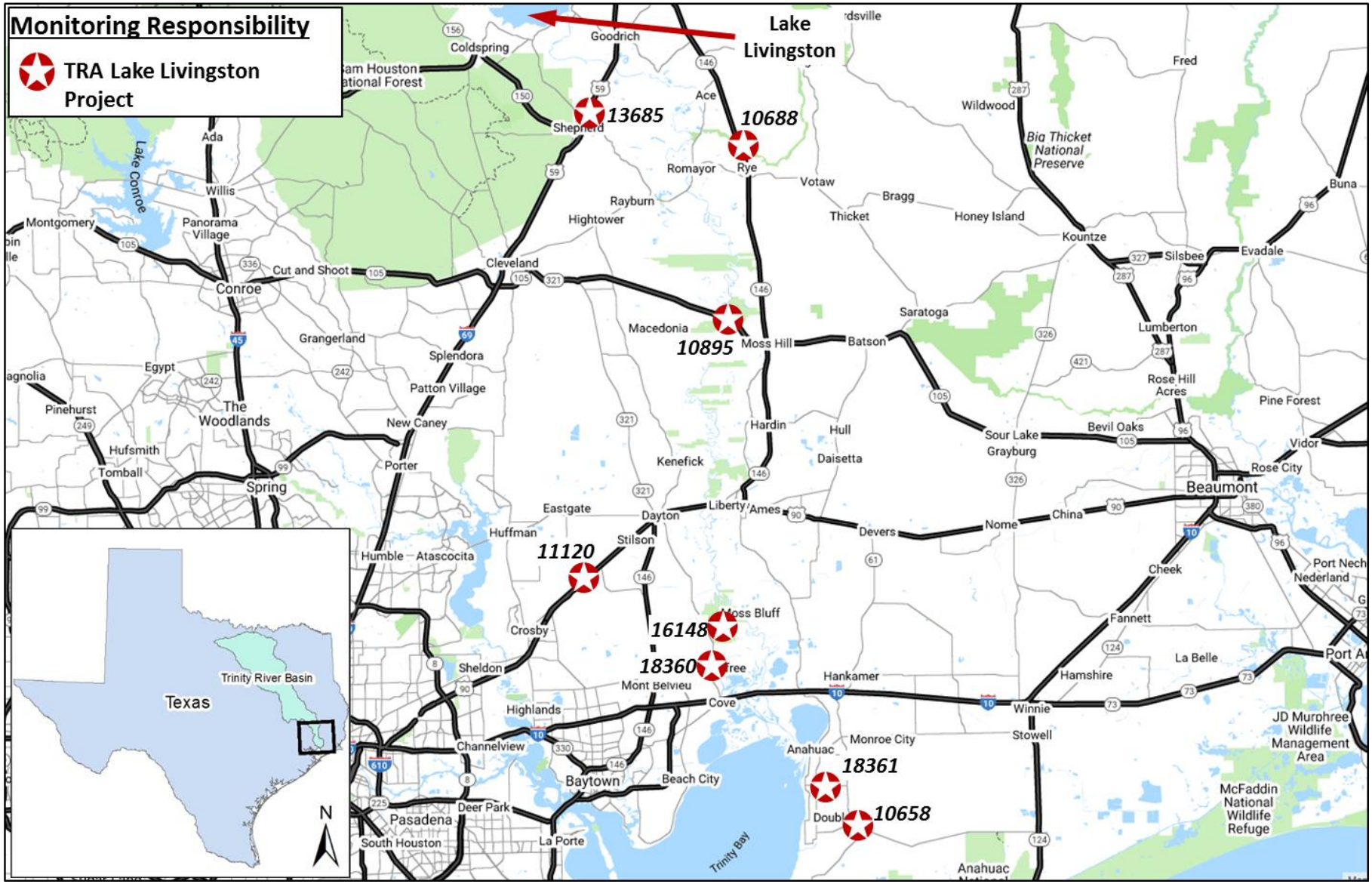


*Figure 11: TRA Lake Livingston Project Monitoring (continued)*

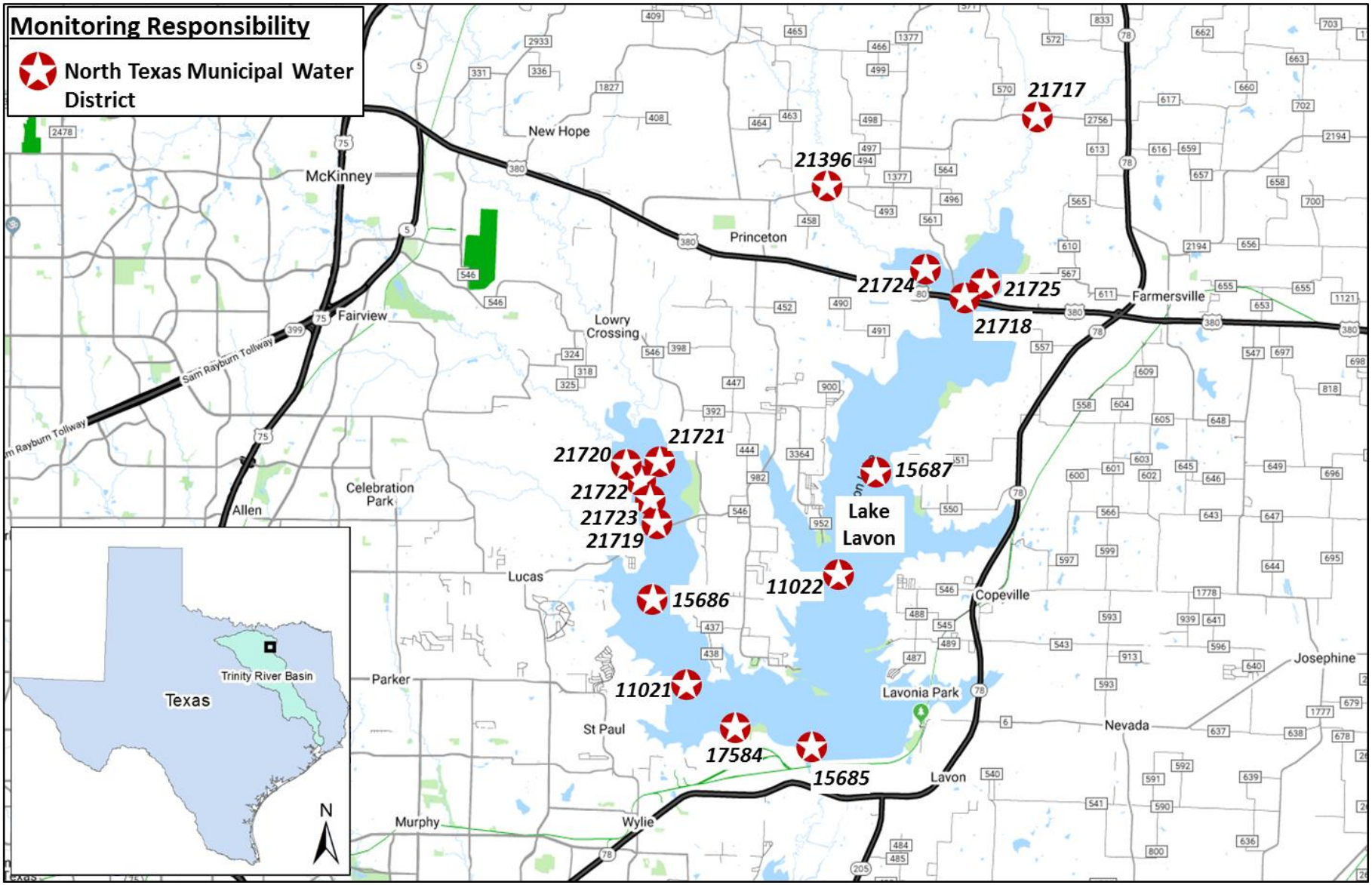


*Figure 12: North Texas Municipal Water District Monitoring*

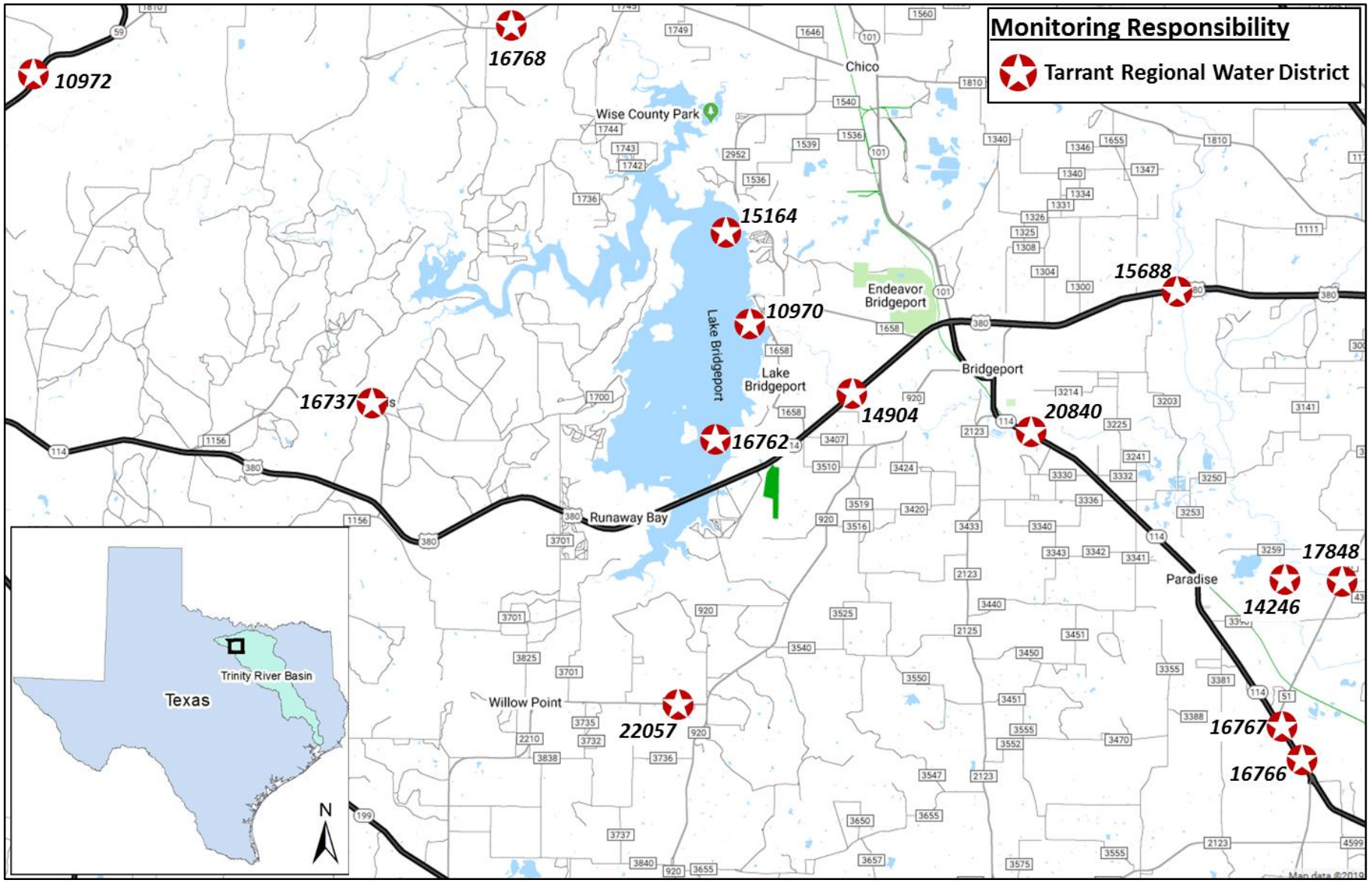


*Figure 13: Tarrant Regional Water District Monitoring*

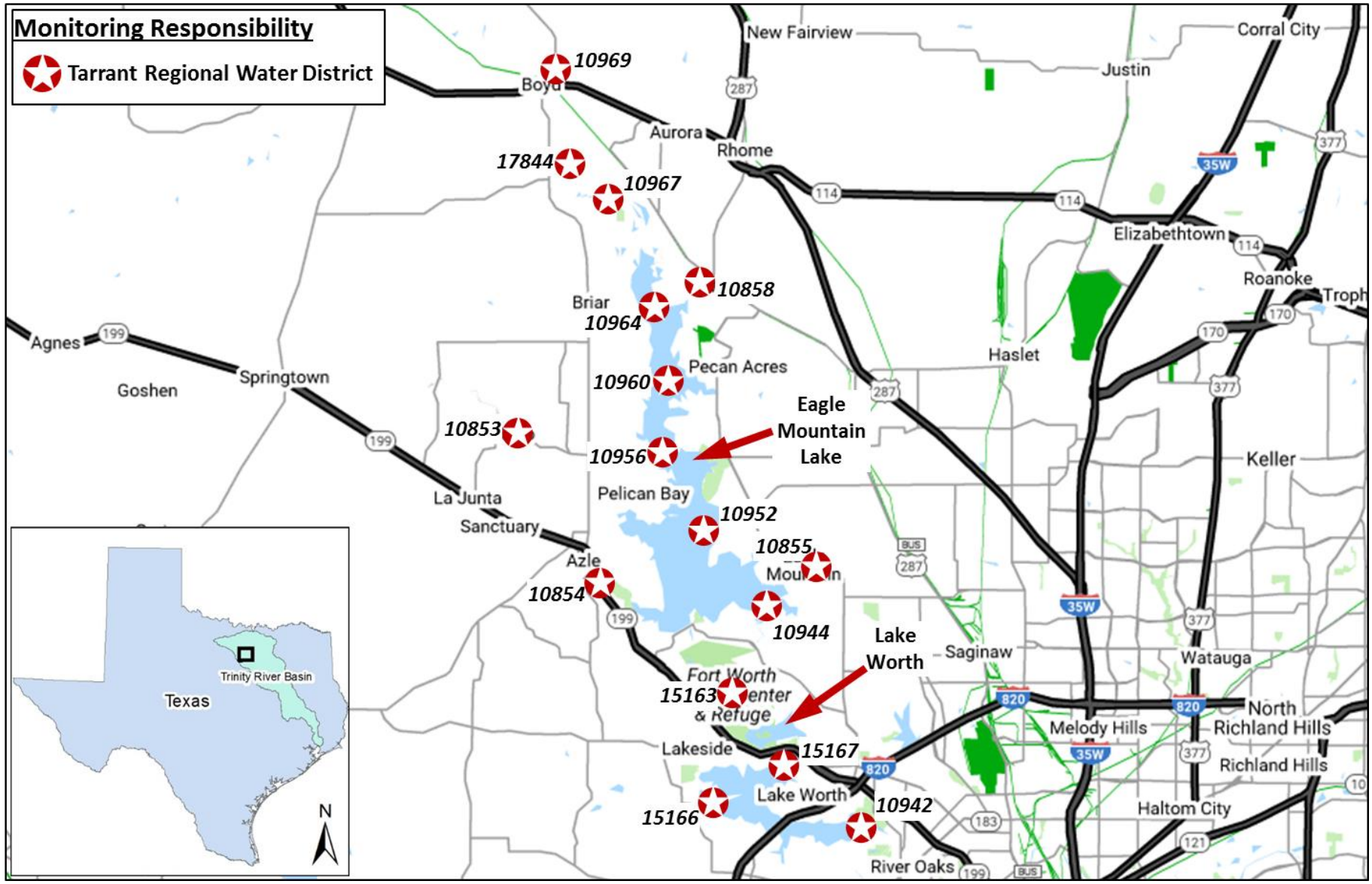


*Figure 14: Tarrant Regional Water District Monitoring (continued)*

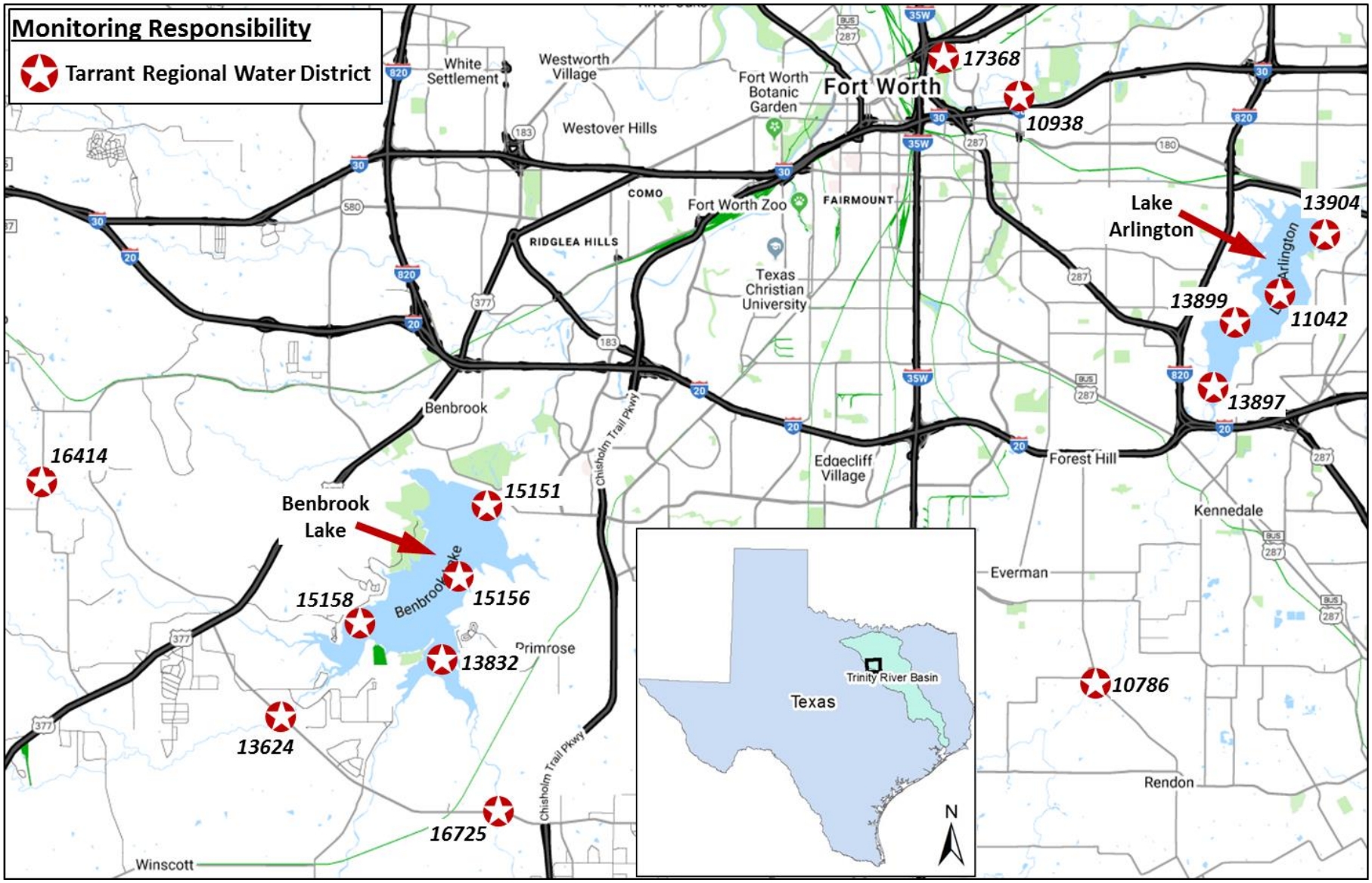


*Figure 15: Tarrant Regional Water District Monitoring (continued)*

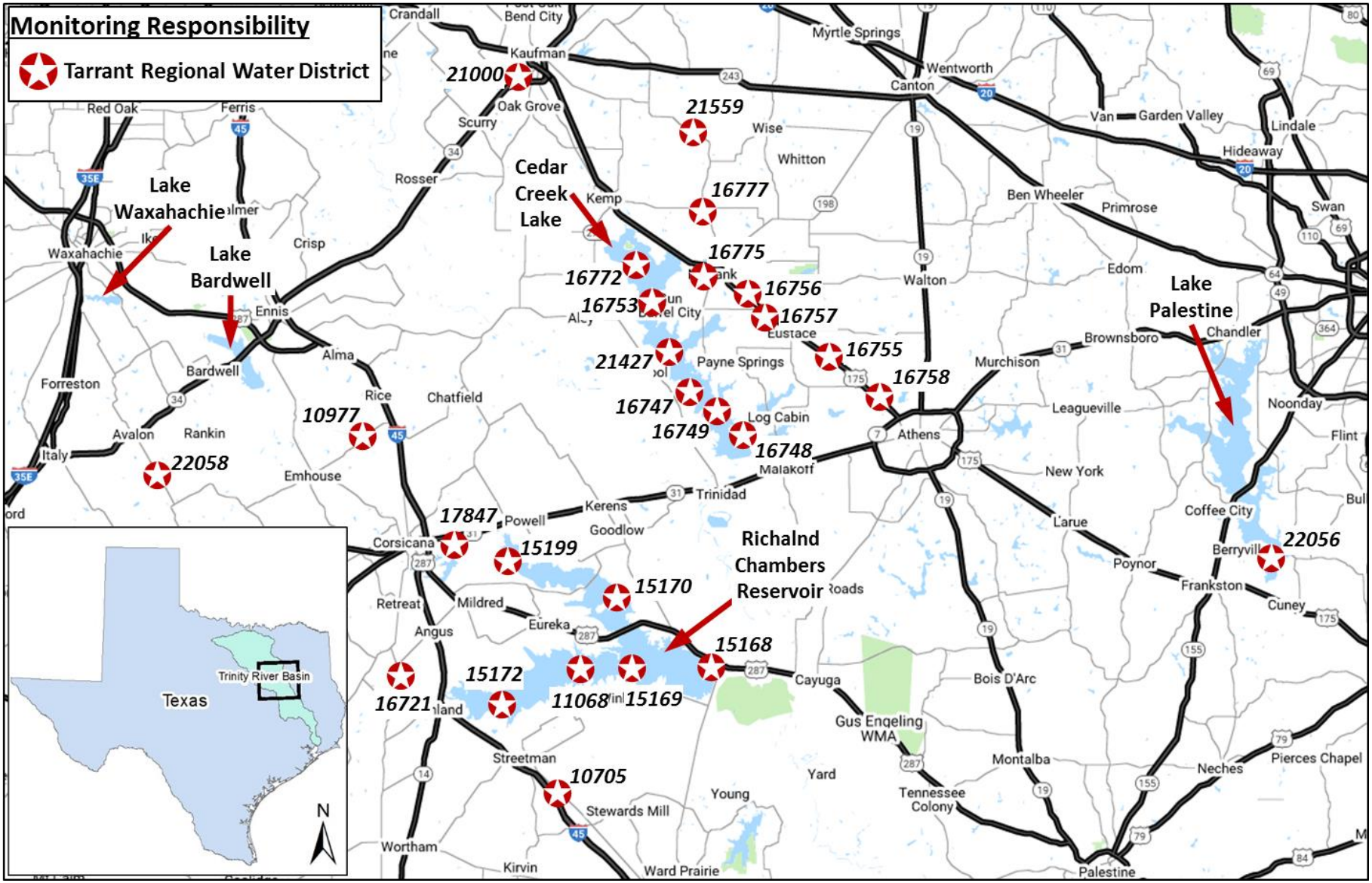


*Figure 16: Tarrant Regional Water District Monitoring (continued)*

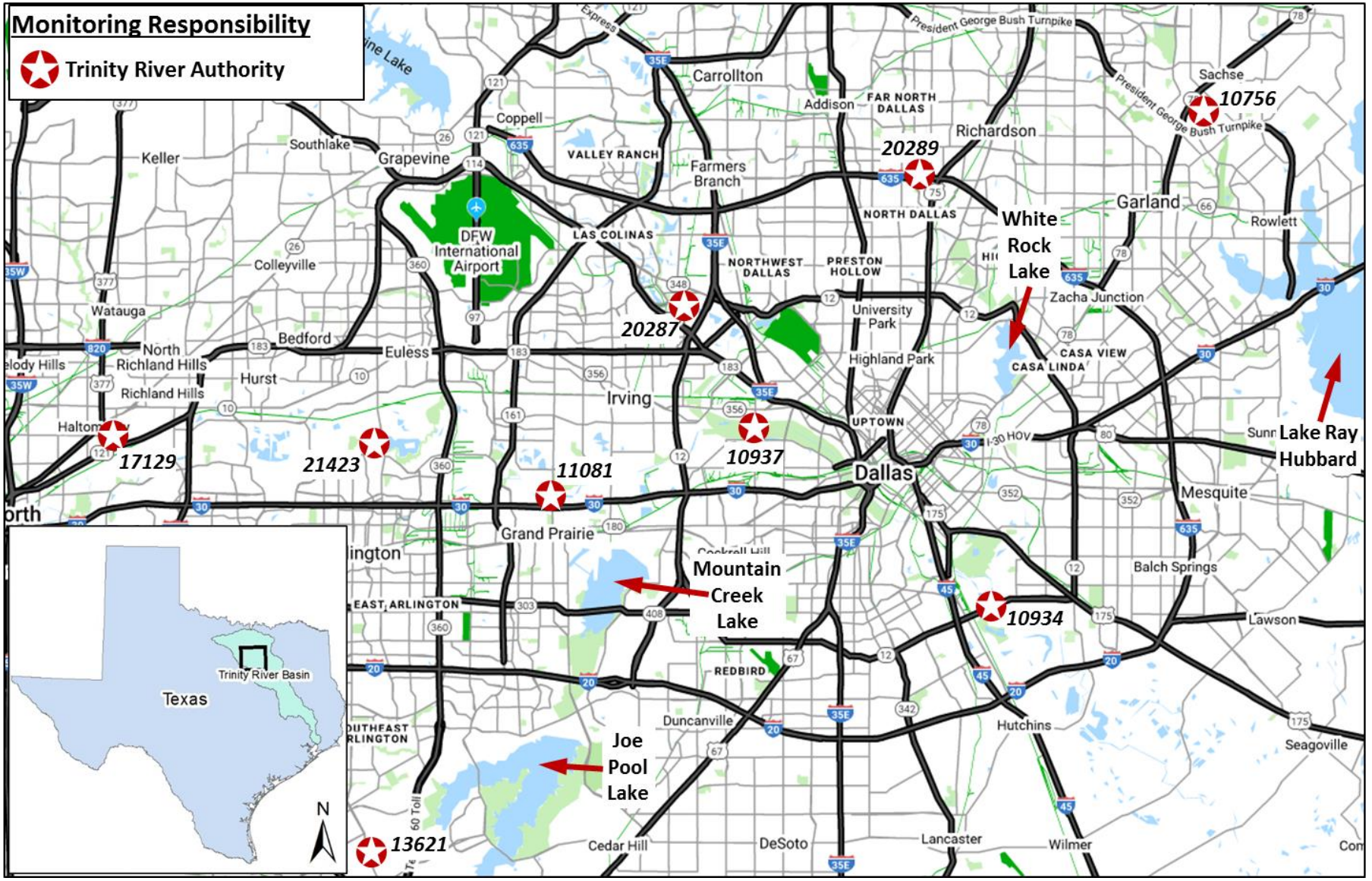


*Figure 17: Trinity River Authority Monitoring*

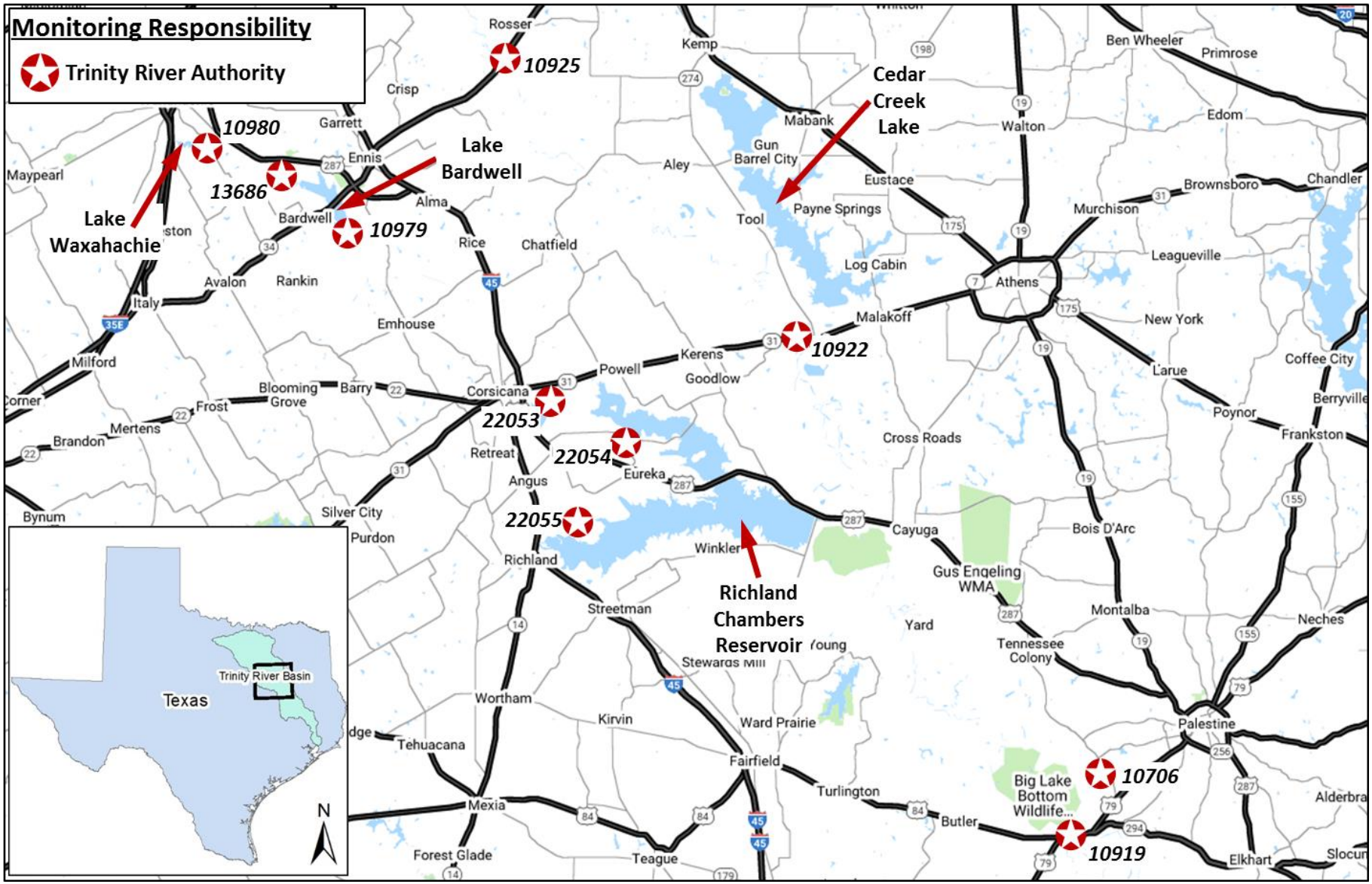


*Figure 18: Trinity River Authority Monitoring (continued)*

# TRA Special Projects

Special projects are typically studies or activities that look at specific issues in-depth. The Trinity River Authority Clean Rivers Program either participates in or administers several special projects during the course of its biennial contracts with TCEQ. Final reports for past special projects are available on the TRA CRP Reports webpage. The following sections discuss special projects undertaken in FY 2018 and those planned for FY 2019.

## Biological Monitoring

Each year, TRA conducts Aquatic Life Monitoring in one or more streams. This monitoring consists of an assessment of the benthic macroinvertebrate and fish populations as well as the available habitat in and around the stream for up to a 500-meter reach in wadeable streams. This information is used to determine if aquatic life uses are being supported.

Aquatic Life Monitoring takes place during the index and critical periods of a single year. The index period is from March 15 to October 15 with the critical period being from July 1 to September 30. These periods represent the warmer times of the year and the portion of the summer where the lowest stream flows, highest temperatures, and lowest dissolved oxygen levels are expected to occur. These times are targeted because it is assumed that if aquatic life uses are being met under these conditions, then they are also being met during the remainder of the year.

The data that are collected are summarized into a score that represents an aquatic life use level of Exceptional, High, Intermediate, or Limited. See Table 1 in the 2018 Basin Highlights Report for details of the metrics for Exceptional and Limits use scores.

In the summer of 2018, monitoring was conducted on Fish Creek downstream of Great Southwest Parkway in Grand Prairie, White Rock Creek downstream of Greenville Avenue in Dallas, and the West Fork Trinity River upstream of SR 59 near Jacksboro. Fish Creek is characterized as a perennial stream based on routine flow data and has a high aquatic life use designation. White Rock Creek is characterized as a perennial stream based on the Texas Surface Water Quality Standards Appendix D and has an intermediate aquatic life use designation. The West Fork Trinity River near Jacksboro is characterized as intermittent with perennial pools sufficient to support significant aquatic life use based on the Texas Surface Water Quality

Standards Appendix A and has an intermediate aquatic life use designation. See **Table 1** for the Aquatic Life Monitoring results for these three streams. See **Figures 19 to 24** for images of habitat and fish specimens from each stream.

*Table 1: FY 2018 Aquatic Life Monitoring Results*

| Period | Date | Fish Score | Benthic Macroinvertebrates Score | Habitat Score |
|---|---|---|---|---|
| **Fish Creek - High Aquatic Life Use Designation** | | | | |
| Index | 6/15/2018 | High | Intermediate | Intermediate |
| Critical | 7/23/2018 | High | Intermediate | Intermediate |
| **White Rock Creek - Intermediate Aquatic Life Use Designation** | | | | |
| Index | 6/20/2018 | Exceptional | Intermediate | High |
| Critical | 7/24/2018 | Exceptional | Intermediate | Intermediate |
| **West Fork Trinity River - Intermediate Aquatic Life Use Designation** | | | | |
| Index | 6/21/2018 | Exceptional | Limited | Intermediate |
| Critical | 8/1/2018 | Exceptional | Intermediate | Intermediate |

*Figure 19: Fish Creek downstream of Great Southwest Parkway in Grand Prairie*


*Figure 20: Warmouth (left) and Green Sunfish (right) collected in Fish Creek*

*Figure 21: White Rock Creek downstream of Greenville Avenue in Dallas*


*Figure 22: White Bass (left) and Largemouth Bass (right) collected in White Rock Creek*

*Figure 23: West Fork Trinity River upstream of SR 59 near Jacksboro*

*Figure 24: Longnose Gar (top) and Channel Catfish (bottom) collected in the West Fork Trinity River*

# PCBs, Dioxins, and Furans in Sediments

In the summer of 2017, sediment samples were collected at 26 sites throughout the basin in response to the extension of the Texas Department of State Health Services fish consumption advisory. See the 2018 Basin Highlights Report for more details. The sampling program was intended to identify any areas where PCBs, Dioxins and Furans may be entering the system.

Based on the sampling conducted at the 26 sites, three areas of interest were identified where concentrations of PCBs, Dioxins, and Furans were higher than at upstream sites. Another round of sampling is scheduled during the current FY 2018-2019 biennium and will take place at twelve sites in these three areas. The first area is located on the Clear Fork Trinity River in Fort Worth. The second area is on the upper Trinity River in Dallas downstream of the Elm Fork Trinity River confluence. The third area of interest is in the arms of the White Rock Creek cove of Lake Livingston near Trinity.

Once this sampling takes place, the results will be evaluated to determine if additional sampling needs to occur or if a well-delineated potential source area has been identified and the information can be turned over to the proper agency for investigation and enforcement.

# *E. coli* in Sediments

During the development of the Village Creek-Lake Arlington Watershed Protection Plan, stakeholders expressed interest in understanding factors that influence bacteria levels in the water column. There are many sources in scientific literature that indicate sediments can be a significant reservoir of bacteria in waterbodies. Most studies have focused on swimming beaches of reservoirs and coastal areas; little work has been conducted on flowing/eroding systems. To more fully understand bacterial impairment issues in the streams of the Trinity basin, a study was begun in FY 2018 to identify the extent to which bacteria in sediments may affect water column concentrations.

Sampling took place on a roughly bimonthly basis (depending on stream flow conditions) at seven sites across four streams. Sampling took place at low to normal flows in order to reduce any background influence in the resultant data set from nonpoint source runoff and in-stream sediment disturbance. Activities consisted of the collection of an undisturbed water column *E. coli*

sample, collection of a sediment *E. coli* sample as well as additional sediments for particle size and total organic carbon analysis, and the collection of another water column *E. coli* sample after an artificial disturbance of the stream sediments.

The goals of this project are to: 1) characterize how *E. coli* in sediments may affect water column *E. coli* under conditions in which the sediments are disturbed, 2) establish a baseline for *E. coli* without the influence of nonpoint source stormwater inputs from the watershed, and 3) determine if there are any correlations between sediment *E. coli* levels and specific sediment particle sizes. To date, six sample events from one year of sampling has been completed. Another year of sampling is scheduled. Data analysis has not yet begun. See **Table 2** for a summary of the available *E. coli* data.

*Table 2: E. coli in Sediments Results*

| Sample Date | Undisturbed E. coli (MPN/100 mL) | Sediment E. coli (MPN/100 g dry weight basis) | Post-Disturbance E. coli (MPN/100 mL) |
|---|---|---|---|
| 10798 - Unnamed Tributary of Lake Arlington at Bowman Springs Road | | | |
| 3/12/2018 | 250 | 1,100,000 | 2,200 |
| 4/9/2018 | 70 | 2,800,000 | 6,100 |
| 6/18/2018 | 350 | <1,200,000 | 1,200 |
| 8/6/2018 | 1,100 | 9,000,000 | 20,000 |
| 10/3/2018 | 160 | 3,400,000 | >9,700 |
| 1/30/2019 | 43 | 110,000 | 440 |
| 21759 - Quil Miller Creek at CR 532 in Burleson | | | |
| 3/12/2018 | 390 | 9,200,000 | 4,400 |
| 4/9/2018 | 80 | 590,000 | 180 |
| 6/18/2018 | 330 | <1,400,000 | 690 |
| 8/6/2018 | 52 | 330,000 | 150 |
| 10/3/2018 | 39 | 1,900,000 | 240 |
| 1/28/2019 | 34 | 910,000 | 38 |
| 10786 - Village Creek at Rendon Road near Arlington | | | |
| 3/12/2018 | 41 | 110,000 | 260 |
| 4/9/2018 | 15 | 110,000 | 52 |
| 6/18/2018 | 4 | <1,200,000 | 12 |

| Sample Date | Undisturbed E. coli (MPN/100 mL) | Sediment E. coli (MPN/100 g dry weight basis) | Post-Disturbance E. coli (MPN/100 mL) |
|---|---|---|---|
| 8/6/2018 | <10 | <130,000 | <10 |
| 10/3/2018 | 120 | 930,000 | 170 |
| 1/28/2019 | 30 | 320,000 | 30 |
| 13621 - Walnut Creek at Matlock Road near Mansfield | | | |
| 3/13/2018 | 260 | 5,000,000 | 1,100 |
| 4/10/2018 | 130 | 2,500,000 | 380 |
| 6/19/2018 | 4 | Error | 1,000 |
| 8/7/2018 | <20 | 3,100,000 | 2,800 |
| 10/2/2018 | 300 | 18,000,000 | 720 |
| 1/29/2019 | 100 | 240,000 | 330 |
| 21990 - Walnut Creek at Katherine Rose Memorial Park footbridge in Mansfield | | | |
| 3/13/2018 | 210 | 2,700,000 | 300 |
| 4/10/2018 | 280 | 2,600,000 | 300 |
| 6/19/2018 | 150 | 16,000,000 | 3,300 |
| 8/7/2018 | 370 | 12,000,000 | 3,700 |
| 12/6/2018 | 190 | 1,100,000 | 360 |
| 1/29/2019 | 120 | 130,000 | 120 |
| 16434 - Mountain Creek at US 287 near Midlothian | | | |
| 3/13/2018 | 30 | 170,000 | 73 |
| 4/10/2018 | 39 | 1,800,000 | 300 |
| 9/13/2018 | 110 | >170,000 | 220 |
| 10/2/2018 | 130 | 5,700,000 | 2,000 |
| 12/5/2018 | 22 | 560,000 | 1,100 |
| 1/30/2019 | 16 | <140,000 | 12 |
| 13622 - Mountain Creek at FM 157 near Venus | | | |
| 3/13/2018 | 260 | 27,000,000 | 660 |
| 4/10/2018 | 34 | 7,300,000 | 16 |

| Sample Date | Undisturbed E. coli (MPN/100 mL) | Sediment E. coli (MPN/100 g dry weight basis) | Post-Disturbance E. coli (MPN/100 mL) |
|---|---|---|---|
| 6/19/2018 | 4 | <2,900,000 | 4 |
| 8/7/2018 | <20 | <210,000 | <20 |
| 10/2/2018 | 39 | 20,000,000 | 74 |
| 1/29/2019 | 4 | 3,500,000 | 4 |

# White Rock Creek *E. coli* Source Identification

White Rock Creek above White Rock Lake (segment 0827A) was identified as having a concern due to elevated levels of *E. coli* in the 2014 Integrated Report (IR). This concern was upgrade to an impairment in the Draft 2016 IR. This watershed is rather large and passes through mostly urban and suburban areas. Sources of bacteria into the stream could include runoff from pets, wildlife, and small pockets of livestock as well as failing septic systems or broken infrastructure such as sewage pipelines. A study was developed in the FY 2018-2019 biennium to potentially identify a source or sources of *E. coli*.

Sampling will take place at 23 bridge crossings upstream of the IH-635 north service road near Addison. Sampling will occur during dry and wet conditions and ideally will occur in one day. Dry condition sampling is intended to identify any inputs into the creek that are not related to storm water runoff such as illicit discharges or broken infrastructure. This sampling will be initiated when flows are low and there has been no recent precipitation. Wet condition sampling will initiate when there has been sufficient recent precipitation to increase flows in the stream. This sampling is intended to identify any runoff related sources of E. coli such as residential areas, golf courses, parks, and other sources.

Based on the results of these two sampling events, additional sampling will take place in any areas where an order of magnitude increase in bacteria levels occurs between one bridge and the next downstream bridge and in the two reaches with the highest positive relative percent differences in E. coli levels between the upstream and downstream bridges. Once these reaches are identified, field staff will walk the reach and note any obvious sources of bacteria such as evidence of wildlife, broken pipes, illicit discharges, flowing storm drains during dry conditions, sanitary sewer overflows during wet conditions, et cetera. If broken pipelines or sanitary sewer overflows are identified, city officials will be notified. Otherwise, additional E. coli samples will be collected along the reach in order to narrow down areas which may be contributing to the bacteria impairment. If an area is identified, the information will be turned over to the proper agency for further investigation and enforcement.

# Water Quality Review

TCEQ releases an assessment of all waterbodies in the state every two years. This assessment, the Integrated Report (IR), can be found on the Draft 2016 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d) webpage.

The IR describes the attainment of designated uses by each waterbody. Designated uses include Aquatic Life, Contact Recreation, Public Water Supply, Fish Consumption, and General Uses. Attainment of designated uses are classified as Fully Supporting, Not Supporting, No Concern, or Concern. Below is a simplified outline of the requirements for each of these classifications. A full description of the assessment process is available in the Draft 2016 Guidance for Assessing and Reporting Surface Water Quality in Texas which can be found on the webpage listed above.

1. Fully Supporting (FS)
    a. Data are assessed against a water quality standard
    b. A sufficient number of data points are available for assessment (for example: 10 data points)
    c. A majority of the data set is meeting the water quality standard
2. Not Supporting (NS)
    a. Data are assessed against a water quality standard
    b. A sufficient number of data points are available for assessment (for example: 10 data points)
    c. A specified number of data points (dependent on the total number of data points in the sample set) are not meeting the water quality standard
3. No Concern (NC)
    a. For Near Non-Attainment
        i. Data are assessed against a water quality standard
        ii. Less than a sufficient number of data points are available for assessment (for example: 4 to 9 data points)
        iii. A majority of the data set is meeting the water quality standard
    b. For Screening Level
        i. Data are assessed against a screening level
        ii. A sufficient number of data points are available for assessment (for example: 4 data points)
        iii. A majority of the data set is meeting the screening level

4. Concern
    a. For Near Non-Attainment (CN)
        i. Data are assessed against a water quality standard
        ii. Less than a sufficient number of data points are available for assessment (for example: 4 to 9 data points)
        iii. A specified number of data points (dependent on the total number of data points in the sample set) are not meeting the water quality standard
    b. For Screening Level (CS)
        i. Data are assessed against a screening level
        ii. A sufficient number of data points are available for assessment (for example: 4 data points)
        iii. A specified number of data points (dependent on the total number of data points in the sample set) are not meeting the screening level

# Changes from the FY 2014 to the Draft FY 2016 IR

The 2014 Integrated Report was discussed in depth in the TRA 2015 Basin Summary Report. Basin Highlights Reports in the form of a program update were released in FY 2016 and FY 2017. The FY 2018 Basin Highlights Report provided updates to the information presented in the 2015 Basin Summary Report considering more recently collected data. The Draft 2016 Texas Integrated Report was released in late 2018. For the purposes of this Basin Highlights Report, major changes from the 2014 IR to the Draft 2016 IR will be discussed.

## Fish Consumption Advisories

In December of 2015, the Texas Department of State Health Services issued the Fish and Shellfish Consumption Advisory Number 53. This advisory extended the southern border of an existing advisory on the Trinity River from US 287 near Cayuga to US 90 near Liberty and included Lake Livingston. The advisory included assessment units (AUs) 0804_06 to 0804_01 of the Trinity River above Lake Livingston, all AUs in segment 0803 AUs (Lake Livingston), and all AUs in segment 0802 (Trinity River below Lake Livingston). It advises restricted consumption of Blue Catfish, Flathead Catfish, Freshwater Drum, all species of Gar, Smallmouth Buffalo, Striped Bass, and White Bass due to elevated levels of Dioxins and PCBs in edible tissue. These

segments and AUs made their first appearance in the Draft 2016 Integrated Report for failure to meet the Fish Consumption Use.

# Nutrient Reservoir Narrative Criteria

For many years, nutrient and chlorophyll-a screening levels have been used to assess the general water quality of waterbodies throughout the state. These parameters specifically address the potential for excessive algal growth also known as algal blooms. With the 2010 revisions to the Texas Surface Water Quality Standards, TCEQ presented numeric chlorophyll-a standards for reservoirs. Since then, the EPA approved 39 or the 75 chlorophyll-a standards that TCEQ had proposed. This included four reservoirs in the Trinity basin. Standards for 10 Trinity basin reservoirs were disapproved. TCEQ developed protocols to assess chlorophyll-a for both the approved and disapproved standards using multiple lines of evidence which results in a more robust analysis of water quality. If the full suite of parameters is not available, then the reservoir will not be assessed. **Table 3** lists the criteria used for the 14 Trinity basin reservoirs.

*Table 3: Trinity Basin Reservoir Nutrient Criteria*

| Segment | Reservoir | EPA Approved | Draft 2016 IR Stations Used | Chlorophyll-a (ug/L) | Secchi Depth (m) | TN (mg/L) | TP (mg/L) | 10 Year Change in TSI | Draft 2016 IR Concerns or Impairments for DO in any AU? | Draft 2016 IR Level of Support |
|---|---|---|---|---|---|---|---|---|---|---|
| 0803 | Lake Livingston | Disapproved | 10899 | 20.64 | 0.67 | 0.80 | 0.16 | 10 | Yes | Not Assessed - Inadequate Data |
| 0807 | Lake Worth | Disapproved | 10942 | 30.00 | 0.65 | 0.80 | 0.09 | 10 | No | No Concern |
| 0809 | Eagle Mountain Reservoir | Disapproved | 10944 | 22.94 | 0.80 | 0.80 | 0.07 | 10 | Yes | No Concern |
| 0811 | Bridgeport Reservoir | Approved | 10970 | 5.32 | 1.01 | 0.80 | 0.04 | 10 | No | Fully Supporting |
| 0813 | Houston County Lake | Approved | 10973 | 11.10 | 1.27 | 0.80 | 0.03 | 10 | No | Fully Supporting |
| 0815 | Bardwell Reservoir | Disapproved | 10979 | 20.44 | 0.56 | 0.80 | 0.05 | 10 | No | No Concern |
| 0816 | Lake Waxahachie | Approved | 10980 | 19.77 | 0.63 | 0.80 | 0.03 | 10 | No | Fully Supporting |
| 0817 | Navarro Mills Lake | Approved | 10981 | 15.07 | 0.37 | 0.80 | 0.08 | 10 | No | Concern Near Non-Attainment |

| Segment | Reservoir | EPA Approved | Draft 2016 IR Stations Used | Chlorophyll-a (ug/L) | Secchi Depth (m) | TN (mg/L) | TP (mg/L) | 10 Year Change in TSI | Draft 2016 IR Concerns or Impairments for DO in any AU? | Draft 2016 IR Level of Support |
|---|---|---|---|---|---|---|---|---|---|---|
| 0818 | Cedar Creek Reservoir | Disapproved | 10982, 16749 | 27.81 | 0.80 | 0.80 | 0.07 | 10 | Yes | No Concern |
| 0823 | Lewisville Lake | Disapproved | 11027, 17830 | 16.39 | 0.60 | 0.80 | 0.06 | 10 | No | Not Assessed - Inadequate Data |
| 0826 | Grapevine Lake | Disapproved | 11035, 16113, 17827 | 10.48 | 0.84 | 0.80 | 0.10 | 10 | Yes | Screening Level Concern |
| 0827 | White Rock Lake | Disapproved | 11038 | 29.73 | 0.40 | 0.80 | 0.10 | 10 | No | No Concern |
| 0830 | Benbrook Lake | Disapproved | 15151 | 24.42 | 0.75 | 0.80 | 0.07 | 10 | Yes | No Concern |
| 0836 | Richland-Chambers Reservoir | Disapproved | 15168 | 13.88 | 1.13 | 0.80 | 0.04 | 10 | Yes | Screening Level Concern |

For reservoirs where EPA approved the proposed numeric chlorophyll-a criteria, TCEQ assesses the waterbody according to the protocol illustrated in the flowchart in **Figure 25**. For reservoirs where EPA disapproved the proposed numeric chlorophyll-a criteria, TCEQ assesses the waterbody according to the protocol illustrated in the flowchart in **Figure 26**. The flowcharts in these figures were developed by TCEQ and were presented to the Surface Water Quality Monitoring Guidance Advisory Workgroup. The details of the Draft 2016 Integrated Report for these reservoirs can be found in the TCEQ documents titled "Supplemental Data for Reservoir Nutrient Assessment" and "Assessment Results for Basin 8 – Trinity River Basin". Information from these documents are summarized in **Tables 4 and 5**.

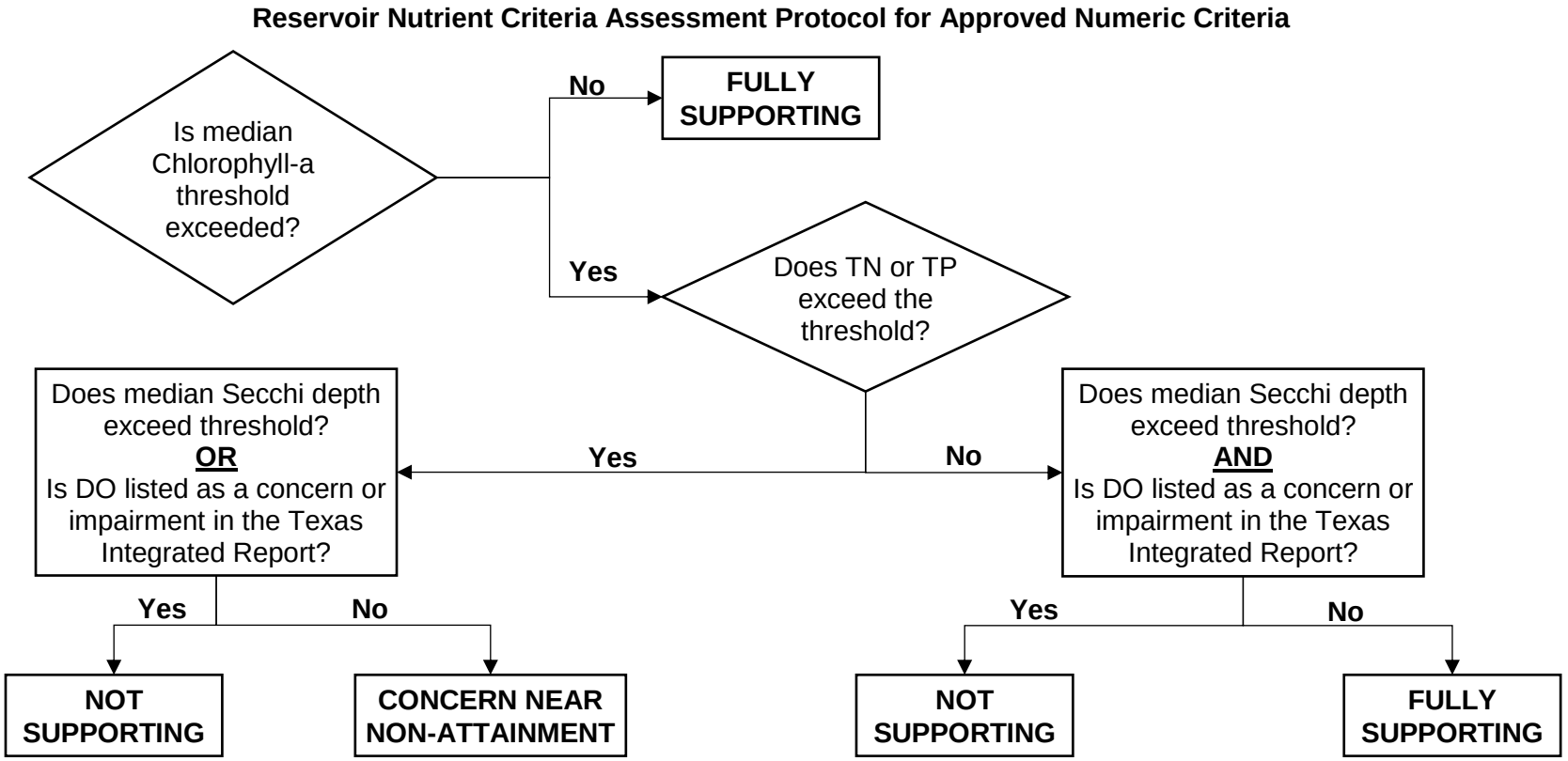


*Figure 25: Reservoir nutrient criteria assessment protocol for EPA approved numeric criteria.*

*Table 4: Reservoir Nutrient Numeric Criteria Results*

| | Chlorophyll-a (ug/L) | | | Secchi Depth (m) | | | TN (mg/L) | | | TP (mg/L) | | | 10 Year Change in TSI | | | Draft 2016 IR Concerns or Impairments for DO in any AU? | Draft 2016 IR Level of Support |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reservoir** | **Criteria/ Threshold** | **Samples Assessed** | **Median** | **Criteria/ Threshold** | **Samples Assessed** | **Median** | **Criteria/ Threshold** | **Samples Assessed** | **Median** | **Criteria/ Threshold** | **Samples Assessed** | **Median** | **Criteria/ Threshold** | **Samples Assessed** | **Median** | | |
| 0811 - Bridgeport Reservoir | 5.32 | 40 | 6.70 | 1.01 | 38 | 0.90 | 0.80 | 38 | 0.54 | 0.04 | 36 | 0.04 | 10.00 | NA | NA | No | Fully Supporting |
| 0813 - Houston County Lake | 11.10 | 26 | 8.89 | 1.27 | 27 | 1.50 | 0.80 | 23 | 0.58 | 0.03 | 20 | 0.03 | 10.00 | NA | NA | No | Fully Supporting |
| 0816 - Lake Waxahachie | 19.77 | 18 | 19.00 | 0.63 | 54 | 0.55 | 0.80 | 10 | 0.73 | 0.03 | 22 | 0.04 | 10.00 | NA | NA | No | Fully Supporting |
| 0817 - Navarro Mills Lake | 15.07 | 19 | 18.70 | 0.37 | 19 | 0.40 | 0.80 | 18 | 0.90 | 0.08 | 15 | 0.07 | 10.00 | NA | NA | No | Concern Near Non-Attainment |

**Reservoir Nutrient Criteria Assessment Protocol for Narrative Criteria (Disapproved Numeric Criteria)**

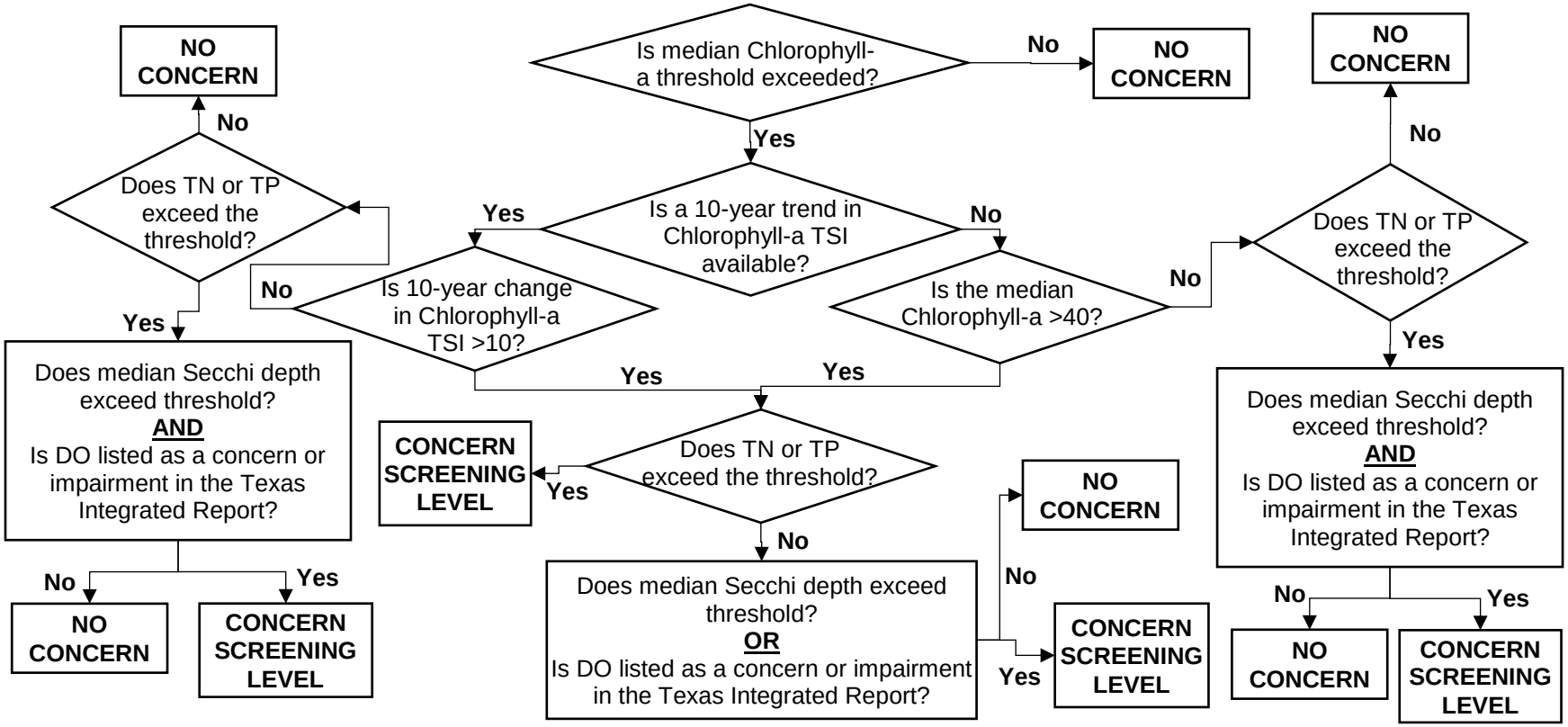


*Figure 26: Reservoir nutrient criteria assessment protocol for narrative criteria.*

*Table 5: Reservoir Nutrient Narrative Criteria Results*

| | Chlorophyll-a (ug/L) | | | Secchi Depth (m) | | | TN (mg/L) | | | TP (mg/L) | | | 10 Year Change in TSI | | | Draft 2016 IR Concerns or Impairments for DO in any AU? | Draft 2016 IR Level of Support |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reservoir | Criteria/ Threshold | Samples Assessed | Median | Criteria/ Threshold | Samples Assessed | Median | Criteria/ Threshold | Samples Assessed | Median | Criteria/ Threshold | Samples Assessed | Median | Criteria/ Threshold | Samples Assessed | Median | | |
| 0803 - Lake Livingston | 20.64 | 26 | 26.00 | 0.67 | 27 | 0.48 | 0.80 | 0 | 0.00 | 0.16 | 28 | 0.08 | 10.00 | 42 | 4.90 | Yes | Not Assessed - Inadequate Data |
| 0807 - Lake Worth | 30.00 | 32 | 29.15 | 0.65 | 32 | 0.71 | 0.80 | 65 | 0.98 | 0.09 | 32 | 0.06 | 10.00 | 32 | 6.86 | No | No Concern |
| 0809 - Eagle Mountain Reservoir | 22.94 | 32 | 22.35 | 0.80 | 31 | 0.94 | 0.80 | 67 | 0.85 | 0.07 | 32 | 0.06 | 10.00 | 46 | -0.90 | Yes | No Concern |
| 0815 - Bardwell Reservoir | 20.44 | 19 | 20.00 | 0.56 | 64 | 0.35 | 0.80 | 11 | 0.97 | 0.05 | 21 | 0.05 | 10.00 | 29 | 1.98 | No | No Concern |
| 0818 - Cedar Creek Reservoir | 27.81 | 30 | 25.80 | 0.80 | 25 | 0.81 | 0.80 | 35 | 0.77 | 0.07 | 31 | 0.06 | 10.00 | 0 | NA | Yes | No Concern |
| 0823 - Lewisville Lake | 16.39 | 34 | 9.50 | 0.60 | 51 | 0.85 | 0.80 | 35 | 0.77 | 0.06 | 17 | 0.03 | 10.00 | 0 | NA | No | Not Assessed - Inadequate Data |
| 0826 - Grapevine Lake | 10.48 | 45 | 14.50 | 0.84 | 30 | 0.83 | 0.80 | 21 | 0.82 | 0.10 | 10 | 0.03 | 10.00 | 35 | 4.58 | Yes | Screening Level Concern |
| 0827 - White Rock Lake | 29.73 | 20 | 32.75 | 0.40 | 22 | 0.44 | 0.80 | 18 | 0.96 | 0.10 | 19 | 0.06 | 10.00 | 0 | NA | No | No Concern |
| 0830 - Benbrook Lake | 24.42 | 33 | 24.90 | 0.75 | 34 | 0.83 | 0.80 | 46 | 0.78 | 0.07 | 33 | 0.05 | 10.00 | 51 | 3.52 | Yes | No Concern |
| 0836 - Richland-Chambers Reservoir | 13.88 | 33 | 14.68 | 1.13 | 28 | 0.91 | 0.80 | 39 | 0.85 | 0.04 | 32 | 0.04 | 10.00 | 38 | 5.24 | Yes | Screening Level Concern |

# Delistings

Segment 0814, Chambers Creek above Richland-Chambers Reservoir, was delisted for chloride in the Draft 2016 Integrated Report. This was due to an incorrect standard of 50 mg/L being used in previous assessments. The correct standard for this segment is 90 mg/L. The average chloride value for the period of record used in the Draft 2016 IR was 68.48 mg/L. Therefore, the level of support for this parameter was changed from "Not Supporting" to "Fully Supporting".

AUs 0822B_01 on Grapevine Creek, 0841_02 on the Lower West Fork Trinity River, and 0841H_01 on Delaware Creek were listed in the 2014 Integrated Report as not supporting the contact recreation use due to elevated levels of *E. coli*. These impairments were removed in the Draft 2016 Integrated Report with geomeans of 75.52, 119.08, and 107.63 MPN/100 mL, respectively. However, based on the date range to be used in the 2018 Integrated Report, AUs 0822B_01 (geomean 131.97 MPN/100 mL) and 0841H_01 (geomean 163.15 MPN/100 mL) may still have concerns for with elevated *E. coli*. As shown in **Figure 27**, *E. coli* in these streams increased with flow indicating that these issues may be runoff related.

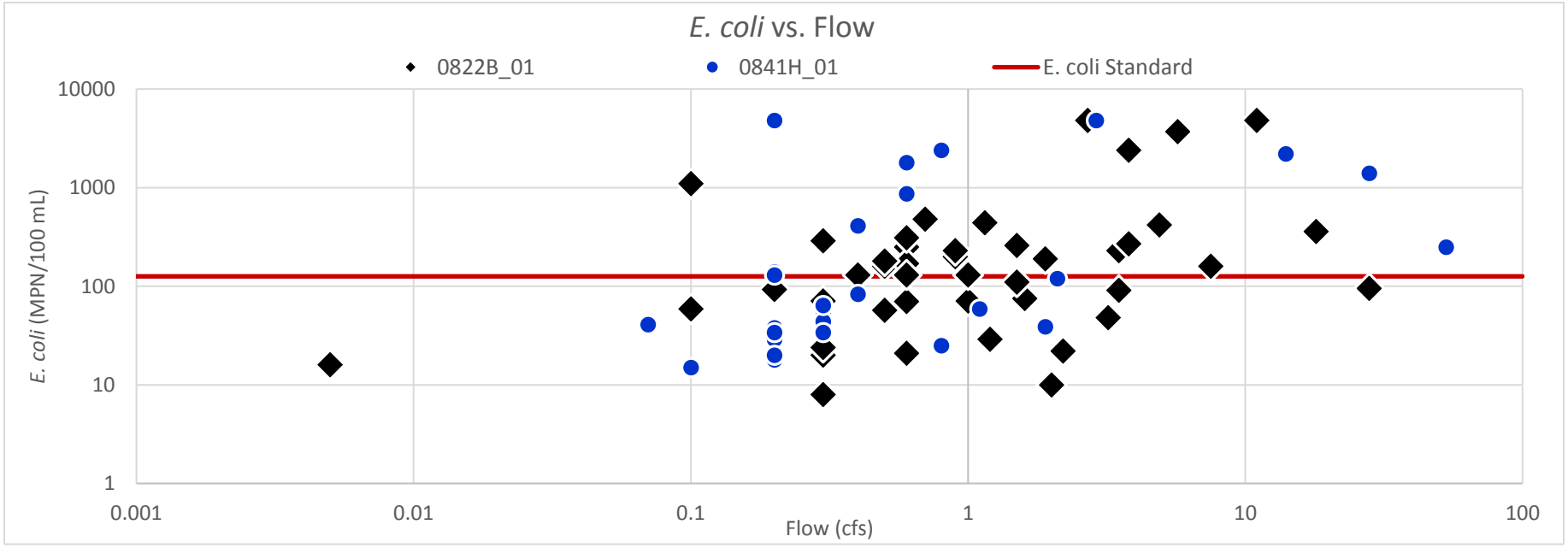


*Figure 27: E. coli vs. Flow for 0822B_01 and 0841H_01.*

# Muddy Creek Copper

The Draft 2016 Integrated Report identified an impairment due to elevated copper in water in Muddy Creek (segment 0820C). The Chronic and Acute Toxic Substances in Water standards for Copper were 9.31 and 13.93 ug/L, respectively. The standard for copper and several other metals and organics are calculated from a formula that includes a hardness value. Fourteen data points were used to assess this parameter in the 2016 IR. The average of the data was 10.04 ug/L which exceeded the chronic standard and 4 of the 14 data points exceeded the acute standard. This resulted in a finding of non-support. However, the NTMWD determined a site-specific standard for copper for Muddy Creek using a Streamlined Water-Effect Ratio Procedure for Discharges of Copper with samples collected in 2013. The Water Effects Ratio Study performed by Huther and Associates, Inc. demonstrated the copper standard was overly protective for Muddy Creek and on Jan. 29, 2014 the NTMWD requested the TSWQS be revised. This water effects ratio 4.98 was included in the 2018 revisions of the Texas Surface Water Quality Standards. Using this value, the chronic and acute standards would be 46.36 and 69.37 ug/L and may no longer result in an impairment.

# Sulfate and TDS in Segment 0822

The Draft 2016 Integrated Report identified impairments due to elevated levels of sulfate and total dissolved solids (TDS) in the Elm Fork Trinity River Below Lewisville Lake (segment 0822). As shown in **Figure 28** for sulfate, these impairments were related to prolonged drought conditions, specifically those experienced from 2010 to 2015.

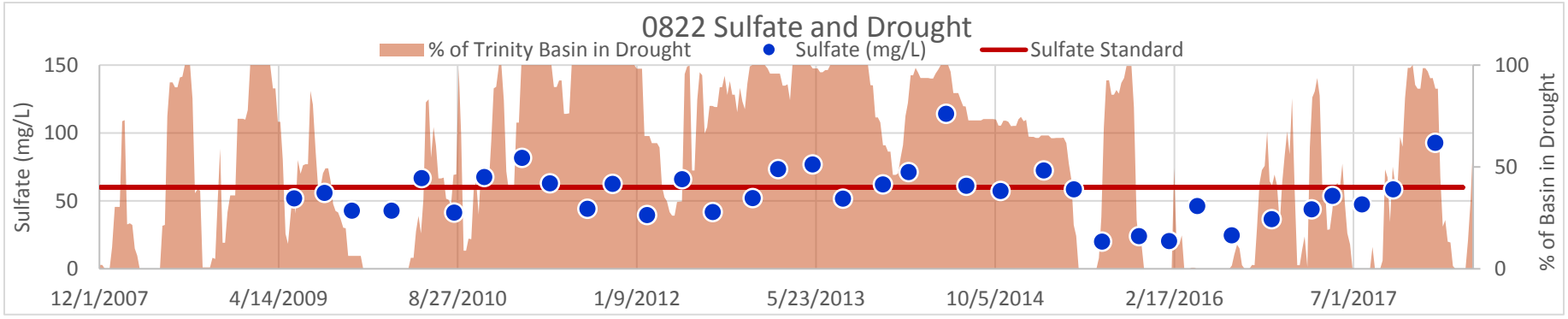


*Figure 28: Segment 0822 sulfate and drought.*

# New Bacteria Concerns

The Draft 2016 Integrated Report identified 14 new concerns for near non-attainment of the *E. coli* standard where there had previously been no data available. Many of these were new unclassified segments which had sufficient data for the 2016 assessment cycle. A few were in existing segments or AUs which did not have sufficient *E. coli* data prior to the 2016 assessment cycle. See **Table 6** for details. Full impairments require 20 samples while concerns can be assessed with at least 4 samples. It appears that the issues for these segments and AUs will continue as the geomeans for the date range to be used in the 2018 Integrated Report were all above the standard of 126 MPN/100 mL. As shown in **Figure 29**, *E. coli* generally increased with increasing flow. This indicates that these issues are likely runoff related. These streams are located in rural areas. Based in this information, the most likely sources of bacteria in these AUs are wildlife and livestock.

*Table 6: New E. coli Concerns*

| Segment | Assessment Unit | Draft 2016 IR Stations Used | Segment or AU Status | Draft 2016 IR Number Assessed | Draft 2016 IR Geomean | First *E. coli* Sample | 2018 IR Period Geomean | 2018 IR Geomean Count |
|---|---|---|---|---|---|---|---|---|
| 0804K Lower Keechi Creek | 0804K_01 Perennial stream from the confluence with the Trinity River in Leon County upstream to the headwaters in Jewett in Leon County | 20382 | New Segment | 13 | 251.07 | 11/3/2010 | 184.97 | 25 |
| 0804L Town Creek | 0804L_01 Perennial stream from the confluence with the Trinity River upstream to SH 256 | 10706 | New Segment | 5 | 238.09 | 11/19/2013 | 372.86 | 17 |
| 0809C Dosier Creek | 0809C_01 Perennial stream from the confluence of Dosier Slough cove upstream to the confluence with an intermittent stream 1 km upstream of Boat Club Road | 10855 | New Segment | 9 | 412.01 | 12/29/2010 | 406.49 | 27 |
| 0809D Derrett Creek | 0809D_01 Perennial stream from the confluence with Derrett Creek cove to 0.22 km upstream of FM 718 where the waterbody meets an intermittent stream | 10858 | New Segment | 10 | 282.58 | 2/24/2011 | 391.34 | 23 |
| 0811A Big Creek | 0811A_01 From the confluence with Bridgeport Reservoir at normal pool elevation upstream to the headwaters adjacent to FM 2127 in Jack County | 16768 | New Segment | 5 | 939.98 | 5/23/2011 | 542.91 | 21 |

| Segment | Assessment Unit | Draft 2016 IR Stations Used | Segment or AU Status | Draft 2016 IR Number Assessed | Draft 2016 IR Geomean | First *E. coli* Sample | 2018 IR Period Geomean | 2018 IR Geomean Count |
|---|---|---|---|---|---|---|---|---|
| 0811B Beans Creek | 0811B_01 Perennial stream from the confluence with Bridgeport Reservoir at normal pool elevation upstream to the headwaters approximately 4.4 km north of Perrin in Jack County | 16737 | New Segment | 5 | 1,541.39 | 1/10/2012 | 658.16 | 26 |
| 0814 Chambers Creek Above Richland-Chambers Reservoir | 0814_02 From just above the confluence with Cummins Creek up to just above the confluence with Waxahachie Creek. | 10977; 20000 | Existing AU | 7 | 805.12 | 1/11/2013 | 1359.51 | 27 |
| 0818B Cedar Creek above Cedar Creek Reservoir | 0818B_01 Perennial stream from the confluence with Cedar Creek Reservoir at normal pool elevation upstream to the confluence of Muddy Cedar Creek and Rocky Cedar Creek in Kaufman | 17842; 21559 | New Segment | 12 | 3,078.82 | 4/26/2011 | 2058.15 | 37 |
| 0818C Kings Creek | 0818C_01 Intermittent stream with perennial pools from the confluence with Cedar Creek Reservoir at normal pool elevation upstream to the headwaters adjacent to FM 986 | 16778; 21000 | New Segment | 9 | 2,155.26 | 4/26/2011 | 1461.17 | 33 |
| 0818D Lacy Fork | 0818D_01 Intermittent stream with perennial pools from the confluence with Cedar Creek Reservoir at normal pool elevation upstream to the confluence of Dry Lacy Fork and Wet Lacy Fork | 16777 | New Segment | 7 | 3,761.27 | 1/10/2012 | 1993.87 | 19 |
| 0818G North Twin Creek | 0818G_01 Perennial stream from the confluence with Twin Creeks cove to 3 km northeast of the intersection of highway 175 | 16756 | New Segment | 5 | 17,703.65 | 12/6/2011 | 4463.83 | 15 |
| 0818H South Twin Creek | 0818H_01 Perennial stream from the confluence with Twin Creeks cove upstream to 3.15 km northeast of where the waterbody intersects highway 175 | 16757 | New Segment | 4 | 4,376.64 | 12/6/2011 | 1518.35 | 13 |
| 0836D Post Oak Creek | 0836D_01 From the confluence with Richland Chambers Reservoir to the upper end of the creek | 17847 | Existing Segment | 5 | 6,239.33 | 6/22/2011 | 5707.38 | 20 |
| 0837 Richland Creek Above Richland-Chambers Reservoir | 0837_01 From the confluence of Pin Oak Creek in Navarro County to Navarro Mills Dam in Navarro County | 11070 | Existing Segment | 16 | 198.98 | 1/11/2010 | 126.58 | 28 |

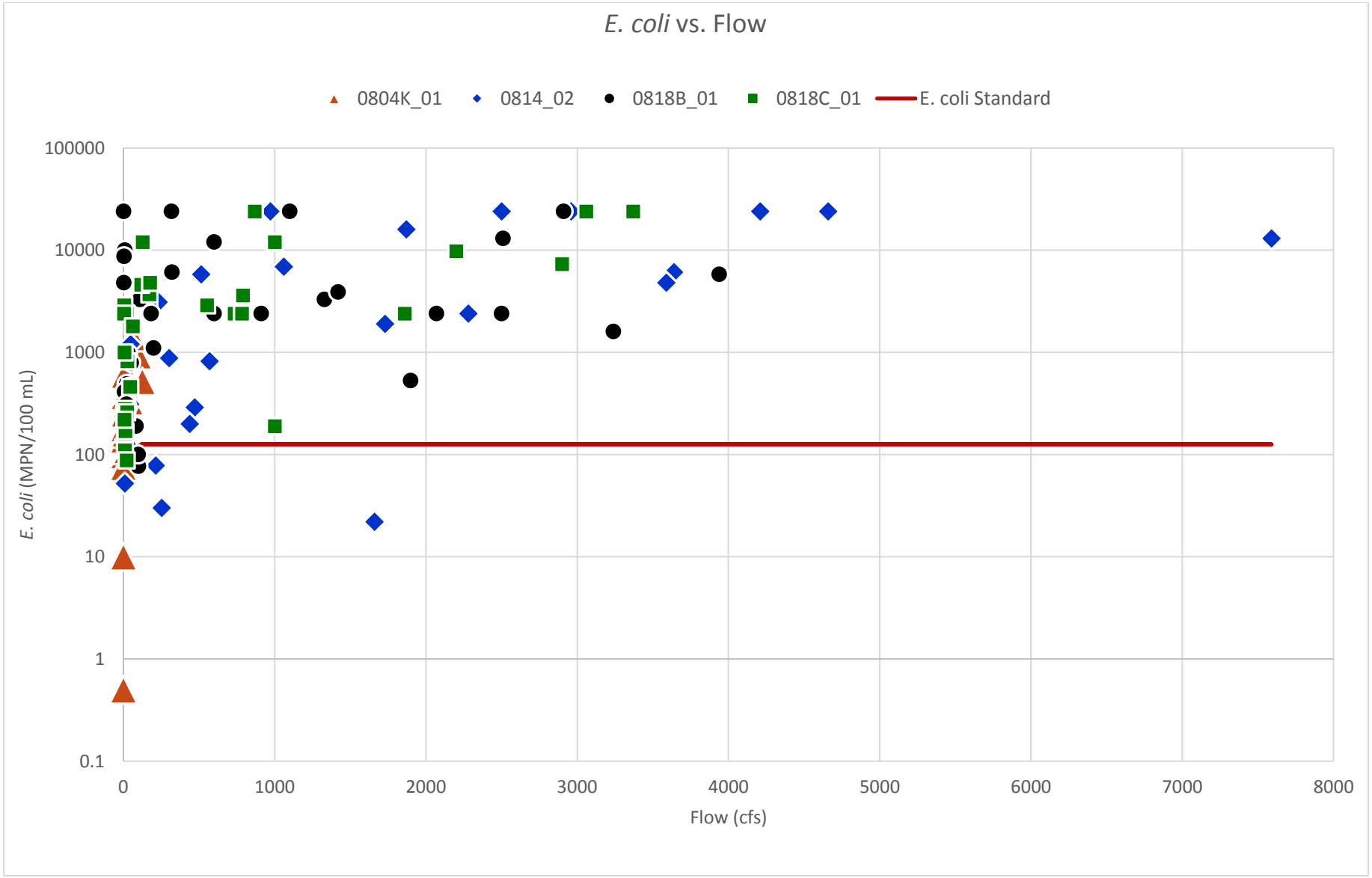


*Figure 29: E.coli vs. Flow for AUs 0804K_01, 0814_02, 0818B_01, and 0818C_01.*

# Bacteria Changes

There were nine AUs that were changed from fully supporting or concern for near non-attainment of the *E. coli* standard in the 2014 Integrated Report to concern for near non-attainment or not supporting the standard in the Draft 2016 Integrated Report. See **Table 7** for details. Six of these AUs are located in rural areas while 0827A_01, 0829_02, and 0841Q_01 are located in urban or suburban areas. Similar to the AUs discussed in the previous section for New Bacteria Concerns, the issues in these AUs mostly appear to be runoff related (see **Figure 30**). For the rural areas, it is likely that wildlife and livestock are contributing bacteria. Wildlife, pets, and failing infrastructure may be contributing in the urban and suburban areas. Most of these issues are ongoing as the geomeans for many of these AUs exceeded the standard for the period of record to be used for the 2018 Integrated Report. There is a special project planned for AU 0827A_01 to identify potential sources. See the White Rock *E. coli* Source Identification section for more details.

*Table 7: Changes in E. coli Assessments*

| Segment | Assessment Unit | Draft 2016 IR Stations Used | 2014 IR Results | Draft 2016 IR Results | Draft 2016 IR Number Assessed | Draft 2016 IR Geomean | 2018 IR Geomean Count | 2018 IR Period Geomean |
|---|---|---|---|---|---|---|---|---|
| 0804G Catfish Creek | 0804G_01 Twenty mile stretch of Catfish Creek running upstream from US 287 in Anderson Co., to Catfish Creek Ranch Lake just upstream of SH 19 in Henderson Co. | 10717; 18596; 18597 | FS | CN | 23 | 138.29 | 23 | 241.36 |
| 0804H Upper Keechi Creek | 0804H_01 From the confluence with segment 0804 Trinity River up to confluence with Twin Branch | 18401; 20771 | FS | CN | 10 | 336.53 | 21 | 74.26 |
| 0812 West Fork Trinity River Above Bridgeport Reservoir | 0812_01 Lower 25 mi of segment | 10972; 18058; 18059 | CN | NS | 21 | 512.85 | 33 | 593.15 |
| 0824 Elm Fork Trinity River Above Ray Roberts Lake | 0824_03 3.5 mile reach near SH 51 | 15635 | FS | NS | 24 | 209.78 | 24 | 297.39 |
| 0827A White Rock Creek above White Rock Lake | 0827A_01 Perennial stream from the headwaters of White Rock Lake upstream to the confluence with McKamy Branch east of the City of Addison | 15280; 18517; 20289; 21556 | CN | NS | 29 | 343.82 | 29 | 278.18 |

| Segment | Assessment Unit | Draft 2016 IR Stations Used | 2014 IR Results | Draft 2016 IR Results | Draft 2016 IR Number Assessed | Draft 2016 IR Geomean | 2018 IR Geomean Count | 2018 IR Period Geomean |
|---|---|---|---|---|---|---|---|---|
| 0829 Clear Fork Trinity River Below Benbrook Lake | 0829_02 From 1 mile upstream of the confluence with West Fork Trinity River up to the confluence with Mary's Creek. | 11044; 11045; 16122; 18456 | FS | CN | 30 | 150.43 | 98 | 149.38 |
| 0831 Clear Fork Trinity River Below Lake Weatherford | 0831_01 Lower 12.75 miles, downstream from South Fork Trinity River confluence | 13691; 16414; 17444 | FS | NS | 22 | 206.86 | 20 | 302.88 |
| 0836 Richland-Chambers Reservoir | 0836_07 Remainder of reservoir | 16721 | FS | CN | 14 | 889.16 | 31 | 1547.82 |
| 0841Q North Fork Fish Creek | 0841Q_01 North Fork Fish Creek from confluence with Fish Creek in Dallas Co. upstream to SH 360 in Tarrant Co. | 10724; 17678; 20838 | CN | NS | 84 | 182.51 | 70 | 173.34 |

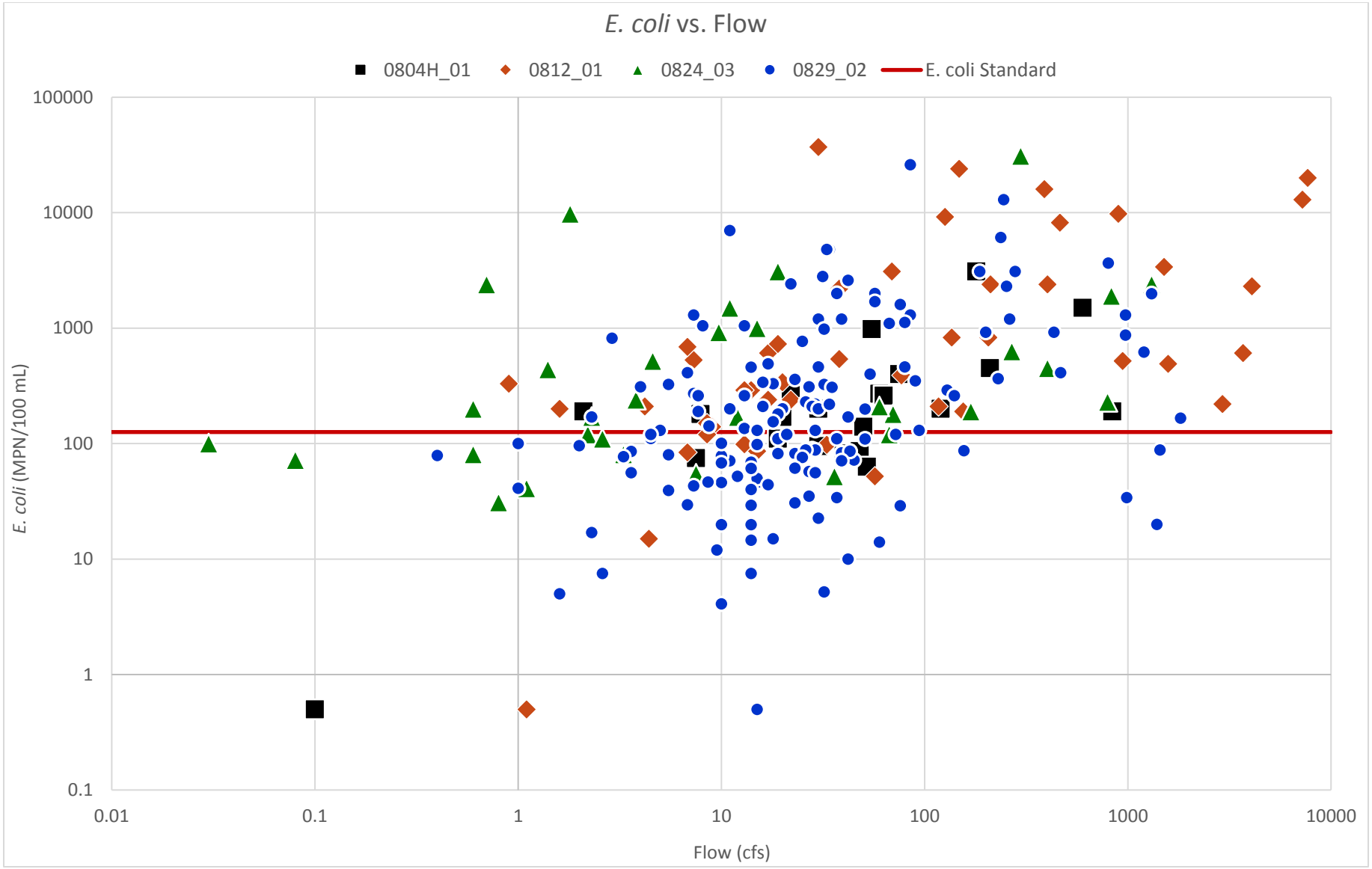


*Figure 30: E. coli vs. flow for AUs 0804H_01, 0812_01, 0824_03, and 0829_02.*

# Bardwell Reservoir Sulfate

The Draft 2016 Integrated Report identified an impairment for sulfate in Bardwell Reservoir (segment 0815). The standard for sulfate in this segment is 50 mg/L. As shown in **Figure 31**, elevated concentrations of sulfate tended to increase during periods of prolonged low reservoir elevation. Prolonged drought conditions likely caused the sulfate impairment in this reservoir. Generally, concentrations of parameters such as sulfates increase during droughts due to evaporation. Once reservoir elevations started increasing again starting in 2015, sulfate levels decreased.

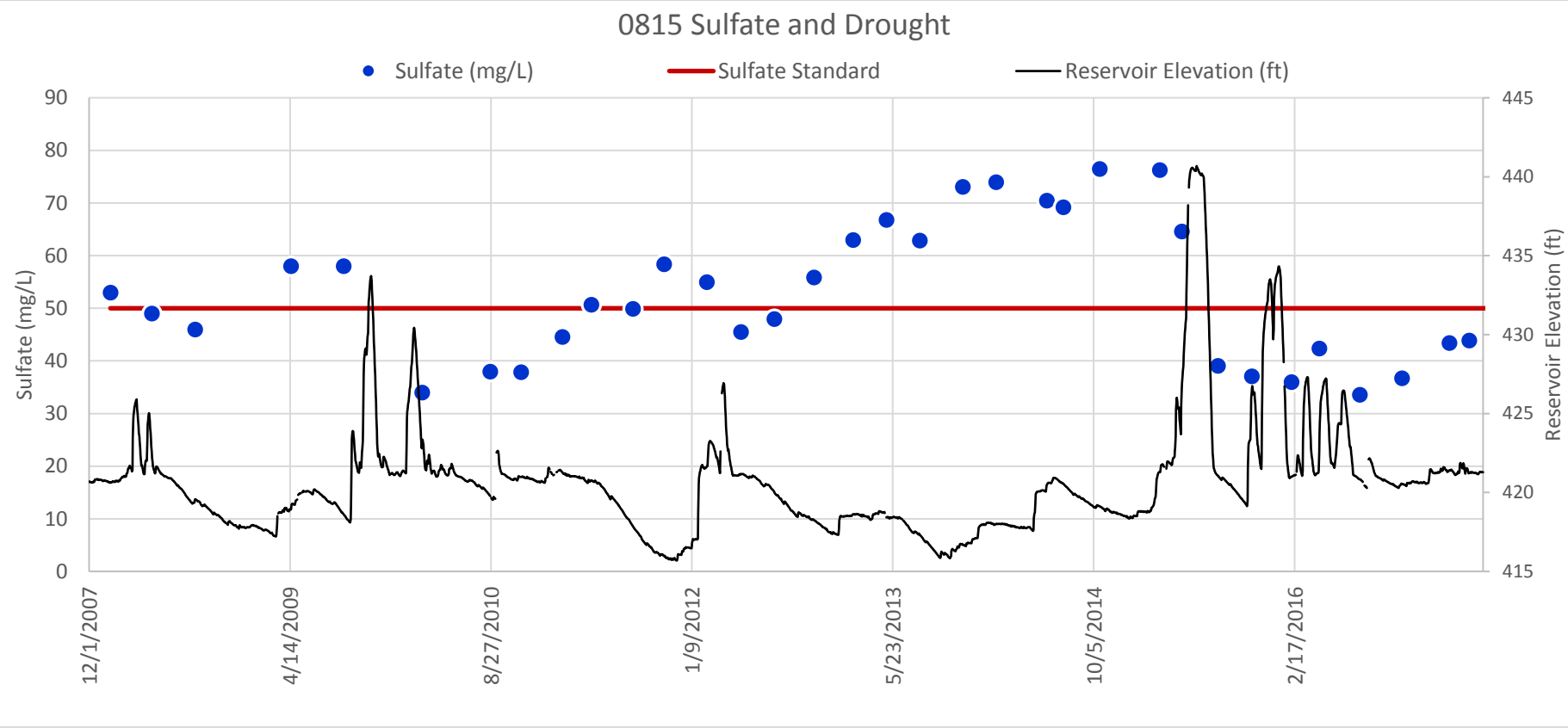


*Figure 31: Sulfate and drought conditions in segment 0815.*

# Dissolved Oxygen

The Draft 2016 Integrated Reported identified eleven new issues for dissolved oxygen (DO). See **Table 8** for details.

0801_01, 0801B_01, and 0801C_01 did not have any available flow data in order to determine if low flows influenced dissolved oxygen. Dissolved oxygen was not well correlated to chlorophyll-a in 0801_01 or 0801B_01 suggesting that algal populations probably did not influence DO in these Assessment Units. DO was weakly correlated to chlorophyll-a in 0801C_01 (correlation coefficient -0.21) so algal populations may have had some influence on DO in this AU.

DO issues in 0804G_01, 0804K_01, 0809A_01, 0824_03, 0836_07, and 0841M_01 appeared to be due to low flows. As shown in **Figure 32** for AU 0809A_01 and 0824_03, the DO values that were reported below the screening levels or standards generally occurred at low flows during the summer months (May to September) when water temperatures are typically warmer. Correlation coefficients for dissolved oxygen and water temperatures in these AUs were -0.79 and -0.60, respectively. This indicates that as water temperature increases, dissolved oxygen decreases.

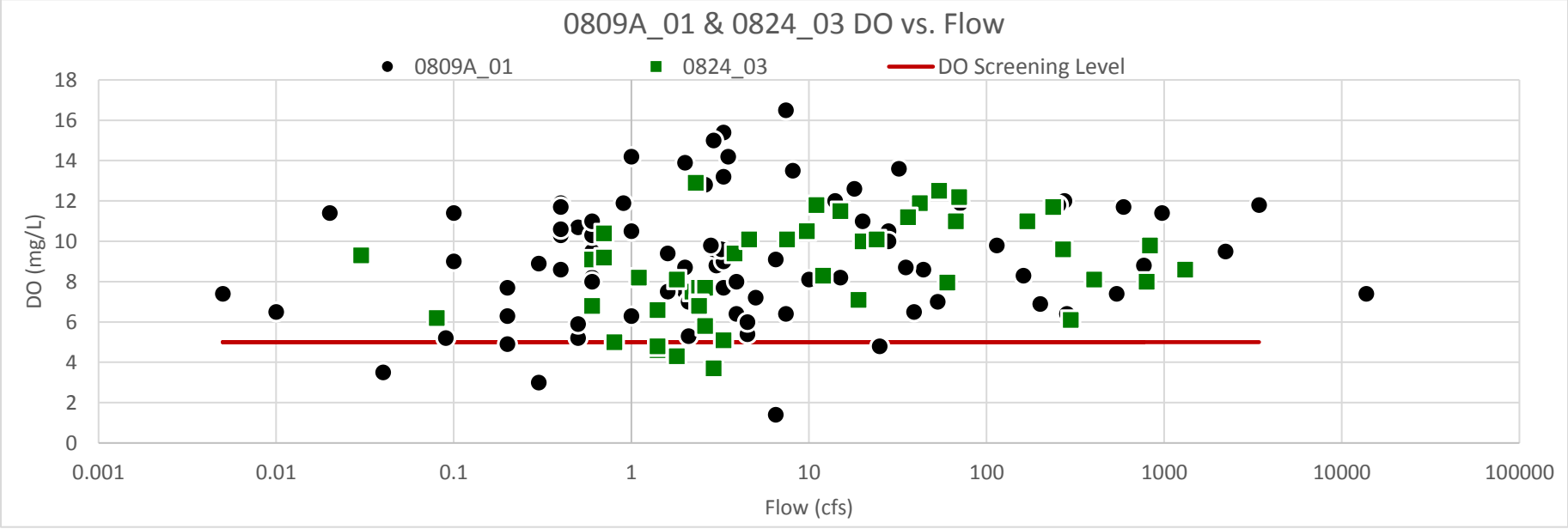


*Figure 32: DO vs. flow for AU 0824_03.*

Low DO in 0809_01 and 0841W_01 appeared to be influenced by algal populations as measured by chlorophyll-a. As shown in **Figure 33**, DO values tended to decrease as chlorophyll-a levels increased.

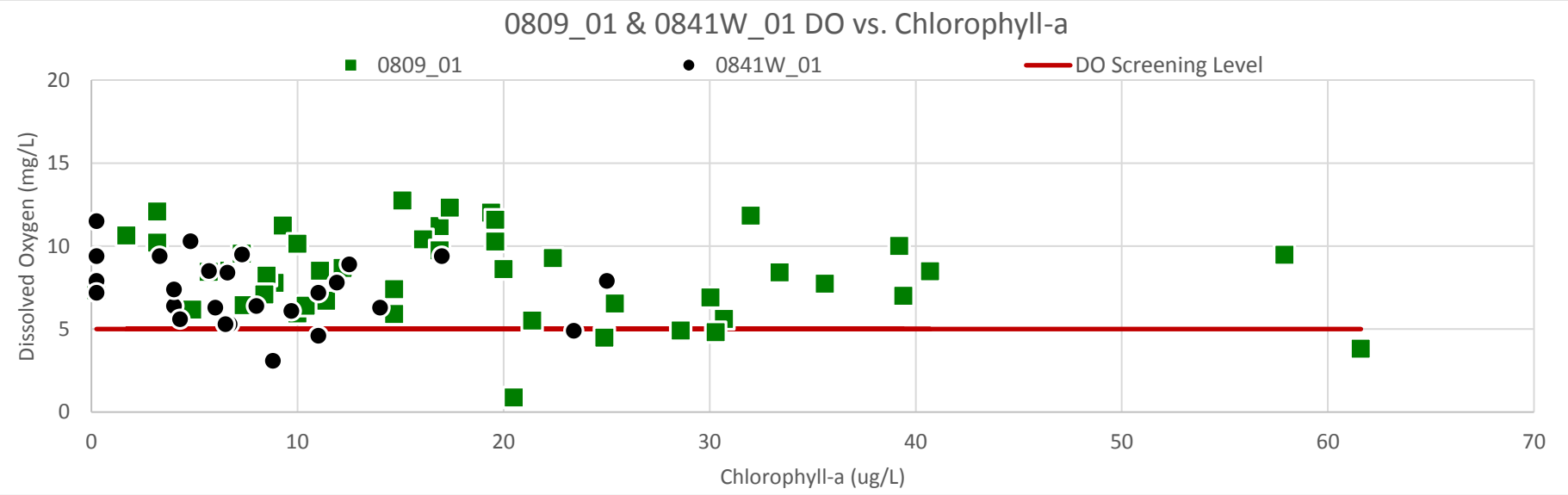


*Figure 33: DO vs. chlorophyll-a for AUs 0809_01 and 0841W_01.*

*Table 8: Dissolved Oxygen Impairments and Concerns*

| Segment | Assessment Unit | Draft 2016 IR Stations Used | Method | Criteria | 2014 IR Results | Draft 2016 IR Results | Draft 2016 IR Number Assessed | Draft 2016 IR Number of Exceedances |
|---|---|---|---|---|---|---|---|---|
| 0801 Trinity River Tidal | 0801_01 From the saltwater barrier, which is 5.5 km (3.4 mi) downstream of IH 10, in Chambers County upstream to the Lynchburg Canal in Liberty County | 10892; 20839 | Dissolved Oxygen grab screening level | 4 | NC | CS | 38 | 5 |
| 0801B Old River | 0801B_01 From IH 10 in Chambers County to approximately 9 mi upstream of confluence with Cherry Point Gully. | 18360 | Dissolved Oxygen grab screening level | 5 | NC | CS | 46 | 6 |

| Segment | Assessment Unit | Draft 2016 IR Stations Used | Method | Criteria | 2014 IR Results | Draft 2016 IR Results | Draft 2016 IR Number Assessed | Draft 2016 IR Number of Exceedances |
|---|---|---|---|---|---|---|---|---|
| 0801C Cotton Bayou | 0801C_01 From the confluence of Cotton Lake southeast of Mont Belvieu in Chambers County upstream to a point approximately 1 mi north of IH 10 in Chambers | 17629; 18696; 18697; 20003 | Dissolved Oxygen grab minimum | 3 | CN | NS | 52 | 10 |
| 0804G Catfish Creek | 0804G_01 Twenty mile stretch of Catfish Creek running upstream from US 287 in Anderson Co., to Catfish Creek Ranch Lake just upstream of SH 19 in Henderson Co. | 10717; 18596; 18597 | Dissolved Oxygen 24hr minimum | 3 | FS | CN | 10 | 2 |
| 0804K Lower Keechi Creek | 0804K_01 Perennial stream from the confluence with the Trinity River in Leon County upstream to the headwaters in Jewett in Leon County | 20382 | Dissolved Oxygen grab screening level | 5 | | CS | 15 | 5 |
| 0809 Eagle Mountain Reservoir | 0809_01 Lowermost portion of reservoir near east end of dam | 10944 | Dissolved Oxygen grab screening level | 5 | NC | CS | 7 | 1 |
| 0809A Walnut Creek | 0809A_01 From the normal pool elevation of Eagle Mountain Reservoir up to the headwaters approximately 2.1 mi upstream of State Highway 199 in Parker County. | 10853 | Dissolved Oxygen grab screening level | 5 | NC | CS | 23 | 5 |
| 0824 Elm Fork Trinity River Above Ray Roberts Lake | 0824_03 3.5 mile reach near SH 51 | 15635 | Dissolved Oxygen grab screening level | 5 | NC | CS | 28 | 4 |
| 0836 Richland-Chambers Reservoir | 0836_07 Remainder of reservoir | 16721 | Dissolved Oxygen grab screening level | 5 | | CS | 13 | 3 |
| 0841M Kee Branch | 0841M_01 Six mi stretch of Kee Branch running upstream from confluence with Rush Creek to upper end of the creek | 10792; 15103; 16896 | Dissolved Oxygen grab screening level | 5 | NC | CS | 14 | 3 |
| 0841W Mountain Creek above Mountain Creek Lake | 0841W_01 From the confluence with Mountain Creek Lake upstream to the Joe Pool Lake dam | 17681 | Dissolved Oxygen grab screening level | 5 | | CS | 80 | 10 |

# New Nutrient Concerns

The Draft 2016 Integrated Report identified five new concerns for nutrients. See **Table 9** for details. As discussed in the New Bacteria Concerns section, 0804L and 0818C were new segments that did not previously have enough data to assess. These two AUs exhibited the nitrate and total phosphorus (TP) patterns typically seen in wastewater treatment effluent dominated streams where concentrations were higher at low flows and decreased as flows increased due to dilution from precipitation (see **Figure 34**). There is at least one municipal wastewater treatment facility discharging into each of these streams.

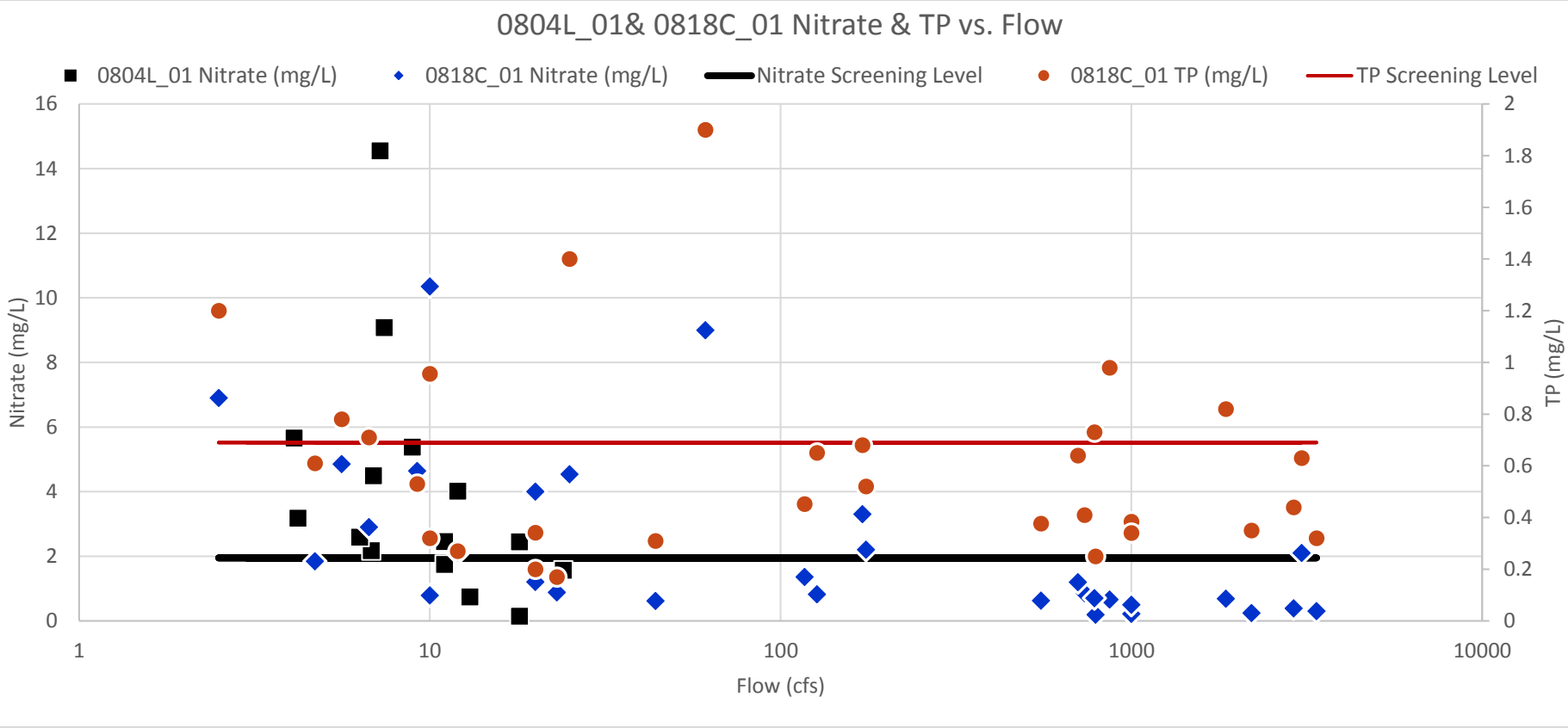


*Figure 34: Nitrate and TP in AUs 0804L_01 and 0818C_01.*

In contrast with 0804L_01 or 0818C_01, concentrations of TP in AUs 0812_01 and 0814_02 increased with increasing flow (see **Figure 35**) which indicates that the concerns were runoff related. The watersheds for these AUs are rural with grazing land and some row crop agriculture. Therefore, the most likely sources for TP in these AUs may be agricultural in nature including livestock wastes and fertilizer usage.

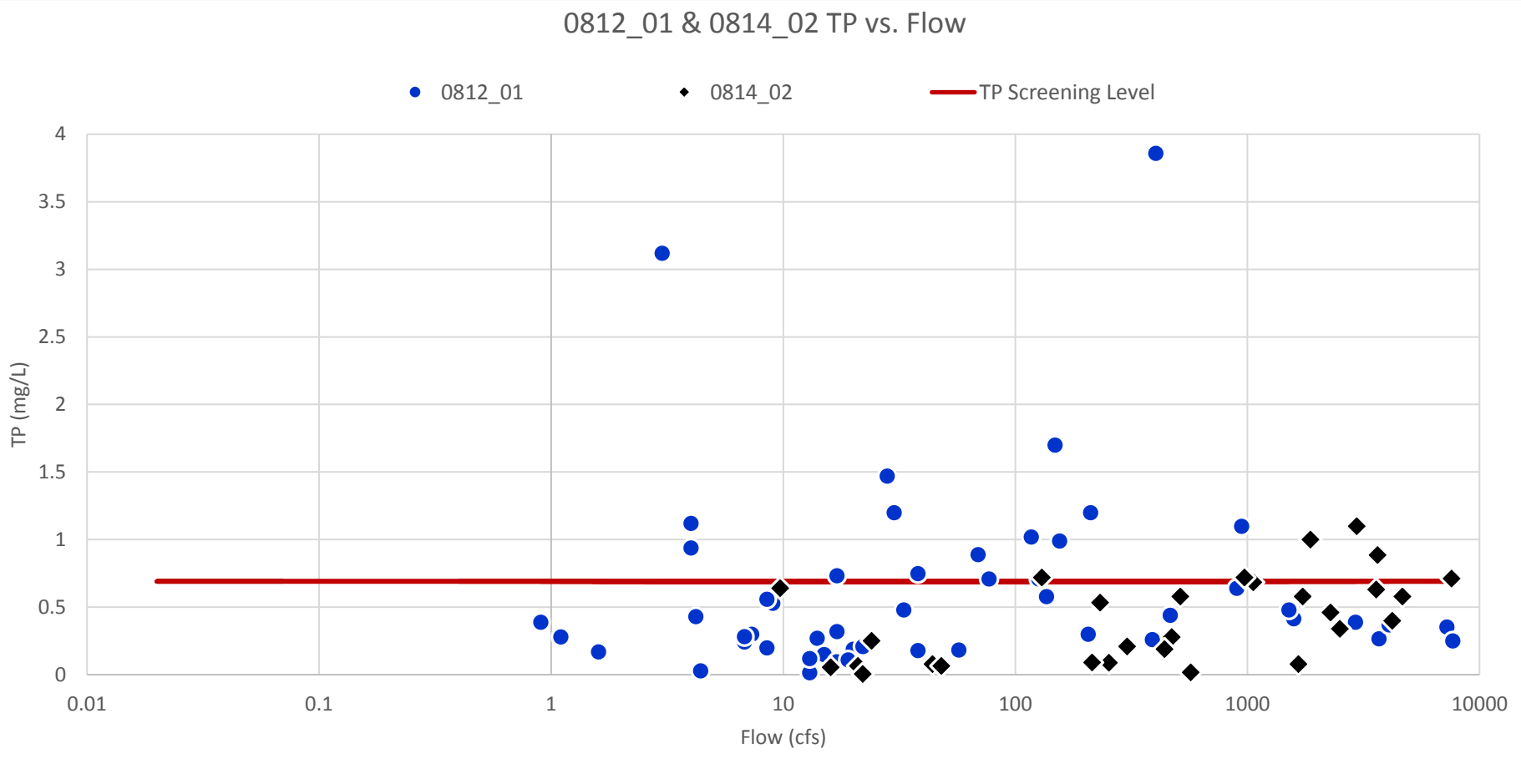


*Figure 35: TP vs. flow for AUs 0812_01 and 0814_02.*

*Table 9: New Nutrient Concerns*

| Segment | Assessment Unit | Draft 2016 IR Stations Used | Parameter | Criteria | 2014 IR Results | Draft 2016 IR Results | Draft 2016 IR Number Assessed | Draft 2016 IR Number of Exceedances |
|---|---|---|---|---|---|---|---|---|
| 0804L Town Creek | 0804L_01 Perennial stream from the confluence with the Trinity River upstream to SH 256 | 10706 | Nitrate | 1.95 | | CS | 5 | 3 |
| 0812 West Fork Trinity River Above Bridgeport Reservoir | 0812_01 Lower 25 mi of segment | 10972; 18058; 18059 | Total Phosphorus | 0.69 | NC | CS | 18 | 8 |
| 0814 Chambers Creek Above Richland-Chambers Reservoir | 0814_02 From just above the confluence with Cummins Creek up to just above the confluence with Waxahachie Creek. | 10977; 20000 | Total Phosphorus | 0.69 | NC | CS | 7 | 3 |
| 0818C Kings Creek | 0818C_01 Intermittent stream with perennial pools from the confluence with Cedar Creek Reservoir at normal pool elevation upstream to the headwaters adjacent to FM 986 | 16778; 21000 | Nitrate | 1.95 | | CS | 9 | 6 |
| 0818C Kings Creek | 0818C_01 Intermittent stream with perennial pools from the confluence with Cedar Creek Reservoir at normal pool elevation upstream to the headwaters adjacent to FM 986 | 16778; 21000 | Total Phosphorus | 0.69 | | CS | 9 | 4 |

# New Chlorophyll-a Concerns

The Draft 2016 Integrated Report identified six new chlorophyll-a concerns on streams. See **Table 10** for details. Chlorophyll-a was correlated to varying degrees with nutrients in each of these AUs with the exception of 0841_02. The correlation coefficients between chlorophyll-a and the best-fit nutrient are listed below. This indicated that algal communities in these AUs are utilizing nutrients.

- 0803F_01 correlation coefficient with TP = 0.49.
- 0804F_01 correlation coefficient with TKN = 0.77.

- 0822A_01 correlation coefficient with TKN = 0.27.
- 0829_02 correlation coefficient with TKN = 0.42.
- 0841O_01 correlation coefficient with TP = 0.33.

The best-fit correlation coefficient for 0841_02 was 0.02 with TKN. This AU is located in the middle of the DFW Metroplex and has many upstream tributaries. As discussed for 0841_01 in the 2015 Basin Summary Report, it is likely that algal populations were washed in from upstream tributaries and reservoirs which may have led to the chlorophyll-a concern in AU 0841_02.

*Table 10: New Chlorophyll-a Concerns*

| Segment | Assessment Unit | Draft 2016 IR Stations Used | Criteria | 2014 IR Results | Draft 2016 IR Results | Draft 2016 IR Number Assessed | Draft 2016 IR Number of Exceedances |
|---|---|---|---|---|---|---|---|
| 0803F Bedias Creek | 0803F_01 From the confluence with segment 0803 Trinity River up to confluence with Poole Creek | 10702 | 14.1 | | CS | 11 | 7 |
| 0804F Tehuacana Creek | 0804F_01 27 miles of Tehuacana Creek from confluence with 0804 Trinity River to confluence with Caney Creek | 20770 | 14.1 | NC | CS | 15 | 6 |
| 0822A Cottonwood Branch | 0822A_01 A 2.5 mile stretch of Cottonwood Branch running upstream from confluence with Hackberry Creek to approx. 0.5 miles downstream of N. Story Rd., Dallas Co. | 17167; 17168 | 14.1 | NA | CS | 12 | 5 |
| 0829 Clear Fork Trinity River Below Benbrook Lake | 0829_02 From 1 mile upstream of the confluence with West Fork Trinity River up to confluence with Mary's Creek. | 11044; 11045; 16122; 18456 | 14.1 | NC | CS | 27 | 10 |
| 0841 Lower West Fork Trinity River | 0841_02 From the confluence with Johnson Creek upstream to confluence of Village Creek. | 11084; 11087; 17160; 17669 | 14.1 | NC | CS | 26 | 8 |
| 0841O Mountain Creek | 0841O_01 Four mi stretch of Mountain Creek running upstream from confluence with West Fork Trinity, to approx. 0.3 mi downstream of Mountain Creek Lake in Grand Prairie | 10815; 17682 | 14.1 | NC | CS | 53 | 17 |

*Figure 36: Village Creek near Kennedale (top left), Great Blue Heron on Lake Arlington (top right), a 4 to 5 foot long alligator on the bank near Tennessee Colony (bottom left), and a bluff overlooking the river between Fairfield and Tennessee Colony (bottom right).*